100 years of SOIL SCIENCE
past achievements and future challenges

International Union of Soil Sciences

Centennial Celebration and Congress of the International Union of Soil Sciences

Florence - Italy

May 19 - 21, 2024

ABSTRACT BOOK

Under the Auspices:

MINISTERO DELL'AGRICOLTURA DELLA SOVRANITÀ ALIMENTARE E DELLE FORESTE

REGIONE TOSCANA

COMUNE DI FIRENZE

ACCADEMIA DEI GEORGOFILI

ACCADEMIA ITALIANA DI SCIENZE FORESTALI – FIRENZE

UNASA – Accademie per le Scienze Agrarie

CA4SH – COALITION OF ACTION 4 SOIL HEALTH

ENEA – Italian National Agency for New Technologies, Energy and Sustainable Economic Development

ESSC – EUROPEAN SOCIETY for SOIL CONSERVATION

FIDAF – Federazione Italiana Dottori in Scienze Agrarie e Forestali

International Science Council – The global voice for science

GLOBAL SOIL PARTNERSHIP

ITALIAN SOIL PARTNERSHIP

SICA

SIPe – Società Italiana di Pedologia – Italian Society of Pedology

SOCIETÀ GEOLOGICA ITALIANA – 1881 – MENTE ET MALLEO

SOCIETÀ ITALIANA DI AGRONOMIA – S.I.A.

WASWAC

SISEF

S.It.E. - Società Italiana di Ecologia

EJP SOIL – European Joint Programme

ANA – Accademia Nazionale di Agricoltura

CIHEAM BARI

SIN – Società Italiana di Nematologia

Consiglio Nazionale delle Ricerche

SOIL HUB

anci toscana

crea – Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria

SIA – Società Italiana d'Arboricoltura - o.n.l.u.s. – Sezione Italiana dell'International Society of Arboriculture

RE SOIL FOUNDATION – Regeneration for a clean and healthy soil.

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GENERAL THEMES

Soil health in achieving the Sustainable Development Goals

Soil health is defined as "the ability to sustain productivity, diversity and environmental services of terrestrial ecosystems", extending the significance of soil health far beyond the historically concepts of soil fertility and soil quality, including human health and sustainability goals for planetary health. Thus, it will significantly contribute to reaching the targets of the following Sustainable Development Goals (SDGs): SDG 2 (zero hunger); SDG 3 (Health); SDG 6 (clean water and sanitisation); SDG 12 (sustainable consumption and production); SDG 13 (climate action) and SDG 15 (life on land).
However, several issues have to be addressed to achieve such goals. For example: Defining soil health indicators, Dynamics and functional role of soil biodiversity, Harmonizing soil monitoring strategies, Soil pedodiversity and biodiversity, Soil legacy effects.

Soil governance

Soil is a non-renewable resource. Its use requires policies, strategies, and processes of decision-making at the local, national and supra-national level.
Governing the soil requires international and national collaboration between governments, local authorities, industries, research institutions and citizens to ensure implementation of coherent policies that encourage practices and methodologies that regulate the soil's use to avoid conflict between users to promote and ensure soil security and sustainable land management. Coherent soil governance is the foundation for promoting sustainable agriculture and ensuring food security in addition to all essential ecosystem services.
Under this theme, different sessions could address issues like: Soil Security, Soil Policies, Soil Economy, Soil ecosystem Services, Soil and Education, Soil Awareness, Soils and Societal Development, Sustainable Soil Management, Sustainable Agriculture, Participatory processes in Soil Conservation, Soil Role in Food and Water Security, Soils as Cultural Heritage, Soils and Landscape Management, Soil Partnerships, Living Labs and Lighthouses.

Soil in the circular economy

Circular economy is an economic system focused on maximizing the reuse of natural resources and products, minimizing their depreciation. We consider the soil a natural resource as the water. As the formation of topsoil and the recovery of land and soil quality are extremely slow processes, they are considered as non-renewable resources. Therefore, the recovery and reuse of land and soil is necessary to secure future provision of natural resources and services for the growing world population.
Soil plays an important role in the circular economy as, for instance, the provider of space for societal activities to take place. It stores the stock of mineral resources and offers possibilities for producing biobased resources to replace the use of mineral resources.
Soil's role in the biogeochemical cycles is very important for closing the cycles of water and nutrients. The use of natural cycles as ecosystem services is efficient in reducing the implementation of resource-intense technical practices.

GENERAL THEMES

Soil sciences impact on basic knowledge

Soil consists of a three-phases system containing solids, liquids and gases that strongly interact with each other in the pedogenic processes. Mineral fragments, organic matter, and soil air evolve through a series of biological activities, chemical reactions, and physical forces that are influenced by different environmental factors.
Soil health refers to the capacity of soil to sustain or improve productivity, plant health, and higher trophic levels, as well as air and water quality in natural and managed ecosystems. Interdisciplinary knowledge of chemistry, physics, atmospheric science, soil science, biology, natural history, and ecology is needed to recognize the role of soil in regulating greenhouse gases, reducing nutrient export from agricultural land, controlling pests, and supporting biodiversity that provides many ecosystem services to society.

Soil in the digital era

Soil information technology supports many research fields including pedology, landscape modeling, natural resources management, land evaluation, land use planning, carbon storage, land use/land cover change, environmental risk assessment and modeling and smart/precision farming. There is increasing demand for soil information as it relates to: location, quality and quantity of soil properties, processes and interactions with various natural resources.
Under this theme, different sessions could address issues like: Digital Soil Mapping, Pedometrics, Geostatistics, Soil Spatial Variability, Soil Information Systems, Soil Spatial Infrastructures, Decision Support Systems, Soil Modeling, Environmental Modeling and risk assessment, Soil Proximal Sensing, Soil Remote Sensing, Soil Management in Smart Farming, Mapping and Modeling of Soil Ecosystem Services, Mapping and Modeling of Soil Threats, Soil use and climate change modelling.

Soil and humanity

Soils underpin, directly or indirectly, most of the ecosystem services defined as the benefits humanity obtains from ecosystems. Soil scientists have the responsibility to make clear to civil society, policy makers, scientists and experts in other disciplines the overwhelming importance of soil in their lives.
This implies the need for integrating soil sciences in education at all levels and for increasing soil awareness of general public. A well informed society will have the possibility to exploit the numerous functions soil provides while sustaining the continuous provision of ecosystem services. Under this theme, different sessions could address issues like: soil and humanistic disciplines – history, philosophy, sociology, art, religion; soil and human health, soil and sustainable and liveable cities, soil security and land grabbing, soil education and promotion, soil and human rights.

GENERAL THEMES

Equity, diversity, and inclusivity in soil sciences

Globally, women play a substantial role in agriculture and strong linkages between sustainable soil management (SSM) and gender equality have been demonstrated. However, a number of cultural and social constraints exist which hinder a full recognition of women's role in SSM. An insufficient soil education is one of them. Besides, local soil knowledge, often women driven, is nowadays considered a tool for a sustainable soil management. Despite some encouraging signals, women are still underrepresented in soil science, and in particular in leadership positions and in awards rates.
Supporting equity, diversity and inclusivity in soil science is a key issue for addressing fundamental scientific questions and societally relevant environmental challenges.
Under this theme, different sessions could address issues like: Women in soil science, Underrepresented minorities in soil sciences and soil-related scientific societies, Local knowledge and SSM, Soil education tailored on women and on local/indigenous communities, Ethnopedology.


SESSIONS

1. EQUITY, DIVERSITY, AND INCLUSIVITY IN SOIL SCIENCES

131441 - BOOSTING GLOBAL SOIL SCIENCE COLLABORATION: FOSTERING EQUITY, DECOLONIZATION, AND CAPACITY STRENGTHENING

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133426 - GENDER INEQUALITIES AND SOIL HEALTH

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133511 - MOVING TOWARD DIVERSITY, EQUITY, AND INCLUSIVITY IN SOIL SCIENCE SOCIETIES

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S. DAROUB – IUSS and National Autonomous University of Mexico, and University of Florida, Soil, Water & Ecosystems Sciences Dept., Gainesville, USA

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S. CHAPMAN – Soil Science Society of America, Madison, USA
S. GRUNWALD – University of Florida, Soil, Water & Ecosystems Sciences Dept., Gainesville, USA
T. CARTER – US Dept of Agriculture National Resources Conservation Service (USDA-NRCS), Lincoln, USA

2. SOIL AND HUMANITY

124495 - YOUTH DIGGING – THE PROGRESS OF EARLY CAREER GLOBAL SOIL RESEARCH

LEAD CONVENER:
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CO-CONVENER:
A. CERÓN GONZÁLEZ – National Autonomous University of Mexico, Mexico City, MEXICO

129339 - THE DEVELOPMENT OF SOIL SCIENCE IN THE IUSS COUNTRIES: 100 YEARS OF HISTORY

LEAD CONVENER:
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CO-CONVENERS:
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K-H. FEGER – University of Dresden, Germany
T. KOSAKI – University of Tokyo, Japan

129617 - SOIL HEALTH FROM MULTIPLE PERSPECTIVES

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P. WATTS – Ecoartspace Organization, Santa Fe, USA

129928 - SOIL SCIENCES ENTERING INTO TRANSDISCIPLINARY RESEARCH

LEAD CONVENER:
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CO-CONVENER:
M. PARADISO – University of Naples, Naples, ITALY

132213 - SOIL AND LITERATURE

LEAD CONVENER:
R.M. POCH – Universitat de Lleida, Lleida, SPAIN

CO-CONVENER:
E.A.C. COSTANTINI – IUSS, Florence, ITALY

132332 - SOIL SCIENCE AND GEOETHICS: CONTRIBUTING TO CREATE A MORE SUSTAINABLE SOCIETY

LEAD CONVENER:
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132746 - SOILS FOR PLANNING SUSTAINABLE CITIES

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133512 - CHILDREN AND YOUNG PEOPLE SAY PRESENT AT THE IUSS CENTENARY CELEBRATION

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133548 - MICROBIOME AS A COMMON THREAD FROM SOIL TO HUMAN HEALTH: INTERACTION, IMPACT AND ROLE OF SOIL-PLANT-HUMAN MICROBIOME AS A NEW CHALLENGE OF INNOVATIVE AGRICULTURE AND QUALITY FOOD

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133559 - SOIL LITERACY, COMMUNICATION AND CITIZEN ENGAGEMENT

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133574 - SOIL AND WATER CONSERVATION ISSUES WORLDWIDE: FROM THE PAST TO THE FUTURE

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133584 - SOILS IN ARCHAEOLOGY

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133597- SOIL, SOUL AND SOCIETY: TRANSFORMATIVE PATHWAYS IN SOIL CARE PRACTICES

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133604 - HISTORIES OF INTERNATIONALIZATION OF SOIL SCIENCE

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133605 - EPISTEMOLOGIES AND ONTOLOGIES OF SOIL: TOWARDS NEW POLITICS OF SOIL KNOWLEDGE

LEAD CONVENER:
C. BOYER – International Center for Research on Environment and Development, AgroParisTech, Paris, FRANCE

CO-CONVENER:
T. LAW – Development Studies, Cornell University, Ithaca, USA

133780 - SOIL AS A CULTURAL HERITAGE: THE SOIL KNOWLEDGE AS A HERITAGE FOR THE FUTURE GENERATIONS.

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S. MANTEL – ISRIC World Soil Information

134978 - SUITMA (SOILS OF URBAN, INDUSTRIAL, TRAFFIC, MINING AND MILITARY AREAS)

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3. SOIL GOVERNANCE

133567 - SOIL AND WATER CONSERVATION: WATER- DRAINAGE AND IRRIGATION STRATEGIES: FROM SECURING PRODUCTION TO PROTECTING ENVIRONMENT

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CO-CONVENER:
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133591 - IMPACT OF GLOBAL TRADE OF FOOD, FEED AND FIBER (3FS) ON SOIL C AND N DYNAMICS, GHG EMISSIONS AND LAND USE CHANGES

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S.K. LAM – University of Melbourne, Melbourne, AUSTRALIA

133724- INDUSTRY, POLICY AND SCIENCE: WORKING TOGETHER FOR MEANINGFUL SCALING OF SOIL ASSESSMENT AND CLIMATE MITIGATION

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A. WICK – Syngenta Group, Fargo, USA

133729 - NITROGEN USE EFFICIENCY AS INFLUENCED BY THE MICROBIOME

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CO-CONVENER:
C. SCREPANTI- Syngenta Group, Stein, SWITZERLAND

133775 - SOIL GOVERNANCE: BUILDING ON STAKE-HOLDERS INTERACTIONS AND INVOLVEMENT FOR A SUSTAINABLE MANAGEMENT OF SOILS

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F. POINÇOT – Acta / RNEST, Paris, FRANCE

4. SOIL HEALTH IN ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS

123826 - SOIL SCIENCE LESSONS FROM 100 YEARS OR MORE OLD EXPERIMENTS

LEAD CONVENER:
B. MAHARJAN – University of Nebraska-Lincoln, Scottsbluff, USA

124990 - TOWARDS HARMONIZED SOIL HEALTH MONITORING. NOVEL METHODS AND PERSPECTIVES AND SCIENTIFIC, INSTITUTIONAL, AND SOCIETAL CHALLENGES

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125012 - MATCHING FOOD SECURITY AND ENVIRONMENTAL GOALS: PHOSPHORUS, A KEY GLOBAL ELEMENT

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131145 - DYNAMICS AND FUNCTIONS OF SOIL ORGANIC MATTER UNDER NEW AND TRADITIONAL AMENDMENTS

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131649 - THE CENTRALITY OF ORGANIC CARBON IN BALANCING THE MULTIFUNCTIONAL NATURE OF SOILS FOR SUSTAINING HUMAN AND PLANETARY HEALTH

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132182 - SOIL MICROBIOMES – IMPORTANCE FOR CLIMATE RESILIENT FUTURE, DEGRADED LANDS RESTORATION AND PLANT HEALTH CONTROL

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132261 - ECOSYSTEM SERVICES PROVIDED BY NEMATODES AND OTHER SOIL INVERTEBRATES AND SPECIFIC PROTECTION GOALS

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133435 - OPTIMIZATION OF PLANT-SOIL-MICROBE INTERACTION UNDER CROP DIVERSIFICATION

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133521 - CARING FOR MOUNTAIN SOILS, THE HIDDEN KEY TO CLIMATE CHANGE ADAPTATION AND SDGS: CHALLENGES, THREATS, SUCCESS STORIES

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133530 - SOIL DEGRADATION CONTROL, REMEDIATION AND RECLAMATION

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133539 - DEVELOPMENT OF EFFICIENT SOIL EDUCATION SCHEME FOR TOMORROW

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133547 - LANDUSE CHANGE IMPACTS ON SOIL HEALTH

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133566 - SOIL FAUNA AS A TOOL TO IMPROVE SOIL HEALTH ASSESSMENT

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133568 - MANAGING SOIL CARBON AND NITROGEN FOR CLIMATE-SMART AND SUSTAINABLE AGRICULTURE

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133569 - REVITALIZATION OF MINING RESIDUE DEPOSITS

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S. NORRA – University of Potsdam, Division of Soil Science and Geoecology, Potsdam, GERMANY

133571 - CONTAMINANTS OF EMERGING CONCERNS IN SOIL: OCCURRENCE, FATE AND TRANSPORT, TOXICITY AND REMEDIATION

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Y. LUO- Nanjing Institute of Soil Science, Chinese Academy of Sciences, Nanjing , CHINA
H. LI- Department of Plant, Soil and Microbial Sciences, Michigan State University, East Lansing, USA

133576 - SOIL N2O EMISSIONS: UNDERSTANDING THE UNDERLYING MECHANISMS AND ASSESSING THE IMPACT OF SOIL MANAGEMENT STRATEGIES

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E. DIAZ-PINES – University of Natural Resources and Life Sciences Vienna (BOKU), Institute of Soil Research, Vienna, AUSTRIA

CO-CONVENER:
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133577 - SUSTAINABLE SOIL MANAGEMENT AND AGRONOMIC PRACTICES FOR CARBON FARMING: CHALLENGES AND OPPORTUNITIES

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A.W. KISHIMOTO-MO – Institute for Agro-Environmental Sciences, National Agriculture and Food Research, Tsukuba, JAPAN

133578 - SOIL CARBON FARMING PRACTICES IN THE AGRICULTURE AND FORESTRY SECTORS

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A. REY SIMO – Department of Biogeography and Global Change, National Museum of Natural Science (MNCN) Spanish Scientific Council (CSIC), Serrano, Madrid, SPAIN

133580 - SUSTAINABLE GRASSLAND MANAGEMENT FOR HEALTHY SOILS AND VICE VERSA

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133583 - SOIL CARBON SEQUESTRATION AND LAND USE CHANGE

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133598 - ANTHROPOGENIC DRIVERS OF SOIL BIODIVERSITY, ITS FUNCTION AND FEEDBACK TO CHANGES

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133607 - BLACK SOILS: THEIR IMPORTANCE FOR FOOD SECURITY AND CARBON NEUTRALITY

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133608 - DEVELOPING NEW MODELS OF URBAN SOILS

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133609 - HOW WILL WE MONITOR SOILS IN THE COMING CENTURY?

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133610 - CHARACTERIZING AND SELECTING SOIL HEALTH INDICATORS AT VARIOUS SCALES

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133611 - SOILS AND THE ENVIRONMENT

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133622 - SOIL ORGANIC MATTER STABILITY AS KEY DRIVER TO SOIL CARBON SEQUESTRATION

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133628 - MICRO- E NANOPLASTICS (MNPS) IN SOIL ECOSYSTEM

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CO-CONVENERS:
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133791 - SOIL RESEARCH TOWARDS DISASTER RISK REDUCTION

LEAD CONVENER:
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CO-CONVENER:
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D. CALCATERRA – Università di Napoli Federico II, Napoli, ITALY

5. SOIL IN THE CIRCULAR ECONOMY

133614 - SOIL NEEDS IN INDUSTRIAL AGRICULTURE AND HIGHLY POPULATED AREAS

LEAD CONVENER:
M. CAGGIANO – Re Soil Foundation, Torino, ITALY

6. SOIL IN THE DIGITAL ERA

125400 - APPLICATIONS OF PROXIMAL SOIL SENSING TECHNOLOGIES AND BEYOND

LEAD CONVENER:
A. WADOUX – LISAH, Univ. Montpellier, IRD, INRAE, Institut Agro Montpellier, Montpellier, FRANCE

CO-CONVENER:
S. PRIORI – University of Tuscia, Department of Agriculture and Forest Sciences, Viterbo, ITALY

129252 - QUANTIFYING AND MAPPING SOIL FUNCTIONS

LEAD CONVENER:
A. WADOUX – LISAH, Univ. Montpellier, IRD, INRAE, Institut Agro Montpellier, Montpellier, FRANCE

CO-CONVENER:
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129517 - DIGITAL SOIL MAPPING AND ASSESSMENT AT DIFFERENT SCALES – WHERE TO GO NEXT?

LEAD CONVENER:
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129630 - SOIL AND VITICULTURE

LEAD CONVENER:
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133437 - NOVEL APPROACHES TO PROCESS-BASED MODELLING IN AGRICULTURAL SOILS

LEAD CONVENER:
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133441 - SOIL EROSION AND LAND DEGRADATION: METHODS, OBSERVATIONS AND PERSPECTIVES

LEAD CONVENERS:
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D. GODONE – National Research Council Research Institute for Geo-Hydrological Protection, Turin Office, Turin, ITALY

CO-CONVENERS:
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S. CREMA – National Research Council Research Institute for Geo-Hydrological Protection, Padua Office, Padua, ITALY
S. MORETTI – Department of Earth Sciences / University of Florence, Florence, ITALY
S. PELACANI – Department of Earth Sciences / University of Florence, Florence, ITALY

133592 - DIGITAL SOIL MAPPING, DECISION SUPPORT TOOLS AND SOIL MONITORING SYSTEMS IN THE EU

LEAD CONVENER:
C. SCHILLACI – European Commission Joint Research Centre, Ispra, ITALY

CO-CONVENERS:
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G. LANGELLA – University of Napoli, Napoli, ITALY
L. MONTANARELLA – European Commission Joint Research Centre, Ispra, ITALY

133601 - SOIL INFORMATION STANDARDS AND SYSTEMS - CURRENT INITIATIVES AND ADVANCES

LEAD CONVENER:
F. VAN EGMOND – ISRIC – World Soil Information, Wageningen, THE NETHERLANDSLY

CO-CONVENERS:
M. FANTAPPIE – CREA, Florence, ITALY
K. TODD-BROWN – University of Florida, Gainesville, USA

7. SOIL SCIENCES IMPACT ON BASIC KNOWLEDGE

125430 - ADVANCES IN SOIL SCIENCE: PAST, PRESENT AND THE FUTURE

LEAD CONVENER:
A. HARTEMINK – University of Wisconsin, Madison, USA

CO-CONVENER:
S. SPARKS – University of Delaware, Newark, USA

129627 - PLANT-SOIL-MICROBE INTERACTIONS IN THE RHIZOSPHERE AND THEIR POTENTIAL TO ADDRESS GLOBAL AGRICULTURAL CHALLENGES

LEAD CONVENER:
D. SAID-PULLICINO – University of Torino, Dept. of Agricultural, Forest and Food Sciences, Grugliasco, ITALY

CO-CONVENERS:
F. DIJKSTRA – University of Sydney, Sydney Institute of Agriculture, School of Life and Environmental Sciences, Sidney, AUSTRALIA
T. GE – Ningbo University, Environmental Soil Science and Biogeochemistry, Zhejiang, CHINA
D. VETTERLEIN – Helmholtz Centre for Environmental Research UFZ, Department of Soil System Science, Halle, GERMANY

130893 - SOIL CLASSIFICATION: PAST AND PRESENT CONCEPTS AND SOLUTIONS

LEAD CONVENER:
C. KABALA – Wroclaw University of Environmental and Life Sciences, Wroclaw, POLAND

CO-CONVENERS:
C. MONGER- New Mexico State University, New Mexico, USA
C. VAN HUYSSTEEN – University of the Free State, Bloemfontein, SOUTH AFRICA

131303 - SOIL ORGANIC MATTER TRANSFORMATION, STABILIZATION AND STORAGE

LEAD CONVENER:
C. ZACCONE- University of Verona, Department of Biotechnology, Verona, ITALY

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B. JANSEN – University of Amsterdam, Institute for Biodiversity and Ecosystem Dynamics, Amsterdam, THE NETHERLANDS

132267 - PEDODIVERSITY: MAJOR DRIVING FACTORS AND INFLUENCES ON ECOSYSTEM FEATURES

LEAD CONVENER:
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V. HETMANENKO – Natural Resources Institute (Luke), Espoo, FINLAND
C. SCHILLACI – European Commission JRC Directorate D – Land Resources and Supply Chain Assessments, Ispra, ITALY

133540 - THE BRIGHT FUTURE OF PEDOLOGY

LEAD CONVENER:
C. ZUCCA – University of Sassari, Sassari, ITALY

CO-CONVENER:
A. HARTEMINK – University of Wisconsin, Madison, USA

133542 - KNOWING TOPSOIL TO MANAGE ECOSYSTEMS

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L. MO – School of Geographical Science, Guangzhou University, Guangdong, CHINA
N. BERNIER – Muséum d'Histoire Naturelle, Brunoy, FRANCE

133552 - NATURE BASED SOLUTION FOR SUSTAINABLE SOIL AND WATER MANAGEMENT

LEAD CONVENER:
F. ALTOBELLI – CREA – Research Center for Policy and Bioeconmy, Rome, ITALY

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133558 - MECHANISMS OF INTERACTION OF (HARMFUL) SUBSTANCES WITH THE SOIL PHASE

LEAD CONVENER:
L. BÖHM – CREA – Justus Liebig University Giessen, iFZ Research Centre, Institute of Soil Science and Soil Conservation, Giessen, GERMANY

CO-CONVENERS:
M.H. GERZABEK – University of Natural Resources and Life Sciences Vienna, Departm. of Forest and Soil Science, Inst. for Soil Research, Vienna, AUSTRIA

133570 - DIGGING DEEPER: ADVANCES IN SUBSOIL SCIENCE

LEAD CONVENER:
D. EVANS – Cranfield University, Cranfield , UNITED KINGDOM

CO-CONVENER:
C. ZACCONE – University of Verona, Verona, ITALY

133581 - SOIL MINERALOGY: CURRENT STATE AND PERSPECTIVES

LEAD CONVENER:
S. LESSOVAIA – St. Petersburg state University, St. Petersburg, RUSSIA

CO-CONVENER:
D. BORTOLUZZI- University of Passo Fundo, Passo Fundo, BRAZIL

133768 - SOILS OF THE PAST FOR PRESENT AND FUTURE: MARKING THE 100TH BIRTHDAY OF DAN H. YAALON

LEAD CONVENER:
M. BRONNIKOVA – Institute of Geography, Ruussian Academy of Sciences, Department of Soil Geography and Evolution, Moscow, RUSSIA

CO-CONVENERS:
E. SOLLEIRO REBOLLEDO – Instituto de Geología, Universidad Nacional Autónoma de México, Institute of Geology, Mexico City, MEXICO
F. SCARCIGLIA – Università della Calabria, Dipartimento di Biologia, Ecologia e Scienze della Terra, Arcavacata, ITALY

8. OTHER

124518 - ASSESSING SOIL SECURITY

LEAD CONVENER:
D. FIELD – The University of Sydney, Sidney, AUSTRALIA

CO-CONVENER:
A. MCBRATNEY – The University of Sydney, Sidney, AUSTRALIA

133440 - TAILORED MICROBIOME-BASED SOLUTIONS FOR A SUSTAINABLE AGRICULTURE

LEAD CONVENER:
A. BEVIVINO – ENEA, Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Rome, ITALY

CO-CONVENER:
S. MOCALI – CREA, Agriculture and Environment, Firenze, ITALY

133541 - SUSTAINABLE SOIL NUTRIENT MANAGEMENT: IMPLICATIONS FOR FOOD, ENVIRONMENT, AND ECOLOGY

LEAD CONVENER:
F. ZHANG – College of Resources and Environmental Sciences, China Agricultural University, Beijing, CHINA

CO-CONVENER:
R. SHEN – State Key Laboratory of Soil and Sustainable Agriculture, Institute of Soil Science, Chinese Academy of Sciences, Nanjing, CHINA

133600 - GENESIS OF PATTERNED GROUND IN PERMAFROST AFFECTED AND NON AFFECTED SOILS.

LEAD CONVENER:
S. COCCO – Department of Agricultural, Food and Environmental Sciences, Ancona, ITALY

CO-CONVENERS:
D.C. WEINDORF – Central Michigan University, Mt Pleasant, USA
A. AGNELLI – Department of Agricultural, Food and Environmental Sciences, Perugia, ITALY
V. CARDELLI – Department of Agricultural, Food and Environmental Sciences, Ancona, ITALY

133606 - LIFE, AGRICULTURE, AND PRODUCTIVE SYSTEMS IN SOILS FROM ARCTIC, ANTARCTIC AND OTHER COLD REGIONS

LEAD CONVENER:
G. CORTI – CREA – Council for Agricultural Research and Economics, Centre of Agriculture and Environment, Firenze, ITALY

CO-CONVENERS:
S. IMHOFF – ICiAgro Litoral -CONICET-UNL, Esperanza, ARGENTINA
K. VANCAMPENHOUT – KU Leuven Association, Leuven , BELGIUM

133613 - ADVANCES IN SOIL HEALTH MONITORING

LEAD CONVENER:
L. WINOWIECKI – Coalition of Action 4 Soil Health (CA4SH), NAIROBI, KENYA

CO-CONVENERS:
B. MINASNY – University of Sidney, Sidney, AUSTRALIA
C. MORGAN – Soil Health Institute, Morrisville, USA

133620 - SOIL AMBITIONS: DRIVING SOIL HEALTH INTO NATIONAL AND INTERNATIONAL POLICY

LEAD CONVENER:
L. WINOWIECKI – Coalition of Action 4 Soil Health (CA4SH), Nairobi, KENYA

CO-CONVENERS:
S. GARRY – British Society of Soil Science, Cranfield, UNITED KINGDOM
P. LUU – 4p1000, Montpellier, FRANCE
M. LOUM – Institut National de Pédologie, Dakar, SENEGAL

133822 - PEATLANDS IN A CHANGING WORLD

LEAD CONVENER:
C. ZACCONE- University of Verona, Department of Biotechnology, Verona, ITALY

CO-CONVENERS:
K. BAO – School of Geography, South China Normal University, CHINA
L. MELLING – Sarawak Tropical Peat Research Institute, Malaysia

100 YEARS OF SOIL SCIENCES

Edoardo A.C. Costantini
International Union of Soil Sciences, President
CNR-IBE, Sesto Fiorentino, 50019 (Italy)

Reporting facts is no longer enough. To really engage laypeople and stakeholders we have to tell a story, and we have a great story to share.

One hundred years ago, on the 19th of May, our Society was established in Rome during the Fourth International Conference of Pedology. For one hundred years, our organization has served as the home for soil scientists from all corners of the globe. The main global melting pot of Soil Sciences, where new ideas are forged and tested by peers.

The inauguration speech of the Centennial Celebration and Congress delineates the distinctive traits of the International Union of Soil Sciences, illustrating the organization's nature and operational framework, including its composition, governance, and scientific structures.

The innovative approach employed to organize the event, based on a bottom-up methodology, is explained, highlighting the key components of the program. The themes of the Congress are not only centred around Science but also encompass Knowledge, drawing from lessons learned in our history and acknowledging that our future is rooted in the past.

Special emphasis is placed on valuing insights from colleagues in other disciplines, including social sciences, education, humanities, and art, who deliver remarkable presentations and exhibitions during the Congress, and a thematic excursion. This holistic approach ensures a comprehensive exploration of Soil Sciences and their broader implications.

Key words: IUSS, Centennial, Celebration, Congress, inauguration speech.

IUSS PLENARY SPEAKERS

THE ROLE OF SOIL IN THE GLOBAL POLICIES

SALVATORE ARICÒ

CEO, International Science Council, Parigi, FRANCE

The recognition of soil diversity and the importance they play in ensuring ecosystem services – from provisioning to cultural – has been consolidated in the past 20+ years largely due to relevant policy processes at the global level. What scientists have advocated in scientific terms for more than a century has come to policy and wider public acceptance also in light of pressing societal issues such as food insecurity including famine, human and environmental health concerns, poverty and inequality, as well as the expansion of global markets and how these impinge on food commodities and the underpinning soil properties and management, etc. In such a context, soil sciences often had to provide responses to societal concerns more promptly than other branches of sciences. In doing so, soil scientists possibly learned from the crises it faced more learned than other branches of science and, today, they have adapted, evolved and are now increasingly capable of providing anticipatory insights into how soils should be managed, governed and protected for the safety and security of society. This plenary lecture will illustrate how soil sciences have responded to solicitations beyond conventional research questions and learned to put inter- and increasingly trans-disciplinary sciences and knowledge in action. The International Union of Soil Sciences is quite fit-ready to tackle these and further upcoming challenges, and the International Science Council, of which the IUSS is a member, stands ready to continue accompanying and working with the IUSS in its role of delivering actionable knowledge on soil issues for the benefits of society.

WHO CONSTITUTES THE FUTURE OF SOIL SCIENCES? – GENDER, AGE, AND CITIZENSHIP AMONG THE YOUNG AND EARLY CAREER SCIENTISTS

AXEL CERÓN GONZÁLEZ[1,2] AND BARTŁOMIEJ GLINA[1,3]

[1] International Union of Soil Sciences “Young and Early Career” Working Group
[2] Vrije Universiteit Brussel, Belgium
[3] Poznań University of Life Sciences, Poland

The ***International Union of Soil Sciences*** (IUSS) witnesses a century-long narrative of technological and social transformations, significantly influencing the path of individuals becoming soil scientists. Although the IUSS has been essential in diversifying soil paradigms since the 1920s, the last decade condensed a disrupting episode to amend structural disparities among soil scholars. The democratic election of the first woman from the Global South as IUSS President in 2018 and the establishment of the Young and Early Career Working Group (YECS) in 2022 represent a shift towards considering three components in shaping the future of soil sciences —gender, age, and citizenship.
Who constitutes the future of soil sciences? An exploration into the fabric of YECS, featuring over 350 members from 58 countries who responded to a structured questionnaire as of January 2024, reveals intriguing singularities. Europe is nearing gender equity, and Latin America demonstrates increased participation of young women. The average age of young soil scientists worldwide is 30 years. Notably, there are distinct gender variations in the Middle East, where the average age for men is 27 years, while for women is 35 years. Similar patterns persist within IUSS, women are prominently engaged in *Division 4 – Sustaining Society and the Environment*, while men continue to lead the rest. Analysis of binary gender and age disparities among young soil scientists reveals potential areas for improvement within YECS and IUSS. This prompts reflection on strategies to promote more diverse spaces, including potentially underrepresented queer identities. For a more inclusive future soil science.

Keywords: soil science paradigms, structural disparities, diversity, inclusive future

EARLY INTERNATIONAL CONNECTIONS IN THE DEVELOPMENT OF SOIL SCIENCE

ALFRED HARTEMINK

The University of Wisconsin-Madison, Department of Soil Science, FD Hole Soils Lab, 1525 Observatory Drive, Madison 53711, USA

The scientific study of soil became more systematic and profound when researchers from different countries started to visit each other's laboratories. Findings and ideas were exchanged on how plant take up nutrients, how soils were formed, and how to measure the texture of the soil. Some had a background in agricultural chemistry, others were schooled in geology or bacteriology. The *International Society of Soil Science* was formed to accelerate the exchange of information, to develop a common language, and to standardize procedures for soil analysis and classification. The *Fourth International Conference of Pedology* was held in Rome in 1924 and brought together 300 soil researchers. A large group of soil scientists gathered at the *First International Congress of Soil Science* that was held in the USA in 1927 and included an extensive fieldtrip across the USA and Canada. It created a soil community and format that was used in subsequent soil congresses that were held across the globe. In this talk, I will review some of the great international connections and scientific explorations which were vital for the development of soil science.

PROTECTING SOILS FOR FUTURE GENERATIONS: THE DEVELOPMENT OF SOIL POLICIES IN EUROPE AND IN THE WORLD

LUCA MONTANARELLA

Chair - International Network of Soil Information Institutions (INSII) of the GSP, Ispra, VA, ITALY

Soil can be considered as a non-renewable natural resource, given the long time frame needed for its formation. Hence the need for sustainable management in order to assure that this precious limited resource will be available also for future generations. There is the need to develop appropriate policy instruments creating the necessary legal framework for the implementation of sustainable soil management practices. Unlike air and water, soil related policies need to be locally tailored to the very different pedoclimatic conditions. Soils are highly variable in their properties in space while being relatively resilient in time. In Europe the European Union has been at the forefront of the development of transnational soil policies aiming at the achievement of sustainable soil management. Starting from 2006 several legislative proposals have been put forward by the European Commission addressing sustainable soil management. At global scale, following the adoption of the World Soil Charter, the development of the Global Soil Partnership has been driving the establishment and implementation of many programs and initiatives that have raised awareness of the relevance of protecting soils for food security and sustainable development.

SOIL HEALTH TOWARDS THE REALIZATION OF SUSTAINABLE DEVELOPMENT GOALS: PROGRESS AND TRENDS IN CHINA

XIN SONG, JIABAO ZHANG, RENFANG SHEN, ZHONGJUN JIA, HAIYAN CHU, RONGJIANG YAO

Institute of Soil Science, Chinese Academy of Sciences, Nanjing, CHINA

Soil health is critical to human and planetary health and for achieving sustainable development goals (SDGs). In this study, the progress and trends of soil sciences in China towards the realization of zero hunger, human health, biodiversity and climate control are provided. We begin with the soil health assessment, in which a comprehensive set of indicators are developed, and a framework has been proposed. To achieve food security in China, research activities on sustainable plant production, including increasing soil productivity and reducing threats from soil acidification and soil salinization, are summarized. In the effort to reduce biodiversity loss, models with the functions of capturing and predicting spatial and temporal trends have been developed to track and conserve soil biodiversity. Furthermore, to meet China's share of greenhouse gas (GHG) emissions reduction in achieving carbon neutrality goals, the research progress on soil carbon sequestration and GHG emission reduction will be reported. Finally, an in-depth discussion on the soil pollution, in particular related to the emerging contaminants of per- and polyfluoroalkyl substances (PFASs), are presented. It is worth noting that the research activities on soil health in China focus on both technology development and implementation, such that these technologies remain relevant to all stakeholders.

IUSS DIVISIONS PLENARY SPEAKERS

DIVISION 1

THE EVOLUTION OF PEDOLOGY - DRAWING FROM THE PAST, ADAPTING TO THE FUTURE

ALEX. MCBRATNEY

The University of Sydney, AUSTRALIA

Pedology – the fundamental understanding of soil in space and time has been studied effectively and energetically for more than a century. What is its future? There are many possibilities; here are three areas which, if attended to, will pay dividends for pedology.

1) Pedology has been cautious generally in taking up new technologies and ideas; while some areas have moved forward profitably. It is beyond doubt that pedology can be aided by the digital age. To some degree all of our research and teaching had been enabled, enhanced and expanded by digital convergence. Digital proximal and remote soil sensors have been widely implemented, and new tools such as cell phones and apps, and metagenomics techniques are becoming available. There are areas crucial to pedology for which no major digital technology obstacles exist, but which have not been thoroughly investigated, e.g. to devise a truly digital soil field description or the building of a formal digital quantitative system of soil identification and classification. There are some caveats brought by digital convergence such as the lack of new theory, proprietary (black-box) soil prediction and lack of new understanding brought by machine-learning models. A future of what may lie over the horizon of digital pedology soil science is prognosticated.

2) The realisation, that *h* humanity is fast becoming the most important soil-forming factor requires us to change our thinking substantially. For example, the increase in temperature of soil profiles by at least 1C degree to depth all over the world, through human-induced climate change, will alter properties and increase the rate of soil processes everywhere.

3) Finally, soil is key to existence. Rather than downplaying the pedocentric view we should advocate soil centrism with vigour and enthusiasm. Such a view is lead by pedology.

DIVISION 2

SOIL PROPERTIES AND PROCESSES - RETHINKING THE TRANSFORMATIVE POWER OF SOIL

GEORG GUGGENBERGER AND JENS BOY

Leibniz University Hannover, Institute of Earth System Sciences, Section Soil Science, GERMANY

Climate change, overutilization of natural resources and demographic changes are just a few pressures on our societies we caused by transforming nature without foreseeing the outcome. Nowadays we are increasingly able and willing to understand transformative power of nature, even in its most complex ecosystem compartment - the soil. Thus, we need to learn from the transformative power of soil, foster this power and use it to cope with the above-mentioned challenges by this.

Sustainable and regenerative agriculture is based on less energy and nutrient input to assure a high and stable yield without harming or even improving the environment. This requires the transformative power of soil with respect to the reestablishment of plant-microbiota-soil interactions. Functional diversity in soil can be used as a key transforming agent in agriculture and ecosystem conservation. Tight and diverse plant-microbiota-soil interactions at microinterfaces are prerequisites for closing nutrient cycles, re-establishing a good soil structure, controlling pests, and thus assuring food security. At the end soil and its organisms can be even used in industrial processes like the production of biotic concrete.

We just need to unleash and foster the soil's transformative power for the good of our environment and our societies.

DIVISION 3

FROM SUMERIAN AGRICULTURE TO THE AGRICULTURE OF THE 3RD MILLENIUM: SOIL SALINIZATION, A WORLDWIDE CONCERN. THE ROLE OF IUSS COMMISSION 3.6.

JORGE BATLLE-SALES

IUSS Commission Chair and INSAS Chair, Murcia, SPAIN

Soil salinization, characterized by the accumulation of salts in soil, has been a historical concern, with roots tracing back to ancient civilizations like the Sumerians around 4000 BCE. The Sumerians, pioneers of irrigation agriculture, inadvertently triggered soil salinization through the buildup of salts from irrigation water from Euphrates and Tigris, which contributed to the decline of their civilization.

Today, the challenges of soil salinization are compounded by global warming and climate change, exacerbating aridity in many regions worldwide. Areas already susceptible to aridity face intensified water stress, further complicated by the imperative to sustain a growing global population.

The issues surrounding salt-affected soils have garnered widespread international interest among soil scientists for decades. Even before the establishment of the International Society of Soil Science (ISSS) in 1924, concerns about salt degradation prompted the formation of specialized groups. The Alkali Subcommission, established during the 1st International Congress of Soil Science in 1927, was the pioneering effort within the ISSS to address this issue.

Over time, the focus of soil conservation has evolved in response to changing societal paradigms. Initiatives initially aimed at expanding irrigated agriculture by reclaiming wetlands gradually shifted towards conservation movements emphasizing resilience and sustainability in natural and agricultural ecosystems. Presently, the conservation paradigm has progressed towards ecosystem restoration, exemplified by recent legislative efforts such as the EU's commitment to restoring 20% of degraded ecosystems by 2030.

In 2019, the International Network on Salt-Affected Soils was launched under the auspices of the FAO-Global Soil Partnership. This initiative efforts, concretized in organized symposia, publications, webinars, and working groups activity, aligns synergistically with the efforts of the Commission on Salt-Affected Soils of the International Union of Soil Sciences (IUSS). The forthcoming Global Status of Salt-Affected Soils report, compiled by the INSAS, promises to serve as a comprehensive reference document for scientists, technicians, farmers, and stakeholders alike, fostering informed action towards addressing the challenges posed by soil salinization in the modern era.

DIVISION 4

THE ROLE OF SOILS IN SUSTAINING SOCIETY AND THE ENVIRONMENT: THE CARBON MANIA?

CLAIRE CHENU

INRAE, France

In the last ten years, soil carbon has received a great deal attention from the research community and receives much attention from the media and society at large, both from a climate and from a soil health perspective. Here, we ask whether it is a real trend, whether it is justified and what are the characteristics and outcomes of this trend.
Indeed, the proportion of soils-related scientific articles devoted to soil carbon has increased over the last decades. The attention given to soil carbon is sustained by the fact that soil organic matter is key to soil functions and ecosystem services, and is highly responsive to ecosystem management. Furthermore, the large size of the soil carbon pool has brought soils into the debates on global change and climate change mitigation.
This has led to, or been associated with, a rapid knowledge development about the nature and dynamics of soil organic matter and paradigms have changed. The centrality of soil organic matter relative to soil function, and that soil carbon has long been measured, makes it the soil characteristic most widely measured soil characteristic in soil monitoring. However, measurement methods are still not harmonized and the soil carbon targets and thresholds needed to assess soil health have not yet been defined.
In terms of knowledge sharing and transfer, soil C has been an effective communication tool over the last decade, but is associated with oversimplification, as soil organic matter is not just carbon.
In terms of knowledge application, soil carbon management is a powerful lever for protecting or restoring soil health. The ideas that there is no silver bullet in terms of management of agricultural soils and that sustainable soil management is specific to the pedoclimatic context seems to have made a good progress, but still lack developments on the ground. In the policy arena, soil carbon is at the heat of global initiatives, such as the 4p1000 initiative and has been taken up by EU and international policies, as a multifaceted indicator.
Overall, we discuss whether developing, sharing and transferring, harmonizing and organizing as well as applying knowledge on soils has benefited from soil carbon being used as a banner.


KEYNOTE LECTURES

ID ABS WEB: 136091

1. Equity, diversity, and inclusivity in soil sciences
1.02 131441 - Boosting Global Soil Science Collaboration: Fostering Equity, Decolonization, and Capacity Strengthening

FROM TRADITIONAL KNOWLEDGE TO SCIENTIFIC UNDERSTANDING: EMPOWERING RURAL WOMEN TO PROMOTE SOIL HEALTH IN THE CONGOLESE COASTAL PLAINS

L.S. KOUTIKA

CRDPI, Pointe-Noire, REPUBLIC OF THE CONGO, CONGO (BRAZZAVILLE)

For centuries, rural population of the Congolese coastal plains used to be very mobile following numerous epidemics, conflicts with another ethnic group and/or crop yield decline. These three main drivers of this mobile life style led to the permanent search for the healthy and peaceful land and potential increased crop production. This mobile life style helped to restore the health and biodiversity of soil and ecosystem. However, the slash-and-burn, a common and widely used practice in the tropics, mainly in Sub-Saharan Africa (SSA) including the Congolese coastal plains, harms soil land and ecosystems. The practice deteriorates soil health i.e., the decline in biological activity and organic residues, quick release of nutrients, and reduced physical properties (aggregation, porosity).

For over five decades, research has been conducted in silviculture, environment and socio-economic for surrounding population of forest plantation ecosystems established in the Congolese coastal plains. It highlighted how the health of nutrient-poor and sandy soil could be improved through organic matter management or introduction of nitrogen-fixing species (NFS). Mixed-species plantations involving NFS improved C and N stocks, and available P, i.e., soil health. Non-fixing species benefit from N2 fixed by NFS, while stand wood biomass increased in mixed-species stands relative to monoculture of both NFS and non-NFS. This warranties the need of population in fuel wood energy as over 90% of households rely on fuel wood energy.

The transfer of these findings to societies, through participatory research i.e., project implementation is barely made in the Congolese coastal plains, regardless of tremendous scientific findings. Congolese society and especially rural populations have very limited knowledge of these findings. A project on agroforestry systems aiming to empower rural women through C capture to mitigate climate change, boost soil fertility and staple food security in the Congolese coastal plains has been implemented. Funded by TWAS-UNESCO and ELSEVIER Foundation, this project is promoting the transfer of scientific knowledge, while considering positive aspects of traditional knowledge.

Keywords: Traditional knowledge,Scientific understanding,Transfer,Rural women,Congolese coastal plains

ID ABS WEB: 137731

2. Soil and humanity
2.01 124495 - Youth digging - The progress of early career global soil research

UNVEILING YOUTH INVOLVEMENT IN SOIL RESEARCH, EDUCATION, AND AWARENESS IN A RESOURCE CONSTRAINED ENVIRONMENT

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Nepal Agricultural Research Council, LALITPUR, NEPAL

Acknowledging the fact that there is a deficit of human resources in soil education and research worldwide, the South Asian context is not an objection amidst resource constraints. This study is a nationwide survey and a personal experience shared by an early-career scientist from Nepal, a resource-constrained country in South Asia. In Nepal, seven universities (private and public) offer undergraduate soil courses and two universities offer postgraduate soil courses. Annually, around 20 postgraduates enter the job market. This survey aims to understand the retention and motivation of young soil graduates in the national soil research, education, and extension sectors under resource constraints. Soil research and extension depend on soil education, but our preliminary findings suggest that the disconnection between education and research/extension leads to the incapacity of human resources in research and extension, resulting in poor development of soil technologies and inadequate extension/awareness. Moreover, the lack of human resources (60% deficiency in research and 40% deficiency in extension), limited financial resources (<0.01% research budget), and few capacity development programs (<5 trainings) worsen the situation. Therefore, it is a major concern that requires global attention to encourage and support youths from the developing world to work in resource-constrained environments and to enhance capacity development and research funding.

Keywords: Awareness,Youth engagement,Soil education and research,Soil Science communication,Youth learning/experience

ID ABS WEB: 137307

2. Soil and humanity
2.02 129339 - The development of Soil Science in the IUSS countries: 100 years of history

A CENTURY OF SOIL SCIENCE EVOLUTION DOCUMENTED IN THE NATURE AND PROPERTIES OF SOILS TEXTBOOK

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RAYRWEIL SOILSCIENCE, Hyattsville, USA

The Nature And Properties of Soils has served as an introductory University soil science textbook as well as a professional reference for more than 100 years. First published in 1922 under the authorship of TL Lyon and H O Buckman, the book was an outgrowth of an earlier book first published in 1905 under the title Soils their Properties and Management at Cornell University in the US state of New York. Generations of soil scientists throughout the world have been educated using later editions of this textbook, which has been translated into many of the world's major languages. The evolution of this textbook reflects the evolution of both the science of soils and the pedagogy of University teaching. This talk will highlight how basic concepts of soil science from pedology to soil physics, from soil chemistry to soil ecology have changed over the past century. In some cases, classic concepts have stood the test of time while in other cases they have been refuted and replaced with more modern and accurate approaches.

Even in this digital age, the textbook plays an important role in both education and knowledge consolidation and integration. This textbook provides an integrated systems view of soils that fragmented Google searches and multi-author chapter compendiums cannot replace. With modern teaching approaches using a “flipped classroom” in which students spend in-class time with the professor solving problems while preparing themselves with out-of-class learning, the role of the textbook may even have increased its importance compared to earlier generations.

Keywords: Textbook,Education,Pedagogy,Soil Systems,Ecology

ID ABS WEB: 137779

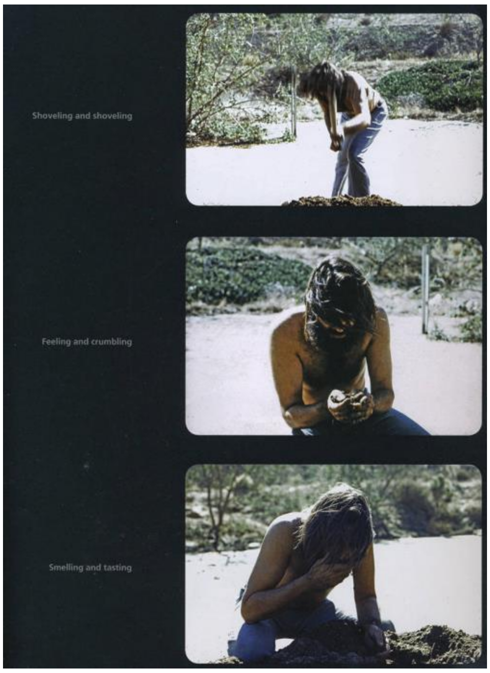
2. Soil and humanity
2.03 129617 - Soil Health from Multiple Perspectives

TODAY'S ECOLOGICAL ARTISTS ENGAGING SOILS AS BOTH MEDIUM AND NON-HUMAN COLLABORATOR

P. WATTS

Ecoartspace, Santa Fe, USA

Iron and other minerals found in soils have provided a range of pigments for making paintings dating back over 45,000 years. The oldest is a recently discovered drawing made with red ochre pigment found in a limestone cave in Indonesia. In the late 1960s, contemporary artists began a new relationship with soils, reaching beyond the material resource to depict representational art. Art movements that evolved along with the genre of Conceptual Art included the Arte Povera movement in Italy and the Earth Art movement in the United States. A radical notion of what art could be emerged for artists working with unprocessed materials and while creating art outdoors in and with nature. This was a distinct reaction to emergent consumer culture, where art was being made to blur with everyday life. In 2021, the international ecological art platform ecoartspace initiated the Soil Dialogues for artists and scientists interested in soils and textiles to collaborate on a project. The common focus has been the technique of burying decomposable textiles in soil to visualize soil chemical and microbial activity. Approximately thirty artists have met monthly via Zoom for almost three years to discuss their unique sites. Some artists did soil nutrient testing and soil DNA extraction to learn more about the microbiological profile of each site. After the artists' unearthing of the textiles, they observe and document the soil interactions and then decide how they will co-create their unique soil story. The interpretation of the range of colors and other evidence of microbial activity is unique to each artist. Other artists will add additional media to the textile, performing a collaborative artwork with the non-human world. For my presentation, I will share examples of early soil care art practitioners and the outcomes from the Soil Dialogues including the artists' process, and their research findings; providing an arts and cultural perspective for inspiration and dialogue around soil health with a broader audience.



Keywords: arte povera,earth art,soil dialogues,ecoartspace,soil care art practitioners

ID ABS WEB: 137380

2. Soil and humanity
2.10 133559 - Soil literacy, communication and citizen engagement

NURTURING SOIL LITERACY: THE INNOVATIVE STRATEGIES FOR AWARENESS AND ACTION OF FAO'S GLOBAL SOIL PARTNERSHIP

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FAO - Food and Agriculture Organization of the United Nations, Global Soil Partnership of the Land and Water Division, Rome, ITALY

Established in December 2012, the Global Soil Partnership (GSP) of the Food and Agriculture Organization of the United Nations (FAO) serves as a globally recognized mechanism with the mission of elevating soils in the global agenda and advocating for sustainable soil management. As part of its mission, it also seeks to raise awareness on the vital role of soils in promoting healthy populations and ecosystems, thus reducing soil illiteracy through effective communication strategies.
World Soil Day, celebrated every year on 5 December, is a platform dedicated to preserving soil health and promoting sustainable soil management to a wide audience. With this in mind, the GSP, together with all FAO Members, has launched impactful activities such as the King Bhumibol World Soil Day Prize and the Glinka World Soil Prize to bring soil research and innovation into people's daily lives. Through these awards, outstanding organizers and field-oriented work are recognized, strengthening society's awareness of the essential role and value of soil.
The GSP reinforces soil education with interactive materials, including activity books and laboratory experiments for children. Painting competitions for children and teenagers, combined with tutorials on soil painting techniques, promote hands-on learning about the importance of soil in everyday life.
Numerous competitions and activities, such as 'From soil to plate', child-oriented laboratory experiments and annual photo, book and poster contests, have involved citizens of all ages by highlighting the societal importance of soil.
Throughout the year, the GSP, with the support of FAO's corporate communications unit, actively engages with a global, diverse audience on various social media on soil health and protection encouraging all to take action.Through this range of activities, the strategy has successfully mobilized billions of people, sparking collective imagination and connecting with citizens' lives with the overall objective to contribute to the green transition by promoting soil health and sustainability. This approach surpasses the mere provision of scientific information, resonating with people's existing practices, values, and concerns.

Keywords: Communication strategies,World Soil Day,Soil awareness,Citizen engagement,FAO's Global Soil Partnership

ID ABS WEB: 140522

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

NEW APPROACHES TO SOIL AND WATER MANAGEMENT AND CONSERVATION FOR A SUSTAINABLE FOOD PRODUCTION UNDER FUTURE GLOBAL CHANGES

ILDEFONSO PLA

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Soil and Water resources are the basis for current and future food production and water supply for an increasing population and plays a central role in determining the quality of our environment. Both resources are subjected to increasing pressure under global change effects, including population growth, land use and management and global climate changes. Water resources management and land management are intricately linked. Increasing competing demands will reduce land and water availability for food production. At the same time, expected increases in food demands will require increased agricultural production and agricultural water use. Increased human influences on soils frequently results in widespread land and soil degradation processes. Associated with land and soil degradation there is a decrease in available and acceptable quality water for agriculture, urban and industrial needs, and decreased biodiversity. The of soil and water degradation processes are linked through unfavorable alterations of the hydrological processes determining soil water regimes. Like climate, soil and socio-economic conditions differ significantly from one location to another, and because they are changing continuously, there cannot be simple universal prescriptions about practices for sustainable soil management for crop production and environmental protection. A hydrological approach to the evaluation and prediction of the conservation of soil and water is essential for adequate development, selection and application of sustainable and effective land use and management practices. Based on that premise, we have derived a hydrological modeling approach, which may be and has been used to evaluate and predict soil hydrological processes and derived effects. Such a modeling approach can be adapted to deduce the appropriate land management for a more efficient and sustainable use of soil and water resources. The substantial number of factors, and their complex interactions, determining and affecting soil and water degradation processes, and conservation practices, require more interdisciplinary approaches and research, to be able to identify, to evaluate and to find adequate valid and sustainable alternatives to the different problems. The main objective

ID ABS WEB: 136510

2. Soil and humanity
2.16 133780 - Soil as a cultural heritage:
the soil knowledge as a heritage for the future generations.

HOW TO ENHANCE SOIL LITERACY AND SOIL AS A CULTURAL HERITAGE

R. BARBETTI [1], B. MASOLINI [2], C. OLIVERIO [2], F. CONTI [2], S. CASTIGNONI [3], M. ZANINI [4], C. LOZANO FONDON [5], M. FANTAPPIÈ [5]

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Increasing soil literacy in society is a current long-term objective of the European Union. The proliferation of soil museums in recent years is a step towards making soil as a cultural heritage. Similarly, bringing closer the soil to society comes through teaching, which requires basic knowledge about the soil system. In addition, the involvement of some artistic skills in the whole process could enhance the acquisition of fundamental concepts about the soil, which could derive into a sort of “soil art” practice. We aim to review some significant experiences in the representation of soil for educational and cultural purposes in Italy, which we call Terrae Scientia. This generic definition includes a whole series of exhibitions on soil that combine art and science. Some of them have been collected from the literature, while others come from our own experience and so, new terminology has been assigned to them (i.e. Soilfloor map). We summarized and evaluated the impact of each type of Terrae Scientia using a set of metadata that defines aspects such as the possible installation costs, purposes and benefits for educational learning, entertainment, and scientific and artistic value. We focus on those Terrae Scientia that, because of their interdisciplinary nature, are more closely linked to the territory, such as eco-museums. We found that soil monoliths are the most common form of illustrating soil in exhibitions, but other performances related to soil can be an alternative but equally impressive, and with a high educational value (i.e pedolites or soilboxes). Special mention deserves the natural environment with presence of “pedosites”. They represent the best opportunity to organize natural itineraries that can be combined with teaching or rural tourism. We believe that the set of activities we collected improves soil culture to citizens of all ages, delivering an educational message through beauty and creativity. In addition, they could provide important employment opportunities for tour guides, exhibition curators, artists, information technology companies and freelancers.

Keywords: soil exhibitions,pedosites,soil literacy,museums,soil art

ID ABS WEB: 136429

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

NOTES ON THE DEVELOPMENT OF A METHODOLOGY FOR SEMIQUANTITATIVE ASSESSMENT OF URBAN SOIL HEALTH

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Soil health assessment is an essential part of policies for soil and environmental management and protection. In particular, maintaining and enhancing soil health can be particularly challenging in urban environments, where soils are exposed to many degradation processes and can be deeply disturbed by anthropic activities and contamination. However, many difficulties arise for the actual assessment of soil health and we are currently far from having widely accepted methods for assessment or even indicator selection. In this work, the development of a simple semiquantitative methodology for urban soil health assessment will be presented, based on scoring tables and the EU framework. The methodology has been tested using a database from previous works on the urban soils of Santiago de Compostela, including physical, chemical and biological properties in soils developed over different parent materials and under different land uses. Lessons learnt in this case study regarding the future development and application of soil health assessment schemes in urban soils will also be discussed.

Keywords: Urban soil,Cities,SUITMA,Soil health,Soil quality

ID ABS WEB: 136616

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

PLANT COVER AS AN IMPORTANT SOIL-FORMING FACTOR CONTROLLING TECHNOSOL EVOLUTION: A CASE STUDY FROM ABANDONED IRON ORE MINE IN POLAND

L. UZAROWICZ [1], W. KWASOWSKI [1], J. LASOTA [2], E. BLONSKA [2], B. GÓRKA-KOSTRUBIEC [3], M. TARNAWCZYK [1], E. PAWLOWICZ [1], D. MURACH [1]

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The objective of the study was to examine the transformations of properties of Technosols following spontaneous development of forest habitats on dumps of the former Fe ore mine in Czarniecka Góra village, S Poland. Despite the similar age (60 years), the soils showed differences in chemical and biological properties, which was related to the different degree of development of the plant cover appearing on the heap as a result of natural succession. The emergence of vegetation and its further development into more and more developed plant communities causes acidification of the upper part of the soil profile, washing out of carbonates from the upper parts of the soil and the accumulation of soil organic matter manifested by an increase in the content of TOC, TN in the upper parts of the soil. The highest magnetic susceptibility was found in the upper parts of the soil profiles representing the places with the most advanced succession. This suggests that the progress of pedogenesis on the studied heap probably causes the transformation of mineral phases towards phases with higher magnetic susceptibility. Development of vegetation on the heap promotes the development of microorganisms in Technosols, which is manifested by an increase in the enzymatic activity of soils in the upper parts of the profiles. The conducted research shows that plant cover is one of the most important soil-forming factors controlling the direction of property transformation of technogenic soil substrate and the course of soil-forming processes in the initial Technosols on post-industrial waste heaps.

Keywords: Technosols,pedogenesis,plant succession,mine wastes

ID ABS WEB: 137021

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

OUR MOST USED SOILS ARE SUITMAS: THE CASE OF TRAFFIC SOILS IN URBAN AREAS

W. BURGHARDT

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Why traffic soils? When thinking of soils, we have natural bodies in mind which developed by the action of their environment and by use. With coming up of civilization, and by this growing influence of men on environment, new ways of soil formation occur. They are based on men decisions and not on nature as factors of soil formation in landscapes. Thus we can discern two types of soil groups: Soils which are by-products and soils which are tied on the target of human activities. From many decisions of social affairs and economy follow as by-products movement, transport and deposition of soil and soil forming materials at diverse locations. The second type are soils such as of waste tips and of traffic areas which are bound to the intention of decisions and to defined locations.
Traffic soils are today the most used soils. Our fast growing urban areas would not be sustainable without traffic soils. Thus they provide a large part of SUITMAs (Soils of Urban, Industrial, Traffic, Mining and Military Areas). Traffic soils are soils of roads, paved walkways and gravel roads, and soils of train tracks. Soils of roads and paved walk ways are already known as Ekranosol and Dialeimmasol, and of train tracks as Intrusol. Until now, not described are gravel roads, which can be designated as Podosol (podo, greek foot). Like natural soils, traffic soils are subject of change by the impact of the environment.
This presentation will in short feature the development of traffic soils. The subsoil can vary according to the origin of the soil forming substrate, the site use and contamination. The top soil horizons correspond with the specific construction demands. There occur soil forming processes underneath the bearing layer and within the bearing layers from reduction, leaching and dust intrusion and dust deposition. Thus the individual traffic soils can be characterised by both: specific substrates (soil forming materials) und soil horizons.

Keywords: Urban soil genesis,Urban soil properties,Soils of men`s decision,Traffic soils

ID ABS WEB: 137216

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

ATMOSPHERIC DEPOSITION OF METALLURGICAL PARTICLES IN URBAN SOILS: HOW TO DETECT THEM AND MONITOR THEIR IN-SITU EVOLUTION AND MIGRATION ?

M. CASETTA [1], D. PRÊT [2], L. COURCOT [1], S. PHILIPPE [1], C. LAFOREST [2], M. HERMOSO [1], J. CAILLAUD [1]

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The atmosphere of Dunkerque agglomeration (northern France) is closely monitored due to the huge quantities of dust emitted by its metallurgical industries (> 2700t in 2021). In such a context, the atmospheric deposition of industrial metallic particles on the local soils is particularly pronounced. The fate of industrial metals in these ecosystems is a major concern, especially because of their potentially harmful effects on human health.

The city of Gravelines (Dunkerque agglomeration) is known to be exposed to chronic industrial dust fallout (particle size > 20 µm), especially during North-East windy and dry events. Anthropogenic particles such as coal, alumina dust, slag, iron ores... are thus incorporated into the soils. Each type of particle is identified by significant concentrations of specific metals (Cr, Ni, Mo…), enabling its environmental traceability.

Although total chemical analyses of topsoil samples collected in Gravelines showed diffuse metal contamination, their quality appears diminished by industrial metals according to Tomlinson et al. (1980) (PLI values ranging from 1.2 to 1.8). Besides, the fate of dust particles and their associated metals in soils remains of a significant interest in the long-term.

To understand the various processes involved in the integration of industrial dust in soils, large thick sections were made from contaminated soil cores (0-15cm) by using an advanced resin impregnation procedure. Scanning Electron Microscopy (MEB-FEG JEOL 7900F) coupled with cutting-edge annular EDS allowed (through high resolution, large field chemical mapping and image processing) to locate and identify in-situ atmospheric particles. In one soil section, more than 30 particles/cm² were counted in the first few centimeters. The coupling with µXRF analyses and mapping of trace elements (Cr, Ni, Mo…) makes it possible to precisely spatialize the industrial particles at core scale according to their tracer metals. This innovative approach enables to study the distribution of metallurgical particles within the soil and then to highlight their possible migration mechanisms and interactions with the different soil or biosphere components.

Keywords: Urban soils,Industrial dust,Metal contamination,Microanalyses

ID ABS WEB: 137876

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

A CO-DESIGNED APPROACH TOWARDS DEVELOPING AN AGRI-ENVIRONMENTAL SCHEME WITH STAKEHOLDERS: LONG-TERM AGREEMENTS FOR LANDSCAPE-SCALE NATURE RECOVERY

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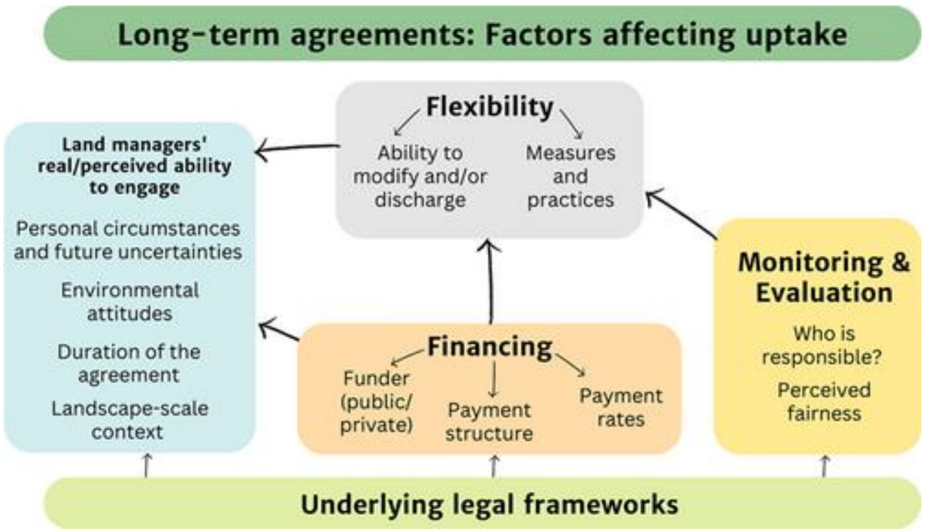
Countryside and Community Research Institute, University of Gloucestershire, Cheltenham, UNITED KINGDOM

Research was undertaken to explore the potential of long-term agreements (30 years+) for securing landscape-scale nature recovery in the UK. Improving soil health is paramount for achieving this goal, including ambitious measures such as land use change and the restoration of natural waterways. Measures and practices relevant to soil health were thus expected to be embedded throughout such agreements. A co-design research approach was used to iteratively engage with stakeholders, including agricultural land managers who would hold long-term agreements, alongside other interested parties who may be otherwise involved, for example through contributing to funding, monitoring, or evaluation. These stakeholders included representatives from various non-governmental bodies, private water companies, natural capital enterprises, and local nature partnerships. Here, we present the results of this research. A template long-term agreement was co-developed with stakeholders, where their views shaped both the research design and the outputs. A initial rapid evidence assessment, a series of workshops, interviews, and a public consultative webinar resulted in participants feeling empowered and feeling that the outputs which resulted reflected the views of all stakeholders, even those with differing agendas. The resulting template agreement was positively received despite continued uncertainties around the feasibility of long-term agreements themselves, largely because it was redrafted across the study, including after the final evaluation interviews and consultative public webinar. During this talk, we will share our co-design approach to governance and provide an overview of the resulting agreement template. Our approach, where stakeholders were repeatedly consulted with using a participatory methods, provides a useful approach for future democratically-focused stakeholder engagement relating to soil policy.



Keywords: Co-design,Stakeholders,Agri-environment policy,Agricultural management,Participatory methods

ID ABS WEB: 136396

4. Soil health in achieving the Sustainable Development Goals
4.01 123826 - Soil science lessons from 100 years or more old experiments

LONG -TERM MANURE APPLICATION IMPROVES SOIL HEALTH IN CONTINUOUS MAIZE PRODUCTION SYSTEM

B MAHARJAN

University of Nebraska-Lincoln, Lincoln, USA

Body

Soil health lies at the core of a sustainable food production system. A comprehensive evaluation of different agronomic practices and their effect on soil health is essential to determine the best practices that support soil ecosystem services. However, it may take years or decades to observe measurable changes in soil health under varying management practices. The objective of this experiment was to evaluate the effects of long-term (>77 years) manure and inorganic nitrogen (N) fertilizer on soil health and determine the interrelationship among the measured soil bio-physicochemical indicators. The study also aims to understand the sustainability of the monocropping maize production system under long-term manure and inorganic N fertilizer management. The experiment site is the historic Knorr–Holden Plot, established in 1910 and continued till today. Over the years, the treatments were constant, with manure as the main factor and N rates as the sub-plot factor. Aligning with advancements in agronomic management, the rates of fertilizer and manure have been revised from time to time. Analysis of soil health indicators showed a significant effect of manure on different labile C & N fractions, soil enzymes, and soil organic matter (SOM). Manure treatment improved C stabilization and reached a C equilibrium for management. Water holding capacity was significantly improved at the wilting point and field capacity for manure treatment. Nitrogen treatments only affected soil pH, cationic exchange capacity (CEC), and P. SOM was determinative for C & N fractions and CEC. SOC can be used as a proxy for soil total N ($R2$ = 0.98). Water extractable fractions of C and N were interrelated and can be used as determinative factors for each other. Although a monocropping system can be maintained using long-term manure application, other conservation practices such as crop rotation and minimal tillage would enhance sustainability efforts.

Keywords: Soil health,Nebraska,Cattle manure,Knorr Holden,Soil Carbon

ID ABS WEB: 137286

4. Soil health in achieving the Sustainable Development Goals
4.01 123826 - Soil science lessons from 100 years or more old experiments

GRADIENTS OF SOIL HEALTH IN THE ROTHAMSTED LONG-TERM EXPERIMENTS

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The Rothamsted Long-Term Experiments (LTEs) in the UK include the ‘Classical’ experiments established by Lawes and Gilbert at Rothamsted in 1843-1856. They are the oldest continuous agronomic experiments in the world. Originally established to examine the effect of inorganic fertilisers and organic manure on crop yield and nutrient cycling primarily, they have become increasingly important as a platform to conduct research on aspects of the key societal challenges of sustainable agriculture, food security and climate change. The long history of different treatments on the LTEs has resulted in a gradient of measurable soil physical, chemical, and biological properties and functions, on the same soil type and under the same climate, which collectively define ‘soil health’. Here we introduce some of the key findings on the relationship between agronomic management and soil health on the Rothamsted LTEs.
Most obviously, long-term application of fertilisers and limes have affected nutrient availability, and organic manure application has increased soil organic carbon (SOC). There are differences in the persistence of SOC fractions with management, affecting long-term sequestration. Long-term management, and especially its effect on soil nutrients and SOC, affects the soil microbiology including the microbiome and the abundance of genes that control soil functions. There is an observed relationship between management, SOC, and soil physical properties on the LTEs, with implications for soil structure and its stability, the ease with which soil may be cultivated, and the ability of soil to support root penetration. Furthermore, SOC, soil structure and soil microbiology combine in distinct associations to control important soil functions such as nutrient delivery to plants, the retention and transmission of water, and the ability of soil to be a sink or source of greenhouse gases.
The Rothamsted LTEs, within the family of global LTEs, continue to yield new insights into the properties and functions of soils and how they may be managed to achieve soil health and sustainability goals in agricultural systems.

Keywords: soil properties,soil functions,long-term experiments,inorganic fertiliser,organic manure

ID ABS WEB: 135901

4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

UNITED STATES (U.S.) EFFORTS TO ALIGN SOIL TEST P AND K RECOMMENDATIONS: THE FERTILIZER RECOMMENDATION SUPPORT TOOL (FRST)

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Soil tests and resulting fertilizer recommendations developed over half a century ago were the product of state-level research. Soil-test based recommendations have recently come under scrutiny for various reasons including a lack of current research, inconsistent terminology, and different soil test methods and fertilization philosophies among geographic regions and states within a region. The amount of historical correlation and calibration data to support recommendations and resources to refine recommendations has varied widely among states in the U.S. To bridge differences among states and provide transparency and confidence in soil testing, we have developed the Fertilizer Recommendation Support Tool (FRST) project. Although FRST started by comparing nutrient recommendations for phosphorus (P) and potassium (K) in 14 southern states, the project currently includes researchers from 44 states and one U.S. territory, 3 not-for-profit organizations, and 4 U.S. Department of Agriculture agencies. This collaborative national project involves over 100 soil fertility research and extension personnel. FRST activities include a national soil fertility survey, the development of a minimum dataset for P and K soil fertility trials, a standardized relative yield equation and critical soil test level model for the FRST tool, development of a relational database, and the decision support tool. Activities and accomplishments from FRST will be presented.

Keywords: Soil fertility support system,P & K fertility,Scientific collabotoration

ID ABS WEB: 138056

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

FROM LTE DATA TO THE SUSTAINABLE CONTROL OF SOIL FERTILITY

Authors
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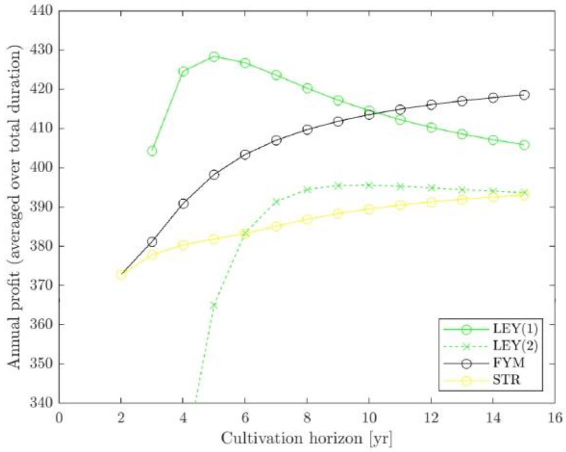
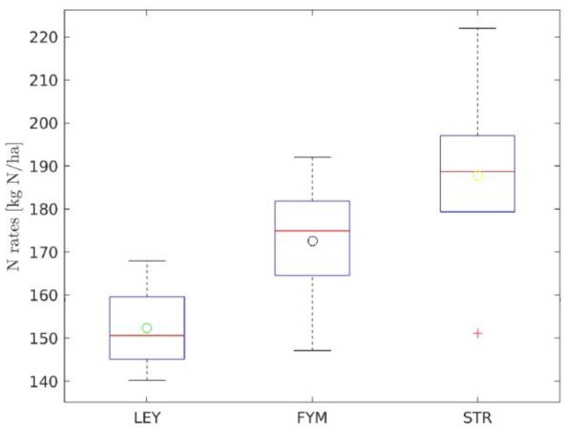
Sustainable agriculture requires that soil fertility be optimal to maintain levels of food production whilst also maintaining environmental quality and even improving both together. Like inorganic fertiliser, organic amendments such as manure can increase crop yield and could partly replace artificial nitrogen, but we need a multi-year strategy, because yields may decrease when amendments cease. Other measures to manage arable land such grass and clover leys used in rotation can also enhance crop yield and mitigate soil degradation. Here we propose a way to assess the sustainability of agricultural practices by seeking optimal means for improving the fertility of land that takes account of the dynamics of the yield-enhancing benefits of organic amendments and leys alongside annual applications of artificial fertiliser. Using optimal control theory, we shall present a rational basis for combining applications of inorganic fertiliser and organic matter treatments of arable land to a sequence of crops grown in consecutive seasons that ensures maximum profit from crop production and improves soil fertility. Instead of a complex mechanistic approach, we use the empirical idea of a nutrient response curve, which is extended to include both the effects on yield of the nutrients themselves and also the long-lasting benefits of different types of organic matter management using ad hoc recurrence relations to model the carry-over of soil carbon and nitrogen from one season to the next. We will discuss useful key features of the design of an organic manuring long-term experiment at Rothamsted which allowed for the selection and the parameter identification of a single nutrient response curve valid for different organic treatments. In the context of the field experiment used and the economic conditions assumed, our control theory approach suggests that growing wheat for four years in rotation with one year of a ley can both reduce the use of nitrogen fertilisers and maximise the farmer's annual profit compared to other organic amendments.





Keywords: organic amendments,optimal management practices,long-term experiments,fertiliser,carbon

ID ABS WEB: 136188

4. Soil health in achieving the Sustainable Development Goals
4.06 131649 - The centrality of organic carbon in balancing the multifunctional nature of soils for sustaining human and planetary health

ENSURING PLANETARY SURVIVAL: THE CENTRALITY OF ORGANIC CARBON IN BALANCING THE MULTIFUNCTIONAL NATURE OF SOILS

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Soils provide 98.7% of the calories consumed by humans, but our near-exclusive focus on using soils to produce food, fibre, and energy (biomass) through agricultural systems is now causing substantial soil degradation. Here, we show that although soil provides numerous functions upon which planetary survivability depends, the accelerating soil degradation caused by focussing largely on a single function (biomass production for food, fibre, and energy) is occurring at the expense of other critical planetary functions – these are ‘trade-offs’ in soil functionality. In particular, we focus on how land-use change for biomass provision is rapidly decreasing the ability of soils to regulate the carbon pool, with this contributing to climate change, decreasing the ability of soil to cycle the nutrients that sustain plant growth, to protect the 25% of global biodiversity that is found in soil, and to cycle the Earth’s freshwater supplies. We demonstrate that soil organic carbon plays a central role in soil multifunctionality and is a master indicator for soil functioning. Given the threats facing humanity and their economies, it is imperative that we recognize that Soil Security is itself an existential challenge and that we need to increase our focus on the multiple functions of soils for long-term human welfare and survivability of the planet.

Keywords: Soil organic carbon,Soil organic matter,Planetary survivability,Soil multifunctionality

ID ABS WEB: 136200

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes - Importance for climate resilient future, degraded lands restoration and plant health control

HOW THE SOIL MICROBIOME COULD BE ENHANCED BY VERMICOMPOSTING STRATEGIES: AN EXPERIMENTAL CASE

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Food security depends primarily on growers which intrinsically rely on the capacity and condition of soils to deliver functions and services that are mostly provided by healthy soil microbiomes. The need for alternative solutions to fertilizers and pesticides and better sustainable soil management surges into the farming community as production cost and soil depletion increase. Vermicomposting has been accepted as an environmentally beneficial waste stabilization process for transforming organic wastes into high-value organic amendment. In the framework of soil bioremediation and soil food web modeling, vermicomposting is considered as an evolving sustainable technology providing soil microorganisms stored into their gut microbiome. In this study we aim to highlight the key role of earthworms, especially the potential of Eisenia Fetida, as significant indigenous microorganisms (IMO) accumulators and an alternative solution in remediating soil microbiome and restoring soil functions. The experimentation takes place into a vineyard in the southeast of France that applies agroecological practices for 5 years and has a non-optimized system (no irrigation, no fertilizers, no pesticide treatments). The vermicompost have been made with the Soil Food Web method of Dr. Elaine Ingham. Vermicomposting was a necessary prior stage for one year to develop the microorganism's diversity and obtain the second and third soil trophic levels. The earthworms were fed with local organic matter in order to inoculate their gut microbiota with IMO. Once mature, the earthworms' substrates were removed in order to extract and breed the IMO produced by the earthworms into a food-enriched oxygenated water, called Vermicompost Oxygenated Tea (VOT). From April to June 2023, the VOT were used as foliar sprays to protect plants from diseases and applied to soil. Preliminary results show that VOT reduced 3 times disease of leaves vines ($p<0.001$) (Fig 1), reduced water retention time ($P<0.001$) (Fig 2) and increased soil penetrability ($P<0.001$) (Fig 3) for the experimental plot compared to agroecological and control plots.

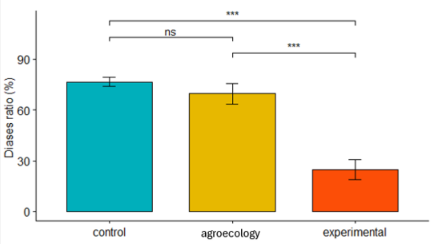

Fig 1. Disease infection (%) in function of soil treatment for year 2023.
Significant difference at p <0.001.

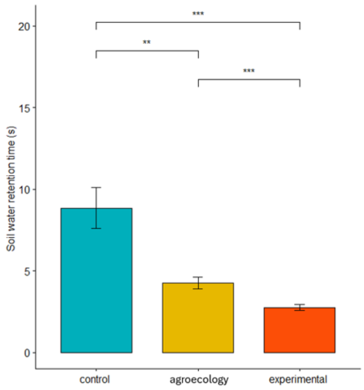

Fig 2. Soil water retention time (s) in function of soil treatment for year 2023.
Significant difference at p <0.001.

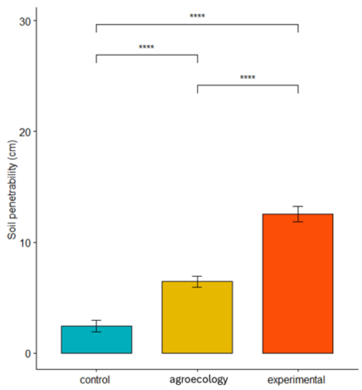

Fig 3. Soil penetrability (cm) in function soil treatment for year 2023.
Significant difference at p <0.001.

Keywords: Soil microbiome,Vermicompost,Soil functions,Disease management,Food security

ID ABS WEB: 137884

4. Soil health in achieving the Sustainable Development Goals
4.08 132261 - Ecosystem services provided by nematodes and other soil invertebrates and specific protection goals

BIODIVERSITY SOIL RESILIENCE (BSR): A NEW INDEX TO ASSESS RESILIENCE IN ENVIRONMENTALLY STRESSED ECOSYSTEMS

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Over the last century, natural habitats and semi-natural environments have been under increasing environmental pressure, leading to significant changes and a decline in biodiversity. The soil is fundamental to terrestrial ecosystem function and environmental health, contributing significantly to support and regulation services. To address these challenges, a new resilience index named Biodiversity Soil Resilience (BSR) is proposed. This index focuses on the intricate relationship between biodiversity and soil health. It involves a comprehensive analysis of soil biodiversity, with a particular emphasis on entomopathogenic nematodes (EPN), entomopathogenic fungi (EPF), earthworms, and soil microarthropods. Numerous studies support the crucial roles of these components in ecosystem resilience, offering diverse benefits that contribute to environmental stability. For example, entomopathogenic nematodes (EPN) and entomopathogenic fungi (EPF) play a significant role in biological control, the food chain, nutrient cycling, adaptability, and interactions with soil. Earthworms enhance soil aeration, promote the mixing of organic and mineral material, increase microbial biomass, provide biological control against pathogens, and foster beneficial symbioses. These organisms exhibit adaptability to various environmental conditions, contributing to the ecosystems' ability to withstand and recover from environmental stresses. Microarthropods, including mites and collembola, also play a crucial role in the BSR-Index by contributing to soil properties such as decomposition, nutrient cycling, soil structure, biodiversity, adaptability, and resilience. Additionally, they engage in fundamental interactions with vegetation and other microorganisms, further influencing ecosystem health. A key innovation in this research is the development of a dedicated app/software for real-time data collection in the field. This tool streamlines the gathering of information on specific organisms and contributes to a global database of soil biodiversity data. The BSR-Index is envisioned as a monitoring tool for the scientific community and government authorities The Index, incorporating environmental stresses, soil biodiversity, and soil biological quality (QBS-ar and QBS-e), supported by chemical and physical parameters, aims to enhance our understanding of ecosystem health and promote informed decision-making for a resilient and sustainable future.

Keywords: Ecological indicators,Soil quality,EPN and EPF,Microarthropods,Earthworms

ID ABS WEB: 135942

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

CROPPING SYSTEMS FOR SOIL HEALTH: DOES DIVERSITY MATTER?

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In cropping systems there are three primary means to achieving plant diversification: (i) diversifying crop rotations, (ii) intercropping, and (iii) using cover crops. The choice of which cash crops to grow in rotation or to intercrop is highly constrained. However, cover crops grown as part of a crop rotation during periods of the rotation when the soil would otherwise be bare are primarily grown to improve soil health. Unlike rotation diversification and intercropping, cover crops offer a promising means to combine a diverse mixture of plants from a variety of different plant families with contrasting physiology, elemental stoichiometry, or rhizosphere microbial community. In theory, any combination of plants could be grown without fundamentally changing how or when the preceding or proceeding cash crop is managed or harvested. Therefore, cover crops are the most flexible means to increasing plant diversity on farms.

Several experiments have observed greater delivery of functions where more diverse mixtures of plants are grown. However, this observation can often be explained by the 'selection effect'. The 'selection effect' states that functionally efficient species are more likely to be present within a mixture as the number of species increases. This phenomenon can be controlled for statistically by testing all species within a mixture individually and nesting them within a 'single crop' factor. The 'single crop' factor is then compared with the mixture and the difference represents a real interaction between the species in the mixture. This real interaction, caused by a scientifically explainable mechanism, is known as 'complementarity'.

In this talk I will provide examples of where we have observed complementarity and where we have not observed complementarity in experiments undertaken in laboratory and field experiments employing plant mixtures established in crop rotation, intercropping and cover cropping scenarios. I will particularly focus on the possible mechanisms for the synergistic effect observed when returning biochemically contrasting cover crop residues on soil microbial biomass and carbon storage.

Keywords: Cover crops,Intercropping,Rotation,Soil Organic Matter,Complementarity

ID ABS WEB: 137866

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

SOIL AGGREGATE STABILITY ALONG A GRADIENT OF FLOODING INTENSITY IN THE RIPARIAN ZONE: THE ROLE OF ROOT FUNCTIONAL TRAITS

P. HUANG [1], Y. RAN [1,3], Y. LIU [1,3], K. ZHU [1,3], X. WANG [1,3], X. YI [1,3], Y. WANG [1], M. MA [1], S. WU [1], J. ZHANG [2,3]

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Soil aggregates in riparian zones serve as the foundational matrix for critical ecosystem services, yet their stability is intricately linked to the functional traits of plants during rehabilitation. Flooding, a common stressor in these ecosystems, has the potential to alter plant communities and their functional traits, yet the role of these traits in aggregate turnover and stabilization remains poorly understood. To bridge this knowledge gap, we conducted a thorough investigation into the soil aggregate turnover in a typical riparian zone of the Three-Gorges Reservoir. We closely tracked water level fluctuations and their impacts on vegetation, using undisturbed soil sampling and sieving techniques to assess aggregate size distribution dynamics. Additionally, we employed on-site plant quadrat surveys, minirhizotron observations, and lab analysis of above- and below-ground traits to assess the changes and relative contributions of plant functional traits to aggregate stability. Controlled indoor experiments further clarified the mechanisms by which root functional traits influence soil aggregate formation and stability. Our findings revealed that soil aggregate stability decreased significantly with the increasing flooding intensity, but not in a linear fashion. Oxides played a crucial role in aggregate stability under intense flooding, while organic carbon dominated under milder conditions. We observed significant variations in above- and below-ground biomass with flooding intensity, and species diversity had contrasting effects on small macro-aggregate formation. Perennial herbs with fibrous root systems were essential for soil aggregate stability under intense flooding, while plant diversity was critical under milder conditions. Root volume density mediated the effects of plant diversity on riparian soil aggregate stability. This study highlights the complex interactions between flooding, plant functional traits, and soil aggregate stability in riparian zones. Understanding these dynamics is crucial for effective management and restoration of these vulnerable ecosystems.

Keywords: Soil Aggregate,Root Traits,Ripaian Zone,Microbial Community,Flooding Intensity

ID ABS WEB: 138170

4. Soil health in achieving the Sustainable Development Goals
4.17 133569 - Revitalization of mining residue deposits

DEVELOPING A REVEGETATION TOOLBOX FOR MINE RESIDUE DEPOSITS IN THE SOUTHERN AFRICAN REGION.

S. NORRA

Potsdam University, Potsdam, GERMANY

Body

In southern African countries, such as South Africa or Namibia, numerous mine resediue deposits of various commodities such as Gold, Coal, Copper, Lead, Zinc or Uranium are potential threats to the environment. Water resources can be contaminated or dust from these deposits can be resuspended and pollutes the atmosphere. A vegetation cover would improve the situation but often the climate and the soil properties are limiting the spontaneous growth of plants. To identify and implement sustainable solutions the Mine Water Management Network was established in 2021 to develop adapted solutions solving the specific challenges at the specific deposits. Since in these environments, water is often a scarce resource it is one aim to use mine waste water for irrigation of revegetation measures. Since at some sites, the mine water has high salt or heavy metal contents, adapted solutions have to be developed to at least semi-purify the mine waste water before use. This must not be always a high end reverse osmosis system; local materials form concrete works or water treatment facilities also potentially can be used. Furthermore, it has to be decided which plants can be grown on the deposits, able to cope with specific site conditions. In case of the absence of potential contaminations crops can be planted. If the contamination of the food chain is too serious, plants for biomass and energy production can be chosen. Under very dry climates, at least contributions to support biodiversity can be undertaken. In all of these cases a sound analyses of the soil physics and the continuous spatial monitoring of soil water content is important to optimize the irrigation modes.
Thus, many aspects have to be considers to successfully revegetate MRD under dry conditions. Here, the project WaMiSAR (Sustainable and climate adapted water management in mining of the Southern African Region) aims to develop and compile a revegetation toolbox that contains all necessary tasks for revegetation in this region.

Keywords: Southern African Region,Mine Residue Deposits,Soil physics,Revegetation

ID ABS WEB: 140657

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

EMERGING CONTAMINANTS IN THE WASTEWATER-SOIL-PLANT CONTINUUM

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Municipal treated wastewater and biosolids are historically under-utilized resources but are finding increasing uses in agriculture. Due to urbanization and climate-change induced water scarcity, treated wastewater is viewed as a valuable water source for agricultural irrigation, especially in arid and semi-arid regions. Biosolids, the primary by-product of wastewater treatment, are widely used as soil amendments for their nutrient value. Irrigation with treated wastewater and application of biosolids or animal waste introduce numerous contaminants of emerging concern (CECs) into our food crop production systems. Transfer of CECs in these “waste” sources from soil to our food produce constitutes a potential food safety and human health risk. We have carried out systematic research to evaluate uptake of common CECs into vegetables and to mechanistically understand their plant metabolism pathways. A comprehensive risk assessment and management of CECs in agroecosystems is constrained by multiple factors, the utmost of which is the enormous number and diverse characteristics of CECs. Here we provide an overview of current knowledge, and then outline a bottom-up tiered approach as the path forward to identify priority CECs to better address this concern. We further propose several strategies to minimize the potential risk of CECs during the beneficial reuse of treated wastewater and biosolids. This research contributes to environmental sustainability while ensuring safety in beneficial reuse of these valuable resources.

ID ABS WEB: 136432

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

NITROUS OXIDE DRIVERS IN NATURAL AND MANAGED MEDITERRANEAN ECOSYSTEMS, ARE WE OVERESTIMATING EMISSIONS?

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DISTABIF, University of Campania Luigi Vanvitelli, Caserta, ITALY

Nitrous oxide (N2O) is a microbial by-product and/or intermediate of reaction, and terrestrial ecosystems, where the flow of N is accelerated by anthropogenic causes, are considered its main global source. Different co-factors contribute to switch and magnify N2O fluxes in soils, such as pore water saturation and high respiration rates in soil hotspots. Finer drivers might be represented by the quality vs quantity of available substrates, natural and artificial inhibitors of microbial processes, competition for substrates. Contrarily to the prediction of high N2O fluxes from macro drivers, such as fertilization or tillage of organic soils, the causal relationship between N2O emissions and N and C cycle dynamics and ecosystem characteristics is less clear where fluxes are lower. This is often the case of Mediterranean ecosystems, in particular in southern areas where drier climate and specific conditions might result in even lower fluxes than expected, leading to overestimating their global contribution. We present some examples including drivers of N2O fluxes in Mediterranean southern areas of Europe, in monospecific coppices, in leguminous fields, in pastures under conventional and adaptive management, in agricultural sites. Indications might be relevant for adaptation strategies and C farming and mitigation policies.

Keywords: Mediterranean,Land management,Adaptation,C farming,N2O

ID ABS WEB: 138242

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

INCREASING SOIL CARBON AND SOIL HEALTH IN PRODUCTIVE SYSTEMS IN COSTA RICA, MEXICO, AND TOGO THROUGH THE FAO´S RECARBONIZATION OF AGRICULTURAL SOILS (RECSOIL) INITIATIVE

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The Food and Agriculture Organization of the United Nations (FAO) has launched the Recarbonization of Agricultural Soils (RECSOIL) initiative, being implemented through its Global Soil Partnership. RECSOIL focuses on increasing or maintaining soil organic carbon (SOC) stocks and improving soil health in agricultural and degraded lands through the adoption of sustainable soil management (SSM). This study observes the impact of RECSOIL in pilot implementation sites in Mexico, Costa Rica, and Togo.

RECSOIL identified implementation sites using the Global Soil Organic Carbon Sequestration Potential (GSOCseq) map and atlas of Global Change Issues, selecting sites with high SOC sequestration potential and convergence of global issues. Site-specific SSM practices were selected with producers, technicians, and scientists. The “Protocol for the assessment of Sustainable Soil Management” and “A protocol for measurement, monitoring, reporting and verification of soil organic carbon in agricultural landscapes” (GSOC-MRV Protocol) were followed to establish a baseline of SOC stocks and soil health status. The FAO’s EX-Ante carbon Balance Tool (EX-ACT) is used to monitor greenhouse gas (GHG) emissions.

Agave farmers in Mexico identified erosion and soil moisture retention as concerns while corn farmers identified biodiversity loss and pests as major soil threats. SSM efforts would mitigate up to 59 tons CO2eq annually across 140 hectares through cover cropping in agave crops and through intercropping in corn crops, while addressing other soil threats identified.

In Costa Rica, approximately 45 dairy and coffee farmers would reduce GHG emissions up to 872 tons of CO2eq annually across 500 hectares through grazing management, erosion control, and enhanced residue cover.

In Togo, the degradation of native ecosystems necessitates a shift in management. Recommended practices included raising small livestock and facilitating agroforestry to promote soil restoration. New management practices would reduce GHG emissions by approximately 146 tons CO2eq annually across 250 hectares.

SSM practice implementation through RECSOIL is demonstrating to be a powerful tool for improving soil health and increasing resilience.

Keywords: soil recarbonization,soil health,sustainable soil management,farmer,carbon sequestration

ID ABS WEB: 138334

4. Soil health in achieving the Sustainable Development Goals
4.24 133598 - Anthropogenic drivers of soil biodiversity, its function and feedback to changes

SOIL FAUNA AND ECOSYSTEM SERVICES PROVISION: THE FAUNASERVICES AND SOILFAUNA PROJECTS

G. BROWN [1], J. MATHIEU [2], M. COOPER [3], W. DEMETRIO [3], E. THEBAULT [2], A. POTAPOV [4], Z. LINDO [5], B. PEY [6], G.S. MACROFAUNA CONSORTIUM [7], N. EISENHAUER [7]

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Soil animals represent up to 27% of all known species worldwide, and many taxa are frequently used as bioindicators of disturbance, land use management and soil health. This is because they contribute to the provision of important ecosystem services to human beings, in all categories: cultural, provisioning, supporting and regulating. Services provided include soil formation, habitat for organisms, decomposition and nutrient cycling, climate regulation, pollination, seed dispersal, biological control of pests and pathogens, preservation of cultural heritage, recreation, food, fiber and fuel production, source of pharmaceuticals and genetic resources, water availability and quality, and erosion control. In this way they also help achieve the United Nations Sustainable Development Goals (SDGs). However up to now, few attempts have been made to assess and value their multiple services provided in different land uses worldwide.
Both the FaunaServices and the sOilFauna projects, involving a large number of collaborators worldwide aim to assess various services provided by the soil macrofauna communities sampled using standard methods (handsorting following TSBF/ISO) in both natural and anthropogenic ecosystems. This is being achieved by using data on the abundance (density and biomass) of up to 12 main taxa of soil macrofauna, among a wider list of almost 45 taxa collected in over 8500 sites worldwide (sOilFauna) and 1500+ sites in the Amazon and Atlantic Forest biomes (FaunaServices). Foodweb models and knowledge on biological and stoichiometric relationships of the taxa are being used to assess C, N and P cycling, pest control, decomposition, and bioturbation rates. By calculating these functions and using current market values, avoided and replacement costs, the value of a range of services will be estimated in contrasting land uses to assess opportunity costs and benefits associated with management and conservation of soul fauna communities. These actions intend to support policy development, awareness raising, and the achievement of goals associated with the CBD's International Initiative for the Conservation and Sustainable Use of Soil Biodiversity.

Keywords: soil fauna,soil health,bioindicators,land use,ecosystem services

ID ABS WEB: 136297

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

"LISHU MODEL"- AN INTENSIVE YET SUSTAINABLE SYSTEM FOR THE BLACK SOILS OF NORTHEAST

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The black soils of Northeast China contribute to about 25% of national grain production. The traditional intensive farming system, however, has led to severe soil degradation (e.g., erosion, compaction, and losses of organic carbon and biodiversity), which threatens grain security in China. To overcome these problems, we introduced the technology of conservation farming that consists of crop rotation, minimum or no tillage, and maintaining permanent crop residue on soil surface in maize production. We also developed a promotion system, to publicize and transfer the concept and technologies of conservation farming to local farmers with collective efforts from scientists, government agencies, industries, and local farmers. The conservation farming practices, along with the extension system, is named the "Lishu Model" in China. With continuous efforts for more than 10 years, we have established more than 100 "Lishu Model" research and development bases in the four provinces of Northeast China, and the new farming system is being practiced in an area over 3.3 million ha. The major advantages of the "Lishu Model" are: (1) improved soil water retention and supply capacity; (2) buildup of soil organic matter (SOM concentration was increased by more than 10%) and a reduction of chemical fertilizer application (by about 20%); (3) reduction of runoff (by 60%) and soil loss (by about 80%); (4) greater crop yield (5%~10% increase over the conventional system); (5) greater soil biodiversity (e.g., 6 times more earthworms than that of the conventional system) and improved soil biological properties; (6) improved farming profits (by saving costs as much as 1000 - 1400 yuan/ha) and lower carbon emission (by reducing 25 - 30% fuel consumption); and (7) improved corn grain quality. We conclude that the Lishu Model achieves the synergies between soil health, food security, and climate change mitigation, and will become the mainstream farming technology in Northeast China, which will significantly contribute to soil quality improvement and expansion of agricultural production capacity.

Keywords: No tillage,Conservation tillage,Black soil,Lishu model

ID ABS WEB: 137097

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

CARBON STORAGE IN CROPLAND SOILS: INSIGHTS FROM IOWA, UNITED STATES

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Restoration of soil organic carbon in agricultural soils is imperative to sustaining crop production and restoring other ecosystem services. We compiled long-term studies on the effect of management practices on SOC from black soils in Iowa, USA, to highlight constraints on detecting changes in SOC and to inform research needed to improve SOC measurement and management. We found that strip-tillage and no-tillage increased SOC by 0.28-0.33 Mg C ha-1 yr-1 compared to conventional tillage. However, diversifying crop rotations with extended rotations, and supplementing synthetic fertilizer with animal manure, had highly variable and inconsistent effects on SOC. Conversion of cropland to perennial grassland increased SOC by 0.21-0.74 Mg C ha-1 yr-1. Improved predictions of changes in SOC require experiments and observations that can identify and disentangle multiple sources of variability; whole-profile SOC monitoring; monitoring the effect on SOC in long-term studies of multiple conservation practices used in combination; and effective collaboration between field soil scientists and modelers.

Keywords: Black soils,Mollisols,soil variability,detection of change,whole-profile SOC

ID ABS WEB: 137149

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

ONSET TIME AND ACCRETIONARY FORMATION OF MOLLISOLS IN NORTHEAST CHINA

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Mollisols are one of the most fertile soils in the world thanks to the thick organic-rich mollic layer. It remains unanswered questions when Mollisols started to form and how thick mollic layer formed, due to the complex nature of soils and the limitations of soil dating techniques. In this study, by dating diverse materials including charcoal, buried mollic layer and naturally developed mollic layer, with both 14C and OSL dating techniques, we determined that prevalent formation of Mollisols in northeast China commenced during the Bølling-Allerød interstadial period. This is much earlier than previously reported age data by using 14C dating which dominantly showed that Mollisols started to form during the Holocene in northeast China and other parts of the world. By comparing the OSL age and 14C age we further proposed that formation of Mollisols followed an accretionary pedogenic model, which provided a new perspective to understand the forming mechanisms for such thick mollic layer in northeast China. By this model, thick mollic layer formed as a result of simultaneous accumulation of soil organic matter and continuously deposited dust (loess). According to age data we estimated that on geomorphically stable land surface, Mollisols formed at a rate of ~6 cm ka-1. Beside, this model well explains the generally underestimated onset time of Mollisols by 14C dating of bulk soils or soil organic fractions.

Keywords: Mollisols,Black soils,soil age,soil dating,OSL

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4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

SUSTAINABLE MANAGEMENT OF BLACK SOILS: URGENT NEED FOR ACHIEVING GLOBAL FOOD SECURITY AND CLIMATE CHANGE MITIGATION

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Black soils, characterized by their thick, dark horizons enriched with organic matter, epitomize highly fertile soils. However, their fertility decreases rapidly with intense and non-sustainable land utilization, leading to degradation processes such as soil erosion, nutrient depletion, pollution, compaction, salinization, and acidification. Notably, these soils may become significant contributors to global greenhouse gas emissions, primarily due to substantial losses in soil organic carbon (SOC), when production practices detrimental to the soil are used for crop and livestock production. Despite these challenges, black soils play a pivotal role in global food production. This work delineates the progress of the FAO's International Network of Black Soils (INBS). Since the establishment of the INBS, experts in the network have developed a general definition of black soils, published a Global Status of Black Soils report, and launched a Global Black Soil Distribution Map. The key publications highlighted that black soils cover an approximate area of 725 million hectares, with the Russian Federation, Kazakhstan, and China collectively harboring over half of this expanse, and extensive areas also in Argentina, Mongolia, Ukraine, United States of America, Colombia, Canada and Mexico. Agriculturally, these soils underpin significant proportions of global crop yields, contributing with 66% of sunflower seeds, 30% of wheat, and 26% of potato outputs. The SOC content in the upper 30 cm of these soils is estimated at 56 Petagram. Sustainable management of black soils is imperative for ensuring world food security and addressing climate change on a global scale.

Keywords: Black soils,INBS,Soil organic carbon,Food security

ID ABS WEB: 136381

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

THE CHALLENGE OF PREDICTING SOIL ORGANIC CARBON VARIABILITY IN TEMPERATE AGRICULTURAL LANDS USING OPEN PREDICTORS: INSIGHTS FROM REMOTE SENSING

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This study addresses the need for effective monitoring of soil organic carbon (SOC) in agricultural management, particularly caused by land-use change. Conventional methods for SOC measurement are often challenging, time-consuming, and expensive. Focusing on temperate farmland, and using a ten-year dataset generated on mixed temperate farmland of the North Wyke Farm Platform long-term experiment (LTE) in southwest England, the study employs field-based statistical models, and compares linear, additive, and mixed regression models to predict soil organic carbon (SOC) based on environmental variables. We distinguished between freely accessible measures including remote sensing (RS) techniques (open) and those requiring direct measurement or farmer questionnaires (closed), evaluating their relative utility in providing a cost-effective approach to assess soil organic carbon stocks. Generalized Additive Models (GAMs) proved most effective in predicting space-time SOC variability. Total nitrogen (TN) was as the strongest predictor when combining open and closed factors. Excluding TN, ploughing management, soil units, aspect, and temperature were identified as significant predictors. The best-fitting open data GAM—incorporating a RS-derived Ecosystem Services Provision Index (ESPI), aspect, and slope—provided acceptably accurate SOC predictions which were practical and cost-effective to generate at landscape scales. This model offers a valuable tool for understanding SOC variations in temperate farmland, providing insights into the impact of different environmental and management factors. The combination of LTE and RS datasets offers a promising avenue for accurate and efficient monitoring of SOC changes, contributing to the development of sustainable and resilient agricultural policies. This model can serve as a decision-support tool for understanding temporal and spatial variations in SOC under different land-uses and management practices.

Keywords: Ecosystem Services Provision,land use change,open data,remote sensing,soil organic carbon

ID ABS WEB: 136331

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

SMAF SOIL QUALITY INDICES IN TEMPERATE AND TROPICAL AGROECOSYSTEMS

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Initially developed for US agroecosystems, the Soil Management Assessment Framework (SMAF) can assess soil health as affected by management practices and land use changes. Recently, SMAF has been applied as a soil health assessment tool in Brazil, but the sensitivity of SMAF scoring functions and their relationship with ecosystem services are not yet proven for tropical, highly weathered soils. This study aimed to assess SMAF soil quality indices (SQI) in agroecosystems in the US Mid-South and Brazil, and investigate the ability of SMAF to differentiate management practices and the relationship of SMAF with ecosystem services. For this, we compiled 12 SMAF studies published in Brazil (n = 206) and 61 studies published for the Mid-South US (n = 553). Management practices were defined based on levels of soil disturbance. Analysis of variance was used to compare soil indicators [pH, P, K, bulk density (BD), aggregate stability (AGS), soil organic C (SOC), and microbial biomass C (MBC)] and SMAF soil quality indices between conservation and conventional agricultural practices. Linear regressions assessed the relationship between SMAF SQI and SOC stocks. Reducing soil disturbance through conservation management increased SOC, MBC, and AGS, and reduced BD in both regions. In the US Mid-South, perennial systems had the highest SQI ($p < 0.05$; 0.81), followed by no-till (0.75), and reduced (0.73) and conventional tillage (0.69). In Brazil, SQI in perennial systems (0.74) was higher than no-till ($p < 0.05$; 0.64), which did not differ from reduced (0.63) and conventional tillage (0.62). SMAF scoring functions need to be revised to better capture the impacts of conservation agricultural practices on soil health in tropical regions. The positive relationship between SMAF SQI and SOC stocks (R2 = 0.33-0.66) indicates that SMAF relates to the ability of agroecosystems to provide regulating ecosystem services. After revision and calibration, SMAF can be a valuable tool to demonstrate the benefits of conservation practices on soil health in tropical regions.

Keywords: soil health,conservation agriculture,ecosystem services,soil organic carbon,aggregate stability

ID ABS WEB: 136120

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

CHARACTERIZING SOIL CLAY MINERALS USING MID-INFRARED SPECTROSCOPY

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Clay minerals determine the physio-chemical properties of soils, and properties such as cation exchange capacities and swell-shrinkage behaviour are particularly affected by clay types. The composition of clay minerals is usually determined by X-ray diffraction (XRD) analysis. However, separation of clay fraction through particle-size analysis is time-consuming, and identification of clay minerals requires multiple treatments of oriented slide samples. Fundamental vibrations of minerals fall within the mid-infrared (MIR) region (2500–25,000 nm), and various soil properties have been successfully predicted by MIR spectroscopy. Hence, MIR spectroscopy serves as a promising tool for clay mineral determination due to its low cost and high throughput. This study aims to use MIR spectroscopy to predict the abundance of clay minerals in soils and identify the dominant clay mineral type. Eight mineral types were chosen as targets: calcite, chlorite, gibbsite, kaolinite, mica, montmorillonite, quartz, and vermiculite. A total of 7193 soil samples were obtained from the national database of the Kellogg Soil Survey Laboratory (KSSL) in Lincoln, Nebraska, USA. Their dominant clay mineral types were assessed by XRD analysis, and the amount of each mineral was quantified into five grades based on their peak heights. MIR spectra were trimmed to 4000–600 cm-1 and pre-processed by Savitzky-Golay (SG) smoothing, followed by Standard Normal Variate (SNV) transformation. Partial least squares regression (PLSR) models were built for each of the mineral types, and dominant mineral types were predicted by direct comparison of PLSR results. Over 65% of the dominant mineral types in the testing samples were correctly predicted by PLSR models, and the kappa coefficient was 0.57, indicating a moderate agreement between XRD and MIR results. Furthermore, in 89% of the testing samples, the predicted dominant mineral type ranked within the top three abundant minerals by XRD measurements, implying that PLSR models successfully identified the major clay mineral types. These results provide preliminary outcomes for MIR to differentiate major clay types in soils.

Keywords: clay,mid-infrared spectroscopy,partial least squares,X-ray diffraction

ID ABS WEB: 137464

6. Soil in the digital era
6.06 133437 - Novel approaches to process-based modelling in agricultural soils

ENHANCING A DYNAMIC SOIL ORGANIC CARBON TURNOVER MODEL USING EARTH OBSERVATION DATA

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Soil organic carbon (SOC) is an important soil quality indicator. While in large parts of the world SOC content in agricultural soil is decreasing, awareness on restoring or improving the SOC content is growing. Measures like sowing green manure after harvest or adding compost to the soil, can help increasing the SOC content. Increasing SOC content can make a soil more resilient and increase the overall soil fertility, but it also helps combatting climate change by sequestering CO2 from the atmosphere. A clear Monitoring, Reporting and Verification (MRV) system is required for the assessment of SOC stock changes and potential SOC stocks. However, because the existing SOC stock is large, the increase is relatively small which makes it difficult to measure on the short term. Dynamic soil organic carbon turnover models can solve this problem by assessing SOC stock changes over longer time periods. The RothC model is a scientific, widely adopted SOC turnover model that requires simple input data that is often available at field level. Assumptions in the input data were made running the model at national level in the Netherlands, but these assumptions seem to be quite rough when running the model at field level. Making use of Earth Observation (EO) data, which can provide additional information on vegetation cover, the growth period of cover crops, grassland renewal, and (cover) crop production, can help improving the model input data. This study shows the effect of replacing some input data of the RothC model by EO data. The model will simulate soil carbon stock changes for time period 2018-2023 (i.e. 6 years) for the whole of the Netherlands with varying spatial resolution (i.e. at postal code level for ~3400 units and parcel level for ~500.000 parcels). In a later stage, the RothC simulations will be validated against soil C-measurements taken in approximately 400 fields as part of the national soil sampling campaign of 2018 and 2024.

Keywords: CO2 sequestration,climate change,carbon stock,RothC

ID ABS WEB: 137958

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: Methods, observations and perspectives

SOIL EROSION MODELLING: CHALLENGES AND RECOMMENDATIONS

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Current anthropogenic pressures on land, soil, and water resources are unsustainable. Humans are using these resources as if they inhabited 1.75 Earths. Multiple lines of evidence suggest that this overuse of land and water resources is likely to continue into the future. One direct consequence of these changes is the acceleration of land degradation by soil erosion, depleting the soil resources, dispersing sediment and potential sediment-bound pollutants in the environment. To promote more resilient landscape management, it is therefore necessary to develop soil erosion models that can target the most vulnerable zones and guide the implementation of the most appropriate soil conservation strategies.
However, soil erosion processes exhibit significant variability both in space, depending on the soil and landscape characteristics, and in time, ranging from the effects of the temporal dynamics of successive rainfall events to seasonal variations influenced by climate or by anthropogenic land use changes. These spatial and temporal variations interact nonlinearly and are subject to thresholds, highlighting the complexity of erosion processes. It is very complex to integrate all these processes in soil erosion models, which thus need to be based on strong hypothesis limiting their validity to specific applications.
Therefore, a range of different concepts and approaches has been developed, depending on the modeller's objectives, from non-dynamic, lumped empirical models for generic landscape management to "physically-based" high spatial and temporal dynamic models that can help test research hypotheses. In this study, we will review the application of different soil erosion modelling approaches in contrasting environments to illustrate the capabilities and limitations of the different approaches. We will then attempt to identify the main challenges and recommendations that can be drawn from this exercise.

Keywords: Soil erosion,modelling,catchment,scale,connectivity

ID ABS WEB: 138329

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

INTEGRATED SOIL EROSION ASSESSMENT: CONCEPTS, APPLICATIONS AND PERSPECTIVES

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Soil Erosion processes are threatening global soil resources in terms of loss of fertile topsoil, reduction of soil water storage capacity as well as loss of biodiversity and soil organic matter releasing CO2 to the atmosphere. Moreover, soil erosion leads also to off-site damages due to the sediments produced that fill up reservoirs or reduce water quality. Especially semiarid areas already suffer in terms of a sustainable agricultural production as well as of providing ecosystem services and functions. The challenges coming along with soil erosion processes are manyfold. Thus, a proper assessment of these processes under changing future conditions such as climate and landuse/landcover changes is a prerequisite to allow for a suitable land management. Therefore, the quantification of different soil erosion processes and the prediction of these processes in space and time is needed. In this talk concepts and methods to numerically assess different soil erosion processes are reflected, some case studies presented and future challenges and perspectives of an integrated soil erosion modelling are discussed.

Keywords: Soil erosion,slope processes,sediment dynamics,quantitative assessment,scenario analysis

ID ABS WEB: 135963

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

MACHINE LEARNING BASED PEDOTRANSFER FUNCTION IMPROVES SOIL BULK DENSITY PREDICTION BUT NOT FOR SOIL ORGANIC CARBON STOCK

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Being a fundamental indicator of soil health and quality, soil bulk density (BD) plays an important role in plant growth, nutrient availability, and water retention. Due to its limited availability of BD in databases, pedotransfer functions (PTFs) has been widely used in predicting BD, while the impact of PTFs' accuracy on soil organic carbon (SOC) stock calculation has not been explored. Herein, we proposed a local modeling approach for predicting BD across EU and UK using LUCAS Soil 2018. Our approach involved a combination of neighbor sample search, Forward Recursive Feature Selection (FRFS) and Random Forest (RF) model (local-RFFRFS). The results showed that local-RFFRFS had a good performance in predicting BD (R^2 of 0.58, RMSE of 0.19 g/cm^3), surpassing the traditional PTFs (R^2 of 0.40-0.45, RMSE of 0.22 g/cm^3) and global PTFs using RF with and without FRFS (R^2 of 0.56-0.57, RMSE of 0.19 g/cm^3). Interestingly, we found the best traditional PTF (R^2=0.84, RMSE=1.39 kg/m^2) performed close to the local-RFFRFS (R^2=0.85, RMSE=1.32 kg/m^2) in SOC stock calculation using BD predictions. However, the local-RFFRFS still performed better (δR^2>0.2 and δRMSE>0.1 g/ cm^3) for soil samples with low SOC stock (<3 kg/m^2). Therefore, we suggest that the local-RFFRFS is a promising method for BD prediction while traditional PTFs would be more efficient when BD is subsequently utilized for calculating SOC stock.

Keywords: Pedometrics,Soil bulk density,Soil organic carbon stocks,Machine learning,Pedotransfer functions

ID ABS WEB: 136285

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

SOIL NITRIFICATION MICROORGANISMS AND NITROGEN MANAGEMENT IN AGRICULTURAL ECOSYSTEMS

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Nitrification, as a critical component of the nitrogen (N) cycle, is a microbially-mediated oxidizing process from ammonia to nitrate, contributing to enormous N losses of fertilizers through atmospheric emissions of greenhouse gas N2O and nitrate leaching to groundwater. The process of nitrification is mainly driven by nitrifying microorganisms, including ammonia-oxidizing bacteria (AOB) which were discovered over 130 years ago in 1890, ammonia-oxidizing archaea (AOA) which were discovered in 2005, and complete ammonia oxidation (termed as comammox) bacteria which were discovered in 2015. This paper will introduce our research on the niche differentiations of these ammonia-oxidizing microorganisms. Our research findings contribute to biological manipulation and N fertilizer management for improved N using efficiency and mitigated N losses in agricultural ecosystems.

Keywords: Nitrification,Ammonia-oxidizing microorganis,Nitrogen fertilizers,Agricultural land,Nitrogen cycling

ID ABS WEB: 136270

7. Soil sciences impact on basic knowledge
7.03 130893 - Soil classification: past and present concepts and solutions

THE 4TH EDITION OF THE WRB HAS A NEW FIELD GUIDE AND NEW HORIZON DESIGNATIONS REPLACING THE FAO GUIDELINES FOR SOIL DESCRIPTION

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At the 22nd World Congress of Soil Science in 2022 in Glasgow, the 4th edition of the international soil classification system World Reference Base for Soil Resources (WRB) was published. The 32 Reference Soil Groups (first level) of the 3rd edition were maintained but changes were made to the qualifiers (second level) and to the diagnostics in order to sharpen many definitions.
For the first time, WRB received its own Field Guide and its own Horizon and Layer Designations, added as Annexes. Until 2022, the FAO Guidelines for Soil Description were used. This caused many problems:
- The FAO Guidelines were not sufficiently precise.
- In many cases, the FAO Guidelines and the WRB applied different limit values.
- Some characteristics required by the WRB were completely missing.
- And the biggest problem: The FAO classification (1974, 1988) and the WRB (1998, 2006, 2015) adopted many definitions from the US Soil Taxonomy, which descend from earlier issues of the US Soil Survey Manual (example: ‘weakly cemented to indurated’) and were neither defined in the WRB nor in the FAO Guidelines.
The new WRB Field Guide provides the following:
- Precise definitions of field characteristics.
- Didactical explanations of the characteristics to be surveyed.
- A code system for field characteristics.
- A Soil Description Sheet.
Providing precise definitions for field characteristics is the most important progress of the new WRB edition. Many of them are close to the definitions in current US Soil Taxonomy field documents, which brings WRB and Soil Taxonomy closer together. Among the characteristics described are soil-forming factors (e.g., climate, topography), surface characteristics (e.g., rock outcrops, surface sealings), and all common horizon and layer characteristics (e.g., texture, structure, redoximorphic features). For hand texturing, a simple and precise flowchart was developed.
The Horizon Designations use the well-known master symbols and suffixes of the FAO Guidelines, but more precise definitions are given and some additional symbols introduced.

Keywords: WRB,Soil Survey,Field Characteristics,Horizon Designations

ID ABS WEB: 136353

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

HIGH ORGANIC CARBON ACCUMULATION IN PLAGGIC AND OTHER SANDY AGRICULTURAL SOILS ASSOCIATED WITH ALIPHATIC-RICH AND AGED SOIL ORGANIC MATTER

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The investigations into carbon sequestration in Plaggic Anthrosols are often based on bulk soil carbon inventories, neglecting considerations of carbon form (particulate or mineral-associated), storage capacity, and chemical composition. Our focus is on the unusually high organic carbon (OC) accumulation in sandy Plaggic Anthrosols and their adjacent reference soils under agricultural use. Despite the commonly assumed significance of fine-sized particles (fraction smaller than 20 µm) in OC stabilization, their mass proportion is very low in these soils. Soil organic matter (SOM) physical fractionation was performed to assess OC quantity and quality in topsoils (Ap horizon). For the resulting fine fraction smaller than 20 µm, we measured OC concentration, radiocarbon concentration, calculated OC storage capacity and contribution, and analyzed carbon unit chemical composition using solid-state 13C NMR spectroscopy.
These highly sandy soils (80–90%) exhibited OC accumulation surpassing conventionally calculated saturation levels controlled by the proportion of fine fraction. Surprisingly, no correlation was found between topsoil OC concentration in the medium, fine silt and clay sized fraction and the mass percentage of particles smaller than 20 µm. Plaggic Anthrosols and reference soils were comparable in fractional concentration of OC, radiocarbon age, and OM composition. The fine fraction's SOM composition was notably rich in alkyl C, with a minor proportion of O-alkyl C and low percentages of aryl C.
Radiocarbon concentration and conventional radiocarbon age suggested that fine fraction OM in topsoils accumulated low OC inputs from recent photosynthesis and is stored for long periods with high mean radiocarbon ages, not only for Plaggic Anthrosols (F14C: 0.92 ± 0.04; 14C: 639 yBP) but also for reference soils (F14C: 0.93 ± 0.04; 14C: 575 yBP). It remains unclear if the inherited OM is stable under present-day soil and management conditions. Our data imply specific mechanisms at play in sandy OM-rich agricultural soils for storing substantial amounts of OM beyond a mechanistic explanation based solely on OM association with fine mineral surfaces.

Keywords: Plaggic Anthrosols,13C NMR spectroscopy,radiocarbon age,sandy soils

ID ABS WEB: 138303

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

STORING ADDITIONAL CARBON IN SOIL: DIFFERENT PRACTICES, DIFFERENT STABILITIES OF THE ORGANIC MATTER?

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A diversity of agricultural practices and systems enable the accrual of soil organic C (SOC) stocks, with variable efficiencies. These C-storing practices increase SOC stocks, either by increasing the inputs of plant biomass or exogenous organic matter, or by decreasing the outputs of SOC reducing SOC mineralisation rates, or both. In the perspective of contributing to climate change mitigation, the temporal stability of the additional SOC stored is critical.
Different approaches can be used to assess the stability of soil organic matter, such as physical fractionation of soil organic matter, chemical extractions, long term incubations and analysis of the thermal behaviour of the organic matter using Rock-Eval© analysis. These address contrasting residence times, such as of months to years (long term incubations), to several decades and centuries (particle size fractionation, Rock-Eval© analysis coupled with PARTYSOC model)
We used the literature and long-term agricultural experiments in which management options (application of exogenous organic matter, conservation agriculture, organic agriculture, agroforestry) result in increased SOC stocks. We investigated the stability of the additional SOC stored, compared to the reference management option.
Methods currently used in the literature to assess the temporal stability of soil organic matter do not address the same SOC kinetic pools. Care must be taken to specify which range of residence times is considered when using any method intending to evaluate the biogeochemical stability of soil organic matter, as well as when using the terms stable or labile.
Management options result in slightly contrasted stability of the additional organic carbon, the application of exogenous organic matter resulting in the most stable additional carbon, compared to management options that increase belowground plant biomass inputs to soil. Carbon storing agricultural management options mobilize different stabilization processes of soil organic matter: chemical recalcitrance, organo-mineral interactions and physical protection.

Keywords: SOC storage,Agroecological practices,stabilization,SOM fractionation,RockEval© analysis

ID ABS WEB: 136677

7. Soil sciences impact on basic knowledge
7.08 133542 - Knowing topsoil to manage ecosystems

PRIMORDIAL SOILS ARE PRIMORDIAL ECOSYSTEMS - PARA HUMUS SYSTEMS UPDATE

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[10] et al.

Classifying nature helps us humans to understand it. Extraterrestrial primordial ecosystems with early soils may be billions of years away. Fortunately, there are also initial and/or curious humipedons all over our planet today. They have been described as Para humus systems; in the present work we will add 7 new Para systems to the 6 published in 2017.

A) Already described humipedons (https://doi.org/10.1016/j.apsoil.2017.09.043):
1. Crusto: soil crusts made by fungi, cyanobacteria, algae, lichens and other microorganisms
2. Bryo: made by mosses and lichens and microorganisms
3. Rhizo: made by root systems and microorganisms in aerated humipedons
4. Archaeo: made by microorganisms of acidic environments, or of high temperature or pressure
5. Anaero: made by microorganisms and animals in river, lake and marine shore and bottoms
6. Ligno: made by animals and fungi that feed on wood and microorganisms

B) New humipedons:
7. Abio: abiotic humipedons (living organisms of all types including viruses: absent; organic matter: possible), mineral substrate modified by abiotic factors. Ex. on the moon, mars, meteorites
8. Into: generated by the microorganisms of the digestive system of heterotrophic organisms, under the partial and involuntary physiological control of the latter
9. Filmo: made by microorganisms in thin layers, everywhere
10. Cryo: made by microorganisms and animals of frozen environments, snow, permafrost, glaciers, etc.
11. Litho: rocky debris and dust colonized by microorganisms, generally on/in the screes at the base of the rocky walls of the mountains and other similar environments
12. Mangro: made by root systems and microorganisms in semiterrestrial environment
13. Fireo: microorganisms and animals in burned organic and organo-mineral matter (Fig. 1).

Extending Para classes to include these early stages of soil formation will be useful and fun. These are the microorganisms that were the first to colonise our planet surface in strange extreme conditions. Such new settlement did not only happen about 2 billion years ago, it still happens when new surfaces are revealed, such as after rockfall or volcanic eruption – or after an industrial area becomes abandoned.

Figure 1: soil before and after fire

Keywords: Humipedon,Para humus systems,Biofilm,Initial soils,Fire

ID ABS WEB: 136165

7. Soil sciences impact on basic knowledge
7.10 133558 - Mechanisms of interaction of (harmful) substances with the soil phase

DESORPTION HYSTERESIS TESTING IS IMPORTANT IN SOIL SORPTION EXPERIMENTS

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Sorption of inorganic and organic compounds onto soil controls the environmental fate of chemicals. Desorption and sorption isotherms determined in solution experiments may not coincide, producing a (commonly) non-closed hysteresis loop. Yet, the understanding of hysteresis is limited, and hardly clear recommendations are provided for experimentalists. Hence, soil sorption studies may not examine whether desorption is hysteretic. Lack of testing for hysteresis rules out an option to confidently claim on attainment of a full equilibrium. The consideration that if sorption kinetics were shown completed then, regardless of desorption hysteresis, sorption isotherms may be treated as being at equilibrium is not necessarily correct since slow sorption may be overlooked in short-term experiments. It is in particular true considering an OECD recommendation indicating that 'a period of 24 h is generally sufficient' to attain a soil sorption equilibrium and often indiscriminately referred to in the literature. The lack of inspecting for hysteresis may lead to confusion in distinguishing between the thermodynamic and kinetic factors controlling the environmental fate of chemicals, and, possibly in an inappropriate interpretation of sorption models and mechanisms. Thus, even if a demonstrated hysteresis is not fully understood, its examination is important. This presentation addresses two scenarios when the sorption-desorption hysteresis is identified, with no indications for continuing kinetics. (1) May the sorption isotherm be necessarily treated as being at equilibrium? A (negative) answer is illustrated using the recently proposed concept of gate-sorption site coupling[1]; the concentration-dependent accessibility of sorption sites capable of irreversible binding may lead to time-independent sorption isotherms to which equilibrium sorption models are not applicable. (2) Apparent equilibria (potentially proven by isotope exchange experiments) are reached across both sorption and desorption isotherms: such a 'true' hysteresis is quantified in thermodynamic terms using a properly computed sorption-desorption loop area[2]. Is the sorption isotherm suitable for environmental fate modeling? Not necessarily.

[1]Borisover, M. (2023). Adsorption, 29, 87-102.
[2]Borisover, M. (2019). Chemosphere, 215, 490-499.

Keywords: Soil sorption,Desorption,Hysteresis,Equilibrium isotherm,Sorption mechanisms

ID ABS WEB: 136402

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

OPPORTUNITIES AND CHALLENGES ORGANO-MINERAL FERTILISERS CAN PLAY IN ADDRESSING AGRICULTURAL CARBON FOOTPRINT – A PERSPECTIVE

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Introduction
With increasing mineral fertilisers price and declining soil health, innovative solutions are needed to meet crop nutrient demands. One solution can be organo-mineral fertiliser (OMFs) as a new concept that take organic waste products and combines them with mineral fertilisers to produce a lower carbon footprint product.

The aim of this Perspective is to present an outlook on how OMFs can be considered as part of the toolbox to add the opportunities and challenges posed in tackling agricultural carbon footprint.

Methodology
The approach is in the form of a framework using Strength Weakness Opportunities and Threat (SWOT) which will critique how OMFs can play a role in agriculture.

Results and discussion
The strengths of using OMF is its potential to contribute to organic matter and increasing water holding capacity. Carbon content of the feedstocks used to formulate OMFs can be important for improving soil health. The weaknesses of using OMF can be related to traceability due to variability of feedstocks used to formulate OMFs. Variability can be determined using novel approaches such as near and mid-infrared sensors (nutrient content) and high energy sub-atomic particles such as neutron and muon (physical status). Contaminants levels of feedstocks needs to be controlled so that the final products are suitable. The opportunities for using OMF can be capitalised by technologies such as artificial intelligence, remote sensing and Internet of Things (IoT) to collate data on soil health and crop productivity. The threat is the need to assess the willingness to pay for it, due to uncertainty on its efficacy. OMF will be subject to regulatory restrictions to ensure that it is not classed as a waste and requires End-of-Waste status.

Conclusion
The SWOT analysis will provide a critique and set the perspective on future directions to consider OMF as an option in the toolbox to mitigate declining organic matter whilst tackling climate change, reducing carbon footprint and implementing a circular economy approach.

Keywords: organo-mineral fertiliser,nutrients,soil carbon,regenerative agriculture,organic amendments


ORAL PRESENTATIONS

ID ABS WEB: 137117

1. Equity, diversity, and inclusivity in soil sciences
1.02 131441 - Boosting Global Soil Science Collaboration: Fostering Equity, Decolonization, and Capacity Strengthening

SOIL SCIENCE IN THE INDIGENOUS PEOPLES OF PUEBLA, MEXICO

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The indigenous peoples who are located in the northern part of the state of Puebla, Mexico, have strengthened their knowledge about soils, by participating with the Center for Research in Agricultural Sciences (CICA) of the Benemérita Universidad Autónoma de Puebla (BUAP), in the realization of projects on the management and conservation of soils on hillsides and food production in backyard plots.
These projects have been funded by government agencies through different calls for proposals during the last 10 years (2006-2016). The communities are located within the Totonaca region of the state and are dedicated to the planting of self-consumption products on soils with slopes of 35%, which has led to an increase in erosion and is classified as severe. The proposal began with the establishment of stone barriers and green barriers with Vetiver (Chrysopogon zizanioides). The groups were made up of men (35%) and (65%) women in the community of Huehuetla and in the community of Lipuntahuaca, men (53%) and (47%) women.
The construction of living and stone barriers was achieved in 8 plots of the inhabitants and the establishment of 6 productive gardens in the plots in each community. The work was added to the incorporation of children and young people that allowed to increase the information, generating 12 training courses on the topics carried out. We continue to visit the sites through other projects and we observe a 73% maintenance in the works of the barriers, the rest suffered a change of land use, mostly for residential use. In the case of the orchards, it is observed that they have been maintained and increased by other villagers who have seen their benefits.

Keywords: manejo y conservacion de suelo,suelos en laderas,pueblos originarios

ID ABS WEB: 137913

1. Equity, diversity, and inclusivity in soil sciences
1.02 131441 - Boosting Global Soil Science Collaboration: Fostering Equity, Decolonization, and Capacity Strengthening

A SOIL SCIENCE JOURNEY: INCLUSIVE RESEARCH FOR REALIZING SOIL HEALTH IN THE GLOBAL SOUTH

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Improving the rigor of soil science for sustainable agriculture includes promoting equity and inclusion of scientists from the global south. This is an on-going journey. There have been many bumps along the way in efforts to improve the relevance of applied soil science and management through including all voices, especially those who have been marginalized. Participatory action research is one approach that holds out promise for soil science that makes a difference in agricultural development, and the presentation will draw on experiences in Malawi. In addition, an inclusive, positive environment is important. Mentorship programs, learning from pioneers and appropriate performance assessment guidelines are efforts at CIMMYT's program, including the "Catalysts of Change" promoting gender, equity and social inclusion (GESI) in the crop and soil sciences. Decolonizing research requires both internal reflection, and building strong partnerships with national agricultural research systems and universities. Audience participation and discussion.

Keywords: participatory,mentorship,Gender (GESI),pioneer,decolonial

ID ABS WEB: 138066

1. Equity, diversity, and inclusivity in soil sciences
1.02 131441 - Boosting Global Soil Science Collaboration: Fostering Equity, Decolonization, and Capacity Strengthening

IMPACT4SOIL: THE ONLINE PLATFORM BOOSTING INTERNATIONAL RESEARCH COLLABORATION

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During this presentation, we will officially launch Impact4Soil, developed as part of the ORCaSa Horizon Europe project. It is the dedicated worldwide knowledge platform to address the critical challenges of soil carbon within the “Soil Carbon International Research Consortium”. Impact4Soil is a science-based, aggregative and cooperative platform designed to meet the needs of scientists, practitioners, farmers and foresters, policymakers and funders from all over the world.

We apply scientific standards to verify, gather and share trustful information.

The platform will feature 5 services:
- Geospatial data
- Scientific evidence
- Network (of projects, initiatives, research institutions…)
- Practices
- Datasets

This will enabling users to :
- Access geographical information to increase transparency on historical, current and future trends of soil carbon stocks at different spatial scales,
- Access aggregated and up-to-date scientific data to make decisions,
- Access and contribute to aggregated and up-to-date scientific data on the impact of practices on soil carbon,
- Access to consolidated, quality-assessed and reusable data,
- Sharing and discovering practices and soil carbon management experiments,
- Have an up-to-date view of ongoing efforts to manage current soil carbon stocks,
- Develop their networks.

Impact4Soil will thus contribute to the involvement of soil scientists from all regions. It will facilitate knowledge exchange and collaboration among scientists from different regions, enabling collective efforts to address global soil challenges while respecting local contexts.

Impact4Soil

Keywords: online platform,research collaboration,international collaboration,network,soil literacy and data

ID ABS WEB: 135455

1. Equity, diversity, and inclusivity in soil sciences
1.03 133426 - Gender inequalities and soil health

FARMING WITH CARE - THE CASE OF HOME GARDENS IN MYANMAR

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In a time of anthropogenic climate change, agriculture has become a major focus for deconstruction among feminists. New questions are being posed about how global agriculture might be practised otherwise, while growing sufficient food in a manner that replenishes the soil, the planet and its climate. In the past decade soils have been placed at the heart of agricultural transitions and soil care practices in farming have been identified as the determinants towards achieving a regenerative agriculture. Feminist political ecologist's draw the attention to gendered and racialized processes within the politics of environmental degradation and the neo-liberalization of agriculture. This work explores the different soil care practices that take place among different agricultural actors in the context of sustainability transitions in Myanmar. Drawing on Feminist Political Ecologies (FPE) I untangle the kinds of caring practices that are validated and allowed to take place through the neoliberalization of agriculture in Myanmar investigating women´s everyday practices in home gardens and farm fields as well as emerging organic farmers. I examine how ethnic minority women experience the current sustainability transitions and how increased agricultural changes and choices restrict and constrain their soil care practices in home gardens and beyond through the case study of indigenous women's home gardens in the Shan mountains of Myanmar. On the one hand, this analysis highlights the importance of thinking through the tensions between reproductive and productive binaries in agriculture and how those binaries invisibilise the practice of home gardens and the potential they offer to envisage diverse ways of farming and regenerative agriculture. On the other hand, together with care ethicists, I stress the necessity to think of care that considers humans and the more-than-human world in the ecological economics of agriculture. This work concludes that the marginalization and invisibility of reciprocal care practices among women is rendering alternative food projects such as home gardens less important and capable of transformative change towards a more regenerative agriculture.

Keywords: Home gardens,Feminist political ecology,care ethics,Myanmar

ID ABS WEB: 136227

1. Equity, diversity, and inclusivity in soil sciences
1.03 133426 - Gender inequalities and soil health

RELATIONS OF CARE AND RESPONSIBILITY FOR REBUILDING SOIL

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In the EU, 2/3 of soils are degraded. Soil degradation has happened because we have been treating soil as inanimate. Soil is living and it is the microbiota that is the bridge between the macro-organisms (plants and animals) and the climate, building and keeping soils healthy by literally gluing together mineral particles and recycling nutrients. Just like us and our gut microbiome, the soil microbiome needs energy and materials to stay alive and to keep maintaining and restoring soil structure to provide the ecosystem services essential for all terrestrial life. Collaborating with the soil microbiota will help us deliver net zero (SDG13), net biodiversity gain (SDG15) and to improve both human (SDG6) and planetary health.

But we are killing soil. Partly because many of the carbon and mineral rich materials that are food for the soil microbiome are not returned to soil. And partly because there is a lack of access to financial resources or capital and governance structures for women in many societies. This talk explores using more feminist approaches to soil health, and focuses on how we can work with society to benefit from partnering with soil as a living material rather than treating soil as an inanimate matrix in the crop production line. We discuss how our education system needs to change so that society can learn that soil, like people, needs feeding. The role of caring is one that is largely assigned to women, and is often resisted in typically male-dominated fields like farming, soil science and agronomic infrastructure development. A more feminist approach inherently involves inviting concepts like emotion, risk, desire and individual, case-by-case discernment, as opposed to post-industrialisation formulaic, one-size-fits-all agronomic and policy approaches. A benefit of utilising a relational, feminist approach is that it can illuminate why fulfilling our obligations to rebuild soil health are integral to addressing structural inequalities and injustices in our environmental, economic, and social relations.

Keywords: soil health,women,rebuilding,care,SDG

ID ABS WEB: 136411

1. Equity, diversity, and inclusivity in soil sciences
1.03 133426 - Gender inequalities and soil health

WHY DOES GENDER MATTER TO THE TRANSITION TOWARD SOIL HEALTH MANAGEMENT?

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Healthy soils play a critical role in supporting agricultural productivity, climate change mitigation and resilience, and a range of ecosystem services. Degraded and poorly responsive soils cover large areas of Africa and represent the majority of poor farmers' fields in certain regions. While many technical options for soil improvement or restoration sit 'on the shelf', there are many sociocultural, institutional, economic, and policy barriers hindering their adoption at large scale. Gender inequality is deeply embedded in and reinforces these barriers, and represents a wicked problem requiring context – and culture-specific understandings and approaches. This study builds on a conceptual framework proposed by Zhang et al. ("Soil health and gender: why and how to identify the linkages", International Journal of Agricultural Sustainability, 2021). The conceptual framework helps illuminate important gender considerations for soil health management and highlights how a range of separate and joint assets held by men and women in households, and the intrahousehold distribution of use, management, fructus, and alienation rights shape the management practices that contribute to, or undermine, soil health. These considerations are essential for identifying gender-based constraints, opportunities, and unintended consequences in promoting soil management technologies. Applying the framework, we review the empirical literature on quantitative studies of the effects of gender on soil health-related practices, decision-making (at intra-household and other relevant levels), and outcomes, and conduct a meta-analysis to shed light on the magnitude of the gender gap in the space of soil health and sustainable land/soil management. We consider both the gender of household heads and the gender of plot manager or decision-maker, although empirical studies on the latter are scant due to the lack of plot-level gender disaggregated data. Based on the meta-analysis results, we make the attempt to quantify the cost of the gender gap in soil health to the economy and call for greater investment in research and programs that empower men and women to become more effective soil health stewards.

Keywords: soil health,gender

ID ABS WEB: 137623

1. Equity, diversity, and inclusivity in soil sciences
1.03 133426 - Gender inequalities and soil health

POWER DYNAMICS, GENDER RELATIONS AND INTERSECTIONALITY WITHIN REGENERATIVE AGRICULTURE IN THE U.K.

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This presentation will apply a critical gender and intersectional lens to regenerative agriculture (RA) in the UK, using results from a mapping of RA actors and their relative power and positionality. It will highlight relationships and power dynamics between actors, critically assess how they are shaping the national conversation around RA and soil health, consider who is excluded, and analyse how this influences RA practices and outcomes from a social and environmental justice point of view.

A 2010 study by academics at Cranfield University estimated that soil degradation was costing the British economy £1.2 billion per year. The UK government's 25 Year Environment Plan includes a focus on addressing concerns around soil health, with the stated goal of managing England's soils sustainably by 2030.

One increasingly popular approach to improving soil health in the U.K. is the concept of regenerative farming. While there is no formal agreed definition of RA, a focus on soil restoration – through methods such as mob grazing, a reduction in synthetic inputs and minimal soil disturbance – is central to most regenerative approaches. RA has attracted vocal support from a broad spectrum of actors, ranging from individual smallholders and tenant farmers through to NGOs, policymakers, large landowners and international food companies.

The relative power dynamics between actors may be having an outsize impact on how regenerative agriculture is understood and the types of support (both political and financial) that are being provided as part of the post-brexit agricultural transition. Those already disadvantaged due to gender, class, ethnicity, immigration status, sexual orientation and other forms of discrimination, in particular, may find themselves being overlooked, silenced, self excluding or negatively impacted within these policy discussions.

It is hoped that this research will provide a starting point for broader discussions about who is – and who ought to be – represented in ongoing attempts to identify, understand and support efforts to battle soil degradation in UK agriculture.

Keywords: gender,intersectionality,regenerative agriculture

ID ABS WEB: 138161

1. Equity, diversity, and inclusivity in soil sciences
1.03 133426 - Gender inequalities and soil health

LIVELIHOODS DIVERSIFICATION AT WHAT COST: IMPACTS OF LAND RENTALS ON ETHNIC MINORITY LIVELIHOODS IN NORTHERN UPLAND VIETNAM

J PO

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Generations of ethnic minority communities have created and maintained rice terraces to control the downward flow of water in mountainous regions of northern Vietnam. The sub-tropical region has attracted a sharp rise in land rentals for 'hi-tech' agriculture for commodities: flowers and vegetables. The provincial government of Lào Cai approved the development of lily and rose farms in three communes since 2018. This study explores the impacts of land rental arrangements on the natural resource base and the rural livelihoods of Hmong and Yao ethnic minorities. Adopting a feminist care ethics and sustainable rural livelihoods approach, the author analysed in-depth interviews with 14 Hmong and Yao farmers from 2018 to 2019.
The paper explores the experiences of semi-subsistence farmers that are led into five-year lease agreements with a hi-tech agricultural enterprise. In an effort to diversify their livelihoods, ethnic minority households find themselves coping with land trades within an existing context of tourism boom, women working as trek guides, and distrusts between marginalized ethnic communities and ethnic majority group, which dominates the business and public sectors. Notable findings include residents being paid lease fees equivalent to the market value of rice produced on their farms instead of land market prices due to existing system of land governance. Others reported a physical pressure to enter into rental agreements as their parcels are surrounded by neighbours' parcels allocated for flower production, effectively cutting access to water for rice cultivation.
Common concerns on the lack of regulations on chemical inputs for non-food crops, decreasing soil fertility, and public health in the commune, with the fear of eventual depletion of soils when the horticultural boom ends. Residents' accounts contrasted with the publicised advantages of hi-tech agriculture as minimizing environmental impacts. This case study features how ethnic minority households' livelihood diversification through land rentals have increased households' vulnerability to food price volatility and increased risks to sustaining their natural resource base.

Keywords: ethnic minorities,land rentals,hi-tech,terrace system,diversification

ID ABS WEB: 135800

1. Equity, diversity, and inclusivity in soil sciences
1.04 133511 - Moving toward Diversity, Equity, and Inclusivity in Soil Science Societies

A MULTINATIONAL EVALUATION OF GENDER EQUITY IN SOIL SCIENCE

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Issues of diversity, equity, and inclusion (DEI), including gender equity, have gained increasing recognition at the beginning of the 21st century. As an academic discipline, soil science has been late in addressing gender equity, but a number of peer-reviewed studies have been published in the last four years. This study investigated gender equity in the soil science faculty, national soil science societies, and soil leadership positions of six countries (Canada, Egypt, Mexico, Nigeria, the United Kingdom, and the United States of America) using data publicly available on the internet and from the soil science professional societies. We found that women still lag behind men among our soil science faculty by considerable margins, and that the percentage of women in soil science faculty positions are similar to those for women faculty in many other scientific fields. There are differences in gender equity by soil science subdiscipline that vary by country. However, in countries where data is available to make comparisons over time the gap has closed to some extent, both overall and for subdisciplines, over the last 6-8 years. Women also often hold leadership positions at rates that are lower than their representation among the faculty and membership in professional societies. In addition, women are less frequently recognized with high level awards such as society Fellowship awards compared with men. This study concluded that progress has been made on several fronts, particularly in the last 6-8 years, but there is still much work to be done to achieve gender equity in soil science.

Keywords: diversity, equity, inclusion,gender equity,soil science faculty,soil science societies,soil science awards

ID ABS WEB: 136048

1. Equity, diversity, and inclusivity in soil sciences
1.04 133511 - Moving toward Diversity, Equity, and Inclusivity in Soil Science Societies

PATHWAYS TO INCLUSIVITY: PRIORITIZING DEI RECOMMENDATIONS

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In a world that requires creativity, collaboration and innovation to address the issues of our changing planet, it is crucial for our Societies to reflect the values and importance of diversity, equity, and inclusion (DEI). The Soil Science Society of America, along with its sister Societies (American Society of Agronomy, Crop Science Society of America) recognized diversity, equity, and inclusion (DEI) as a top priority in recent strategic plans and acknowledge that enhancing representation within our Societies is essential to fostering strength, creativity, and innovation in our scientific fields. The program is comprehensive and all-encompassing throughout programs, processes, and systems and continuously expands as we delve into the work.

The ASA, CSSA, SSSA DEI Committee is dedicated to strengthening and diversifying the potential workforce in agricultural and environmental sciences by enhancing equity within our sciences and inclusion throughout our Societies. Our vision is to conduct our scientific and professional activities in a manner that provides a safe and welcoming environment for all participants. The committee works to address the overall Societies' DEI initiatives as informed by Members, the Boards of Directors, the elected leadership, staff, and a member survey, all leading to an approved DEI Recommendations Report.

The Recommendations from the Report are listed in priority order with the first four viewed as most important by members:

- Professional Conduct and Anti-Harassment Policies Development
- Education/Training Planning
- Mentoring Program
- Support and Collaborations Development
- Leadership, Governance, and Policies Review
- Communications Actions
- Metrics Measurements
- Internal Staff Programs

Highlights of the presentation will focus on data from the research of DEI in the Societies, the recommendations, and associated actions that have been taken to build on diversity, equity, and inclusion in SSSA, ASA, and CSSA.

Keywords: diversity,equity,inclusion,initiative,soil science

ID ABS WEB: 136400

1. Equity, diversity, and inclusivity in soil sciences
1.04 133511 - Moving toward Diversity, Equity, and Inclusivity in Soil Science Societies

EMPOWERING WOMEN IN SOIL SCIENCE: BRIDGING THE GENDER GAP THROUGH COMMUNICATION AND EDUCATION PROGRAMS

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A comprehensive exploration of the empowerment of women in soil science, focusing on bridging the gender gap through strategic communication and inclusive programs, is necessary. Highlighting the contributions of women in the field's history, light is shed on their historical achievements and the hurdles they have confronted. The objective delves into the pivotal role that effective communication plays in reshaping the narrative of women in soil science. Various initiatives and programs that have successfully amplified women's voices in the discipline are analyzed, including projects designed to empower women and marginalized communities in soil and other sciences by creating a supportive and inclusive ecosystem through networking events, educational initiatives, and advocacy campaigns aimed at increasing the representation of women in soil science. Through this presentation, the aim is to contribute to a more inclusive and equitable future in soil science and related fields. The findings and insights offer valuable lessons and strategies for creating a diverse and welcoming community that bridges the gender gap and empowers all individuals, regardless of their gender or background.

Keywords: Gender equity, Diversity, Inclusion, Mentoring, Empowerment

ID ABS WEB: 136588

1. Equity, diversity, and inclusivity in soil sciences
1.04 133511 - Moving toward Diversity, Equity, and Inclusivity in Soil Science Societies

GENDER EQUALITY AND HUMAN FLOURISHING IN SOIL SCIENCE

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Globally the importance of diversity, equity, and inclusion (DEI) in soil science has been recognized by the International Union of Soil Sciences as well as professional organizations, and universities. The growing institutionalized regulations and federal laws express the normative ethics undergirding DEI efforts in soil science, and science, technology, engineering, and mathematics (STEM) disciplines. However, gender inequality concerns, stereotyping of women and intersectionality issues are still prominent as have been reported in various recent publications. Disparate valuations of the work of men and women irrespective of productivity similarities express the double and triple-bind that women, especially women of color or from minority groups, have faced in soil science. Hegemonic masculinity theory has been proposed to perpetuate such gender inequality. Hegemonic masculinities, that have manifested in many cultures around the globe and across time are considered social and gendered constructions, involving men's domination over women and other men, often minority and underrepresented groups in society. Discursive construction and heightened uncertainty about one's place in the world and gender order open new perspectives of addressing power hierarchies in STEM and soil science. Equity-oriented actions and resource allocations lifting women and minorities up are one way to address imparities. However, the over emphasis on equity tends to create new gender, social, educational hierarchies, and social disparities. We advocate for promoting the principles of equality in the soil science profession to create work cultures with a human face with honoring social equality and justice, belonging, and care for each other. Equality embraces the ethical belief that equal treatment of people co-creates global human flourishing and a sustainable planet Earth. The United Nations Educational, Scientific and Cultural Organization has recognized that science and gender equality are essential to achieve sustainability at global scale. Strategies that create a culture of equality with a human face honor core human values through investment in pro-social and emotional development, mentoring, coaching, allyship, and human flourishing

Keywords: Gender Equality,Mentoring,Soil Science Societies,Sustainability,Social development

ID ABS WEB: 136733

1. Equity, diversity, and inclusivity in soil sciences
1.04 133511 - Moving toward Diversity, Equity, and Inclusivity in Soil Science Societies

GROWING TOGETHER: MENTORSHIP DYNAMICS IN SOIL SCIENCES

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Mentoring is a significant tool for the personal and professional development of soil science society and institutional members. However, mentoring programs are often disconnected, member-driven with little resources, and do not have the capacity to educate and train members on effective mentoring. If approached thoughtfully, higher education and professional soil science organizations can utilize mentoring programs to create more inclusive environments that enhance equity among underrepresented groups and retention of members. In 2021, the Soil Science Society of America, along with the Agronomy Society of America and Crop Science Society of America (the Societies) released results of a Diversity, Equity, and Inclusion (DEI) membership survey in which mentorship was one of the highest ranked potential programs to enhance DEI within the Societies. Furthermore, the Societies commissioned a “Future of Membership” survey where an average of 85% of participants somewhat or strongly support the need for development of a formal mentoring program. Therefore, our overall goal is to develop a comprehensive, online, user-friendly mentoring program that connects members within and across societies and institutions. In 2023, the Societies secured funding for an online mentoring platform that will contain customizable program tracks to provide members the unique opportunity to connect on several platforms, such as within specific programs, divisions, 1-on-1, and groups (specialty groups, graduate student committees, etc.). This program contains i) MatchIQ 2.0 technology that will allow us to effectively match participants based on key traits, ii) built in training models and certifications, iii) dynamic connections plans that prompt mentors and mentees to incorporate tasks, goals, and content delivery into their discussions, iv) automation for every step of the process, if desired, enabling for a larger scale mentoring program to be ran more efficiently, and v) tracking of program metrics. This talk will discuss the development of the Societies’ mentoring program and the potential impact it will have on members and creating a more inclusive environment.

Keywords: mentoring,mentoring software,inclusivity,mentoring program

ID ABS WEB: 137946

1. Equity, diversity, and inclusivity in soil sciences
1.05 133836 - Preparing the Next Generation of Pedologists - Needs and Opportunities

CREDENTIALING – A PROPOSED PATH FOR FUTURE PEDOLOGY PROFESSIONALS

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As times change and we consider more global needs for having an integrated soil science workforce, there is a corresponding need for understanding appropriate curricula, training, and expectations for future soil scientists and the challenges they will face. This talk will focus on initiating a discussion on how to engage, train, and provide meaningful credentials to the next generation of soil scientists. This is necessary not only in the U.S., but across geographic boundaries and on a global scale. Soil, along with water, form the basis of life by providing food across all scales of our landscapes. We need a plan to enhance recognition of the soil science discipline and its expertise of applications in biology, chemistry, physics, ecology, etc., as integral to our management of healthy soils and sustainable land use. We need to prepare future pedologists to meet that challenge and at the same time assure the general public that pedologists have the working knowledge needed to address many issues. The Soil Science Society of America has had a soil science credentialing program in place for over 30 years. It serves to provide assurances to the general public that a Certified Soil Scientists have required education, experience, and knowledge to perform soils related work. There are others that also have credentialing programs related to soil. Experience from existing credentialing programs could be used to develop a global credential for future pedologists that is meaningful globally and provides recognition for those who have the relevant knowledge, experience, and qualifications to make recommendations regarding our soil resources.

Keywords: credentialing,education,knowledge,skills,workforce

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1. Equity, diversity, and inclusivity in soil sciences
1.05 133836 - Preparing the Next Generation of Pedologists - Needs and Opportunities

PREPARING FUTURE PEDOLOGISTS - A CANADIAN PERSPECTIVE

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As Canada is located within temperate and polar latitudes, global warming is projected to result in substantial changes to temperature and precipitation patterns across Canada's vast ecoregions. This will require ongoing adaptation to the evolving nature and functionality of soils in both managed and natural ecosystems. The intensification of land management, notably for precision agriculture, made possible by technological innovations, is driving demand for relevant interpretative information, derived through proximal and remote sensing, with respect to reference profile information. In Canada, as elsewhere, dedicated soil science programs are frequently being incorporated into broader programs, often resulting in a progressive loss of disciplinary expertise, as well as the ability to attract critical numbers of students to sustain advanced level disciplinary courses. Moreover, as universities struggle with budgetary shortfalls, practical training (e.g., laboratory and field courses) is often sacrificed. At the same time, there is an increasing need to provide effective linkage to allied sciences, such as geology, hydrology and botany. On the other hand, the rapid evolution of virtual technologies presents opportunities for national inter-institutional strategies to maintaining the capacity to deliver rigorous education. Finally, evolving generational career expectations continue to present challenges to the practice of soil science in both public and private sectors, as 'desk' jobs are often preferred over 'in-field' jobs. This presentation will provide a snapshot of the pedology in Canada, and strategies being employed to address the evolving needs of practicing professionals.

Keywords: climate change,post-secondary institutions,technological innovations,knowledge,skills

ID ABS WEB: 136160

2. Soil and humanity
2.01 124495 - Youth digging - The progress of early career global soil research

IT'S GETTING HOT IN HERE – GLOBAL WARMING AND THE SOIL OF MOUNTAIN NORWAY SPRUCE STANDS

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Global climate change is threatening the sustainability of forest ecosystems. The observed increase in atmospheric temperature has been unparalleled in the past two thousand years. In temperate zone, Norway spruce is a species particularly sensitive to changing environmental conditions. The process of spruce decay in mountain areas has been observed for several decades, but little attention has been paid to the relationship between climate warming and the the topsoil in spruce stands. Also, little is known about future scenarios for changing the species composition of these stands. The aim of the presentation is to present the results of two climate experiments during which warming was simulated in situ. The research, based on the artificial 0.5 °C soil warming, was carried out in the Western Carpathians. Results showed a significant effect of warming on the chemistry of the topsoil and ground vegetation. Warming caused a decrease in the content of total and labile forms of carbon and nitrogen in the soil, as well as total phosphorus, proving faster mineralization of soil organic matter. A significant increase in the content of ammonium in the warming soil was observed, which was the prime reason for the significant increase in the pH of the warming soil. The increase in soil pH under warming was related to a decrease in the strength of organic acids and an increase in the proportion of aluminum in the sorption complex. The aboveground parts of ground vegetation subjected to warming were characterized by increased leaf carbon content. Warming also had a different impact on the photosynthetic activity and pigment composition of the leaves of the young generation of beeches and spruces, which suggested a diverse acclimation potential of these species. The observed symptoms of changing habitat conditions will negatively affect the health of spruce stands. The results obtained can serve as a basis for silvicultural planning in mountainous areas where Norway spruce is still the dominant species.

Keywords: climate warming,forest soil,Norway spruce,soil organic matter,temperate forest soil

ID ABS WEB: 137172

2. Soil and humanity
2.01 124495 - Youth digging - The progress of early career global soil research

ORIGIN, PROPERTIES AND TRANSFORMATIONS OF SOIL LAMELLAE - A CASE STUDY FROM SOUTHERN POLAND

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Lamellae are morphological illuvial forms containing an ordered clay fraction on mineral grains, and increased content of iron and aluminum oxides and soil organic matter. Over the years, lamellae have been the subject of research in various fields, including paleogeography, sedimentology, geomorphology, and soil science. They are commonly found in soils formed from Quaternary deposits. The mechanisms of lamellae formation have been mainly described in soils developed from sandy materials of various origins; however, detailed studies on lamellae in loess soils are rare.

The aim of the study was to determine the origin, properties and transformation of lamellae in soils formed from sandy and silty parent materials, subjected to various soil-forming processes.

The studied soils from southern Poland were described and sampled. A detailed description of lamellae morphology has been included. Physical and chemical analyses, including texture, mineral and chemical composition, total carbon content, and concentration of pedogenic forms of iron and aluminum, as well as micromorphological studies, were conducted. The studied soils were classified according to the WRB system.

Lamellae are formed due to the illuviation of clay fraction, emphasizing the key role of pedogenesis in their formation. In soils developed from loess, lamellae form as a result of clay translocation, initiated after the decalcification of the upper soil parts. Conversely, characteristics of sandy parent material determine the redistribution and accumulation of pedogenic forms of iron and aluminum, clay fraction, and soil organic matter, playing a crucial role in the pedo-petrogenic origin of lamellae in sandy soils.

The transformations of soil lamellae can be categorized based on the direction of change, either towards the degradation of lamellae – caused by processes such as bioturbation, swelling and shrinking, eluviation, and chemical dissolution of iron compounds – or towards the enhancement of lamellae expression. The latter occurs gradually through the illuviation of clay fraction and iron compounds.

The research was financed by the National Science Centre in Poland (Grant No. 2018/29/N/ST10/00398).

Keywords: lamellae,illuviation,pedogenesis,micromorphology,evolution

ID ABS WEB: 137853

2. Soil and humanity
2.01 124495 - Youth digging - The progress of early career global soil research

FROM SOIL TO WATER - PATHS OF SOM TRANSFORMATION WITHIN MOUNTAIN PEATLAND SOILS DUE TO DRAINAGE ON THE EXAMPLE OF THE WESTERN BIESZCZADY MOUNTAINS

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Specific examples among mountain peatlands are those related to ombrogenic conditions which are highly sensitive to changes in the environment. One of the most important research issues addressed in the functioning of peatland ecosystems and organic soils related to peatland drainage is the phenomenon of releasing water-soluble organic matter and nitrogen compounds into surface waters. Ombrogenic peat soils occurring in mountainous areas are often overlooked in global analyses concerning carbon sequestration and the storage of biogenic compounds.
Therefore, the aim of the presented research was to determine the potential release of dissolved organic matter and nitrogen compounds from organic soils characterized by varying degrees of transformation. An attempt was also made to compare the molecular composition of organic matter in the solid phase of soil, dissolved in the soil solution, and circulating in the waters within the peatland.
The organic soils selected for the study were located in three ombrogenic peatlands in the Upper San River Valley (Eastern Carpathians Mts.). The main characteristic distinguishing these sites and consequently, the soils, is the impact of human activity. The drainage of peatlands dating back to the 19th century have led to noticeable contemporary changes in the morphology and properties, mainly of the surface horizons. Differences between the studied soils resulting from the degree of transformation are clearly evident in soil pH, degree of organic matter decomposition and mineral nitrogen transformations. The higher advancement of organic matter transformations caused by progressing mineralization with increasing peatland transformation degree, which is primarily demonstrated by the narrowing of the C/N ratio and the decrease in organic carbon concentration, does not result in an increase in dissolved organic matter towards more drained soils. Additionally, it was observed that the organic matter released into the soil solution and groundwater is characterized by a different molecular composition than the one originally accumulated in the examined organic soils.

Keywords: Mountain peatlands,Soil organic matter,Drainage,Dissolved organic matter,Mineral nitrogen

ID ABS WEB: 138011

2. Soil and humanity
2.01 124495 - Youth digging - The progress of early career global soil research

GLOMUS MACROCARPUM ASSOCIATED WITH GRASSES OF THE GENUS AXONOPUS P. BEAUV. IN AREAS OF PRESERVED CERRADO

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Arbuscular mycorrhizal fungi (AMF) enhance plant development, especially in adverse conditions. However, little is known about the presence of these microorganisms associated with native grasses of the Brazilian Cerrado biome under natural conditions. The present work aimed to evaluate the presence of AMF in grasses of the genus Axonopus P. Beauv. in two areas of the Federal District characterized as fragments of Cerrado, aiming to subsidize future work on the recovery of degraded areas in the central region of the Cerrado. For this purpose, the roots and adjacent soil were collected to evaluate the rate of mycorrhizal colonization and the abundance of AMF spores. Subsequently, some AMF species were identified based on morphological aspects of the spores. The highest colonization rate was observed in the Axonopus sp. (95%) and the lowest value for the Axonopus aureus sample (59%). The average density of AMF was 9 spores g-1 soil in the Bernardo Sayão Ecological Park, and 12 spores g-1 soil in APA Paranoá in 2017. (Seventeen) 17 species of AMF were identified, with Glomus macrocarpum being the predominant species comprising more than 71% of the total spores in the Axonopus species studied. It is concluded that AMFs are strongly associated with grasses of the genus Axonopus, with their symbiotic relationship with the species Glomus macrocarpum having high potential in plans that aim to adopt microbiological tools as a basis for the recovery of degraded areas.

Keywords: Spore diversity,Mycorrhizal colonization,Area recovery,Drought stress,Native grasses

ID ABS WEB: 138197

2. Soil and humanity
2.01 124495 - Youth digging - The progress of early career global soil research

ANALYSIS OF AGRICULTURAL EMISSIONS OF NITROUS OXIDE AND CULTIVABLE AREA IN MÉXICO

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In comparison to reports prior to the Industrial Revolution, the current concentration of nitrous oxide (N2O) has increased by approximately 20%, with the agricultural sector being the most representative source, contributing to 50.4% of total gas emissions due to the excessive use of nitrogenous fertilizers. However, the land allocated to the agricultural sector in México has been decreasing each year in response to the development of infrastructure and housing, coupled with the abandonment of agricultural activities due to climate effects, safety concerns, and ongoing uncertainty regarding the profitability of small and medium-scale production systems. The objective was to analyze the impact of the reduction in agricultural land in México and its effect on agricultural N2O emissions. To achieve this goal, historical data on N2O agricultural emissions in thousands of metric tons (TMM) and hectares of land dedicated to agriculture in México from 1965 to 2021 were obtained. Subsequently, an autoregressive integrated moving average (ARIMA) model was applied to both series, followed by an intervention analysis on the N2O emissions series. An ARIMA (1,1,0) model was employed for series analysis, revealing an annual deterministic trend yt-1 of 763.30 TMM of N2O, even when, starting from 2007, there was an annual average reduction of 7.5 million hectares dedicated to agriculture. The intervention model identified six outliers: 1997, 1998, 1999, 2000, 2017, and 2018, corresponding to years with the greatest impact on the reduction of N2O emissions, aligning with México's inclusion in national and international environmental treaties, as well as the increase in agricultural input costs. The area allocated to food production in México has significantly decreased without observing significant decreases in N2O emissions from agriculture.

Keywords: Intervention analysis,Time series,Greenhouse emissions

ID ABS WEB: 138201

2. Soil and humanity
2.01 124495 - Youth digging - The progress of early career global soil research

REPRESENTATIVENESS OF ORGANIC MATTER IN THE PHYSICAL QUALITY OF SOILS UNDER INTENSIVE TILLAGE

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Intensive agricultural management results in alteration of soil, causing a decrease in quality and physical fertility. Physical properties of soil, as well as the content of organic matter, influence to generate indices of physical quality of soil and evaluate effects on crop production. The objective was to evaluate the physical quality index of soils exposed to frequent changes in their characteristics due to intensive tillage effects. Unaltered samples from five vertisols from Acámbaro, Guanajuato, México, were used; these soils were put through a comprehensive characterization of physical properties, as well as the determination of organic matter content. To understand the impact of the absence of organic materials in the soil, organic matter was removed using 30% hydrogen peroxide and compared with soils from which the organic materials were not removed. Principal component analysis was applied using SAS® statistical software to obtain the representativeness of the model variables and to obtain the degradation index and subsequently generate soil physical quality indexes. One soil (S4) with a low degradation index was found, a result of particle stability due to the aggregation effects favored by its high organic matter content (6.83%). The remaining soils (S1, S2, S3, and S5) obtained a high degradation index, reflecting that the constant tillage intensity to which the soil has been subjected for crop production. The physical quality index of all soils was low when the organic matter was removed, showing that high physical quality indexes in soils appear with the presence of organic materials, ensuring a favorable physical condition for crop growth and development. The contribution of organic matter in intensive agriculture improves the physical quality index over a considerable period of time, positively impacting soil conservation.

Keywords: Intensive agriculture,Physical fertility,Soil conservation

ID ABS WEB: 138337

2. Soil and humanity
2.01 124495 - Youth digging - The progress of early career global soil research

USE OF UNITED STATES MID-INFRARED MODELS FOR SOIL ORGANIC CARBON PREDICTION IN HAITI

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Soil organic carbon data can inform management for soil functions, agricultural productivity, and soil security, but current measurement methods can be expensive. Large mid-infrared soil spectral libraries, such as that curated by the USDA, provide an opportunity to build robust calibration models that can be used to predict organic carbon in new areas like Haiti. However, appropriate selection of calibration sets is required. The objective of this study was to evaluate the effectiveness of pedologic criteria and spiking to construct a calibration model from a United States mid-infrared soil spectral library (i.e., general library) that would accurately predict organic carbon content in the Cul de Sac region of Haiti (i.e., target area). Eight schemes were tested to construct calibration models using a fraction of the general library to predict organic carbon in the target area. The schemes included models constructed from observations of the same soil taxonomic orders as in the target area, the same suborders, same taxonomic class in combination with a minimum carbonate content, and spiked variations of all models. Memory-based learning was used for the general library models. Additionally, a partial least squares regression was used to construct a calibration model using a random sample of target area observations. Subsetting by shared suborders (RMSE = 0.65 and 0.70%; RPIQ = 1.56 and 1.44 for the suborders and suborders plus carbonate content model, respectively) improved predictive performance over subsetting by shared orders (RMSE = 0.76 and 0.81%; RPIQ = 1.34 and 1.25 for the orders plus carbonate content and orders model, respectively). Spiking the general library calibration sets with 25 target area observations produced the most desirable and reliable predictions (RMSE: 0.28-0.33%; RPIQ: 3.16-2.72). In addition, the spiked models outperformed the target area model. Our results suggest that these optimization techniques are effective in reducing model prediction error and can be used to predict organic carbon content in new target areas using USDA's mid-infrared soil spectral library.

Keywords: Haiti,Spectroscopy,Organic Carbon,Library Transfer,MIR

ID ABS WEB: 136323

2. Soil and humanity
2.02 129339 - The development of Soil Science in the IUSS countries: 100 years of history

THE ROOTS AND DEVELOPMENT OF CZECH SOIL SCIENCE AS AN INTEGRAL PART OF THE IUSS COMMUNITY

B. SARAPATKA

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Deeper understanding of soil science began to significantly expand in the 18th century, thanks to influential persons in various countries. Agricultural institutions were established at universities during this period, including one at the University of Prague in 1776. Subsequently, especially in the 19th century, the field of soil science saw the documented contributions of numerous individuals. In the early 20th century, notable names like Josef Kopecky and Julius Stoklasa emerged, both being appointed honorary members of IUSS (ISSS) in 1924 and 1935, respectively. Notably, Prof. Kopecký excelled not only in soil physics but also in soil mapping. In 1922, he organized a Prague conference that preceded the establishment of ISSS (now IUSS) in Rome in 1924.
Following the formation of Czechoslovakia in 1918, other noteworthy persons include Prof. Novak, Dr. Spirhanzl, and Prof. Smolik. The post-World War II period saw the influence of collectivization of agriculture on Czechoslovak soil science due to the urgent need for increased food production. Consequently, soil survey and mapping gained significance, leading to the initiation of the Comprehensive Soil Survey from the early 1960s, covering 7.5 million hectares of agricultural land in Czechoslovakia.
Over time, soil science expanded into various domains, with current research results being published in international journals and applied in agricultural and forestry practices. Professors Kas, Kosil, Peliosek, and Nemecek were influential in the early post-war decades. The appointments of Professors Miroslav Kutilek and Josef Kozak as honorary members of IUSS (1998 and 2016) affirm the high academic standard maintained by Czech soil science. International collaboration and participation in the IUSS community remain crucial, with ongoing close cooperation with Slovak colleagues despite the division of Czechoslovakia into two states.

Reference:
Sobocka, J., Sarapatka, B. a kol. (2018): 100 let ceske a slovenske pedologie (100 years of Czech and Slovak soil science). NCPP-VUPOP Bratislava, 192 p. (in Czech)

Keywords: history,Czech society of soil science,famous soil scientists,research

ID ABS WEB: 138246

2. Soil and humanity
2.02 129339 - The development of Soil Science in the IUSS countries: 100 years of history

CONTRIBUTION OF THE GERMAN SOIL SCIENCE SOCIETY (DBG) TO ISSS/IUSS SINCE 1926

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The German Soil Science Society (DBG) was founded in 1926 as a section of the International Soil Science Society (ISSS). In the 1930s DBG already had up to 200 members from which about the half was also members in the ISSS. Already at the very outset soil scientists from Germany had become engaged in the international cooperation of soil science as a rather young but quickly developing discipline. This applies in particular to Emil Ramann and Friedrich W. Schucht who together with David J. Hissink (Netherlands) tirelessly worked to make the foundation of the ISSS happen.

Emil Ramann (1851 - 1926) can undoubtedly be regarded as a precursor and leading pathfinder for the ISSS. Friedrich Schucht (1878 - 1941), served as President of the ISSS between 1935 and 1941. Already before WW-I he had fostered international cooperation by editing the International Reports on Pedology which appeared until 1924 - even during the time of WW-I. Thereafter until his death in 1941, Schucht was in charge of the Proceedings of the ISSS, the society's central organ which appeared together with Soil Research as its supplement in the three publication languages English, French and German. WW-II shattered all plans for the fourth ISSS Congress which was foreseen to be held in 1940 in Heidelberg. Hermann Stremme (1879 - 1961), G.A. Krauss (1888 - 1968), and E.A. Mitscherlich (1874 - 1956) significantly contributed to ISSS activities. The Nazi takeover in 1933 also affected the DBG and its relationship to ISSS.

After the end of the terrible war and collapse of the Nazi regime the DBG like other scientific associations in Germany was dissolved. The re-establishment took place in 1949. Thankfully, rather soon the international isolation could be overcome. Karl H. Hartge was President of the ISSS (1982 – 1986) and organizer of the 13. World Soil Congress 1986 in Hamburg. Rainer Horn served as IUSS President during the period 2015 – 2016.

Keywords: German Soil Science Society,History,Contribution to IUSS

ID ABS WEB: 138318

2. Soil and humanity
2.02 129339 - The development of Soil Science in the IUSS countries: 100 years of history

SOIL AND LAND RESOURCES RESEARCH IN EAST AFRICA: A HISTORICAL PERSPECTIVE

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The Soil Science Society of East Africa (SSSEA) at its inception in 1974 continued to recognize the importance of soils and devoted its focus and dedication to advancing knowledge, and devising management practices with scientific evidence to manage, conserve and sustain soil functions and services in agriculture, general environment with a focus on the ecosystem and landscape (watershed). The Society continued to promote the study, research, teaching and application of soil science and related subjects and disciplines in East Africa. Some of the major activities carried out over the lifespan of SSSEA include surveying and mapping of soil and land resources, Integrated Soil Fertility Management (ISFM), and soil and water conservation.

Soil research in East Africa dates back to early activities during colonial times. The Provisional Soil Map of East Africa from 1937 is based on the Catena concept (G. Milne, 1898–1942). Before WW-I, the German Paul Vageler (1882-1963) had undertaken a pioneering soil survey which can be seen as a precursor of Milne's Catena concept. Early soil science development in Tanzania also included soil fertility and soil testing research centers, most of which are still operational to date.

In Uganda, a committee formed already in 1910 conducted a series of detailed soil surveys to examine the effects of various farming systems on soil fertility and crop production. In 1958/61 a soil map of Uganda was produced at the scale of 1:250,000. In Kenya, knowledge of soil was promoted in 1926 by motivating the public to participate in soil analysis through the publication of hints on collecting soil samples and soil mapping. Most of the soil works during the pre-war period, concentrated in coffee-growing areas. The post WW-II years manifested the resumption of soil and land resource surveys. This was mainly in connection with the development of new land for African settlements but later extended to detailed surveys for irrigation, sugarcane development, and improved land use.

Keywords: East Africa,History,Soil Science Soc. East Africa,Catena concept,Soil mapping

ID ABS WEB: 135973

2. Soil and humanity
2.03 129617 - Soil Health from Multiple Perspectives

BURIED CLOTH TECHNIQUE: SOIL MICROBIAL ART AS A TEACHING TOOL FOR LABORATORIES

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Soil, the hidden, frontier; these are the voyages of the soil fabric-ship, with a continuing mission to explore new worlds, seek new life forms, meet new communities, and receive communication signals from the most ancient life forms, where no one has gone before.
This modified quotation from Star Trek: Enterprise is usually the opening of my soil art laboratory. This is where I explain to my soil microbiology students how we can visually see the effect of the soil microbial community on the fabric after burying a piece in the soil for at least one month. The buried cloth technique can be used to compare activity of soil with different amendments and different conditions. Any variation in the soil environment can lead to a shift in the microbial community creating different colors and patterns on the fabric. The microbial art is then correlated to the activity of the soil microbial community. Exploring the soil structure and the minute universe of interactions among air, water and minerals leads to a better understanding the soil microhabitats affecting the life forms in that ecosystem.
In this oral presentation, we will illustrate how the buried cloth technique has been used in our classrooms, and how it can be a simple tool for teachers and soil scientists to assess the soil microbial activity. Results obtained in this visually allow them to record observations and describe what factors were more effective in controlling the microbial activities. Photographs are taken of the fabric pieces and digitally used for educational purposes. This initiative aims to cross link the fields of soil biology, physics and chemistry. Moreover, the learning lessons collected from the microbial art pieces symbiotically weave the relationship between art and science. This intricate relationship seems to be gaining more attention from educators, where art is adding a new dimension to science and technology, and science can become more of a personal relationship through art.

Keywords: Buried cloth,Soil art,Teaching tool,Soil Microbiology

ID ABS WEB: 136103

2. Soil and humanity
2.03 129617 - Soil Health from Multiple Perspectives

ANIMATING SOIL HEALTH: BREATHING LIFE INTO SOIL, CAMPAIGNING THROUGH STOPMOTION FILM

J. PEARL

Ecoartspace, Santa Fe, USA

Our visual understanding that soil is healthy is generally gathered by reading how green a landscape is, how lush the plants growing there are. There is little understanding in the general public that soil is a highly complex biome. Making the invisible, visible is one of the artist's key roles in society, including what may be hiding in plain sight: like the awe-inspiring biodiversity in healthy soil.

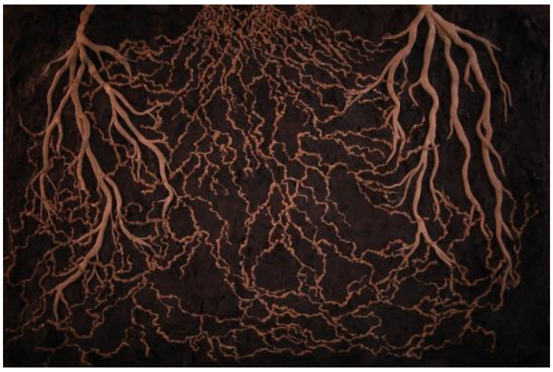
In this multidisciplinary session, artist Jo Pearl (UK) will share two short films about soil health and discuss methods for creating environmentally-charged, stop-frame animations.

In her project 'Unearthed,' Pearl draws the viewer's perspective down to examine the choreography of ever-more tiny beings that inhabit the soil through material-rich, claymation. Pearl will also present a short collage animation by Cindy Stockton Moore (USA) titled 'Urban Refuge' a playful soil portrait of John Heinz Natural Refuge in Philadelphia that combines chromatography, buried cloth experiments and extracted DNA data analysis with hand-drawn animation.

After the short screenings [with a combined running time of 8 minutes] the artist will discuss the potential of art activism to change mindsets about soil: by bringing ideas to life, revealing hidden beauty, and catching audiences off guard.

The time-intensive process of animation, slowly breaking down and building up imagery, is an apt metaphor for how healthy soil is created. While taking different approaches, both artists use cinematic arts to take a closer look at the organisms thriving underground - engaging connections between the human and more-than-human world.

This session asks: When nature can be off-putting and statistics too dry, how can we enchant a germaphobic, modern audience about soil? How can we invite them to appreciate that the ground beneath our feet is a secret world of breath-taking biodiversity, with mysterious agency and a treasure trove of solutions to the climate crisis? Does animation have a special role to play in bringing the subject to life?



Keywords: Art,Animation,Soil Awareness,Communication

ID ABS WEB: 136479

2. Soil and humanity
2.03 129617 - Soil Health from Multiple Perspectives

A BRIEF HISTORY OF THE "BURIED COTTON CLOTH ASSAY" USE IN SCIENCE AND ART AND CURRENT COMPARISONS OF DIVERSE SITES USING METAGENOMIC INDICATORS

R. JANKE

Kansas State University Dept. of Horticulture, Manhattan, USA

The "buried cloth" technique received significant interest in the 1980s among soil scientists and biologists seeking new ways to evaluate soil and environmental quality, though the original use of the method can be traced to 1947. Ecologists have historically used bags of plant materials in "litter bag studies" where the rate of decomposition could be quantified, but the use of cotton offers a new way to standardize the test. Currently, artists, researchers, and farmers are using it as both a quantitative and a qualitative, visual method to measure the rate of decomposition caused by bacteria, fungi, and other soil creatures that feed on cellulose. In some cases, the results correlate with soil carbon, and in other cases, with soil nutrient levels – with higher levels resulting in more decomposition. A more difficult task is to determine which species of microbes are responsible for the decomposition. Prior to the use of metagenomic identification tools, 99% of soil microbes were unculturable, and little is known about them. I have used the buried cloth method to illustrate the importance of soil quality to students and farmers, along with soil nutrient testing. In collaboration with fellow art students at Goddard College, we documented participants' experiences regarding the process of burying and then digging up the cloth. Later, we created a site-specific public art installation, to document the biological activity of eight different soil series found at Fort Worden state park, in a project called "The Soil Remembers." The most recent project includes multiple participants from the ecoartspace soil dialogue group, where soil quality testing and DNA (metagenomic) identification of archaea, bacteria, and fungi was performed on multiple sites across many ecosystems on two continents, in conjunction with use of the buried cloth. The process of collaboration and results will be presented to inspire future research and artistic collaborations with soil.

Keywords: soil microbiology,bioassay,environmental indicators,metagenomics

ID ABS WEB: 136681

2. Soil and humanity
2.03 129617 - Soil Health from Multiple Perspectives

SOUND OF SOILS: TWO APPROACHES TO A MULTISENSORY UNDERSTANDING OF SOIL

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[2] Ecoartspace Member, Dubbo, AUSTRALIA

K Goldsmith and A Yoncha are two artist members of the Soil Dialogues work group of Ecoartspace. In 2023-2024, they each buried cotton fabric samples underground for about a month, in Central West New South Wales Australia and Ada Oklahoma USA, respectively. This process unearthed interventions made on the fabric by the soil microbiome community, which is materialized via sound.

Goldsmith's "#SoundOfSoils" project puts an ear on the tenuous, rudimentary soils of Central West New South Wales, capturing an intimate, reciprocal conversation between the artist and these 'good-for-nothing' soils. Seventy per cent of soils in Australia are considered unproductive because they are arid or semi-arid. However, these ancient soils have supported an ecosystem of native Australian flora and fauna for hundreds of thousands of years.

"#SoundOfSoils" celebrates ancient earthy sands and their value to more-than-human life in a rapidly changing climate. Goldsmith captures the initial silence of the soils at burial through to an increasing range of clicks, rasps, crackles, munches and rustling as the subterranean world comes to life, clearly demonstrating how the ecosystems depending on these soils have adapted to extreme conditions.

Yoncha's "Cross-timbers" project draws from non-traditional, music notation. The unearthed fabric acts as a musical score, with data isolated from her soil sample in the lab translated into sound. We hear patterns in repeated musical motifs – ratio of aerobic versus non-aerobic bacteria, ratio of gram negative versus gram positive bacteria, moving musical lines representing motile microbes, softer sounds representing rounder shapes.

The microbes become the writers or composers of this piece, directing decisions about what data we see and hear. Humans are the performers or interpreters. This reversal engages with questions about non-human agency, and creative and communicative potential of our microbial neighbors.

These projects reveal the power of sound as a creative and expressive medium for not only sharing the story and life contained within soil but as an indicator of soil health.

Keywords: Soil microbial community,Soil biome metagenomics,Environmental art,Art science collaboration,Data sonification

ID ABS WEB: 137066

2. Soil and humanity
2.03 129617 - Soil Health from Multiple Perspectives

TWO PAINTERS' COLLABORATION WITH SOIL - A SEARCH FOR UNDERSTANDING

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[2] Ecoartspace, Santa Fe, USA

Leonardo da Vinci said The noblest pleasure is the joy of understanding. Scientists and artists are both in the business of trying to understand the world around us by asking a lot of questions. Whether we rely on experimentation, data analysis, visual analysis or personal experience to find answers, we are all continually asking questions. There is a long history of artists and scientists looking to soil as a way to analyze, investigate, understand and interact the earth.

Pamela Casper and I have both been experimenting with burying cloth as a way to use the soil as a creative partner.

For Pamela, the fascination of soil's cooperative relationships among fungi, tree roots, plants, and other organisms are a driving force and represent the theory of cooperative evolution. The paintings are a visual concept of underground life systems difficult to observe and that unfold endlessly. The resulting watercolors integrate nature's mark making represented on urban and rural buried cloths. The actual cloth is integrated into each final work, resulting in a rural and urban invented underground map, which probes how life processes fit together.

Inspired by Albrecht Durer's, Great Piece of Turf from 1503, I dig shovels full of soil from my suburban yard and bring it into my studio to observe. The resulting drawings and paintings are portraits, a type of record keeping, a way to log and organize and communicate the observed. The buried is used as a substrate to draw attention to the evidence of the soil activity vs how the soil itself looks in its static state. The paintings are oil paint (pigment and oil) and the drawing is done with ink and charcoal that I have made from the dirt and wood found on sight.

This talk will present images of our work, discuss its connection to the science of soil and contextualize it within a broader art historical context.

Keywords: Art,Urban Soil,Transdisciplinary,Citizen Science,Collaborative Research

ID ABS WEB: 137860

2. Soil and humanity
2.03 129617 - Soil Health from Multiple Perspectives

BURIAL SHROUD: A MULTISPECIES AND ECOFEMINIST PERSPECTIVE ON HUMAN/MICROBIAL RELATIONSHIPS IN SOIL FERTILITY AND DECOMPOSITION, AS EXPRESSED THROUGH ART.

D. PINDELL

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[2] Ecoartspace, Santa Fe, USA

Recent forays from the environmental humanities into the subject of soils have explored questions of caring for soil as it cares for us through food production, and speculation into Western views of labor and colonization. The relevance of these philosophical inquiries arises when the time comes to apply the hard-won data of science to the motivation of the general public, expressed through attitudes, actions, and policies regarding the preservation and improvement of soil ecosystems. The ecological imperative is clear - soil feeds the world - yet necessary action lags far behind the need. How might art serve to bridge that gap?

The Soil Dialogs working group, a collective of artists and scientists, began a long-term inquiry with the simple “cloth burial’ method of envisioning soil health as the central prompt, then radially expanded with a broad range of sensory, aesthetic, and intellectual expressions. This presentation offers examples with a particular focus on deep empathy and kinship as pathways for connecting humans with the more-than-human, multispecies, microbial reality of soils.

As an example, Burial Shroud is a textile sculpture that uses these buried, stained, and microbially munched textiles to expand our concept of our human selves into a fully reciprocal, embodied and entangled relationship with the microbial life of healthy soils. Burial Shroud asks us to engage with our own decomposition after death. We must give up the identity of ourselves as an envelope separate from the activity and agency of the microorganisms both inside and outside of our bodies.

Why is this radical reframing of relationships necessary? The extent of human empathy toward our multi-species world will outline the extent of our long-term survival on this planet. Burial Shroud recognizes soil microbes as kin, the porosity of boundaries between species, and mortality as an antidote to the human hubris that drives abuse of soils.

Keywords: Multispecies,Ecofeminism,Kinship,Posthumanism,Empathy

ID ABS WEB: 138062

2. Soil and humanity
2.03 129617 - Soil Health from Multiple Perspectives

SKY INSIDE THE SOIL – ARTISTIC RESEARCH OF THE RHIZOSPHERE AT A SUPERFUND SITE IN BITTERFELD-WOLFEN

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“The sky. What kind of a feeling was it as I let it settle upon me, absorbing the toxic yellow-gray smog into my consciousness, counting the high funnels from which it spewed out and then hung like a roof over the city?” (Monika Maron, 1981). What traces of yellow-grey smog from Maron’s controversial critique of environmental degradation in the former GDR are visible forty years later? In Bitterfeld-Wolfen, industrial heritage is a fundamental part of the cultural fabric of the city. Literally. Cellulose-choked wastewater from the film industry, combined with a slurry of chemical fibers from Soviet era synthetic textiles production, were once richly discarded in the quarry ponds of the former brown coal mining pit nicknamed “Johannes”, now commonly known as Silbersee (Silver Lake).

“The Sky inside the Soil” is a multi-phase artistic research project that explores the rhizosphere and its inhabitants in an environment of extreme toxicity. Following the seasonal cycle of ruderal plants growing around Silbersee, we re-imagine the historical trajectories of labor, leakage, and repair on the former mining pit once used for wastewater from the former ORWO film factory and chemical textiles plant. In a series of print works, we use historical images, field photography, and pigments derived from plant biomass to reflect on the social, economic, and aesthetic dimensions of pollution through the medium of silkscreen – a tightly woven nylon mesh, not unlike the synthetic nylon products once manufactured in Bitterfeld-Wolfen. We consider changes in viscosity over time and invite an embodied understanding of such changes though the repetitive process of silkscreen printing: prepare, pour, flood, stroke, lift, repeat. In this iteration of the project, we buried screen-printed cotton handkerchiefs bearing historical images of polluted skies along the lake’s embankment. While atmospheric pollution is no longer visible, traces in the topsoil are revealed through soil quality testing and analysis. What once hung like a roof over the city now belongs to the rhizosphere.

Keywords: rhizosphere,mining soils,artistic research,cultural soil memory,remediation

ID ABS WEB: 136605

2. Soil and humanity
2.04 129928 - Soil sciences entering into transdisciplinary research

UNDER THE CONCRETE: EXPLORATIONS OF SOIL BIODIVERSITY THROUGH ART AND SCIENCE IN THE LOS ANGELES RIVER

L BON , M GARCIA

Metabolic Studio, Los Angeles, USA

As Los Angeles has grown, and so has the need for water to sustain it. Bending the River is an adaptive reuse of LA River infrastructure and will divert a portion of the LA River, treat the water using a native wetland habitat, and then distribute it to the 52-acre adjacent LA State Historic Park.

In-river construction for Bending the River included excavating a trench 90m long, to install clay pipes to carry the water to Metabolic Studio, and a 20m deep well, to receive the diverted LA River water before it passes through to the wetland treatment. According to traditional construction practices, that 4000 cubic meters of excavated soil should be sent to the landfill. Instead, we preserved this valuable soil for further study.

During the well excavation, we took soil samples every 1.5 meters - two 64L boxes and two 50mL tubes were immediately placed in the freezer, and two 3L jars in the refrigerator. The remaining soil was stored at room temperature in an empty warehouse. Because of the site's industrial past, every 1.5m in situ, we tested the soil for heavy metals using a handheld XRF analyzer. Fortunately, both lead and arsenic readings were at safe levels.

One area of interest was biodiversity. We performed a preliminary carbon dating analysis at five different depths, and the results indicate carbon present from 6,000 to 9,000 BP, the era of the Early Chumash people. We also conducted germination experiments and observed plant, moss, and fungi species that could correspond to seeds preserved under the LA River's concrete. Additionally, we used paleogenomic tools, and extracted environmental DNA to identify the genetic legacy of the organisms that lived in these ecosystems.

Because of the size of our soil sample, we plan to continue our experiments, looking at the past of this soil, but also towards the future, as we discover new stories to tell about the ground beneath our feet.

Keywords: bioremediation,biodiversity,paleogenomics,germination,water

ID ABS WEB: 136722

2. Soil and humanity
2.04 129928 - Soil sciences entering into transdisciplinary research

THE EXPANDED SOIL PROFILE, A TOOL FOR TRANSDISCIPLINARY SOILS RESEARCH: REFLECTING ON SUCCESSES, OBSTACLES AND NEXT STEPS AFTER FIVE YEARS OF COLLABORATION

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Problems threatening the biosphere—climate change, food insecurity, biodiversity loss, contamination—cannot be resolved without restoring soils, the complex living systems undergirding all lands. Solving these 'wicked' problems by renewing soil will demand a transdisciplinary approach. Our transdisciplinary method, the Expanded Soil Profile (ESP), seeks to map the complex web of relations (i.e., cultural, historical, and physiographic) that embody a specific soil. Expanding on the conventional profile by extending it vertically, temporality, and conceptually, the ESP blends instruments of soil science (i.e., biochemical analysis), social science (i.e., political economic analysis) and humanities (i.e., semiotic analysis) to assess soil care practices and propose future pathways for soil and land use, management, and stewardship. Ultimately, it amplifies traditional soil sampling and analysis with qualitative research to decipher a cohesive, integrated narrative of how humans have lived with soil, and how realigned social and cultural relationships with soil might begin to resolve unfolding threats to the biosphere.

In this paper, I'll discuss our transdisciplinary collaborations at two organic farms in Canada, and I'll reflect on the difficulties of working across disciplines and sectors. First, I'll explain our methodology, which involved: (1) collecting soil monoliths and samples from three main genetic horizons in a virgin forest and adjacent cultivated field and analyzing them to compare physical, chemical, and biological properties and (2) interviewing key informants and conducting historical research to show the dynamic field of symbolic interaction overlaying and interweaving with the soil, from management practices and worldviews to social-ecological systems and agricultural policy. Next, I'll share our findings, which show that soil care practices guided by an ecological mindset correlated in both cases with increased soil health, indicated by high levels of soil organic carbon. Finally, I'll discuss some of the difficulties in working across disciplines and sectors, including the absence of a common language, and some of the successes we experienced, particularly the use of the soil monolith as a tool for dialogue.

Keywords: expanded soil profile,transdisciplinary research,soil monolith,soil health,ecological mindset

ID ABS WEB: 137809

2. Soil and humanity
2.04 129928 - Soil sciences entering into transdisciplinary research

THE NANTESBUCH SOIL INITIATIVE – FOSTERING SOIL KNOWLEDGE AND STEWARDSHIP ACROSS SOCIETY

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Soils are the critical zone on and from which humanity lives. Climate change, biodiversity losses and global population growth with ever increasing demand on natural resources illustrate the essential role of soils for the survival of mankind.

Advances in soil science led to productive soil management practices with emphasis on the protection of soil functions. In case of mal-management well established options for restoring soil functions in inter- and transdisciplinary contexts are available.

Despite the available knowledge soils are degrading due to anthropogenic and natural impacts - often enhanced by the effects of climate change. An important reason for this development is the missing societal consciousness for the relevance of soils for human life.

Against this background the non-profit Nantesbuch Art and Nature Foundation (www.kunst-und-natur.de) aims at increasing the visibility for the importance of healthy and multifunctional soils. The foundation offers spaces and interdisciplinary programmes for engaging with art and culture as well as nature and landscapes.

Currently the foundation is building a soil competence network. This transdisciplinary structured network gathers soil relevant knowledge and experience from all relevant disciplines and sectors directly or indirectly linked to this topic.

Furthermore, the soil initiative will contribute to a better awareness for soils by utilizing the various pathways of art and culture for an evidence based emotional approach.

The network will gradually be developed towards an international forum in order to address the global dimension of soil-related challenges by enabling an unbiased and open-ended exchange of decision-makers from science, business, politics and the general public. This broad and international engagement requires es a long-term commitment, and the initiative's success will highly depend on the participation of already existing networks and organizations such as the IUSS.

The contribution will detail the conceptual strategy of this unique initiative based on scientific and practical knowledge, highlight some of the recent key activities and indicate opportunities of how to become part of this comprehensive soil initiative.

Keywords: soil knowledge & stewardship,healthy soils,soil competence network

ID ABS WEB: 138368

2. Soil and humanity
2.04 129928 - Soil sciences entering into transdisciplinary research

THE SOIL COOPERATIVE RESEARCH CENTRE - BRINGING FARMERS, INDUSTRY AND RESEARCHERS TOGETHER

M. CRAWFORD

Cooperative Research Centre for High Performance Soils, Callaghan, AUSTRALIA

The Cooperative Research Centre for High Performance Soils (the Soil CRC) is a virtual research centre that brings together research, industry and farmers from 39 participant organisations including universities, government agencies, industry bodies and farmer groups from across Australia. It commenced in 2017 with 10 years of funding from the Australian Government and its partners. The main purpose of the Soil CRC is to undertake soil-related research that helps farmers better manage their soil and in turn, improves their productivity and profitability.

Importantly, while the Soil CRC has a focus on soil, it is not just a research centre for soil scientists. A key part of the Soil CRC's success to date has been the involvement of a broad range of social, economic and scientific disciplines working side-by-side with practitioners and end-users (farmers). Farmers, as represented through place-based and issue-based farmer groups, have played a key role in helping to identify priorities, develop proposals, implement projects, interpret results and communicate findings.

In turn, the involvement of 39 participants, including eight universities, has enabled access to a broad range of complementary and diverse expertise and discipline input.

This has not been without its challenges, as individuals and disciplines struggle to communicate in a discourse that is common and understandable to all. However, individual and organisational participants have welcomed the opportunities and synergistic outcomes that have been achieved through this process.

In my presentation, reference will be made to specific examples to illustrate both the learnings and the successes and the values that are implicit in the research activity of the Soil CRC.

Keywords: soil health,multidisciplinary,trans-disciplinary

ID ABS WEB: 138252

2. Soil and humanity
2.05 132213 - Soil and literature

SOIL INCANTATIONS – A CONVERSATION BETWEEN A SOIL SCIENTIST AND A POET

K VANCAMPENHOUT, L VANCAMPENHOUT

KU Leuven, Leuven, BELGIUM

In this contribution, soil scientist Karen Vancampenhout and professional writer and poet Luc Vancampenhout embark on an extraordinary journey to invite non-specialists to be amazed by the concealed beauty beneath our feet. Inspired by the works of Francis D. Hole and Robert Macfarlane, they leverage the evocative power of poems and incantations to illuminate the essence and narratives intrinsic to diverse soil types. Their work is an interplay between the beauty of soil profiles and the meticulous adaptation of both language and style to mirror the distinct properties of each soil - from the complex and layered stories of palaeosols, over the lingering effects of ancient climate cycles, to the macabre movements of organic matter in Podzols.

In an era where the urgent need to advocate for soil protection and care is undeniable, the duo employs their interdisciplinary approach to bridge the gap between scientific knowledge and artistic expression. By weaving images and words that resonate with the unique characteristics of different soils, they invite participants to explore a world often overlooked but profoundly connected to our existence. And, in turn, foster a deeper appreciation and collective commitment to safeguarding this invaluable resource.

Keywords: Soil profiles,Poetry,Arts,Awareness

ID ABS WEB: 136238

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

ASSESSING AND MAPPING SOIL ECOSYSTEM SERVICES IN URBAN AND PERI-URBAN AREA: PROVIDING SUPPORT TOOLS FOR URBAN PLANNING IN THE MUNICIPALITY OF FORLÌ (NE ITALY).

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Urban developers and planners rarely pay attention to the quality of urban soils, to their functions and to the supply of ecosystem services to the citizens. This work contributes to raising awareness about the role of soil in the built-up environment, to provide tools to assess and map urban soils ecosystem services and to highlight the possibility of integrating soil knowledge into urban planning.
In 2023, the urban soils of Forlì (NE Italy), were surveyed, sampled, analyzed, and mapped over an area of ca. 5700 ha. The outcomes of the survey allowed the integration of the existing knowledge about soils and land use with the urban plan and provided the basis to produce a 1:10,000 map of urban soils. Soil data were interpolated over the entire case study area providing the inputs for locally calibrated pedotransfer functions whose outputs were used to assess a set of seven indicators of soil ecosystem services (SES) potential supply: soil biodiversity, buffer capacity, carbon storage, agricultural production, biomass production, water regulation, and water storage. Results show that for several services, hotspots occur not only in the peri urban agricultural areas but also in unsealed soils within the urban fabric, and that different soils provide high quality services in diverse constellation depending on soil characteristics and degree of sealing.
We estimated that the unsealed soils of the green areas within the city (412 ha) store within the first 30 cm of depth 17,0409 Mg of organic carbon (63,890 Mg CO2 eq.) corresponding to an average carbon density of 42.2 Mg ha-1, which is significantly higher than the corresponding average of the agricultural soils of the municipality (36.8 Mg ha-1). Furthermore, over the same reference depth (0-30 cm), the soils of the green areas store up to 17,707 m3 of water, corresponding to 43 m3 ha-1.

Keywords: Urban soils,Ecosystem services,Urban planning,Soil sealing,Soil quality

ID ABS WEB: 136375

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

MAPPING SOIL QUALITY FROM A URBAN PLANNING PERSPECTIVE: A SUPRA-LOCAL FRAMEWORK REVIEW

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The problem of soil consumption is well known and developed in international literature, but there is not a univocal definition of soil and soil quality, despite during the decades these concepts have evolved in the scientific community. Without definition is not possible to measure and evaluate the value of soil consumption at the planning scale: so, its effect at wide area is underestimated by local authorities, which should build greater awareness of soil role and enforce soil monitoring. Therefore, this research proposes a soil quality detection framework adequate for the supralocal planning, identifying a consistent list of indicators for better valorising soil peculiarities, services and vulnerabilities, consciously protecting it from degradation and consumption.

On the one hand the coordination and strategic role of supralocal planning should support organic and integrated wide-area planning and act as an autonomous and authoritative guide, bringing out supra-municipal issues with respect to local interests. On the other hand, the research outcome could represent a valuable reference for local soil quality characterization and be used as a support for planning decisions for the municipalities, which acquire in this way an effective reference for building more accurate Land Use Maps at the local scale. The municipality coordination about this issue is done by Provinces (NUT3) and regulations and laws are done by Regions. Both suffer a weak condition: Province is a second level administrative body and not all the Regions adopt laws on urban containment. So, a revision process of the planning instruments is advisable, with the ultimate aim to reduce soil consumption.

The indicators proposed at the planning scale could be better understood in a provincial-level cartography deepening and detailing the soil quality characterization, useful then at municipality level. Soil quality is detected in the widest perspective: the indicators proposed valuate not only the soil characteristics in physical, chemical, hydraulic terms, but also the services it gives and the main threats it is subjected to.

Keywords: Urban containment,Land vs soil,Land quality mapping,Urban and rural areas,Soil degradation

ID ABS WEB: 136562

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

DRAWING RELATIONS: DEVELOPING TOOLS FOR THE PARAMETRIC DESIGN OF SOIL IN LANDSCAPE ARCHITECTURE

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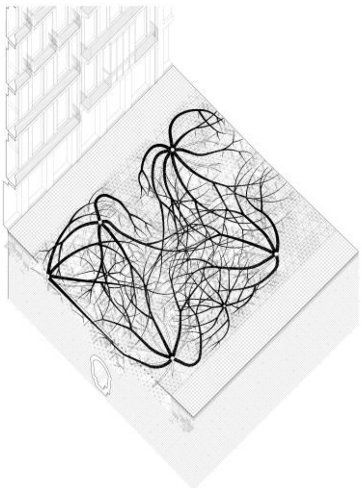
While soil is foundational to the field of landscape architecture, it is typically addressed as a narrow technical concern late in the design process, once many major decisions have already been made. Designers lack the tools to creatively and iteratively integrate soil dynamics into the early design phases, which limits the potential for the specific soil conditions of a site to influence the landscape design. Not only does this constrain the aesthetic and performative potentials of landscape architecture, it results in urban spaces that are ill equipped to support vibrant nonhuman ecologies. This is most obvious in the well-documented plight of urban trees, which often struggle due to an insufficient volume of appropriate soil.

Recognizing this issue, we have developed a series of parametric drawing tools that support the inclusion of soil dynamics in early landscape design phases. Drawing is a core part of the design process because it simplifies the complexity of the site into a legible abstraction, allowing designers to work quickly yet precisely. The drawing tools we have developed reduce the complexity of soil to several key parameters, such as texture, depth, compaction, and organic matter content. These parameters are integrated into an algorithmic model in Rhinoceros 3D, a common Computer Aided Drafting (CAD) software used by designers. The algorithmic model brings the soil parameters into relation with climatic variables, such as precipitation and potential evapotranspiration. The model enables designers to quickly modify the multi-variable relationships between soil, climate, and vegetation. Since the parametric model is integrated into existing CAD software, these experiments can directly inform design decisions about form, scale, and materiality. In this presentation, we will introduce the drawing tools and methodology through a series of design studies developed by Masters of Landscape Architecture students at the ETH Zurich. The students explored how to transform the surface and substrate of a street in Zurich to meet the needs of urban trees.



Keywords: Landscape Architecture,Design,Drawing,Street Trees,Urban Soil

ID ABS WEB: 136590

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

SOIL RECOVERY, RE-USE AND CREATION IN URBAN MASTERPLANNING – WHAT IS NEEDED TO ACHIEVE POSITIVE OUTCOMES FOR BIODIVERSITY, THE ENVIRONMENT AND SOCIETY

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Soils provide a wide range of ecosystem services important for our environment, society and economy. This has resulted in the overuse and exploitation of soils from many users, often exceeding the natural system boundaries, in part due to the existence of stringent waste regulation compared to non-existent legislation focused on the services which come from healthy soils. There is also a strong element of a lack of understanding of soils and soil forming materials and how they can be re-used by matching soil characteristics to the requirements of the proposed land use.

Soil health is a term which is gaining wider usage, although probably remains a poorly or mis-understood term. Any framework for soil resource recovery and re-use to support urban development needs to be based on the understanding of natural soils, soil function, soil health and recognition of the central role soils play in supporting the sustainable delivery of the biodiversity projects. It also needs to be based on an understanding of what comprises soil forming materials which may be available for re-use and how these can be combined to create sustainable and functioning soils.

This study will present details of what processes and expertise are required to ensure full recovery and re-use of soils and soil forming materials within the urban environment. Examples will be presented, through the project lifecycle, of the information, data and expertise required to ensure the appropriate re-use of available soils and the use of soil forming materials to create soil profiles suitable for the intended end use, whether that is for landscaping, parks, allotments or sustainable drainage systems, for example.

With the right expertise it is possible to use a full understanding of the soil / soil forming resources present as a platform to maximise re-use to deliver multi-functional post-construction systems, providing quality and resilient environments within urban areas which support both biodiversity net gain and the local community.

Keywords: Sustainable soil reuse,Soil forming materials,Urban soils,Communities,Multi-functional systems

ID ABS WEB: 136989

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

RETHINKING CONSTRUCTION AND DEMOLITION SOIL WASTE UNDER A CIRCULAR ECONOMY FRAMEWORK

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Since the 1950s, UK has been experiencing high urbanization rates and it is predicted that by 2050 another 0.3 million hectares, in England alone, might be required for housing and infrastructure development. Therefore, million tonnes of soil will be permanently displaced in order to facilitate the development plans and potentially lose its multifunctionality with environmental and financial repercussions.
Urban soils are often overlooked but they play a major role in humans' lives, as the loss of soils functions can have disastrous consequences, for example the loss of soil's water infiltration function can cause increase flooding risk. Steps have been taken through existing policies and guidance to minimise the environmental impacts of construction in England, however soil derived from construction activity is often overlooked. In 2021, 55 Mt of soil waste, deriving from construction and demolition, were received to permitted facilities in England with 97.9% characterised as inert and over 50% of that was sent to landfill.
In an attempt to introduce soil removed from construction and demolition sites to a circular economy framework, we investigated the potential of introducing a soil reuse system in England under existing policy landscape. We collaborated with the Environment Agency, which is an executive non-departmental public body responsible for the regulation Environment of England and Wales. Following a review of existing international soil reuse schemes, a plan was developed for prioritising the safeguarding of soils' multifunctionality and ecosystem services delivery. The scheme was developed with the scope to accommodate multiple soil qualities arisings during development; from naturally occurring excavated soil material to treated contaminated soil, as well as the possibility of soil "manufacture" utilising other waste streams, especially green waste. The establishment of a soil reuse scheme in England and Wales would divert soils from landfill, recognising the value of soil as a non-renewable resource and helping achieve the national circular economy and net zero targets.

Keywords: Urban soils,Soil reuse,Circular economy,Construction

ID ABS WEB: 137711

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

FINDING SUITABLE SOILS FOR COFFIN GRAVES TO HELP LONG-TERM URBAN PLANNING

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Cemeteries are part of the urban landscape that once established, will remain untouched nearly “forever”, as the presence of human remains prevents alterations. The incomplete decomposition of human remains in cemeteries has long been an unspoken issue in Norway. The contest for land areas, especially in/near urban areas, is greater than ever, inciting the need to find the key factors influencing decomposition in cemeteries. In many cases, the conditions set by law for reuse are not met, and the resulting need to construct new cemeteries adds to the pressure on urban planners. Modern graves and their respective soils have been studied in the last few years to help design suitable soils for new coffin graves. The presentation will report on the findings of a survey of reused graves in six municipalities of Norway, and the subsequent opening of 73 graves where the soil was characterized, and the rate of decomposition was graded based on a visual inspection of the remains. We will also report the first biological elements off a lysimeter experiment that was established to study the decomposition potential of numerous artificial soil mixes.

Keywords: Economic, environmental impact,Soil-decomposition interaction,Traditional coffin graves,Artificial soil mixes,Soil properties

ID ABS WEB: 137733

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

EVALUATION SYSTEM FOR SOILS IN URBAN PLANNING

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As soils provide a large range of ecosystem services in urban areas, it should be of high priority to protect them in the urban environment. Soil protection faces the challenge of urban sprawl and land take by roads and infrastructure. Thus, soil protection aims at avoiding or minimizing, or, where this is not possible, mitigating or compensating land take and soil sealing. For urban planning it is crucial to consider the soil quality in current and future development. Therefore, a sustainable soil management approach should be developed using multidisciplinary methods.
In the project 'URBAN soil management strategy' implemented through the CENTRAL EUROPE Programme co-financed by the European Regional Development Funds, helpful strategies for urban soil management have been identified. Some of them will be showcased in the presentation. One of these strategies focuses on introducing compensation measures and validation of soil functions: A handbook was developed for measures enhancing soil function performance and compensating soil loss during the urbanization process. It introduces compensation measures with the potential to restore or improve soil functions in a sustainable and measurable way.
In the recent project DACHBODEN, financed in the framework of the D-A-CH cooperation transport infrastructure 2021, the main goal was the development of a decision tool, which allows an assessment of soil destruction caused by road construction as well as an estimation of the costs incurred for the compensation of the soil destruction. This tool can also be used for an evaluation of impacts and compensation needs due to new buildings or new infrastructure forseen in urban planning.
This evaluation tool, which combines status of soil functions, evaluation of the intensity of the modification of the soil by road construction and monetary evaluation of the required compensation may provide a basis for inclusion of soil compensation in legal requirements or regulations for urban planning. The functioning of this tool will be explained by means of a concrete example of road construction.

Keywords: urban soil management strategy,soil functions,soil evaluation,soil compensation,soil destruction

ID ABS WEB: 137821

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

SCIENCE-BASED CHOICE OF SOIL MAY IMPROVE THE SUSTAINABILITY OF BLUE-GREEN AREAS IN URBAN SETTINGS

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Knowledge about functional soil properties, such as soil physical and hydraulic properties, is crucial for the responsible planning of immovable elements in (peri-)urban landscapes like cemeteries. Soil in Norwegian cemeteries has received more and more attention in recent years due to problems with incomplete decomposition of human remains. These problems prevent property managers from reusing older graves, and lead to the necessary expansion areas allotted as cemeteries which increases the pressure on urban planners. An accompanying presentation by Økland et al. introduced the core problem and the sequence of ongoing actions in Norway to address these challenges. Given the dynamics of grave-turnover, allocation of new cemetery areas is inevitable in many Norwegian municipalities. Such areas are fitted with constructed soils, and under the auspices of circular resource use, there have been several recommendations to use soil mixes that include various coarse materials of natural origin. For example, artificial crushed sand is a cheaper and more sustainable option to natural sand, which is already being used in new cemeteries and urban greening facilities. However, limited knowledge exists about the properties of these artificial soil components and the resulting soil mixes, and they are suggested to have different porosities and different hydraulic behavior than their natural counterparts of the same size fraction. A lysimeter experiment was established with different soil types, including crushed sands, natural sands and their mixes, to study their decomposition potential. We have performed saturated and near-saturated infiltration tests in situ on 8 such soil mixes, and subsequently sampled them for laboratory analysis of basic physical and chemical properties, soil water retention, as well as 3-D X-ray tomography imaging. This presentation will report on and compare these characteristics and put them in context with initial indications of decomposition potential presented by Økland et al. in the same session.

Keywords: Constructed soil,Soil hydraulic properties,Sustainable cemeteries,Teabag method

ID ABS WEB: 137910

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

FROM LAND USE TO LAND RE-USE: INTEGRATING CIRCULARITY IN SPATIAL PLANNING

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In the current global context, the destructive effects on the territory due to the progressive reduction of soil fertility and the increasing scarcity of natural resources are highlighting that the linear model of expansion, on which the growth of urban areas has historically been based, is no longer sustainable. This model is evidencing today, more than ever, that the presence or absence of spatial resources can have a strong influence on the structure of urban landscapes in contemporary cities.
These landscapes are closely linked to the types of available soils, whether they are virgin and fertile, polluted or associated with unused, underutilized or inaccessible buildings. It is precisely the soil resource that intervenes in environmental sustainability policies, and in particular in those developed within territorial planning processes, as the main physical support for human transformations and as a significant component for the ecosystemic adaptation of urban environments.
In this perspective, it is therefore necessary to rethink current models to structurally reduce soil consumption and limit the loss of associated ecosystem services, through processes of reconstruction, rebirth, prevention, care and reuse of the territory, and the dissemination of a new territorial paradigm that looks towards circularity.
The focus is particularly on the possibility and potential to act in discarded, abandoned, unplanned or neglected peri-urban contexts, deprived of their function, generally recognized as waste landscapes, to be recognized as reserves of territory to be reused and as enabling contexts for the activation of more circular and structured territorial regeneration processes.
The adaptive reuse of these contexts aims, therefore, to integrate into a circular economic system, focused on maximizing the reuse of resources, an approach that considers the soil as a valuable and limited resource, to be preserved and enhanced, proposing the development of the idea of a circular use of land, capable of redefining territorial planning models, leading to a more sustainable management of urban resources and to more resilient cities.

Keywords: soil management,circular spatial planning,adaptive reuse,waste landscape transformation,territorial regeneration

ID ABS WEB: 138160

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

MULTI-LAYER CONSTRUCTED TECHNOSOL SYSTEMS WITH DIFFERENT CONFIGURATIONS FOR GREEN ROOFS: RHIZOBOX STUDY

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This study evaluates the performance of multi-layered soil systems for green roof applications, which are common in blue green infrastructure. Unlike single-layered soils, these systems have different evapotranspiration, infiltration, contaminant removal, and plant support properties. However, the water and solute transport across the layer interfaces is poorly understood. We built 18 rhizoboxes with one, two, and four-layered soil systems on a raised bed on an open-air roof. We used intensive green roof substrate and coarsely grained expanded clay as the layer materials. We report the initial results of the first nine months of monitoring, during which we planted two plant species in the rhizoboxes after starting with bare-soil. We measured the water balance components to assess the hydraulic functioning of the soils. We also applied invasive and noninvasive methods to investigate the capillary barrier, finger flow, and air entrapment phenomena in the multi-layered soils. We adapted a modeling approach for water and solute transport in natural soils to multi-layered constructed soils. Our study aims in long term to provide valuable insights for the design and management of green roofs with multi-layered soils.

Keywords: Constructed Technosol,Layered soils,Rhizobox,Green roof

ID ABS WEB: 138203

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

SOIL INFORMATION EXTRACTION FOR URBAN PLANNING THROUGH REMOTE SENSING

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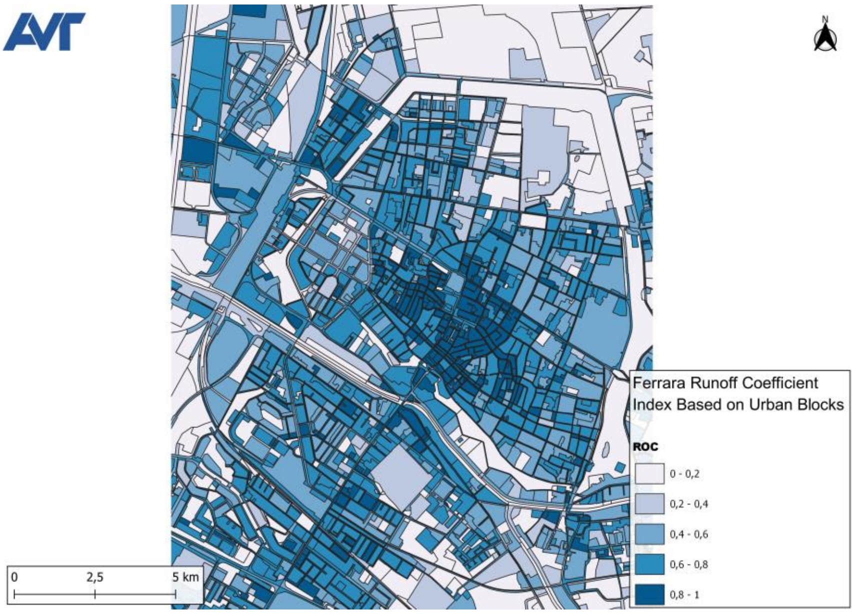
Remote sensing is commonly used for thematic information extraction of the land cover from hyperspectral and thermal images. Among the available remote sensing platforms, satellites are the best known. However, although their good spectral coverage (i.e. VNIR, SWIR, LWIR), their spatial resolution is poorly effective for urban planning. At the urban level, aerial surveys guarantee very high spectral and spatial resolutions. Using hyperspectral aerial images detailed classification maps of the surface materials can be obtained, showing different soil coverages (bare soil, sand, asphalt, gravel, concrete…), roof materials, asbestos, solar panels, and similar. This classification is also critical for land surface temperature retrieval in combination with thermal images and for the calculation of urban ecological indices such as runoff coefficient (in Figure), infiltration and imperviousness. It is also possible to classify tree species and to study the health of vegetation (e.g. nitrogen content, water content, etc.) or soil properties using spectral indices (i.e.montmorillonite content). Aerial thermal imagery acquired in winter time is useful for identifying underground heat losses, detecting poorly insulated buildings and studying any relationship between soil and heat. Aerial thermal flights in summer time are fundamental to study the generation of heat islands or the mitigation effect of water. On rural soils they can show the distribution of water or fertilizers. The presentation will show and critically discuss the results obtained in AVT Airborne Sensing from hyperspectral and thermal aerial surveys on the cities of Ferrara (Italy) and Graz (Austria), using the AisaFENIX hyperspectral sensor and the DualDigiTHERM thermal camera. In Ferrara the thermal flights were executed in January and July 2023 (day and night) and the hyperspectral one in July 2022. In Graz the thermal flights were performed in September 2021 and one hyperspectral flight in October 2021. Part of the activities is co-financed by the Horizon Europe USAGE project (no 10105995).



Keywords: AERIAL SURVEY,SOIL MATERIAL MAPPING,REMOTE SENSING,THERMAL IMAGES,SOIL ANALYSIS

ID ABS WEB: 138376

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

A METHOD FOR ASSESSING SOIL ECOSYSTEM SERVICES TO IMPROVE LAND USE PLANNING DECISIONS AND PRESERVE HIGH QUALITY SOILS

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Soil sealing is one of the greatest threats to soils in Europe. The soil ecosystem services (SES) are numerous and not easy for the layman to recognise and understand. Spatial planners usually do not know much about soils, different soil qualities and, above all, the ecosystem services that soils provide. When planning cities or infrastructures, better or worse planning decisions can be. Planners have to choose between different planning options and can avoid sealing the best soils. In order to follow the principles of rational soil, an effective method and an automated tool that helps to recognise which soils are the best would be useful.
This paper presents a method for assessing the SES in urban planning. The method addresses the eleven key ecosystem services that are important for four key human and environmental needs: healthy food, drinking water, safe environment and climate change mitigation. Method consists of two steps. In the first step, the ability of the soils in the planning area to provide the most important SES is assessed. Empirical algorithms were developed and embedded in the Excel tool, which analyses a selection of very basic soil parameters: Total soil depth, topsoil organic matter content, acidity, and nutrient content. The ability of the soil to provide SES is scored from 1 (worst) to 100 (best). The optional fifth criterion is soil pollution. In this case, the tool analyses the concentrations of heavy metals in topsoil, persistent organic compounds, HCH&PAH using national soil pollution limits. In the second step, the tool evaluates each planning option in terms of land sealing and soil quality. Comparing the scores of the planning options in terms of soil ecosystem services within the same planning area enables the selection of the better planning decision and therefore the preservation of the best soils.
The method can help to limit land take and soil sealing, as set out in the EU Soil Strategy for 2030.

Keywords: rational planning,soil sealing,soil protection,zero net land take

ID ABS WEB: 136067

2. Soil and humanity
2.08 133512 - Children and young people say present at the IUSS Centenary Celebration

THE HOME OF LIFE: I AM A LIVING SOIL

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Educating children and young people is a duty of science to promote the sustainability of the soil resource as a common good to be preserved. Constructing the knowledge of this audience focused on soil conservation offers society opportunities to learn how to care for our natural resources through a respectful balance with nature, fostering a culture of protection for our most precious asset, the origin of life. Within these principles, we understand that education plays a fundamental role in achieving a balanced planet for the living beings that inhabit it. In a playful and enjoyable manner, this special audience is invited to understand that within the soil live very small animals that play a vital role in ensuring we have clean water and food because they help us take care of this resource. Furthermore, we are responsible for caring for the soil along with these animals, as co-responsible for maintaining the different scales of life. In this way, we present an award-winning work that secured third place among the 97 competitors from 75 countries in the first edition of the competition promoted by the International Union of Soil Science (IUSS) and the Food and Agriculture Organization of the United Nations (FAO/GSP), under the theme 'keep the soil alive, protect soil biodiversity.' The book provides a simple approach to the importance of the beings that are part of the biodiversity of the House of Life (the soil) for our larger home, planet Earth. Originally written and published by FAO in English, it has already been translated and published in Portuguese and Spanish, with the German version currently being finalized. It has reached over 276 institutions in more than 73 municipalities across over 21 states in Brazil, 15 countries, spanning 4 continents. These institutions have undertaken various educational activities with the book published by Embrapa, contributing to the popularization of soil science.

Keywords: Soil,Biodiversity,Children's literature

ID ABS WEB: 136071

2. Soil and humanity
2.08 133512 - Children and young people say present at the IUSS Centenary Celebration

SOIL EDUCATION – CURRENT STATE AND CHALLENGES FOR TEACHING 'DIGITAL NATIVES' GENERATION

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One of the challenges of the modern world is to increase social awareness of the environment and geography lessons create an opportunity for transferring the skills of conscious management of the Earth's resources. The research clearly shows that soils topics are underrepresented (Charzynski et al., 2022) and students lack an awareness of threats related to the environment (Urbanska et al., 2022). The awareness of threats related to various Earth spheres is considerably differentiated. Research shows that the soil issues are the least known in this aspect. Soil education is deficient in many countries. In schools, soil topics are usually taught briefly and with little detail. This may result in students' perceiving the pedosphere as less important than the other spheres– "just" 'dirt' we walk on! A proper approach to the issues of sustainable development without an full knowledge of the environmental threats is impossible.
How to encourage a "digital native" to understand the soil - something so "down-to-earth"? The best option is to change the way of knowledge transferring to make this process much more attractive for modern generations. There are a lot of possibilities: mobile games related to soil (free game-based learning platforms) or on-line and off-line mobile applications for the soil profile description to combine soil education with ecological issues and edutainment social networking service. This motivational, challenging, and rewarding digital environment helps learners work toward a goal while choosing actions, and experience the competition and consequences of those actions (experience level/ranks/digital rewards/skills badges/points). This kind of interactive competitive game-based techniques in learning process can be a perfect way to increase public awareness of soils. " Learning by doing" or even "learning by playing" is a key aspect of multitasking nature of digital natives as well as the ability to apply the knowledge in practice.

Keywords: soil awarness,soil threats,soil education,gamification,edutainment

ID ABS WEB: 136187

2. Soil and humanity
2.08 133512 - Children and young people say present at the IUSS Centenary Celebration

“THE MYSTERY OF ANCIENT SOILS! CHILDREN'S BOOKLET TO UNDERSTAND THE SOILS OF THE PAST: A MULTILINGUAL AND JOINT INQUA-IUSS INITIATIVE.”

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In science education, fostering a connection between children and the natural environment is crucial. Soil and paleosol sciences, often overlooked in traditional curricula, play a vital role in shaping our understanding of Earth's history and sustaining life on our planet. Introducing children to these disciplines can profoundly impact their appreciation for the environment and scientific inquiry. Paleosols, or ancient soils, provide a fascinating window into Earth's past. By studying these remnants, children can explore the geological and climatic changes that have shaped our planet over millions of years. This connection to history helps children appreciate the dynamic nature of Earth and the importance of safeguarding its future. The Mystery of Ancient Soils! The children's booklet results from a collaborative effort by the INQUA Paleopedology Working Group, IUSS Paleopedology Commission, and IUSS Young and Early Career Scientists. This project is an educational illustrated short story focused on the concept of soil memory (a fundamental pillar of contemporary paleopedology research), as well as the features of the soil throughout geological history. The story features youthful characters and incorporates elements of cultural significance to vividly underscore the importance of modern and ancient soils as facets of our shared heritage. This book is now available in eleven languages: Spanish, English, French, Polish, German, Russian, Portuguese, Hebrew, Arabic, and Turkish. The Mystery of Ancient Soils! It will not only contribute to educational outreach and help preserve our understanding of soil heritage for generations to come but also promises to be a valuable addition to paleopedology.

Keywords: science education,children's booklet,paeosols,soil

ID ABS WEB: 136626

2. Soil and humanity
2.08 133512 - Children and young people say present at the IUSS Centenary Celebration

FACING FIRE: A SERVICE-LEARNING APPROACH TO IMPROVE TRAINING AND AWARENESS ON SOIL CONSERVATION AFTER WILDFIRES

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Forest fires are a global complex, especially in Mediterranean ecosystems, seriously impacting the environment, rural development, and the economy. Although there has been substantial research and technical advances in recent years, larges areas are burned annually and in most cases restoration or soil conservation practices are not adopted. The Plantando Cara al Fuego (PCF project, FacingFire) is an initiative that proposes the reinforcement of training capacities of young students (from secondary school to university) on wildfire management.
Noteworthy, the project introduces the Service-Learning (S-L) approach, an educational methodology in which students learn while acting to solve real problems. Multidisciplinary teams of students participate in prevention, restoration and awareness-raising projects in areas affected by fires. Regarding soil conservation, students know the processes of soil degradation processes and different techniques for soil protection and restoration. Nevertheless, other important fire aspects are considered as forest fuel management, fire prevention, environmental awareness, and outreach/communication.
Currently, within the framework of the Spanish Ministry of Science and Innovation and the Erasmus+ program, the initiative has expanded and different Spanish regions (https://www.plantandocaraalfuego.org/) and some European countries (https://facingfire.eu/) are adopting the S-L methodology to transfer knowledge and to improve the training of new generations in forest fire management and soil protection. One of the main outputs was the FOREST FIRE TRAINING NETWORK, hosted at FUEGORED (http://fuegored.weebly.com/).
Since the beginning of the project, >100 university students from different disciplines (forest sciences, education, biology, audiovisual sciences, journalism) and >20 agents (primary and secondary schools, local and regional administration, forest communities, companies, NGOs) have participated in >15 projects. In general, participant responses were highly positive, since S-L projects served to create an environment that facilitates learning on different environmental topics including soil conservation and restoration. In addition, other relevant aspects of S-L projects are the interaction of students from different disciplines, the application of theoretical contents, knowledge transfer or the exchange of good teaching practices between participants.

Keywords: Service-learning,WIldfires,Student participation,Community engagement,Multidisciplinary projects

ID ABS WEB: 136894

2. Soil and humanity
2.08 133512 - Children and young people say present at the IUSS Centenary Celebration

EDUCATE TO CONSERVE: CONTRIBUTIONS TO THE EDUCATIONAL PROJECT ASÍ SON LOS SUELOS DE MI NACIÓN

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Así son los suelos de mi nación is an educational project that began in Mexico in 1986 with the support of Fundación UNAM. Currently, it is a cross-cutting project throughout Latin America. Its purpose is to educate new generations in preserving and conserving soil as a common good. This paper aims to present the activities and educational tools in the teaching-learning process of soil in children and young people in Mexico, carried out within the framework of the Symposium on Educational Innovations in Soil Science Teaching. The Symposium has been held uninterruptedly for the last 17 years; one of its particularities is that children and young people are responsible for presenting presentations on topics and research results related to the soil; within this event, soil scientists of the country are involved in didactic workshops and simple practices that strengthen the understanding of the soil in topics related to soil functions, biodiversity and degradation. The average number of participants in the last three events is 145 students from preschool to high school, 22 researchers and 12 teachers; as a result, continuous work collaborations have been generated among the participants, allowing experts to carry out outreach activities and identify soil as an element of great importance in socio-ecosystems; likewise, the Symposium has awakened interest in conducting simple research from an early age in elementary schools, as well as motivated the development of early vocations. A point to highlight is the recent inclusion of indigenous schools, which allows the identification of their cosmovision about this natural common good and the exchange of knowledge among participants from rural and urban environments. In this context, the Symposium is seen as a didactic-pedagogical tool of great importance in teaching soil science.

Keywords: EDUCATION,SOIL,TEACHING,CONSERVATION,INNOVATION

ID ABS WEB: 137351

2. Soil and humanity
2.08 133512 - Children and young people say present at the IUSS Centenary Celebration

THE IUSS GOES TO THE SCHOOL

L.B. REYES-SÁNCHEZ

UNAM & IUSS, Cuautitlán Izcalli, MEXICO

Not having a fertile soil that allow us to have enough food and water is already a serious problem, but more serious are the social situations that its deficit engenders: loss of food safety and public health, poverty, displacement, inequality, violence, and injustice as a result of famine (Reyes-Sánchez, 2012 & 2015). The loss and degradation of the soil resource means the loss of all terrestrial flora, and with it that of the fauna that it feeds (Reyes-Sánchez, 2018). It also means a terrible loss of biodiversity at planetary level, a serious destruction of the food chain of which we are a part, as well as the reduction of its capacities of available water reserve and C capture to lessen climate change in the long term but in real terms. In this context the protection of the soil resource and an interdisciplinary and innovative education and practice of sciences to raise citizens' awareness on the importance of its preservation -working all the sciences as a team in a mediatized world-, are keys to achieving the Sustainable Development Goals, and therefore, are the long-term goals and priority objectives of the International Decade of Soils of the IUSS (Horn, 2015), and they base its educational project (IUSS, 2022).

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Reyes Sánchez L. B. 2015. “La educación como política pública de concientización para la preservación del suelo como recurso natural limitante para la existencia de la vida” en “Redescubriendo al suelo y su importancia ecológica”. Gerardo Cruz y Alma Bella (Eds). División de Investigación de la FES-Zaragoza UNAM y CONACYT. ISBN: 978-607-02-7468-8; e-ISBN: 978-607-02-7467-1.

Keywords: Soil Science,Education,Awareness,Creative literacy,Interdisciplinary teacher

ID ABS WEB: 137383

2. Soil and humanity
2.08 133512 - Children and young people say present at the IUSS Centenary Celebration

SOWING SEEDS OF AWARENESS: THE GSP AND IUSS UNITE FOR YOUTH SOIL ADVOCACY

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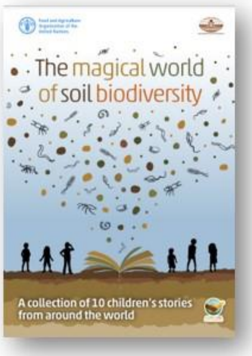
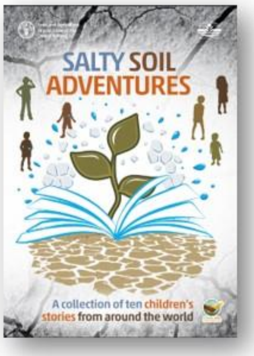
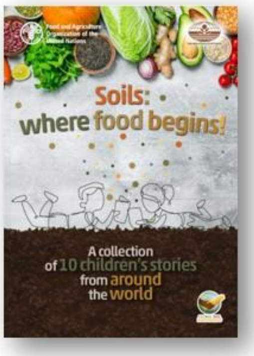
Established in December 2012, the Global Soil Partnership (GSP) of the Food and Agriculture Organization of the United Nations (FAO) serves as a globally recognized mechanism with the mission of elevating soils in the global agenda and advocating for sustainable soil management. Since its establishment in 2014, World Soil Day (WSD) has witnessed an increasing level of participation and engagement. In 2023 alone, the global community organized over 10 000 events and featured in 569 articles in leading newspapers, reaching nearly 1 billion people. This day is marked by various events, actions, and initiatives aimed at raising awareness about the potentialities and challenges of sustainable soil management.
Since 2021, the GSP, in collaboration with the International Union of Soil Sciences (IUSS), has introduced an annual booklet contest. This contest invites soil scientists and designers to team up and submit creative book proposals for children based on WSD annual theme. The winning book, designed for children aged 6 to 11, is selected by a committee based on criteria such as creativity, originality, content quality, technical and scientific proficiency, and the artistic/visual impact of the book.
Contributions from participants worldwide, including soil scientists, researchers, professors, teachers, students, practitioners and designers from seventy countries, have resulted in the creation of over 200 booklets.
Each year, a curated collection of ten stories is released, offering a well-balanced representation of entries from various regions. These stories, centred on themes such as soil biodiversity, salt-affected soils, and soils for nutrition, engage children in a fun and unique way, introducing them to the fascinating world of soil. The publication of these booklets strategically captures the interest of young children in soil science during their formative years, moulding them into potential future decision-makers.
Through educational projects, global artistic expression, and engagement with youth, the GSP, in collaboration with the IUSS, has effectively initiated conversations that underscore the importance of preserving soil resources and promoting sustainable soil management.



2021



2022



2023

Keywords: Youth soil advocacy,Annual booklet contest,Children's books,Soil awareness,FAO's GSP and IUSS united

ID ABS WEB: 137683

2. Soil and humanity
2.08 133512 - Children and young people say present at the IUSS Centenary Celebration

SOILS AWARENESS AND KNOWLEDGE AMONG ITALIAN SECONDARY HIGHER SCHOOL STUDENTS

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Soil is one of the most important natural resources and its degradation is one of the global environmental challenges. However, compared to other natural resources and their related threats, soils are often ignored or overlooked by general public. Indeed, there is a lack of soil awareness and knowledge received through formal and informal education. The goal of protecting soil resources cannot ignore soil awareness and education.
In Italy some soil science basic concepts have been added quite recently in primary and secondary lower schools scientific curricula, but the decision of teaching soil related topics is up to the teachers. The latter often have little knowledge about soil and could not feel comfortable to teach about it. Last, apart from agricultural technical schools, soil teaching is lacking in secondary high schools, even in the earth sciences curriculum.
To test the soil awareness and knowledge of high school students, we conducted a survey among several schools in Tuscany, Italy, which took part in an university dissemination programme related to environmental issues. The results show that, although most of the students had been taught at school about soil, they were not aware of the role that soil plays in human life and ecosystem services provision. Students were generally aware of problems related to air and water pollution, but less than a half of them shared the same concern about soil pollution and just a minority was aware of the role of soil in climate change mitigation. Overall, there was a general low awareness of soil; most of the respondents live in cities and do not even associate the urban environment with soil. Young people's lack of soil awareness is a crucial issue soil scientists should debate about as it can hinder the interest and knowledge of soil value for the whole society, as well as decreasing over time the number of future soil science students, eventually worsening the problem.

Keywords: soil education,High school,soil awareness

ID ABS WEB: 136178

2.09 133548 - Microbiome as a common thread from soil to human health: Interaction, Impact and Role of Soil-Plant-Human Microbiome as a new challenge of innovative agriculture and quality food

PLANT MICROBIOMES AND THE PRODUCTION OF NUTRACEUTICAL COMPOUNDS: THE CASE OF MYCORRHIZAL SYMBIONTS

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Mycorrhizal symbioses are beneficial associations between soil fungi and plant roots, involving about 6,000 fungal species and 240,000 plant species. Among the different mycorrhizal symbionts, arbuscular mycorrhizal fungi (AMF) are the most important, establishing the symbiosis with about 80% of land plants, including the most important food crops, such as rice, corn, barley, wheat, legumes, vegetables, fruit trees. AMF receive carbon from the plant, in exchange for mineral nutrients absorbed from the soil and translocated to the host plant, by means of an extensive network of extraradical hyphae, where P and N transporter genes are differentially expressed. Plants colonized by AMF show enhanced growth and higher tolerance to biotic and abiotic stresses. Beyond plant growth and nutrition, AMF can modulate plant secondary metabolism and the production of health-promoting compounds: actually, a number of mechanistic studies showed a differential expression of genes encoding for the relevant enzymes, upregulated in mycorrhizal plants compared with controls. The production of antioxidant enzymes and phytochemicals has been investigated in mycorrhizal medicinal and aromatic plants, as well as in many fruits and vegetables, such as grapevine, strawberry, artichoke, lettuce, onion, pepper, potato, tomato. For example, higher levels of antioxidant compounds, caffeic and rosmarinic acid, essential oils and anthocyanins were found in mycorrhizal sweet basil. Large increases in total polyphenolic content and antioxidant activity were reported in artichoke flower heads, the edible part of the plant representing a good dietary source of nutraceuticals. Though, different AMF species and isolates showed differential performance, as one out of six AMF symbionts was the most efficient in the promotion of total phenols and chlorogenic acid content in artichoke, while a higher content of anthocyanins was produced in red leaf lettuce plants inoculated with Rhizoglomus irregulare, compared with those colonized by Funneliformis mosseae. Here, an overview is provided on the multiple roles played by plant root microbiomes - AMF and associated bacteria - in the production of nutraceutical compounds.

Keywords: Soil Microbiome, Plant Microbiome, Health promoting compounds, Mycorrhizal symbionts, Nutraceuticals

ID ABS WEB: 136944

2. Soil and humanity

2.09 133548 - Microbiome as a common thread from soil to human health: Interaction, Impact and Role of Soil-Plant-Human Microbiome as a new challenge of innovative agriculture and quality food

SOIL MICROBIOME CHARACTERIZATION OF VINEYARDS REPRESENTATIVE OF THE BARBERA D'ASTI WINE TERRITORY

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Agricultural practices can impact the complex interactions between soil, plant and microorganisms, modifying soil fertility and crop resilience to various stresses. In the case of grapes, soil microbiome can also affect its wine-making process and the final quality of the wine, as well as the definition of the terroir. In this study, the microbiome of eleven vineyards representative of the various Barbera d'Asti production areas in one of the most important wine-making territories of Piedmont (Italy) was studied using amplicon sequencing of 16S rDNA V4 gene region for bacterial and archaeal and ITS1 and ITS2 gene regions for fungal sequences. Biodiversity indices and variations in taxonomic composition among the vineyards were analysed, identifying the taxa that characterize the vineyards differently. Actinobacteriota and Ascomycota were the two most abundant phyla for bacteria and fungi, respectively. As evidenced by the beta diversity data, different vineyards showed different microbial community composition, while the alpha diversity measured with the Shannon index did not show significant variation between vineyards. Based on the different taxonomic composition of the fungal and bacterial soil communities, vineyards could be distinguished into four groups.
Interestingly, a vineyard (located in Castel Boglione) was specifically characterized for lacking common ASV for bacterial and fungal taxa, and another one (located in Mombaruzzo) contained 10 unique ASV, all belonging to Basidiomycota. Fungal taxa common to all vineyards were 39 ASV. A core microbiome was defined by 21 features related to bacteria and 8 features related to fungi. The analysis of the soil metagenome provides new insight into the complexity of the microbiome in this production area, favouring the definition of specific terroirs useful for the valorization of the Barbera d'Asti wine protected denomination of origin.

Keywords: grape,soil microbiome,terroir,Barbera

ID ABS WEB: 137234

2. Soil and humanity
2.09 133548 - Microbiome as a common thread from soil to human health: Interaction, Impact and Role of Soil-Plant-Human Microbiome as a new challenge of innovative agriculture and quality food

OPTIMISING THE NUTRACEUTICAL PROPERTIES OF SAFFRON CULTURES: APPLICATION OF A BACTERIAL CONSORTIUM TO ENHANCE ACCUMULATION OF BIOACTIVE COMPOUNDS AND SOIL BIODIVERSITY

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Saffron (Crocus sativus L.) is an autumn-flowering geophyte known for its stigmas. However, the stigmas, stamens, and petals contain several bioactive compounds that can be used for pharmacological and nutraceutical purposes. Plant-microbe interactions have been shown to influence plant growth and the accumulation of bioactive compounds. Therefore, the use of bacterial inoculants could be a sustainable tool to improve the production of bioactive molecules. The aim of this study was to evaluate the effect of a selected bacterial consortium inoculation on saffron plant growth and bioactive compound accumulation in stigmas and petals. Two-year field and greenhouse experiments were conducted during the 2022 and 2023 growing seasons. The saffron corms were soaked in the bacterial inoculum for one hour and dried overnight. The control group was treated with water using the same procedure. The growth of the plants was monitored in both greenhouse and field experiments. During the flowering stage, leaves were collected for chlorophyll estimation, and stamens and petals were analysed for carotenoids, phenolic content, and antioxidant activity. Moreover, stigmas were processed to analyse the main bioactive compounds of saffron, including picrocrocin, safranal, and crocin, following ISO protocols. Soil samples were analysed for enzymatic activity (1-dehydrogenase activity - DHA) and microbiota structure (16S rRNA gene metabarcoding by NGS). Results showed that bacterial inoculation had a positive impact on saffron plants, resulting in earlier and more abundant flowering, as well as higher accumulation of bioactive compounds compared to the control. Furthermore, the bacterial inoculation had a positive impact on soil fertility by increasing enzymatic activity and microbial diversity compared to the control. The study highlights the role of bacterial inoculants in managing saffron crops. The findings demonstrated that microbial inoculants could enhance the nutraceutical qualities and yields of saffron, as well as improve soil biodiversity.

Keywords: saffron,microbial inoculants,bioactive compounds,soil biodiversity,sustainable agriculture

ID ABS WEB: 137618

2. Soil and humanity
2.09 133548 - Microbiome as a common thread from soil to human health: Interaction, Impact and Role of Soil-Plant-Human Microbiome as a new challenge of innovative agriculture and quality food

THE USE OF FUNCTIONAL MICROBIOMES AS A TOOL IN THE ASSESSMENT OF SOIL CONDITION

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Microbial communities in agricultural soils are very diverse associations shaped by the applied management during cropping cycles. Their reaction to changes and perturbations are fast and complex, by modifying the use of resources through multiple levels of interaction. The current context of soil use relies on multiple approaches toward conservation of this resource and maintaining its fertility and functionality. The study of soil functional microbiomes implies both the analysis of their diversity and their reaction to soil management. A comparison between multiple soil sites is necessary to identify the effect of each technological link based on microbiome reaction. The establishment of a control site is necessary to create the basis of comparison. All the changes observed within a treated (or affected) functional community can be related to this level of the microbiome. This value enables the survey of any normal increases in functional microbiome, which is assessed as an intensification, and the expansion of a specific microbiome above the normal level. On the other hand, all the decreases observed can be treated as a normal narrowing due to treatments or even a severe contraction of a specific microbiome. Based on the full exploration of soil functional microbiomes can be detected the functional alteration of specific microbiomes – at guild or group level – produced by the application of a treatment. The reconstruction of a previous soil condition can be forecasted based on synergetic effect of both biotic and abiotic factors at a functional group or guild level, which makes the entire process more specific. The analysis of soil functional microbiomes can be applied both to detect the changes that can occur in a specific soil environment or to asses its current functionality.

Keywords: soil microbiome,microbial communities,ecosystem pressure

ID ABS WEB: 137883

2. Soil and humanity
2.09 133548 - Microbiome as a common thread from soil to human health: Interaction, Impact and Role of Soil-Plant-Human Microbiome as a new challenge of innovative agriculture and quality food

ROLE ON THE PRODUCTIVITY AND NUTRACEUTICAL PROPERTIES OF CORN BY NITROGEN-FIXING AND PHOSPHORUS-SOLUBILIZING COMPONENT OF THE SOIL MICROBIOME

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The soil microbiome, comprising diverse microorganisms such as bacteria, fungi, and protozoa, plays a pivotal role in soil health, plant nutrition, and enhancing the nutraceutical properties of crops. These microorganisms are essential for nutrient cycling, maintaining soil structure, and improving the nutritional and medicinal values of plants, which is increasingly important for sustainable agriculture and health-conscious consumerism.
In this context, nitrogen-fixing bacteria within the soil microbiome, like Azotobacter chrococcum, Azotobacter vinelandii, and Bacillus megaterium, are of particular interest for cereal crops such as maize. These crops cannot utilize atmospheric nitrogen directly, leading to a heavy reliance on chemical fertilizers. However, current environmental initiatives, including the European Green Deal and the Farm to Fork Strategy, advocate for a reduction in the use of chemical fertilizers, highlighting the need for sustainable alternatives.
Our study explores the impact of these nitrogen-fixing bacteria on maize yield. By converting atmospheric nitrogen into a form plants can use, these bacteria offer a potential solution to reduce reliance on chemical fertilizers. The field experiments involved pre-planting
inoculation of maize seeds with the bacteria and treatments during the growth phase. The experimental setup included a control (non-treated) and three variants, each treated with one of the bacterial species, replicated three times.
Results showed a significant increase in maize productivity, particularly in plots treated with Azotobacter vinelandii. This finding suggests that nitrogen-fixing bacteria can serve as a sustainable alternative to chemical fertilizers, supporting increased food production and
conservative agricultural practices. Future research will further investigate how these bacteria improve the quality of cereal crops, enhancing their nutritional value. This study not only underscores the potential of nitrogen-fixing bacteria in sustainable agriculture but also emphasizes the broader role of the soil microbiome in boosting the nutraceutical qualities of
crops, contributing to a holistic approach to agricultural sustainability and public health.

Keywords: Microbiome,Nitrogen fixation,Nutraceutic properties,Azotobacter,Cereals

ID ABS WEB: 138038

2. Soil and humanity
2.09 133548 - Microbiome as a common thread from soil to human health: Interaction, Impact and Role of Soil-Plant-Human Microbiome as a new challenge of innovative agriculture and quality food

BIOCHAR AS A PREBIOTIC FOR SOIL MICROBIOTA? AN EXPERIMENT IN SALAD FIELDS.

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Microbiota is crucial for fertility of the soil and, therefore, agriculture. Among several substances and practices that can enhance soil microbiota, biochar is emerging as a very promising solution. Biochar not only offers ecological services (i.e. carbon sequestration) but has been reported as providing benefits to cultivation such as better nutrition and pathogen suppression. Despite this, the mechanism of action of biochar is unclear and several studies report different, sometimes even contradictory, results of biochar application, suggesting that both the nature of the biochar and the investigated culture are important variable.

In this study we monitored the microbiota composition from 2019 to 2020 in fields used for chicory cultivation in Northern Italy, comparing three different conditions: i) plots with organic farming management, ii) plots with integrated farming management, iii) plots with integrated farming management and treated with biochar. Each condition was evaluated at three time points, always at the end of a cultural cycle of chicory.

After DNA extraction from the soil, a portion of the 16S gene was amplified and sequenced on an Illumina platform. This metabarcoding data allowed to determine the following dynamics in the microbiota: the strongest driving force in microbiota structure was sampling time but the different treatments, especially organic versus integrated farming, were distinguishable; the application of biochar gave a first response in which the soil microbiota structure became intermediate between organic and integrated management but, in the following time point, the samples either became indistinguishable from the organic management samples, or reverted to the initial integrated management situation; the overall diversity and quantity of bacteria in the soil was not improved by biochar treatment, but the quality of the microbiota became more similar to that of organic management, without losing any productivity compared to the integrated management.

These results suggest that the use of biochar in salad cultivation may help promote a healthier soil microbiota and thus maintain soil fertility.

Keywords: Biochar,Soil microbiome,Agricultural soil management

ID ABS WEB: 138165

2. Soil and humanity
2.09 133548 - Microbiome as a common thread from soil to human health: Interaction, Impact and Role of Soil-Plant-Human Microbiome as a new challenge of innovative agriculture and quality food

SOIL MICROBIOME AS A RESOURCE FOR HUMAN HEALTH

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Soils host a large and diverse community of microbes. The soil microbiome is responsible for a wide array of soil functions, including biomass decomposition, delivery of nutrients to plants, water retention, and the suppression of insect predation and disease on crops, among other soil services. Studies have shown that diet is among the major factors influencing the composition of the human microbiome, notably the gut microbiome, which has been associated with important regulatory roles in the immune system and the metabolism of food and drugs. An active area of research is understanding how the soil microbiome directly affects the human gut microbiome. It is well known that the soil microbiome is a reservoir of antibiotic-resistant genes. Additionally, the microbiome is a rich source of bioactive compounds for treating human diseases. Two-thirds of the antibiotics currently used in human medicine are derived from soil microbes, and numerous pharmaceuticals originate from the soil. Given that only an estimated 1% of the soil microbiota have been cultured outside of their natural communities, the genetic diversity of the soil microbiome is believed to be an untapped resource of molecular compounds for beneficial uses in human health and other applications. Because of its direct and indirect relationships to human health, there is a significant need to manage soil resources to preserve future benefits. In agriculture studies, identifying management actions to reduce soil degradation is considered the highest global threat to the loss of the soil as a beneficial human resource.

Keywords: Antibiotics,Pharmaceuticals,Nutrients

ID ABS WEB: 138231

2. Soil and humanity
2.09 133548 - Microbiome as a common thread from soil to human health: Interaction, Impact and Role of Soil-Plant-Human Microbiome as a new challenge of innovative agriculture and quality food

SOIL ORIGINS AND ENVIRONMENTAL CORRELATES OF GUT MICROBIOTA FOR CHILDREN IN RURAL KENYAN HOUSEHOLDS

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The human gut microbiome (GM) is shaped by both genetic and environmental factors, and influences many dimensions of health and disease from infancy through adulthood. Recent research has demonstrated several pathways for environmental exposures to affect health via their influence on GM, including exposures to microbes in soils. Soil microbiota have already been correlated with characteristics of human microbiota; however, little is known about direct linkages between the soil microbiota (SM), GM, and health for children in East Africa, where economic, social, and climate factors are driving rapid changes in lifestyles, livelihoods, and landscapes with implications for SM exposure.

In this study we used SM and GM samples collected from 140 children from rural households in western Kenya to assess contributions of the household SM to the child GM. Microbial source-tracking analyses show that, in more than a quarter of households, the proportion of the GM that is attributed to the household's SM exceeds 0.10, and in some households reaches 0.37. To explore environmental correlates of these SM-GM relationships, we draw on household questionnaire data to identify potential contributions of drinking water sources, hygiene and sanitation, and household economics to these observations. We find that households using surface drinking water sources, including Lake Victoria and surrounding waterways, have significantly higher proportions of the GM attributed to the local SM when compared with other sources (Kruskal-Wallis $p < 0.01$). Using data from iSDAsoil, ISRIC SoilGrids, and CHIRPs, we further explore contributions of soil classes, soil properties, and local climate to the observed SM-GM relationships. Using several machine learning approaches, we find that 1-month prior precipitation and temperature, soil pH, and soil bulk density are among the strongest predictors of the proportion of the GM attributed to the SM. These results show that the SM contributes to the GM for children in rural households, and that these contributions may be moderated by characteristics of the landscape including soils and seasonal climate.

Keywords: Soil microbiota,Gut microbiota,Climate and seasonality,Microbial source tracking

ID ABS WEB: 138251

2. Soil and humanity
2.09 133548 - Microbiome as a common thread from soil to human health: Interaction, Impact and Role of Soil-Plant-Human Microbiome as a new challenge of innovative agriculture and quality food

MEDEUBIOTICS: BUILDING RESILIENCE AGAINST ENVIRONMENTAL POLLUTANTS THROUGH AGROECOLOGY, ORGANIC MEDITERRANEAN DIET AND EUBIOTICS TO PROTECT THE ECOSYSTEM, SOIL AND HUMAN HEALTH.

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Chemical substances harm ecosystems and cause health issues. Soil erosion, climate change, and monoculture farming contribute to the loss of arable land and reduce crop nutritional value.Agroecological systems prioritizing organic matter input and crop diversification improve soil microbiota and prevent erosion and nutrient leaching. By endorsing environmentally friendly cultivation techniques like agroecology and eubiotic agriculture, which focus on soil microbiota health, higher bioactive compound content can be maintained in food compared to conventional cultivation. This supports the production of food enriched with healing and detoxifying compounds. The Mediterranean organic diet and the eubiotic diet share similarities and emphasize natural and organic foods for health benefits. The EcoFoodFertility research project experiments with more advanced dietary models to build resilience against environmental pollutants, particularly focusing on their impact on reproductive health. From a One-Health and preventive medicine perspective, as intended by Lago Galdston in his definition of Eubiotic Medicine, which goes beyond disease prevention to directly act on the development and overall well-being of individuals in close connection with the environment, the Mediterranean diet with organic foods, combined with eubiotics, seeks to outline a new interpretative horizon in terms of human resilience to environmental pollution. From a biological perspective, pollutants can alter cellular structures through oxidative stress. Imbalances of radical oxygen species (ROS) and antioxidant defenses increase the susceptibility to oxidative stress diseases, making the consumption of a Mediterranean diet with antioxidants crucial. The Mediterranean diet's components like fruits, vegetables, and olive oil possess antioxidants that neutralize ROS and protect cells. Phytochemical compounds in plant foods can prevent or counteract the harmful effects of environmental pollutants through various mechanisms. 'Organic' foods, cultivated based on agroecological criteria, have a higher bioactive compound content than conventional foods. MedEubiotics combines the organic Mediterranean diet with principles from eubiotic medicine to promote preventive medicine and overall well-being in individuals in connection with the environment.

Keywords: MEDITERRANEAN DIET, MEDEUBIOTICS, EUBIOTIC MEDICINE, ENVIRONMENTAL HEALTH, AGROECOLOGY

ID ABS WEB: 136391

2. Soil and humanity
2.10 133559 - Soil literacy, communication and citizen engagement

THE 'SOIL OF THE YEAR' PROGRAMME IN POLAND

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Although people, in particular farmers and foresters, agree that 'soils are important', knowledge of the diversity and functions of soils, as well as an understanding of the need to protect soils, is insufficient in public space. Therefore, the 'Soil of the Year' has been initiated in Poland during the 80th anniversary of the Polish Soil Science Society (PSSS) in 2018, based on the experiences of the German Soil Science Society. The 'Soil of the Year' has a broad formula and emphasizes both scientific aspects and educational and popularizing goals. Rendzina was elected the first 'Soil of the Year 2018', followed by Chernozems, Technogenic soils, Rusty soils (Brunic Arenosols), Alluvial soils, Clay-illuvial soils (Luvisols and related) and Organic soils for 2024. Soil of the year is elected by members of the Commission of the Soil Genesis, Classification and Cartography of the PSSS. Among the scientific activities dedicated to the soil of the year is the symposium (oral and poster presentations) focused on the state-of-the-art and unsolved questions (origin, distribution, classification, degradation, management, etc.) followed by field session. The Special Issue of the Soil Science Annual (IF 1.5) presents a collection of articles (reviews and original contributions). Among educational activities, the following should be highlighted: posters and calendar, in printed and electronic versions, special lectures and presentations for various groups of participants (universities, research institutes, local authorities and offices, public and private companies, secondary and primary schools, etc.), broadcasts on television and radio, advertisements on social media, special events at the soil museum, during 'science festivals' and 'knowledge competitions', etc. The PSSS applies to the permanent patronage and financial support of the Ministry of Agriculture or the Ministry of Environment.

Keywords: soil awareness,education,soil services,knowledge popularisation

ID ABS WEB: 136423

2. Soil and humanity
2.10 133559 - Soil literacy, communication and citizen engagement

RAISING PUBLIC AWARENESS OF THE IMPORTANCE OF UNDERSTANDING AND PRESERVING SOIL : FEEDBACK FROM 10 YEARS OF ORGANIZING WORLD SOIL DAY IN FRANCE

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In 2002, the International Union of Soil Science (IUSS) recommended an international day as a global platform for raising awareness on soil issues. In December 2013, the United Nations General Assembly designated December 5, 2014 as the first official World Soil Day.

Every year since 2014, the French Soil Science Society (AFES www.afes.fr) has organized World Soil Day (WSD) on a French scale. The objectives of this event are to :

- Raise awareness of the state of existing scientific knowledge on the theme chosen each year by the Global Soil Partnership (Soil Information Systems in 2024).
- Promote local solutions that can be implemented to preserve soil quality. Since 2017, we organize the WSD in different region every year..

Initially organized as a one-day event, the WSD is growing in scope each year, with 8 days of events in 2023, including more than 20 highlights to reach a wide range of audiences (young people, technicians, scientists, agricultural professionals, the general public, political players, etc.). Nearly 2,000 people, including 500 in person, took part in one of the highlights of the 2023 edition of the JMS, and the special youth event this year reached over 800 young people.

This presentation will explain how the WSD event in France has evolved since its establishment in 2014 to better meet the expectations of various stakeholders in the territories in terms of access to scientifically reliable information on soils. We will also detail the method used to work with French soil networks and host territory players to organize WSD events each year, a key element in the growing success of this event in France. We will also focus on the different event formats organized each year to reach a variety of audiences.

In 2024, AFES also initiated the setting up of a Europe-wide network to exchange experience on the different formats for organizing events around the World Soil Day.

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Keywords: Mobiliser,Société civile,Sols,Terrain,Engagement

ID ABS WEB: 136621

2. Soil and humanity
2.10 133559 - Soil literacy, communication and citizen engagement

ACTION SOIL OF THE YEAR IN GERMANY – LESSONS LEARNED FROM 20 YEARS OF EXPERIENCE

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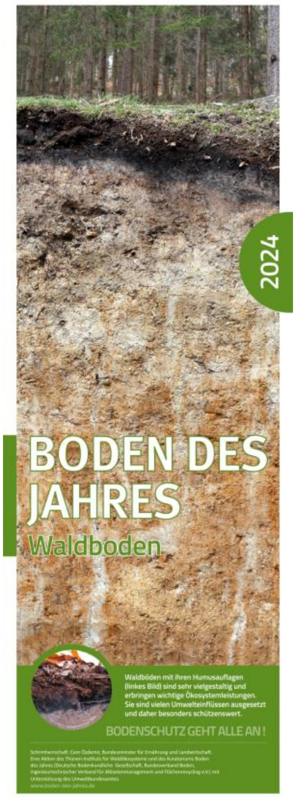
Since 2005, the German Soil Science Society has co-organized the ‘Soil of the Year’ campaign under the joint umbrella of several governmental an non governmental institutions. Under the annually changing patronage of national and federal state ministries, the action has gained great public visibility over the years. Activities are primarily intended to raise public awareness of soils and their functions in landscapes, as well as their crucial role in providing ecosystem services. Thereby, the overall aim of the action is to capture the interest of as many people as possible in order to foster the responsible use and, in this way the protection, of this vital resource. In retrospect, after a period of 20 years, the action has experienced a development from an initially close taxonomic focus to a more ecological valuation of soils and a look at different land use systems and their specific interactions with soils, while the “Soil of the Year” not always necessarily corresponds to one specific soil type anymore. Also, the practice of public relation and communication changed over time. Definitely, the action “Soil of the Year” has become the most successful initiative among various efforts of increasing public soil awareness in Germany.



Keywords: Soil of the Year Germany,Players,Messages and Target Groups,Principles of Operation,20 Years Soil of the Year

ID ABS WEB: 137837

2. Soil and humanity
2.10 133559 - Soil literacy, communication and citizen engagement

ECHO PROJECT - ENGAGING CITIZENS IN SOIL SCIENCE: THE ROAD TO HEALTHIER SOILS

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ECHO is a Research and Innovation Action co-funded by the European Union under the Horizon Europe programme, and UK Research and Innovation lasting 4 years – from June 2023 to May 2027. The project aims to engage citizens in protecting and restoring soils by building their skills and enhancing their knowledge on soils. Citizens will actively contribute to the project's data collection, promote soil stewardship, and foster behavioural change across the EU. With 16 partners from Europe and Scotland, under the coordination of the Free University of Bolzano-Bozen, ECHO will develop 28 tailor-made citizen science initiatives across EU Member States and Scotland to collect soil health data from up to 16,500 sites across Europe and Scotland in different climate and biogeographic regions. These unique data will be gathered in a long-term open access repository, the ECHOREPO, with a direct link to the EU Soil Observatory (EUSO) that will enable the citizen science data collected during ECHO to be available for use by scientists, general public, policy makers, farmers, landowners and other end-users, providing added value to existing data and other relevant soil monitoring initiatives. ECHOREPO will provide valuable information about the state of soil health, helping citizens make informed decisions about land use and conservation.
Ultimately, ECHO aims to engage citizens by enhancing their knowledge, stimulating interest in soil health-related issues, and motivating them to protect and restore soils. It seeks to empower citizens by encouraging active participation in data collection and soil science to generate knowledge on soil health for the benefit of all. Additionally, ECHO aims to enable citizens to play an active role and participate directly in decision-making on soil issues based on acquired knowledge.
The project strives to provide local-scale data on soil health to expand and complement established soil databases, supporting critical landscape decisions and policy development. ECHO also endeavours to contribute to the enlargement and enrichment of the EUSO with citizen science data.

Keywords: Citizen Science,Soil monitoring,Soil literacy,Citizens engagement,Soil biodiversity

ID ABS WEB: 137892

2. Soil and humanity
2.10 133559 - Soil literacy, communication and citizen engagement

BRIDGING NARRATIVES ON RESEARCH AND SOIL HEALTH: A TRANSDISCIPLINARY APPROACH CENTERED ON COMMUNICATION AND CITIZEN ENGAGEMENT

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This contribution addresses the intricate dimensions of communication and citizens' engagement as exemplified by the BRIDGES project— an initiative aimed at: Building reflexivity and Response-ability Involving Different narratives of knowledGE and Science. The project explored how transdisciplinarity and extended-peer communities of knowledge production represent a groundbreaking effort in communicating soil health as a complex socio-ecological issue. Through the integration of diverse perspectives from various disciplines, and a regular, inclusive and non-formal internal and external communication activity BRIDGES highlighted the interplay among ecological, social, and cultural factors shaping soil representation. BRIDGES designed and facilitated communication activities engaging researchers from different backgrounds, citizens and local stakeholders through artistic workshops, webinars and a citizen science campaign. Communication was the key to the project to make transdisciplinarity alive and inclusive. It was not framed to disseminate activities, but to build relationships, empower younger researchers and engage people, knowledge and epistemic views at every stage of the process.
With a 40-day citizen science experiment to monitor soils in the urban area of Milan, BRIDGES engaged an extended community of peers to co-produce relevant knowledge. Engaged citizens contributed with diverse perspectives to the intricate fabric of soil health thanks to personal immersive monitoring, meetings, local initiatives and online webinars for a mutual understanding of research perspectives and local concerns. To create new narratives on soil-health the project proposed a collaboration between scientists and artists to stimulate collective imagination. Artistic practices served as a conduit, interweaving scientific concepts with experiences capable of transcending rational thought, thus increasing public awareness of the deeper connection between society and soil health. The data collection on peri-urban soils in Milan emphasized the active role of citizens, involved not as mere data collectors but as knowledge producers. Citizen engagement was framed as an empowering force, encouraging individuals to actively contribute valuable insights to soil health research.

Keywords: Science communication,Transdisciplinary research,Arts and Science,Public engagement

ID ABS WEB: 138236

2. Soil and humanity
2.10 133559 - Soil literacy, communication and citizen engagement

FOR EUROPE: STIMULATING SOIL LITERACY, SUSTAINABLE SOIL RELATIONS AND USE WITH THE HELP OF CULTURAL SOIL INTELLIGENCE AND WAYS OF ARTS.

N. PATZEL

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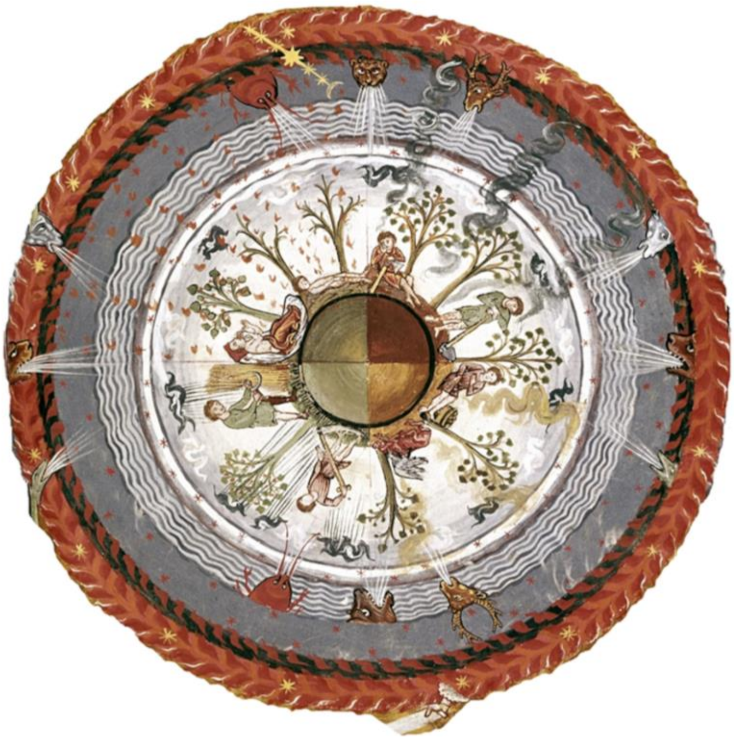
Keep our soils alive and bearing fruits! The outer soils of Europe in responsible accordance with its inner soils? Europe is a multifarious cultural area and has been skilled in powerful war and exploitative use of global natural wealth. At the same time, Europe's long and diverse history also contains many cultural fundamentals and some traditions for sustainable coexistence in nature with its/her/his/our soils.

Let cultural orientational knowledge and new experiences and approaches to direct and indirect soil communication artfully interact. This also with the help of civil society and EU-funded projects. Let our societal and mental landscapes of human-soil relations develop across scales to reach a European cultural soil sustainability.

This presentation is based on work of the IUSS Division 4 Commission 'Cultural Patterns of Soil Understanding' since 2016; and it includes an outlook on the new EU project SOILSCAPE (Horizon 'A Soil Deal For Europe').



Keywords: soil literacy,soil communication,cultural appropriateness,ambiguity of myths,Upcoming EU project

ID ABS WEB: 138285

2. Soil and humanity
2.10 133559 - Soil literacy, communication and citizen engagement

FIRST TWO YEARS OF THE WORMEX II EXPERIMENT, A QUANTITATIVE CBPR TO RAISE AWARENESS ABOUT THE IMPORTANCE OF HEALTHY SOILS AND OF THEIR HYDROLOGICAL FUNCTIONS

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Soil health is hydrologically reflected in the water-storing capability and in the reduction of runoff peaks in favour of the aquifers recharge. It is consequence of many factors, but an important role is played by macroporosity, as a source of preferential flow.
Aiming at contributing to disseminate the importance of healthy soils for the society and at highlighting their hydrological functions, we designed the WormEx II experiment, an educational experiment and a citizen-based participatory research (CBPR) performed in high-school classes, in view of attracting students' attention on the hydrological role played by macropores, through the observation of some aspects of earthworm digging activity.
The core of the experiment consists in replicating Charles and Horace Darwin's famous observations on the sinking of stones. We reproduced a couple of wormstones (inspired by that positioned by Horace Darwin at Down House), and we positioned them in the garden of the Liceo Copernico high-school in Brescia in March 2022. Since then many sinking measurements were performed with the participation of high-school and university students, teachers and faculty staff.
The analysis of the experiment is multi-faceted and offers many interpretative keys. Firstly students meet Charles and Horace Darwin's original works on the matter. They go in depth with the text analysis, recognizing both Charles' rigorous epistemological approach based on ample data collection and Horace's attitude at designing an experiment to obtain good quality data. Contextually they deal with the scientific importance of patient practice and long lasting data collection. According to Charles Darwin's definition of «minima», students appreciate how meaningful changes in Nature are mostly given by the reiterate superimposition of minimal ones. They observe aspects of earthworm ecology, regarding their digging activity into relationship with the antecedent meteorological conditions, and recognize the soil attitute at behaving as a low-pass filter of the meteorological variability. Finally, they approach the quantitative treatment of data thus attempting to overcome the qualitative approach of most CBPR activities.

Keywords: Soil Hydrology,Participatory research,Darwin,Earthworms,Citizen engagement

ID ABS WEB: 136092

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

IMPACT OF VEGETATION RESTORATION ON CHANGES OF RUNOFF/SEDIMENT AND UNDERLYING MECHANISM ON LOESS PLATEAU

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To improve the ecological environment, China issued a policy of GFG in 1999. Afforestation and revegetation play a prominent role in improving soil properties and controlling soil erosion. A typical catchment was selected to analyze the trends in climate, LUCC, and runoff/sediment from 1960 to 2020, and investigated the role of vegetation restoration in the changes of runoff/sediment in these land-surface processes and the underlying mechanism.

1) Annual precipitation in the area showed a slight decreasing trend over the past 60 years. Landsat-image interpretation showed that, compared to 1980, the area of farmland in 2020 decreased by 46.4%, and that of vegetated area increased by 25.6%. While the average annual streamflow decreased significantly from 35mm in the 1960s to 19mm in the 2010s. The average annual sediment yield dropped from 0.99 billion t to 0.10 billion t over the period.

2) Planting trees and grasses since 1999, significantly affected soil properties. It increased the organic matter content, decreased the soil bulk density, increased the content of >0.25mm water-stable aggregates, enhanced the stability of aggregates, increased the soil porosity, and improved the soil infiltration performance. The structural equation model indicated that soil bulk density, total porosity, and macroaggregate content are the key soil parameters affecting the saturated soil hydraulic conductivity.

4) Budyko's elasticity-coefficient method and fractal theory approach tested that, large-scale ecological restoration since 1999, contributed 66.3% and 81.7% to the change of runoff and sediment yield in the area, respectively. SWAT and the Geodetector tool were further used and found that the explanatory power for the spatial distribution of runoff, is significantly greater for soil properties such as saturated hydraulic conductivity, organic matter, and total porosity, than for surface human activities like increased vegetation cover and climate factors like precipitation changes.

These findings reveal and corroborate that vegetation restoration affects runoff-sediment changes, in essence by improving soil quality and enhancing water storage and retention capacity.

Keywords: Soil property,Vegetation restoration,Change of runoff and sediment,Loess Plateau

ID ABS WEB: 136151

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

REVIEW AND ENLIGHTENMENTS OF SOIL AND WATER CONSERVATION ON THE LOESS PLATEAU OF CHINA IN LAST 70 YEARS

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The Loess Plateau is an important birthplace of the Chinese civilization. However, this region has become the area with the most serious soil erosion and ecological fragility because of the quick and unreasonable land-use and the population increase. Since the 1950s, a series of major soil and water conservation projects have been implemented, and most of the barren mountains and hills have been covered by vegetation. The annual average amount of sediment delivery of the Yellow River decreased significantly.
According to the main objectives and measures, the past 70 years could be identified as 3 stages. (1) The first stage (1949-1979) was characterized by fortification due to harm. The main goal is to control slope soil erosion, reduce sedimentation yield to the Yellow River, and increase grain production and river safety. After 30 years of efforts, large-scale basic farmland construction and some backbone projects were implemented, which greatly promoted the change of local agricultural basic conditions, as results in improving local people's living level and reducing Yellow River sediment. (2) The second stage (1980-2000) is characterized by small watershed comprehensive management. In this stage, a small watershed was taken as a unit to rationally allocate land-use and measures of soil and water conservation, aimed at improving the rural economy integrated agriculture, forestry, and animal husbandry. (3) The third stage (after 2000) is characterized by ecological restoration. In this stage, GGP (Green for Grain Project) is implemented in which the Chinese government supported farmers to transfer the cropland on the slopes into forests and grassland.
After soil and water conservation of 70 a, remarkable achievements on the Loess Plateau have been achieved, but it is very important to realize clearly that the Loess Plateau still faces severe challenges caused by natural and human activities. Many original factors causing soil and water loss still exist, as well as many new factors arise. Therefore, the tasks of soil erosion control are still arduous.

Keywords: Loess Plateau,Soil and Water Conservation,Ecological conservation,Yellow River Basin

ID ABS WEB: 136306

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

LAND DEGRADATION DUE TO WATER EROSION IN THE CZECH REPUBLIC AND POSSIBILITIES OF CORRECTIVE MEASURES USING STRIP CROPPING AND THE LANDSCAPE CONNECTIVITY CONCEPT

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Water erosion is the most significant degradation factor affecting soil quality in the Czech Republic (CZ), where more than half of agricultural land is at risk. Accelerated erosion is largely influenced by anthropogenic factors, with a substantial increase in the average size of arable land blocks to around 20 hectares (largest in the EU) during the post-war period in CZ due to collectivization, and the removal of almost two-thirds of scattered landscape greenery. As a result of erosion processes, significant changes in the physical, chemical, and biological properties of the studied soils are now documented. These changes affect both production and non-production functions, having an impact not only on the soil environment, but extending to biodiversity and water management. Changes in soil properties, on-site and off-site effects in a productive agricultural area will be presented in this contribution. Addressing this situation requires carefully designed landscape restoration projects and sustainable agricultural systems, to mitigate soil damage, and other environmental components. Based on the modeling of erosion processes and landscape connectivity, we are working on measures that can reduce overall erosion risk and contribute to increased biodiversity. One option is strip cropping. Over a model area of 750 hectares, we will present the effects relating to a reduction in erosion processes for the most common crops, including the application of soil conservation technologies. According to our analyses, this approach can reduce soil loss due to erosion in the studied area approx. three times. This farming system also positively affects runoff conditions and water retention in the area. Non-productive areas are also part of these measures, influencing the enhancement of landscape biodiversity and the protection of water sources. The proposal of such elements, respecting geomorphological conditions and using the connectivity concept, will also be presented in the model area. Addressing these issues is a focus of projects coordinated by the Czech Technological Agency, projects SS02030018 and SS06010290, aligning with EU and CZ strategies.

Keywords: land degradation,erosion,water retention,runoff,strip cropping

ID ABS WEB: 136538

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

THE FURUTURE OF SOIL WITHIN THE CITIES: CHALLENGES AND OPPORTUNITIES FOR THEIR CONSERVATION

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World Association of Soil and Water Conservation-WASWAC, Valencia, SPAIN

In a few decades 80% of humanity will live in cities. Cities will become one of the most important terrestrial ecosystems This trend is a changing paradigm with important implications that offer the opportunity to design friendlier, more resilient, healthy and sustainable cities. In this context, adequate management and conservation of the urban soils are key elements in the functioning of a re-naturalized city. This will require to develop urban-specific soil ecological knowledge and appropriate management-conservation for soil health and productivity. Urban soils provide a number of important ecosystem services including reduced and delayed storm water and runoff volumes, enhanced groundwater recharge, increased carbon sequestration, urban heat island mitigation, reduced energy demand, improved air quality, additional wildlife habitat and recreational space, improved human health and aesthetical values, opportunity for recreation, exercise, therapy, and education, increased land values and are basic for urban agriculture, among others.

Urban soils can be affected by physical degradation, such as compaction and sealing, which reduces their water-holding capacity. This can lead to increased runoff, flooding, and urban heat island effects, as well as reduced soil fertility and biological activity. Furthermore, urban soils can lose their natural diversity and functionality, as they are often disturbed, contaminated, mixed, or replaced by artificial materials.

Urban soils are unique entities that demand expanding the scope of soil-water conservation, restoration and sustainable management to enhance their agro-ecosystem services as well as improve their resilience and adaptation to climate change. Among these measures, nature-based solutions (NBS) should be considered, with strong priority to the biological component of soil, ecological restoration, improvement of biodiversity, mechanical interventions, structures, prevention of contamination and improving of the physical, chemical and biological properties of the soil.

The incorporation of new and more ecological perspectives in the management and conservation of urban soils will have a crucial and positive impact on the design, management and viability of the green, friendly and sustainable cities of the future.

Keywords: Soil conservation,Urban Soils,Future soiil conservation appr,Greening cities,Nature Based Solutions

ID ABS WEB: 137106

2. Soil and humanity

2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

ESTIMATING BIOLOGICAL CONSERVATION MEASURES FACTOR B IN THE CSLE USING GOOGLE EARTH ENGINE

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Soil conservation planning often requires estimates of soil erosion at a catchment or regional scale. So far the most widely applied and accepted empirical models are Universal Soil Loss Equation (USLE) and its revised version (RUSLE), Based on USLE/RUSLE, the Chinese Soil Loss Equation (CSLE) was developed with the consideration of soil and water conservation measures, and the cover and management and support conservation factors (CP) in the USLE/RUSLE are divided into three factors, i.e. biological (B) engineering (E) and tillage (T) factors, which make the operation easier for practical applications. The CSLE model describes the main factors based on natural and anthropogenic environmental components. Among the soil erosion parameters, the vegetation cover and biological conservation measures B-factor has been one of the most difficult to estimate over broad geographic areas. In this study, we developed an optimal computational procedure for estimating and mapping the B-factor in the Google Earth Engine (GEE) cloud computing environment using multiple data sources. We evaluated the availability of daily precipitation data (CHIRPS, ERA5, and PERSIANN-CDR data) against the data at national meteorological stations, and calculated the ration of rainfall erosivity over a 24 half-month periods. MOD09GA, Landsat8, and Landsat7 images were used to patch the missing data in the Sentinel-2 imagery, to calculate the NDVI over a 24 half-month period. Based on NDVI data, the pixel-based binary model was applied to compute the vegetation cover, and the average vegetation cover for the 24 half-months period was then derived. Then the B-factor were calculated and mapped based on rainfall erosivity, vegetation coverage, and land use types. We found that the restored high-resolution Sentinel-2 data fit nicely with the 10-m resolution land use data, enhancing the B factor calculation accuracy from the region to the spot level. The B factor computation procedure developed in this study is applicable to various river basin and regional scales for soil erosion monitoring and mapping.

Keywords: B-factor,CSLE,Google Earth Engine,Soil erosion,Data patching

ID ABS WEB: 137757

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

REVIEW AND ASSESSMENT OF CHINESE SOIL AND WATER CONSERVATION POLICY

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The new China was funded in 1949. Over the past 75 years, China has continuously adjusted and improved its SWC policy, and formed a policy system containing erosion prevention, erosion control, and technology assistance.
During the 1950s to 1970s, China established SWC administration at the central level, even the SWC Commission of the State Council. In 1957, the State Council released the Provisional Outline of Soil and Water Conservation of the PRC. It's the first legal document of SWC in China. In 1963, The State Council issued the Decision on Soil and Water Conservation in the Middle Reaches of the Yellow River, pointed the Loess Plateau to be the focus area of the state's SWC work.
During the 1980s and 1990s, National SWC Projects have been set up, funded by the central government, to control soil erosion by the way of small watersheds comprehensive control. Three-North Shelter Forest Program came into operation, in the wind-erosion area. In 1991, the Law of Soil and Water Conservation was enacted.
Since 2000, the central government increased investment in the National Soil and Water Conservation Projects and the Three-North Shelter Forest Program. The project of returning farmland to forest or grassland has been implemented.
Since the new century, the area of soil erosion and the amount of sediment discharge in large rivers in China have decreased obviously. The water erosion area increased from 1.53 x 10^6 km2 in the early of 1950s to 1.79 x 10^6 km2 in the late of 1980s, then decreased to 1.09 x 10^6 km2 in 2022. The wind erosion area increased from 1.88 x 10^6 km2 in the late of 1980s to 1.96 x 10^6 km2 in the early 2000s, then decreased to 1.56 x 10^6 km2 in 2022. The change of soil erosion area is not only affected by soil and water conservation policies, but also by population, land use structure, economic development level and other factors.

Keywords: Soil and Water Conservation, China, Policy, Review, Assessment

ID ABS WEB: 137776

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

SOIL AND WATER CONSERVATION VS SOCIETY AND WORLD CONSERVATION: THE EARTH BENEATH OUR FEET BEARS OUR FUTURE

F. WANG [1], R. LI [1, 2], W. GE [1, 2], J. HAN [1, 2], S. SHI [1, 2], H. CHEN [1, 2]

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Soil-based system is the fundament of human development. The nutrient depletion and soil loss are hundreds and thousands of times faster than the formative process of soil and its ecosystem. There were many ancient civilizations, such a Maya, Indus and Easter Island, collapse because or partly because of the degradation of soil-based system.
The soil erosion and its various impacts on natural resources, environment and human health has been noticed and approved by the development of modern science and technology mainly in last century. The soil and water conservation evolved greatly from prevention and control of water and wind soil erosion for growth, to disaster mitigation for agriculture and living conditions, and to nature-based solution for better ecosystem services and wellbeing of human, and the adaptation to climate change. We must accept the truth that the soil is utmost element on the earth because of the soil has already been playing an irreplaceable role in our plenary. It is reasonable to treat soil and water conservation as society and world conservation from now on.
It is worth to gain some knowledge on the important of soil and water conservation in a glace of 100 years of soil sciences, but it is still far not enough to solve many challenges of soil-based system with active and positive soil and water conservation mainly because of the awareness and wisdom of people and communities. It is time to analysis the conditions relating to soil erosion and UN SDGs carefully, and to find the promising technologies and approaches with local suitability for demonstration, extension and updating in various conditions and objectives based on the past lessons of soil and water conservation in last century from successful cases worldwide.

Keywords: Soil and water conservation,Soil-based system,Sustainable development,Ecological civilization,Climate change adaptation

ID ABS WEB: 136033

2. Soil and humanity
2.12 133584 - Soils in Archaeology

CHARCOAL BURNING – A NEGLECTED SOIL-FORMING FACTOR IN CULTURAL LANDSCAPES

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About 20 years ago, the systematic archaeological study of remains from pre-industrial charcoal burning, known as Relict Charcoal Hearths (RCHs), commenced in open-cast lignite mines in South Brandenburg, Germany. In the Jänschwalde open-cast mine alone, more than 1,500 RCHs have been documented through archaeological excavations, with hundreds of kilograms of charcoal sampled, offering a unique foundation for future research. Expanding geopedological research to other regions in Germany and the Northeastern USA has significantly augmented our understanding of the formation, properties, distribution, and function of RCH soils. Soil profiles on RCHs display distinct morphology, characterized by profound charcoal-rich technogenic substrate layers. These layers demonstrate heightened carbon content and distinctive physical and chemical properties, including relatively low bulk density, high porosity, increased plant-available water content, reduced thermal conductivity, and variations in cation exchange capacity and nutrient status. Utilizing LiDAR-based high-resolution Digital Elevation Models (DEMs) allows for the mapping of RCH sites due to their unique relief signature. This landform fingerprint, coupled with findings from RCH soil profiles and catenae, contributed to deriving a morpho-genetic catalog for RCH classification applicable in various contexts. Employing machine learning-based remote sensing methodologies shows promise in comprehensively assessing the extent of charcoal burning legacies on a landscape or catchment scale, including aspects such as soil carbon sequestration and soil moisture dynamics. Our presentation will highlight the primary outcomes of our extensive study on RCH soils and unveil recent research findings. While RCH research has made considerable progress in the last five years, the understanding of ecological legacies remains limited. Hence, there is a need for further interdisciplinary and integrative ecosystem studies, requiring expertise in both archaeology and pedology as fundamental prerequisites.

Keywords: Legacy effect,Past land-use,Geoarchaeology,Environmental history,Relict charcoal hearth

ID ABS WEB: 136342

2. Soil and humanity
2.12 133584 - Soils in Archaeology

REVISITING PEDOLOGICAL CONCEPTS OF 'TIME ZERO' AND 'MATURITY' IN SOILS OF ARCHAEOLOGICAL STONE-WALL BENCH TERRACES

D. ITKIN

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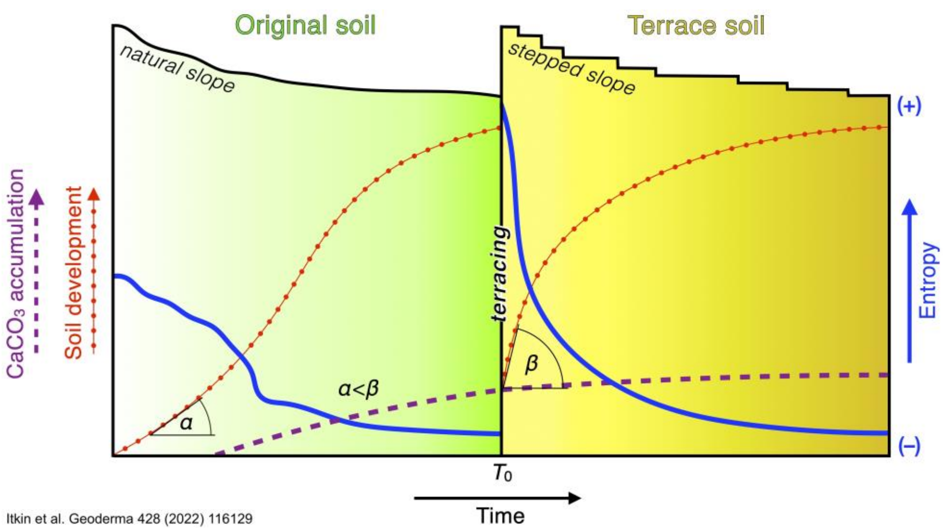
Archaeological stone-wall bench terraces cover about 85,000 km2, most of which are found in temperate and arid climatic zones. Many terracescapes are obscured by newer land usages. Terrace soil (also 'fill material') may be found either exclusively at the forefront of a terrace, throughout its whole space, or at any setting in between. These soils develop through deposition of locally human-transported soil, inheritance of aggregates from their parent soil, thickening (soil aggradation) and neopedogenesis that involves structure development, reaggregation with little occurrence of organic matter, and frequently low levels of lessivage and CaCO3 redistribution.
Early stages of terrace soil development occur chaotically and much faster than natural soils, thus different from classical soil models and pedogenic concepts of 'time zero' and 'maturity'. 'Time zero' (T0) is when a catastrophic event is completed and new material forms at the land surface. However, the presence of ex situ mature constituents in terrace soils, including richer biodiversity compared to natural soils' T0, contradicts the applicability of the time zero theory. The forming of terrace soils also challenges the 'space–time continuum' model that argues that no soil is present before T0.
There are two possible ways to consider the age of terrace soils. The notion that ex situ soil is aggregated as legacy material in terrace soils implies that it is composed of older material than the terrace itself. Another way to evaluate the age of terrace soils is by the 'geomorphic surface' concept, in which the age of a geomorphic surface and its soils are regarded the same.
Soils can be described as an open system driven by external factors toward 'pedogenic order', hence minimum entropy and highest energy in the soil system. Therefore, the development of natural soils is characterized mainly by an entropy decrease. In contrast, the first formation stage of terrace soils is chaotic and dissipative, thus characterized by an entropy increase.



Keywords: Pedology,Terrace soil,Time zero,Soil maturity,Entropy

ID ABS WEB: 136421

2. Soil and humanity
2.12 133584 - Soils in Archaeology

SEARCHING FOR BRUSSELS' LATE MEDIEVAL GARDENS: GEOARCHAEOLOGICAL RESEARCH IN THE ANCIENT WETLANDS OF THE SENNE VALLEY (BELGIUM)

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Historians advocate that, alongside cereal cultivation and animal husbandry, horticulture was one of the key elements in the development of the city of Brussels. According to them, during the late Middle Ages (13th-15th centuries) part of these horticultural activities were concentrated in the marshy areas of the Senne Valley on the north side of Brussels (Charruadas & Deligne 2007). Archaeologically, however, these gardens remained undiscovered until an emergency intervention in 2014 in the heart of the ancient wetlands.
At that occasion, archaeologists excavated on the site of Rue des Boîteux/Rue d'Argent a buried late medieval Anthrosol (Dark Earth) on top of a thick Holocene peat layer. As diagnostic features such as fences, implement marks or drainage ditches were not observed, confirmation of its identification as being the remains of an ancient garden required an integrated geoarchaeological approach.
The present contribution discusses how the geoarchaeological study permitted to identify this anthrosol as a late medieval garden. We will hereby focus on how an in-depth study of soil thin sections, involving a variety of specialists, contributes to document a series of ancient horticultural practices in urban wetland areas, including drainage, soil working and manuring.

Bibliography
Charruadas, P. & Deligne, C., 2007. La ville au milieu des marais: dynamiques entre économie urbaine et zones humides dans la région de Bruxelles, XIIe-XVIe siècles. Les productions des espaces humides. Aestuaria, 9: 65-82.

Keywords: Urban Dark Earth,Soil Micromorphology,Urban Archaeology,Horticulture,Urban Geoarchaeology

ID ABS WEB: 136456

2. Soil and humanity
2.12 133584 - Soils in Archaeology

NEOLITHIC FORMATION OF CHERNOZEM IN SOUTHEAST GERMANY

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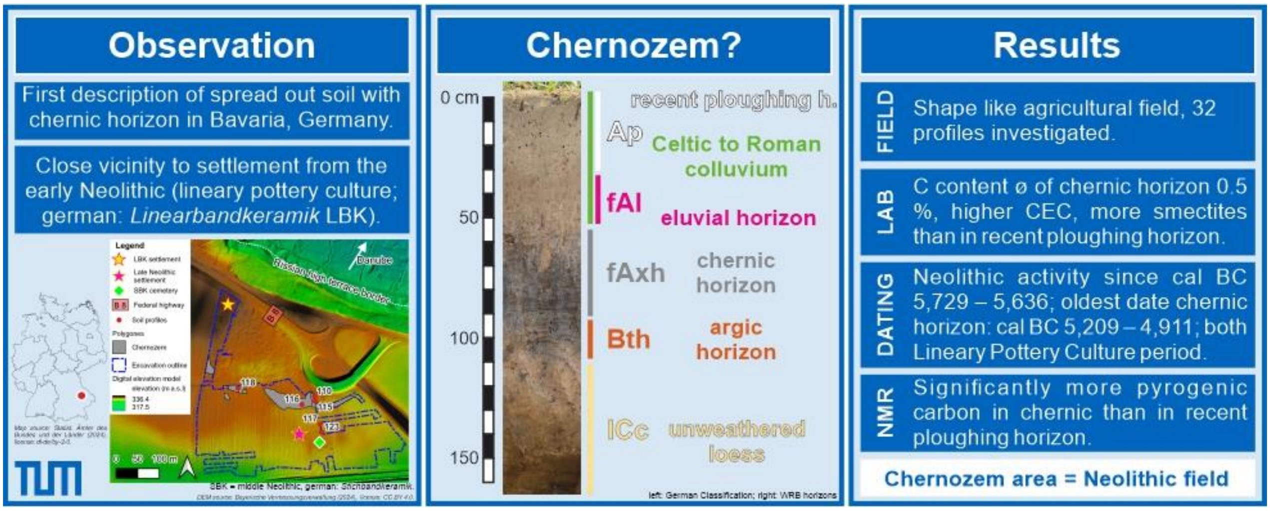
Chernozems are a group of soil types with different origins and ages. The development and age of Chernozems in Germany is still not fully understood. While a significant share of Chernozems in Central Germany is assumed to have formed naturally, such a natural formation can be excluded for all of southeastern Germany for paleoclimatic and -vegetative reasons. Another type of Chernozem formation, consisting of active soil alteration by the human population in the Neolithic, has been observed in other regions of Germany. The Chernozem investigated in this study is located close to Straubing in Bavaria, southeast Germany. The prevailing natural soil type in the area is a calcic Luvisol on loess substrate. The Chernozem is in close proximity to a Neolithic settlement and its graveyard. We hypothesise that the inhabitants of the nearby Neolithic settlement used the area with the chernic horizon as an agricultural field and were managing it actively. The field is rectangular, and the excavation revealed a surface of ca. 0.83 ha containing the chernic horizon. Several decimetres of Holocene colluvium buried it in the Late Bronze Age and subsequent periods (OSL- and 14C-Dating). Dating results from the chernic horizon prove human impact on the soil starting in the Linearbandkeramik (LBK) period (cal BC 5,209 – 4,911, 14C-Dating). NMR- and FTIR-DRIFT-analysis show high contents of pyrogenic carbon in the chernic horizon, which leads to a dark colour (Ø 10YR 5/3), even though the mean share of carbon is not higher than 0.50 ± 0.03 % (mean ± se). These results match those of recent literature and, therefore, indicate that Neolithic farmers also applied their targeted soil amendment practices in southeastern Germany. This follows archaeological findings on the colonisation of the area by the Neolithic settlers: Coming from the south of the Alps, they followed the Danube and brought their agronomic knowledge from the prior settlement area, where their active soil management is archaeologically proven.



Keywords: Chernozem,Neolithic,Lineary Pottery Culture (LBK),black soil,prehistoric agriculture

ID ABS WEB: 136685

2. Soil and humanity
2.12 133584 - Soils in Archaeology

THE EFFECT OF VOLCANIC ACTIVITY IN ANCIENT HUMAN POPULATIONS: THE CASE OF COLOMBIA AND MEXICO

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Volcanic activity has strongly affected human societies over time. Some have been resilient to an explosive eruption, while others could not recover after volcanic activity. Additionally, soils or volcanic materials could be further used, representing a resource for agriculture or construction. This work presents two study cases from Colombia and Mexico, which were affected by volcanic phenomena. In the case of Colombia, the archaeological site at Aguazuque, Savanna de Bogota, shows a long-term human occupation during the Holocene (between 8,000 and 2,500 BP), which causes complex interactions with the landscape. In particular, the studies have documented occupation in Aguazuque (a pre-ceramic site). This site is on a high plateau area (2600 masl), surrounded by sandstones. The geoarchaeological survey reveals the use of re-worked soils with similar characteristics to Andosols, which differ from those around the site. They are dark brown but compact with an angular blocky structure, properties associated with vertic processes. However, they are beneath a 50 cm-whitish sediment of fine volcanic ash. This material was probably used for the construction of the site, which suffered pedogenesis or deep transformation by human manipulation. On the other hand, we studied the Cerro del Teúl area in western Mexico, where the archaeologists found a 10 cm white ash covering the infills of the main structures. This ash was characterized geochemically and petrographically and showed a great affinity to the Jala eruption of the Ceboruco volcano, which occurred around 1000 AD. This event did not cause the site's abandonment, but the inhabitants used the volcanic material for construction, immediately after the ash fall. Consequently, the Teúl site reflects a re-occupation and adaptation of new conditions.

Keywords: volcanism,infills,volcanic ash,pedogenesis,resilience

ID ABS WEB: 136694

2. Soil and humanity
2.12 133584 - Soils in Archaeology

ARCHAEOLOGICAL LAND EVALUATION AROUND THE MONUMENTAL SITE OF S'URACHI IN WEST-CENTRAL SARDINIA (ITALY)

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A land unit map was created for an area of 78 km2 in western central Sardinia centered on the archaeological complex of S'Urachi that was first built in the Bronze Age and that remained continuously occupied until the early Roman Imperial period. The site of S'Urachi is located ca. 15 km inland from the west coast of Sardinia in the northern part of the Campidano graben. The aim of this land evaluation was to assess the suitability of local soils for land utilization types (LUTs) in late prehistory and the early historical period, broadly covering the 1st millennium BCE, that largely rely on low-technology arable farming. In addition, we also aimed to identify unsuitable land units that could still be employed for pasture or left fallow. The definition of LUTs used derives from cereal remains and the faunal assemblage retrieved during the excavations at S'Urachi and from the study of pollen obtained from a core drilled in a low-lying area ca. 3.5 km SW of the site. These archaeo-environmental data have been therefore included in the approach to present-day land evaluation, that was carried out employing the standard FAO (1976) guidelines. The land characteristics that were taken into consideration were slope, drainage class, soil texture, stoniness, rockiness, and soil type all thought to be determining factors in 1st millennium BCE land use and that could still be determined today. The result of this archaeological land evaluation is the first approximation of a land unit map.

FAO 1976 - A Framework for Land Evaluation, FAO Soils bulletin 32, Rome.

Keywords: Archaeological Land Evaluation,Soil Mapping,Sardinia,S'Urachi,Archaeology

ID ABS WEB: 137157

2. Soil and humanity
2.12 133584 - Soils in Archaeology

PALAEOSOLS OF SARDINIA: NEW EVIDENCE FROM GEOARCHAEOLOGICAL AND GEOCHRONOLOGICAL RESEARCH AT THE CENTRAL-NORTHERN SITE OF PUNTA FERULOSU (BONORVA, SS)

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Despite being the second largest island of the Mediterranean and bearing dense and monumental evidence of prehistoric human occupation since the onset of the Middle Holocene, the Holocene soil-environmental history of Sardinia remains poorly understood. Much palaeo-environmental research has focused on the Sardinian coastline, exposing the impact of changing climate on coastal geomorphic systems and late Holocene communities. This leaves a significant gap in the understanding of palaeoenvironmental conditions on the rugged uplands away from the sea and their interplay with dense prehistoric settlements.
To shed new light on these issues, high-resolution field and laboratory geoarchaeological analyses examined the upland landscape surrounding the archaeological site of Punta Ferulosu, Bonorva (SS), an area which was densely occupied by Final Neolithic and the Copper Age societies (6000-4000 BP). Sedimentary and buried soil archives were investigated in the field with lithological and pedological analyses, and sampled for physicochemical, micromorphological, and geochronological laboratory analyses. These have allowed the identification of a reddish buried soil with a well-developed cambic horizon (with fine clay coatings) whose evidence only survives beneath the prehistoric stone structures of the site dated to ca. 5000 BP. This buried soil can be associated with pedogenesis under warm and wet climate conditions that promoted dense vegetation cover and slope stability over the Early-Middle Holocene. Geochronological analysis integrated with micromorphology of a nearby sedimentary archive has identified the source of the sediments from the erosion of the buried Cambisol and provided the first radiocarbon-dated geological evidence, ca. 6000 BP, of Final Neolithic-Copper Age landscape transformation.
The new sedimentary and buried soil record starkly contrasts the modern-day poorly developed Leptosol found across the landscape and contributes valuable insights into palaeopedological records and the history of human-environment interactions in Sardinia, pre-dating the anthropogenic impacts on the island's landscape.

Keywords: Prehistoric human impact,Soil trajectories,Middle Holocene,Geochronology,Western Mediterranean

ID ABS WEB: 137786

2. Soil and humanity
2.12 133584 - Soils in Archaeology

FLUCTUATING NATURE OF PREHISTORIC SETTLEMENT AND LAND USE PRESERVED IN PEDOSEDIMENTARY RECORD OF VANISHED GULLY

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The long-inhabited Central European lowlands have exposed to significant erosion since prehistoric times, primarily due to deforestation and agricultural practices, leading to colluvium formation and erosional features. Infilled erosional gullies, particularly near abandoned settlements, may offer insights into landscape changes and settlement evolution. Our research delved into the complex interaction between human settlement, land use and the environment in prehistoric times, focusing on pedosedimentary record found within an infilled loess gully on the Predmostí u Prerova site (Czech Republic). We employed a combination of geoarchaeological and palaeoecological methods such as physico-chemical analysis, soil micromorphology, OSL and C14 dating as well as palynology and anthracology, along with archaeological geophysics and extensive development-driven excavations, to examine erosion, soil formation and settlement histories. By combining geophysics and excavation results, we investigated settlement and land-use patterns, correlating these with the environmental and pedosedimentary record of an infilled gully. The incision of the gully represented initial phase of erosion at this site. Formed before 2300 BC, it is among the oldest in the region, likely triggered by Late Neolithic land use. The study further identified cyclical patterns in both population dynamics and the pedosedimentary record, likely linked to changes in settlement and land-use practices. Periods of reduced or absent population pressure led to surface stabilisation and pedogenesis. In contrast, times of increased anthropogenic impact were associated with the erosion of surface soils and deeper erosion, followed by sediment accumulation in the gully. Our findings indicate four main erosion phases correlated with primary settlement peaks: the Early Bronze Age (2300–1600/1500 BC), the Young/Late Bronze Age (1500–900 BC), the Hallstatt period (900–400 BC) and the La Tène period (400 BC–50 BC/1 CE). Future research on additional erosion gullies could confirm and refine these findings and determine whether this is a regional pattern.

Keywords: Prehistory,Erosion,Soil regeneration,Landscape formation,Soil micromorphology

ID ABS WEB: 138067

2. Soil and humanity
2.12 133584 - Soils in Archaeology

MICROMORPHOLOGY OF URBAN DEPOSITS: FROM IRON AGE CITIES TO MEDIEVAL DARK EARTH (FRANCE)

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Urban archaeology encompasses a great diversity of archaeological stratifications and excavations of various sizes. One of its goal is to restore the organisation and the evolution of past towns and cities as well as their status. Over the last few decades, micromorphological analyses provided new archaeological data and helped to reconstruct past anatomy and activities of sites. In France, we carried out analyses on numerous French urban archaeological sites dating from Iron Age, Roman Period and Early Middle Ages on the French territory (Northern and Southern France, mediterranean climate and oceanic to continental zones).
Results of the analyses include the identification and sedimentary characterisation of various type of activities (trampling, grinding, animal enclosure, fire-related activities…) and types of spaces (courtyard, traffic area, living quarters, different types of Dark earth…) and their evolution through time. They reveal cultural and geographical specific aspects, such as building materials, construction / refection rhythms, and use of space.
The repetition of studies uncovers methodological issues between micromorphological data and archaeological results. It leads to propose a theoric framework, which help reconstructing past activities and organisation in the towns / cities, and facilitate the pluri disciplinary exchanges.
Moreover the results of these studies go beyond the archeological field of study as they provide information on the nature and the pedological functioning of urban soil and its variability, which are of interest for current research on urban soils.

Keywords: Urban archaeology,Methodology,Roman Period,Stratified deposits,Thick dark layers

ID ABS WEB: 138104

2. Soil and humanity
2.12 133584 - Soils in Archaeology

SOIL-DRILLING GRID AS ARCHAEOLOGICAL RESQUE METHODOLOGY IN ENVIRONMENTAL LICENCING PROCESSS IN BRASIL

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Brazil, a nation endowed with unparalleled biodiversity and a rich cultural variability, places a paramount emphasis on sustainable development. At the heart of this commitment lies the environmental licensing process designed to harmonize economic progress with environmental and cultural preservation. In navigating this intricate landscape, two critical components—rescue archaeology by soil-drilling grid—emerge as pillars. The environmental licensing process is meticulously attend both federal and state legislation to uphold rigorous environmental standards. A soil grid use a Krige methodology in order to obtain the best sample for drilling. Kriging can be understood as linear prediction or a form of Bayesian Inference. It assumes that nearby points in space tend to have more similar values than points that are further away. The Kriging technique assumes that data collected from a given population are correlate in space. At its core, this process seeks to evaluate the potential impacts of proposed projects, ensuring adherence to environmental regulations before granting the necessary permits for construction or operational activities. The journey through the licensing process involves EIA/RIMA is running a Rescue Archaeology Process leading by IPHAN/INAHH- Istituto do Patrimônio Histórico Artistico Nacional which is the main governmental institution for safeguarding Brazil's Cultural Legacy. Such proactive practice of rescue archaeology is a testament to Brazil's commitment to preserving its rich archaeological cultural heritage. Archaeologists jointly with geologists employ drilling techniques to analyse soil composition, stability, and contamination levels in and around the project site. The utilization of soil-drilling grid is not merely a reactive measure; it is a proactive strategy to identify and address potential environmental risks before they materialize. By integrating soil drilling into the licensing process, regulators and project developers alike, become stewards of the environment, ensuring that development initiatives proceed with an acute awareness of their environmental and culture heritage footprint. In order to clarify better such process, a study cases will be present as a symbiosis of cultural heritage preservation and environmental responsibility.

Keywords: Archaeological Culture Heritag,EIA-environmental impact asses,IPHAN/INAHH-Instituto Patrimôn,RIMA-environmental impact repo,soil-drilling grid

ID ABS WEB: 138143

Topic: **2. Soil and humanity**
Sub Topic: **2.12 133584 - Soils in Archaeology**

THE MISSING FEATURES OF THE PO PLAIN – A CASE FOR ENVIRONMENTAL MAGNETISM AND WHAT IT CAN TELL ABOUT FORMATION PROCESSES AND ENVIRONMENTAL SETTINGS OF FEATURES AND SITES

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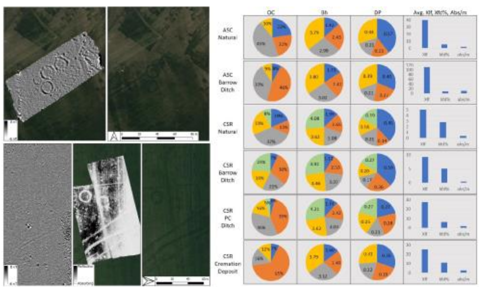
Geophysical methods, especially magnetometry due to its applicability, are some of the most used and effective tools for monitoring, controlling, managing and investigating buried archaeology. Alluvial settings are challenging environments for geophysical methods and therefore the Soprintendenza Archeologia, Belle Arti e Paesaggio of Cremona, Lodi and Mantova wanted to assess the use of magnetometry and ground penetrating radar (GPR) across sites from the Bronze Age to the Middle Ages in the central Po Plain, Northern Italy.

Aerial photographs indicated an abundance of archaeological features across the sites. GPR corroborated these when ground conditions permitted however less by magnetometry. Two sites with similar archaeology, however magnetically visible and invisible, were therefore examined for their magnetic and chemical properties.

Environmental magnetism allows examining soils by their magnetic characteristics, such as the type of magnetic mineral, their concentration and domain states. These characteristics directly relate to a soil's formation and post-formation processes, the parent material and prevailing environmental conditions and therefore vital insights into the environmental history of a feature and its site.

Magnetic susceptibility, magnetic hysteresis, isothermal remanent magnetisation and back-field remagnetisation curves alongside pXRF allowed identifying the magnetic and chemical characteristics of the natural and archaeological soils. This enabled differentiating the natural and archaeological soils through their magnetic minerals, their concentration and magnetic domain states while the magnetic unmixing allowed examining the contribution of the individual magnetic components. Alongside pXRF this allowed characterising the natural and archaeological soils of the sites and features and their similarities and dissimilarities providing vital insights into their formation and post-formation processes.

Identifying the magnetic and chemical properties allowed addressing the different magnetic (in)visibility at the two sites while importantly providing vital insights of the formation and post-formation processes at the sites and their archaeological soils. Such allowed for a better understanding and future application of magnetometry in the region while also providing vital insights into environmental changes at the two sites by using environmental magnetism.



Keywords: Environmental magnetism, pXRF, Magnetometry, Ground penetrating radar, Environmental conditions

ID ABS WEB: 138237

2. Soil and humanity
2.12 133584 - Soils in Archaeology

PROJECT SIGNATURE: APPLICATION OF SOIL SCIENCE TECHNIQUES COMBINED WITH REMOTE SENSING IN ARCHAEOLOGICAL RESEARCH

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The potential of satellite imagery as a technique of archaeological site prospection, particularly in the Middle East, has been widely recognised since the beginning of the 21st century (e.g., Donoghue, 2001; Donoghue et al., 2002; Philip, Donoghue, et al., 2002; Pournelle, 2003). However, while traditional extensive desk-based survey methods have proved effective in locating the morphologically distinctive nucleated tell sites characteristic of settlement in the Bronze and Iron Ages, they have been less successful in recognising the smaller, pastoral, dispersed settlements common during prehistoric and Graeco-Roman and Medieval occupation – especially in landscapes where mudbrick was the main building material and/or where topographic features have been reduced by ploughing. Many such sites can only be distinguished from background soils by differences in soil reflectance (colour, texture). While multispectral satellite imagery can reveal areas of differential reflectance, not all such features are sites, and the relationship between surface reflectance and the composition of archaeological deposits in different environments is poorly understood. This paper presents the scopes of the project SIGNATURE—an ongoing MSCA project intends to combine big Earth Observation data, machine learning and geoarchaeological signatures of anthropogenic soils in high-performance computational workflows to push forward our capabilities to identify, characterise and protect endangered cultural soilscapes. This paper shows initial ideas about addressing this gap by investigating and comparing the field-observed and image-derived reflectance properties of the soils/sediments from a sample of archaeological sites, of different types, located from several geomorphological units of the Middle East, India and Spain thus increasing the ability of researchers to identify anthropogenic despots when reliant upon satellite imagery.

Keywords: Satellite Imagery,Site prospection,Machine Learning,Geoarchaeological signatures,Anthropogenic soils

ID ABS WEB: 138290

2. Soil and humanity
2.12 133584 - Soils in Archaeology

DIGANOSTIC SOILS ANALYSIS OF THE MIDDLE BRONZE AGE TELLS OF THE BÜKKKALJA

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Relatively little is known about the natural soil properties of the Middle Bronze Age sites and their surroundings in Bükkalja. It is hoped that diagnostic soil analyses will help us to better understand the selection characteristics of the Bronze Age communal area.
Our study involved the preparation of a diagnostic soil map of a Middle Bronze Age tell and its surroundings in the Bükkkalja area. A soil survey of the area was carried out between 2023-2024, resulting in a precision-scale digital soil map. During the survey, soil horizons were sampled from several different soil profiles. The soil classification followed the guidelines of the WRB system.. A full physical and chemical analysis of the soils in the sampling area was conducted after processing the samples. In addition to the soil analyses, a full geospatial and topographic analysis was also carried out.
In the light of the results, it can be concluded that there is a correlation between certain soil types and the location of the plots. In addition to the diagnostic results obtained, we can also observe the impact of the human activity on the environment.

Keywords: Archaeology,Geoarchaeology,Digital Soil Mapping,Geoinformatics,Soil classification

ID ABS WEB: 135934

2. Soil and humanity
2.13 133597 - Soil, soul and society: transformative pathways in soil care practices

INCLUDING SOILS – WORKING TOWARDS KNOWLEDGES, ACTIONS AND VALUES OF SOIL CARE THROUGH EXPERIMENTATION IN RESEARCH, EDUCATION AND BROADER SOCIETY.

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Soils often go unnoticed and remain largely under-recognised, especially in their complexity and plurality. This is true for society at large, but also for students and scientists who regularly come into contact with soils. In this paper, as a cultural geographer and a soil biologist, we challenge our ongoing engagements with soils by foregrounding how we may know what soils need. We critically inquire how soils' needs may inform our practices as researchers and what this means for our work with (soil science) students and people who are not scientifically bound to soils. In this inquiry we take inspiration from scholars working on care, the critical zone and relational thinking. This paper bridges both our experiences in working with soils in research, education and beyond to illustrate the (dis)connections between our diverse practical and theoretical engagements with soils. We share work we have done together and individually, and how - through this work - we came to similar insights and concerns about where soils and specifically knowledges and research engagements on soil health are heading.
Taking inspiration from these insights, we experiment with redirecting our work on soil health by trying to reach out to other practitioners, scientists and artists working with and fostering soil health. In this experimentation we centralise that soils do not need humans as much as humans need soils. This insight is humbling and at the same time makes reciprocal engagement with soils inherently troublesome, because it raises dilemmas about what types of human engagement with soil might be just.
Our experiences and reflections illustrate that ongoing work attempting to include soils (and the people who work with them) in all their plurality is generative and therewith promising for the futures of soils' wellbeing. Simultaneously, the work taught us how distant much of the scientific and didactic engagements with soils are from recognising soils as affective beings, as vibrant webs of life-and-matter which are continuously co-becoming.

Keywords: transdisciplinairy,soil care,rethinking,experimentation

ID ABS WEB: 136469

2. Soil and humanity
2.13 133597 - Soil, soul and society: transformative pathways in soil care practices

FOR AN ECOLOGY OF WELCOME. THE AGROECOLOGICAL APPROACH OF FATTORIA PIANETA TERRA (MILAN, ITALY)

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The agroecological paradigm aims to restore the conditions which have permitted to agroecosystems in the past to function properly with a small amount of external antropogenic inputs. Agricultural landscape has been deeply affected by conventional practices: homologation, trivialisation and, less frequently, maizification are the terms used to define the impoverishing process suffered by it. In particular, these labels stress the removal of key landscape elements (e.g. hedgerows) fundamental for the connectivity between the agroecosystems and the wider ecosystems in which they are located.
Soil stands at the core of the transformation of agrarian production. Indeed, this deeply affects the health conditions of agroecosystems. Therefore, paying attention to and caring of the soil means not only ensuring its productivity today, but also preserving a common good in the long run. In order to gain the purposes of the agroecological transition, scientists and practioneers have cooperated to produce transdisciplinary and localized knowledge. Nowadays cultural and institutional dimensions are increasingly important to understand how to intervene effectively within the different territorial contexts.
Fattoria Pianeta Terra (Milan, Italy) has been developed starting from these premises, with the purpose to create a large community capable of taking care of a rich and complex portion of territory located at the eastern edges of the Municipality of Milan. The project aims to create a multifunctional place, a renovated old farmstead and its surrounding fields, to welcome a community for minors.
In addition to ensuring local and high quality food production, the project intends to restore also other the ecosystem services, in particular the regulating and cultural ones. In order to pursue this objectives, agroecological practises will be implemented as well as various social farming and craft activities. Fattoria Pianeta Terra involves several public, private and third sector actors, with a long experience in regenerative practices, willing to not just imagine, but rather concretely build, transformative pathways for more just and sustainable futures.

Keywords: Agroecology,Regenerative practices,Territory,Local community,Transformative knowledge

ID ABS WEB: 137379

2. Soil and humanity
2.13 133597 - Soil, soul and society: transformative pathways in soil care practices

OLTRETERRA ART PROJECT

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Our proposal is addressed to share the experience of Oltreterra art project, where contemporary art was a mean for connecting aesthetics, art history, science, local history, soil knowledge, nature care.
Started in 2023, Oltreterra art project is an interdisplinary contemporary art project, focused on the artistic experimentation on the ancient Sienna pigment. The artist Samantha Passantiti, for this project, made a cycle of artworks using the same pigment used since the 13th century, taking it from the same area where it was extracted originally. She went to the quarries – now abandoned - placed in the country of the Amiata Mount, between the cities of Grosseto and Siena, in order to take the original earthy matter of the pigment. Throught this material, the artist experimented the tradition of natural Sienna pigment, very important in the medieval art history, on the field of contmporary art, according to her usual visual language. By this way, Passaniti, deepening her personal research on natural elements in art practice, contributed to renew sustainability awareness. Moreover, also to enhance forgotten places throught the history of soil use.
Indeed, together with the main artistic activity, Oltreterra, thanks to its interdisplinary identity, has been supported by several partners, as art musuems, natural history museums, scholars specialized in geology and ecology, pro-environment associations, citizen unions. The project, during its year-long duration, organized a lot of different events, such as art shows, lectures, workshops, tours in nature. In each case, practicing an inclusive approach and ever involving a different kind of public.
Oltreterra experience has been collected in a final editorial project, including contributions by humanistics and scientists. So, we would like to promote both a very actual way of conceiving art projects and the importance of topics related to ecological practices in art-making, soil knowledge, sustainability.

Keywords: transdisciplinarity,artistic research on soil,collaborative research,citizen science,soil vitality

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2. Soil and humanity
2.13 133597 - Soil, soul and society: transformative pathways in soil care practices

CARING FOR SOILS REQUIRES CARING FOR FARMERS: A REFLEXIVE EXPERIENCE OF THE AFFECTIVITY INVOLVED IN THE FARMER'S RELATIONSHIP WITH THE SOIL.

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Agriculture is a human practice steeped in relationships with non-human entities. The world's agrobiodiversity and the heterogeneity of human societies have been shaped by these relationships, which can be understood in several dimensions (material, spiritual, social, cultural, sensitive, affective, etc.). Farmers' relationships with soils are multiple and singular. Farmers know their soils personally. When it comes from previous generations, the transmission of this knowledge through farming fosters a personal relationship with the soil. Scientific approaches such as ethnopedology or agroecology give attention to farmers' soil knowledge, but the affective dimension of this knowledge is often missing. One reason may be that addressing personal intimacy is delicate and requires mutual trust. Scientific research should not have to reach every level of human-soil intimacy, but affectivity has been neglected and crushed by the agro-industrial model promoted by agronomic sciences. This denial has left a wound partly responsible for the farmers' current suffering. Alternatives to this model are opportunities to give space again to this affectivity. Accounts from farmers involved in transformative pathways reveal the joy of re-experiencing a personal relationship with the soil and attachment to the land through soil care practices. Supporting and accompanying transformative pathways in agriculture requires also taking care of this affective dimension. Transdisciplinary approaches can allow, in the same movement, both to include the affective dimension in understanding farmers' knowledge and, through a reflexive approach, to highlight the affectivity also present in scientists' relationship with soil and farmers. The experience presented here results from a transdisciplinary research dedicated to collaborative soil health assessment in the Cordoba region of Spain. This collective learning process was an opportunity to learn from farmers and approach their personal relationship with soil. The hypothesis presented here is that considering the affective dimension of agriculture in knowledge dialogue, can significantly facilitate mutual understanding and promote the elaboration of common perspectives between scientists and farmers on how to take care of soil.

Keywords: Soil-farmer relationship,Knowledeg dialogue,Affective dimension,Soil care,Transdisciplinarity

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2. Soil and humanity
2.13 133597 - Soil, soul and society: transformative pathways in soil care practices

LANGUAGE OF SOIL

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Soil protection is a quintessential ‘wicked problem’ of our times. Soils are situated at the nexus of interconnected social, cultural, and environmental crises. Caring for soils urgently requires a transdisciplinary approach. Transdisciplinarity, however, does not just happen. Researchers from different disciplines and backgrounds need time and support structures to develop a shared language for transdisciplinary soil research. This is the objective of an innovative new publication project initiated by Anna Krzywoszynska and Alexandra Toland, co-chairs of IUSS Commission 4.5 on the History, Philosophy and Social Science (and Arts) of Soil Science. Still in the early stage of realization, the book project aims to establish a rich foundation for wide-reaching and long-term transdisciplinary collaboration on soil research. It does so by building an in-depth glossary of the “language of soil” and creating relationships between disciplines via author community-building. The book production is a fully transdisciplinary process. The proposed publication includes over 100 participants from academia and civil society, with whom the editors will map the field of transdisciplinary soil research. In the process, the editors will identify key boundary objects as introduced by sociologists Susan Leigh Star and James R. Griesemer (1989): concepts, methods, tools and practices which, while they are interpreted differently, by different groups, nonetheless allow members of different disciplines to talk and work together. The Language of Soil – A Handbook for Transdisciplinary Soil Research is proposed as a unique physical and online open-access collection of concepts and tools for transdisciplinary collaboration in soil research, addressed at scholars and students of social sciences, humanities, arts and natural sciences interested in soils; soil practitioners; transdisciplinary researchers; soil educators: communicators; and policy makers. Its objectives are strongly in line with the overall remit of IUSS Division 4. The book will help will increase the recognition of and engagement with the IUSS across disciplines, working to help establish the „soil humanities“ as an important field of inquiry within transdisciplinary soil research.

Keywords: Transdisciplinarity,Language,Soil Care,Knowledge

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2. Soil and humanity
2.13 133597 - Soil, soul and society: transformative pathways in soil care practices

SOIL AS MEDIUM: EXAMINING HOW SOILS ARE MADE KNOWABLE, SENSABLE AND RELATABLE ACROSS FIELDS

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Soils are challenging entities to understand and relate to: consisting of organic and inorganic compounds, conceived as inert matter or living ecosystems, hidden beneath more or less accessible surfaces, from concrete and sea beds to agricultural fields. The Norwegian Research Council project Anthropogenic Soils: Recuperating Human-Soil Relationships on a Troubled Planet (SOILS, 2022-2028) seeks to examine existing soil knowledges and relationalities, with focus on anthropedogenetic processes and remediation practices towards soils that are depleted or polluted, endangered or dangerous. This paper emerges from the author's PI role in the SOILS work package Experiential Soils, and from the question of how soils can be accessed and engaged with, artistically and phenomenologically.

Philosopher Marshall McLuhan's slogan "the medium is the message" (2001, p. 7) has been mobilised by scientists in discussions of the biological medium of water (Frenkel-Pinter et al. 2021). What does it mean to consider soil as a medium? This paper departs from the established idea of soil as a growth medium for plants and fungi, taking this as a starting point for considering how soils are made knowable, sensable and relatable across fields. The paper draws upon perspectives from media studies, art, postcolonialism, geopolitics and indigenous knowledges in addressing different senses in which soil can be considered a medium. Engagements with soils are also mediated through the various technologies with which we perceive and analyse soils. Finally, the concept of soil remediation is considered through the interlaced lens created by these multiple meanings of soil as medium, exploring how this lens might assist in rethinking conceptions of good soil, soil care, and soil health.

Frenkel-Pinter, M., Rajaei, V., Glass, J. B., Hud, N. V., & Williams, L. D. (2021). Water and Life: The Medium is the Message. J Mol Evol, 89(1-2), 2-11.
McLuhan, M. (2001 [1964]). Understanding Media. The Extensions of Man. Routledge.

Keywords: Soil art,Soil relationalities,Soil care,Transdisciplinary research,Phenomenology

ID ABS WEB: 138273

2. Soil and humanity
2.13 133597 - Soil, soul and society: transformative pathways in soil care practices

ANTHROPOGENIC SOILS: COLLABORATIVE ENVIRONMENTAL HUMANITIES OF SOIL RECUPERATION

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This paper presents the multidisciplinary research project Anthropogenic Soils: Recuperating Human-soil relationships on a Troubled Planet, based at the University of Oslo as a collaborative experiment for studying soils in the Anthropocene. The project studies the ways people in different parts of the world have invented, practiced, and imagined ways of recuperating soil health. We argue that soils need to be conceptualized not as natural resources to be exploited, but as anthropogenic, as lively and dynamic natural-cultural composition responsive to human recuperation and healing. The project combines studies of repairing contaminated, toxic, and depleted soils in different parts of the globe –from South Asia to Norway and the Arctic –as well as artistic and multimedia research into the ways in which Indigenous writers and artists offer alternative modes of relating to soils, and for building possible future of earthly survival. Closely collaborating across the humanities, social sciences arts and life sciences, SOILS combines ethnographic, multispecies and praxiographic methodologies with speculative and artistic research to generate new knowledge about emergent human-soil relations.

Keywords: Anthropogenic Soils,Multidisciplinarity,Soil Repair,Soils Humanities

ID ABS WEB: 138321

2. Soil and humanity
2.13 133597 - Soil, soul and society: transformative pathways in soil care practices

SHAPING SOIL LITERACY: UNRAVELING PARADIGMS IN EDUCATION FOR SUSTAINABLE HUMAN-SOIL RELATIONS

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The global soil crisis presents a significant threat to socio-ecological sustainability, demanding a re-consideration of the paradigms that shape soil education. Paradigms are normative assumptions describing how we understand the world, make sense of the human-soil relationship, and respond to soil-related sustainability challenges. The intricate material and scalar complexity of soils include diverse knowledge and practice systems. How communities perceive soil varies across contexts, resulting in a debate with deeply rooted social and cultural concerns. Inevitably, different assumptions and perceptions about soil influence educational practices, and what and how we teach and learn about soil. The LOESS project, a collaborative and transdisciplinary initiative, seeks to enhance soil literacy by mapping, connecting, and engaging with diverse educational levels, from primary to higher education and civil society, across 15 European countries. LOESS aims to co-create and test pedagogical techniques helping reconsider how we understand soil and foster human-soil relations, stimulating discourses between educators and learners, and bridging different knowledge systems. Wageningen University team within the LOESS project conducted qualitative research in the Netherlands educational context, exploring soil knowledge practices and the paradigms shaping human-soil relations. The research focuses on how educators envision soil education, specifically examining which paradigms-considering the mechanistic and the ecological paradigms-are chosen to enhance knowledge and cultivate a sense of care for the soil among students. The mechanistic and ecological paradigms offer different perspectives on the natural world: universal versus local, atomistic versus relational, and controllable versus chaotic. A curriculum rooted in a specific worldview shapes students' understanding of soil and environmental issues. Findings from interviews and focus groups with educators, from diverse educational levels, reveal how assumptions shape the purpose of soil education, ranging from agricultural use to environmental preservation. Educators' conceptualization of education and teaching of soil-related topics are influenced by paradigms, whether mechanistic or ecological. This study recognizes the diversity of knowledge systems and paradigms that shape human-soil relations, contributing to addressing the global soil crisis.

Keywords: soil education,soil-human relationships,paradigms,qualitative research,diverse knowledge systems

ID ABS WEB: 136486

2. Soil and humanity
2.14 133604 - Histories of internationalization of soil science

THE EMERGENCE OF TROPICAL SOILS AS A CATEGORY OF SPECIALIST RESEARCH IN BRITAIN

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In 1944, a group of British soil scientists gathered with the agricultural advisor to the Colonial Secretary at the Rothamsted Experimental Station in England to discuss the future of soil science across Britain's colonial empire. In what would be the first of many meetings, attendees outlined the need for more trained soil scientists to work in the colonies and the difficulty of establishing any uniform system of soil classification for the colonial empire with their existing knowledge. This committee, later known as the Soils Sub-Committee, would go on to influence the direction of soils research in Britain and its colonies throughout much of the post-war period. One of the features of developments in British 'colonial soil science' during this time was the emergence of tropical soils as a category of specialist research: the first conference on tropical and sub-tropical soils was held at Rothamsted in 1948, and in 1950 a Tropical Soils Adviser was also appointed for the first time. Whilst the fertility of tropical soils had been the topic of discussion in the past, this was the first time tropical soils had been given this much institutional support and attention as a specific category of specialist research, at least in Britain. The aim of this paper is to point out the broader context of British colonial development in which these events were situated. Experiences during the interwar years had a profound influence on the place of soil science in visions of colonial development after the Second World War, particularly the idea that soil surveys were an important yet difficult way of scientifically planning colonial territories. Understanding the politics of soils research in colonial contexts is helpful to unpack the meanings of tropical soils and thus some of the more contemporary controversies that have surrounded them.

Keywords: Tropical soils,Development,Soil surveys,Maps,History

ID ABS WEB: 137513

2. Soil and humanity
2.14 133604 - Histories of internationalization of soil science

A THEORY OF CHANGE TO UNDERSTAND THE IMPACTS OF HISTORICAL SOIL AND LAND USE APPRAISALS ON AGRICULTURAL POLICY DEVELOPMENT IN THE CARIBBEAN CONTEXT

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Background
Since the 1930s, British scientists carried out soil and land use surveys with the support of colonial governments. Maps, soil surveys, and aerial photos contributed to policy decisions for agriculture, forestry, and conservation. While newly independent countries have pushed to modernize agricultural systems towards national goals, critical examination is lacking on the enduring legacies of colonial structural injustice, at times, at the cost of development progress. This research critically examines how soil and land use appraisals contributed to key agricultural policies and practices pre- and post-independence in the Caribbean. The paper presents a theory of change (TOC) on decolonizing soil science via the examination of science-policy pathways in natural resource management. We ask, "to what extent did soil and land evaluations contribute to the policies and practices of colonial and post-colonial agricultural systems?"

Methods
We draw on literature and archival review with a focus on soil and land resource evaluations, soil-human relation within agricultural systems using archival data from Land Resources Division (formed in 1956 and part of the Natural Resources Institute since 1990) and an overview of the key actors across government and development sectors and agricultural policies of two Caribbean countries, drawing on Food and Agriculture Policy Decision Analysis policy database. The TOC is produced by an interdisciplinary team of soil scientists and social scientists via group model building (Vennix, 1996) to include critical examination of the historical contexts, methodological assumptions and limitations, societal forces under which science-policy pathways generally take place.

The study aims to examine the internationalisation of soil science under varying support towards decolonisation of agricultural science within British colonial contexts. It aims to build on existing frameworks addressing science-policy pathways in order to re-imagine more just and sustainable human-soil relations.

Vennix, J.A.M. Group Model Building: Facilitating Team Learning Using System Dynamics; John Wiley & Sons, Inc: Hoboken, NJ, USA, 1996; ISBN 978-0-471-95355-5.

Keywords: aerial photo,agricultural policy,archive,decolonisation,structural legacy

ID ABS WEB: 137982

2. Soil and humanity
2.14 133604 - Histories of internationalization of soil science

EARLY INTERNATIONAL CONNECTIONS IN THE DEVELOPMENT OF SOIL SCIENCE

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The scientific study of soil became more systematic and profound when soil researchers from different European countries started to visit eachother's laboratories. Ideas were exchanged on how plant take up nutrients, how soils were formed, or how to measure the texture of the soil and water movement. The International Society of Soil Science was formed to accelerate the exchange of information, and to standardize the different procedures for soil analysis and classification. The Fourth International Conference of Pedology was held in Rome in 1924 and brought together 300 soil researchers. A large group of soil scientists gathered at the First International Congress of Soil Science that was held in the USA in 1927. In this talk, I will review some of the great international connections which were vital for the development of soil science.

Keywords: pedology ISSS 1927

ID ABS WEB: 138297

2. Soil and humanity
2.14 133604 - Histories of internationalization of soil science

SOVIET SOIL SCIENCES IN CENTRAL ASIA: LABORATORIES FOR REMEDIATION RESEARCH

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This contribution examines Soviet soil sciences, especially soil ecology, and its complex relations to international organizations and local research in the republics. It focuses on the work of pedologists in Central Asia and their research on soil melioration, degradation, and remediation. Since the late 1950s, Khrushchev's modernization campaigns propelled agricultural production in Uzbekistan and large-scale projects of "greening the Central Asian steppe" through irrigation and mechanization in Kazakhstan. During the 1960s, Institutes for Soil Sciences and Agrochemistry were founded in Tashkent and Almaty. Despite the strong academic tradition of the Dokuchaev school, the status of soil sciences as an academic discipline was unstable in the USSR and soil sciences were moved from the Academy of Sciences into more applied agricultural institutes. At the same time USSR soil scientists played an active role in international projects coordinated by UN agencies, dedicated to irrigation and soil salinization within UNESCO programs on desertification and, later, in the Man and Biosphere (MAB) program and the Scientific Committee of Problems of the Environment (SCOPE). Soviet soil scientists were instrumental in FAO's world soil mapping endeavor and brought Vernadskii's conceptualization of biogeochemical processes and the importance of soils in the biosphere to international attention. While a few scientists, close to the political elites in Moscow, acted as diplomats on the UN stage, local scientists in Central Asia carried out the groundwork, often under constraints and with limited access to publishing. Since the early expeditions of Russian colonial sciences, the arid steppe areas with their extreme climates as well as the cotton production regions in Central Asia have continued to function as laboratories and training spaces for soil scientists. In this paper we reconstruct these entangled pasts and describe the complex positionality of soil sciences in Central Asia in order to make visible some understudied strands of soil remediation research in the Anthropocene.

Keywords: Soviet soil sciences,Central Asia,Soil remediation,UN organizations,Postcoloniality

ID ABS: 136028

2. Soil and humanity
2.15 133605 - Epistemologies and Ontologies of Soil: Towards New Politics of Soil Knowledge

THE COSMOPOLITICS OF SOIL RESOURCEFULNESS: THE POLITICAL HISTORY OF SOIL SCIENCES AND THE CONSTITUTION AND CONTESTATION OF AGRARIAN ORDERS

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The soil humanities are committed to unearthing alternative onto-epistemologies and praxeologies of soils and soil relations which challenge hegemonic conceptions of soils as resources. Sympathetic to this program, this paper seeks to contribute to it by providing a more historically substantiated understanding of how this resource-being of soils can be theorized by outlining a cosmopolitical history of the sciences of soils.

This history is explored and organised around three scientific paradigms around soils which predominated in (European and North American) debates in a roughly chronological fashion since the 19th century: agrochemistry, agrogeology, and earth system science. These paradigms have generated particular problematisations of the resource-beings of soils and have thereby been involved in the construction of technologies and practices through which soils are used and governed. Agrochemistry, with its concern with the nature and availability of soil nutrients, for instance, is linked to 19th century debates on sewage innovation and artificial fertilisers, but also to the constitution of experimental agricultural communities based on recycling principles. Similar histories concern agro-geology, pedology and more recently earth system science, whose understanding of the resourcefulness of soils contest and promote particular practices and technologies.

Rather than uniform and uncontested, then, the historical resource-being of soils involves an ongoing resourcing of soils in which soils' resourcefulness (i.e. their values and functions) and their resourcelessness (their liminalities and vulnerabilities) are redefined. Furthermore, these soil resourcings have responded to and generated concerns over widespread soil destruction since the 19th century onwards, giving rise to projects and imaginaries of (re-)fashioning human societies' values and metabolic processes through soils, primarily centered on agriculture. Through this theorisation of the resource-being of soils and an exploration of its relation to agrarian orders of different kinds, this paper seeks to raise more sharply the question of appreciating and articulating the historically situated differences and relations between alternative conceptions of soils and resource-ontologies of soils that is central to the soil humanities.

Keywords: Soil resourcefulness,cosmopolitics,planetary governance,history of soil science,power/knowledge

ID ABS: 136132

2. Soil and humanity
2.15 133605 - Epistemologies and Ontologies of Soil: Towards New Politics of Soil Knowledge

IN THE SHADOW OF CARBON: WHAT KNOWLEDGE IS NEEDED TO REGENERATE AGRICULTURAL SOILS?

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A dramatic change — in which carbon, not just food, is becoming a key product of agricultural soils — is silently under way. Influential policy movements, such as the French-government backed “4 per 1000” initiative and the Horizon Europe mission “Soil Deal for Europe” assert that increasing the concentration of carbon in soils will significantly contribute to mitigating climate change (Vermeulen et al., 2019). Consequently, there is rapidly growing investment in the public and the private spheres into developing epistemic and technological practices which would make carbon sequestration in soils a reality on farms, and into promoting the uptake of these practices amongst farmers.

In this paper, we trouble the idea that carbon farming is an obvious ‘win-win’ for farming and for farmers. We are particularly concerned with how the carbon focus is overshadowing the more fundamental and more urgent concerns around the future of agricultural lands and of land workers. We argue that subjecting farming knowledges and practices to the objective of carbon sequestration may undermine rather than support the urgent work of rural regeneration. To regenerate rural soils and communities, we need forms of knowledge which attend to and improve relations between humans and the multiple living and non-living entities who make life possible in specific places. Focusing on carbon sequestration as the primary outcome of farming activity, and promoting carbon as the primary lens through which to understand and reconfigure farming, threatens to subject these heterogenous socio-ecological and multi-species relations to a new homogenizing knowledge paradigm. By constraining the horizon of epistemic and practical action, it also threatens to further undermine the capacity of farmers to adapt and innovate their livelihoods in durable and sustainable ways. Drawing on preliminary data from Australian farmers, we indicate the tensions between knowing soil and farming through the lens of carbon, and the holistic knowledges needed for agrarian regeneration.

Keywords: soil carbon,regenerative agriculture,soil governance,soil knowledge,local knowledge

ID ABS: 137076

2. Soil and humanity
2.15 133605 - Epistemologies and Ontologies of Soil: Towards New Politics of Soil Knowledge

MAKING SOIL A SYSTEM: HANS JENNY'S STATE FACTOR MODEL OF SOIL FORMATION AND THE CLASSIFICATION OF CALIFORNIA SOILS

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Body
This paper delves into the development and dissemination of Hans Jenny's State Factor Model of soil formation, shedding light on its significance in the context of soil taxonomies and ecological history. Jenny's perspective offered a unique lens through which to view soil, one that positioned it as a living, dynamic entity deeply integrated into its ecosystem. However, for soil to assume this active role within ecosystems, it had to undergo a process of delineation, dissection, and abstraction. This study examines how Jenny grappled with the definition of his state factors, particularly the biotic and the human factor, as independent actors. In moments of definition and classification, Jenny resorted to establishing arbitrary boundaries, differentiating between individual soil plots as well as between soil and vegetal matter. These demarcations, combined with Jenny's systematic characterization of soil, rendered his State Factor Model particularly attractive to soil taxonomers and classifiers, especially those engaged in the United States soil survey. Much more significantly, however, Jenny's scientific interest in biotic soil characteristics dovetailed with his lifelong efforts to conserve unique soil profiles of California. This paper explores how Hans Jenny's State Factor Model of soil formation, which viewed soil as a living and integral component of ecosystems, incorporated the language of classification and boundary-making to define soil as a valuable and distinctive resource, thus demonstrating the interplay between ecological thought, soil surveying, and conservation and environmental history.

Keywords: Hans Jenny,State Factor Model,Ecosystems thinking,Boundary making,Soil taxonomy

ID ABS: 137829

2. Soil and humanity
2.15 133605 - Epistemologies and Ontologies of Soil: Towards New Politics of Soil Knowledge

ACCOUNTING FOR SOIL CARE. AN INQUIRY OF SOIL ONTOLOGY THROUGH ECOLOGICAL ACCOUNTING IN AGROECOLOGICAL FARMING

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In the midst of growing multidisciplinary scientific interest, heightened public awareness, and evolving political and regulatory agendas, soil is undergoing a process of mainstreaming. New practices, strategies, and tools are emerging to integrate soil ecology into organizational frameworks, particularly in spatial planning, ecological engineering, and agroecology. Despite the interdependence of most organizations with soil ecosystems, the incorporation of soil ecologization into their accounting systems and tools remains largely invisible. Accounting, serving as the architecture of organized activity, plays a central role in comprehending, modeling, controlling, and governing organizations.

This research relies on an ethnographic inquiry into the land and agroecological transitions of a former military airbase in the South of the Paris Region, France. We investigate soil preservation practices to address the emerging concern and care for soil. In resistance to urban sprawl and soil artificialization, an alternative farming collective reassigns contaminated soils, shaping novel approaches to care for and live with these soils. Consequently, they engage in soil knowledge-making practices that challenge the scientific understanding of soils, advocating for the pluralization of soil ontologies and epistemologies in agroecological transitions. We demonstrate how the design of an ecological accounting system for soil unfolds various controversies surrounding soil preservation. We introduce the concept of matters of care to define, assemble, and articulate soil food web care practices across spatial and temporal scales, thereby defining soil ontology. We illustrate how ecological accounting, extending beyond mere quantification and monetization, facilitates the expansion of care networks and constitutes a comprehensive caring project.

This paper builds upon previous research on ecological accounting by exploring the case of soil to shed light on and support collective soil management across scales. It contributes to the development of new participatory methodologies for exploring ontological controversies related to ecological transition. Lastly, this proposition offers an original perspective on soil ontology, intertwining relational ontologies and formal ontologies through accounting translation and the notion of capital.

Keywords: soil ontology,soil capital,ethnography,agroecology,care

ID ABS: 137940

2. Soil and humanity
2.15 133605 - Epistemologies and Ontologies of Soil: Towards New Politics of Soil Knowledge

EXPLORING SOIL FERTILITY THROUGH SCIENCE AND ART: TOWARDS HYBRIDIZATION OF RESEARCH

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According to the current western narrative, to meet the food needs of a rapidly growing world population, soil must be intensively exploited leading to depletion of its nutrients and vitality, with destructive impacts on natural habitats and wildlife. This is often due to a reductionist technoscientific culture that colonizes or delegitimizes local knowledge and practices, which, over centuries, have fostered a deep, intimate, affective, and not merely instrumental relationship with the land.
At the same time, soil is also the ground where the scientific community can experiment a concrete transformation of its approaches and narratives. The experience of hybrid networks of citizens, artists, farmers around the world who carry out projects of cultural regeneration of land and food production can inspire this process. Their model is often agroecology, which questions the epistemological foundations of modern science; it is based on a non-hierarchical pluralism of knowledge and practices, with a focus on the interconnectedness of ecosystems, and on a closer relation between human and non-humans. The political awareness of the importance of taking care of soil drives these networks to save it from overbuilding and degradation, thereby reshaping the very concept of food and soil as common goods.
This presentation shares insights from the transdisciplinary project BRIDGES (Bringing Reflexivity and Response-ability Involving Different Narratives of KnowledGE and Science), which employs soil fertility as a key study to investigate the essential conditions for fostering reflectivity and hybridization in scientific research.
The project places significant emphasis on the artistic and aesthetic exploration of soil proposed as a methodology that investigates the concept of relation. Engaging with soil through the arts can stimulate critical ontological and epistemological reflections regarding the status of living beings, the relationship between visible and invisible, humans and non-humans, the boundaries and connections between different knowledge systems, the multiple narrative, and the potential for collective and multifaceted action.

Keywords: transdisciplinarity,soil fertility,post-normal science,hybridization,reflexivity

ID ABS: 137944

2. Soil and humanity
2.15 133605 - Epistemologies and Ontologies of Soil: Towards New Politics of Soil Knowledge

GROUNDING CLIMATE SOLUTIONS THROUGH SOIL HEALTH: THE MICRO-BIOPOLITICS OF SOILS AS CLIMATE INFRASTRUCTURE

T LAW

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In this moment of entangled climate and topsoil crisis, soil is simultaneously conceived as imperiled and as an existing climate solution. Drawing upon eight months of qualitative fieldwork in Central New York State agriculture, I trace how soil relations are shifting amidst State and farmer efforts to mitigate and adapt to climate change. Engaging recent literature on soil's relational materiality (Krzywoszynska and Marchesi, 2020), infrastructure studies (Nelson and Bigger, 2022) and political ecology (Byrant, 2018), I examine the recent attention to soils' lively components as essential climate functions, marking a shift towards envisioning and engaging soil as a form of natural climate infrastructure. I consider the biopolitical doubling of this conceptualization, how farmers are being conditioned to see soil differently via soil health extension, and how farmers enact this vision, through new attention to soil life to prepare for extreme weather and sequester carbon. I offer a typology of emerging soil ontologies and relations initiated in this visualization, including convivial, carbon and capitalist soils. I argue that through this process soil becomes both naturalized and depoliticized as a climate solution, increasingly centering a reductionistic carbon ontology of soil that precludes other soil relations. I conclude by considering how this carbon ontology amplifies capitalist relations to soil through new efforts of carbon farming, creating new avenues for value accumulation, ultimately rendering soil investable anew.

Keywords: ontology,microbiopolitics,infrastructure,climate solutions,soil health

ID ABS: 138051

2. Soil and humanity
2.15 133605 - Epistemologies and Ontologies of Soil: Towards New Politics of Soil Knowledge

SOIL PERSONHOOD – ON THE POSSIBILITY OF PED-ONTOLOGICAL PROTECTION OF SOIL BEINGS AND LIVELIHOODS

A. TOLAND

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In kinship worldviews and recent developments in environmental protection policy, recognition of personhood has been given to rivers, mountains, and rock formations. Can soils also be recognized as persons with legal standing? The concept of an individual "soil person" is hardly comparable to individual rivers, mountains or other non-human natural entities. Roy Simonson was one of the first soil scientists to note that "soils are seldom set apart from their neighbors by sharp boundaries." Instead, soil has historically been imagined as a place where multiple spheres merge into one: the dynamic interface between biosphere, lithosphere, hydrosphere, atmosphere, and all that plays out in the technosphere. Soils at first seems to resist subjectivity because of their soft boundaries and wide-spread distribution, or what philosopher Timothy Morton calls "hyper-objects." Human classification of individual "species" of soils—organized as soil groups such as podsols, alfisols, or luvisols— are described in taxonomic handbooks, or passed on as local knowledge.

Building on previous work, this paper expands the scope of current soil assessment procedures to include aspects of personhood such as intrinsic worth, cultural status, and the capacity for reciprocity, memory, decision-making, and social interaction. The transdisciplinary, mixed-methods project draws on ideas from the soil humanities, indigenous and feminist STS, and artistic research to recognize the subjectivity of soil beings under existential threat by multiple megatrends of the Anthropocene. Elements of instructional art, speculative fiction, and soil taxonomy are used to develop new protocols for soil personhood recognition that can be used in soil assessment. Extending Kathryn Yussof and Elizabeth Povinelli's ideas about geontology to the soil, the paper 1) begins with examples of speculative critical design and art practices focused on engaging with soil beings and livelihoods; 2) then expands these with views from soil scientists and educators, policy experts, and soil care practitioners; to 3) argue for ped-ontological protection based on existing legal frameworks, transdisciplinary scholarship, and political resistance movements.

Keywords: Ped-ontology,soil kinship,soil subjectivity,transdisciplinary,soil assessments

ID ABS WEB: 138183

2. Soil and humanity
2.15 133605 - Epistemologies and Ontologies of Soil: Towards New Politics of Soil Knowledge

HARVESTING SOIL CARBON ON ENGLISH ARABLE FARMS

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A voluntary soil carbon market has recently emerged in Europe, aimed mainly at arable farmers and driven largely by FinTech start-up platforms which offer to generate and/or trade credits on behalf of farmers. Based on ethnographic research, this paper explores the process of the commodification of soil carbon within an English arable farming context. The findings suggest that much of the soil carbon being traded is unlikely to correspond to additional storage of atmospheric carbon since the farmers engaging in these schemes generally are those who have already adopted soil conservation practices, motivated by agronomic benefits and the current economic and post-Brexit policy climate. The apparently limited impact of the soil carbon trading platforms is in contrast with their portrayals of themselves as transformers of agricultural and food systems and their alignment with the regenerative agriculture movement. This is consistent with previous descriptions of 'non-disruptive disruption' within the cleantech industry (Fairbairn and Guthman, 2022; Goldstein, 2018).

Keywords: Soil politics, Carbon

ID ABS WEB: 138241

2. Soil and humanity
2.15 133605 - Epistemologies and Ontologies of Soil: Towards New Politics of Soil Knowledge

LEARNING FROM SOIL AND FARMERS: INSIGHTS FROM AN INTERDISCIPLINARY STUDY OF SMALLHOLDER FARMER USE OF HUMAN EXCRETA-DERIVED SOIL AMENDMENTS IN TAMIL NADU, INDIA

W. BARRETT

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Soil scientists and agronomists can gain deeper understanding of soil and crop management practices and those practices' cultural, social, and economic implications by complementing standard soil chemical, physical, and biological assays with social science methods such as interviews and participant observations. I will discuss findings from semi-structured interviews and participant observation within my study of the use of soil amendments derived from human feces and urine among smallholder farmers in Tamil Nadu, India.

Farmers throughout the Global South have disparate access to organic soil amendments. While many national governments, including the Government of India, subsidize inorganic fertilizers, farmers typically rely on local, unsubsidized sources for organic soil amendments. Simultaneously, people in the Global South have inconsistent access to improved sanitation. Ecological sanitation (ecosan) represents an approach to ensuring that nutrients and carbon obtained from agriculture are returned to agricultural land while also providing people in both rural and urban spaces with improved sanitation.

The appearance of composted human feces, which have a lighter color and little or no objectionable odor when fully composted, was regularly identified as facilitating farmer use. Farmers also indicated that they observe benefits to rice crop health and crop yield following the application of human feces compost. These results suggest that organizations involved in the implementation of ecological sanitation should work to ensure that latrine users receive training and support in composting and agronomic advice to promote the integration of excreta-derived fertilizers into farmers' existing soil fertility management strategies.

Keywords: ecological sanitation, soil fertility management, excreta derived fertilizers, circular bionutrient economy

ID ABS: 138380

2. Soil and humanity
2.15 133605 - Epistemologies and Ontologies of Soil: Towards New Politics of Soil Knowledge

BAROQUE SOIL

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Mexico City's ongoing environmental crisis is characterized by three primary problems: flooding, subsidence, and water scarcity. Over the course of the 20th century these problems have become increasingly inextricable from one another. Large scale urban land subsidence causes infrastructural damage and topographic changes that cause flood risk, which in turn results in ever more water scarcity and increased subsidence. Today, the consequence of this environmental condition is a silent and unacknowledged 'poverty trap' for residents who lives are subject to the precarity and perennial uncertainty of geological risk. Debts related to the repair and survival of subsidence related damage accrue disproportionately in parts of the city that are already marginalized, however the geography of this inequality is not determined by the center-periphery dynamics that historically shaped the city's urbanization. Instead, the largest debts emerge at the intersection of volcanoes and lakes, in an area whose boundaries are defined by a particular soil.

This soil, more than any other material condition, has shaped the contours and conditions of possibility for Mexico City's environmental crisis today. In this presentation, the soil's legal, technical, and metaphysical illegibility to the primary institutions of civil society in the 20th century will be considered in detail through an analysis of six key soil profiles in the Mexico City-Mezquital Valley hydrological system. Each profile takes up a different kind of illegibility through the specific soil chemistries, social relations, and historical events that have factored in the soil's formation.

Keywords: soil taxonomy,wastewater agriculture,anthropocene,Mexico

ID ABS WEB: 136185

2. Soil and humanity
2.16 133780 - Soil as a cultural heritage:
the soil knowledge as a heritage for the future generations

SUELÓFONO: HOW TO FOSTER GLOBAL SOIL AWARENESS THROUGH A SPANISH-LANGUAGE PODCAST

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Soil, a fundamental resource crucial for sustaining Earth's ecosystem, often goes unnoticed due to it remains invisible and hidden beneath our feet. To address this knowledge gap, we introduce the Suelófono initiative—a pioneering podcast in Spanish dedicated to soil science. Developed collaboratively by the Proyecto Suelox and the Institute of Geology at the National Autonomous University of Mexico, with support from the International Union of Soil Sciences Stimulus Fund, Suelófono aims to provide accessible insights into various aspects of soil science.

This initiative, strategically launched during the pandemic, spans three seasons, each consisting of six episodes. The podcast features expert interviews, predominantly from Mexico, supplemented by discussions with international soil science authorities such as John Galbraith (in English), Peter Schad (Germany), and Alberto Hernandez (Cuba). Topics explored include the formation duration of soil, degradation rates, paleosols, and the presence of extraterrestrial soils.

We are delighted to report that Suelófono has been enthusiastically received in Mexico and other Latin American countries, as well as Spain, and has even piqued the interest of non-Spanish speaking nations like Turkey, Poland, and Thailand. In summary, this initiative has made a positive impact in spreading the knowledge of soil science and received international recognition when honored with the FAO's King Bhumibol World Soil Day Award 2022.

Keywords: Soil awareness,Soil education,Global impact,Digital dissemination,Proyecto Suelox

ID ABS WEB: 137272

2. Soil and humanity
2.16 133780 - Soil as a cultural heritage: the soil knowledge as a heritage for the future generations

BIOLOGICAL SOIL CRUSTS AND TEACHING: AN INNOVATIVE WAY TO TEACH SOIL SCIENCE THROUGH PROJECTED AUGMENTED REALITY

F. AYALA-NIÑO [1], J. SOSA-QUINTERO [2], D. FABILA [3], F. LÓPEZ-GALINDO [1], A.G. OSEGUERA-BORJAS [3], M. SOSA-BÁRCENAS [3], A. AMBRIZ-HERNÁNDEZ [3], M. HERNÁNDEZ-CHÁVEZ [3]

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Thanks to advances in augmented reality interfaces, and the use of direct-projected augmented reality (DirectAR), it is possible to display or project AR images on surfaces with arbitrary shapes or colors under random lighting environments without image distortion using a projector camera system, creating new possibilities for educative tools that would be applicable to any academic level allowing innovative and interactive learning environments. In the case of earth sciences, and specifically soil sciences, this technology has the potential to create a learning tool for bachelor students in earth and biological science areas, trying to attract students' attention through digital media in combination with real samples, seeking to develop aptitudes and analytical skills as observation for the search of detailed features of the species for identification purposes. In the present study, we use a total of 22 samples of biological soil crusts from Tehuacan Valley, Puebla México to develop a projected augmented reality system for classroom teaching, before fieldwork experience as training for the student. The present proposal aims to establish an interactive and immersive learning strategy designed for students, seeking the development of an application focused on forest and soil sciences as an alternative to what is established in the scientific literature with a medical or industrial focus, being one of the first works focused on these
biological groups.

Keywords: BIOLOGICAL SOIL CRUSTS,PROJECTED AUGMENTED REALITY,EDUCATION,DIGITAL MEDIA,SOIL SCIENCES TEACHING

ID ABS WEB: 137587

2. Soil and humanity
2.16 133780 - Soil as a cultural heritage: the soil knowledge as a heritage for the future generations

THE SOIL MUSEUM OF PERTOSA-AULETTA (ITALY) – ESPLORING THE SOIL - A HIDDEN WORLD UNDERGROUND

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A unique museum in Italy, with few counterparts around the world, inaugurated on April 22, 2016, the day when the United Nations celebrate Earth, offering a singular knowledge journey dedicated to the soil, specifically to what happens in that space underground, fundamental for life on our planet. Beneath our feet, there is tumultuous activity, chemical, physical, and biological, upon which the landscape we inhabit, the food we eat, and our survival on the planet depend. The Soil Museum in Italy is precisely located in the Campania Region, Salerno Province, and the Municipalities of Auletta and Pertosa. The museum consists of 1,500 square meters of covered exhibition space and connected paths outside the museum. An extraordinary adventure to experience with all five senses through a series of activities to observe, touch, play, and be amazed. A narrative about soil alive and soil formation processes, and their relationships with ecosystems, living communities, and landscapes, the long-term interaction with human societies.
The Soil Museum is part of a naturalistic complex located in the Alburni Mountains, in the Cilento Geopark, which includes the caves of Pertosa-Auletta. They are also the only caves in Europe to preserve the remains of a pile-dwelling village dating back to the 2nd millennium BC, which also inspired the creation of an archaeological speleo museum a unique exhibition in the world that tells the story of the past of the caves of Pertosa-Auletta when the cavity housed a settlement on stilts and was considered a sacred place. The museum complex, managed by the MIDA Foundation, aims to be an attractive system that revolves around the enhancement of local environmental resources and cultural assets, and support for scientific and technological research. The Museum consistently promotes scientific and social research activities in synergy with local stakeholders. Its model, based on the sustainable management of environmental and cultural heritage, has been recognized as a national excellence

Keywords: Soil Museum,Alburni Mountains,Archaeological speleo museum,MIDA Foundation,Soil Alive

ID ABS WEB: 137677

2. Soil and humanity
2.16 133780 - Soil as a cultural heritage: the soil knowledge as a heritage for the future generations

RAISING THE PROFILE OF SOIL THROUGH SOIL ART

K. KURTZ

Cornell University, Ithaca, USA

Kirsten Kurtz is an artist and soil scientist who creates paints from soil that she uses to create multi-layered paintings. She shares her methods publicly, and they are now taught in classrooms around the world.
As an artist, Kurtz led a team to win an international soil painting contest sponsored by the United Nations-Food and Agriculture Organization to celebrate World Soil Day 2017, and she has been recognized as an Artist for the Earth by the Earth Day Network. As a scientist she manages the Cornell Soil Health Laboratory, a leader in soil health assessments. In both roles, she endeavors to draw global public attention to soil as a precious natural resource, as important to our quality of life as clean air and water.
Kurtz will share a digital art show of her work as she discusses the historical use of soil pigments in paint and her work communicating the importance of soil through her commissioned pieces, soil painting events and the media coverage of her work. She will offer practical tips on holding soil painting events for the public, share her methods for inspiring interest in soil and discuss the power of creative scientific communication.

Keywords: Soil art,Soil awareness,Scientific communication

ID ABS WEB: 138293

2. Soil and humanity
2.16 133780 - Soil as a cultural heritage:
the soil knowledge as a heritage for the future generations

DEATH TO THE BORING BROWN BLOB!

K. VANCAMPENHOUT

KU Leuven, Leuven, BELGIUM

'It is a shame that the many excellent and interesting papers by soil scientists remain confined to library shelves. New findings by chemists, geologists and ecologists are regularly reported by the media, but new information about soils is overlooked.' - These are the words of Hans Jenny, written in 1984. Forty years later, despite the shift from library shelves to digital databases, soil science still struggles for recognition in popular science communication. In the face of global challenges tied to soil, it is imperative for soil scientists to enhance their efficiency in popularizing their discipline. Unfortunately, efforts thus far have often resorted to portraying soils as a 'boring brown blob,' a misleading oversimplification hindering public engagement.
Beyond being inaccurate, oversimplification lacks intrigue and fails to convey the soil as a living, integral part of ecosystems susceptible to degradation. Protecting a generic brown substance is hardly a compelling message. Moreover, it denies non-specialists the opportunity to explore soils themselves. Pedology plays a crucial role in providing the language needed appreciate the below-ground world. Just as amateur ornithologists or astronomers start by learning names of birds and constellations, understanding the natural beauty, variability, and occurrence of soils begins with basic soil types as a foundational language for comprehension.
Basic pedology is not overly challenging—remembering 32 soil reference groups or 12 soil orders is comparably straightforward. The challenge lies in how the information is presented. Soil heritage, in-situ or in exhibits, provides an excellent starting point to introduce soil stories and language. As the below-ground world remains hidden from most, uncovering the beauty and legacies of soil heritage sites can create the immersive, authentic experiences needed to reconnect people to soils.
Drawing on numerous personal experiences in soil storytelling, exhibits and installations, this contribution explores effective methods to communicate soil science, emphasizing the need for engaging narratives that captivate audiences and facilitate a deeper engagement with the intricate world beneath our feet.

Keywords: soil literacy,soil heritage,collections,communication,story telling

ID ABS WEB: 138304

2. Soil and humanity
2.16 133780 - Soil as a cultural heritage: the soil knowledge as a heritage for the future generations

TALES OF THE SOIL: BRIDGING THE GAP BETWEEN SOILS AND PEOPLE

S. MANTEL

ISRIC World Soil Information, WAGENINGEN, THE NETHERLANDS

Soil is a complex and variable medium. Even though soils are omnipresent and essential for life, most people are unfamiliar with the resource. The complexity and hidden nature of soil is only partly the cause for lack of awareness of soil as a resource and its functions. The general lack of perception of soils means that sensory information on soils is not processed to the extent that it leads to understanding and awareness. In other words, people that have no education or prior knowledge in soils need to be introduced to it to be able to engage in it and appreciate it.

The World Soil Museum informs and educates about the nature and the diversity of soils and what that means for society and for science. The museum displays soil monoliths from around the globe. Soil monoliths are undisturbed, vertical soil samples of about 1.5 m depth. They present the soil very close as to how they are seen in a profile pit in the field, with the layering, colors and structure of the soil. The monoliths are accompanied by physical and digital media. The gap between the visitors and the topic of soils and the monolith collection is bridged through guidance and tours and is supported with digital (online) media and audio-visual material. Storytelling is used to bring soils closer to people in a way that it inspires and is more easily remembered so that it will be passed on in communication between people. Stimulating stories are told of soils placed in the context of society. They stick to the mind as they link with perception and understanding of the public on topics such as people, history, land management, food security, and climate change. Examples are given of these stories and how that stimulates learning and dialogue with museum visitors.

Keywords: Storytelling,Dialogue,Digital media,Learning

ID ABS: 136424

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

THE LEGACY OF URBAN SOILS IN BRUSSELS (BELGIUM)

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Urban soils have been largely neglected for a very long time. Illustrative for this is for instance the Belgian soil map that shows a blank for the urban areas. Over the last decades there is an increased interest in the urban soils. One of the triggers are the manifold archaeological excavations realized in urban areas. Facing the complexity of the urban stratigraphy, archaeologists started to involve geoarchaeologists in their research. In Brussels this led to the systematic study of urban soils on all the archaeological interventions, whatever their size (Devos et al., 2020). Whereas initially the main research topics concerned the understanding of complex site stratigraphy, the last decades the perspectives widened and new avenues, such as the understanding of late medieval agricultural and horticultural practices in an emerging city, the organization of urban space, the preservation of urban soils and ancient soil pollution, were explored. It also resulted in the development of an interdisciplinary research protocol to tackle the emerging research questions.
The present contribution intends to illustrate how the improved understanding of the formation of urban soils in Brussels impacts on the current research, and how it creates awareness for the importance of urban soils for past, current and future communities.

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Devos, Y., Nicosia, C. & Wouters, B., 2020. Urban geoarchaeology in Belgium: Experiences and innovations. Geoarchaeology, 35, 27-41.

Keywords: Urban Soils,Soil Preservation,Soil Pollution,Urban Development,Urban Geoarchaeology

ID ABS WEB: 136571

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

ASSESSING AVAILABILITY AND BIOACESSIBILITY OF LESS STUDIED ELEMENTS IN BARCELONA URBAN TOPSOILS: A GEOCHEMICAL SURVEY

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Urban soils are receiving increasing attention due to the large number of ecosystem services these provide: a resource for local food production, fostering social community resilience, and serving as a means to enhance green spaces within urban areas. However, their quality is largely impacted by anthropogenic activities including industrial operations and traffic emissions. As a result, they act as both primary and secondary potential-pathways for the exposure of humans and the ecosystem to potentially toxic elements. While extensive research has focused on heavy metals in soils, a thorough assessment of potential risks to urban dwellers requires studying a wider range of elements, especially those found in ultra-trace levels with poorly understood ecotoxicological effects from chronic exposure to low doses. To address these knowledge gaps, we surveyed topsoils from 20 urban allotments and 17 parks across Barcelona (Spain) and determined the concentrations of 55+ elements, as well as their 0.01M KNO_3, 0.05M EDTA and 0.005M DTPA extractable concentrations as estimates of their bioavailability. We also size-segregated soils to extract the involuntarily ingestible and inhalable particles to examine multi-pathway exposure estimates. The majority of soils were relatively unpolluted, with only few sites showing high metals loading reflecting anthropogenic inputs. In general, the mobility of elements was moderately low although the EDTA and DTPA-extractable pools of several specific trace elements deemed worth further investigation. Our findings also evidence that the physiologically relevant soil particles (i.e $<250\mu m$) are compositionally different to the bulk soil in terms of levels of total and mobile trace/ultra-trace elements. Two in-vitro tests simulated dissolution processes in lung environments following inhalation, while another mimicked gastrointestinal dissolution. Results revealed that only a limited number of trace elements are soluble in the (sub)ppm range in these synthetic fluids. Our findings suggest that while total concentrations are the exposure metrics used by guidelines, other estimates may provide more accurate environmental assessments of the fine surface particulates and their potential impact on human health.

Keywords: Urban allottments, Soils fractionation, Ultra-trace elements, Bioavailability, Bioacessibility

ID ABS: 136599

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

COMPARATIVE ANALYSIS OF GREEN ROOF SUBSTRATES WITH RECYCLED MATERIALS: A THREE-YEAR STUDY

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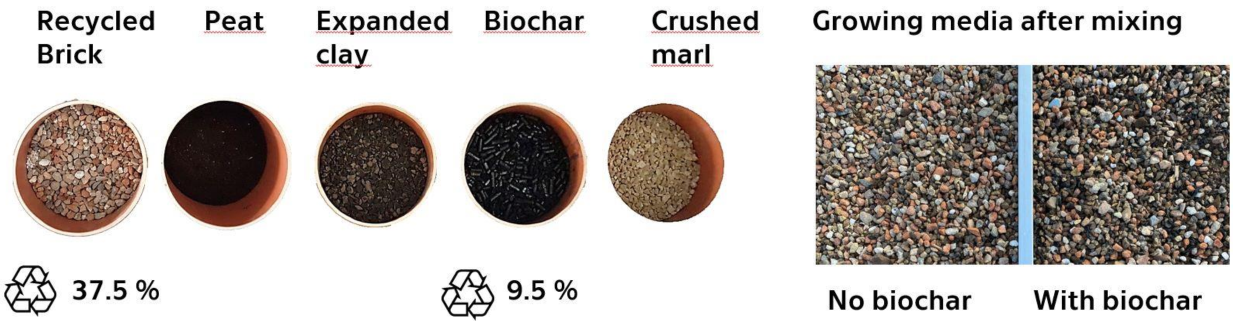
The study aimed to test newly developed green roof substrates containing a significant amount of recycled materials under real conditions and compare them with a commercially available substrate.
A two-layer extensive green roof of 7×5 m2 was constructed using three different substates. Two of them were based of recycled materials to reduce primary materials extraction and increase the utilization of recyclate. These two substrates contained the same amount of recycled demolition waste with major proportion of crushed brick (37.5% by volume), but differed in the amount of pyrolyzed sewage sludge biochar (9.5% by volume in one and none in the other). The commercial substrate consisted mainly of expanded shale, lava and pumice. To enhance the water retention layer, hydrophilic mineral wool was used as the bottom layer of the green roof system. Vegetation was established using sedum carpets.
The experiment was established in 2020. Undisturbed substrate samples were taken in 2021, 2022, and 2023 to monitor changes in hydrophysical properties, such as retention curves, saturated hydraulic conductivity, and grain size. Vegetation development was visually monitored over time, while substrate temperature and humidity were continuously measured by autonomous sensors.
The results showed that plants in the biochar amended substrate rooted faster and achieved higher cover. Plants in the biochar-containing plot remained lush green for a longer period, even during periods of lower rainfall or more extreme temperatures, while those in plot with commercial substrate or without biochar turned red in response to stress. Moreover, the biochar-amended substrate showed a greater number of emergent plants, primarily grasses which is attributed to the increased availability of nutrients from biochar.
The surface temperature amplitudes were higher than those of the substrate and mineral wool temperatures, locally influenced by the plant biomass surrounding the sensors. The temperatures of the substrate and hydrophilic mineral wool were more stable. Differences in substrate temperatures were observed particularly between substrates containing recycled materials and the commercial substrate.



Keywords: Recycled materal,Green roof substrate,Biochar,Recycled demolition waste

ID ABS: 136693

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

EFFECT OF PLANT SUCCESSION ON PROPERTIES OF TECHNOSOLS DEVELOPED ON A HEAP OF HISTORICAL POLYMETALLIC ORE MINE IN RADZIMOWICE, SUDETY MTS., SW POLAND

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Metal ore mining results in the formation of mine waste heaps, which formerly were not reclaimed and were subject to spontaneous plant succession, which initiated the formation of Technosols. The aim of the study was to determine the influence of plant succession on soil properties of Technosols developed on a heap of historical polymetallic ore mine. The study area was located in Radzimowice, Sudety Mountains, SW Poland, where copper and silver ores were mined (from the 15th century to 1925). A sequence of three soil profiles on a heap representing areas with increasing degree of natural plant succession (profiles RA1<RA2<RA3), was studied. Standard soil science research methodology was applied to determine soil properties. X-ray diffraction method was applied to determine soil mineral composition. Total content of trace elements was measured, as well as mobile forms of these elements dissolvable in H2O and 0.1M HCl were determined. The investigated soils were strongly skeletal with fine earth characterized by loamy texture. The pH value of the soils ranged from 4.4 to 7.8. The total organic carbon (TOC) content ranged from 0.29% (C horizons) to 43.8% (O horizons). The Ca2+ dominated among the basic exchangeable cations in the sorption complex. Quartz and mica were predominating minerals, followed by chlorite, feldspars and admixtures of calcite. According to Polish regulations, the studied soils were contaminated with As, Cu and Pb. The permissible contents of Co and Sb were exceeded in some horizons. The trace elements studied are stable in H2O. In 0.1M HCl, Cu, Cd and Co had high mobility (above 20% on average), whereas Mn, Ni and Zn were slightly mobile. Arsenic, Cr, Sb and Fe were the least mobile elements. Research showed that the appearance of vegetation on the mine waste heap caused the accumulation of soil organic matter (SOM) in the topsoil. The accumulation of SOM caused soil acidification and increased the cation exchange capacity in the upper parts of the profiles.

Keywords: Technosols,plant succession,pedogenesis,mine wastes

ID ABS: 136912

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

PERMEASOL – ECOLOGICAL TRAJECTORY OF A DESEALED URBAN SOIL

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Soil sealing is a prominent feature of urbanization. Yet it leads to numerous pressures: destruction of natural habitats, increase of floods, urban heat island effect. Current climate and biodiversity crisis led to question this type of land management with desealing of urban soils. Moreover, while sealing effects on soil are well-known, desealing effects are less characterized. Using a holistic approach to characterize the evolutions of urban soil after desealing is thus crucial to understand the effect of such practice on water, soil and biodiversity, but also the underlying mechanisms and the required time to retrieve a functional soil.
Permeasol aims at studying the ecological trajectory of a desealed urban soil over 3 years: can this intervention allow the growth of a functional ecosystem, to what extent and how fast? This project questions the long-term effects of urban soil sealing, even after desealing.
Three plots were desealed – removing the asphalt layer –, between September 2023 and January 2024: two located in an urban environment (Strasbourg, France) and one in a nearby forest. Sealed surfaces directly next to each desealed plot (~600m2 each) were maintained: the evolution of this control allows comparing the dynamics of desealed and sealed soils.
Several analyses are regularly carried out to try and integratively capture the system dynamics: water infiltration and storage, quantity and functional characteristics of vegetation and soil microorganisms, soil fertility and pollution, and soil chemical composition. The interactions and loops between associated processes will be investigated.
At first, the desealed soils were characterized as a sand/gravel mix (~70% of soil particles >2mm) with little organic matter (~1%), low biological activity (~220mgC/kg) and no plants. Water infiltration has significantly increased after desealing. Vegetation appeared within a month, with both pioneer and typical asphalt-specific species. Soil heat decreased following desealing, and is expected to maintain this pattern with vegetation growth. Both water storage and organic matter content are expected to increase in the next months.

Keywords: Urban soils,Desealed soils,Interdisciplinary studies,Soil biodiversity,Soil physics and chemistry

ID ABS: 137184

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

INNOVATIVE APPROACH ENABLING SOIL AND FOOD QUALITY IN VEGETABLE GARDENS OF THE METROPOLITAN AREA OF NAPLES

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Urban soil is a non-renewable resource, threatened by anthropic activities, infrastructure sprawl and sealing. Urban agriculture is a common practice enabling a sustainable use of soil and enhancing its ecosystem services. Although many soils in the metropolitan area of Naples are already used for crop production, little is known about soil health and food quality/safety.
The research activities of 2-year HealthySoil4QualityFood project (CUP-E53D23011040006 PRIN-2022, financed in the frame of European Union Next Generation EU), aim at increasing the knowledge on: i) soil fertility and possible chemical contamination in vegetable gardens of Naples metropolitan area; ii) irrigation water quality; iii) crop biodiversity and sustainability of cultivation practices, and chemical quality of edible biomasses (mineral nutrients, bioactive compounds and possible contaminants); iv) risks associated to possible contamination, throughout integrated environmental and human exposure modelling; v) public awareness about soil ecosystem services and social benefits of urban farming.
Five case studies were recently selected based on geographical distribution and proximity to potential sources of contamination, scope of cultivation (self-consumption of crops or educational gardens) and type of land users/farmers. In these areas, we started assessing the soil physicochemical properties and fertility and irrigation water quality. The first results evidenced an overall good quality of urban soils, showing a sandy-loam texture, neutral-to-sub-alkaline pHs, good nutrient bioavailability and low-to-moderate occurrence/bioavailability of contaminants. The nutritional value and safety of food products will be monitoring in different growing seasons. Realistic exposure scenarios to possible contaminants in each case study will be developed by MERLIN-Expo tool.
The cultivation techniques and the management of vegetable gardens will be oriented toward sustainable/resilient and site-specific models, leading to a better use of resources and enhancement of soil fertility, biodiversity and food quality/safety. At the end of project (Oct 2025), HealthySoil4QualityFood will integrate the obtained information and, in collaboration with main stakeholders engaged during the project, will develop specific indicators and guidelines to better assess and manage the soils in urban environments.

Keywords: urban soil,sustainable use of resources,food quality and safety,potentially toxic elements,health risk assessment

ID ABS: 138016

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

TRANSPLANTATION OF GIANT TREES USING PEAT-BASED GROWING SUBSTRATE

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There are many giant trees (old trees, protected trees, natural monuments, etc.) in cities and provinces in Korea. These giant trees are threatened with survival due to various factors such as changes in the ecosystem caused by urbanization and industrialization, land use change, environmental pollution, and submersion caused by dam construction. As a result, the need for transplantation of many giant tree has emerged in Korea since the early 1980s. In this paper, we would like to share experiences of giant tree transplantation using growing substrate developed from peat resources in Korea. Two most famous cases are 400-year-old Chinese scholar tree (Styphnolobium japonicum L. Schott) transplanted at the Central Agricultural Cooperatives in Seoul in 1983 and 780-year-old ginkgo tree (Ginkgo biloba) transplanted in Yonggye-ri, Andong in 1993. Due to construction of a new building, the Chinese scholar tree was transplanted some 100 m from the original location. Submersion of Yonggye-ri, Andong caused by a dam construction was the reason for transplantation of the important giant tree. It took 6 months to transplant (lift) the gingko tree 17.5 m from the original position. The space between the original position and transplanted position was filled with the peat-based growing substrate. The growing substrate used in this study had superior water and nutrient holding capacity compared to coir-dust- and moss-peat-, the widely used components based growing substrates. In addition, the growing substrate for this study can be mixed with other materials such as all kinds of chemical fertilizers, growing substrates, compost, perlite, vermiculite, zeolite, etc. Therefore, the potential use of the growing substrate used in this study can be expected to indoor plants and agricultural purposes.

Keywords: giant tree,tree transplant,peat,growing substrate

ID ABS: 138258

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

MICROBIAL COMMUNITIES OF URBAN AND INDUSTRIAL POLLUTED SOILS IN THE RUSSIAN ARCTIC

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Russian Arctic is a unique research area where soil is affected by high anthropogenic pressure coinciding with severe climatic conditions. The effects of urbanization and industry on SMC in the Russian Arctic remain overlooked. This research aimed to compare urban (Murmansk, Apatity) and industrial polluted (Pechenganickel copper nickel plant, Kandalaksha aluminum plant) soils to natural Podzols and explore relationships between chemical pollution and microbial properties. The SMC activity and diversity were analyzed based on 1) number of rRNA microbial gene copies by real-time PCR method; 2) community level physiological profile of SMC by MicroRespTM technique; and 3) taxonomic diversity of SMC by metabarcoding. The principal changes in urban soils' properties compared to the natural references included a shift in pH and an increase in C and nutrients' contents. Industrially polluted soils had a higher content of heavy metals (copper-nickel plant), fluorine and aluminum (aluminum plant) compared to urban and natural soils, whereas carbon content and pH were similar to natural references. The SMC structure in all soils was dominated by bacteria, however the share of fungi in urban soils was four and times higher compared to soils of natural and industrial areas. Industrial pollution decreased microbial biomass and diversity, whereas an opposite patter was found for urban soils, where the number of rRNA gene copies and Shannon diversity index were significantly higher than in natural Podzols. The taxonomic structure of fungal communities was sensitive to the type of anthropogenic influence with the specific species dominating SMC in urban (e.g., Sordariomycetes) and industrial (e.g., Agaricomycetes) areas. Urban and industrial development represent the two alternative pathways of SMC evolution in anthropogenically disturbed soils. Industrial development suppresses SMC, whereas urbanization including development of urban green infrastructures creates a new niche for SMC. These outcomes highlight the potential of urban soils to support microbial diversity and functionality that shall be considered for sustainable development strategies and soil-based solutions in vulnerable ecosystems of Arctic cities.

Keywords: Anthropogenic pollution,Urbanization,Soil health,Microbial activity,Arctic cities

ID ABS WEB: 137826

3. Soil governance

3.01 133567 - Soil and Water Conservation: Water- drainage and irrigation strategies: from securing production to protecting environment

EFFECTS OF RAINWATER HARVESTING PITS ON SOIL MOISTURE IN CZECH TEMPERATE FORESTS

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In temperate climates, efficient use of rainwater is becoming an increasingly important tool for maintaining soil moisture in sustainably managed forests. Here, we describe the use of rainwater harvesting pits to concentrate rainwater infiltration into deeper layers to maintain soil moisture at suitable levels in beech (Fagus sylvatica) forests. In spring 2022, two 6.5 m3 test pits were established alongside forest roads at two test localities, the first a “dry” locality, characterised by low soil moisture, spatial homogeneity and Cambisols, and the second a “wet” locality, characterised by increased heterogeneity, with hydromorphic Stagnosols and Gleysols dominating. In each case, one pit was located near a pipe culvert and the second at a site with no centralised inflow. In addition, soil moisture was assessed in the same stand, away from the test pits, as a control. Soil moisture was monitored at depths of 10, 30 and 60 cm, 1 m from the pit edge, on the left, right and downslope sides. Here, we present preliminary results (7/2022 – 12/2023) showing the soil hydrological response to pit installation at the two localities. Early results indicate that i) the pits show unexpectedly low efficiency in retaining rainwater in the soil; ii) in winter, soil moisture around the pits increased to soil-water retention capacity more rapidly than at the control site; iii) despite this, soil drying was similar between pits and the control site over the 2023 growing season; and iv) both test pits showed less soil moisture variability during rainfall events than the control site, most likely due to a reduction in preferential pathways in soil around the pits. Despite the range of natural hydric conditions tested at the localities (wet/dry), the rainwater harvesting pits appear not to have fulfilled their expected potential for supporting the soil hydric regime. Nevertheless, soil moisture monitoring will continue at both localities to assess any long-term effects on soil hydrology.

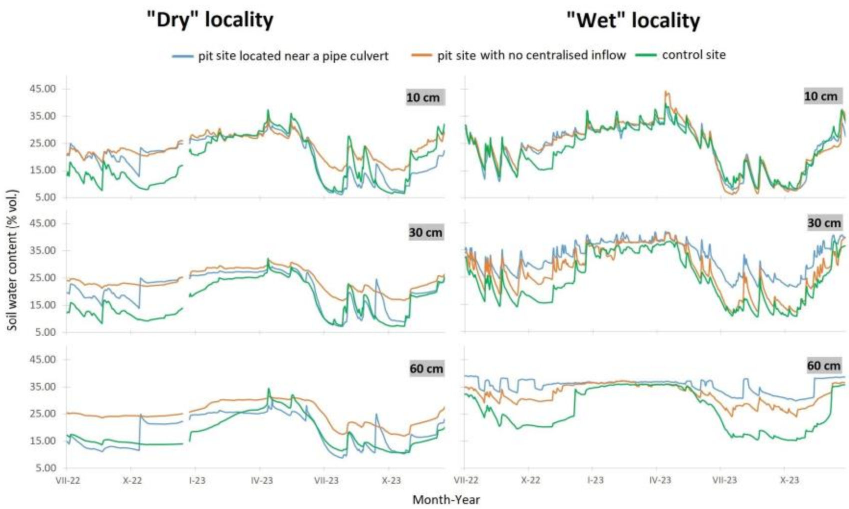

Fig. 1 The course of daily mean soil moisture at the monitoring sites of both localities ("dry"/"wet"), measured at different depths

Keywords: Forest management,Forest soil,Infiltration pits,Soil moisture content,Water storage

ID ABS WEB: 138308

3. Soil governance
3.01 133567 - Soil and Water Conservation: Water- drainage and irrigation strategies: from securing production to protecting environment

OPPORTUNITIES FOR VARIABLE RATE IRRIGATION IN RESPONSE TO VARIABLE SOILS

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Variable rate irrigation (VRI) is the ability of an irrigation system to apply different amounts of water to different areas of a field. This is usually done because of differences in soil water-holding capacity throughout the field. Irrigation technology has advanced to where this capability is possible, especially with center pivots, the most popular irrigation system in the United States. VRI is done by either varying the speed of the irrigation system or by cycling sprinklers to apply different amounts of water along the pivot lateral, or both. This publication will take a theoretical approach to estimate the amount of water and power savings that can be achieved through variable rate irrigation technologies. Modeled water and power savings are estimated for a variety of different conditions. We will also discuss the conditions under which large water and monetary savings are most likely to be realized.

Keywords: Variable Rate Irrigation,Variable Soils,Profitability

ID ABS WEB: 138328

3. Soil governance
3.01 133567 - Soil and Water Conservation: Water- drainage and irrigation strategies: from securing production to protecting environment

DRAINAGE- FROM SECURING PRODUCTIVITY- TO ENVIRONMENTAL PROTECTION IN NORWAY

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Northern conditions have high seasonal variations -wet climate and winter period with frozen soils and snow cover. Short growing season and wet soil restrict possibilities for agricultural production. In Norway, the National Soil Inventory has classifies that about 2 /3 of the agricultural area need drainage for agricultural production. In the middle of the 1800 silty soils were cold in spring and had low nutrient status and was valued low. Before 1860 the drainage methods were open ditches, narrow channels with stones. Tile drainage started from about 1860 and increased from about 1920. There was a main change in drainage activity and systematic drainage between 1950- 1970 resulting in yield increase between 20- 30 %. More use of tractors and maschinery lead to increased need of drainage. Subsidies for drainage – covering up to 40 % of costs also promoted the activity. New mechanisation for drainage and spesialised contractors also boosted the activity. Plastic pipes were introcuced by the end of the sixties. Subsidies for drainage was ended by the end of the 1980-ties and led to very low drainage activity-even though economic analyses showed it was economic profitable. Now. large area need new drainage on parts of the area or on entire fields. Heavier maschinery have led to soil compaction, reduced yield and increased runoff, erosion and loss of nutrients. In Norway, this has led to new introduction of subsidies for drainage on earlier drained areas. Changes in climate with more wet and rainfall period needs new recommendations of drainage design and intensity. Now there is also documented that nitrogen is being lost through drainage system and that measures like controlled drainage, or wetland to reduce losses. Drainage can also transport both erosion particles and phosphorus to waterbodies through cracks and preferential flow. Drainage plays also a role in controlling emissions on greenhouse gases. Drainage needs to be balanced both for agriculture and for environmental purposes.

Keywords: drainage,environmental effects,yield,drainage design,drainage challenges

ID ABS WEB: 140102

3. Soil governance
3.02 133591 - Impact of global trade of food, feed and fiber (3Fs) on soil C and N dynamics, GHG emissions and land use changes

EVIDENCE-BASED NITROGEN INDEXES FOR GLOBAL FOOD SUPPLY CHAINS: PRODUCTION, CONSUMPTION, SPATIAL DISTRIBUTION AND REDUCTION RESPONSIBILITY

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Reactive nitrogen (Nr: all species of N except N2) is essential for agricultural production and human nutrition, but its use is also one of the largest causes of global pollution with serious impacts on human health, biodiversity and ecosystem services, and costs for society. Nr pollution induced by agri-food systems is the global aggregate of millions of diverse producers/products, operating/ produced under vastly different climates, soils and agronomic management, and further complicated by the international trade and socio-economic impacts. To identify effective solutions for this diverse agri-food systems, we present a framework to quantify evidence-based nitrogen (N) indexes to characterize the Nr performance with different Nr loss pathways (losses as N2O, NOx & NH3, aqueous NO3- and with food losses/waste) at varying levels of detail and complexity. This framework allows comprehensive assessment of Nr loss, Nr loss intensity - Nr loss per unit of food or per unit of N produced (NLI) - for individual food items, which are indicators of associated environmental impacts and societal costs. We demonstrate how our N indexes can be used to, firstly, establish N labelling and rating to incentivize farmers to adopt more sustainable N management practices and to guide consumer choice for food products with lower NLIs; secondly, identify hotspots of Nr loss and estimate the associated environmental impacts and societal cost of N pollution; thirdly, estimate Nr loss responsibility driven by consumption to allocate a fair share of responsibility for reducing global Nr loss; fourthly, highlight regions, agri-food systems, and management practices as potential foci for mitigation; and ultimately, make global agri-food systems more sustainable, less polluting and more profitable.

Keywords: Evidence-based indexes,Food supply chain,Responsibility sharing,Incentivize mitigation,Sustainability

ID ABS WEB: 136119

3. Soil governance
3.02 133591 - Impact of global trade of food, feed and fiber (3Fs) on soil C and N dynamics, GHG emissions and land use changes

EVIDENCE-BASED NITROGEN INDEXES FOR GLOBAL FOOD SUPPLY CHAINS: PRODUCTION, CONSUMPTION, SPATIAL DISTRIBUTION AND REDUCTION RESPONSIBILITY

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Keywords: Evidence-based indexes,Food supply chain,Responsibility sharing,Incentivize mitigation,Sustainability

ID ABS WEB: 136651

3. Soil governance
3.02 133591 - Impact of global trade of food, feed and fiber (3Fs) on soil C and N dynamics, GHG emissions and land use changes

INTEGRATED CARBON AND NITROGEN BUDGETS AND COST-EFFECTIVE MANAGEMENT IN CHINA

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Carbon and nitrogen are pivotal elements in the global biogeochemical cycle, exerting significant influence on air and water quality, biodiversity, and human health. Over the past four decades, China has released substantial amounts of carbon and nitrogen compounds into the environment, resulting in noteworthy global and regional repercussions. To effectively monitor and regulate these chemicals, we have developed an integrated model (CHANS-CN) for quantifying carbon and nitrogen budgets in China, investigating their interplay on an ecosystem scale from 1980 to 2020. During the study period, carbon emissions experienced a 6.9-fold increase, while nitrogen emissions saw a 1.3-fold rise, shifting from predominantly agricultural emissions before 2000 to industrial emissions thereafter. Strategic management of carbon and nitrogen in tandem holds the potential for a 75% reduction in nitrogen pollutants released into the air and water, coupled with a 91% decrease in carbon emissions to the atmosphere by 2060. In comparison to the separate control of carbon or nitrogen, co-management could result in an additional reduction of 1.8 million tons of nitrogen and 26.6 million tons of carbon by 2060 for China. This approach comes with a 42% decrease in unit abatement costs and an overall societal benefit of 2,298 billion USD. These findings underscore the necessity of joint carbon and nitrogen management, aligning with China's overarching goals of achieving zero carbon emissions and fostering clean air and water initiatives synergistically.

Keywords: carbon,nitrogen,co-management,cost-effectiveness,integrated model

ID ABS WEB: 137090

3. Soil governance
3.02 133591 - Impact of global trade of food, feed and fiber (3Fs) on soil C and N dynamics, GHG emissions and land use changes

MODELING SOIL CARBON CHANGES IN CLIMATE-SMART PRACTICES WITH A MULTI-MODEL ENSEMBLE APPROACH IN THE US MIDWEST

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This study explores the potential of a multi-model ensemble approach to assess the impact of climate-smart practices on soil organic carbon in agricultural soils across the US Midwest.
We employed eight distinct cropping system models, encompassing a time span of 30 years and a resolution of 4x4 km^2, across 12 States in the US Midwest. We implemented different climate-smart scenarios based on variations in tillage practices (no-till and conventional till) and nitrogen management (full required N application and 75% of it). The multi-model ensemble approach demonstrated promising results in capturing the differences between climate-smart practices. The accuracy of the ensemble's overall mean varied depending on the time span and soil depth under consideration.
By using multiple models, we were able to reduce uncertainties and constraints inherent in individual models, thereby enhancing the accuracy of our assessments. This novel approach holds promise for advancing climate-smart agriculture and could pave the way for more informed decision-making in the face of climate change challenges.

Keywords: Multimodel ensemble,Soil Carbon Changes,Regenerative agriculture,No Tillage,Cover Crops

ID ABS WEB: 137423

3. Soil governance
3.02 133591 - Impact of global trade of food, feed and fiber (3Fs) on soil C and N dynamics, GHG emissions and land use changes

MITIGATION RESPONSIBILITY OF AGRICULTURAL NR LOSSES EMBODIED IN INTERCOUNTY TRADE IN CHINA

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Integration between sustainable agricultural practices, environmental considerations, and economic viability is crucial for the long-term health of the agricultural sector. Here, we conduct a comprehensive analysis of the direct nitrogen (N) flows in cropland and the embodied losses in intercounty trade related to agriculture across 1690 counties in China in 2015 using multiregional input-output analysis. Results show that the total direct Nr losses in cropland was 54.5 Tg N yr-1, while the embodied Nr losses was 30.1 Tg N yr-1. Counties in the East exhibited the most significant embodied N net inflow, and counties in the northeast had the largest embodied N net outflow. Better N management could lead to a 49% reduction (10.4 Tg N) in synthetic N fertilizer inputs, with a 35% decrease (19.1 Tg N) in direct Nr losses and a 41% reduction (12.3 Tg N) in embodied Nr losses while meeting the food demand in 2050. The reduction of synthetic N fertilizer use could achieve 29.1 billion $ economic benefits due to cost saving for farmers and ecological gains, simultaneously causing the varied impact on economic sector, such as yield price and labor demand. Setting the intercounty cooperation mechanisms and allocating a fair share of responsibility for reducing Nr loss can help improve agricultural sustainability.

Keywords: sustainable N management,embodied emissions,intercounty trade,reduction obligations

ID ABS WEB: 138302

3. Soil governance
3.02 133591 - Impact of global trade of food, feed and fiber (3Fs) on soil C and N dynamics, GHG emissions and land use changes

A NOVEL APPROACH DEFINING CARBON INTENSITY SCORE: AN APPLICATION IN EMILIA ROMAGNA

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In the next future, the carbon footprint per unit of surface area will define the farmers capability selling their products on the market. Agricultural products with a lower impact on the carbon footprint will have a higher value, potentially leading to a higher income for the farmer. In this context, the definition of a carbon intensity score, as a metric of the environmental impact of different agricultural practices application, will support the future UE community programs providing the correct carbon credit to each single field. Therefore, the scientific community together with the farmers need to start planning the way to accomplish these new programs. In the complex system of the carbon footprint estimation, our study tries to combine the classic Life Cycle Assessment approach with the state of the art of the carbon sequestration modeling in agricultural soils. Our approach aims to define quantify the carbon intensity of maize grown in Po' Valley by accounting for the carbon emissions and the soil carbon sequestration at the same time, providing an accurate carbon footprint when applying different regenerative agriculture practices (RA). The case of study is the Emilia Romagna region, where different regenerative agriculture practices (with different tillage intensities and crop rotations) were applied over large scale to evaluate the emissions and soil's potential as carbon sink. The results offer a better understanding of the impact of different RA and provide the scientific base for a better understanding on the possibility that farmers, industry and society have to mitigate and adapt to climate change.

Keywords: soil organic carbon,carbon footprint,carbon intensity score,Life Cycle Assessment,no till

ID ABS WEB: 138089

3. Soil governance
3.04 133595 - Soil Governance to Prevent Loss of Fertile Lands: Soil Remediation and Photovoltaics

BIOCRUSTS AND SOLAR ENERGY IN DRYLANDS: A NEW APPROACH IN RESTORATION PRACTICES TO TACKLE SUSTAINABLE DEVELOPMENT

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The ongoing transition towards global decarbonization to achieve sustainable development goals of Agenda 2030 entails a shift in land use, particularly for accommodating to the implementation of renewable energy sources such as solar energy. Nevertheless, the expansion of photovoltaic farms (PVF), which require extensive land areas situated in arid or semi-arid zones, contributes to the degradation of these already impacted regions. It exposes soil to substantial alterations that involve depletion of key soil functions, thereby adversely affecting biodiversity and ultimately their capacity to provide ecosystem services.
Traditional restoration practices often result unfeasible due to the inherent climatic characteristics in these drylands and the especially adverse environment following soil degradation during construction of PVF. However, the utilization of native biocrusts coupled with the installation of solar panels (PVP) which provide partial shading, less extreme temperatures and reduced evapotranspiration offers a promising alternative as biocrust nursery.
Within this framework we propose employing native biocrust forming cyanobacteria to reinstate soil functions after installation of PVP to prevent erosion, conserve soil microbiome biodiversity, and promote ecological restoration and succession. We investigated the effect of soil inoculation with a consortium of cyanobacteria alone or combined with different mulching treatments based on by-products derived from native plants, in soils with contrasting particle size distribution within a PVF in Almeria, SE Spain. We found that the inoculum application especially combined with plant-based mulches have a positive effect on the survival and growth of cyanobacteria and on soil properties, as evidenced by an increase in chlorophyll content and gain in soil organic carbon, with differences between soil textures. We can conclude that the application of this inoculum facilitates the development of an incipient biocrust under PVP conditions in both textures contributing to restoring soil functions. This represents a novel and highly interesting strategy for addressing the need for ecological restoration and integrating it with sustainable development in PVF.
Financed by: TED2021-132332B-C21, project funded by MCIN/AEI/10.13039/501100011033 and UE “NextGenerationEU”/PRTR”.

Keywords: Biocrusts,Photovoltaics,Sustainable development,Soil Remediation,Drylands

ID ABS WEB: 137094

3. Soil governance
3.05 133724 - Industry, Policy and Science: Working Together for Meaningful Scaling of Soil Assessment and Climate Mitigation

SYNERGIES IN COLLABORATIVE MULTI-SCALE SOIL ORGANIC CARBON MODELLING

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Soil organic carbon (SOC) is a crucial component of terrestrial ecosystems. In agricultural systems, it is considered the key indicator of soil health but, given the current pressure to increase food production, soil resources are under threat all over the world. It is critical to monitor changes in soil across the planet, not only to identify vulnerable areas and stop its degradation but also to assess the effectiveness of any potential soil regeneration program. At large scales, monitoring SOC changes usually depends on soil surveys conducted in a top-bottom approach, with a single publicly funded organisation in charge of organising and executing the survey. This centralised framework is cumbersome and has led to a dearth of data that prohibits a regular assessment of soil threats at the national and global scale. At the local scale, farmers and land managers need to routinely survey their properties in order to measure changes in soil condition. Detailed maps are required to adequately apply management practices, comply with environmental regulations and provide accurate carbon sequestration estimates if they decide to participate in carbon credits schemes. However, despite the many methodological and technological developments in soil sciences and related fields, the current in-farm cost of accurately measuring changes in soil remains a barrier to the widespread adoption of practices such as carbon sequestration. The aforementioned problems arise due to the disconnection between local and global or national scales, thus, the challenge is to improve the data and model connectivity between them. Here we present examples of modelling techniques that integrate these working scales to generate synergy and obtain benefits at all levels. Specifically, a) how to effectively integrate local data of dynamic properties such as SOC to inform policies at national or global level without compromising user's privacy and b) how local users can benefit by using global/national models to potentially reduce the data requirements and cost of assessing carbon.

Keywords: soil assessment,multiple stakeholders,multi-scale,collaborative modelling

ID ABS WEB: 137674

3. Soil governance
3.05 133724 - Industry, Policy and Science: Working Together for Meaningful Scaling of Soil Assessment and Climate Mitigation

ASSESSING INDICATORS FOR RESOURCE USE EFFICIENCY IMPACTED BY AGRICULTURAL SOIL MANAGEMENT: AN OVERVIEW

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Understanding the impact of soil functions on crop growth is crucial for transitioning to a sustainable bioeconomy. It's essential to explore how agricultural management can improve efficiencies by targeting soil functions and whether such improvements are possible regardless of soil considerations. To this end, this study presents a systematic literature review on indicators for resource use efficiency in agricultural soil management, defined as the ratio between benefits generated by agricultural production processes and the resources used. Our focus encompasses cropland and pasture management within mixed farming systems, excluding livestock husbandry and greenhouse based horticulture. The review considers quantifiable benefits such as crop yield, financial gains, and embodied carbon or energy, alongside inputs like production costs, fertilizer, land area, fossil energy, or water. Employing keyword searches in Web of Science, Scopus, and Google Scholar, we narrowed down 18,400 results to 266 relevant English journal articles published from 2009 to 2023, excluding conference papers. In the Scopus search, we employed terms like 'efficien*' within title, 'indicator and agricultur*' within title, abstract, and keyword. Similarly, in Web of Science, our search criteria involved 'efficien*' within title and 'indicator,' along with 'agricultur*' within the topic. Regarding resource use efficiency indicators in agricultural soil management, our evaluation considered whether articles addressed agricultural practices, explored connections with resource use efficiency indicators, scrutinized soil functions, and examined interrelationships among different resource use efficiency indicators. We categorized the information extracted from the review into six primary indicators (benefits) groups: aboveground biomass, embodied energy, embodied nitrogen, financial benefits, yield, and sequestered carbon. Each group comprises subdivisions (inputs), resulting in a total of 25 fact sheets that offer definitions and descriptions of the indicators, their correlations with soil management, and insights into their strengths and weaknesses concerning impact area measurement. This dataset serves as a comprehensive toolbox for researchers, enabling them to identify indicators aligned with their specific research requirements.

Keywords: Resource use efficiency,Soil management practices,Indicators,Impact assessment,Literature review

ID ABS WEB: 137989

3. Soil governance
3.05 133724 - Industry, Policy and Science: Working Together for Meaningful Scaling of Soil Assessment and Climate Mitigation

DROUGHT RESILIENCE CALCULATOR: A TOOL FOR FARMERS AND SUSTAINABILITY SPECIALISTS

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Natural climate solutions are essential in fulfilling commitments made in the Paris Agreement, accomplishing UN Sustainable Development Goals, and ensuring sustained and responsible use of natural capital for future generations. While the benefits of adopting regenerative agricultural practices have been well documented, our ability to quantify the impacts of management-induced changes on dynamic soil properties, such as plant-water relations, is limited. For example, previous equations in soil science studies have not accurately represented the positive relationship between management-induced increases in soil organic carbon and plant available water holding capacity (AWHC). Our work uses a pedotransfer function that predicts changes in AWHC that occur from changes in organic carbon that result from adopting reduced tillage practices. This pedotransfer function is being developed into a decision support tool to provide farms and soil managers with locally relevant, benefit-relevant, information on additional water they could expect for crop growth during the growing season if they reduce tillage and increase organic matter. The same tool is being made adaptable to account for these improvements in water availability for supply sheds and sustainability commitments by buyers of agricultural products.

Keywords: Soil Health,Decision Support,Soil Physics,Available Water,Drought

ID ABS WEB: 138207

3. Soil governance
3.05 133724 - Industry, Policy and Science: Working Together for Meaningful Scaling of Soil Assessment and Climate Mitigation

PARTNERSHIPS SCALE SOIL HEALTH PRACTICE ADOPTION AND MITIGATE CLIMATE

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As sustainability goals are developed across industry, we look to the science for robust solutions and education to implement new practices on-farm. Bringing groups working in these areas together in a meaningful way is critical to support the entire system for the desired outcome of climate mitigation. Challenges include, designing research studies and soil assessment methodology to support measurement of practice changes and confidence in claims. Also, internal science- and logistics-based upskilling of companies and other organizations working on climate to ensure the skillsets are developed to support practice adoption and develop meaningful goals. Lastly, consistency in communication of these results to growers who are embracing practice change is critical. It is not reasonable to work in silos, therefore, intentional development of partnerships is needed. We will provide real-world examples of how industry, research institutes and grower-facing organizations are working together to have impact.

Keywords: scaling,soil health,industry,policy,research

ID ABS WEB: 138208

3. Soil governance
3.06 133726 - Potential of Soil Archives to Answer Management Questions Today

WHAT LONG-TERM RESEARCH CAN TELL US ABOUT US AGROECOSYSTEM C STORAGE POTENTIAL.

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Agroecosystem management impacts long-term sustainability of crop production and soil health. Soil organic C is an overall soil health metric and an important greenhouse gas sink for mitigating climate change. Long-term studies are critical in determining the overall impact of conservation management practices. Here, we characterized the impacts of 71 years of cultivation on surface soil carbon (0-12”) at three long-term sites in Akron Colorado, Big Spring Texas, and Moccasin Montana, which span a broad climatic gradient. Sites at Big Spring and Moccasin lost 14-30% SOC and N since 1947. Conversely, SOC increased by 16% at Akron, likely due to the inclusion of conservation management practices such as no-till and continuous cropping. Stable isotope values for SOC shifted to a more C3 signature, reflecting long-term inputs from C3 crops such as cotton, wheat, and other small grains. Interestingly, over seven decades, soil textures changed, which was an unexpected result given that texture is considered a stable inherent soil property. Soil organic carbon was related to changes in percent silt+clay at all sites. A decrease in SOC was correlated with a decrease in silt+clay content at Big Spring. However, the decrease in SOC at Moccasin was correlated with and an increase in silt+clay content. Together, these results suggest changes in physical properties over time, perhaps due to erosion or deposition, will contribute substantially to SOC stock changes. Estimates of soil C storage potential that rely on soil texture will need to account for changes over time. Best-management practices, such as no-tillage and implementation of continuous cropping at these sites will be critical in maintaining soil health.

Keywords: Soil carbon,long-term experiments,isotopes,soil change,texture

ID ABS WEB: 138300

3. Soil governance
3.06 133726 - Potential of Soil Archives to Answer Management Questions Today

THE ISRIC WORLD SOIL REFERENCE COLLECTION: A UNIQUE RESOURCE

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From 1966 onward, ISRIC has established a reference collection and collects, documents, studies the soils of the world, contributes to standards for analysis, description and classification and provides a global overview of soils and their properties. The ISRIC World Soil Reference collection consist of: 1100 soil monoliths (undisturbed sample from a profile wall and conserved with lacquer and glued to a board for display in our museum) from over 75 countries, 5000 soil samples with physical and chemical data, 3500 thin sections, photographic documentation of soil (site and soil profile). These samples have been collected and analyzed in a consistent way, according to international standards and 75% are considered reference soils: complete descriptions, monoliths with accompanying sample material, data from certified, reference lab, characteristic of the map units of the FAO Soil Map of the world.

The ISRIC soil reference collection provides: 1) a reference for (evolving) soil international classification systems (definition and verification of criteria), 2) a basis for research on soil formation, soil properties and soil functions and methodology development, and 3) a unique source for education and advocacy.

The reference collection is used for a wide variety of purposes across the world. Examples are: 1) creation of a global reference IR-spectral library for various soil attributes (ICRAF, Kenya), 2) estimation of soil organic carbon from smartphone images and soil color, 3) comparison of pre- and post-Chernobyl soil conditions in the Middle East (ICARDA, Syria) to assess the impact of nuclear fall-out on soils, 4) research on cesium behavior in a variety of soil types throughout the world by UCL (UCL, Louvain-la-Neuve, Belgium), assessment of soil biota richness and composition through assessment of soil DNA.

Key words: reference collection, monoliths, samples, global

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Keywords: reference collection,monoliths,soil samples,global,standards

ID ABS WEB: 136284

3. Soil governance
3.07 133729 - Nitrogen Use Efficiency as Influenced by the Microbiome

CONTRASTING NITROGEN SOURCE IMPACTS ON NITROGEN USE EFFICIENCY AND SOIL HEALTH UNDER SILAGE CORN PRODUCTION IN A SEMI-ARID ENVIRONMENT

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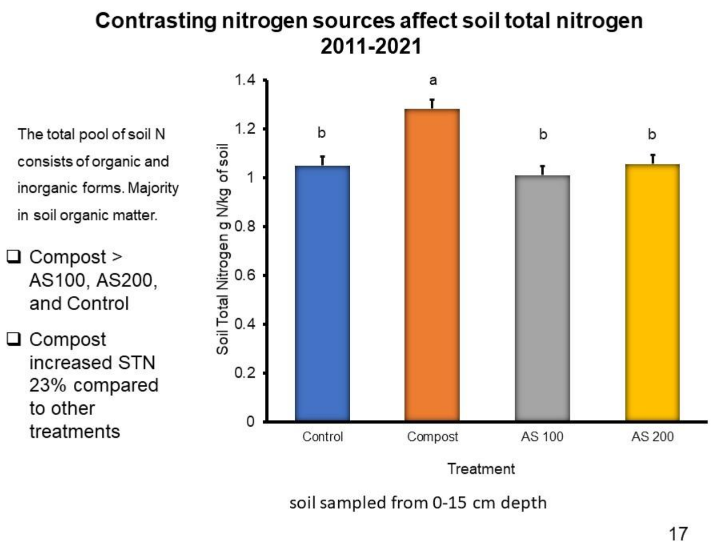
Silage corn production challenges sustainable intensification and soil health in semi-arid environments because the entire aboveground biomass is harvested and removed from the field. An irrigated silage corn field study was conducted for over a decade comparing nitrogen fertility sources using a complete randomized block design with four treatments: control with no nitrogen fertilizer, low ammonium sulfate at 112 kg N/ ha (AS100), high ammonium sulfate at 224 kg N /ha (AS200), and steer manure compost at 224 kg total N/ ha (compost). Research focused on the impact of these contrasting nitrogen sources on silage corn production, nitrogen use efficiency (NUE), N cycling and soil health indicators.
Variable responses in yield, NUE, and soil health indicators across years emphasized the importance of multi-season studies. Yield under compost treatment exhibited a notable 41% increase compared to control but was approximately 31% lower than the average yield under AS100 and AS200 treatments. AS100 achieved a yield comparable to AS200 and demonstrated higher NUE, challenging conventional belief that increased nitrogen applications ensures maximum yield and profitability.
Despite lower yield and NUE, the compost significantly enhanced soil total nitrogen and soil organic carbon by 23%. Multiple soil health indicators increased with strong positive correlations between carbon and nitrogen indicators. These observations highlight interactions between soil carbon and nitrogen and the responsiveness of active organic matter pools and enzyme activities. The nitrifying microbiome was affected by ammonium sulfate fertilizers with increases in both abundance and activity of the ammonia oxidizing bacterial communities in contrast to the response to composts. While AS fertilizers proved effective in achieving higher silage corn yields and NUE compared to compost treatment, compost enhanced soil C and N and soil health indicators. These positive shifts underscore the advantages of combining compost with fertilizers for sustainable soil management. Farmers are encouraged to adopt a balanced approach, incorporating compost alongside commercial fertilizers and implementing soil health practices for sustainable silage corn systems.



Keywords: soil health,maize agroecosystems,enzyme activity,compost,nitrification

ID ABS WEB: 137031

3. Soil governance
3.07 133729 - Nitrogen Use Efficiency as Influenced by the Microbiome

HIGHER THAN EXPECTED: NITROGEN FLOWS, BUDGETS, AND USE EFFICIENCIES OVER 35 YEARS OF ORGANIC AND CONVENTIONAL CROPPING

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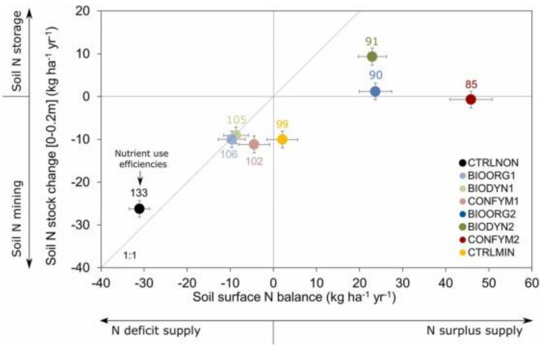
Organic and conventional cropping systems differ in type and amount of nitrogen (N) inputs. In organic cropping only organic fertilizers are permitted, while both organic and mineral fertilizers are used in conventional cropping. Fertilizer type and amount can affect N use efficiency of a cropping system, but contributions via symbiotic N fixation and changes in soil N stocks are rarely quantified based on field data when computing nutrient budgets.

We calculated an N budget that accounts for these contributions based on annual data records for a period of 35 years at the Swiss DOK field experiment. Different organic and conventional cropping systems have been maintained at two fertilization levels: typical for the respective system, and half these doses (low). In each of the 7-year crop rotation periods, legumes (grass-clover ley, intercrops, soybean) were grown in three years. Their symbiotic N fixation was quantified based on 15N studies and legume N yield data. Soil surface budgets (sum of N inputs from fertilization, symbiotic fixation, seeds, and deposition minus N outputs via crop harvests) yielded balances from -31 kg N ha^{-1} yr^{-1} (in non-fertilized control) to +46 kg N ha^{-1} yr^{-1} (conventional system with typical fertilization level).

Nitrogen use efficiencies (NUE; N output with harvests as % of sum of N inputs) reached values >100 % in treatments with negative balances while NUE ranged from 85 % to 99 % in treatments with positive balances. Changes in topsoil (0–0.2 m) N stocks over time ranged from -26 to +9 kg N ha^{-1} yr^{-1} and declined in both unfertilized and mineral fertilized controls, and in systems receiving animal manure at low fertilization levels.

Thus, positive soil surface N balances and animal manure are needed to maintain or increase topsoil N stocks. While NUE was generally high in all cropping systems there remains a trade-off between either soil N mining at higher NUE or potential N loss to the environment at lower NUE.



Keywords: Symbiotically fixed N,Animal manure,Soil N stock,Mineral N fertilizer,N balance

ID ABS WEB: 137727

3. Soil governance
3.07 133729 - Nitrogen Use Efficiency as Influenced by the Microbiome

PHOSPHORUS ADDITION IS REQUIRED FOR IMPROVING SOYBEAN-RHIZOBIA INTERACTIONS AND RATES OF NITROGEN FIXATION

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The capacity of soybean to fix atmospheric nitrogen (N2) through its interaction with rhizobia in the soil microbiome is driven by the multistep process of nodulation, successful nodule development and successful nodule function. Demand for soybean production is continuing to increase, one potential way to meet this demand is through improved N2 fixation efficiency, we are suggesting this can be achieved by optimising phosphorus (P) fertiliser use. Phosphorus is an essential nutrient for nodule formation and function, with adequate P supply being required to optimise N2 fixation and improve soybean yield.

We examined the influence of P fertiliser addition on soybean nodulation, nitrogen fixation and yield following inoculation with USDA 110 in a greenhouse trial, with harvests completed at the R1 (beginning flowering), R3 (beginning pod formation), R5 (beginning seed filling) and R7 (beginning of full maturity) growth stages, to address the following hypotheses:
1. Phosphorus addition will increase soybean nodulation across soybean growth stages, with N2 fixation peaking at the R3 growth stage.
2. Through increasing N2 fixation phosphorus addition will increase biomass production, leading to increased grain yield at the R7 growth stage.

Through addressing these hypotheses, we aim to address potential mechanisms driving improved N2 fixation through the study of plant photo-efficiency, nodule leghaemoglobin concentration, and plant-soil nutrient partitioning.

Results of preliminary experimental work found a ~20% increase in N2 fixation following P addition, resultant from a significant increase in nodule number and dry weight. Work is currently ongoing, and results will be presented at the symposium. The results of this study will enable better mechanistic understanding of the role of P in improving soybean N2 fixation, allowing for improved nitrogen use efficiency and crop productivity.

Keywords: Nitrogen fixation,Phosphorus,Soybean,Yield,rhizobia

ID ABS WEB: 137828

3. Soil governance
3.07 133729 - Nitrogen Use Efficiency as Influenced by the Microbiome

INTEGRATING ALFALFA (MEDICAGO SATIVA L.) INTO ANNUAL CROPPING SYSTEMS TO ENHANCE SOIL MICROBIOME DIVERSITY AND NUTRIENT CYCLING

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Alfalfa or lucerne is a perennial legume forage with the ability of fixing large amount of atmospheric N2 through symbiosis with rhizobia. Crops planted after termination of alfalfa can benefit from the nitrogen mineralized from alfalfa, reducing the need for chemical fertilizer. Alfalfa is colonized by arbuscular mycorrhizal (AM) communities which have an important role in providing nutrients to alfalfa. The objectives were: 1) to determine the AM fungal colonization in alfalfa production systems in North Dakota (ND) and South Dakota (SD) and the factors affecting AM colonization rate; 2) to determine alfalfa variety and K fertilizer rates influence on AM fungal colonization and proliferation; 3) to identify AM community composition in alfalfa roots in intercropping with corn, and 4) to identify the impact of AM fungal additives on the AM community composition of alfalfa. Several experiments were established in both states between 2020 and 2023. In 2021, alfalfa roots were sampled at 30 locations in ND and 22 locations in SD. The AM fungal colonization ranged from 12 to 88%. Plant density, grazing, and irrigation affected AM colonization. For the second objective, three different varieties and K treatments were applied: 0, 168, and 336 kg K2O/ha in single- and split-application. Total seasonal forage yield was significantly lower when no K was applied. All plants showed similar AM colonization rate of 50 to 60%. In Objective 3, alfalfa was grown alone or in intercropping with corn and two row spacings. Corn grain yield decreased only with the wider row spacing. Intercropping did not have an effect on the colonization or diversity of the AM community composition of alfalfa. The AM fungal communities were mainly represented by species of the family Glomeraceae (Funneliformis, Septoglomus, Glomus, Rhizophagus) with mean relative abundances ranging from 68% to 100%. Fungal additives did not increase yield or nutritive value of alfalfa but increased abundance of AM in the Glomeraceae family.

Keywords: alfalfa,arbuscular mycorrhizae,intercropping,potassium,nutrient cycling

ID ABS WEB: 136509

3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

ESTABLISHMENT OF THE WESTERN BALKANS SOIL PARTNERSHIP (WBSP) AS A STRATEGY FOR SUSTAINABLE SOIL MANAGEMENT

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The soils in the Western Balkans (WB) are under pressure due to rising demands for food, feed, and energy supply. Soil degradation in the (WB) poses a transboundary issue, necessitating responsible engagement from all stakeholders to ensure sustainable soil management in alignment with the goals of the 2030 Agenda for Sustainable Development.
The Soil Partnership for the Western Balkans (WBSP) commenced in 2021 under the leadership of the Regional Rural Development Standing Working Group in South Eastern Europe (SWG). Serving as an open forum, the partnership facilitates the gathering of all stakeholders in the region to discuss and exchange knowledge, data, best practices, and experiences related to sustainable soil management. The Western Balkans Soil Partnership was formally established in December 2022 with the aim of preserving, protecting, and restoring soils in the Western Balkan region. Participating countries include Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia, despite differences in developmental stages. The formation of such a partnership is justified, given that the region shares common economic and social challenges, as well as a similar cultural and scientific heritage.
Despite being endowed with some of Europe's most fertile soils, the Western Balkans soil is facing natural constraints such as salinity, sodicity, acidification, poor drainage, texture conditions, shallowness, stoniness, and other nature-based and human-induced limitations. The expert group formed by SWG initiated various short and long-term activities within the partnership, including a general assessment of available data, identification of drivers affecting soil quality, analysis of primary soil degradation processes, capacity assessment for each country in dealing with sustainable soil management, and identification of best soil management practices. Other initiatives include the establishment of a GIS-based regional soil map and information system, a soil monitoring system throughout the region, and the creation of the Western Balkans Soil Museum. These endeavors aim to address the shared challenges in policy reform, harmonization, information systems, economic development, and limited institutional capacity across the region.

Keywords: Soil partnership,Soil degradation,Western Balkans (WB),Soils without Borders

ID ABS WEB: 137189

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

CAN LIVING LABS OFFER A SUSTAINABLE APPROACH FOR LONG-TERM SOIL HEALTH MANAGEMENT? SOUTH TYROL AS A CASE STUDY

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Living Labs (LLs) are dynamic ecosystems in which stakeholders interact to co-create innovations to reach joint objectives within real-world environments at territorial, landscape, or regional scale. In Europe, about 2/3 of the soils are estimated to be unhealthy (EUSO, 2023). The connections established between soil science, policy, and stakeholders in LLs could provide a pathway for a more sustainable soil management by maintaining and restoring soil health as aimed by the EU and the new Soil Monitoring Law. The present study explores the integration of LLs into soil research over the past decade through a systematic literature review and presents a local case study in South Tyrol, Italy. Results revealed that, among over 3000 works published on LLs in the last 10 years, only about 3% were inherently related to soil. While majority of them are still within EU, there is an evident expansion towards Sub-Saharan Africa, Oceania and Asia in most recent years. Findings also indicate a great interest in soil related research in LLs (67%, n=41), followed by reviews (26%, n=16) and limited number of editorials (n=4) & keynote papers (n=1). Our findings highlight the potential of LLs to assess local soil health issues (e.g. above-below ground biodiversity, C stocks, pollution) ensuring feasible solutions and innovations applicable in the real-world conditions. In our South Tyrolean LL case study, we address the local need of carbon sequestration, C stock conservation and improved nutrient management by applying different cover crops in apple orchards. This case study illustrates a successful implementation of a sustainable, long-term management approach that embraces stakeholder interaction (scientists-farmers-apple consortium) at a regional scale. Through such collaborations, collective efforts can address real-world challenges with greater speed and efficiency.

Keywords: Living Lab,Cover Crops,Soil Carbon,Soil Biodiversity,Soil Health

ID ABS WEB: 137339

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

SOIL NEEDS ASSESSMENT – CONCEPTUAL FRAMEWORK, METHODS, AND SYNTHESIZED RESULTS FOR 20 REGIONS IN EUROPE

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Healthy soils provide an abundance of ecosystem services (e.g. food provision, water storage and purification, biodiversity conservation, climate change mitigation, cultural heritage). However, human activity and environmental changes may impact the provisioning of ecosystem services and driving soils into an unhealthy state. Linking these aspects requires a systems perspective of the human-environment interactions related to soils. In this context, we define soil needs as the requirements from existing and emerging socio-economic and geo-biophysical perspectives that determine soil health and related services to human society. The aim of the study was an assessment of soil needs in the natural and the socio-economic system via validation from stakeholders. Socio-economic and soil system interactions are subject to strong regional variations. Hence, we consider systems in agricultural, forestry, urban and (post-)industrial, and mixed land uses. Within the land uses we selected 20 representative regions across Europe and applied the SNA. The SNA is based on the Driver-Pressure-State-Impact-Response (DPSIR) framework which categorises human-environmental system interactions in drivers for decision-making on land use and soil management (pressures), the current state of ecosystems, the impacts on ecosystem services and governance, policy, and management options for soil health improvements. Methodologically, the SNA combines natural science knowledge on the functioning of soils and ecosystem services, with social science research methods (participatory workshops and qualitative interviews). Our results disclose the drivers of soil health dynamics, which are characteristic for regionally specific combinations of economic conditions, policy, land use history, land managers perceptions and geophysical and climatic conditions. The results are abstracted to a land use level along the categories of the DPSIR framework.

Keywords: Human-Environmental Systems,Stakeholder interactions,Systems,Soil needs,Soil health

ID ABS WEB: 137643

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

DECISION-MAKING PRACTICE OF IMPLEMENTING AN INTEGRATED URBAN ENVIRONMENTAL CONTROL SYSTEM IN A RAPIDLY INDUSTRIALIZING CITY

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Global investors have been looked for new investments, relying on the significant ability of the Hungarian state to improve cross border capital raising. The investments were mainly implemented in new industrial parks, which fundamentally changed the urban landscape and land use in large urban areas. The city of Debrecen, which is the second largest city (total area 365 km2) in Hungary, is a typical example of similar urbanization processes worldwide.
The implementation of new unknown technologies, such as soil / land use and water management related to the automotive industry, has increased the lack of knowledge and, in part, uncertainty among the population. In addition to increasing the environmental security of the population, the goal of the city stakeholders is the sustainable development of integrated green-blue infrastructure. The first part of CIVAQUA Hungarian project providing the largest ecological water supply, has already been realized till end of last year, where the water of the Tisza River was utilized in this water-poor urban environment, revitalizing the wetlands of the Tócó creek in its urban catchment. A new interdisciplinary, environmental decision-making forum was established, where city leaders, scientists of the University of Debrecen, representatives of relevant authorities and representatives of the population developed and implemented the Environmental Control System. This industrial sector independent new control system includes not only soil, water, biodiversity, and air noise resources, but also law and IT working groups. It identified common reference sampling points, measuring base stations and additional specific points for specific resources such as soil and water, depending on topography, climate, soil type and land use. The necessary methods of investigation and method of interpretation were also adapted based on sites
The research work supported by Hungarian TKP2021-EGA/TKP2021-NKTA fund.

Keywords: Sustainable soil management,Stake-holders consultation,Integrated monitoring,Urban soil

ID ABS WEB: 137686

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

APPROACHING A DECADE OF THE '4 PER 1000' INITIATIVE: THE CRUCIAL ROLE OF MULTI-STAKEHOLDER COLLABORATION FOR SOIL HEALTH ENHANCEMENT

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Healthy and carbon rich soils are an essential part of the solution to some of today's most existential issues, including climate change, biodiversity decline and food and water insecurity. Approaches like agroecology can increase soil organic matter storage and improve soil health and ecosystem functioning and, hence, help to mitigate and adapt to climate change, secure biodiversity and enhance food security. While most farmers are genuinely motivated to safeguard and nurture their land, the adoption of sustainable soil management practices necessitates policy interventions and the availability of trusted, locally relevant information to create the right enabling conditions supporting farmers, especially, but not only, in the transition phase. Simultaneously, decisions should be based on a combination of scientific insights and traditional knowledge pertaining to soil processes and socio-economic contexts. Collaborative programmes must be crafted together with the practitioners on the ground. For almost a decade, the international "4 per 1000" Initiative has been striving to facilitate the dialogue and cooperation between government and non-governmental agencies, scientists, farmers and other stakeholders to share evidence-based best practices and develop solutions at all levels. Approaching a decade of the "4 per 1000" Initiative offers the perfect opportunity to reflect on the evolution of our understanding concerning the contribution of enhancing soil carbon and soil health to meeting global challenges as well as on successful strategies and further needs for action in the years ahead.

Keywords: multi-stakeholder action,soil health,soil carbon sequestration,climate change,food security

ID ABS WEB: 137707

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

INNOVATIVE AND SUSTAINABLE MODELS FOR SOIL HEALTH: A LIVING LAB FOR THE DEVELOPMENT OF A SUSTAINABLE AGRICULTURE IN LOMBARDY (ITALY)

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In recent years, deep structural changes affected Lombardy agriculture: the reduction in the number of farms and total agricultural land, the increase in average farm size and the progressive concentration of livestock farms. This intensive management system, based on high use of external inputs and modest crop diversification, impacted the environmental matrices. Furthermore, the agronomic use of manure, although supplying beneficial substances to soil and promoting less use of synthetic fertilizers, requires careful management to prevent negative environmental impacts.
European policies push towards an agriculture model sustainable, productive and able to provide environmental services. A recent tool for the consolidation of training, knowledge sharing and demonstration actions is represented by Living Labs, based on the interaction and collaboration between different actors involved for the application of innovative solutions. In this scenario, local authorities, through knowledge of the territory and direct relations, play a prominent role acting as “brokers”, recording knowledge needs and existing barriers to their dissemination and aggregating stakeholders at different levels.
In 2022 ERSAF, technical agency of Lombardy Region dealing with agricultural services, founded the Living Lab (LL) “Innovative and sustainable models for soil health” with Università Cattolica del Sacro Cuore and Università degli Studi di Milano. The objectives were to calibrate and introduce sustainable management practices within intensively managed agricultural lands of Po Valley and to monitor, report and verify agroecosystem performances towards healthy agricultural soils. This goal will be achieved through a multiactor approach, involving farmers, researchers and other stakeholders, especially focused on the development of conservative management practices, associated with preservation and increase of soil organic carbon content in connection with EU MISSION “A Soil Deal for Europe” objectives related to Carbon Farming and on the resources management. In addition, complementary activities aimed at the improvement of innovative and sustainable soil management models can be developed. Currently the LL is composed by 1 Long Term Experiment, 9 Lighthouse Farms and a growing number of partners.

Keywords: soil health,Living Lab,sustainable agriculture,soil organic carbon,multiactor approach

ID ABS WEB: 137794

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

25 YEARS OF SOIL PROTECTION IN SWITZERLAND: A MIX OF HARD LAW, SOFT LAW AND COMMUNICATION

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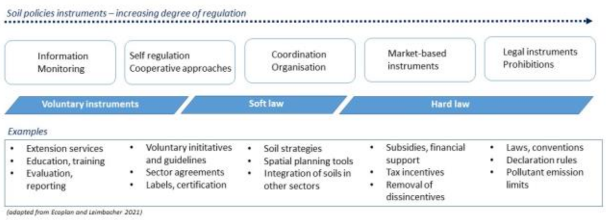
Soil is at the centre of competing uses and obviously, sustainable soil management involves a multitude of stakeholders. Developing and implementing a coherent policy is complex and difficult – but not impossible. Two examples from Switzerland illustrate the process of developing soil policies and implementing sustainable soil management. In many cases, the use of a mix of approaches (smart regulation, see figure) and cooperation between the stakeholders will allow for a more effective soil protection.
(1) Specific protection against physical soil threats was included into law in 1989, however, a legal framework is not sufficient for an operational implementation. Establishing the instrument of "specialists of soil protection on construction sites" has required a long development process and collaboration between a number of stakeholders. The effective implementation has involved different levels of regulation (hard law, soft law, voluntary instruments) and has demonstrated the effectiveness of a smart regulation approach. Along with the legal requirements and the scientific input, a strong and long-lasting collaboration with the Swiss Soil Science Society, which brings together scientists, policy makers and practitioners, was decisive in achieving this success.
(2) Sustainable soil management depends on environmental factors and management practices, and is underpinned by the interaction of its physical, chemical and biological components. So far soil policies struggle to integrate this complexity into legal instruments. In Switzerland, the creation of a networks of scientists and policymakers in the field of biological, chemical and physical soil protection has enabled direct exchange of strategical information (balance between policy needs and possible scientific results) and the design of several applied research projects. Cooperation carried out for over 30 years by the working groups that include representatives of federal and cantonal administrations and research institutions has proven to be an effective approach in designing soil policies and in contributing to the (ongoing) process of revising the current law on soil protection.



Keywords: Swiss soil legislation,Developing policies,Smart regulation,multi-stakeholders cooperation

ID ABS WEB: 138009

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

SOIL SCIENCE AND POLICY IN AUSTRALIA: INFLUENCING FROM THE GROUND UP, DOWN UNDER

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This case study provides insight into how the creation of trusted and committed relationships between scientists and policy makers enables robust development and effective implementation of public policy.

Australia's former National Soils Advocate, the Hon Penelope Wensley AC, promoted such a partnership, resulting in the Parliamentary Friends of Soil (PFOS) group being established in 2020.

Strong links with parliamentarians created momentum for increasingly effective networking events and other opportunities for influence.

PFOS is a non-partisan forum for parliamentarians to meet and interact with soil scientists and researchers, policy-makers, farmers and land managers, industry representatives and stakeholder groups on matters relating to the health and maintenance of Australia's soils.

The group was re-established under the 47th Australian Parliament ahead of World Soil Day 2020, by which time membership had more than doubled to 24 members.

The role of the National Soils Advocate was discontinued in August 2023. However, the former Advocate continues influencing in her long-held roles as Patron of both Soil Science Australia and the Australian Cooperative Research Centre for High-performance Soils.

Many initiatives established under the former Advocate are now being advanced by the broader soil community in Australia.

Soil Science Australia is driving ongoing engagement with PFOS. The World Soil Day networking event at Parliament House in 2023 was backed by 15 government and non-government supporters.

Hear how Soil Science Australia is engaging with PFOS to position the critical findings of soil science and promote soil health as a significant and leading consideration for policy in Australia.

Keywords: Advocacy, Influence, Support, Policy, Politics

ID ABS WEB: 138093

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

CULTIVATING SUSTAINABLE SOIL MANAGEMENT: FAO´S GLOBAL SOIL DOCTORS PROGRAMME IN ACTION

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The Global Soil Doctors Programme of the Food and Agriculture Organization of the United Nations stands at the forefront of promoting sustainable soil management worldwide. This presentation showcases the Programme's pivotal role in fostering collaboration and equipping farmers with essential tools for soil assessment.
Operating in 15 countries across Africa, Latin America, the Caribbean, Asia, and Eurasia, the programme has successfully trained 611 trainers, empowered 1400 soil doctors and over 7500 farmers. Its adaptability to local conditions is underscored by collaborative partnerships with national stakeholders and the translation of training materials into local languages. To date, materials have been translated to more than 18 languages, further increasing accessibility and impact. This initiative, spanning academia, government, private sectors, and farmers, signifies a harmonious global approach.
The success of the programme lies in bridging the gap between scientific knowledge and practical implementation. Collaboration with academia enriches training with theoretical insights and innovative practical exercises, while government support integrates sustainable soil management into local policies. Participation in collaborative projects and partnerships with organisations strengthens the commitment to holistic solutions. Private sector participation not only helps sponsor activities but also brings their technical expertise, amplifying the programme's impact.
The farmer-to-farmer training model, emphasizing hands-on learning, has empowered individuals and garnered community recognition, ensuring its continuity. This practical approach ensures not only knowledge acquisition but also internalization, deepening the understanding of sustainable soil management. The programme's impact is assessed through valuable trainee feedback, focusing on methods' effectiveness and trainees' and Soil Doctors capacities for informed decision-making in sustainable soil management.
The presentation will feature captivating videos to demonstrate the programme's impact, inviting audience input and fostering increased collaboration with soil science societies. The presentation will delve into the importance of collaborative models, emphasizing the bridge between scientific knowledge and grassroots application. As we share insights from the programme's implementation, we invite engagement, to meet the evolving needs on the front lines of sustainable agriculture.

Keywords: Sustainable soil management,Global soil doctors programme,Stakeholder collaboration,Farmers empowerment,Soil assessment

ID ABS WEB: 138154

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

DISSEMINATION AND ADOPTION RATE OF SUSTAINABLE SOIL MANAGEMENT PRACTICES: THE KEY ROLE OF AGRI-FOOD SYSTEM STAKEHOLDERS' NETWORKS

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Healthy soils are fundamental to sustain agri-food systems. Intensive farming practices and global changes profoundly affect agricultural soils across European regions, causing a loss of biodiversity, a decline in organic matter content, and heightened susceptibility to erosion. To counteract this dynamic, it is essential to implement policy measures related to protection and soil restoration at all levels, from local to global.

Recognizing these challenges, some farmers are embracing agro-ecological innovative approaches to enhance soil quality, as conservation or organic farming, or other specific regenerative practices adopted in conventional farming. But the diffusion and adoption of these innovations does not always go as planned by policy makers. Economical and climatic uncertainties inherent of these socio-ecological systems make their management complex. Choices, decision-making processes and practices of farmers are based on both objective and, to some extent, subjective, value-laden elements, influenced by their own history, worldviews and knowledge.

This study aimed at documenting the adoption process of innovative soil management practices related to conservation agriculture in twenty European countries involved in the EJP SOIL i-SoMPE project by applying an original methodological approach inspired by social sciences. Qualitative open-ended interviews of main stakeholders were done by partners in each country involved in the project. Data collected were processed using cognitive mapping, which makes it possible to combine qualitative and quantitative techniques.

We explore the barriers and opportunities to the diffusion and adoption of practices linked to conservation agriculture. Our results highlight the importance of networks between stakeholders. The smooth running of these networks is of interest for many factors, among which the most important is related to the knowledge production, availability and sharing between farmers and with advisors and researchers. The others important factors are linked to financial incentives coming from a safe economic and policy environment, involving policy makers and local administration, and the adequate availability of machinery adapted to local pedo-climatic conditions, involving, among other, industrial actors.

Keywords: innovative practices,actor networks,knowledge,conservation agriculture,machinery

ID ABS WEB: 138177

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

LASOL: A LIVING LAB TO HELP INTEGRATE SOIL PROTECTION INTO SPATIAL PLANNING AND CONSTRUCTION

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In Switzerland, despite numerous detailed tools to help apply soil protection in construction, there is a lack of application of good practice. In the area of land use planning, only land classified for its production potential is strongly protected. However, the swiss soil strategy has set clear objectives, including integration of soil value into spatial planning and elimination of persistent soil damage such as compaction. Soil protection working groups note that these objectives have largely not been achieved. Why this failure? What are the obstacles and the needs of the various stakeholders? Where are opportunities for soil protection?
A living lab has been set up to answer these questions. It is focusing on a 60-hectare land development project called Chamblioux-Bertigny, in the Canton of Fribourg. The project comprises the construction of a hospital, a motorway cover, a neighborhood development and an urban park. These different projects are at very different stages of the process, and are not under the control of the same project owners. LASOL brings together project owners, soil protection supervisory bodies, spatial planning and soil specialists, and facilitators.
The project aims to identify the key moments for soil protection in the timeline of the various projects, to develop a common lexicon for talking about projects and soil, to identify the key people and their needs, so that soil protection and the transfer of information can take place through the stakeholders. Finally, existing tools are evaluated or new tools are developed to help achieve these objectives.
6 months of LASOL's life have revealed first stumbling blocks: the lack of mutual understanding of the fields specific languages, their processes and the levels of constraints relating to the decision-making stages. The second difficulty lies in the different timeframes of the projects, despite the fact that they cover the same territory. Mapping tools are proposed to both identify the difficulties and attempt to resolve them among them Soil quality index tools.

Keywords: Living Lab,Construction chain,Spatial planing,Soil quality,Zero net land uptake

ID ABS WEB: 138543

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

CONNECTING STAKEHOLDER KNOWLEDGE TO SUPPORT EUROPEAN AND NATIONAL POLICY DEVELOPMENT FOR CLIMATE-SMART AND SUSTAINABLE SOIL MANAGEMENT

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As part of the European Green Deal and EU soil and biodiversity strategies, European Commission is developing policies and solutions for soil health and climate-smart sustainable agriculture such as EU Soil Monitoring and Resilience Directive and EU Carbon Removal Certification framework. Member States will need to implement these policies and fit them into national policies and schemes. A broad spectrum of stakeholders is crucial for this process, including European, national and regional policy makers, researchers and practitioners. The European Joint Programme, EJP SOIL (Towards climate-smart and sustainable agricultural soil management), developed an innovative instrument to effectively incorporate soil research in practice and policy solutions within 24 participating countries, to connect stakeholders with each other and to the European science-policy-practice arena.
The network of committees of soil stakeholders, called National Hubs, were established in 2020. National Hubs are mostly led by a ministry that is responsible for agricultural soils and consists of farmers, farmers advisors and farmers organisations, industry and agrobusiness, NGOs, local or national governance and policy implementing representatives, scientists. National Hubs (i) provide feedback to the EJP SOIL activities and outputs and support the dissemination of EJP SOIL outcomes, (ii) voice national position and needs, and (iii) contribute to and learn from the work done in research.
The analysis of the functioning of the National Hubs reveals multiple modes of functioning (size of the hub, frequency of meetings, topics of discussion, level of engagement) that is related to historical developments and cultural aspects of a specific country. This analysis allows to identify the factors of success of such instruments. Despite of the heterogeneity, National Hubs have proved to achieve the joint objective and are a successful instrument for supporting European and national policy development, on which current soil related initiatives can build upon.

Keywords: sustainable soil management,National Hubs,stakeholder engagement,EJP SOIL

ID ABS WEB: 136013

4. Soil health in achieving the Sustainable Development Goals
4.01 123826 - Soil science lessons from 100 years or more old experiments

ENHANCING AGRICULTURAL SUSTAINABILITY THROUGH LONG-TERM CROP ROTATION: INSIGHTS FROM A 128-YEAR OLD COTTON ROTATION EXPERIMENT

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Established in 1896, Auburn University's Old Rotation is the United States' oldest ongoing cotton (Gossypium hirsutum L.) experiment. This experiment has been instrumental in documenting the long-term impacts of crop rotation and winter cover cropping on crop productivity in the highly weathered soils of the southeastern United States. Treatments at the Old Rotation consist of 1) continuous cotton with no winter legume cover crop and no nitrogen fertilizer, 2) continuous cotton with a winter legume cover crop but no nitrogen fertilizer, 3) continuous cotton with no winter cover crop but with nitrogen fertilizer, 4) cotton-corn rotation with a winter legume cover crop but no nitrogen fertilizer, 5) cotton-corn rotation with a winter legume cover crop and nitrogen fertilizer, and 6) a three year rotation of cotton, winter legume cover crop, corn, wheat, and soybean. After 128 years, the practice of rotating cotton with corn and winter legumes has significantly enhanced the chemical, physical, and biological properties of the soil, particularly in the top 15 cm, thereby improving overall soil health. Notably, continuous cotton rotations incorporating a winter legume cover crop contain 2.5 times more soil organic matter and yield over 3 times more cotton lint than continuous cotton without any winter legume cover crop, and this is achieved without the use of supplemental nitrogen fertilizer. This finding underscores the substantial benefits that winter legume cover crops offer in enhancing crop productivity and promoting agricultural sustainability.

Keywords: Historic,Cover Crop,Cotton,Sustainable Agriculture

ID ABS WEB: 136068

4. Soil health in achieving the Sustainable Development Goals
4.01 123826 - Soil science lessons from 100 years or more old experiments

CENTURY-LONG COVER CROP, ROTATION AND FERTILITY MANAGEMENT PRACTICES ON SOIL HEALTH AND ORGANIC MATTER COMPOSITION IN A SUBTROPICAL COTTON FIELD OF USA

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Organic matter dynamic plays a major role in maintaining soil health for sustainable crop production and is influenced by functional molecular diversity interplay with spatial and temporal variations. In this study, we explore long-term effects of crop rotation, winter legume cover crop and nitrogen (N) fertilization on soil organic carbon (SOC) molecular fractions, aggregate stability as well as enzyme activities that control nutrient cycling by characterizing soils of the world's oldest (> 120 years) continuous cotton experiment. Field treatments include: 1) Continuous cotton with no winter legume/no inorganic N fertilizer, 2) Continuous cotton with winter legume, 3) Corn-cotton rotation with winter legume, 4) Corn-cotton rotation with winter legume plus inorganic N fertilizer, and 5) Continuous cotton with inorganic N fertilizer. Total organic C (TOC), total N (TN) as well as acid-hydrolysis C (AHC) and water extractable organic C of bulk soil and different aggregate fractions along with SOC composition were characterized. Corn-cotton rotation with winter legumes significantly increased bulk soil TOC, AHC and TN as well as aggregates-associated C over other treatments. Corn-cotton rotation with winter legumes increased macroaggregates by over 90%, whereas continuous cotton with winter legumes or inorganic N fertilizer had less than 7% increase compared to control plots. Soil samples of corn-cotton rotation with winter legumes or winter legumes plus inorganic N fertilizer had more diversified compounds of polysaccharides, aliphatic, aromatic, lignin, and phenols than continuous cotton with winter legumes or inorganic N fertilizer. Corn-cotton rotation also showed higher activities of glucosidase, glucosaminidase, phosphatase and arylsulfatase than continuous cotton without corn rotation regardless winter legume inclusion or inorganic N fertilization. Aggregate mean weighted diameter and geometric mean diameter were positively related to TOC, N-containing compounds, phenols as well as polysaccharides and aliphatics. Synergistic interactions induced by diversified inputs of SOM compositions between corn rotation and winter legumes were responsible for observed SOC accumulations, aggregate stability as well as enhanced enzyme activities in these subtropical cotton fields.

Keywords: SOC composition,Aggregate stability,Enzyme activity,Crop rotation,Legume cover crop

ID ABS WEB: 136356

4. Soil health in achieving the Sustainable Development Goals
4.01 123826 - Soil science lessons from 100 years or more old experiments

LEVERAGING 135 YEARS OF CONTINUOUS RESEARCH AT SANBORN FIELD TO UNDERSTAND SOIL HEALTH

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Sanborn Field, established in 1888, is the 3rd oldest continuous research site in world. The 40 experimental plots focus on crop rotation, crop species, and fertility inputs. Approximately every 25 years beginning in 1915, four 1.2 m soil cores are taken from each plot and divided into fixed, 10 cm increments. Historically, sample analysis focused on basic soil fertility measurements. In 2020, an additional four cores were taken from each plot and divided into soil horizons and analyzed for soil health indicators. In grain production systems, monoculture wheat (Triticum aestivum) had higher soil health indicators regardless of fertilizer or manure compared to monoculture corn (Zea mays) or soybean (Glycine max) and were similar to crop rotation within fertility treatment. For example, water stable aggregate stability (WSA) was 328 mg g-1 for continuous wheat with manure, 333 mg g-1 for continuous wheat no fertilizer inputs, compared to 270 mg g-1 for continuous corn with manure, and only 110 mg g-1 for continuous corn with no fertilizer inputs. In addition, WSA was 395 mg g-1 in a corn-wheat-red clover (Trifolium pratense) rotation with manure versus 220 mg g-1 with commercial fertilizer. However, WSA values were reduced to 230 mg g-1 when soybean replaced red clover in the rotation with manure and was unchanged in the commercial fertilizer treatment. Soil health indicators were analyzed using the Soil Health Assessment Protocol and Evaluation (SHAPE) method to evaluate which soil health indicators were the most limiting. It was found that higher soil health scores under wheat can be attributed to greater microbial activity rather than to greater TOC and AC whereas, manure was important to improving soil health as a source of TOC and AC. Surprisingly, even in perennial systems soil health at Sanborn Field is limited by TOC and AC. Results illustrate the value of long-term research in guiding current management decisions affecting sustainable cropping systems while maintaining optimum soil health.

Keywords: Long Term Research,Soil Health,Aggregate Stability,Manure,Rotation

ID ABS WEB: 136618

4. Soil health in achieving the Sustainable Development Goals
4.01 123826 - Soil science lessons from 100 years or more old experiments

THE 100-YEAR-OLD FIELD EXPERIMENTS OF THE INSTITUTE OF AGRICULTURE, WARSAW UNIVERSITY OF LIFE SCIENCES – SGGW, SKIERNIEWICE, CENTRAL POLAND: HISTORY, RECENT RESEARCH AND FUTURE PERSPECTIVES

L. UZAROWICZ, W. STEPIEN, D. GOZDOWSKI, E. HEWELKE, J. JONCZAK, T. NIEDZINSKI, A. PERZANOWSKA, A. PEDZIWIATR, B. RUTKOWSKA, Z. ZAGORSKI

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Long-term agricultural field experiments of the Institute of Agriculture, Warsaw University of Life Sciences – SGGW, are located in Skierniewice, central Poland . The long-term fertilization experiments in Skierniewice were established in 1921 on Luvisols. These experiments are the oldest existing experiments in Poland, 5th in Europe and 7th in the world. The experiments have been carried out on an area of 4.8 ha where 670 plots are located. The experiments have been carried out in various fertilization combinations (Ca, CaNPK, NPK, CaPK, CaPN, CaNK, PK, PN, KN, farmyard manure) including control plots with no fertilization. Different fertilizer types are used in the experiments. The four crop rotation are applied: 1) 5-field crop rotation, 2) rotation without manure and legumes, 3) rotation without manure with legumes and 4) three long-term monocultures (rye, potatoes and triticale). Long-term agricultural field experiments of the Institute of Agriculture, Warsaw University of Life Sciences – SGGW, have been the subject of many studies in the area of agricultural sciences, soil sciences, environmental sciences, biological sciences and food sciences. In recent years, long-term agricultural experiences have become increasingly important due to the possibility of observing long-term trends in changes of soil properties and yields depending on long-term agricultural practices and weather/climatic conditions. Observations of long-term trends may, in turn, be the basis for creating forecasts of changes in crop yields and the rate of sequestration/loss of organic carbon in the soil in the context of climate change. Forecasts can be used by decision-makers at the national and international level to develop agricultural development strategies and introduce good practices to reduce the impact of agriculture on the environment, including the climate.

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Keywords: Long-term agricultural field e,Fertilization experiments,Changes of soil properties,Changes of soil crop yield

ID ABS WEB: 136872

4. Soil health in achieving the Sustainable Development Goals
4.01 123826 - Soil science lessons from 100 years or more old experiments

LONG-TERM FIELD EXPERIMENTS IN BAD LAUCHSTÄDT - A TREASURE OF DATA FOR THE DEVELOPMENT OF MODELS

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The Research Station in Bad Lauchstädt operates a variety of long-term field experiments with different treatments and scientific foci. The oldest experiment is the Static Fertilization Experiment, which was established already in 1902. It is 4 ha in size and consists of 8 field stripes supplied with different amounts of organic and mineral fertilizers. The soil is a highly productive Chernozem and its topsoil properties and plant parameters are continuously monitored. The experiment has survived wars and political upheavals. While the crop rotations changed for the first time in 2014, the fertilization regime has not and, above all, the agricultural management is documented in detail for all experimental plots. With that, this experiment is a highly valuable treasure of data, especially for a better understanding of soil processes and their interactions. This understanding feeds into mechanistic simulation models. They are essential tools to actually predict the impact of changing boundary conditions, brought about by changes in climate, land use and agricultural management practices, on multiple soil functions. In this presentation, we will demonstrate how this long-term field experiment helped to develop and validate the systemic soil model BODIUM. We further show how the integration of modelling and long-term monitoring of soil and plant variables can increase the impact of long-term experiments in the future.

Keywords: Soil monitoring,Soil functions,Systemic modelling,Fertilization,Soil carbon

ID ABS WEB: 137163

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CROP AVAILABILITY OF SOIL PHOSPHORUS IN SWEDISH LONG-TERM SOIL FERTILITY EXPERIMENTS

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The Swedish university of Agricultural Sciences (SLU) has a long tradition of agricultural field experiments, going back to early 20th century. Currently there are 61 active long-term experiments (LTE) at SLU covering: plant nutrition, crop production systems, landscape ecology, water quality management, agricultural water management, soil tillage, and weed biology and weed control. One of the unique features of the Swedish LTES are the geographical gradient, with experimental sites spanning from Piteå in the north to Trelleborg in the South. The Swedish LTE infrastructure includes an extensive database and a physical sample archive.

One important experimental series is the Swedish long-term soil fertility experiments, consisting of nine separate sites established between 1957 and 1966. These experiments have a complex design, and one of the experimental factors is the level of phosphorus (P) fertilizer addition. By using historical yield and soil data and archived samples from six sites, we studied how the P budget (P input– P removed by harvest) related to grain crop yields, chemically extractable soil P, and isotopically exchangeable soil P. We found that when P fertilizer was omitted average crop yields were 55-97 % of maximal yield, but the yield levels did not decline during >50 years at five out of six sites, showing that the soils had a large ability to mobilize P for crop uptake. At most sites there was no increase in average grain yield when more P than what was removed by harvest was added. Both extractable and exchangeable P were strongly correlated to the P budget. About half of the added excess P could not be accounted for in an increase in total P in the top 0-20 cm soil. The results indicates that the majority of the added excess P that stayed in the top soil has been retained in plant available forms. However, when the P budget was close to zero, both Olsen-P and oxalate-P decreased over time.

Keywords: long-term experiments,plant nutrition,phosphorus,small grain cereals,agriculture

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4. Soil health in achieving the Sustainable Development Goals
4.01 123826 - Soil science lessons from 100 years or more old experiments

OVER 130 YEARS OF VOLCANIC SOILS INVESTIGATION IN INDONESIA

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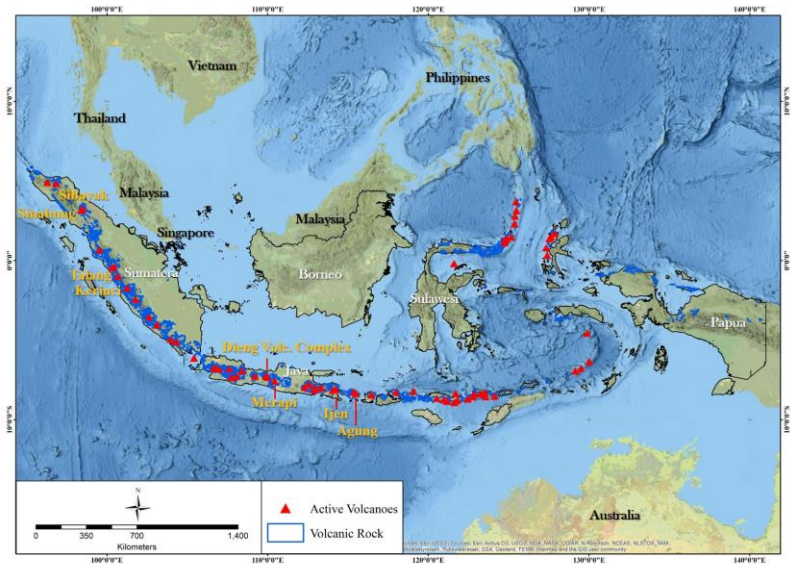
Indonesia is well-known as one of the most active volcanic regions . Volcanic soils cover an area of 31.7 million ha, are considered as the most productive soils, high agronomical value and a high human carrying capacity. Soils in Java known for their high productivity are mostly developed from volcanic products. Nevertheless not all volcanic soils are the same, it can range from acidic-infertile soils derived from Rhyolitic parent materials to andesitic to dacitic volcanic materials. Here we show the geochemical properties of various volcanic materials and how they developed into various types of soils. For example, in Kerinci,, after 100 years of tea cultivation the soils are friable with low BD, SOM is still high, have high P-retention (>90%). Soil weathering controls P-retention, with an increasing P-retention as the soils weathered. We further identify research gaps in soil C storage, microbial interactions, and volcanic ash management.
Despite the renowned high OC content, resilience of volcanic soils, current soil management practices have led to a significant reduction in their carbon content. This ongoing depletion presents a concerning trend, and addressing the repercussions of this depletion is a critical knowledge gap. t is imperative to evaluate the susceptibility of volcanic soils in Indonesia to the impacts of climate change and formulate strategies to bolster their resilience. Further research into the intricate interplay between microbial communities is needed, regarding their contributions to fertility, nutrient and carbon cycling, and plant productivity, offering valuable insights for agriculture and land management.
To bridge the gaps, collaborative interdisciplinary research is imperative. Continuous monitoring and data collection are essential to comprehending the dynamic nature of volcanic soils and their responses to evolving environmental conditions. Researchers and institutions in Indonesia, in collaboration with international partners, have a pivotal role in advancing our understanding of volcanic soils and securing them. The study of volcanic soils and soil science in Indonesia aligns with and contribute significantly to achieving multiple



Keywords: Climate change,Soil Security,Anfdisols,Sustainable Development Goals,Volcanic ash

ID ABS WEB: 138214

4. Soil health in achieving the Sustainable Development Goals
4.01 123826 - Soil science lessons from 100 years or more old experiments

THE IMPORTANCE OF A HARMONIZED APPROACH IN SOIL MICROBIAL ANALYSIS: THE STANDARD OPERATING PROCEDURES OF THE FAO'S GLOBAL SOIL LABORATORY NETWORK (GLOSOLAN)

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Soil microbes are a key component of soil biodiversity and play an essential role in soil ecosystem services including nutrient cycling . Their presence and abundance are used as indicators to assess soil biodiversity and soil health status. Over the last several years, different parameters have been developed to monitor soil microbes, but the lack of harmonized protocols makes comparison of results among laboratories across the world challenging.
The FAO's Global Soil Laboratory Network (GLOSOLAN) has developed a bottom-up, inclusive approach to harmonize and publish standard operating procedures (SOPs) that actively involves all its members. Globally harmonized SOPs greatly enhance global cooperation and comparability of data.
According to the Global Soil Laboratory Assessment 2020, only about 44 percent of soil laboratories worldwide have the capacity and equipment needed to measure soil biological parameters. A joint working group on soil biological analysis established between GLOSOLAN and the FAO's International Network on Soil Biodiversity (NETSOB), has organized activities to build the capacity of soil laboratories worldwide to measure soil biological parameters. Moreover, globally harmonized SOPs have been published for the determination of soil respiration rate, microbial biomass, and enzyme activities. Other protocols on micro-, meso- and mega-fauna are under development as well and will be added to the other 25 SOPs already published by GLOSOLAN on soil chemical and physical parameters, which are open access in various languages.
Such SOPs are being adopted as new standards to harmonize soil data globally. When possible, GLOSOLAN encourages national governments to support soil laboratories to combine bottom-up and top-down activities for the development and adoption of globally harmonized SOPs.

Keywords: Soil microbes,Standard Operating Procedures,Harmonization of methods,Global Soil Laboratory Network

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4. Soil health in achieving the Sustainable Development Goals
4.02 124990 - Towards harmonized soil health monitoring. Novel methods and perspectives and scientific, institutional, and societal challenges

ADVANCING SOIL HEALTH ON GRAZED PASTORAL FARMS – A NEW ZEALAND PERSPECTIVE

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Pastoral farms rely on soils for the provision and regulation of a wide range of ecosystem services that benefit the farm and its surrounding environments. Maintaining services such as primary production and water purification and regulation is dependent on the chemical, physical, biological and organic condition or health of the soil. Despite global interest in advancing the measurement and management of soil health, there is currently no universal assessment available for growers to use.

On-farm assessments of soil condition in New Zealand are largely limited to fertility, to inform nutrient management plans. Additional assessments of soil organic matter, physical condition and biological activity provides a more complete picture of the overall health of a soil and its ability to provide ecosystem services. We detail a method that extends current soil fertility monitoring to include such additional indicators of soil health. Selected indicators have target ranges identified for optimal performance and are known to be influenced by management decisions.

This soil health assessment approach is currently being evaluated in a study conducted on dairy farms across multiple soil types and climates in New Zealand. Annual assessments of soil health have been conducted on the major land management units on each farm. Differences in soil health were observed across soil types. There were some changes across three years, with specific events having the ability to degrade soils quickly, while the recovery of some indicators has been slow. Overall, soils across the farms tended to be in good health, with only a few indicators outside the target range.

Extending soil assessment from fertility to a broader consideration of soil health enriches the knowledge of growers, with the potential for improved decision making on-farm. Better linkages between the health of the soil and its ability to provide ecosystem services are still required to ensure the total value of healthy soils is recognized in the context of the farm and its surrounding environments.

Keywords: Soil health,Pasture,Monitoring

ID ABS WEB: 136477

4. Soil health in achieving the Sustainable Development Goals
4.02 124990 - Towards harmonized soil health monitoring. Novel methods and perspectives and scientific, institutional, and societal challenges

SOIL HEALTH - POLICY INTERFACE IN THE CONTEXT OF THE EU AND NATIONAL STRATEGIES

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Opportunities to include soil health in the EU policies and strategies are highlighted in Green Deal which aims to transform the EU into a modern, efficient, and competitive economy. Soil Strategy to 2030, Directive on Soil Monitoring and Resilience, the European Soil Observatory and Soil Mission Board EU are listed recently which is very good message mainly for soil scientists. The question is: how to convince stakeholders, including farmers, policy makers, agricultural investors etc. to implement measures addressing future threats? A solution provides Soil Mission Board EU. It recommends development of a National Hub builds upon the existing stakeholder participation with structure best suited to each specific country. The National Hubs composed of a broad range of different stakeholders, all include at least policy makers and scientists, etc. and represent a significant instrument for stakeholders' engagement. National Hubs will no longer have a formal role but could develop into Soil Mirror Groups. Which is expected to contribute to raising stakeholder awareness (soil literacy) and know-how about the importance of conserving and improving soil health for different land use contexts, such as agriculture, forestry, (post-)industrial and cities. Ideally, the Mirror Group is composed of two sub-groups: 1) Policy Group: composed of representatives of entities under the sectoral Ministries with alignment with the Mission (Agriculture, Environment, Science, et al) + Soil Mission Board member. Stakeholder Group includes sectoral organizations, researchers, and representatives of key groups in civil society, as well as representatives of Soil Mission Living Labs and existing Communities of Practice. Some common success criteria for active and functional National Hub members in the EJP SOIL were identified. Many questions are needed to response: What do we know about people managing soil? How do they make decisions? How to implement new business models? Which type of regulations are needed? How R&I should be linked to practice via living labs?

Keywords: soil health,Soil Mission Board,stakeholders,soil strategies,mirror group

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USING COMBUSTION ANALYSIS TO SIMULTANEOUSLY MEASURE SOIL ORGANIC AND INORGANIC CARBON FOR SOIL SURVEY

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Soil organic carbon (SOC) and soil inorganic carbon (SIC) are of longstanding interest due to their relationship with other key soil properties and indications for soil health and carbon storage. At the USDA-NRCS Kellogg Soil Survey Laboratory (KSSL), total carbon is determined via dry combustion analysis, while calcium carbonate (CaCO3) equivalent is determined via manocalcimetry. For calcareous (carbonate bearing) samples, SIC is estimated as 12% of CaCO3 equivalent, while SOC is estimated as the difference between measured total carbon and estimated inorganic carbon. An alternative dry combustion method for the measurement of SOC and SIC pools was evaluated with the goal of directly measuring – not estimating – SOC and SIC The alternative dry combustion method comprises two variants that differ in temperature-ramps and carrier gases used. Both variants were applied in duplicate to 110 diverse samples, including 32 calcareous samples, from across the USA that had been previously characterized by the KSSL. Samples were selected to capture wide variability in carbon contents. Comparing carbon data outcomes with legacy KSSL characterization data revealed one method variant as best for calcareous samples, whereas the other variant was preferred for non-calcareous samples. A combination of the two method variants offers an accurate and direct measurement of SOC and SIC. For calcareous samples, mid-infrared spectral analysis demonstrated the alternative method as slightly more accurate than legacy KSSL methods for estimating SOC and SIC.

Keywords: Organic Carbon, Inorganic Carbon, Soil Health Monitoring, Laboratory Analysis, Novel Method

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SPATIAL PATTERNS OF HISTORICAL CROP YIELDS REVEAL SOIL HEALTH ATTRIBUTES IN US MIDWEST FIELDS

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The long-term analysis of spatial and temporal patterns of crop yields provides insights on how yields vary in a field, with parts of field constantly producing either high yields or low yields and other parts that fluctuate from one year to the next. The concept of yield stability has shown to be informative on how plants translate theeffects of environmental conditions (e.g., soil, climate, topography) across the field and over the years in the final yield, and as a valuable layer in developing prescription maps of variable fertilizer rate inputs. Using known relationships between soil health and crop yields, we hypothesize that areas with measured constantly low yield will return low carbon to the soil affecting its heath. On this premises, yield stability zones (YSZ) provide an effective and practical integrative measure of the small-scale variability of soil health on a field relative basis. We tested this hypothesis by measuring various metrics of soil health from commercial farmers' fields in the north central Midwest of the USA in samples replicated across YSZ, using a soil test suite commonly used by producers and stakeholders active in agricultural carbon credits markets. We found that the use of YSZ allowed us to successfully partition field-relative soil organic carbon (SOC) and soil health metrics into statistically distinct
regions. Low and stable (LS) yield zones were statistically lower in normalized SOC when comparedto high and stable (HS) and unstable (US) yield zones. The drivers of the yield differences within a field are a series of factors ranging from climate, topography and soil.

Keywords: Soil Health,Yield Stability,Sampling,Soil Carbon

ID ABS WEB: 137343

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EXPLORING THE AGGREGATE - ORGANIC MATTER - MICROBIAL COMMUNITY CONTINUUM FOR CHARACTERIZING SOIL HEALTH CHANGES UNDER HUMAN DISTURBANCE:

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Soil health should be envisaged with characterizing soil organic carbon (SOC) preservation, microbial biomass/activity and biochemical performance in a soil continuum context. A soil landscape sequence of forest land on hills, orchards and drylands in slope lands and paddy fields in the basin was established and undisturbed topsoil cores randomly sampled for each soil-landscape, in a hilly rural area. Water-stable aggregate size fractions (macroaggregate, microaggregates and silt-clay) were separated. Dissolvable OC (DOC), microbial biomass OC(MBC), phosphorus lipid fatty acids (PLFAs) contents and extracellular enzyme activities as well as biomarker molecular abundance analyzed for all topsoil samples across the landscapes sequence. There was a sharp decline in topsoil SOC in cultivated soil-landscapes with a great reduction of macroaggregates mass proportion and significant increase in the microbial abundance and DOC portion to SOC. Parallelly, diversity of PLFA groups and functional diversity with EEAs were lower in cultivated lands compared to conserved forest. Meanwhile, abundances of biomarker molecules were all higher in forest than in drylands and paddy, with a higher ratio of plant derived lipids to microbial derived lipids. While the relative abundance of bound lipids and of stable lignin was well correlated, the relative abundance of labile OC was closely correlated to total SOC across the landscapes. Moreover, X-ray CT tomography of macroaggregates revealed that total porosity and connected porosity was both indicative of OC decline (POC in particular) in aggregate fractions, in line with the mass proportion change. Thus, soil health was greatly impacted by cultivation, mimicked with the changes in OC level, pool distribution and molecular composition in combination of microbial abundance, diversity and biochemical activity, across the SOM-Aggregates-Microbes-Enzymes continuum. Overall, the ratio of DOC/SOC, DOC/MBC and abundance ratio of G+/GC and of PLFAs/SOC could trace microbial shift from K strategy to R strategy while the ratio of POM/MAOM and abundance ratio of plant lipid to microbial lipids are those for SOM protection and selected preservation in the soils.

Keywords: soil health,aggregate,organic matter,Microbial activity,soil continuum

ID ABS WEB: 137617

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CHALLENGES AND OPPORTUNITIES TO IMPROVE SOIL MONITORING SYSTEMS: THE CASE OF THE EMILIA-ROMAGNA REGION IN ITALY

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The new proposed Directive of the European Parliament and of the Council on Soil Monitoring and Resilience (also called “Soil Monitoring Law”, SML) positions soil health as a key concept to increase the resilience of European soil systems and their capacity to mitigate climate change. The directive is a fundamental step to guide concrete actions and criteria to reach targets related to the extent and containment of soil degradation, it sets targets to restore degraded soils; as well as the indicators to be monitored to do so. The SML opens up an important discussion forum from the pedological technical point of view, mainly regarding indicators and thresholds to be used to monitor sol health status in face of the great pedo-climatic diversity of the different EU member states. In Italy, despite the absence of an institutional soil monitoring network at national scale, soil monitoring activities are carried out by regional soil services, mainly in the frame of regional funded projects (e.g. rural development programme RDP). In this context, the Emilia-Romagna (ER) region in northern Italy, has built, maintains and integrates along the time a rich-data soil information system thanks to multi-institutional efforts. The ER soil information system offers public access, thematic high-resolution maps on several soil properties and soil-based ecosystem services to support stakeholders on environmental decision-making and monitoring of soil health status with respect to regional land use and management. Some of these experiences are at odds with some of the SML prescriptions. These discrepancies are related mainly to those indicators and their thresholds applicable at the EU level, where many of the prescribed thresholds are considered rather harsh given the ER regional conditions and experience. On the other hand, the SML also opens up great opportunities for the expansion of current soil monitoring efforts, mainly in relation to those indicators where the member states can decide on thresholds criteria such as heavy metals and persistent organic pollutants concentrations.

Keywords: Soil monitoring,Soil information system,Soil health,Indicator thresholds

ID ABS WEB: 137657

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BETWEEN SOIL QUALITY AND SOIL HEALTH - TOWARDS A MORE COHERENT UNDERSTANDING AND BALANCED CONSIDERATION OF PHYSICAL, CHEMICAL, AND BIOLOGICAL INDICATORS

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Soils play a vital role across many sectors, particularly agriculture and forestry. With the need to feed a growing population, maintaining healthy soil to ensure the production of food and fiber becomes essential. There is still an ongoing debate about the use of the terms “soil quality” versus “soil health”, despite the need for a clear definition for soil assessment purposes. Soil quality has been primarily used by scientists since the 1970s, developing from an agricultural productivity-focused definition to including the importance of soils to sustain biological productivity, to maintain environmental quality, and to promote animal and plant health. Starting in the 1990s, criticism developed regarding the focus of these definitions on the use aspect of soils for humans. Consequently, increasing attention, especially by non-scientist stakeholders like farmers, was given to the concept of soil health, including the capacity of soil, defined as a finite non-renewable resource, to function as a vital living system. This definition emphasizes a more holistic understanding of soils and its biological processes, rather than the provision of services exclusively for human benefit. Our research aims to investigate these concepts and related aspects like indices, by using the methods of literature review and meta-analysis. Our preliminary results and synthesis of literature will be presented.

Keywords: Soil Health,Soil Quality,Indicators,Integration,Management

ID ABS WEB: 137673

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HOW CAN WE MEASURE THE IMPACT OF AGROECOLOGICAL PRACTICES ON SOIL FUNCTIONS? FIRST ASSESSMENT AFTER 6 YEARS OF USING THE BIOFUNCTOOL SOIL HEALTH KIT

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The recent European directive, the Soil Monitoring Law, defines soil health as the capacity of soil to function and provide ecosystem services. However, this functionalist view of soil health does not align with current literature. Most studies and databases on soil health focus mainly on stock indicators such as C, N and microbial biomass, while indicators of soil functions are rarely included. To address these methodological limitations, a new field method has been developed to assess soil functions. Biofunctool® is a method that addresses the multifunctionality of soil. It takes into account the relationship between physico-chemical and biological properties. It includes nine low-cost field indicators that allow the assessment of three main soil functions: carbon dynamics, nutrient cycling, and maintenance of soil structure. Biofunctool® is particularly useful for assessing the impact of agricultural practices on soil health. The Biofunctool® methodology has been applied in a variety of soil contexts, including tropical soils in Asia and Africa, and in different agronomic situations, such as conservation agriculture, agroforestry and tree plantations. This study aims to present a synthesis of Biofunctool® applications to highlight their relevance for the evaluation of agroecological practices. The study combines the results of six published articles and ongoing projects that use the Biofunctool® methodology. Biofunctool® has been shown to improve our understanding of the impact of agricultural practices on soil functions and could serve as a basis for integrating soil health into broader environmental analyses. However, we will also discuss the current main limitations of the method and suggest different perspectives for improving the method and facilitating its wider dissemination.

Keywords: Soil health,Low-Cost Field indicator,Soil functions,Tropical soils,Soil Multifunctionality

ID ABS WEB: 137772

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4.02 124990 - Towards harmonized soil health monitoring. Novel methods and perspectives and scientific, institutional, and societal challenges

PROPOSING A FLEXIBLE ASSESSMENT FRAMEWORK TO ADDRESS SOIL HEALTH GAPS IN THE GLOBAL SOUTH

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Soil health is the capacity of soils to perform multiple ecological functions, impacting broader societal benefits connected to sustainable development goals (SDGs). Smallholder farmers in the Global South are particularly vulnerable to soil degradation resulting from unsustainable agricultural management, exacerbated impacts of climate change and threatening food security and rural livelihoods. Tackling these interlinked global challenges requires a focus on restoration of soil health. The popularity of the soil health concept has led to an overwhelming demand for indicators, methods and technologies that can be used to assess soil health in robust and cost-effective ways, while obtaining evidence of the links between agricultural practices, soil health and agronomic, environmental and social benefits.
We discuss progresses and challenges for the development of soil health assessment frameworks and their application in the diverse contexts of smallholder farmers in the Global South. Based on literature review and experiences working across cropping systems in Africa and Latin America, we propose a flexible soil health framework adaptable to various systems, contexts and end users. We also identify research gaps that need to be addressed to strengthen its application and impact.
We conclude that (i) there are still challenges associated with the measurement and interpretation of the multiple dimensions of soil health, especially for biological indicators, 2) empirical studies linking soil health to agronomic and environmental outcomes, including trade-offs, are scarce, especially in the context of smallholders in developing countries; 3) the use of practical and low cost soil health indicators to support farmer decision making has received little attention. This flexible soil health assessment framework can help end-users gain insight into the baseline status of their soil, contextualize soil health, monitor changes, reveal and optimize trade-offs and synergies that affect the sustainability of the agronomic interventions and inform interventions. Ways to overcome knowledge or information gaps are discussed focusing on approaches that offer promise to create positive impact for smallholder farmers in the Global South.

Keywords: Smallholder farmers,Soil functions,Soil health metrics,Monitoring,soil management

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4. Soil health in achieving the Sustainable Development Goals
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SITE-SPECIFIC BENCHMARKS OF INDICATORS FOR A TAILORED SOIL HEALTH ASSESSMENT IN DENMARK

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Successfully achieving the goal of promoting healthy soils requires gathering data, information, and knowledge, particularly due to the significant diversity in soil types, climatic conditions, and land uses. We used a set of indicators and a site-specific benchmarking approach for evaluating soil health in arable lands from Denmark.
We compiled national datasets detailing topsoil organic carbon (OC), bulk density, soil pH, electrical conductivity, clay-to-OC ratio, and two model-informed properties such as water erosion, and nitrate leaching. To define units with similar conditions and account for variations in these soil health indicators, we categorized Danish soils into different strata using textural classes, landscape elements, and wetland types. We computed benchmarks for the indicators by analyzing data from each stratum. Our approach provided point-based results that allowed us to analyze the status of every single indicator, but also provided a spatially explicit overview of soil health, allowing the integrative analysis of the indicators by interpreting the occurrence of atypical areas in various indicators. We implied that the use of organic sources for fertilization would improve the soil health status relative to average conditions from the benchmarks; however, specific sources must be cautiously managed as improper application can lead to overfertilization, severely impacting soil and water quality.
We offered a concept for setting practical targets tailored to specific farming environments. The insights garnered from this study may be a basis for establishing a soil monitoring network for Denmark, in compliance with the Soil Monitoring Law that aims to achieve healthy soils across Europe by 2050. This approach avoids reliance on generic thresholds, ensuring a more unbiased assessment.

Keywords: European Soil Monitoring Law,Indicators Benchmarking,Soil Health Assessment,Soil Health Indicators

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PUZZLE PIECES OF SOIL HEALTH THROUGH SOIL ANALYSES

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Soil health encompasses soil physical, chemical, and biological characteristics. Commonly, many different tests are needed for a full soil health assessment, which is laborious, expensive, and many tests have a high environmental footprint. New broad-spectrum soil tests offer the potential to assess many soil characteristics quickly, but often face challenges with calibration and validation. Here we describe the results of an extensive research program which aimed at overcoming the aforementioned challenges. Two broad-spectrum techniques were selected, i.e., Near Infra-Red Spectroscopy (NIRS) and 0.01 M CaCl2 extractions of soil (1:10 soil:solution ratio) followed by discrete analysis and ICP-MS of the extractant for assessing plant available nutrients. NIRS was extensively calibrated and validated for various countries in Europe, as well as for various regions in China, New Zealand and Vietnam. Since its step-wise implementation in 2004, more than 3 million soil tests have been conducted. The results of the research program indicate that the accuracy of NIRS determinations for a wide range of soil physical, chemical and biological indices is high (R2 >0.90). The multi-constituent soil analysis (trough NIRS) are used in the Soil Carbon Check (SCC), a rapid tool to measure and monitor C(O2) sequestration (SDG13) in farmers' fields. To get insight in the bio-availability of nutrients and (heavy) metals, 0.01 M CaCl2 is used for 15 essential and beneficial nutrients and for 9 (heavy) metals. The two broad-spectrum soil tests combined have been calibrated and validated now for more than 35 soil characteristics (puzzle pieces). These soil characteristics (including Clay/SOC ratio, available phosphorus, sodicity and salinity indices, pH-water/CaCl2, bio available heavy metals and biological indices) were incorporated in Soil Health Indicator, which is accompanied by a comprehensive soil health report for users (farmers, advisors, research, retail and government). The approach allowed us to routinely introduce the soil nutrient intensity-buffering-quantity concept into agricultural practice and to provide guidance to attain healthier soils, and thereby contribute to achieving the SDSs.

Keywords: soil health,soil test,SDG's,monitoring,NIRS

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INTRODUCING A NEW SOIL HEALTH KEY - SHERPA: SOIL HEALTH EVALUATION, RATING PROTOCOL AND ASSESSMENT

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Soil health has become a key topic for governments, stakeholders, and scientists following the proposal of a soil monitoring law by the EU aimed at protecting and restoring soils. Soil health is commonly associated with soil quality for crops, but is essentially a very different concept and is equally important concept for grasslands, forests and wetlands. Various soil health indicators, such as chemical, physical, and biological indicators, are utilized to assess the health of soils. However, knowledge of these indicators for specific soils, topographies, and land use and land cover (LULC) is limited. Not all indicators can be universally applied to all LULC types. Therefore, it is essential to first understand the area and then utilize appropriate information to define soil health accurately.
We propose a new soil health framework called SHERPA (Soil Health Evaluation, Rating Protocol, and Assessment), which considers a soil healthy if its natural functions are not reduced or disturbed by humans. This framework is divided into two parts. Part 1 provides thresholds and criteria to identify human-induced soil degradation processes, such as soil erosion, landslides, drainage, heavy metal contamination, nitrogen surplus, and phosphorus deficiency. Part 2 offers scientific criteria for different indicators (e.g., geology, climate, organic layer composition, and soil structure information) to assign a soil health index for various LULC types. We have defined scientific criteria and a rating protocol for the LULC types grasslands, arable lands, orchards, and vineyards, forests and wetlands. The goal of SHERPA is to develop a soil health index map at the European scale within the R environment.
Acknowledgement: This presentation is part of the project- Accerlating collection and use of soil health information using AI technology to support the Soil Deal for Europe and EU Soil Observatory (AI4SoilHealth) that received funding from the European Unions's Horizon Europe research and Innovation Programme under grant agreement No. 101086179.

Keywords: Soil health,SHERPA,Soil degradation processes,indicators,European scale

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CONTENT AND STABLE ISOTOPE COMPOSITION OF ORGANIC AND INORGANIC CARBON POOLS OF DIFFERENT CALCAREOUS SOILS – THE EFFECT OF PRE-TREATMENT

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The precise determination of soil organic carbon (SOC) and soil inorganic carbon (SIC) content in calcareous soils is still open to debate. One way to quantify the SOC and SIC pools in a soil sample is to remove one or the other pool via pre-treatment and then calculate total carbon (TC) as the sum of SOC+SIC. Another option is to determine total carbon (TC) and SIC (or SOC) content separately and then calculate the SOC (or SIC) content, by difference. Both approaches have drawbacks. This study examined the effect of pre-treatment on carbon content measurements. Altogether, 71 surface and sub-surface soil samples were collected in Germany, Hungary and France. HCl decarbonation and ignition was applied to eliminate SIC or SOC, respectively.
In general, the TC content of bulk samples was lower than the sum of SIC+SOC content (R2=0.952): in samples with less than 6% TC content, the sum of SIC+SOC either over- or under-estimated TC but in samples with more than 6% TC content, the sum of SIC+SOC consistently overestimated TC. This suggests that pre-treatment resulted in incomplete carbon removal.
Measured values of the d13C of SIC were usually higher than -14‰, although several samples with SIC contents below 1% were depleted in d13C (as low as -31‰), indicating the presence of SOC in these samples. This suggests that SOC is not completely eliminated by ignition. This conclusion is supported by the fact that calculated values of the d13C of TC (using weighted averages of the d13C of individually measured SIC and SOC pools) were more negative than measurements of the d13C of TC obtained from direct analysis of bulk soil.

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Keywords: calcareous soils,methodology,soil organic carbon,soil inorganic carbon,stable carbon isotope

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LEGACY DATA DRIVEN SAMPLING DESIGN FOR MEDITERRANEAN AREAS

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Soil survey at large scale for monitoring soil health at high space-time resolution is on top of the political agenda, and it has recently gained importance for EU R&I and many other stakeholders. Sampling strategies based on selections of legacy and new locations can be efficient and best capture the soil (physicochemical and biological) spatial variability.
Traditionally, the definition of new sample locations has been based on randomized and stratified sampling designs and is sometimes supported by geostatistics optimization, mainly by studying the spatial dependence in vast regions with rugged terrain and the ease of reaching a specific area. However, contemporary digital soil mapping mostly relies on environmental data (digital elevation models, gridded climate data such as mean annual temperature and precipitations and their derivatives), upon which machine learning (ML) models predict soil properties.
In this work, a simulation explored the impact of various sample strategies and densities using legacy soil knowledge to allocate samples. The case study is built upon a legacy dataset of soil pedological profiles and digital soil maps where soils are classified according to the WRB system. The main scenarios evaluated are an equally spaced grid versus stratified sampling, depending on environmental variability and legacy data availability. Soil types were aggregated to define pedo-landscapes, and similarities were analysed statistically. In contrast, locations of legacy point data were considered as possible priority locations for allocating new monitoring sampling points.
Measurement errors were assessed across multiple sampling designs and scored according to the pedo-landscape and soil properties. Our findings will indicate the optimal density of samples per pedo-landscape.

Keywords: European Union R&I,PRIMA,Sampling design,LUCAS soil methodology,Pedodiversity

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SOIL BIOANALYSIS (SOILBIO): A SENSITIVE, CALIBRATED, AND SIMPLE ASSESSMENT OF SOIL HEALTH FOR BRAZIL

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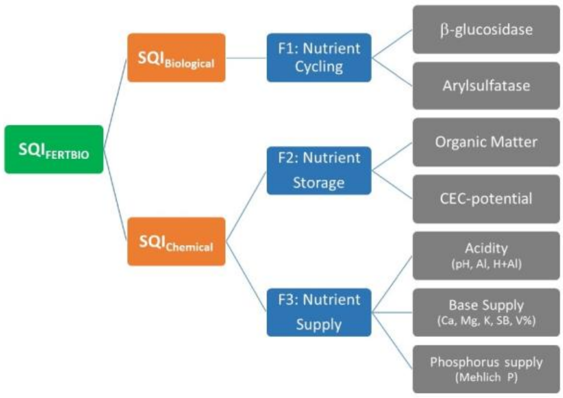
In alignment with global health concerns of agricultural soils, since July 2020, Brazil has adopted the Soil Bioanalysis (SoilBio) approach, a groundbreaking initiative that integrates two key soil enzymes – arylsulfatase (ARYL) and beta-glucosidase (GLU) – into routine soil testing.
This approach has allowed soil health (SH) monitoring at the farm scale by combining chemical and biological indicators within a Soil Quality Index (SQI) framework, which includes three soil functions: (F1) nutrient cycling (based on ARYL and GLU activities), (F2) nutrient storage (based on SOC and potential cation exchange capacity, CEC), and (F3) nutrient supply (based on Ca2+, Mg2+, K+, P, pH, H+Al; Al3+, sum of bases and base saturation).
Based on a series of previous studies, the following important features were defined for the SoilBio protocol (i) the choice of the 0 to 10 cm depth as the diagnostic soil layer, sampled by the same procedure as for soil chemical fertility analyses and using air-drying and sieving (smaller than 2 mm) for the pretreatment of the soil sample; ii) time of soil sampling after harvest of the second crop, together with that for chemical analysis, facilitating the procedure for farmers (in Brazil, two summer cash crops, e.g. soybean and maize, are grown on most farms), and iii) use of the widely validated and accessible methodology developed by Tabatabai (1994), omitting toluene.
In order to make SoilBio accessible for farmers, Embrapa (The Brazilian Corporation for Agricultural Research) has capacitated commercial soil analysis laboratories through the Embrapa´s SoilBio Network. The reliability of the results across the country is ensured by the nationwide standardization of methods and protocols and appropriate proficiency testing. By January 2024, the SoilBio data bank contained 30,000 results of soil samples from 27 Brazilian states. Since the beginning, this database underlies and feeds the Brazilian Soil Health scoreboard.



Schematic representation of the model used to define the Soil Quality Indices (SQIs) of the SoilBio technology. V%: base saturation; SB: sum of bases.

Keywords: Soil enzymes,beta-glucosidase,arylsulfatase,soil quality,bioindicators

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SEASONALITY AND SENSITIVITY TO LAND USE ARE CRITICAL FACTORS FOR SOIL HEALTH ASSESSMENT IN MEDITERRANEAN CLIMATIC ZONES

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[8] S

Evaluating soil health status related to agronomical, environmental, and ecological aspects is a major scientific challenge. In addition, the optimal sampling season and sampling depth and the impacts of soil texture on an array of soil properties are also in question. To cope with these challenges, we conducted comprehensive field soil sampling campaigns and an intensive analysis to determine the most suitable properties for evaluating soil health. Soil samples were collected at six sites in two critical agricultural regions of Israel, comprising three different soil orders (Vertisols, Aridosols, and Inceptiosols). We selected three adjacent plots at each site representing three agricultural land uses (perennial crops, annual crops, and non-cultivated lands). Each plot was sampled in two seasons (fall and spring) at three replicates in four soil depths (0–10 cm, 10–30 cm, 30–60 cm, 60–100 cm, N = 432). Overall, 94 soil properties were explored in this research based on soil and agronomy experts' opinions. A set of ANOVA and hierarchical clustering analyses were used to objectively reduce this long list of properties to determine the most land-use-sensitive properties for evaluating soil health in Mediterranean climatic zones. The statistical analysis suggested 22 soil properties that well indicate soil health statue, including traditional ones (e.g., mineral N, soil organic carbon, bulk density, etc.) and novel ones, such as free-living nematode and microbial community functionality indicators, the fluorescence emission of dissolved organic carbon, on-situ measurements as the diversity of weeds and visual soil assessments (VSA). Soil texture and depth significantly affected some of the selected soil properties. A possible way of accounting for soil texture effects is to develop relative indicators based on quantification of the relative proportion or performance of the chosen properties out of their overall population. In addition, the recommended sampling depth can be determined according to the sensitivity of the measured soil property to soil depth.

Keywords: land use,soil biological properties,soil chemical properties,soil physical properties,soil quality

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INTEGRATIVE LAND SYSTEM HEALTH EVALUATION FRAMEWORK FOR SUSTAINABLE SOIL STEWARDSHIP: INSIGHTS FROM A GRAZING SYSTEM ON AHUAHU, NEW ZEALAND

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This research introduces an advanced soil assessment platform designed for application in commercial agronomy, providing a thorough evaluation of soil biogeochemistry, structural integrity, and microbial biodiversity. It includes the Cornell University / USDA NRCS soil health metrics, comprehensive nutrient testing of all macro- and micronutrients, and advanced soil microbial ecology methods in order to empower agricultural land managers as informed stewards of their soil ecosystems. A pivotal feature of the system is its molecular soil microbiome analysis, utilizing 16S rRNA and ITS region sequencing to detail the composition and abundance of soil microbial populations. This approach enables a nuanced understanding of the soil's biotic environment, which is vital for maintaining ecological balance and promoting agricultural sustainability. The data generated empowers land managers with the insights needed for informed management of soil in commercial agricultural systems. This novel approach encapsulates the essence of modern soil science, merging detailed laboratory data with practical applications in land management. A case study demonstrating the application of this land system health evaluation framework will be presented, detailing its implementation in a cattle and sheep grazing system on Ahuahu (Great Mercury Island), New Zealand. The study highlights the framework's utility in assessing and managing soil within pastoral agricultural systems.

Keywords: soil health,soil microbial biodiversity,sustainable land management

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4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

EXOGENOUS CARBON ALLEVIATED PHOSPHORUS ENVIRONMENTAL IMPACT THROUGH MEDIATING PHOSPHORUS DYNAMICS: A CASE STUDY OF CONTINUOUS MANURE INPUT IN SOUTHWEST CHINA

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Background, Methods
Replacing chemical fertilizer with swine manure to reduce the input of phosphorus (P) fertilizer is a common practice in southwest China. Such practice takes a high risk of environmental impact, e.g. P leaching. Thus, to understand how annual P dynamics response to continuous manure and combined exogenous carbon (C) input is critical for P management. Soil inorganic phosphorus (P) fractions were studied in an 8-year continuous, randomized field trial involving rotating wheat-rice crops. The field trial comprised six treatments: triplicate control plots receiving chemical fertilizers only, and triplicate plots receiving chemical fertilizers and/or swine manure providing 150 to 1200 kg P2O5·ha-1. Soil incubation experiments were also conducted, involving addition of glucose or cellulose as exogenous carbon sources to test their effects on soil P dynamics with a view to reducing environmental damage from P leaching.

Results, Conclusions
Continuous application of swine manure increased soil P content and availability. P accumulated in the soil primarily as Fe-P during the first four years of manure application, but as Ca8-P during the next four years. The main driver of these changes in P fractions was soil total organic carbon (TOC; 31.5% contribution). TOC increased throughout the trial, rising faster in years 1–4 than years 4–8. Addition of cellulose to soil that had received high quantities of swine manure for eight years increased the moderately labile and moderately resistant organic P fractions but decreased the Ca8-P and Olsen-P fractions. This facilitated adsorption of high-activity inorganic P to the organic matter and limited the accumulation of Ca8-P. In terms of the risk of P leaching and of labile P content from soil was judged to be, optimized under a M2 treatment fertilization regime applying 10,300 kg ha-1 y-1 swine manure was the best treatment in our study. To reduce the risk of P leaching, it is recommended that additional cellulose-based organic matter (e.g., straw) be included in swine manure fertilization regimes.

Keywords: Exogenous carbon, Soil phosphorous dynamics, Swine manure, Total organic carbon, Long-term fertilization

ID ABS WEB: 136162

4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

POLYSACCHARIDE-COATED APATITE FORMULATIONS: ENHANCED CROP P-UPTAKE AND REDUCED LEACHING

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The necessity of enhancing phosphorous (P) availability to crops while decreasing its migration in the environment, is well known. We propose to coat apatite with biodegradable polymers for the design of novel phosphorous fertilizers. We hypothesis that the biodegradable coating will specifically stimulate Phosphate Solubilizing Bacteria (PSB) and general bacterial activity and consequently, reduce local pH and thereby enhance phosphorous availability. Apatite was coated successfully with mucilage, a natural polysaccharide, extracted from chia seed. Mucilage loadings reached up to 15%, and the coatings were stable upon rinsing with water. The formulations were applied in sandy soil and the CO2 emissions (indicating microbial activity) of the samples contacting uncoated apatite and of a commercial fertilizer (Triple Superphosphate, TSP) were similar to the control. The highest CO2 emissions were detected from the samples containing apatite coated with mucilage, suggesting high microbial activity. TSP leaching from the soil was 3 orders of magnitude higher than the leaching from the mucilage coated apatite. The effects of general soil bacteria and specific PSB on the local pH of an apatite medium, was demonstrated. In the presence of glucose, general soil bacteria and PSB reduced solution’s pH by ~0.6 and 1-1.7 units, respectively, and the pH reduction directly correlated to enhanced apatite P solubility. A similar, but more moderate trend, was obtained for bacteria in the presence of mucilage. Wheat plants were grown in pots containing sandy soil treated with mucilage (Muci), apatite (Ap), apatite+mucilage (Ap+muci) and TSP. The dry weight of the wheat was significantly higher for the 'Ap+muci' treatment, followed by the plants treated with Ap or TSP, while the control and Muci treatments resulted in significantly low weight. Olsen measurements (P plant availability test) indicated higher P concentrations in the 'Ap+muci' treated soil. These results support our working hypothesis that application of the apatite formulation to the soil enhance microbial activity which induces phosphate release from bacterial populations.

Keywords: P-availability,Apatite,Microbial activity,P-formulation,P-migration

ID ABS WEB: 136385

4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

GRADUAL CHANGES IN ORGANIC AND INORGANIC SOIL P FORMS UNDER DIFFERENT LAND RECOVERY SCENARIOS

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Soil phosphorus (P), a crucial element for ecosystem functioning and long-term plant nutrition, undergoes dynamic changes during soil recovery after disturbance affecting its forms and plant availability. Our approach includes 2 different scenarios of P degradation and recovery important at the global level as intensive land use or post-fire restoration.

Scenario 1. P degradation in post-fire scenarios. Organic and mineral soil layers of Mediterranean forests affected by wildfires (with different severities) and prescribed fires were sampled immediately and one year after fire. We observed an immediate rise in readily available P (orthophosphate) and 31P-NMR spectroscopy revealed a notable transformation in P forms, particularly in the organic layer. Wildfires induced a profound and enduring effect on organic P, resulting in a large P mineralization (large increase of orthophosphate, mono- and diesters disappearance), even at low SBS, with orthophosphate dominance persisting after one year. Conversely, prescribed fire facilitated the recovery of organic P forms to pre-fire levels.

Scenario 2. Grassland restoration after intensive soil use. The recovery of semi-natural grasslands is considered a sustainable opportunity for P recovery in highly degraded soils. Here, we evaluated the accumulation and evolution of organic and inorganic P after a chronosequence of grassland reclamation. This work focused on abandoned croplands from Galicia (NW Spain), which were progressively recovered in a 45 yr chronosequence. Different soil P forms were identified in surface soils (0-5 cm). We observed a gradual soil recovery, and a progressive increase in P content and organic P forms, as well as in other physical-chemical parameters. Transformed grasslands recovered a significant proportion of the initial P content in the long-term (after 45 yr) reaching similar levels to those observed in seminatural forests or adjacent croplands. The increase in the organic P fraction can be considered as the result of high productivity due to climate, soil natural acidity and sustainable management (legume, slurry application), which favor plant growth and litter input.

Keywords: Soil degradation,organic phosphorus,31P- NMR spectroscopy,Wildfires,Grasslands restoration

ID ABS WEB: 136401

4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

ASSESSING SOIL PHOSPHORUS AVAILABILITY FROM STRUVITE APPLICATION IN NEW ZEALAND SOILS

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Phosphorus (P) is a critical nutrient for plant growth and food production. With the projected global population growth to reach 9.5 billion by 2050, the demand for P fertilizers is expected to increase. Most of the P-fertilizers are derived from phosphate rock which is a finite source. Previous studies have shown that precipitated struvite (MgNH4PO4.6H20) is a promising sustainable alternative to traditional P-fertilizers. Nevertheless, little research has been done about its behaviour in New Zealand soils. The objective of this study was to assess changes in soil available P (Olsen-P) over time from struvite in a plant-less incubation with three contrasting soils in their anion storage capacity (ASC) compared with single-superphosphate (SSP), diammonium-phosphate (DAP), and reactive phosphate rock (RPR). Each fertilizer was mixed with the soil at a rate of 50 kg P/ha in replicates, and sampled at 3, 7, 21, 35, and 63 days of incubation. Averaged across sampling days, fertilizer type, and soil type, Olsen-P ranged from 6.0 to 45.0 mg/kg. Overall, Olsen-P increases were influenced by the interaction between soil type and fertilizer type. The addition of struvite generated increases in Olsen-P similar (P>0.05) to those of DAP and SSP in all the evaluated soils. For the soils with lowest and medium ASC, Olsen-P concentration of struvite addition were four and six times greater respectively, compared with the respective initial values, while for the high ASC soils, Olsen-P values from struvite doubled the initial value. These findings situate struvite as a promissory sustainable source of P especially for soils with high ASC where the application of conventional soluble fertilizers is limited due to its high reactivity with the soil components. To thoroughly evaluate the suitability of struvite as an alternative P-fertilizer source for New Zealand soils, further comprehensive research is necessary to gain a deeper understanding of struvite's performance in different soil conditions (e.i. pH) and its agronomic effectiveness for plant grow.

Keywords: Phosphorus use efficiency, Soil fertility, P retention, Circular economy, sparingly-soluble fertilizer

ID ABS WEB: 136735

4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

UNLOCKING THE CHEMISTRY OF SOIL LEGACY PHOSPHORUS TO MAINTAIN SUSTAINABLE AGRICULTURE AND A HEALTHY ENVIRONMENT

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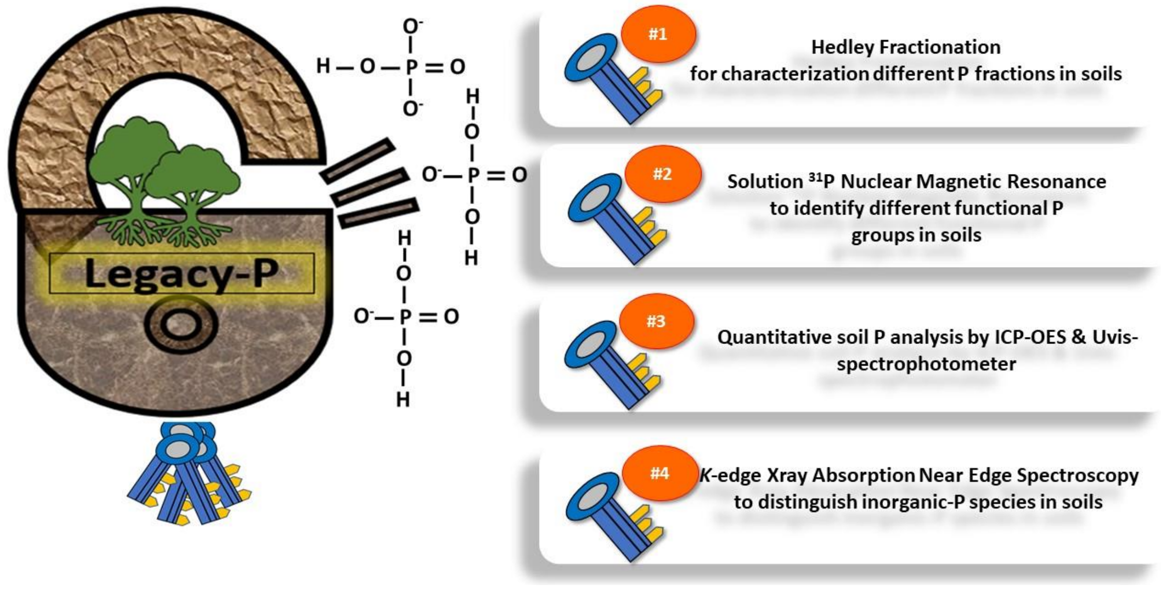
Phosphorus (P) is an essential nutrient for animals, plants, and microbes; however, it could potentially harm the environment and its inhabitants when it is mined and used in unsustainable ways. It is estimated that > 40% of the world's arable land suffers from P deficiency, and finite rock phosphate sources could deplete in 50-100 years. Thus, establishing harmony between agriculture and the environment is critical. The Science and Technologies for Phosphorus Sustainability (STEPS) Center is a National Science Foundation-funded convergence research center with a goal of a 25% reduction in mined phosphates and a 25% reduction in losses from point and non-point sources to soil water resources could lead us to that desired P-balance. As part of this study, soils across three edaphic regions and varying P concentrations will be characterized using combinations of tools such as modified Hedley P-fractionation, P-XANES, and P-NMR that will allow for better understanding of the major forms of phosphorus in soil. Long-term application of animal manure and fertilizer in acidic soils (e.g., North Carolina), native P in muck soils (e.g., Histosol in South Florida), and tightly held P in alkaline calcareous Arizona soils makes the 'legacy P' a promising in situ P-resource. Our goal is to develop management strategies based on research findings that will help shift the P fertilization paradigm from “feed the soil” to “feed the plant”.



Keywords: legacy phosphorus,STEPS,Hedley fractionation,P-NMR,P-XANES

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ASSESSING GLOBAL FOOD SECURITY: THE IMPACT OF FERTILIZER SUPPLY RESTRICTIONS ON AGRICULTURAL PRODUCTION AND ENVIRONMENTAL QUALITY

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Fertilizers are essential for agriculture, accounting for about 60% of yield increases in staple crops over the past 50 years and alleviating food security concerns. However, recent supply chain disruptions due to COVID-19, geopolitical tensions, and trade policies have precipitated a global fertilizer crisis, threatening food security as prices soar.

This crisis endangers the balance between farmer compensation and consumer affordability. Reduced fertilizer availability increases costs for farmers, particularly those cultivating essential crops like wheat, leading to heightened food prices and deepening the hunger crisis. Conversely, overuse of fertilizers results in environmental degradation, including eutrophication and greenhouse gas emissions, posing further challenges to sustainable agricultural practices.

Our research delves into the implications of nitrogen and phosphorus fertilizer supply constraints on food production, trade, land management, and environmental quality. This research will build on efforts further to develop Global Biosphere Management Model (GLOBIOM). Our approach incorporates both spatial and behavioral heterogeneity at regional scales, connecting regional production decisions with global policies.

We built our model with detailed economic, land use, and environmental data from the U.S. region. It represents the agricultural production of 18 crops and seven livestock types, processed for food, feed, and bioenergy markets. We explore various scenarios, including trade restrictions, sustainability policies, and climate change impacts.

Preliminary results indicate global trade restrictions, like export tariffs on fertilizers and quantity constraints, affect U.S. fertilizer consumption, agricultural outputs, and food security. Our future analysis will examine market dynamics under these scenarios and their interplay with other global change drivers.

This work contributes significantly to the modeling of fertilizer policy and food security, offering insights into domestic and global impacts of supply-side constraints. It highlights the importance of integrated, spatially heterogeneous approaches to understanding and responding to complex interdependencies between fertilizer management, food production, and environmental sustainability. This also provides a robust framework to inform policies safeguarding food security while mitigating environmental impacts, emphasizing needs for synchronized global and regional strategies.

Keywords: Fertilizer Policy,Food Security,Environmental Quality,Agricultural Production,Trade Policy

ID ABS WEB: 136813

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PHOSPHORUS IN THE SYSTEM SOIL – CROPS – WATERS: NEW INSIGHTS FROM A DECADE OF GERMANY-WIDE RESEARCH PROGRAMS

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In Germany the issue of agricultural phosphorus (P) use has received great public recognition in the past decade for two reasons: (1) concerns about future P-shortage, fuelled by publications of a “peak phosphorus” and expected global P-shortage (e.g. Cordell & White, 2014), (2) the non-sustainable agricultural P usage, oversupply to soils, and deterioration of water quality in freshwater and marine environments. Governmental boards and funding agencies have set up research programs towards finding solutions for a more sustainable P use, two of which will be presented. The Leibniz ScienceCampus Phosphorus Research Rostock (2014-2024; https://wissenschaftscampus-rostock.de/home.html) has run two graduate schools in which 26 PhD candidates conducted multidisciplinary P-research projects. A similar multidisciplinary approach was the basis of the research program InnoSoilPhos (2015-2024; https://www.innosoilphos.de/) in the frame of the BonaRes Soil Research Program of German Ministry for Education and Research. A few examples of soil-related research outcomes shall prove the author´s thesis that the P issue can be managed sustainably: (1) Current P fertilizer recommendations are too high, saving P by less fertilizer does not mean yield depressions. (2) The legacy P pool in soil, even the mobile fraction, is sufficient for many harvests at omitted P fertilization. (3) The P binding mechanisms are understood at the atomic and molecular scale, offering ways to overcome strong fixation and getting P into solution. (4) Proper crop rotations and even weeds can mobilize P for the main field crop. (5) Many P recycling technologies are at hand, and the P recycling materials release the P slowly, reducing the demand for mineable P resources and the risk of P transfer to waterways. (6) Finally, P governance and policy instruments have been proposed for a better P management. In the light of these new research results, currently, the P issue appears less dangerous than a decade before.

Keywords: fertilizer recommendation,legacy P,computational chemistry,crop rotation,recycling fertilizer

ID ABS WEB: 137136

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OPTIMIZING AGRICULTURAL PHOSPHORUS SUSTAINABILITY: INSIGHTS FROM LONG-TERM FERTILIZATION STRATEGIES AND CLIMATE CHANGE IMPACTS IN CHINA

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Soil phosphorus (P) is unevenly distributed across regions and ecosystems. Historical excessive P fertilization to maximize crop production has led to the accumulation of soil P in some regions. Accumulated soil P is susceptible to loss to water bodies through surface and subsurface runoff, leaching and erosion, which contribute to eutrophication. In 2015, the Chinese government introduced the 'Action Plan for Zero Growth in Fertilizer Usage by 2020', especially for Nitrogen (N) and P, while enhancing its efficacy. This initiative seeks to foster modern agricultural practices prioritizing high productivity, product safety, resource conservation, and environmental sustainability. In this context, we conducted a comprehensive series of long-term field experiments to compare optimal fertilization strategies in the current agricultural system and future climate change scenarios. For instance, through two 13 years of field experiments, we found that annual planning of P fertilizer in paddy-upland rotation farming can reduce fertilizer application and P loss, without affecting crop yields, highlighting the importance of recognizing soil legacy P as a valuable resource. However, to ensure future crop and environmental gains, climate change must be considered a key factor in shaping sustainable strategies for phosphorus management. Our findings from two long-term rice Free Air Carbon Dioxide Enrichment (FACE) experiments, conducted over 15 and 9 years, further suggest that increased transfers of plant-available P from biological, biochemical, and chemical sources under anthropogenic changes are insufficient to compensate for reductions in plant-available phosphorus under long-term exposure to elevated CO2. Hence, addressing the challenge of balancing food security and environmental goals will continue to be a significant challenge in the Agricultural System.

Keywords: Phosphorus fertilization,Soil legacy P,Crop yield,Environmental P loss,Atmospheric CO2 enrichment

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PHENOLOGY STRONGLY REGULATES THE EFFECT OF FERTILIZERS ON THE PLANT-SOIL MICROBIAL INTERACTIONS IN WHEAT.

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Phosphorus fertilizer supply encounters challenges due to scant phosphate rock mines and stringent quality regulations. Recycling high phosphorus wastes is an appropriate alternative to ensure nutrient supply for crops and circular economy strategies. In this work conducted in South East Spain conventional phosphorus fertilization was partially substituted with alternative sources such as meat-bone meal (MB), sludge (S) and its combination (SMB) in a wheat agroecosystem. Results showed that crop yield can be maintained by partially replacing conventional chemical fertilizers with said alternatives. S and the organomineral combination SMB generated higher bioavailable phosphorus compared to traditional treatments, attributed to elevated phosphatase activity. During germination and flag leaf stages, an increase in phosphatase activity was observed in the organomineral treatments, concurring with the highest microbial biomass in these treatments. Significant differences between treatments in soil microbial biomass were observed in flag leaf stages, S and SMB showed the highest microbial biomass. Amplicon sequencing revealed that bacterial and fungal community composition was influenced by crop phenology, while fertilization treatments effect was less pronounced. This organo-mineral fertilization approach emerges as a sustainable method for crop production and soil health improvement, emphasizing the dominant role of crop phenology in shaping soil microbial communities.

Keywords: Phosphorus fertilization,Soil microbial community,Crop phenology,Soil health

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MAPPING PHOSPHORUS AVAILABILITY AT FIELD SCALE USING A COMBINATION OF DIFFUSIVE GRADIENTS IN THIN FILMS (DGT) AND SYNCHROTRON X-RAY FLUORESCENCE MICROSCOPY (XFM)

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Introduction
The diffusive gradients in thin-films (DGT) technique3 is commonly used to estimate the potentially bioavailable concentrations and distribution of nutrients and contaminants in the environment. This method correlates strongly to plant available nutrients because it mimics plant nutrient uptake by acting as an infinite sink. This technique has been used to obtain two-dimensional (2D) images of labile P concentrations or P fluxes in soil using Laser Abalation (LA) ICP-MS. However, conventional DGTs are tedious to prepare and difficult prepare at a scale (10s of cm2) relevant to field scale observations.
The aim of this study was to develop and test a new large, simple to prepare and robust DGT that allows to map the spatial distribution of labile P at field scale in combination with XFM.

Material and Methods
The novel DGT device is based on a new binding layer where Metsorb is deposited on a sheet of polyimide film coated with an acrylic adhesive. The resulting binding layer can be 100s of cm2 and is easy to prepare and extremely robust, making it ideal for field deployments. These large DGT devices were tested in a field experiment in South Australia where different P strategies were applied. The binding layers were analysed at the XFM beamline at the Australian Synchrotron.

Results
The results of preliminary experiments showed that P quantification by XFM provided similar results to LA-ICP-MS. This study showed that reaction of different forms of P fertilizers near the point of application (often called the fertosphere) are complex and this novel DGT design, with a gel-free binding layer that allows analyses through synchrotron XFM, can provide an easy and convenient method to visualize P availability in 2D.

Keywords: Soil,Phosphorus,DGT,XFM,Availability mapping

ID ABS WEB: 137280

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PHOSPHORUS MANAGEMENT IN NORWEGIAN AGRICULTURAL LANDSCAPE: REGIONAL DIFFERENCES, EFFECTIVENESS OF MITIGATION MEASURES, AND FUTURE NEEDS

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Norway faces many challenges for best managing phosphorus (P) in the agricultural landscape, which include large regional differences in climates, soils, production systems and P balances. These differences result in diverse drivers and processes controlling P losses from the landscape and management needs for both water quality and food production goals. In the past, a national policy was implemented to prioritize cereal production in the eastern part of Norway that has suitable climate and soils, and livestock production in the west that is not suitable for cereal production due to high precipitation. The policy helped with food self-sufficiency in the country but has led to a dilemma with manure P surplus in the west. Today, the cereal production areas typically have soil erosion problems that degrade soil quality and cause large amounts of particulate P loss associated with tillage, and the livestock production areas have problems with soil P buildup, loss of dissolved P, and low efficiency of added P for crop production. Notably, P losses from different regions have been monitored since 1990s in 10 representative agricultural catchments across Norway (JOVA program) to report temporal and spatial water quality trends in the streams and assess the impacts of management. Moreover, policy efforts and economic incentives have been made or are being developed to reduce livestock density, avoid winter manure applications, and promote the use of conservation tillage, cover crops and wetlands. The effectiveness of some of the measures to reduced P losses have been tested and demonstrated in the field. In this presentation, we aim to give an overview of (1) the regional differences in soil P distribution and P losses from agricultural catchments to water, (2) the effectiveness of selected mitigation measures to reduce P losses, and (3) future needs for P research and management.

Keywords: Water quality,Phosphorus management,Food production,Norway,Mitigation measures

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MANAGING LEGACY PHOSPHORUS IN SOILS FOR MAXIMIZED CROP PRODUCTION WITH MINIMIZED ADVERSE WATER QUALITY IMPACTS IN THE GREAT LAKES BASIN

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Body
Soils derived from glacial parent materials are fertile and highly productive in the Great Lakes basin. Intensive fertilization excessive to crop removal resulted in build-up of legacy P in soils (LPS), that not only becomes a predominate source of P loading to the lakes but also makes lag of water quality improvement with mitigation efforts of BMP implementation. In order to gain in-depth understanding of the nature of LPS and develop efficient management practices that enable farmers to maximum crop production with minimized adverse impacts on lake water quality, we conducted systematically studies by focusing on the Lake Erie basin, the one with most water quality concerns among the five Great Lakes, in past 25 years. We assessed the stocks and availability status of LPS, developed environmental soil P testing methods, and assessed typical/newly proposed management practices based on which BMPs were developed for efficient use of LPS. The LPS was estimated with 589 kg ha-1, which would supply crops for approximately 40 years without further addition if fully used. Degree of soil P saturation is a practically meaningful procedure for P loss assessment with potential for agronomic P calibration. Legacy P in clay loam soils sustained consistently crop yields for 16 years relative to continuous P addition. Soil test P declined at a rate of 3.1 mg ha-1 year-1, with critical values observed at 10.3-17.1 mg kg-1 for various crops. In sandy loam soils, however, a booster of fertilizer P addition is required to ensure optimum crop growth even if in soils that are very high in LPS. Use of LPS decreased soil P losses in runoff water by 33%, which was further enhanced by winter cover crop combined with controlled drainage and sub-irrigation. Optimized utilization of LPS can be an effective approach to sustain crop production and improve farming profitability and meanwhile to ultimately reach the goal of agri-P loading reduction to water bodies in Great Lakes basin.

Keywords: Legacy phosphorus,Food production,Water quality,Great Lakes,Best management practices

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DOUBLE-EDGED SWORD: LONG-TERM ORGANIC FERTILIZER APPLICATION PROMOTED THE SOIL P BIO-AVAILABILITY AND MAY INCREASE THE SOIL COLLOIDAL P LOSS RISK

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The existing form of phosphorus (P) in the soil is key for the bioavailability, which influence the utilization and loss risk of P. A better understanding of fertilization strategy on regulating P bioavailability and loss risk is urgently required to improve P utilization and reduce P input. In this study, soils of six different fertilization treatments from a long-term experiment in Suzhou (started in 1980) were collected: C0(no fertilizer), CNK (chemical fertilizer of N & K), CNPK (chemical fertilizer of N, P & K), M0 (only manure), MNK (manure + chemical N and K fertilizer), MNPK (manure + N, P and K fertilizer). Results showed that organic fertilizer application elevated soil organic carbon (SOC), Olsen-P and TP contents. The increase in Olsen-P of MNPK treatment was even greater than the additive effect of CNPK and M0 treatments. Soil organic P content and percentage increased under organic fertilizer treatments compared to inorganic fertilizer treatments, and NaOH-Po was the dominant. OM-Fe (Al)-P accounted for about 34.6-70.0% of NaOH-Po. OM-Fe (Al)-P showed a significant positive correlation ($P < 0.05$) with DDI (the degree of decomposition index), amorphous Fe and Al, which indicate that the application of organic fertilizer promoted the DDI of soil OM, which in turn elevated the amorphous Fe and Al content, and hence the OM-Fe (Al)-P content. On the other hand, organic fertilizer application significantly increased soil colloidal P content through co-precipitation of organic matter with Fe/Al. This may increase the P loss risk due to the characteristics of mobility and relatively large specific surface area of colloidal particles. This study suggested that organic fertilizer application may act as a double-edged sword. Organic fertilizer with proper C/P ratio is key to balance the soil P availability and environmental risk.

Keywords: organic fertilizer,soil P bio-availability,soil colloidal P,amorphous Fe and Al

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MINERAL PHOSPHORUS FERTILIZATION FOR SILAGE CORN IN MANURED SOILS IN THE FRASER VALLEY, CANADA

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Starter fertilizer phosphorus (P) is crucial to crop production, but its application beyond what is necessary for plant growth can result in high soil P concentrations and increase P loss from agricultural land to water. The objectives of this work were to assess the effects of increasing rates of starter fertilizer P on: (1) silage corn dry matter (DM) yield and plant P uptake at early growth stages; and (2) changes in soil P. We conducted 20 trials from 2018 to 2021 with increasing starter P rates (0, 5, 10, 15 and 20 kg P/ha) and manure on farmers' fields across the Fraser Valley (British Columbia, BC, Canada). In 2018, DM weight at the 6-leaf stage was affected by starter P in all sites, and the response curve was described by a linear-plus-plateau model with critical starter P of 5.0 and 7.5 kg/ha. In 2019, corn DM weight at early growth stages was not affected by starter P. In 2020 and 2021, at early growth stages of silage corn, DM weight response to starter fertilizer P was not significant, except at one site where the critical rate varied between 5 and 7.5 kg P/ha. Corn DM yields at harvest (20–27.2 Mg/ha) during the four growing seasons were in the optimum provincial range in sites with excess P, with the exception of three sites, one two low initial soil P concentrations and the other with waterlogged soils. These results showed that starter fertilizer P could be reduced or even eliminated completely without affecting the growth of young plants and yield at harvest, decreasing the need for off-farm P inputs and the risk of P loss to the environment.

Keywords: corn dry matter, root surface area and volume, 3- and 6-leaf stages, anion exchange membrane

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AGRONOMIC AND ENVIRONMENTAL OUTCOMES IN RESPONSE TO PHOSPHORUS PLACEMENT IN CONSERVATION-TILLAGE SYSTEMS AND THE ROLE OF SOIL-WATER AND ROOT DISTRIBUTION ON PHOSPHORUS UPTAKE BY CORN AND SOYBEAN

F GERARDO FERNANDEZ

University of Minnesota, St Paul, USA

Broadcast phosphorus (P) applications without soil mixing result in P stratification in the soil profile with greater concentrations near the surface. Some have hypothesize that this stratification is a problem because it forces crops to obtain P from the surface layer that is more vulnerable to drying. For this reason, some have proposed that a subsurface band application might be advantageous because P is placed where there is presumably more available water. Studies were conducted continuously in the same fields for 9-yrs with various P rates broadcast on the soil surface or sub-surface banded 15 cm below the crop-row in both no-till and strip-till. Plant P uptake along with measurements at several soil depth increments (both in the crop-row and between-rows) of soil moisture, root-diameter, -length and -surface density, and soil P were conducted throughout the growing season. The study showed that strip-till improved grain production relative to no-till, but there was no effect of P placement. Root-density was highest in the surface layer and quickly declined with soil depth for both the crop-row and between-rows. Water content was relatively uniform within the top 40 cm of the soil, and while the surface layer dried more during prolonged periods without rain, water content was replenished more in the surface than the subsurface with typical intermittent rainfall. There was no evidence of improved efficiency or potential to reduce P fertilization rates with subsurface band applications. Regardless of P placement, apparent P uptake (change in soil P levels over time) was greatest in the surface layer between-rows. The study determined that for each soil core taken in the P band two to three cores between-rows are needed in a composite to correctly determine the fertility of fields with banded P that created horizontal stratification with bands of high- and low-P across the field. While there were no agronomic benefits, P runoff was substantially reduced with subsurface-banded P even at high-P fertilizer rates.

Keywords: Conservation tillage,Subsurface band phosphorus,corn and soybean,Phosphorus runoff,Soil sampling

ID ABS WEB: 138028

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EFFECT OF PHOSPHORUS-ENRICHED BIOCHAR FROM REAL TREATED WASTEWATER (RTWW) ON SOIL-SUNFLOWER (HELIANTHUS ANNUUS L.) SYSTEM

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Due to the increasing world population, it is necessary to find new source of nutrient for plant grown. Phosphorus, a limited resource, can be recovered from treated wastewaters using biochar, a pyrolysis product. The aim of this study was to evaluate the ability of P-enriched biochar in acting as P fertiliser for sunflower cultivation (Helianthus annuus L.) system. The biochar was enriched using real treated wastewater at a pilot-scale wastewater treatment plant of the Water Resource Recovery Facility of Palermo University. Two types of biochar (B440 and B880), obtained from the same biomass by pyrolysis at 440°C and 880°C, respectively, were used. The experimental design involved the use of calcareous and not calcareous soils, both deficient in P. Four treatments were performed: a control without P, a control with P applied as KH2PO4 at a dose of 50 mg of P per kg of dry soil, a treatment with biochar B440, and another one with biochar B880, both applied to add 50 mg of P per kg of dry soil. The experiment lasted (122 days) and was carried out in a growth chamber. Sunflower was chosen as test plant due to its high P requirement and susceptibility to nutritional deficiencies. The study included extensive investigation such as biochar ATR-FTIR spectra, P release kinetics analysis, a germination index, phytotoxic risk assessment, and the evaluation of biochar's impact on soil and sunflower plants. Biochar B440 released P slower than B880. Germination tests indicated that both biochar positively influenced germination and root growth of lettuce without phytotoxic effects. Notably, the germination index increased by 15% with P-B440 and 20% with P-B880 compared to the control. However, when applied to soil, enriched P-biochar did not affect available P forms and P uptake of sunflower plants did not exhibit differences between soil amended with enriched biochars and control. Anyway, the P replacement value of enriched biochar ranged from 2 to 12% of inorganic fertilizers.

Keywords: Nutrient Recovery,Circular Economy,P uptake,Fertilizer,Replacement Value

ID ABS WEB: 138120

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SOIL WARMING REDUCES THE AVAILABILITY OF PHOSPHORUS

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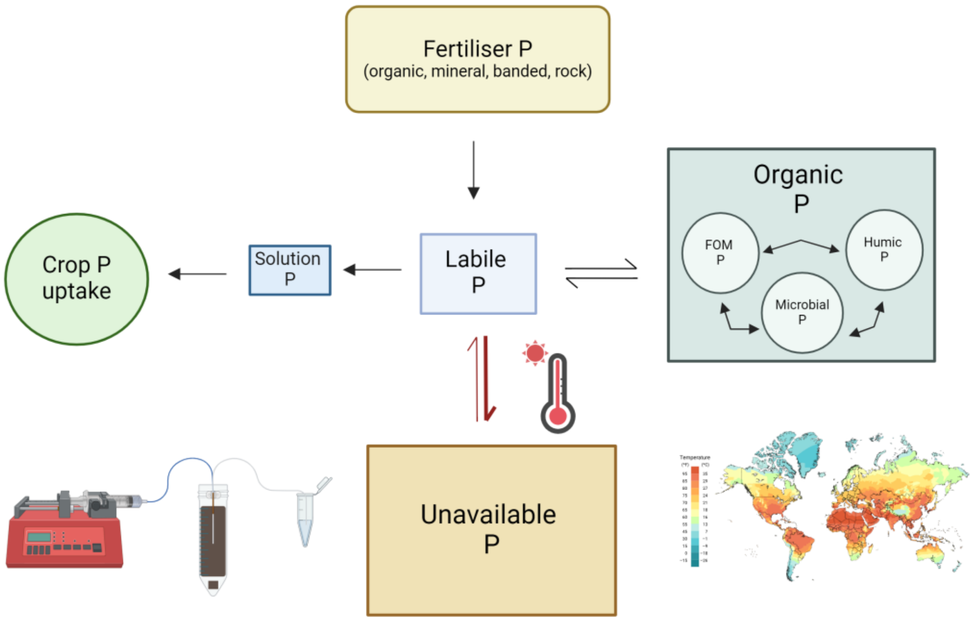
Higher soil temperatures hasten phosphorus (P) sorption and reduce P availability for crops, but the effects of soil warming on initial P sorption rate and P use efficiency (PUE) are unclear. We quantified the fate of P on a black Vertosol, using in situ microdialysis incubations over 165 days, at four temperatures (10, 20, 35, 50 °C), five P application rates (equivalent to 0 (control), 50, 100, 200, 400 kg ha-1 at 10 cm depth), with two P forms: finely ground triple super phosphate (TSP) (Ca(H2PO4)2·H2O) and dissolved KH2PO4. On average, PO4-P availability at 50 °C was 53 % (TSP) and 64 % (KH2PO4) lower compared to 10 °C, across all P rates except the control. There were significant temperature effects on PO4-P for both P forms, but for different reasons. Decreasing PO4-P at 35 and 50 °C caused significant temperature effects sooner and more consistently for KH2PO4. However, temperature effects from TSP were attributed to an increase in PO4-P at 10 and 20 °C at 200 and 400 kg ha-1. We then simulated the KH2PO4 incubation using APSIM Next Generation, which successfully captured variability in available P (95-97 %) with lower accuracy at higher P and temperatures (82 %). We found that historic temperature data of subsoil (100 cm) which increased at a rate of 0.24 °C per year (1983-1995) while topsoil (5-10 cm) temperature reached 50 °C during peak periods (2013-2022). We found that the impact of cumulatively increasing soil temperatures on PUE demands attention, including reporting of soil temperature and testing on a wider range of soils is required. APSIM is emerging as useful tool to predict P availability and inform management (timing, placement and P form, cover crops).



Keywords: sorption processes, climate change, APSIM, modelling

ID ABS WEB: 138185

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DEPTH DISTRIBUTION OF PHOSPHATE 18O ISOTOPE VALUES ALONG THE PAPOSO TRANSECT

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The extreme conditions of the Chilean Atacama Desert preserve life's fingerprints. This is particularly the case for its subsoil which provides enhanced shelter for microbial communities. Our study sampled at Paposo four pits at 10 cm intervals, reaching a depth of 2 m, along a transect with increasing distances from the coast and thus aridity. Subsequently sequential P fractionation and 18OHCl-Pi analysis were conducted to explore the biogeochemical transformation of top- and subsoil P. None of the measured values of 18OHCl-Pi fell within the 'equilibrium' range. This highlighted that soil phosphate present had undergone only partially biological P cycling. Nevertheless, variations were observed at different depths. In the fog-nourished zone, situated within 3.5 km from the coast, the highest 18OHCl-Pi value of 16.6 ‰ was found at the surface, and thereafter gradually decreased with increasing depth. However, a relatively higher value of 15.8 ‰ was detected at a depth of 80-90 cm, pointing to wetter period in the past. Within the inland areas (>10 km from the coast) with only rare rainfall events, a sampled fan (at 1450m) exhibited an increase of 18OHCl-Pi up to 13.1 ‰ its second layer (10-20 cm), while values remained stable with depth in the active section. Our investigation of subsoil P cycling provides novel insights into the historical presence and variation of (microbial) life in association with fluctuations in climatic driven soil wetness conditions.

Keywords: biological P cycling,oxygen isotopes ratio,Atacama Desert,Hyper-aridity

ID ABS WEB: 136034

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

SHORT TERM EFFECT OF NOVEL BIOBASED FERTILISERS FROM FRUIT AND VEGETABLE RESIDUES ON SOIL FUNCTIONING

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The H2020 Rustica project aims to produce novel biobased fertilisers (BBF) from fruit and vegetable residues to reduce mineral fertilizer dependence, improve soil health, and tackle soil organic matter loss. The novel BBF are microbial biomass (MB) from microorganisms cultivation, insect biomass (IB) and frass (IF) from insect farming, and biochar (BI) from pyrolysis.
The application of such new materials can have undesired impacts on soil and, consequently, an exhaustive assessment of their effects on soil functioning is needed.
For this purpose, MB, IB, IF, and BI were applied at a rate of 0.5% to a soil and incubated in the laboratory for 30 days. CO2 and N2O emissions were measured continuously throughout the incubation. After 2, 7, and 30 days, soil samples were analysed for extractable NH4+, NO3- , P, organic C and N (EN), Olsen P, and soil microbial biomass C and N.
The percentages of added C mineralised after 30 days were 0.8%, 25%, 47% and 53% for BI, IF, MB and IB, respectively. The outstanding stability of BI supports its effectiveness to foster soil C sequestration. The different degree of degradability of BBF is supported by their properties in terms of oxygen uptake ratio, water soluble C and N. This is reflected by N2O emissions, with higher levels observed in soil treated with IB and MB.
Biochar and IF did not cause an increase in N availability. On the other hand, IB and MB caused an enhancement in EN compared to the control of 7% and 13%, respectively, suggesting their relevance as N fertilisers.
Soil microbial biomass was increased by MB and IB, and for a lesser extent by IF.
BBF showed large differences regarding their impact on soil quality. As such, they can be applied to exert different functions (mineral fertilizers substitution, soil quality maintenance, climate change mitigation). Moreover, results can be useful to identify management options to maximize BBF potential and avoid detrimental effects.

Keywords: biobased fertilisers, soil functions, exogenous organic matter, soil C cycle, climate change

ID ABS WEB: 136057

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

THE IMPACT OF NEW BIO-BASED FERTILISERS AND CONVENTIONAL AMENDMENTS ON SOIL ORGANIC MATTER AND SOIL HEALTH DYNAMICS: A MULTI-YEAR LIVING LAB APPROACH

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The loss and degradation of soils can occur over relatively short timeframes for example, due to erosion. However, improvements in soil chemical, physical and biological health, including organic matter tend to occur gradually over a number of years or decades. The application of amendments such as bio-based recycled fertilisers is an avenue for returning carbon and nutrients to soils while reducing reliance on conventional imported mineral fertilisers. While bio-based recycled fertilisers contain nutrients, frequently the nutrient profile is not in the correct proportion to match crop and soil fertility requirements. As a result, at a practical agronomic level, when using these amendments fertilisers there is often a need to supplement to crop and soil requirements using mineral fertilisers. In 2019, to help build confidence for farmers to undertake substitution of mineral fertilisers with new bio-based recycled amendments a multi-year bio-based fertiliser living lab and demonstration was established on a moderately drained sandy loam grassland site at the Teagasc, Johnstown Castle Soils, Environment and Land Use Research Centre in the South East of Ireland. At this living lab over the past five years a mineral fertiliser only fertiliser programme has been compared to fertiliser programmes that displace a portion of the mineral fertiliser with cattle slurry, dairy processing sludge, ash and struvite. A no fertiliser treatment is also included. Soil pH, fertility, soil organic matter, soil biology indicators and grass yield performance have been measured over the five year period. The use of new amendments are been demonstrated to farmers and advisors as part of the EU Horizon funded NOVAFERT project while new collaborations to advance soil health improvement have developed on foot of the long running living lab. Initial results indicate that several bio-based amendments can maintain grass yield and build soil fertility and improve soil health indicators. Full results including effects on soil organic matter will be presented.

Keywords: Living Lab, Organic amendments, Biobased fertiliser, Organic matter, Soil Health

ID ABS WEB: 136066

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

NOURISHING THE SOIL: DECODING MICROBIAL RESPONSES TO SPRING-PLANTED COVER CROPS

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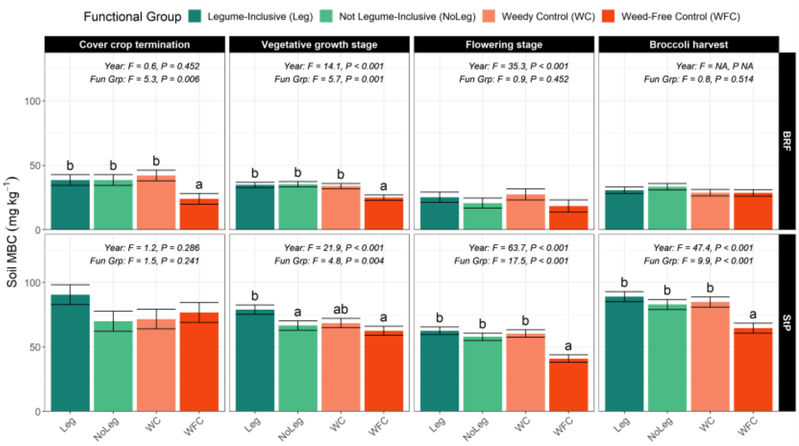
Over the past three decades, organic farming has experienced a significant global surge. In the USA, the latest national survey in 2019 revealed the presence of 5.5 million acres. Organic farming poses challenges in managing soil fertility and nutrient availability, both crucial factors for robust crop production. Cover cropping is widely used in organic farms to provide a source of carbon (C) and nitrogen (N) to the soil among other multiple benefits. The impact of added C and N from cover crops on beneficial microorganisms remains understudied. This is crucial for predicting soil functions like mineralization through which nutrients become available for following cash crops. Our objective was to assess the impact of decomposing spring-planted cover crops on microbial biomass, C/N-cycling enzyme activity and microbial communities.

Cover crops were established in early May and terminated in mid-July 2021 and 2022 at two locations in Minnesota-USA, after which broccoli was transplanted. Treatments included a legume, a forb, a legume/grass mixture, and two controls: a weedy fallow and weed-free fallow. Microbial biomass C/N and four hydrolytic enzymes (Beta-glucosidase, N-acetyl glucosaminidase, Cellobiohydrolase, and Phosphatase) were measured from fresh soil samples. Legume-inclusive treatments showed higher microbial biomass at both locations (Figure 1), suggesting the benefits of incorporating legumes to promote plant-microbial symbiotic relationships.

Microbial biomass as well as enzyme activity was highest 45 days after cover crop termination, which may indicate that nutrient mineralization aligned with cash crop nutrient uptake, representing successful cover crop integration. No enzyme activity differences were observed between cover crop treatments, including the weedy control; however, all of these showed higher values compared to the weed-free control. Preliminary results suggest warm-season cover crops, particularly legume-inclusive options, have the potential to enhance N-fertility goals by promoting active microbial communities. Results from DNA amplicon sequencing for both bacterial and fungal communities are underway to better characterize microbial operational taxonomic units, and correlate their abundance with soil biological functions.



Keywords: Cover crops, Microorganisms, Decomposition, Enzymes, DNA Amplicon Sequencing

ID ABS WEB: 136094

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

UNLOCKING THE POTENTIAL: THREE-YEAR FIELD STUDY INVESTIGATING THE IMPACT OF THE ORGANIC WASTE RECYCLING ON SOIL HEALTH, NUTRIENT UPTAKE, AND CARBON MANAGEMENT IN AGRICULTURE

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The EU promotes organic waste recycling in agriculture for soil health and nutrient supply as an alternative to chemical fertilization. However limited data exists on medium- to long-term benefits.
This study investigated the plant nutrient uptake, the soil organic matter (SOM) variation, and the effect on soil functions using the Carbon Management Index (CMI) over a 3-year field plot test.
Furthermore the natural 13C abundance (delta 13C) of compost and soil carbon was used to assess the fate native and applied organic carbon.
To do this two agronomic pathways were compared: continuous and pulsed compost application of three types of compost: from bio-waste (BWC), from anaerobically digested bio-waste (DC) and from urban/agro-industrial sludges (SC), along with a chemical N-P-K fertilizer (Chem) and a unamended control (Ctrl).

In Path 1, the N-EAR (%) was highest in BWC (112)> DC (105)> SC (74). Indicating SC performed lower N-use efficiency, consistent with its high C:N ratio and biological stability (OUR).

The study revealed Path 2 performed high relative agronomic efficiency (N-EAR% vs. Chem): SC (118)> DC (114)> BWC (109), indicating a general benefit in the use of the chemical N fertilizer following basal compost application.

Continuous compost application led to constant SOM accumulation (10-40%), while pulsed application preserved the native soil organic carbon. The CMI highlighted increased SOM functionality, supporting composts as effective fertilizer substitutes.

Overall, the organic treatments showed higher N efficiency with chemical fertilizer synergy and a good ability to supply P over three years.

The delta 13C of treated soil proved the either carbon accumulation from compost or the preservation of the native soil organic carbon (Figure 1).

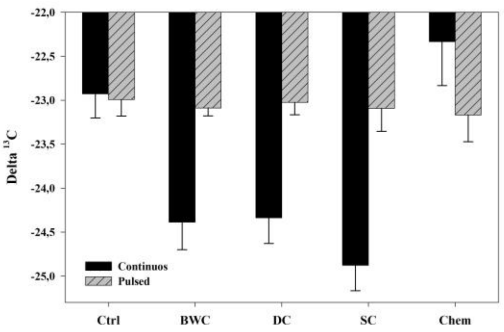

Figure 1 - $\delta^{13}C$ values of soil following three years of cultivation under various treatments in both continuous and pulsed pathways

Keywords: Compost, Organic carbon, Carbon management index, 13C Natural Abundance, Soil organic matter

ID ABS WEB: 136100

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

EFFECT OF BIOCHAR-TC (PYROCHAR) AND BIOCHAR-HTC (HYDROCHAR) AMENDMENTS ON GREENHOUSE GAS EMISSION AND WATER QUALITY IN TOMATO PRODUCTION

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When producers grow tomatoes in greenhouses, they tend to use excess fertilizer and water to maximize yields. This excess leads to the rapidly accumulating carbon, nitrogen, phosphorus, and salts in the growing media. Recently, carbon-rich products from thermal carbonization (Biochar-TC) and hydrothermal carbonization (Biochar-HTC, hydrochar) have been proposed as soil amendments to mitigate greenhouse gas emissions and improve water quality in leachate. This research compared the amendment impact of two different types of biochars on CO2 , CH4 , and N2O emissions and nutrient leaching in tomato production. Fluxes of CO2 , CH4, and N2O were measured in the tomato-growing pots using a manual static chamber method during the tomato-growing season. The chambers are made of cylindrical polyvinyl chloride (PVC) 15 cm in diameter and 20 cm in height. The temperature and soil moisture were measured continuously using sensor pups, and the results were transferred to a data retriever. Gas samples were measured at 0, 15, 30, 45, and 60 min after the chamber closure. The collected gas samples were analyzed using a gas chromatograph (model 8610C, SRI Instruments). Nitrous oxide was detected with the electron capture detector (ECD) operated at 325°C, and CO2 and CH4 were measured with a mechanized interface with a flame ionization detector (FID). These results demonstrate that Biochar-TC application significantly decreased N2O emission compared to the emission from the control treatment. Leaching water was collected from each tomato growing pot daily, and total phosphorus concentration and electrical conductivity (EC) were, on average, 25% and 21 % lower from the Biochar-TC treatment and 8% and 1.8 % lower from the Biochar-HTC (Hydrochar) treatment, respectively, compared with the control. We observed that two different types of soil amendments did not significantly improve tomato production.

Keywords: Biochar, Hydrochar, Greenhouse Gas Emission, Water Quality, Tomato Production

ID ABS WEB: 136223

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

FROM WASTE TO GROWTH: UNRAVELING ROSE WASTE COMPOSTING PATTERNS AND EVALUATING THE EFFECT ON CUT ROSES IN KENYA

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Composting is widely recognized as a sustainable waste management strategy and a valuable soil amendment to enhance SOM content in high-production agricultural soils. These are valuable assets for the Kenyan rose cultivation sector to further improve their circular economy waste-based objectives. However, little is known about green waste, and specifically rose waste, degradation patterns during composting and its subsequent effect on cut rose yield and quality. This integrated study combines molecular insights into rose waste composting and potential co-metabolism of ligneous materials using Py-GC/MS with findings from an 18-month commercial-scale field-experiment in Kenya. This approach not only enhances our understanding of molecular conversions of lignocellulosic waste during composting, but also evaluates the potential of sustainable practices to boosts horticultural productivity. Additionally, it gives an outlook on the impact of compost-originated OM in soils and provides valuable perspectives on its role regarding yield and quality of cut roses. Several compost mixtures were followed closely and temporal trends in the relative abundance of 10 different compound groups were measured. A simultaneous decrease in relative abundance of lignin and polysaccharides during the initial composting phase indicates co-metabolism of lignin. So, while the presence of lignin is commonly regarded as a challenge in composting, it undergoes degradation through distinct mechanisms at the various composting stages. Subsequently, three mature rose-waste based composts were amended prior to seedling planting and either standard fertigation or halved fertigation was administered. Soil quality parameters, leaf nutrient levels and vase life were assessed regularly. Furthermore, yield of cut roses was tracked daily. After 12 months a significant increase of 8% yield in terms of harvested stems and kg's was observed except for the halved fertigation treatment, were this increase diminished after approximately 9 months, indicating depletion of easily available nutrients provided by the compost. Overall, this project provides actionable practices for rose waste management, promoting the re-use of valuable green waste and alleviating soil exhaustion in intensively used horticultural soils.

Keywords: compost, rose waste, molecular degradation, crop yield

ID ABS WEB: 136576

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

AGRICULTURAL SOILS INCREASING C STORAGE: MANURE-DERIVED BIOCHAR AND SPONTANEOUS VEGETATION, TWO VIABLE ALTERNATIVES IN A CLIMATE CHANGE SCENARIO

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Modern soil science faces the challenge of determining the most effective agricultural practices for increasing C storage in different scenarios, such as: varying goals (biodiversity, climate, agronomic), resource availability, and crop and soil conditions. While manure is commonly used to provide nutrients to soil and plants, it can have a priming effect on agricultural soils with high C content. The application of more stable amendments like manure-derived biochar may be a preferable alternative to enhance soil C storage, improve soil properties, and increase crop yield in Andisols in Chile. In arid regions of Argentina, vineyards are a significant crop planted in soil with very low C content, such as Entisols. The spontaneous vegetation that grows in vineyards can offer ecosystem benefits, including carbon storage (soil and biomass) and biodiversity enhancement. We aim to evaluate these two approaches for increasing C storage and their associated benefits in the agricultural soils of Chile and Argentina under field conditions. Our findings in Andisols in Chile indicate that the application of pig and dairy manure biochar after 6 months increased soil C storage (0-30 cm) with an average of 3.08 tC ha-1, and 0.9 t non-oxidizable C ha-1. These amendments also improved soil pH, nutrient availability, and Sorghum sudangrass yield with an average of 9 t ha-1 compared to the unamended soil. On the other hand, not removing the spontaneous vegetation during 5 years in the inter-row of a Argentina vineyard increase 1.1 tC ha-1 in the top-soil (0-30 cm) compared to uncovered soils. This vegetation contributed to aboveground and root biomass, storing between 0.57 to 2.79 tC ha-1 per season. Additionally, its presence improved the biodiversity of the vineyard, (collection of new species of plants). Based on both studies, the use of manure-derived biochar and the preservation of spontaneous vegetation contribute to soil C storage and further agricultural soil targets, such as improved crop yields, increased fertility, and enhanced biodiversity.

Keywords: Soil C storage, Manure-derived biochar, Best management practices, biodiversity in vineyard, Climate change mitigation

ID ABS WEB: 136607

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

EFFECTS OF STRAW-DERIVED ORGANIC AMENDMENTS ON SOIL AGGREGATION AND CARBON AND NITROGEN DISTRIBUTION IN BLACK SOIL

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In this study, we investigated the impact of maize straw return on the stability of black soil aggregates and the distribution of carbon and nitrogen. Soil samples from the plough layer (0-20 cm) were collected and treated with single chemical fertilizer (CK), chemical fertilizer combined with straw (ST), chemical fertilizer combined with compost (CP), and chemical fertilizer combined with biochar (BR). Results showed that compared to CK, the organic carbon content in soils treated with CP and BR increased significantly by 16.2% and 32.4%, respectively. Only the BR treatment showed a significant increase of 4.7% in soil total nitrogen content, resulting in the highest C/N ratio. The proportion of large aggregates (>0.25 mm) increased by 43.3%, 34.1%, and 22.9% in the ST, CP, and BR treatments, respectively, compared to CK. The mean weight diameter (MWD) of aggregates followed the order: ST>BR>CP>CK. Application of different organic materials increased the carbon content of aggregates in all size fractions, with the BR treatment showing the most significant increase (19.9%~65.8%), particularly in the 2~1 mm particle size fraction. The carbon-nitrogen ratio of aggregates in the BR treatment increased significantly (23.7%~41.5%). Biochar return increased soil organic carbon and total nitrogen content in the topsoil, while compost return significantly increased soil organic carbon content. The three organic material treatments resulted in the fixation of soil organic carbon in large aggregates. Biochar return also increased the C/N ratio of soil and aggregates, indicating enhanced biological stability of soil organic carbon.

Keywords: Black soil, Maize straw, Soil organic carbon, Organic amendment, soil aggregate

ID ABS WEB: 136752

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

SUSTAINABLE SOIL AND ORGANIC MATTER MANAGEMENTS TO REDUCE STRAW BURNING, GREENHOUSE GAS EMISSIONS, AND THEIR INFLUENCING FACTORS IN NORTHWEST INDIA

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Soil is supporting sustainable food production with water, climate and nutrients in long-term. India is the largest rice exporter and rice-wheat cropping system in Northwest India has been established since green revolution, based on modern varieties and sufficient water and nutrients. However due to decrease of water availability and intensive continuous cropping, soil fertility and soil organic matter contents started to decline. Miss-managements of crop residues induce environmental problems such as straw burning, air pollutions and even human health.
We have developed India-Japan collaborative research project named Aakash (An interdisciplinary study toward clean air, public health and sustainable agriculture) to study sustainable straw management to reduce air pollution, such as assessing alternative crops rather than rice-wheat, smart straw managements including minimum tillage and biochar, monitoring straw burning by satellite and health conditions by small sensors and questionnaires.
In the international research project, there are 3 working groups (WG) and WG1 has started to examine 1) the effects of incentives aimed to promote behavioral changes on farmers from socioeconomic viewpoint and 2) the various alternatives from rice-wheat system to reduce burning straw from agronomic viewpoint. As for mitigation to reduce straw burning and greenhouse gases (GHGs: CO_2, CH_4 and N_2O) from field, crop residue should be managed properly, such as biochar. In LPU campus, we established field trial to investigate the effect of two kinds of biochar (made from rice husk and rice straw). During wheat cultivation, soil and gas were sampled to see seasonal changes in soil properties and emissions. Biochar reduced GHGs emissions and increased soil carbon, a co-benefit of reduction in air pollution and contribution to international efforts of GHG emission mitigation and sustainable agriculture.
Acknowledgement: This study is financially supported by Research Institute for Humanity and Nature (RIHN: a constituent member of NIHU) Project No. 14200133 (Aakash).

Keywords: Biochar, Greenhouse gas emission, Soil organic matter, Straw burning, Rice-wheat cropping system

ID ABS WEB: 137185

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

EVALUATING CHANGES IN THERMAL STABILITY OF ORGANIC CARBON IN BIOCHAR-AMENDED SOILS DURING MICROBIAL INCUBATION

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Biochar is an emerging solution to treat contaminated and degraded soils. However, it is unclear to what extent biochar plays a role in soil organic carbon (SOC) stabilization. Currently, there are a variety of methods to assess SOC stability in soil, including chemical fractionation, thermal analysis, and spectroscopy. Thermal analysis methods constitute a rapid, convenient alternative to conventional extraction methods, though their sensitivity to changes in SOC due to biochar soil amendments is unknown. It is therefore imperative to develop novel methodologies to provide a consistent basis to evaluate the effectiveness of different organic amendments on SOC stabilization.
In a laboratory experiment, we used Differential Scanning Calorimetry-Thermogravimetry (DSC-TG), to quantify thermal signature changes in biochar-amended soils. We tested biochar-based encapsulated soil amendments produced by our industry partner, YpHen, for use in in-situ bioremediation. These amendments are hypothesized to not only improve soil health, but also play a secondary role in increasing soil carbon stability by providing growth support for microbial communities that stabilize carbon. We thus investigated the impact that biochar-based capsule amendments have on thermal SOC stability during a 4-week incubation period of model soils inoculated with different microbial communities used in bioremediation projects. Additionally, nutrient sources were varied over the samples to represent both simple sugars and complex-molecule carbon systems. The goal of this experiment was multifold: to ascertain DSC-TG sensitivity to small fluctuations in SOC stability, to assess its suitability for gauging the dynamics of SOC stability in amended soils, and ultimately, to validate the efficacy of diverse soil amendment approaches in stabilizing SOC.
In my presentation, I will evaluate the propensity of DSC-TG to identify changes in SOC stabilization from biochar soil amendments. I will also discuss the effects of varied microbes and nutrient sources on carbon stability during incubation. Finally, I will discuss the role that biochar amendments may play in future remediation, not only for soil restoration, but as a driver of carbon stabilization.

Keywords: Biochar, Microbial Ammendments, Soil Organic Carbon, Thermal Stability, Bioremediation

ID ABS WEB: 137252

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

LONG-TERM COMPOST-AMENDMENT INFLUENCE ON TOP- AND SUB-SOIL HYDROLOGY AND PHYSICAL RESILIENCE

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The application of composts to agricultural soil is a well-established practice with evidence showing multiple benefits. With soil health and function becoming increasingly important, as is the drive to increase soil carbon, it is critical to understand the impact of soil organic amendments on multiple functions within both top-soil and sub-soil.

A long-term compost application trial was established in 2004 under continuous spring barley with three differing compost application rates and an unamended control treatment. Plot structure is a randomised block design with soil being a sandy silt loam cultivated under minimum tillage practices. Following establishment in 2004 all treatments, except the control, received 50 t ha-1 of municipal green compost, low (35 t ha-1), medium (100 t ha-1), and high (200 t ha-1), applications in 2006 and 2007 before continuous 35 t ha-1 annual applications from 2008 to 2022. Intact soil cores were collected from both top-soils and sub-soils for each plot in spring 2022 prior to compost application and cultivation. In the laboratory, saturated hydraulic conductivity and water retention curves were tested. Additionally, soil resilience to loading (compaction) and water erosion (aggregate stability) were also assessed. Within top-soils, medium and high compost application rates increased hydraulic conductivity when compared to control plots. In contrast, the low compost application rate decreased hydraulic conductivity when compared to unamended plots. Surprisingly, within sub-soils, compost application was found to significantly impact hydraulic conductivity, with hydraulic conductivity shown to be highest within the medium rate compost application treatment. A significant difference in water stable aggregates within top-soils was observed between treatments. Bulk density decreased with increasing compost levels. Compost amended treatments highlighted greater resilience to loading (i.e., compaction) in both top- and sub-soils.

In conclusions, results show that the influence of compost surface application under minimum tillage practice is not limited to top-soil but can positively impact sub-soil physical properties.
Funding acknowledgements: Scottish Government (RESAS 22-27: Healthy Soils For A Green Recovery (JHI-D3-1))

Keywords: AMENDMENTS, COMPOST, SOIL PHYSICS, ECOSYSTEM SERVICES, AGRICULTURE

ID ABS WEB: 137344

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

IMPACT OF COMPOST AND BIOCHAR AMENDMENTS ON SOIL C POOLS AND CROP PHYTOCHEMICAL QUALITY: RESULTS FROM A LONG-TERM FIELD STUDY IN AN ORGANIC OLIVE ORCHARD

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Soil carbon (C) sequestration is a nature-based solution against global warming and helps to meet the targets of ensuring food supply, mitigating climate change, and sustaining biodiversity. Current projections suggest considerable warming and aridity trends in Mediterranean regions, where crops face a decline in crop yields and climate resilience. The loss of soil organic C (SOC) is enhanced in soils under arid conditions, a ubiquitous circumstance in Mediterranean climates. Also characteristic in arid soils is the accumulation of large quantities of soil inorganic C (SIC) in the form of CaCO3. Traditionally, SIC has been disregarded due to its geological time scale turnover. However, increasing evidence reveals that a relevant fraction of SIC links the long-term geological C cycle with the short-term biological C cycle. Not considering the inorganic C pool in calcareous soils may lead to inefficient strategies against global warming.
Compost and biochar amendments constitute advantageous strategies to increase soil C build-up and maintain soil fertility. However, their impact on SIC has been scarcely evaluated. In 2013 we initiated a long-term field experiment with amendments of compost, biochar, and their mixture (90:10) every two years in an organic olive tree crop. Over 10 years we have studied the accrual of SOC and SIC at several soil depths, the natural 13C abundance in both soil C pools, and the nutritional and phytochemical assessment of the olive trees through yield monitoring and olive leaves analyses.
Our preliminary results show increased SOC accrual in compost and biochar-amended soils, and increased nutrient availability in compost and mixture treatments, even at 50 cm soil depth. Crop yield, nutritional status, and phenolic compounds in leaves have been similar in all the treatments. We expect that the results from δ13C changes in C pools at several soil layers will provide a deeper understanding of the links between SIC and SOC and facilitate more accurate estimations of the C sequestration potential of calcareous soils in arid climates.

Keywords: carbonates, stable isotopes, food security, organic matter, extreme environments

ID ABS WEB: 137740

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

DOES THE CHEMICAL COMPOSITION OF ORGANIC WASTE PRODUCTS APPLIED ON SOIL IMPACT THE DISSOLVED ORGANIC CARBON CONCENTRATION ALONG THE SOIL PROFILE ?

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Organic waste products (OWP) application and cover crops are agronomic levers to improve soil health. OWP can be valorized by anaerobic digestion to produce biogas. The chemical composition of digestate differs from that of its source material. Labile fraction being partly consumed by microorganisms, recalcitrant molecules accumulate in digestate. Studies on transfer of DOM (dissolved organic matter) towards the subsoil in soil receiving digestate are scarce. In a previous lysimeter study over 9 years, higher topsoil-DOC (dissolved organic carbon) concentrations under digestate were observed every year compared to its original slurry and associated with different winter crops, probably in relation to the root development of the crop. The extra-DOC could come from a higher production of root exudates due to a potential auxin effect of the digestate and/or a solubilization of the recalcitrant organic matter from digestate via the alkalinization of rhizosphere. To check this hypothesis, the evolution of DOM chemical composition after digestate application (i) associated with different winter crops, (ii) during the drainage season and (iii) between the topsoil and the subsoil was studied. Lysimeters at 40 cm (topsoil) and 90 cm (subsoil) depths were monitored in 2018-2019 (wheat) and 2020-2021 (mustard), from November to March under pig slurry (PS) and digestate from PS (PS-DIG). The DOM composition of lysimeters samples and water extracts from PS and PS-DIG (WEOM) were analyzed by thermochemolysis coupled to gas chromatography and mass spectrometry (THM-GC–MS). A higher proportion in phenols and dicarboxylic acids was measured in WEOM from PS-DIG compared to PS. Under mustard, the DOM composition of the PS-DIG modality at the beginning of the drainage season was close to the one of WEOM of PS-DIG. Under wheat, the DOM composition of the PS-DIG modality in the middle of the drainage season seemed only partly influenced by the PS-DIG application, with a higher proportion of dicarboxylic acids but no difference in phenols proportion compared to PS.

Keywords: digestate, DOM, chemical composition, THM-GC-MS, recalcitrance

ID ABS WEB: 137823

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

THE POTENTIAL OF NO-TILL AND COMPOST FOR MITIGATION OF SOC LOSS AND GHG EMISSIONS: LESSONS FROM THE LONG-TERM FIELD EXPERIMENT »TILLCOMP«

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The synergy of no-till and compost fertilization has a high potential for increasing soil organic carbon stocks (Corg) and diminishing greenhouse gas (GHG) emissions. Corg stocks and GHG emissions (N_2O, CO_2 and CH_4) were studied in a long-term field experiment »TillComp« in Ljubljana, Slovenia. The experiment was established in 1999 and it focuses on the effects of different fertilization treatments (no-fertilization control, compost fertilization, mineral fertilization) and tillage intensities: conventional plough tillage (CT) to a depth of 25-28 cm and non-inversion minimum tillage to a maximum of 10 cm depth which was replaced by a no-till system (NT) in 2017. Due to more than 20 years of the experiment, the differences in soil quality parameters between treatments are significant. In-situ measurements of GHG emissions were carried out with static chambers (Krauss et al., 2017) in 2021 and 2023, when maize was the main crop. The aim of this study was to evaluate the trade-offs between GHG emissions, Corg stocks and maize yields. We hypothesized that NT increases Corg stocks, but on the other hand poses risk for denitrification. We observed differences in Corg stocks in the top 20 cm of soil after 24 years of the experiment. In NT, Corg stocks are between 14,2 and 26,7 t Corg /ha higher than in CT. The highest Corg stocks are in the treatments fertilized with compost. CO_2 emissions were lower in both years on NT for all fertilization treatments, and N_2O emissions likewise, except for mineral fertilization in short event after fertilizer application, where we measured significantly higher emissions compared to CT. Yield scaled emissions were generally higher with no-till compared to conventional tillage. Regarding fertilization in general, the control had higher yield scaled emissions compared to compost and mineral fertilizer, and compost performed better than mineral fertilizer on NT in 2023. We conclude that the higher Corg stocks in soils with NT do not lead to an increase in GHG emissions.

Keywords: soil organic carbon, greenhouse gas emissions, best management practices,no-till, compost

ID ABS WEB: 137975

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

SOME EFFECTS OF HYDROCHAR, COMPOST, AND THEIR MIX ON SOIL ORGANIC CARBON AND NUTRIENTS

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The application of amendment guarantees the management of soil fertility and carbon sequestration due to their effect on soil organic carbon (SOC). The project “HYDRORG” aims to study these interactions, starting from the organic fertiliser characterization. The hydrochar (HC) is produced from the hydrothermal carbonisation of organic wet waste and the post-treatment can improve its agro-environmental properties.
The HC (190° C for 2 h) was produced from winery and dairy agro-industrial sludges. The HC was compared to compost (COM) and MIX (obtained by mixing HC and compost, 1:1 w/w in an aerated pile). Besides the analysis of nutrients, pH, EC, TOC, the phytotoxicity and the effect on plant growth at increasing doses have been assessed. The effects were defined by incubating amended soil at 10 and 20 Mg/ha, 25°C, and 50% of WHC, for 1 and 12 months. The organic C was analysed by distinguished dissolved organic matter and the soil recalcitrant organic matter.
The MIX pile showed a decrease in oxygen uptake (from 1789 to 421 mgO2/kgVSh). HC has a high content of both TOC and TKN (47 and 4.8 g/kg). P content was different among products (47 g/kg HC, 4.5 g/kg COM, 12.9 g/kg MIX). The MIX had a lower pH value compared to others. MIX showed a phytostimulant effect compared to COM, while HC is phytotoxic. HC contained a greater content of aliphatic compounds than aromatic ones. After 1 month, the soil amended with MIX and HC showed an increase of P available at higher doses. The MIX amended pots reached higher nitrate content (from 25.0 to 54.6 mg/kg), while HC determined higher ammonia content at the beginning of incubation (17.6 mg/kg). TOC increased in both, HC and COM-amended pots compared to control, after 12 months.
The integrated knowledge of the amendments and their effects (chemical, on soil, GHG emission, etc.) can help to plan efficient and efficacy agronomic use and to better comprehend their environmental role.

Keywords: Soil organic carbon, Nutrients, Hydrochar, Compost, Hydrochar - Compost MIX

ID ABS WEB: 137986

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

PYROLYTIC BONE-BASED BIOCHAR POTENTIAL AMENDMENT FOR REMEDIATION OF CLAY LOAM SOIL (NORTH WEST OF TUNISIA)

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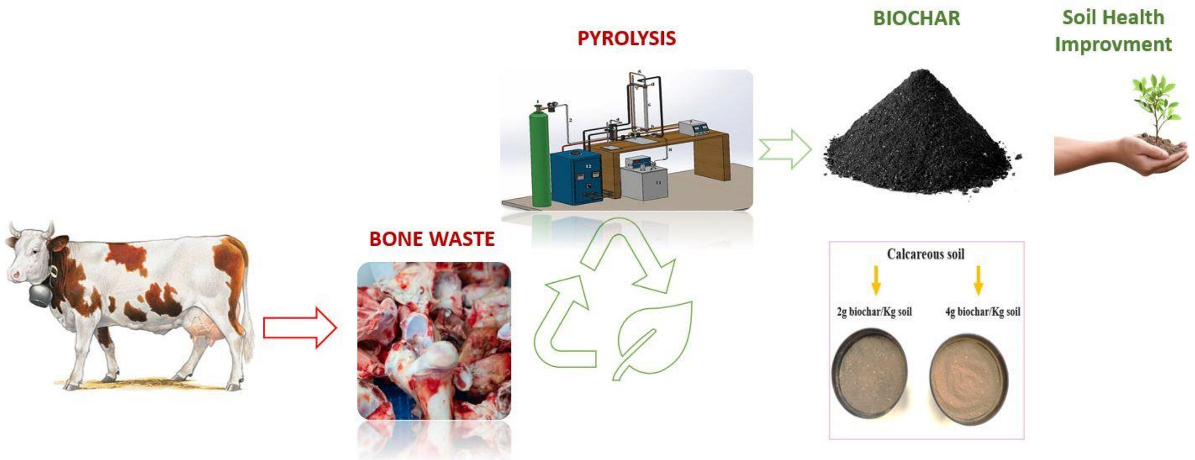
The large quantities of waste from the meat industry represent one of the major environmental challenges facing the food industry today, due to their biological instability, rapid fermentation, and high level of potential pathogenic character. The advances in biochar production through slow pyrolysis by fixed bed reactor offer a sustainable option to exploit the benefits of animal bone waste character-ized by high organic and inorganic content. This study aims to investigate the bi-ochar produced from animal bone waste at different temperatures (500°C and 700°C), at 10 °C/min as heating rate, and 1h as a residence time. The main char-acteristics of the produced chars at different experimental conditions were evaluated in terms of proximate and ultimate analyses, thermogravimetric behavior, FTIR spectroscopy, X-ray diffraction, pH, Electrical Conductivity (EC) and sur-face morphology. A three months pot experiments in a greenhouse using the pro-duced biochars was conducted at the rates of 0, 2 and 4 g. Kg^{-1} soil. The experimental results revealed that the pyrolysis temperature have a significant effect on biochar yields. Thus, the maximum biochar yield was obtained at 500°C (around 55 wt.%). The obtained results showed that the biochar generated have a high Carbon content (~13 wt.%) for the biochar produced at 500°C and surface area (110 m2.g^{-1}) for the biochar produced at 700°C and both biochars have a high ash content (more than 75 wt.%). The addition of ash-rich biochars increased the total phosphorus and calcium, total nitrogen, pH and EC values in the soil. However, there was a decrease in C/N ratios indicating the acceleration of mineralization of the treated soil. The change in soil properties increased with increasing biochar application doses. The results demonstrate the great potential of animal bone waste as a feedstock for the biochar production through slow pyrolysis, as well as its application as an amendment to clay loam soil.



Keywords: Animal Bone Waste, Slow pyrolysis, Soil amendment, Biochar, Clay loam soil

ID ABS WEB: 138026

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

WHEAT (TRITICUM AESTIVUM L.) GROWTH PERFORMANCE AND NITROGEN DYNAMICS IN SOIL AMENDED WITH AMMONIUM-ENRICHED ZEOLITE FROM REAL TREATED WASTEWATER

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This comprehensive study investigates the potential of ammonium (NH4+)-enriched zeolite, using treated wastewater, as a soil amendment for wheat cultivation. The primary objective was to assess the impact of NH4+-enriched zeolite on soil N dynamics and wheat growth, comparing its efficacy with a no-fertilizer control and standard inorganic fertilizer.
The study involved extensive experimentation, including the characterization of the NH4+-enriched zeolites and assessing their influence on two different soil types with wheat as model crop. It provided valuable insights into the NH4+ desorption kinetics from the zeolites and examined the interaction between soil characteristics and zeolite application, particularly the influence of zeolite particle size on NH4+ release and soil improvement.
Key findings revealed that the application of NH4+-enriched zeolites led to similar effects as inorganic fertilizers, enhancing nutrient availability and positively affecting plant growth and N accumulation. The ATR-FTIR analysis confirmed the presence of functional groups indicative of NH4+ enrichment in the zeolites. Notably, the zeolite with smaller particle size exhibited greater NH4+ desorption, and both zeolites tested showed identical kinetic desorption processes, fitting the bimodal pseudo-second order kinetic model. This model highlighted two distinct desorption mechanisms. The study observed no significant soil effect on mineral nitrogen forms, attributing variations in mineral N forms more to nitrogen supply and the interaction between soil and N-supply. Fertilization efficiency varied across treatments, with inorganic N showing the most substantial effect. β-glucosidase activity, an indicator of soil microbial activity, was primarily influenced by soil type and was higher following inorganic N application.
Furthermore, both NH4+-enriched zeolites, were effective in enhancing nutrient availability and plant N uptake, showcasing their potential as viable alternatives to conventional mineral fertilizers. The study concludes that NH4+-enriched zeolites, due to their effective N provision, hold promise for sustainable agriculture, emphasizing the importance of further research in optimizing their use for different crops and soil types in a circular economy perspective.

Keywords: Nutrient Recovery, Circular Economy, N uptake, Fertilizer, Replacement Value

ID ABS WEB: 138090

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

SUPPRESSIVENESS OF NATIVE OR BIOPROCESSED FOOD WASTES TO ROOT-KNOT NEMATODE MELOIDOGYNE INCOGNITA ON TOMATO

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The reuse of food wastes or agroindustrial by-products as soil amendments has been frequently reported for an effective control of several phytoparasitic nematodes, also including root-knot species of genus Meloidogyne, as well as for an improvement of soil quality and crop yield. The aim of this study was to assess the effects of spent coffee ground (SCG), brewer's spent grain (BSG) and wasted bread (WB), either raw or bioprocessed, with lactic acid bacteria (LAB) or a compost tea (CT), on the infestation of the root-knot nematode Meloidogyne incognita on tomato. Spent coffee ground, raw or bioprocessed with a CT extracted from a mature green waste compost, and BSG or WB, raw or bioprocessed with LAB strains, were incorporated to the soil at doses corresponding to 3000 kg ha-1 organic carbon. All the amendments significantly suppressed the multiplication of M. incognita and gall formation on tomato roots as well as significantly increased plant growth. Bioprocessing SCG and BSG with CT and LAB, respectively, significantly improved the suppressiveness of raw materials to M. incognita, while only LAB-processed BSG significantly increased plant growth compared to the raw material. Results from this study indicated that the recovery of the three tested waste materials as soil amendments can provide an additional tool for a sustainable management of root-knot nematodes.

Keywords: soil amendments, spent coffee ground, brewer spent grain, wasted bread

ID ABS WEB: 138267

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

MITIGATION OF DEGRADED SOILS BY USING BIOCHAR AND COMPOST

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Soil quality decline represents a significant constraint on the productivity and sustainability of agriculture in the dryland regions. This study investigated the effects of compost and its mixture with biochar on soil fertility and barley yield in a typical Mediterranean sandy soil. In this context our research was carried out at the experimental field station of the Arid Regions Institute, located in southeastern Tunisia. Treatments were : control (T), 56 t ha-1 compost (C), 10 t ha-1 biochar + 56 t ha-1 compost (B+C), 10 t ha-1 biochar + inorganic fertilizer (B+F) and inorganic fertilizer only (F). At harvest time, plant samples and soils were collected for laboratory analyses. Results showed greater TOC and P under the treatment combination of (B+C) compared to control by 51 and 64%, respectively. Whereas application of biochar in combination with inorganic fertilizer resulted in a significant elevation of soil total nitrogen to 50 % as compared to control. B+C was the most efficient in improving aggregate stability (average improvement of + 48%). Several barley growth and yield parameters are significantly higher for (B+C) and (B+F) treatments. (B+C) significantly increased the grain yield by 30%. Almost all of the studied traits (leaf Chlorophyll content and leaf relative water content) were significantly affected by the application of these treatments. Indeed, B+C significantly increased the leaf chlorophyll content of barley by 13%. Also, it had a positive impact on leaf relative water content compared to the control treatment, with improving rate of 30%. Under the experimental conditions described in this study, biochar mixed with compost could be selected as the most suitable amendment for improving soil fertility and barley productivity.

Keywords: Biochar, Compost, Soil fertility, Sandy soil, Arid areas

ID ABS WEB: 140091

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

LONG-TERM EFFECTS OF COMPOST ON SOIL HEALTH AND YIELD OF WINTER WHEAT IN SEMI-ARID ENVIRONMENTS

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Dryland wheat (Triticum aestivum L.) is an important crop in Utah and the Intermountain Western United States. Yields are often severely constrained by lack of rainfall and, to mitigate crop failure, a wheat-fallow system is used. Organic dryland wheat-fallow systems risk major soil loss due to dependency on tillage and use of organic inputs is generally not cost-effective in the short-term. The objective of this study was to assess the long-term effects of a one-time compost application on soil health and organic carbon (OC) content. Compost made from cattle manure and straw was applied once to a dryland organic winter wheat (Triticum aestivum)-fallow (WW-F) system at 50 Mg ha-1 dry weight in 1994 in a randomized complete block design with three replicates. Soil samples were collected at 0-10, 10-30 and 30-60 cm and OC of bulk soil, particulate organic matter (POM), sand associated organic matter (SMA), silt + clay mineral associated organic matter (MAOM) and dissolved organic carbon (DOC) were measured. Active carbon, microbial biomass, enzyme activities, aggregate stability and soil nutrients were measured on the 0-10 cm depth, and grain yield was collected. Twenty-eight years later, yields in compost plots (1.4 Mg ha-1) remained significantly higher ($P < 0.05$) than in control plots (0.78 Mg ha-1). Plant-available phosphorus, acid phosphatase activity, and total nitrogen were 143%, 37%, and 29%, greater respectively. Soil organic carbon (SOC) and aggregate stability (SLAKES) were 25% and 143% ($P < 0.1$) greater compared to the control while POM and MAOM were greater in surface soils. Since the compost was applied, yields at the site are increasingly constrained by lack of precipitation, but 38% of yield variability was explained by soil OC content, while soil phosphorus availability and soil respiration were also significant contributors to yield fluctuations. Infrequent applications of compost to dryland wheat not only improve soil health but could also provide increased resilience to climate change.

Keywords: Compost, Soil Health, Soil Carbon, Wheat Yield

ID ABS WEB: 136202

4. Soil health in achieving the Sustainable Development Goals
4.06 131649 - The centrality of organic carbon in balancing the multifunctional nature of soils for sustaining human and planetary health

CARBON STOCK AND GREENHOUSE GAS EMISSIONS IN TIDAL MARSHES ALONG THE WHITE SEA COAST

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During field work in late July – early August 2023, a soil-botanical and geomorphological survey of the tidal zone south of the village of Kolezhma located on the Pomor coast of the White Sea was carried out. The study area was located in coniferous forest (taiga) zone with the Dfc climate: the mean annual temperature was 1°C and annual precipitation 435 mm. Halophytic species dominated in the vegetative cover at low marshes: Juncus gerardii L., Salicornia europaea L., Carex salina Wahlend, Bolboschoenus maritimus L., Puccinellia coarctata Parl., and Eleocharis uniglumis Link. High marshes were occupied with zonal grassland species. The soils were classified as Tidalic Fluvisols, Fluvic Stagnosola and Fluvic Gleysols. On average, soil carbon reserves for the study plot amounted to 71.4 ± 38.2 Mg $C{\cdot}ha^{-1}$, and the average reserves of plant C equaled 3.95 ± 2.42 Mg $C{\cdot}ha^{-1}$. We found that the emission of carbon dioxide by soils of marsh ecosystems varied widely from 0 to 122 $mgCO_2{\cdot}m^{-2}{\cdot}h^{-1}$ and averaged 31±41 $mgCO_2{\cdot}m^{-2}{\cdot}h^{-1}$. This indicator was characterized by high spatial variability: the coefficient of variation was 134%. The distribution of CO_2 emission values was asymmetric, the median was shifted towards low values. The high variability in the values of carbon dioxide emissions by soils was due to both the peculiarities of the vegetation cover and the varying moisture content of various sections of marsh ecosystems. In general, the soils of the watts and low marshes are characterized by low CO_2 emissions. The soils of the high marshes and the marine terrace do not differ statistically significantly in CO_2 emissions. The analysis of data on CO_2 emissions from the soils of marshes of the Pomor coast of the White Sea indicates mainly their high spatial variability that should be considered in estimates of greenhouse gas fluxes in the coastal areas.

Keywords: blue carbon, coastal ecosystems, soil organic matter, taiga zone, climatically active substances

ID ABS WEB: 136313

4. Soil health in achieving the Sustainable Development Goals
4.06 131649 - The centrality of organic carbon in balancing the multifunctional nature of soils for sustaining human and planetary health

THE DYNAMICS OF ORGANIC CARBON AT THE SOIL-BEDROCK INTERFACE

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Recent research has revealed the size of the subsoil organic carbon (OC) pool and the mechanisms by which OC is transported to, and incorporated within, subsoils. Despite this, there remains almost no research into the OC pool within soil parent materials underlying soil profiles. Achieving Net Zero carbon relies on us accounting for all carbon pools and sequestration processes in soil profiles, including those that take place across the soil parent material-soil interface, particularly during bedrock weathering and soil formation processes. In this contribution, I will present the findings from one of the first studies globally to examine the role of soil parent materials in storing OC. Thermogravimetric analysis was used to measure the OC content in soils and their underlying SPMs across a variety of land use contexts, and to assess the relative stability (or persistence) of this OC pool. Initial findings demonstrate comparatively large OC stocks in soil parent materials, and I explore potential mechanisms for this. Such a finding extends an ongoing discussion about the role of deep soil horizons in carbon sequestration and could lead to new and innovative approaches for tackling Net Zero. However, some soil parent materials represent large sources of petrogenic (rock-derived) OC which, during soil formation, could become oxidised by microbial communities. Here, I will present some exciting preliminary respiration flux data from protosoils developing over recently exposed carbon-rich bedrock (shale) in the Swiss Alps. Petrogenic OC from soil parent material represents a missing source of OC for the majority of, if not all, soil OC models. Accounting for these inputs is crucial as we improve our understanding and modelling of soil OC over the next century.

Keywords: Soil organic carbon, Petrogenic organic carbon, Soil-bedrock interface, Soil formation

ID ABS WEB: 138240

4. Soil health in achieving the Sustainable Development Goals
4.06 131649 - The centrality of organic carbon in balancing the multifunctional nature of soils for sustaining human and planetary health

NOW YOU SEE ME, NOW YOU DON'T: FEEDBACK LOOPS AND TIPPINGS POINTS IN CARBON DYNAMICS OF TEMPERATE FOREST SOILS

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Restoring biodiversity and ecosystem services in forest ecosystems is a primary focus of the UN Decade on Ecosystem Restoration. The vitality of such forests relies strongly on the intricate dynamics of carbon and nutrient cycling within their soils. However, our understanding of how to strategically manage soil carbon dynamics in forests remains limited. While tree species selection based on litter quality has proven effective in rehabilitating degraded soils and enhancing forest health in some instances, similar efforts in other locations yield inconsequential or even counterproductive results. To advance our comprehension of the contextual factors influencing such outcomes, a deeper understanding of the underlying mechanisms is therefore imperative.

In this contribution, we synthesize a decade's worth of research on acidified forest soils in Europe, encompassing both detailed case studies and extensive European datasets. Our argument posits that the effects of litter and tree species on soil carbon dynamics should be perceived as a nuanced interplay involving tree species, soil fauna, micro-organisms, organic matter composition, soil mineralogy, and soil anisotropy. Furthermore, our findings illustrate that biota, specifically trees and soil fauna, can drive the mechanisms of carbon sequestration and stabilization, as well as nutrient cycling in forest soils, by establishing feedback loops among various components of the soil carbon cycle. Importantly, these feedback loops are limited in space and time, being most pronounced near the tipping points between different geochemical soil process domains. Enhanced understanding of when and where these feedback loops occur serves as a crucial avenue for forest managers to prioritize interventions where they are most likely to yield a positive impact. Additionally, it underscores the perils of consolidating soil carbon data in broad meta-analyses without adequately considering variability and diversity in the soil system.

Keywords: Forest soils, Acidity, Feedback loops, Context-dependency, Carbon cycle

ID ABS WEB: 136530

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes –
Importance for climate resilient future, degraded lands restoration and plant health control

UNRAVELING SOIL SALINITY AND SOIL WATER CONTENT THROUGH MODELLING

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Salt-affected soils and limited availability of freshwater for irrigation are global problems, which are increasing due to climate change. Soil salinity becomes problematic once the concentration of soluble ions negatively affects soil functions and crop development. While the effects of salinity on soil properties have been described in arid and semi-arid regions, its effects on soils in temperate regions and on soil microbes, is poorly characterized. One novel strategy to mitigate the effects of soil salinity is being investigated by SoilSalAdapt project: this is testing the hypothesis that soil microbiome adapts to gradually increasing saline irrigation, which may improve crop tolerance. In order to achieve sustainable farming systems and maintain productivity and soil health, it is crucial to understand the short and long-term impacts of saline irrigation. These impacts can be studied by modelling soil salinity and soil water content and simulating multiple scenarios, considering different irrigation strategies and projected climate change conditions.
Models of soil salinity and soil water content were developed from an experiment to empirically test this hypothesis. In this experiment, spinach was grown in 30 L pots across three different soils (two sandy loams and one loam) inside a polytunnel. Spinach was irrigated with freshwater and, at the end of the growing cycle, with highly-saline water (9 dSm-1), to simulate limited availability of freshwater at this stage. The crop evapotranspiration in standard conditions was obtained with the dual crop coefficient approach, using the software application SIMDualKc. The evaporation and transpiration were used as inputs for HYDRUS-1D, to model soil salinity (electrical conductivity of soil water) and soil water content, integrating the water and salinity stresses during the spinach development. The resulting models for the three soil types have a root mean square error between 1.74 and 3.31 dSm-1 for soil salinity and between 0.024 and 0.063 cm3cm-3 for soil water content.

Keywords: Soil salinity, Soil modelling, SIMDualKc, HYDRUS-1D, EJPSoil

ID ABS WEB: 136549

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes –
Importance for climate resilient future, degraded lands restoration and plant health control

EFFECTS OF COMPOST MADE FROM COMPOSTABLE BIOPLASTIC PACKAGING ADDED TO ORGANIC WASTE ON WHEAT HEALTH AND RHIZOSPHERE MICROBIOME: A FIELD EXPERIMENT

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There is a growing global demand for innovative and sustainable bioplastic packaging to reduce the use of petroleum-based plastics. In line with the principle of a circular bioeconomy, the use of compostable bioplastics (BPs) can bring several benefits to composting and urban organic waste (UOW) management by reducing contamination with conventional plastics and enabling the production of compost that can be safely used in agriculture. However, the potential impact of the presence of BPs in compost on the soil microbiome and plant health needs to be assessed.
This study aimed to evaluate and compare the effects of 'standard' compost (Com) obtained from UOW and UOW composted with 3% BPs (Mater-bi) (BioP) on the health of wheat and its rhizosphere microbiome. Composting was carried out in a industrial composting plant under the supervision of the Consorzio Italiano Compostatori (CIC). In 2021-2022, field trials were carried out at an agricultural experimental station. Three treatments (Com, BioP and Ctrl) were tested with five replicates each. At the time of flowering, ten plants and the associated rhizospheric soils were collected from each plots. Morphological and productive wheat traits were measured. Bacterial and fungal communities were analysed by 16S and ITS metabarcoding.
No significant differences between treatments were found for wheat traits. However, Com and BioP compost addition significantly changed the microbial communities compared to the Ctrl, although few taxonomic and functional differences were observed between the Com and BioP communities. However, network analysis revealed significant differences between these communities, with BioP showing a much more connected community compared to those of Com and Ctrl. Furthermore, the addition of compost, regardless of type, was able to select beneficial taxa involved in nutrient cycling and plant growth promotion.
The results showed that adding BPs did not negatively affect the quality of the compost, neither the wheat nor the health of the soil microbiome. Thus, BPs may represent a valid and sustainable alternative to conventional plastics.

Keywords: rhizosphere microbiome, compost,bioplastic, packaging, wheat

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Importance for climate resilient future, degraded lands restoration and plant health control

LONG-TERM AGRONOMIC LAND MANAGEMENT SHAPES SOIL MICROBIOME BIODIVERSITY AND FUNCTION

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Global land use change, primarily agricultural intensification and abandonment coupled with climate change, threatens soil biodiversity and beneficial soil functions. Soil conservation is critical for ensuring sustainable food production under future climate scenarios. However, we lack a robust framework to predict how environmental and land use changes shape soil microbiome structure-function relationships. While microbial communities are intrinsically dynamic, long-term experiments provide invaluable insights into the cascading effects of microbiome environmental responses on ecosystem-level functionality. The Center for Environmental Farming Systems (CEFS) Cherry Research Farm (Goldsboro, NC, USA) is a large-scale (over 200 acres) research station located in the Mid-Atlantic United States. The CEFS Farming Systems Research Unit (FSRU) is a multi-decade agricultural experiment of replicated systems with varied tillage, cover crops, and cropping systems that have been managed continuously since 1999. FSRU cropping systems include organic management, conventional best practices, integrated livestock, and successional or agricultural abandonment. We used amplicon surveys targeting 16S rRNA genes, ITS, and 18S rRNA genes for characterizing bacterial, fungal, and eukaryotic microbial communities, respectively. We generated this comprehensive microbiome dataset from archived soils sampled in 1999, 2015, and 2023 representing 0, 16, and 24 years of continuous land management. Preliminary amplicon data indicates that long-term management regimes shape community taxonomic structure, with successional plots demonstrating consistent variation compared to agricultural use plots. While community composition varies across system replicates, land use is the strongest predictor of microbiome beta-diversity. Here, we summarize results within the context of soil carbon dynamics. Next, we simulated an extreme weather event (i.e., flooding) and measured greenhouse gas fluxes across soil mesocosms representing different land use treatments. From this experiment, we used shotgun metagenomics to link functional gene potential with ecosystem function and resilience. Understanding how decades of agricultural land management impact soil microbiome structure-function relationships enhances our capacity to engage in sustainable agronomic land stewardship that supports climate-resilient food systems and global food security.

Keywords: soil microbiome, agroecosystem, long-term study, community ecology, biodiversity

ID ABS WEB: 136865

4. Soil health in achieving the Sustainable Development Goals
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Importance for climate resilient future, degraded lands restoration and plant health control

IMPROVING SOIL ECOSYSTEM SERVICES THRU MULTIDISCIPLINARY FRAMEWORK THAT PROVIDES METHODS FOR NATIVE TREE PLANTING & GRASS BIOSWALES WITH FUNGI AMENDMENTS TO INCREASE SUSTAINABILITY & PHYTOREMEDIATION

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Through a multi-partner, large-scale targeted native trees and grasses framework, implemented in the Greater Houston Region (Texas, USA), thousands of high-ranking tree species, prioritized based on their respective levels of GHG and water absorption and carbon sequestration, are being planted in locations that experience substantial flooding, have high rates of health effects exacerbated by air and water pollution and experience multiple days of elevated heat, and/or effects of sea level rise. The region's clay-rich soil composition, made up largely of vertisols and alfisols, influence watershed infiltration and non-point source runoff, especially during heavy rain events, and affect environmental enhancement and recovery efforts due to the dynamics of various heavily commercial industries that intersect with riverine systems and coastal wetlands. Regional programs that effectively provide large-scale conservation models and accompanying tools are discussed, including the Houston Ship Channel Trees Program and Riparian Targeted Use of Buyouts (TUBs) Program – providing thousands of targeted large-scale tree species on industrial properties along the 25 miles of the Houston Ship Channel, and prioritizing federally-qualified contiguous buyout properties adjacent to riparian corridors leading to Galveston Bay, and providing ecosystem services through large-scale targeted native tree plantings and creation of native grass bioswales on the recovered green spaces. These regional efforts are accompanied with fungi amendments with data analysis to provide baseline improvements in soil ecosystem services and illustrate benefit relevant indicators of increase sustainability and phytoremediation. The multidisciplinary framework includes engagement of multisectoral leadership broadened beyond those traditionally working on climate change resilience – including health departments, major energy and gas companies and native tree and grass growers, and community leadership. Aspects of the multidisciplinary framework can also be found in Plants, People, Planet A simple tree planting framework to improve climate, air pollution, health, and urban heat in vulnerable locations using non-traditional partners (https://doi.org/10.1002/ppp3.10245).

Keywords: Soil health, Nature-based infrastructure, Phytoremediation, mycorrhizal fungi, Vertisol

ID ABS WEB: 136953

4. Soil health in achieving the Sustainable Development Goals
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Importance for climate resilient future, degraded lands restoration and plant health control

INSIGHTS INTO THE EFFECTS OF LONG-TERM FERTILIZATION TREATMENTS ON MICROBIAL DIVERSITY OF BLACK SOIL

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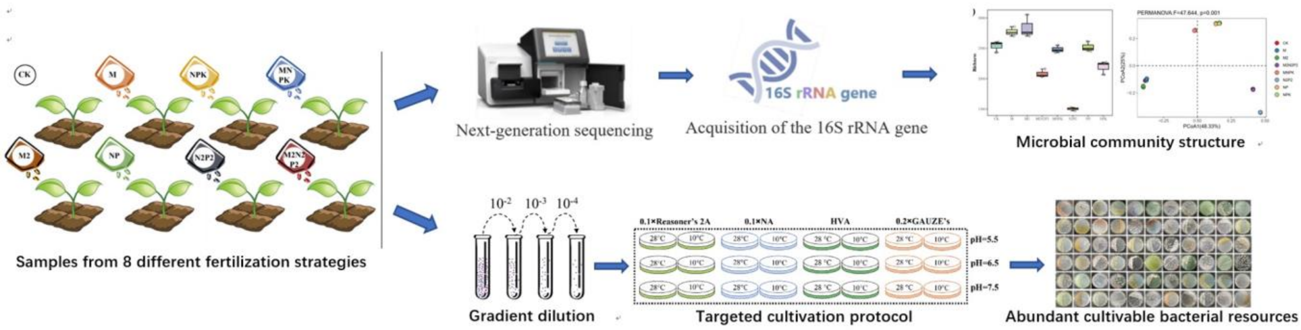
1. Background
Black soil areas of Northeast is the most important commodity grain base in China. However, its health has been compromised due to prolonged, improper fertilization practices. Soil microbial communities are vital for maintaining soil health, but continuous fertilization has altered the diversity of microorganisms in black soil, potentially affecting its functionality, and even threaten the soil health.

2. Materials and methods
Methods for microbial studies of soil samples from eight long-term different fertilization are presented in Figure 1.

3. Result
The compositional differences in microbial communities under all treatments are shown in Figure 2. Group CK-M-M2 exhibited similarity in bacterial communities, while the singly fertilized group NP-NPK-MNPK also showed similarities. The double fertilized group N2P2-M2N2P2 displayed a distinct bacterial community composition. Compared to the CK-M-M2 and NP-NPK-MNPK groups, the N2P2-M2N2P2 group exhibited a significant increase in network nodes, edges, average clustering coefficient, and network density (Fig. 3). Long-term different fertilization caused changes in soil physicochemical properties properties, which in turn affected the bacterial community structure, as shown in Figure 4, soil salinity, available phosphorus and available nitrogen are the key factors affecting microbial community composition in black soil. We cultured bacteria from samples using four targeted culture media, resulting in 2000 pure bacterial isolates. Taxonomically, these isolates were classified into five phyla, nine classes and 116 genera. Figure 5 illustrates the phylum level community composition of these cultivable bacteria.

4. Conclusion
Long-term different fertilization have altered the properties of black soil, resulting in significant variations in the microbial community structures among samples. Our analysis grouped the 8 different fertilization treatment samples into three categories based on microbial community composition similarities: CK-M-M2, NP NPK-MNPK, and N2P2-M2N2P2. Notably, the N2P2-M2N2P2 group exhibited the most complex co-occurrence network. Furthermore, we isolated numerous pure bacterial strains from black soil, laying the foundation for further research on the functional aspects of black soil bacteria at the pure culture level.



Keywords: Black soil, long-term fertilization, microbial community, cultivable bacteria, sustainable agriculture

ID ABS WEB: 136956

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes –
Importance for climate resilient future, degraded lands restoration and plant health control

EXPLORING SOIL MICROBIAL DIVERSITY IN THE ANDES-AMAZON TRANSITION ZONE: CONSEQUENCES OF CONVERTING FORESTS TO PASTURELAND

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Soil microorganisms play a pivotal role in ecosystem functioning, performing a range of essential functions. However, their resilience is tested by disturbances, primarily driven by changes in land use. The Andes-Amazon transition zone, known for its ecological significance, is under increasing pressure due to the conversion of native forests into pasturelands. While efforts to characterize biodiversity in this region have been on the rise in recent decades, our understanding of soil microbial communities and their responses to land use changes remains limited. In this study, we employed a shotgun DNA metagenomic sequencing approach to explore the composition, diversity, and functions of soil bacterial communities in both the litter layer and topsoil (0-10 cm) of a forest located in the Andes-Amazon transition zone in Colombia. Additionally, We evaluate how microbial soil communities are impacted by the establishment of pastures. Our results revealed that the forest litter harbors a distinct microbial ecosystem, characterized by the highest bacterial richness and diversity. This layer was also positively associated with increased carbon (C), nitrogen (N), and phosphorus (P) availability, as well as enzymatic activity linked to the mineralization of these elements. The transition from forest to pasture brought about significant alterations in the microbial community structure, accompanied by a reduction in soil acidity. Proteobacteria, Acidobacteria, and Actinobacteria were the most abundant phyla in all environments, with a predominance of Proteobacteria and Bacteroidetes in the forest litter. In contrast, the conversion from forest to pasture increased the abundance of Verrucomicrobia and Firmicutes in the soil. Functional profiles were most pronounced in the litter layer, followed by pasture and forest soils. These findings establish a fundamental framework for understanding the microbiome in the Andes-Amazon transition zone and its role in ecosystem functioning. Furthermore, this study sheds light on the consequences of land use changes on microbial communities.

Keywords: Metagenomics, microbiome, land use change, soil biology properties, tropical forest

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4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes –
Importance for climate resilient future, degraded lands restoration and plant health control

VIRAL MODULATION OF SULFUR METABOLISM IN ACID SULFATE SOILS: UNRAVELING THE IMPACT OF VIRUSES ON SOIL BIOCHEMISTRY

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Acid sulfate soils cover extensive areas across the globe and pose profound ecological and economic challenges. While microbial activities associated with sulfur metabolisms primarily mediate the formation process of acid sulfate soils, the potential impact of viruses, known for their roles in infecting key microorganisms or encoding auxiliary metabolic genes (AMGs), remains largely unexplored. Here, we characterized the community and biogeochemical impacts of viruses in unoxidized acid sulfate soils (Hypersulfidic soils, pH 6.5-7.3) and oxidized acid sulfate soils (Sulfuric soils, pH < 3.3) using paired viromes and total metagenomes. Our results revealed higher diversity and distinct community composition of viral community in Hypersulfidic soils compared to Sulfuric soils. We identified much higher abundance and diversity of viral-encoded AMGs in Hypersulfidic soils than in Sulfuric soils. Particularly, those AMGs associated with assimilatory and dissimilatory sulfate reduction, organosulfur compound degradation, organic matter degradation, and electron transfer strongly implied the potential role of viruses in regulating sulfur cycling and shaping the formation of sulfidic materials in Hypersulfidic soils. The virus-host predictions linked viruses to a wide range of sulfate reducing and oxidizing microorganisms in both soil types, suggesting that viruses exerted a potential influence on the sulfur cycling processes via infection. Altogether, our findings highlight the roles of viruses in mediating sulfur cycling processes in acid sulfate soils and the potential of harnessing soil viruses for manipulating sulfur cycling microorganisms to control acid generation and mitigate soil acidity in practice.

Keywords: soil viruses, virome, metagenome, sulfure cycling, acid sulfate soils

ID ABS WEB: 137111

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes –
Importance for climate resilient future, degraded lands restoration and plant health control

ROOT MICROBIOTA CONFERS RICE RESISTANCE TO ALUMINUM TOXICITY IN ACIDIC SOILS

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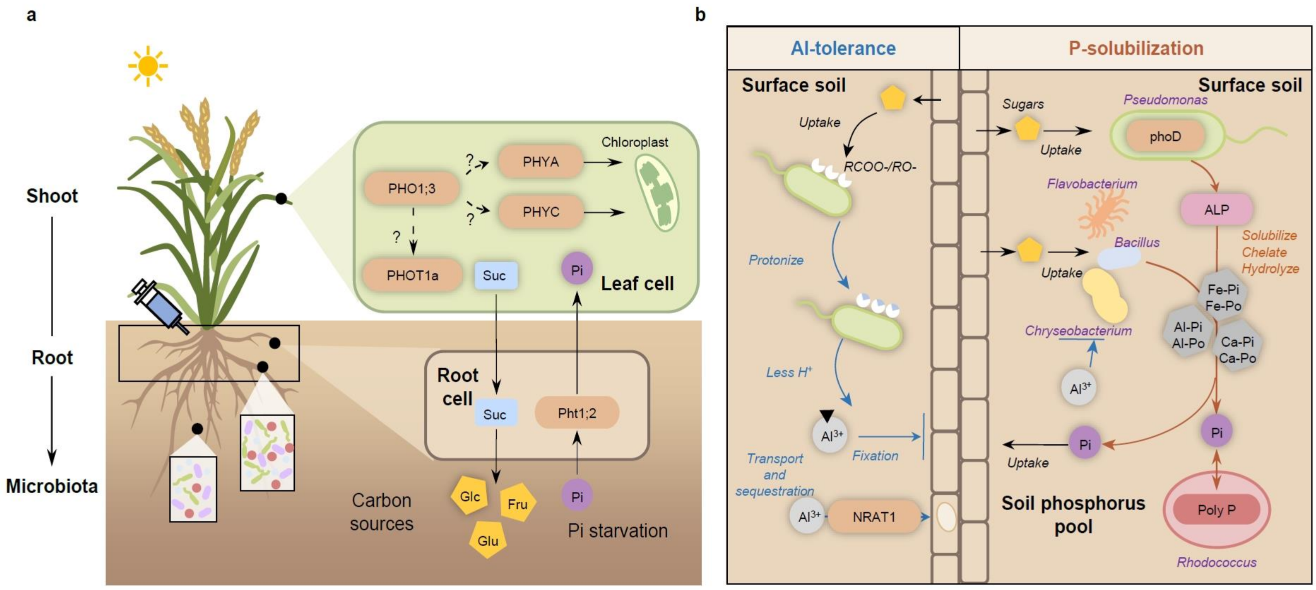
Aluminum (Al) toxicity impedes crop growth in acidic soils and is considered the second largest abiotic stress after drought for crops worldwide. Despite remarkable progress in leveraging the genetic diversity of plants for Al resistance, it is still unknown whether and how the microbiota confers Al resistance to crops. We found that a synthetic community (SynCom) composed of highly Al-resistant bacterial strains isolated from the rice rhizosphere increased rice yield by 26.36% in acidic fields. SynCom harvested rhizodeposited carbon for successful proliferation and mitigated soil acidification and Al toxicity through extracellular protonation. The functional coordination between plants and microbes offers a promising way to increase the usage of legacy phosphorus in topsoil. These findings highlight the microbiota–root feedback involved in crop abiotic resistance and the potential of microbial tools for advancing sustainable agriculture in acidic soils.



Keywords: Synthetic community,Aluminum (Al) toxicity,Extracellular protonation,Rhizosphere microbiota,Phosphorus (P) mobilizing

ID ABS WEB: 137229

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Importance for climate resilient future, degraded lands restoration and plant health control

A COMPARISON OF EL-FAME, PLFA AND QPCR METHODS TO DETECT QUICK CHANGES IN SOIL BACTERIAL AND FUNGAL ABUNDANCE

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Abundance is a key property of soil bacterial and fungal communities, which determines their functionality and their ability to respond to environmental changes. The quantification of fatty acids or marker genes are common methods to assess soil bacterial and fungal biomass. The analysis of soil fatty acids can be conducted via ester-linked fatty acid methyl ester (EL-FAME) or phospholipid fatty acid (PLFA) methods. Quantitative PCR (qPCR) can be used to quantify soil bacterial 16S rRNA and fungal 18S rRNA genes. The sensitivity of these approaches to detect increasing or decreasing microbial abundances in the short term is not well known. Therefore, this study compared PLFA, EL-FAME and qPCR methods to distinguish changes in bacterial and fungal abundances induced by the addition of antibiotics and antifungals (to induce decreasing abundances) and nutrients (to favor microbial proliferation) to soil from badland, agricultural and forest ecosystems after 2, 7, 14 and 28 days of incubation. Changing bacterial and fungal abundances measured through the three methods were also related to the soil microbial basal respiration to identify the approach targeting better the soil living microorganisms. The rates of microbial inhibition and proliferation induced by antibiotics and nutrients, respectively, varied between methods. In the three soil types, the PLFA approach detected the greatest decreasing rates of bacterial and fungal abundances generated by antimicrobials, especially in the very short term. Instead, the highest rates of bacterial and fungal proliferation induced by nutrient addition were detected by EL-FAME and qPCR. The results obtained with the three methods were highly positively correlated, but the correlation was higher between EL-FAME and PLFA for both bacteria and fungi. The bacterial and fungal abundances measured by EL-FAME across the experiment correlated better with soil basal respiration than those measured by PLFA and qPCR. The results from the present study and the lower cost and simpler methodology postulate EL-FAME as a more advantageous method than PLFA and qPCR.

Keywords: Soil microbial abundance, Microbial biomass, Fatty acids, Environmental changes response, Soil bacteria and fungi

ID ABS WEB: 137456

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4.07 132182 - Soil microbiomes –
Importance for climate resilient future, degraded lands restoration and plant health control

INTERCONNECTED MICROBIAL COMMUNITIES IN ALPINE GRASSLAND ECOSYSTEMS

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Soil is referred to as a complex ecosystem, also comprising individual biological entities that harbor microorganisms. Traditional perspectives often examine soil microbial diversity as separate from those of the organisms that inhabit it. Here, we seek to challenge such view and propose an alternative and holistic interpretative framework in which the soil meta-community is the sum of different microbial communities belonging to various organisms found within the soil or interacting with it.
Applying this comprehensive view, this study explores soil prokaryote and fungal diversity and associated microbiota in mammals, invertebrates, and plants in alpine pastures. The study comprises more than 900 samples of soil (Ah horizon), rhizosphere (Carex spp. and Festuca spp.), invertebrates (nematodes, collembolans, earthworms, and beetles) and vertebrates (fecal eDNA of hares, wild ungulates and livestock) along an elevational gradient (which was used as a proxy for climate change) in the European Alps.
We found that, in addition to climatic and soil properties, biotic factors, especially the presence of living organisms like animals and plants, significantly shape soil microbial diversity. Analyses of fungal and bacterial taxa shared between sample types established greater overlaps between soil, rhizosphere, and soil-dwelling invertebrates, compared to other invertebrates and vertebrates. This finding highlights the central role of soil microbiota and the above/belowground and host/habitat-specific associations in the alpine meta-community. Our data reveal the similarity of microbial communities from different organisms interacting with the soil and underline their intricate connections in alpine pastures, even across a 1500 m elevation gradient.

Keywords: microbial diversity, soil ecosystem, meta community, climate change, alpine pasture

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4.07 132182 - Soil microbiomes –
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SOIL MICROBIOME, CONTAMINATION, AND SHRUBLANDS: DECODING THEIR COMPLEX RELATIONSHIP IN A CHILEAN MEDITERRANEAN LANDSCAPE

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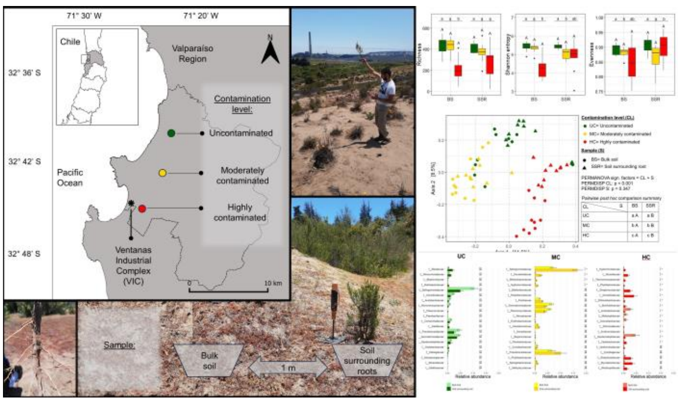
The soil microbiome is an essential component of soil health that can provide multiple ecosystem services. However, anthropogenic disturbances such as contamination by trace elements and soil acidification could neglect microbial communities and their functions. Contrastingly, plants could safeguard the soil microbiome in contaminated conditions. This complex interaction occurs in the Puchuncaví Valley, a Mediterranean landscape of Central Chile impacted by an Industrial Complex. Although vegetation has been clearly affected here, Baccharis linearis (BL), a survivor plant, is prevalent even in the most contaminated areas. We hypothesized that contamination would affect the soil microbiome, but such an effect would be different in bulk soils versus soils surrounding roots of BL. We studied a contamination gradient: UC, MC, and HC (uncontaminated, moderately contaminated, and highly contaminated areas, respectively). In each area, we collected ten samples of bulk soil (BS; at least 1 m without vegetation) and ten samples of soil surrounding roots (SSR) of BL. Our contamination gradient (UC->MC->HC) showed soil acidification only in bulk soils while decreased soil organic matter content and increased copper concentration in both sample types. The bacterial richness was lower in the HC-BS compared to other BS conditions. In contrast, fungal richness did not show significant changes. Microbial communities showed that community similarity between BS and SSR decreases as the contamination increases. This disruption was evident in the compositional analyses. Bacterial Families were shaped by the sample rather than the contamination degree, while both factors were significant for fungi. Network analyses unveiled that the higher the contamination, the less the microbial co-occurrence. Our functional analysis revealed that contamination drastically impacts biogeochemical cycling, by decreasing soil organic matter and decomposing microorganisms. Moreover, we observed that the higher the contamination, the higher the abundance of human disease-associated microbes, but plants reduced this hazard. This final result supports the postulates of one health because the survivor BL plant promotes healthier soil fostering overall environmental well-being for ecosystems and people.



Keywords: soil microbiome, contamination, trace elements, shrublands, one health

ID ABS WEB: 137804

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Importance for climate resilient future, degraded lands restoration and plant health control

UNTANGLING THE INTERPLAY BETWEEN ENVIRONMENTAL FACTORS AND THE BACTERIAL FUNCTIONAL DIVERSITY IN DANISH SOILS

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Understanding the soil and environmental controls of microbial functional diversity is required to determine the consequences of future climatic conditions and land use pressures. Simply counting and categorizing soil microbes based on taxonomy does not reveal their functional roles. We need to delve into functional diversity to understand the relationship between biodiversity and ecosystem functions. This concept captures the various functions that organisms perform within ecosystems. We aimed to explore the influence of soil and environmental variables on alpha-diversity and functional diversity of bacterial communities in Danish soils.
We collected over 7000 topsoil samples from natural and agricultural areas across Denmark. Soil samples were analyzed for their bacterial composition through a DNA metabarcoding approach. From the DNA sequences, an operational taxonomic unit (OTU) table was generated, and the taxonomical information was assigned. We calculated alpha-diversity and we used the FAPROTAX (Functional Annotation of Procaryotic Taxa) database to associate potential functions to bacterial OTUs. We utilized spatial layers of soil properties, climate, vegetation, geomorphology, and parent materials to explain both the alpha-diversity and the potential functions of bacterial communities related to N cycling.
Diversity was higher in natural soil than in human-modified environments as well as the abundance of OTUs potentially performing nitrogen fixation. However, abundance of bacteria potentially involved in nitrification and ammonia aerobic reduction was higher in agricultural soils. Interactions among the explanatory variables best explained spatial patterns of bacterial community diversity and predicted functions. We consider that taxonomical and functional diversity should be studied simultaneously for monitoring purposes as functional diversity influences ecosystem functioning, services provision, and soil health.

Keywords: Soil health, Soil microbial diversity, Modeling, Functional diversity

ID ABS WEB: 137835

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4.07 132182 - Soil microbiomes –
Importance for climate resilient future, degraded lands restoration and plant health control

TEMPERATURE TOLERANCE AND RESPONSE TO CHARCOAL APPLICATION OF ARBUSCULAR MYCORRHIZAL FUNGI FROM AN AGROECOSYSTEM IN THE ARABIAN DESERT

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Arbuscular mycorrhizal fungi have been shown to support the nutrition of their host plants on soils with poor availability of nutritional elements. Though natural vegetation is very sparse in the deserts of the Emirate of Abu Dhabi, AM fungal root colonization is commonly observed in agricultural plants. So far, very little is known about the origin of these AM fungi, their physiological properties, and their responses to management practices. In the first experiment, topsoil material from an agricultural field in Abu Dhabi was used for inoculation of Sorghum bicolor plants grown in sterilized dune sand either or not amended with a 2 % volume of charcoal. Though the sampled field had been left fallow for six months (including the hot summer months) before sampling, the S. bicolor plants showed a high degree of AM fungal root colonization after eight weeks of cultivation. Charcoal application had a positive effect on AM fungal root colonization. To test the temperature tolerance of the sampled AM fungal strains, root and rhizosphere soil samples of the harvested S. bicolor plants were exposed to either – 4, 50, 70, or 100 °C for 48 hours. Control samples remained exposed to room temperature. The samples were then used to inoculate tomato plants grown in sterilized dune soil. Results revealed that AM fungal propagules retained high infectivity after exposure to -4 or 50 °C, while exposure to 70 °C lowered tomato root colonization compared to the control treatments. The plants grown in the presence of inoculum heated at 100 °C remained non-mycorrhizal. Previous soil amendment with charcoal had no impact on AM fungal temperature tolerance. Our findings suggest that AM fungi can well survive in agricultural soils of the UAE, even when these are left fallow during the hot summer months. Temperature tolerance of the sampled AM fungi exceeded that commonly found in other microorganisms and might be part of their adaptation to a hot desert environment.

Keywords: Heat tolerance, Arbuscular mycorrhizal fungi, Charcoal amendment, Arabian desert AMF inoculum, Hot sandy topsoil

ID ABS WEB: 137842

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes –
Importance for climate resilient future, degraded lands restoration and plant health control

DETERIORATION OF SOIL BIOLOGICAL ACTIVITY BY INCREASING SALT STRESS: A COMPARISON BETWEEN CONVENTIONALLY AND ORGANICALLY MANAGED SOILS

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Organic farming is indicated to preserve soil quality and its resilience against abiotic stresses. Among the threats to soil functionality exacerbated by climate change, salinization is one of the most harmful. Salinity governs the osmotic stress in plants and microbial cells, and the toxicity of specific ions can accelerate the decline of soil microbial pool. In this context, increased flooding risk caused by sea level rise can have detrimental effects on coastal soils. The intensity of the stress influences the ability of the system to recover, but proper soil management may reduce or delay the detrimental effects.
Two arable soils differing in management (conventional and organic) were selected and incubated in mesocosms for 5 and 25 days after exposure to 6-hour flooding with artificial seawater at increasing salt concentrations (0 - 34.5 g L-1). Analyses focused on biological aspects, i.e. soil microbial biomass C, soil ATP, respiration rates and soil enzymatic activities. Soil aliquots were air-dried after 5 days incubation and re-wetted, simulating the additional stress of drought, and analysed for soil water potential and ATP content.
Salinity negatively affected soil microbial biomass C while increasing soil respiration rates, which however declined at high salt concentrations. Salt stress seemed to affect the survival of some taxa rather than the overall microbial activity. In fact, despite ATP decreased with salinity, the ATP concentration of microbial biomass decreased significantly only at the highest salinity level. Enzymatic activities seemed poorly affected by the salt in the conventionally managed soil. Conversely, the organically managed soil showed increases in the alkaline phosphatase and cellulase activities and decreasing trends in leucine aminopeptidase with the increase of salinity. Nevertheless, this soil showed a better recovery from the drought stress compared to the conventional one.
Based on our results, we can expect a prompt response to salt stress in the case of organically managed soils, with reduced CO2 emissions and preserved microbial biomass levels and enzymatic activities.

Keywords: abiotic stress, soil management, climate change, salinity, soil biological activity

ID ABS WEB: 137862

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes –
Importance for climate resilient future, degraded lands restoration and plant health control

PREDICTION OF SOIL INFORMATION USING 16S RRNA AND MACHINE LEARNING IN JAPANESE AGRICULTURAL FIELDS

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Soil monitoring is an important component for sustainable crop production. While soil chemical properties have generally been used for agricultural soil monitoring in Japan, soil biological properties are also considered to store much information reflecting soil condition.
Amplicon sequencing of 16S rRNA gene provides us with a snapshot of diverse soil bacterial communities in a high-throughput, cost-effective way. However, the application potential of 16S rRNA data for soil monitoring using machine learning has not yet been fully explored in comparison to chemical property data. In this study, we collected 375 agricultural soil samples from 278 sites across Japan, which covers wide range of soil types, weather conditions, and cultivated crops. We analyzed 16S rRNA data using supervised machine learning models to predict soil chemical properties and soil metadata including soil type and crop. Soil chemical properties, such as pH, carbon contents, and cations, could be predicted by XGBoost regression model using 16S rRNA data with the accuracy of normalized root means squared errors of less than 20%. Furthermore, 16S rRNA-based classification model predicted the soil metadata with higher accuracy than the model based on soil chemical properties. These results support that soil 16S rRNA sequencing provides useful information for monitoring agricultural soils.

Keywords: Soil monitoring ,Microbiome, 16S rRNA, Machine learning, Agriculture

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Importance for climate resilient future, degraded lands restoration and plant health control

MICROBIAL BIOGEOGRAPHY IN AUSTRALIA: DETERMINANTS OF SOIL BACTERIAL AND FUNGAL DISTRIBUTION AT CONTINENTAL AND REGIONAL SCALES

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Soil microorganisms orchestrate a myriad of important processes that influence planetary health. The mapping of Australia's soil microbiome presents a unique opportunity to gain deeper insights into the complex interplay between biotic and abiotic factors on a continental scale.
In this study, we investigate the determinants and controls of soil bacterial and fungal distribution across the Australia. Our dataset encompasses soil samples from diverse bioregions and soil types across the continent.
Our research reveals that at the continental level, the foremost driver of microbial distribution is the interplay between soil properties and climate factors. As expected, soils with similar characteristics tend to harbour similar bacterial and fungal communities, a finding reinforced by principal coordinate analysis.
Building on these insights, we developed digital soil mapping models that establish clear associations between observed microbial abundances and environmental variables. These models have enabled us to generate the first high-resolution continental maps of soil bacteria and fungi. These maps uncover intriguing microbial hotspots across Australia, such as the eastern coast, southeastern coast, and west coast, characterized by the dominance of Proteobacteria and Acidobacteria. For fungi, precipitation emerges as the dominant influence, with Ascomycota prevailing in the central region. Some of these microbial hotspots are situated in areas facing significant human pressure, rendering them vulnerable to environmental changes.
Focusing on a regional scale, our study focuses the effect of human activities on soil bacterial communities. The results underscore that land use changes have a more pronounced impact on the structure of rare sub-communities compared to their abundant counterparts. Abundant sub-communities tend to thrive in cropping environments, while rare sub-communities display lower prevalance and diversity in such areas. This suggests that cropping practices may lead to narrower niches, reduced adaptability to environmental changes, and biotic homogenisation.
Our research highlights the importance of considering soil heterogeneity when assessing the response of soil microbial communities to environmental changes.

Keywords: soil microbial diversity, soil organic matter

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ASSESSMENT OF TEMPORAL DYNAMICS OF SOIL MICROBIAL BIODIVERSITY ON CHRONOSEQUENCES: PRELIMINARY RESULTS

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Soil ecosystems provide habitats for diverse groups of organisms. Monitoring soil biodiversity over the long-term is necessary to identify proper soil management practices and to preserve soil ecosystem services. Archived soil series offer promising opportunities to characterize microbial temporal dynamics. However, soil microbes are usually studied using cryopreserved fresh soils, while almost all archived soils are dried and stored at room temperature.
The aims of the present project are to assess the feasibility of using dried soil samples for the study of microbial biodiversity, to estimate the potential biases compared to frozen samples, and then to use such soils to study the temporal trends of microbial communities in response to environmental changes.
Soil samples were obtained from two long term experiments located in Italy (CREA) and in Slovenia (ULBF). These soils were subjected to different management practices, and were collected in 2011 (or 2012), stored both as frozen and dried (oven-dried or air-dried). Thereafter, the same soils were collected in 2022 and again stored frozen and dried, though for a shorter period of time (7-8 months). DNA was extracted from all these samples and used to quantify the abundance of bacterial functional genes, for sequencing of bacterial V3-V4 16S rDNA to assess the bacterial composition and will also be used for enzymatic analyses.
For CREA samples, we observed no effect of storage conditions on bacterial communities, while the effects of tillage and sampling year were prominent. Conversely, for ULBF, different storage methods influenced the composition of the bacterial communities, while the effect of the different tillage practices resulted masked. It is possible that different physicochemical soil properties or the different soil drying procedure might determine a different preservation of bacterial DNA in dried soils.
Future perspectives include evaluating the effects of different drying procedures and studying the enzymatic activity of these soils to better understand the potential use of archived dried soil samples for soil biodiversity monitoring.

Keywords: Soil microbiome, Long term experiments, Sample storage, Biodiversity, Archived soil series

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ENHANCING GERMINATION AND GROWTH OF INDIGENOUS SEMI-ARID PLANTS THROUGH SEED BIOPRIMING WITH BIOCRUST-FORMING CYANOBACTERIA

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Restoration initiatives in drylands are often hampered by the harsh environmental conditions of these regions, which makes ecosystem restoration challenging. The use of direct seeding has emerged as a potentially effective strategy for large-scale rehabilitation of drylands, offering the prospect of substantial cost reductions. However, the refinement of this technique is imperative to increase seedling survival and establishment. In this context, biopriming arises as an upsurging technique to enhance seed germination and seedling establishment, with cyanobacteria among the most interesting beneficial microorganisms for biopriming applications.
This study evaluates the effect of seed biopriming with native biocrust-forming cyanobacteria on seed germination and radicle length in four plant species—two perennials (Macrochloa tenacissima, Thymus hyemalis) and two annuals (Plantago ovata and Stipa capensis)—chosen for their prevalence in the Mediterranean drylands. Experiment treatments consisted of seed biopriming with cyanobacteria inoculants (biomass + exudate), seed priming solely with cyanobacterial exudate, and control treatments which included seeds immersed in BG11 culture medium and distilled water. Four different native biocrust-forming cyanobacteria species (Nostoc commune, Tolypothrix distorta, Trichocoleus desertorum, and Leptolyngbya frigida) were employed for biopriming.
Results reveal that seed biopriming mostly exhibited neutral effects and above all, showed no inhibitory effect on seed germination. Nevertheless, significant positive effects on radicle length were observed in annual plants. Notably, P. ovata radicles were considerably larger when treated with cyanobacterial exudates, and S. capensis radicles were enhanced when primed with cyanobacterial biomass. These results underscore the species-specific nature of seed biopriming effects, emphasizing that proper selection of plant species, coupled with optimal biopriming treatment, can significantly improve plant survival and establishment in arid areas, thereby improving the overall success of restoration initiatives.

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Keywords: Exudate, Biomass, Annual plant, Perennial plants, Radicle length

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4.07 132182 - Soil microbiomes –
Importance for climate resilient future, degraded lands restoration and plant health control

PATTERNS OF SOIL MICROBIAL COMMUNITIES JOINTLY INFLUENCED BY LAND MANAGEMENT PRACTICES AND SOIL PHYSICAL-CHEMICAL PROPERTIES ACROSS ECOSYSTEMS IN HUNGARY

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Soil microbial communities play an important role in shaping soil health, carbon (C), and nutrient cycling. However, land management practices such as afforestation, grazing, and grassland will influence soil bacterial and fungal communities and abundance is not clear. Furthermore, the impact of EU-subsidised agricultural best practices on soil microbiomes is not fully understood. Here, using DNA sequence and physical-chemical properties of soil samples collected in a countrywide soil survey in Hungary, we assessed the impact of different land management practices, and soil properties to develop an understanding of the drivers and patterns of soil bacteria and fungi in contrasting ecosystems. The results show that bacterial and fungal community composition and abundance significantly differed among land management practices, suggesting the sensitivity of soil microbiomes to soil disturbance. Furthermore, we found significant effects of physical and chemical soil properties on soil bacterial and fungi composition and abundance. Together, the results suggest that soil bacterial and fungal communities and abundance are driven by a much more complex interaction of land management practices and soil geochemical properties than generally considered. Consequently, land use/management history and soil geochemistry should be taken into account when developing mechanistic models for microbial dynamics and related soil health indicators.

Keywords: Land use, Soil-microbiome interaction, Soil health, Microbial indicators, Soil metagenomes

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4.07 132182 - Soil microbiomes –
Importance for climate resilient future, degraded lands restoration and plant health control

PROMOTING GRAPEVINE TOLERANCE TO DROUGHT THROUGH SOIL MICROBIOME MANAGEMENT

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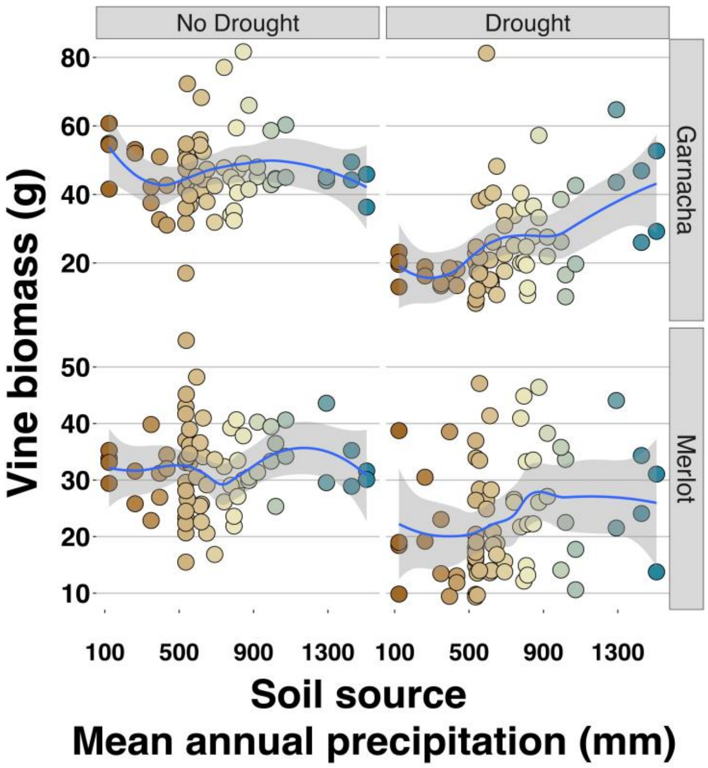
The role of the soil microbiome in mediating important global change stresses to plants, including drought and extreme temperature, is becoming more widely known, but a critical question that largely remains unanswered is whether microbiome multifunctionality can be actively managed to promote a more sustainable future in agriculture? Vineyards represent a large potential source of ecological impact as they cover a vast portion of land worldwide, and also represent an important source of income for millions of people. In this study, we begin to identify the ways addition of microbial communities of whole vineyard soils to grapevines (i.e., microbiome management) can confer critical functions that increase plant tolerance to prolonged drought. We identified soil source-specific factors (e.g. mean annual precipitation) that selected microbial communities and functions that then differentially mitigated the negative effects of drought for one of two grapevine varieties in a large factorial growth experiment. This work highlights the potential of soil microbiome management to mitigate important climate stress factors that threaten sustainability in vineyards while promoting plant productivity.



Keywords: Grapevine microbiome, Drought tolerance, Sustainable management, Microbial functioning, Microbial-mediation

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4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes – Importance for climate resilient future, degraded lands restoration and plant health control

EDAPHOCLIMATIC STRESS CONDITIONS INCREASE SOIL MICROBIAL DIVERSITY IN MEDITERRANEAN MARITIME PINE FORESTS

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Climate change is the main driver of biodiversity loss in terrestrial ecosystems. Soil microbial diversity losses will reduce multiple ecosystem functions, including soil carbon storage and nutrient cycling. Mediterranean forests are one of the hotspots of biodiversity in the world as well as one of the most threatened ecosystems by climate change. More intensive and longer drought periods are forecast for this region. However, how decreased precipitation will affect soil microbial diversity and if and how lithology will mediate the response remains poorly understood. Within the projects LITHOFOR and TRILOBITE, we aim to predict the response of forests to climate change. We selected a unique experimental set-up in the province of Málaga, South of Spain, where maritime pine forests grow on three different substrates in three Sierras along a precipitation gradient (spanning from 1300 to 600 mm annual precipitation). Soil samples from 45 forest plots were collected in the three locations where pine forests grow on three different lithologies (calcareous, metapelite and peridotite). Soil microbial community biodiversity was assessed using high throughput sequencing of 16S rRNA genes (bacteria), the ITS region (fungi) and 18S rRNA genes (eukaryotes). Both precipitation and lithology significantly influenced microbial community structure, showing increased diversity in sites laying on peridotite soils and with the lowest precipitation. While soil microbial diversity was similar among lithologies at the wettest site, diversity increased with increasing aridity, particularly in the most adverse substrate, peridotite. Remarkably, the percentage of shared taxa between the different lithologies increased with aridity. The main variables driving microbial community structure were soil physicochemical characteristics such as Mg/Ca, texture, Ni, pH and $CaCO_3$ and forest structure (growth, diameter and age). Our results highlight the importance of bedrock and lithological substrates for the response of soil microbiome to climate change. Our study suggests that stressful edaphoclimatic conditions, imposed by aridity and lithology, induce higher bacterial, fungal, and non-fungal eukaryotes diversity supporting the stress gradient hypothesis.

Keywords: Soil microbial communities ,Lithology, Aridity, stress gradient hypothesis, Mediterranean forests

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4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes –
Importance for climate resilient future, degraded lands restoration and plant health control

DOES NORMALIZATION OF ENZYME ACTIVITIES IMPROVE THEIR USE AS INDICATORS?

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The use of indicators allows the study of soil health by reducing the necessary number of analytical determinations without putting the decision-making capacity at risk. The different biological parameters that can be analyzed in the soil have demonstrated their usefulness as indicators in different cases: contamination, physical degradation, differences between management in agricultural soils, etc. The analysis of enzymatic activities is shown to be one of the most used biological indicators in the study of soil health. However, there is no consensus on how to analyze the results: some authors use the data on enzymatic activities directly and others normalize them with respect to the organic carbon (TOC) or with the geometric mean of the activities (GMEAN). The objective of this work was to evaluate the influence of different methods of enzymatic activities normalization in olive grove soils with different cover crops. The study area was located in an experimental olive grove, in the center of Iberian Peninsula (Finca Experimental La Chimenea, IMIDRA, Spain). The soil was managed with four treatments: i) conventional tillage, ii) permanent cover of Brachypodium distachyon (L) P. Beauv., iii) permanent cover of spontaneous vegetation and iv) annual cover crop of bitter vetch (Vicia ervilia (L.) Willd). Enzymatic activities related to the C, N, P and S cycles were analyzed: beta-glucosidase, urease, phosphatase and arylsulfatase, respectively. The results obtained by performing Principal Component Analysis (PCA) were compared to the unnormalized enzyme activities (AE), normalized by TOC (AE/TOC) and normalized by GMEAN (AE/GMEAN). The PCA performed with AE and AE/GMEAN obtained similar variance explanation percentages, with the worst results for AE/TOC. The distribution of the enzymatic activities in the PCA of AE would be due to the relationship they present with the TOC, reducing the capacity for analysis of the enzymatic activities, while the ordination in the AE/GMEAN facilitates a better interpretation of the relationships between activities by reducing the influence of covariates.

Keywords: Soil Health, Enzyme activity, Mediterranean area, Indicator, Olive grove

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4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes –
Importance for climate resilient future, degraded lands restoration and plant health control

ENHANCED NUTRIENT AVAILABILITY AND PLANT PERFORMANCE THROUGH PROCESSES MEDIATED BY MICROORGANISMS IN SOILS AMENDED WITH HYDROCHAR

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Soil microbes mediate biogeochemical cycling of essential nutrients (N, P, K, S) and assist in organic matter (OM) decomposition, preserving soil fertility and supporting plant productivity. Despite evidence, more research is needed on the soil-plant-microorganism (SPM) system with organic amendments. With the increasing interest in alternative plant nutrition methods, addressing this topic is justified. A potential alternative could be hydrochar (HC), a carbonaceous material obtained through the treatment of biomass via a hydrothermal carbonization process.
This study employs a multidisciplinary approach to examine the effects of chicken manure HC on the SPM system, evaluating soil microorganism abundance and activity, OM quality and quantity, nutrient availability, and sunflower plant performance under different irrigation conditions. HC was applied to a Cambisol at rates of 3.25 and 6.5 t ha-1 (HC-3.25, HC-6.5), with mineral fertilizer treatments providing equivalent total N contributions for comparison. Sunflower plants were grown in pots under two irrigation conditions (60% and 30% of the soil water holding capacity). Plants were harvested after 77 days, and macronutrient content in soil and plants was analyzed. The quality of OM was assessed using 13C NMR. Microorganism analyses included counting colony-forming units and using qPCR to measure 16S rRNA and ITS gene copies for bacteria and fungi, plus bacterial acid phosphatase (PHO), urease, and B-glucosidase (BG) gene copies. Microbial activity was evaluated by analyzing soil respiration and dehydrogenase, PHO, and BG activities.
Results revealed that HC-6.5 treated soils had higher bacteria and fungi abundance and increased microbial activity. Particularly under well-irrigated conditions, these soils also exhibited a higher proportion of available K and S for plants, leading to improved nutrient uptake efficiency. Since the concentration of both elements did not rise after HC application at the beginning of the experiment, the availability changes are presumed to result from microorganism-mediated processes stimulated by HC. Our findings emphasize that HC amendment impact on soil involves interactions among climate, application rate, plant physiology, and microbial activity.

Keywords: Hydrochar, Organic amendment, Microbial activity, Soil-Plant-Microbe interaction, Circular Economy

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4. Soil health in achieving the Sustainable Development Goals
4.08 132261 - Ecosystem services provided by nematodes and other soil invertebrates and specific protection goals

FLUAZAINDOLIZINE (REKLEMEL™ ACTIVE), A MODERN NEMATICIDE FOR KEY DAMAGING NEMATODES COMPATIBLE WITH MANY BENEFICIAL SOIL ORGANISMS TO PROTECT SOIL HEALTH AND PRODUCTIVITY.

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Due to challenging climatic conditions, the rising lack of fertilizer resources and the increasing demand for sustainable agriculture, the role of healthy soils is expected to becominge more important in the future. Soil health is a key deliverable of the European biodiversity strategy for 2030 contributing to the objectives of the EU Green Deal. Healthy soils have the capacity to lower the impact of climatic stress, reduce the extend of soil-born plant diseases and pests as well as directly to support plant growth via efficient natural nutrient cycles, an improved physical soil structure as well as optimized plant nutrient uptake. Those benefits have been linked to well-developed soil food webs, the presence of natural antagonists of pest and diseases, as well as plant growth promoting microbes. The management of plant-parasitic nematodes, that currently mainly relies on the use of synthetic nematicides could highly benefit from these organisms. Consequently, we need to better understand how soil applied nematicides interact with organisms that contribute to the overall soil health network and to include both into an integrated nematode management approach. Within our talk, we will share recent data on the compatibility of Fluazaindolizine (SalibroTM), a novel nematicide developed by Corteva Agriscience, with various beneficial organism including free-living nematodes, nematode & disease suppressive soil fungi as well as beneficial soil bacteria.

Keywords: NEMATICIDE, SOIL HEALTH, INTEGRATED NEMATODE MANAGEMENT, INTEGRATED PEST MANAGEMENT, BENEFICIALS

ID ABS WEB: 138111

4. Soil health in achieving the Sustainable Development Goals
4.08 132261 - Ecosystem services provided by nematodes and other soil invertebrates and specific protection goals

ORIGINS AND REGENERATION RATES OF SOIL BIOPORES UNDER VARIOUS PEDOCLIMATIC CONDITIONS

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Biopores are of crucial importance in the organization of soil structure, water infiltration and air circulation between the surface and the deep soil. Despite their importance in soil functioning, there is a lack of comprehensive knowledge regarding the contribution of soil engineers to the formation of these biopores and their regeneration rates in field conditions.
To this end, we aimed to investigate: (1) the relationships between soil engineers, i.e., earthworms, ants, termites, beetles and millipedes, and biopores and (2) the potential use of organic matter residues to stimulate macrofauna activity and faster the generation of soil biopores. Our experimental approach involved repacking soil cores into soil bags to create bioporosity-free cores, where soil engineers could colonize them. Soil bags were incubated in twelve contrasted pedoclimatic study sites including five countries (France, Vietnam, India, Laos and Thailand) for a year. After 12 months, the volume of biopores imaged and measured by X-ray computed tomography in soil bags was compared to the volume of biopores measured in control cores from each of the study sites. Furthermore, we explored the relationships between the volume and shape of biopores generated in soil bags with the communities of soil engineers and soil pedoclimatic conditions.
We showed, in most of cases, a complete regeneration of the volume of biopores after 12 months regardless the addition of organic residues or the pedoclimate conditions. The sites with a greater earthworm population exhibited the greatest rates of regeneration. The co-inertia analysis, allowing to compare the diameter and complexity of the regenerated biopores to the soil engineers was not statistically significant. This suggest that either this approach or the 3D parameters used were not suitable for identifying the origin of biopores.
In conclusion, our findings demonstrated that biopores are rapidly regenerated, mainly by earthworm activities regardless the pedoclimatic conditions. However, understanding the specific contribution of soil engineers to biopores remain a complex puzzle to unravel.

Keywords: Soil bags, Biopores regeneration, Soil engineers, Macrofauna

ID ABS WEB: 138139

4. Soil health in achieving the Sustainable Development Goals
4.08 132261 - Ecosystem services provided by nematodes and other soil invertebrates and specific protection goals

REMEDIATION OF HEAVY METAL CONTAMINATED SOIL IMPACTED PLANT RESIDUE UPTAKE INTO MICROBIAL AND MICROARTHROPODAL GROUPS AS REVEALED BY 13C FATTY ACIDS ANALYSIS

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Heavy metal contamination of soils has a great impact on soil biota and carbon turnover. Soil washing with a chelating agent is a potential remediation technique to remove heavy metals. The recovery of the soil biota following washing and associated impact on the soil carbon cycle were investigated in a pot trial using the heavy metal contaminated soil and two washed variants, one amended with vermicompost and biochar. Carbon stable isotope (13C) labeled maize straw was applied as a carbon source. Stabile isotopes were measured in the fatty acids (FA) of single microarthropodal groups (Collembola, Gamasina, Oribatida, Astigmata) and the microbial phospholipid fatty acids (PLFA).
Total microbial biomass and 13C incorporation into microorganisms was significantly increased and the PLFA pattern shifted after remediation of heavy metal contaminated soil. In accordance, the abundance of the microarthropodal groups Gamasina, Oribatida and Collembola were also increased. The relative FA patterns of those groups differentiated significantly among each other, but were not influenced by soil treatment, meaning that the altered microbial PLFA pattern was not transferred into microarthropodal FA. However, the amount of FA per individuum was significantly affected by both soil treatment and groups of microarthropods, with higher FA per individuum in the contaminated soil than washed ones. Incorporation of 13C plant residues in total microarthropods were significantly higher in washed soils, where Gamasina, Astigmata and Collembola incorporated more plant residues in washed soils, while 13C incorporation of Oribatida was constant over the different soil treatments.
These first results revealed, that the relative FA pattern of the microarthropodal groups was not affected by changes in the microbial PLFA pattern due to soil treatments. Differences in the absolute FA amount per individuum and the 13C uptake were rather governed by the life and reproduction strategies, with higher fattiness and low abundance under adverse environmental conditions, constant 13C incorporation in K-strategist and higher 13C incorporation of mainly r-strategist under improved conditions.

Keywords: microarthopods, microorganisms, carbon turnover, stable isotopes, heavy metals

ID ABS WEB: 136159

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

MAIZE EDIBLE-LEGUMES INTERCROPPING SYSTEMS FOR ENHANCING AGROBIODIVERSITY AND BELOWGROUND ECOSYSTEM SERVICES

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Intensification of staple crops through conventional agricultural practices with synthetic inputs has yielded positive outcomes in food security but with negative environmental impacts. Ecological intensification intercropping such as maize edible-legume intercropping (MLI) systems has the potential to enhance soil health and agrobiodiversity and significantly influences crop productivity. However, mechanism underlying enhancement of biological health of soils has not been understood in detail. This study investigated the shifts in rhizosphere and maize-root microbiomes and associated soil physico-chemical parameters in MLI systems of smallholder farms compared to maize-monoculture cropping (MMC) systems. Maize-root and soil samples were collected from twenty-five farms each conditioned by MLI and MMC systems in eastern Kenya. Soil characteristics were assessed using Black oxidation and Walkley methods. High-throughput amplicon sequencing was employed to analyze fungal and bacterial communities, predicting their functional roles and diversity. The different MLI systems significantly impacted soil and maize-root microbial communities, resulting in distinct microbe sets. Specific fungal and bacterial genera and species were mainly influenced and enriched in the MLI systems (e.g., Bionectria solani, Sarocladium zeae, Fusarium algeriense, and Acremonium persicinum for fungi, and Bradyrhizobium elkanii, Enterobacter roggenkampii, Pantoea dispersa and Mitsuaria chitosanitabida for bacteria), which contribute to nutrient solubilization, decomposition, carbon utilization, plant protection, bio-insecticides/fertilizer production, and nitrogen fixation. Conversely, the MMC systems enriched phytopathogenic microbial species like Sphingomonas leidyi and Alternaria argroxiphii. Each MLI system exhibited a unique composition of fungal and bacterial communities that shape belowground biodiversity, notably affecting soil attributes, plant well-being, disease control, and agroecological services. Indeed, soil physico-chemical properties including pH, nitrogen, organic carbon, phosphorus, and potassium were enriched in MLI compared to MMC cropping systems. Thus, diversification of agroecosystems with MLI systems enhances soil properties and shifts rhizosphere and maize-root microbiome in favor of ecologically important microbial communities.

Keywords: Crop diversification, Soil health, Metabarcoding, Microbial communities, Fungal and bacterial activity, Sustainable agriculture

ID ABS WEB: 136514

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

GORSE POSITIVE-EFFECTS ON SOIL RESILIENCE AND CROP PERFORMANCES

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The agricultural ecosystem faces the constant risk of soil degradation and unsustainable use of synthetic nitrogen fertilisers. A paradigm shift, from outsourcing and high inputs to 'ecological intensification' is required. Transformation towards such an approach requires changing the perception that all non-crop species within the farmed environment are 'weeds' that require removal. In fact, their rapid establishment and synanthropic adaptation make these 'weeds' unexplored resources, and good candidates to provide ecosystem services in disturbed and degrading environments. An excellent example of this would be 'gorse' (Ulex europaeus L.), a woody legume native to Britain.
Therefore, we decided to evaluate the potential ecosystem services provided by gorse for soil resilience and crop performance, with soil samples collected at different distances from established gorse bushes (from beneath the gorse to an adjacent cultivated field).
In the laboratory, soil samples were sieved and tested for aggregate stability and recovery after compaction stress. Sampled soils were also used to cultivate barley and spinach in a glasshouse, and hence assess the effects of gorse (mediated by soil) upon crop-performances. Soil aggregates collected from the centre of gorse showed the greatest stability. In contrast, soil collected from the cultivated field was the most unstable. Soil resilience to compaction stress highlighted similar results. After the application of 200 kPa compaction-stress, equivalent to the stress exerted by a tractor tyre, soil collected from beneath gorse bushes showed greater elasticity and recovery. In contrast, field soil showed poor resilience to compaction stress. Barley and spinach plants growing in soil collected close to the gorse also had greater chlorophyll content, indicative of improved nutrient (N) availability.
In conclusion, gorse can have positive effects on both soil- and crop-health, and its utility for agroforestry needs greater consideration and further research.
Funding acknowledgements: Scottish Government (RESAS 22-27: Jhi-d3-1); EU-Horizon Europe - Research and Innovation Action, 'Valorising and balancing the ecosystem service benefits offered by legumes, and legume-based cropped systems' (LegumES, 101135512).

Keywords: Soil resilience, Ulex europaeus, Plant-soil interactions, biological N fixation, Woody legumes

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4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

BARLEY-PEA INTERCROPPING ALTERS SOIL MICROBIAL FUNCTIONAL TRAITS BUT NOT CARBON USE EFFICIENCY

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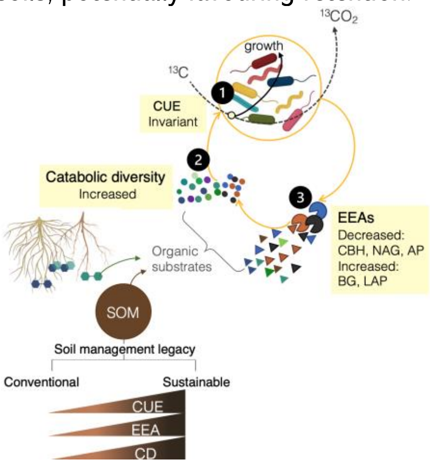
Background and objective
Intercropping can mitigate the adverse environmental impacts of conventional agriculture. Intercropping alters soil microbial communities but its effects on soil microbial functions driving key soil processes are unclear. This study examined microbial functional traits associated with carbon and nutrient cycling ¬¬– including carbon use efficiency (CUE), extracellular enzyme activities (EEA), and microbial catabolic diversity ¬¬– in barley-pea intercropping in soils with contrasting management legacies.
Methods
Barley-pea, barley-barley and pea-pea combinations were grown for 50 days in soils with a history of conventional and sustainable management under laboratory conditions. Microbial CUE , EEAs and microbial catabolic diversity were estimated using 13C isotope tracing, fluorometric assays and MicroRespTM, respectively.
Results
Intercropping did not affect microbial CUE but did increase microbial catabolic diversity and generally decrease EEAs. Compared to the average of the monocrops, barley-pea intercropping decreased the potential activities of cellobiohydrolase, b-1,-4-Nacetylglucosaminidase and acid phosphatase but increased those of b-glucosidase in the conventional soil and leucine aminopeptidase in the sustainable soil. Intercropping also altered microbial substrate utilisation profiles and increased microbial catabolic diversity. Soil management legacy had stronger effects on these microbial traits than crop combination. Regardless of crop combination, sustainable management enhanced CUE, EEAs and catabolic diversity relative to conventional management practice.
Conclusion
Barley-pea intercropping modifies the ability of soil microbial communities to decompose organic substrates while maintaining their efficiency to utilise these substrates for their growth and metabolic activities. This imply that intercropping and sustainable management practice alter the balance between the release and retention of carbon and nutrient in soils, potentially favouring retention.



Keywords: Barley-pea intercropping, Sustainable soil management, Carbon use efficiency, Microbial functional diversity, Hydrolytic enzyme activity

ID ABS WEB: 136586

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

FROM CONVENTIONAL SYSTEM TO ALLEY CROPPING AND REDUCED TILLAGE: EFFECT ON SOIL PROPERTIES AND CROP PERFORMANCES

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Agroforestry makes herbaceous and tree cultivation more sustainable and resilient (Terasaki Hart et al. 2023). Reduced tillage improves soil health and reduces the environmental impact of agriculture (Betancur-Corredor et al. 2022). However, few studies analyzed the short-term effects of switching from monoculture to agroforestry, and from ploughing to reduced tillage, on soil properties (soil organic carbon [SOC]; permanganate oxidable carbon [POX-C], available phosphorus [Olsen P], and bulk density [BD]) during the first years of conversion. The trial was performed in a sub-alkaline (pH 8.2) clay loam soil at Cesa Living Lab (Arezzo province, Italy) during two growing seasons (GS). The experimental design was a randomized complete block design with three blocks and three replicates by block. The main factor was the tillage intensity (plough tillage vs reduced tillage), while the subplot was the presence of alley cropping (none, olive (Olea europaea L.), and hazelnut (Corylus avellana L.) trees) against an herbaceous monoculture. Three different soil depths were investigated (0-5 cm, 5-10 cm, and 10-20 cm). No significant differences were reported in SOC between reduced and conventional tillage in the topsoil layers. On the contrary, a significantly lower SOC was reported in reduced compared to conventional tillage at the deeper soil layer (10-20 cm). Similar results were obtained for POX-C, as significant differences were observed in reduced compared to plough tillage at 10-20 cm soil depth but not in the top layers. As regards BD, a significant increase was detected in reduced tillage compared to the plough tillage. However, alley cropping did not significantly affect soil BD compared to monoculture. Olsen P was significantly higher in plough tillage than in reduced tillage in the 10-20 cm soil layer, while no significant differences were observed in the topsoil. In addition, a significant shift in microbiological population was observed for the tillage and cropping system. No significant differences were reported for grain yield between the cropping systems and between the two tillage intensities.

Keywords: Agroforestry, Conservation agriculture, Soil health, Crop performances, Soil organic carbon

ID ABS WEB: 136736

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

NITROGEN CYCLING IN A DIVERSIFIED ROW-CROP SYSTEM: ROTATIONAL RESPONSES, 15N TRACING AND SOIL HEALTH INDICATORS.

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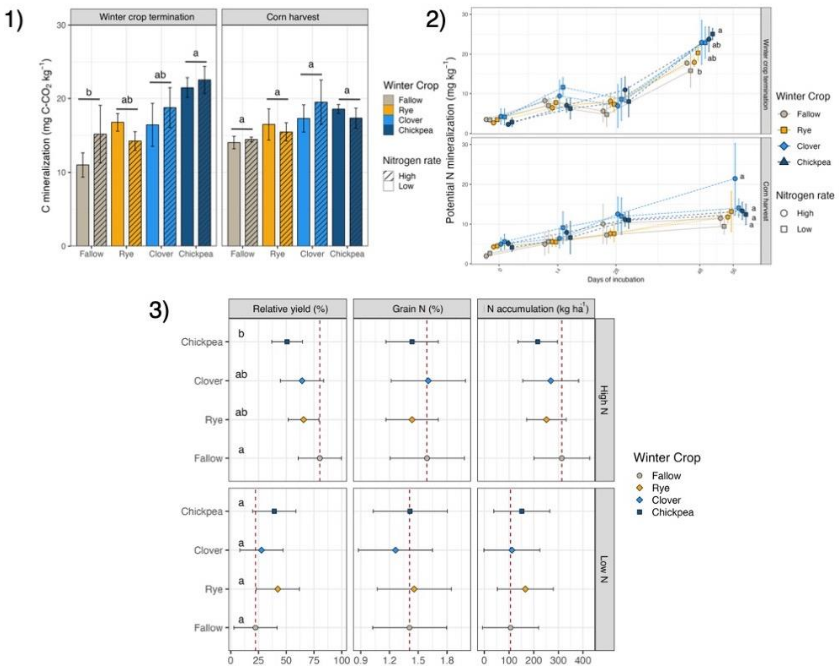
The substitution of fallow periods with a crop (cash crop or cover crop) generates crop residues that contribute to soil organic matter and soil biological activity, which could affect soil fertility and nitrogen (N) cycling. Cover crops (CCs) are often adopted in diversified agroecosystems, yet their adoption is constrained by limited profitability. A dual-purpose crop could fit as an alternative, providing the soil benefits of a cover crop while supplying farmers with income through harvest. We conducted this study in Northern Florida (United States) to investigate how chickpea (a novel cash crop in the area) affects nitrogen cycling in a corn rotation system compared to systems with CCs or a bare fallow. Four treatments were applied during winter and consisted of 1) a control (maintained weed-free with herbicides), 2) cereal rye CC, 3) crimson clover CC, and 4) a commercial variety of chickpea. After terminating winter crops (WCs), 15N-labeled WC-residues were incorporated into subplots, followed by corn planting fertilized with two N rates. Plant biomass was collected at the termination of the crops and soil was sampled after residue incorporation (WCs and corn) to assess soil health indicators, corn responses, and 15N recovery. After WCs termination, chickpea had statistically higher mineralization of carbon and N in contrast to fallow (Figure 1), with clover and rye being intermediate. In contrast, there were no statistically significant differences among WCs at corn harvest. Similarly, WCs did not increase corn yields, grain N concentrations, and whole-plant N accumulation in comparison to fallow (Figure 2). Notably, chickpea resulted in a lower relative yield than fallow at the higher N rate (Figure 2). Finally, as the recovery of 15N from WC-derived residues in corn (biomass and grain) was limited (3 to 11%), this suggests that other WC benefits, such as nutrient retention, improvements in soil health and/or microbial activity, may play a more pivotal role to the system's overall sustainability.



Keywords: cover crops,chickpea, soil health indicators, corn, dual-purpose crop

ID ABS WEB: 138083

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

EFFECTS OF DIFFERENT TYPES OF COVER CROPS AS AN ALTERNATIVE FOR CONVENTIONAL TILLAGE ON SOIL MICROORGANISMS

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Cover crops introduction in olive orchards, as an alternative for conventional tillage, involving changes in the soil's physical-chemical and biological properties. These cover crops act as a protective barrier against erosion, thereby enhancing other ecosystem services such as carbon sequestration through an increase in organic matter content, or by increasing soil biodiversity through nutrients recirculation to the soil, allowing greater bioavailability for microorganisms. Cover crop roots release sugar and amino acids, which can directly influence soil microorganism populations and biomass. Therefore, the use of different plant species in cover crops can also affect the composition of soil microorganism populations and their involvement in biogeochemical cycles. The aim of this work is to evaluate how soil management, with different types of cover crops, influences soil microbiota and their role in nitrogen cycling. A trial was performed in an intensive olive orchard of 238 trees·ha-1 on the Experimental Farm “La Chimenea” (IMIDRA), southern Madrid. There were four different soil managements: i) conventional tillage, ii) permanent grass cover (Brachypodium distachyon (L) P. Beauv.), iii) permanent spontaneous vegetation and iv) annual legume cover (Vicia ervilia (L.) Willd). Soil sampling was carried out at four depths (0-5cm, 5-10cm, 10-20cm and 20-30cm) for the analysis of specific physical-chemical and microbiological properties. Microbiological analysis consisted on extracting DNA from the soil samples and quantifying it by qPCR, determining the abundance of fungi (ITS), bacteria, and total archaea (16SrRNA), along with the amoA, amoB, and ureC genes. Preliminary results indicate that the main differences in the abundance of bacterial population happens in the depth factor, being greater at 0-5cm depth than beneath ($p<0.05$). Regarding soil management, fungal population increases under legume cover comparing to other cover crops ($p<0.05$). Likewise, the abundance of ureC is higher at 0-5cm depth ($p<0.05$). Therefore, the use of different types of cover crops as soil management measures influences the composition of soil microbiota and nutrient cycling and thus, the ecosystem services they provide.

Keywords: Olive orchards, qPCR, Nutrient cycling, Biodiversity, Soil health

ID ABS WEB: 138100

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

DOES INTRA-SPECIFIC DIVERSITY OF WHEAT IN CROPPING SYSTEM INFLUENCE SOIL FUNCTIONING AND ORGANIC MATTER IN MEDITERRANEAN REGIONS?

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Agricultural production of Mediterranean regions is forecasted to be threatened by drought. To improve the sustainability and resilience of agricultural systems it has been suggested to augment plant biodiversity to better face various stresses. In this study, we focused on intra-specific diversity, which may be increased by evolutionary Populations (EP) based on evolved plant variety mixtures and presenting a higher degree of genetic diversity than conventional wheat. EP usually show lower input needs and higher buffering capacity in response to various stresses. We hypothesised that introduction of EP in Mediterranean regions impacts soil functioning through their effect on soil organic matter (SOM) and that EP-soil relationship is stronger in similar sites than those they were let to evolve during their creation.
We conducted a field experiment in Italy (Parma and Roma). We compare a conventional wheat to two wheat EPs, in rotations with legumes. Rhizosphere soil was sampled after the EP cultivation and analysed SOM characteristics using C, N contents and SOM signatures by mid-infrared spectroscopy as well as soil microbial parameters by community characterisation using EL-FAME analysis and enzyme activities.
EP, regardless of their cultivation areas, showed no effect on the measured parameters compared to conventional wheat. Nevertheless, the result showed that the organisation of the microbial community was affected in Parma by EP that evolved in Parma-like conditions with a significantly higher Gram-:Gram+ ratio. We also observed that enzymes activities were significantly higher in both sites under EP that evolved in similar conditions. In parma, rotation with pea induced a decrease of -49 % of the aliphatic:aromatic ratio compounds in soil. In roma, a significant decrease of N content (-17 %) under cicer rotation was observed. That decrease was reduced significantly when EP were cultivated after cicer compared to the conventional wheat. Finally, we observed that SOM signature in soil was more related to soil enzyme activities (co-inertia RV: 0.70) than to microbial community (RV: 0.33).

Keywords: Plant-soil system, Evolutionnary population, Soil organic matter, microbial communities, intra-specific diversity

ID ABS WEB: 138115

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

INTERCROPPING IMPROVES SOIL HEALTH VIA SUPPRESSING SOIL-BORNE PATHOGEN

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Soil is one of the richest life ecosystems on the earth. Soil-borne diseases by fungal or bacterial pathogens cause severe damage in agricultural production. Intercropping, growing at least two crops on the same field at the same time, is one the main practices to control crop diseases. The aim of this study is to determine soil health and fusarium wilt disease in faba beans/maize intercropping.

Based on a long-term field experiment initiated in 2009, which included three P application rates (0, 40 and 80 kg P ha -1) and faba bean/maize intercropping and corresponding monocultures, in 2020-2023, physical, chemical and biological properties of soils were measured, and soil health index (SHI) was calculated using linear scoring function methods, and a minimum data set based on PCA method. Real-time quantitative PCR was conducted to measure the gene copies of Fusarium oxysporum and Fusarium solani in rhizosphere soils and root endosphere of faba bean.

Results showed that the total grain yield of maize/faba bean intercropping was 31.8% (30.5% -33.7%) greater than the weighted means of monocultures. Simultaneously, intercropping enhanced SHI by 10.2%, where average SHIs were 0.76 and 0.69 for intercropping systems and the weighted means of corresponding monocultures across three P levels. Intercropping reduced the fusarium wilt disease incidence of faba bean by 8.1%-30.3%, and the gene copies of F. oxysporum by 18.7-37.7% and F. solani by 15.4-18.4% in root endosphere, compared to monocultured faba bean. Furthermore, intercropping decreased the gene copies of F. oxysporum by 4.9%–29.9% and F. solani by 4.5%-38.9% in rhizosphere soils of faba bean. Intercropping increased bacterial richness by 17.5% and Shannon index by 10.6% relative to monoculture.

Our findings indicated that intercropping improves soil heath via suppressing soil pathogen.

Keywords: Intercropping, Soil health, Soil-born pathogen, Faba bean, Soil microbe

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4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

LONG-TERM INTERCROPPING ENHANCES SOIL ORGANIC CARBON THROUGH MULTIPLE FACETS

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Increasing plant diversity of agroecosystems, such as intercropping, may enhance soil organic carbon (SOC), especially in the long term. However, multiple facets affect soil C degradation and fixation; whether and how long-term intercropping affects SOC is largely underestimated. Based on a long-term field experiment since 2009 in Wuwei City, Gansu Province, PR China, we investigated the effects of cropping systems (maize monoculture, faba bean monoculture, chickpea monoculture, soybean monoculture, oilseed rape monoculture, faba bean/maize, chickpea/maize, soybean/maize and oilseed rape/maize intercropping) on productivity and SOC.

Long-term intercropping enhanced grain yield by 26-42% compared with the weighted mean of monocultures, which also increased root C inputs. Intercropping increased SOC by 6-10% compared with monoculture. We explore the potential effects of C protection and fixation in this experiment. The results showed that intercropping promoted the formation of >2 mm macroaggregate, and enhanced microbial functional genes related to C fixation while decreasing those related to C degradation (Geochip), improving the physical protection of soil C. We also found that intercropping improved the C-related enzyme activity, which may facilitate microbial C acquisition. Improved relative abundance of copiotrophic species (r-strategy) in intercropping, such as Cytophagales, Rhizobiales, and Gammaproteobacteria, partly promoted the accumulation of SOC. The more complex microbial network and enhanced microbial- and plant-derived necromass C also contribute to the accumulation of SOC in intercropping systems than monocultures.

In conclusion, intercropping increased productivity and SOC, which results from the improvement of soil physical structure (physical protection) and the microbial mechanisms (e.g., the relative abundance of r-strategy microbiome and increased necromass C). This study provides a theoretical basis for improving the sustainable development of agroecosystems by intercropping.

Keywords: intercropping, microbial composition, microbial functional gene, necromass C, physical protection

ID ABS WEB: 138274

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

CROP ROTATION: IMPACTS ON PHOSPHORUS COMPOSITION IN SOIL AGGREGATES AND MICROBIAL COMMUNITY STRUCTURE

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Understanding the influence of long-term crop management practices on soil phosphorus composition in aggregates and the soil microbial community is critical for linking soil microbial flora with ecosystem processes such as those involved in soil phosphorus cycling. We collected soil samples from a long-term experimental field (over 25 years) at the 0 to 20 cm depth. We investigated the effects of two crop rotation, 1. maize/maize (MM), 2. maize/fava bean (MF) compared to a control plot, undisturbed soil, (CT), on the distribution of soil P composition determined by 31P nuclear magnetic resonance (NMR), total P, inorganic and organic, and available P in different size fractions of soil aggregates (1–2, 0.5–1, 0.25-0.5, and <0.25 mm). To investigate the effects on bacterial and fungal community structure we used 16S rRNA gene and Internal Transcribed Spacer (ITS) high-throughput sequencing. The results showed that the different treatments influenced the concentrations of soil phosphate monoesters and diesters, and soil aggregate stability significantly. The MF rotation, compared to MM, increased the structural stability and the state of aggregation of the soil. Furthermore, this type of rotation increased the concentration of total organic P and, in particular, of specific forms of organic P, monoesters and diesters. The CT treatment had the highest available P and organic P proportion in total P but not more total soil P content. Furthermore, the small sized macroaggregates (1-0.5mm) showed the largest concentrations of monoesters and diesters, although in undisturbed soil the two classes of molecules are present in lower concentrations in the fractions of aggregates having the smallest dimensions (<0.25mm). The soil microbiota and mycobiota composition were significantly impacted by the different treatments. Our results suggest that long-term management practices influence the structural potential of soil microbial community and soil P turnover that varies between different sized soil aggregates. These findings provide a strong framework to determine the impact of management practices on soil P and soil health.

Keywords: Soil health,P cycling,Organic P fractions,Soil microbial community,31P NMR

ID ABS WEB: 135480

4. Soil health in achieving the Sustainable Development Goals
4.10 133439 - Soil health implications of adapting to the Planetary Health Diet

IMPROVING CROP NUTRITION IN WEST AFRICA THROUGH OPEN DATA: A STUDY OF MANAGEMENT PRACTICES AND NUTRIENT COMPOSITION OF STAPLE FOODS

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African countries have continued to address the myriad of challenges faced in the agriculture to solve its nutrition and food security challenges. We examined the relationship between agronomic management practices and crop nutritional composition of five major food crops in Nigeria and Ghana. The crops include cassava (Manihot esculenta Cranz), corn (Zea Mays), cowpea (Vigna unguiculata), rice (Oryza sativa) and green amaranth (Amaranthus viridis). The study involved 2 fields per state * 5 crops * 3 ecoregions* 2 crop varieties in Nigeria and 2 fields per region * 5 crops * 2 ecoregions * 2 crop varieties in Ghana. Plant samples were collected randomly on farmers' fields and processed for chemical nutritional analysis including ash, fat, fiber, protein, total carbohydrate, food energy value, mineral content, and tannin using methods approved by the Association of Official Analytical Chemists. Questionnaires were administered to crop producers to obtain relevant information on agronomic practices. In Nigeria and Ghana 58 and 85 % respectively reported full tillage, 15 and 13 % respectively have adopted the no-till practice, and 28 and 2 % respectively used reduced tillage. About 50 % of the farmers in both countries reported no fertilizer use while 25 -38 % used synthetic fertilizers and less than 6 - 16 % farmers used organic fertilizers. Nutrient composition varied by crop by country. Conservation farming practices such as reduced/no-tillage and the application of chemical and/or organic fertilizers were main factors driving nutrient density of these crops in both countries. Ecoregion and soil management practices played a significant role in influencing nutrient composition/density. A more nutrient-dense values were seen for crops evaluated compared to that reported by FAO. Data obtained was used to create an open and accessible nutrient database (www.afrinutridata.com) to improve information accessibility of crop nutrition and improvements in Africa. In conclusion, soil health management practices and fertilizer use have the potential to improve the nutrient densities of crops across various ecoregions.

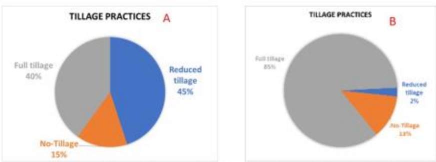
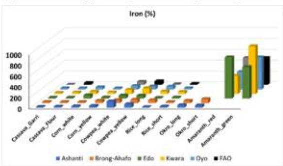


Figure 1: Percentage of sampled farmers practicing various forms of tillage in (a) Nigeria and (b) Ghana.



Figures 2: Nutritional composition-Iron (%) of (a) ash (b) crude protein (c) iron (d) zinc of sampled food crops in Nigeria and Ghana compared to reported FAO regional standards

Keywords: Nutrient density, Food security, Tillage, Ecoregion, Soil health

ID ABS WEB: 136064

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils,
the hidden key to climate change adaptation and SDGs:
challenges, threats, success stories

SOILS OF THE HIGH CENTRAL ANDES. UNVEILING A POLAR DESERT ABOVE 3500 MASL AT 33 SOUTH LATITUDE.

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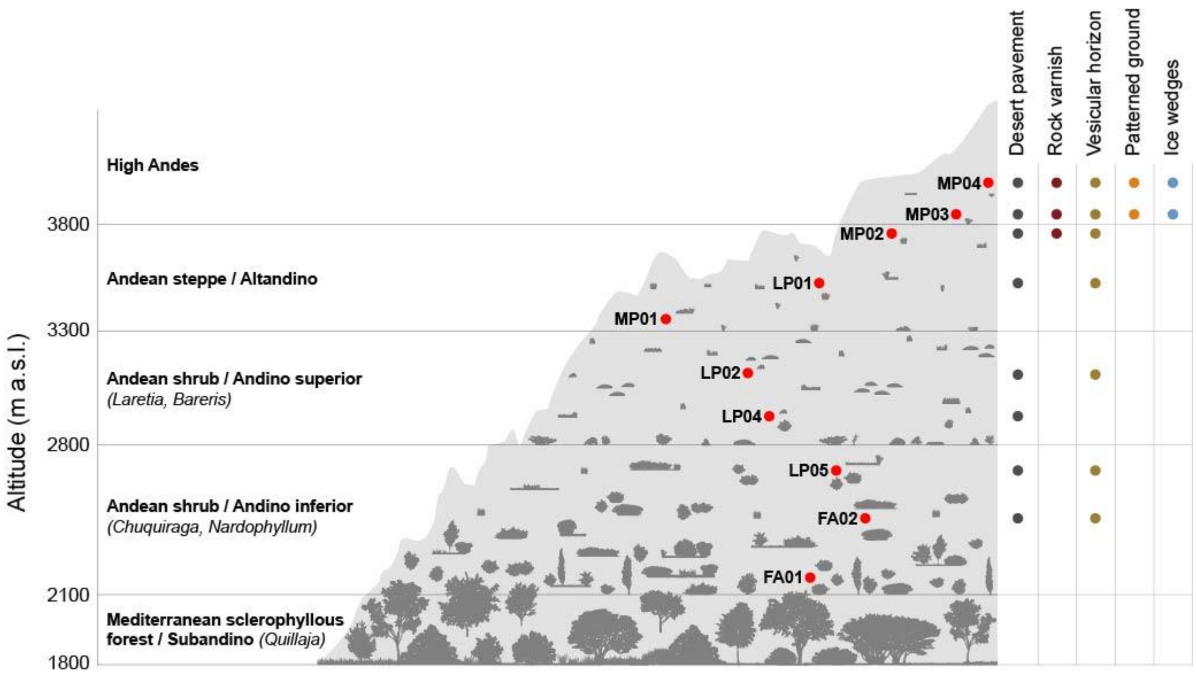
The western flank of the Andes in Central Chile holds unique significance, encompassing a thin strip of land with one of the world's few Mediterranean climates on its high summits. While the soils of the Central Depression and Coastal Range have been extensively studied, the soils of the Andes remain largely unknown. This study examines eleven soil profiles distributed across the lower Andean belt (2500- <3500 masl), the upper Andean belt (3500- <3700 masl), and the nival/desert belt (>3700 masl). Results reveal remarkable variability in soil properties and types over short distances. Along the altitudinal gradient, different drivers influence pedogenic processes. In the lower Andean belt, organisms and weathering play a primary role in forming Mollic, Cambic, and Histic horizons. The upper belt exhibits intensive illuviation, evident in the prevalence of argillic horizons. Above the plant zone, cryogenic processes dominate, leading to features like ice wedges, sorted polygons, lenticular and granular structures in depth, as well as aeolian processes resulting in desert pavement and vesicular horizons. This unique assemblage of features in the upper Andean belts resembles those found in polar desert areas of the northern and southern hemispheres, unreported outside these specific regions. The distinct characteristics of the soils and associated processes in this Andean region prompt questions about the conditions giving rise to them. This work highlights the presence of soils in areas presumed to be primarily covered by rocks, offering valuable insights into soil properties and processes in a region previously unexplored by soil science.



Keywords: Pedogenesis, Alpine soils, Polar Desert, Soil Functions, Cryogenesis

ID ABS WEB: 136069

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

POST-FIRE PHOSPHORUS ENRICHMENT PROMOTES NITROGEN RETENTION BY ATTENUATING SOIL NET NITROGEN MINERALIZATION IN BOREAL FORESTS

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Net nitrogen mineralization (Nmin) is a critical process regulating soil nitrogen (N) availability and the direction and rate of post-fire vegetation succession in N-limited boreal forests. How microorganisms respond to the post-fire N:P (phosphorus) imbalance to alter soil Nmin remains unclear, especially for boreal forest ecosystems. Here, we investigated post-fire N-P dynamics using a global-scale meta-analysis of 377 observations combined with an intensive regional-scale sampling of 17 boreal forests in the Greater Khingan Mountains (Inner Mongolia-China). We found that post-fire boreal forests had an increased risk of N loss by accelerated Nmin compared to tropical forests. The post-fire N:P imbalance created by P enrichment acts as an "N retention" strategy by inhibiting Nmin in N-limited boreal forests. This strategy is attributed to enhanced microbial N-use efficiency and N immobilization. These findings demonstrate that post-fire N-P interactions play an essential role in maintaining ecological balance and functions in boreal forests.

Keywords: Boreal forest, Nitrogen limitation, Ecological stoichiometry, Nutrient cycling, Fire

ID ABS WEB: 136129

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

ALPINE WETLAND DEGRADATION IN THE NORTHERN MALOTI-DRAKENSBERG OF SOUTHERN AFRICA: ON THE NEED FOR BASELINE RESEARCH

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The montane and alpine wetland soils of the Maloti-Drakensberg region hold immense significance as unique systems on the African continent. They play a crucial role in water regulation and provision in southern Africa, carbon sequestration and hosting unique organisms. Despite their vital role, these wetlands are rapidly deteriorating and face a critical endangerment status. However, our understanding of the causes and extent of their degradation remains limited, emphasizing the need for comprehensive baseline research. The objective of this paper is to contribute to the understanding of wetland degradation in the northern Maloti-Drakensberg and propose specific research priorities within an existing framework to address knowledge gaps. Additionally, it aims to raise awareness about the crucial importance of preserving these alpine wetlands in the face of environmental changes.
Utilizing keywords related to Alpine Wetlands in Lesotho, we conducted searches across databases and employed citation snowballing for additional publications. Our interpretations were validated through site visits and aerial/satellite imagery analysis.
While it has conventionally been believed that wetland degradation is primarily driven by livestock overgrazing within the tragedy of the commons narrative, the lack of baseline data to support this notion is alarming. It is essential to explore other potential drivers and assess their prominence, such as road infrastructure and the impact of ice rats. Several key research priorities, including measuring baseline ecological attributes, conducting socio-economic assessments of resource utilization, and monitoring temporal changes and landscape dynamics were identified in this paper. This baseline research will be the primary focus of the recently established Long-Term Socio-Ecological Research (LTSER) platform in the northern Maloti-Drakensberg, known as the Mount-Aux-Sources LTSER.
By addressing the existing knowledge gaps and advocating for the preservation of these alpine wetlands, this paper aims to contribute to the broader understanding of wetland degradation and promote sustainable management practices in the northern Maloti-Drakensberg region.

Keywords: Alpine soils, carbon sequestration, peatlands, water security

ID ABS WEB: 136173

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils,
the hidden key to climate change adaptation and SDGs:
challenges, threats, success stories

PRESCRIBED BURNING TREATMENTS DO NOT IMPACT THE MINERAL SOIL HORIZON IN THE SOUTHERN EUROPEAN ALPS

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Wildfires are ecosystem processes in the majority of terrestrial biomes; nowadays, global change is modifying their regimes. In the Southern European Alps, extreme weather conditions interact with extensive land abandonment. The high flammability of vegetation seasonally threatens the wildland-urban interface. The planning and application of prescribed burning (PB) for fire hazard reduction can serve as a strategic tool to reduce landscape flammability and mitigate the post-fire erosion often observed in steep mountain relieves.
A multi-disciplinary field experiment was performed in the Italian alpine region to test the tolerance of a Scots pine (Pinus sylvestris L.) mountain forest, and underlying soil, to the application of low and high PB intensities. Soil health (chemical-biological properties) and plant functionality (physiology and anatomy) were monitored throughout a whole year (four sampling times). In the present work, we illustrate changes detected in the soil right after PB application (within the day).
The topsoil -at the surface of the mineral horizon- experienced average temperatures of 43° C and 423° C for low and high PB intensity, respectively. Both the intensities caused a decrease in the amount of litter (Oi-Oe horizons) and in the thickness of the organic horizon (Oa). The litter also experienced clear thermal transformations, with an enrichment in lignin and condensed aromatics in the high PB-treated sites. The organic horizon did not display similar enrichments, testifying that the heat transfer was limited.
In the mineral horizon, pH, EC and plant-available phosphorus (P) hardly changed due to PB application. Soil nitrogen (N) was mostly present in organic forms, and PB lead to an increase in ammonium. After fire, no drastic changes in the composition or trophism of soil fungi and bacteria emerged, and the minor decrease in Ascomycota observed was related to seasonal fluctuations.
With these evidences, we highlight no major concerns in applying PB -even relatively high-intensity treatments- in dry conifer forests dominated by Scots pine in the Southern European Alps.

Keywords: fire, topsoil, heating, organic matter, forest

ID ABS WEB: 136312

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

A GLOBAL REVIEW ON THE BIODIVERSITY IN MOUNTAIN SOILS ABOVE THE TREELINE

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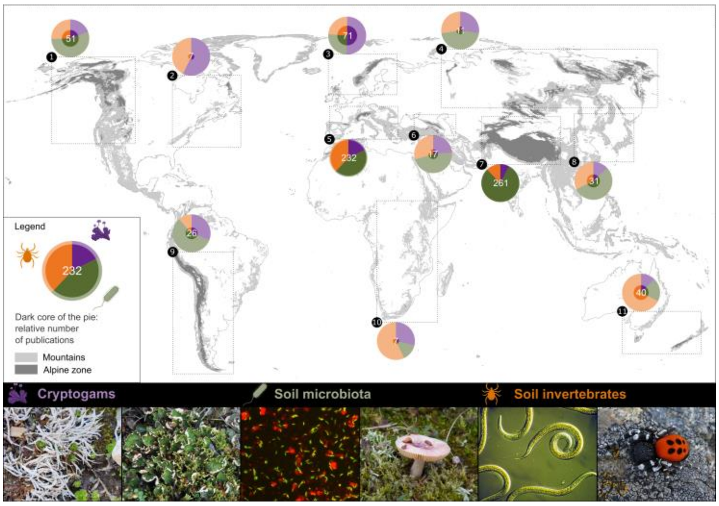
Mountain soils fulfil crucial ecosystem functions and services, also for the surrounding lowland, but little is known about their soil biota diversity. Therefore, we as working group "Mountain Soil Biodiversity" of the GMBA aim to evaluate its current state of knowledge and identify future research needs.
We performed a comprehensive literature research to collate available papers focusing on biodiversity in global mountain soils above the treeline (i.e. alpine soils) for cryptogams, soil microorganisms, and soil fauna. We assessed the paper densities of eleven alpine regions, and allocated the three main taxonomic groups within them. Further, we describe what shapes diversity distribution patterns.
Alpine soil biodiversity studies are available mainly for Central Asia and Southern & Central Europe (261 and 232 papers, respectively), followed by Northern Europe (71). Therefore, many alpine regions remain widely understudied (e.g. the Andes (26) and the Caucasus (17)). Biodiversity is still high at high elevation soils, with many specialist taxa that have developed adaptations (e.g. omnivory, life under snow, and extension of life-history) to cope with the extreme environmental conditions.
We conclude that knowledge on alpine soil biodiversity is still sparse and/or not always freely accessible, especially outside Europe and Central Asia. Therefore, with our global review we bring more attention to these sensitive habitats, as they are currently threatened by climate and land-use change, but are a relevant livelihood for many people. Our review opens research questions and gives recommendations for policymakers to better understand and preserve alpine soil biodiversity, and to include these habitats in their agendas.



Keywords: alpine soils, soil biodiversity, cryptogams, soil microbiome, soil fauna

ID ABS WEB: 136341

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

MODELLING THE EFFECTS OF THREE POST-ABANDONMENT MANAGEMENT STRATEGIES ON SOC STOCK AND WATER RESOURCES IN THE MEDITERRANEAN MID-MOUNTAINS

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Since the mid-20th century, the Mediterranean mid-mountains have been intensely marginalised, with the abandonment of rural activities. As a consequence of the advance of vegetation succession, these marginal areas have shrubbed up, with various effects on the ecosystem. On one hand, we have positive services such as the reduction of erosion, the recovery of natural ecosystems, etc. On the other, we can also find disservices such as the increased risk of fires, the loss of agro-pastoral resources or the reduction of water resources for human consumption. Soil is a fundamental agent in the regulation processes and is acquiring great relevance with regard to Climate Change due to its function as a CO2 atmospheric sink. Likewise, water resources in the Mediterranean region are mostly generated in mountain areas, Thus, the research question arises: what type of management is the most appropriate for the water resources generation and the improvement of soil quality and, specifically, its carbon storage?
In the Leza Valley, La Rioja (Spain), the government has applied over the years different management measures for different purposes in these marginal areas. This baseline situation has allowed us to compare three management strategies: i) shrub clearing and agroforestry; ii) secondary succession; and iii) afforestation. Two models were used to investigate the effects of different strategies in soil organic carbon (SOC) stock and water resources: CarboSOIL and RHESSys model. Both models allow us to run different management scenarios and IPCC scenarios (4.5, most likely, was selected). The results show that all three strategies lead to an increase in the SOC stock 100 years into the future, with afforestation being of great relevance. Water flow can be increased by up to 1.52 hm3 (9% monthly) when shrub clearing is applied and by up to half of this value if climate predictions are considered. These findings contribute to comprehending the soil carbon and water trade-offs in Mediterranean mountains, offering valuable insights to tailor restoration plans.

Keywords: SOC storage, Water resoruces, Mediterranean mountains, Soil quality, Post-abandonment management

ID ABS WEB: 136478

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

SOIL-PLANT INTERACTION AND ECOSYSTEM SERVICES ALONG THE PASTURE-FOREST TRANSITION IN THE ITALIAN ALPS: AN INTERDISCIPLINARY APPROACH

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Land-use affects the critical zone, impacting the soil-plant system and related ecosystem services. The ABRESO project (Belmont Forum, CRA Soils 2020) investigates case studies of land-use change across five countries worldwide employing an interdisciplinary approach. In the case study of the Tesino Plateau (Eastern Alps, Trentino Alto Adige, Italy) socio-economic drivers of landscape change are mainly determined by land-use and abandonment cycles in response to economic and demographic pressures. Satellite data, orthophoto time series and available maps are used to study the spatial landscape changes, with particular emphasis to semi-natural grassland invasion by forest trees induced by abandonment of traditional agropastoral practices. We investigate the effects of pastures abandonment on soil-plant interaction along a transition from extensive pasture to P. abies forest, with an advancing P. abies belt. This transition was chosen as representative sub-area for ground-based investigations. Soil physical, chemical and biological properties, plant biodiversity and leaf functional traits, concentration and stable isotopes of C and N in the soil-plant system were determined. Our results reveal differences in adapting ecological strategy, resource-use efficiency and leaf economics spectrum between pasture and forest species. Managed pasture is characterized by a larger inter-specific variability in leaf functional traits, suggesting the co-presence of species with both acquisitive and conservative traits able to rely on different resource-use strategies, aligning with the niche complementary hypothesis. This alpine landscape shows high soil C concentrations (~10% at 0-10 cm depth) highlighting its potential in terms of C stocks and climate change mitigation. Pasture differs from forest in soil aggregate size and stability, N concentration and C:N ratio in soil and plants, soil enzymatic activities and microbial biomass C. These divergences highlight the impact of the pasture-forest transition on biogeochemical cycles, soil fertility and related ecosystem services. Cultural ecosystem services and stakeholders' perceptions and preferences were evaluated through socio-economic survey. Crossing natural science with socio-economic findings contributes to sustainable soil management in this alpine environment

Keywords: Soil-Plant Interaction, Ecosystem Services, Land-use change, Italian Alps, Interdisciplinarity

ID ABS WEB: 137205

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

INFLUENCE OF ENVIRONMENTAL FACTORS ON MICROBIAL AND ENZYMATIC ACTIVITY IN SOILS CULTIVATED WITH GUAVA IN SANTANDER, COLOMBIA

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The common guava crop (Psidium guajava L.) in Colombia is of great socioeconomic importance for many farming families; this fruit is used for fresh consumption and agroindustrial processing. In the present investigation, the effect of remote environmental variables (edaphic, climatic, NDVI and altitude) on microbial activity (SAM) and dehydrogenase in soils cultivated with guava and located in three municipalities of the department of Santander (Colombia) was determined. The SAM was evaluated by measuring the absorption of CO2 emitted by the microorganisms, taking four readings every 24 hours, while the enzymatic activity was determined using soluble tetrazolium salts as artificial electron acceptors. Edaphic covariates were obtained from digital layers of density, silt, clay, fragments, pH, CEC and N downloaded from the SoilGridsTM 2.0 platform (ISRIC, 2023); covariates related to quarterly precipitation volume were generated by interpolation of a raster surface using the kriging method of ArcGIS® Pro 2.9 software. 0 (ESRI), using data series from the period between 1980 and 2011 provided by AGROSAVIA, while the calculation of the normalized difference vegetation index (NDVI) was obtained from the processing of a multispectral raster of the study area captured by the Landsat 8 satellite on the platform of the U.S. Geological Survey - USGS (2023). An exploratory analysis of the data was performed using MANOVA and factorial ANOVA with Tukey's 5% test and the multivariate technique of Redundancy Analysis (RDA) was implemented to evaluate the importance of the explanatory variables on the response variables. The results revealed that both the individual factors (reading time and municipality) and their interaction had a significant effect on SMA. In addition, redundancy analysis (RDA) showed a significant effect (<0.05) of silt fraction, pH and quarterly precipitation from December to February (DJF) on SAM and dehydrogenase.

Keywords: Psidium guajava L., Soil health, Smallholder agriculture, Agroindustry, Redundancy analysis

ID ABS WEB: 137699

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

A TREE LINE SHIFT EFFECTS ON SOIL CARBON CONTENT AND STOCK

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Information on the effect of tree line shift on soil carbon (C) cycling is needed to predict the consequences of global climate change. Soil C content and C stocks may respond differently to environmental factors altered by tree-line shift. The study focuses on the assessment of C content and C stock in topsoil along mountain slopes from forest to meadow (0.1 km transects) in reserved and grazed sites of the Northwest Caucasus, Russia. In forest, meadow and their border – tree line of each slope, three points were randomly selected for soil sampling at 0-10 and 10-30 cm depth (108 samples in total). Soil C content of topsoil and subsoil increased 1.1-1.5 times from forest to meadow for both land use types, while soil C stock didn't differ significantly (p=0.9 and 0.2 for reserved and grazed sites). The rate of decomposition of soil organic matter (basal respiration, BR) varied with soil C content (r=0.8 and r=0.6 for reserved and grazed sites, respectively). The relationship between soil BR and C stock was negative and weak (r=-0.25 and r=-0.38). Thus, soil C content rather than C stock determined the rates of soil processes related to soil organic matter decomposition. The temperature sensitivity of soil organic matter decomposition (Q10) and specific respiration (BR:C) didn't vary significantly along the forest-meadow transects. Thus, the tree line shift in the Northwestern Caucasus decreased soil C content, but did not affect C stocks, specific respiration and temperature sensitivity of soil organic matter decomposition.
The research was supported by Russian Science Foundation 22-74-10124.

Keywords: Mountain, Soil carbon, Soil microbial activity, Q10

ID ABS WEB: 137738

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

INFLUENCE OF EXTENSIVE MOUNTAIN GRASSLAND MANAGEMENT IN A CLIMATE CHANGE SCENARIO

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Assessing plant-soil ecosystem reactions to climate variability is mandatory for developing more sustainable management approaches aiming to enable both climate change adaptation and mitigation, especially in mountain areas. The main goal of the present work is to assess the impacts of both climate change and land use on the plant-soil system in extensive grasslands in terms of biodiversity and soil-related functions (e.g., carbon sequestration).
To simulate climate change, ten sites (5 meadow and 5 pastures) were identified along an elevational gradient in Trentino Alto Adige, North of Italy, and, in each site, both topsoil (0-15 cm) and plant samples were collected.
Soil samples were characterized for physical (e.g., texture, density) and chemical (e.g., pH, EC, organic carbon, total nitrogen, available phosphorous, major and trace elements, mineralogy) parameters, as well as for biological activities (by enzymatic assays, including FDAH, urease, phosphomonoesterase). Moreover, the functional traits of the 10 most abundant plant species (i.e., 70% of total cover) were measured, including different functional traits, which together describe plant physiology and leaf structure (e.g., specific leaf area, leaf dry matter content).
Preliminary results show higher concentration of organic carbon, total nitrogen and enzymatic activities in pasture compared to meadow, thus suggesting a much higher influence of soil management than climate, while plant physiology and leaf structure showed intra- and inter-specific differences with respect to both soil management and climate/altitude. Thus, the present study underlines how the resilience of extensive mountain grasslands needs to be investigated considering the soil-plant system as a whole.

This study was carried out within the PNRR research activities of the consortium iNEST (Interconnected North-Est Innovation Ecosystem) funded by the European Union Next-GenerationEU (Piano Nazionale di Ripresa e Resilienza (PNRR) – Missione 4 Componente 2, Investimento 1.5 – D.D. 1058 23/06/2022, ECS_00000043). This abstract reflects only the Authors' views and opinions, neither the European Union nor the European Commission can be considered responsible for them.

Keywords: grassland, climate change, mountain ecosystem, ecosystem services, soil organic matter

ID ABS WEB: 138023

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

APPROACH TO THE DETERMINATION OF PHYSICAL PROPERTIES AND POROSITY OF MOUNTAIN SOIL THROUGH SEM IMAGE ANALYSIS AND NMR ANALYSIS

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Mountain soils are characterized by greater fragility and vulnerability to climate change. The relationship between porosity, permeability, and the physicochemical interactions of soils with water are fundamental properties regulating their flows and hydrological capacities. In this study, 12 volcanic soils from a mountain grazing area in the central-southern Apennines were analyzed. The purpose of this work is to assess how the changes in thermopluviometric regimes influence the physicochemical processes associated with the movement of water and the type and pore distribution. Porosity was estimated using Digital Image Analysis (DIA) through the processing of soil thin sections of small aggregate acquired via scanning electron microscopy (SEM). 2D image reconstruction was conducted using both secondary electron and backscattered electron images allowing a porosity estimation with the Image J program. Additionally, hydrological connectivity within the soils was determined using the Fast Field Cycling (FFC) Nuclear Magnetic Resonance (NMR) relaxometry technique. The image analysis allowed the evaluation of pore sizes with diameters ranging from 2 to > 200 μm. The following types of pores were also obtained: rounded, elongated and intermediate. Preliminary results revealed three class of pore. A prevalence of pores (90-95%) in the smaller elongated size range, ranging from 2 μm to 15 μm with high microporosity and asymmetric pore structure. Rounded, intermediate, and large pore was observed between 50-200 μm. Similarly, NMR analyses of the soils confirmed three class of water molecule mobility, corresponding to the major dimensional categories of porosity estimated with DIA. The combination of SEM-EDS and free software proved to be a powerful tool for soil pore size characterization that was related with water affinity measured with NMR.

Keywords: -Mountain soil,-Porosity,-SEM analysis,-NMR relaxometry technique,-Climate change

ID ABS WEB: 138313

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

SMALLHOLDER INDIGENOUS AGROFORESTRY SYSTEMS IN THE NE MOUNTAINS OF TANZANIA: A PROMISING FUTURE FOR ECOSYSTEM SERVICES AND SOIL HEALTH

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Smallholder indigenous agroforestry systems are important components of agricultural landscapes in tropical mountains. These farming systems are important in sequestering carbon and enhancing soil fertility. However, their salient features and their potential are poorly understood and inadequately studied. Regarding the salient features, only a few studies have been undertaken focusing on the tree layer in particular the native tree species which have a multifunctional role. To better understand the nexus of multilayer smallholder indigenous agroforestry-soil-ecosystem services, our study evaluated and compared four different smallholder indigenous agroforestry systems in the NE mountains of Tanzania.
We analyzed the salient features, soil organic carbon stocks and soil fertility (proxied by effective cation exchange capacity). Results indicate that all the studied systems are multi-layered with three or four vertical layers and notable differences in their structure, composition, and diversity. The findings regarding the reported provisioning of ecosystem services (ES) show that increasing resilience and restoring the native tree species of the agroforestry systems can only be successful if knowledge of the ES potential of native species is increased, and interventions are tailored to each system’s ES needs with regard to conservation and livelihood. Our findings demonstrate further that the smallholder indigenous agroforestry systems studied have a higher capacity to sequester soil organic carbon and potential for soil fertility. The multifunctionality of the indigenous agroforestry systems regarding the number of ES and the largest amount of carbon stocks in the soil contribute to the global consensus that indigenous agroforestry systems are an important strategy for climate change mitigation and adaptation. Therefore, the systems can make the smallholder agroecosystem landscapes resilient to climate change and livelihood.

Keywords: Agroforestry ,Mountainous soils, Soil fertility, Excosystem services, Tanzania

ID ABS WEB: 135694

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

THERMODYNAMICS OF NICKEL ADSORPTION FROM AQUEOUS SOLUTION ONTO HUMIC ACIDS EXTRACTED FROM PRE-OXIDIZED LOW-RANK COALS

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The potential of low-rank coals (LRCs) in remediation of heavy metals-contaminated environments has been attracted more attention recently. Nevertheless, the LRCs generally yielded a low content of humic acid (HA) with low polarity. Therefore, there is necessary to activate them. Pre-oxidation is the most frequently used methods to do this. Further, thermodynamic studies on adsorption of heavy metals provide insights into adsorption mechanisms to modify and optimize the performance of adsorbents. In this study, three purified HAs extracted from Yazd LRC including: unoxidized (UOHA), oxidized with acidic 10% H2O2 (OHAH2O2), and oxidized with two acid mixture of 3:1 H2SO4:HNO3 (OHATAM), were used. The chemical characteristics of the produced HAs were determined. The batch adsorption experiments of Ni2+ from solutions containing 0.05 to 0.35 mmol Ni L-1 on HAs were conducted with two replications at three pH levels and four temperatures. Then, the Freundlich isotherm parameters (KF and N) were determined. Furthermore, by drawing qe/Ce vs. qe, the distribution coefficient values (Kd) were obtained for a dual-site Langmuir model. Finally, the thermodynamic parameters (deltaH°, deltaS° and daltaG°) were calculated from the plot of lnKd values vs. 1/T. The yield, the content of carboxyl groups and the E4/E6 ratio of the produced HAs increased after pre-oxidation process. The mean values of KF for UOHA, OHAH2O2 and OHATAM were 61.64, 71.44 and 96.65 L kg-1, respectively. Pre-oxidation of LRC significantly reduced the adsorption intensity of low energy sites and increased that of high energy ones. The mean values of deltaH° for the unoxidized and oxidized HAs were 8.79 and 17.63 kJ mol-1, respectively. Furthermore, the mean values of deltaS° for the unoxidized and oxidized humic acids were 75.19 and 104.10 J mol-1°K-1, respectively. The value of deltaG° for all adsorption data (except OHATAM at pH 3 and 4) was -13.30 kJ mol-1. Despite the effectiveness of pre-oxidation treatment, unexpected results were observed with increase in pH and temperature due to OHATAM dissolution.

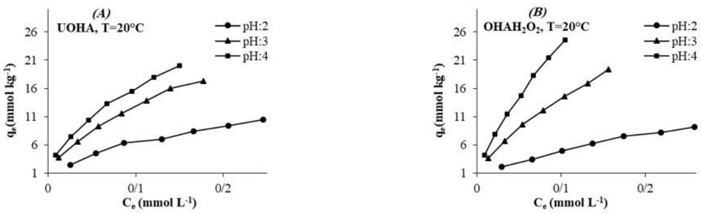

Figure 1. Adsorption curves of Ni(II) onto unoxidized humic acid (UOHA) (A) and H_2O_2-oxidized humic acid (H_2O_2OHA) (B), at various pH and 20°C.

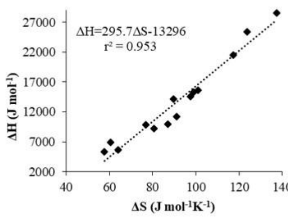

Figure 2. Relationships between enthalpy (ΔH) and entropy (ΔS) for the adsorption of Ni(II) onto two sites of all humic acid-based adsorbents studied (except OHATAM at pH values of 3 and 4).

Keywords: Distribution coefficient,Dual-site Langmuir model,Freundlich isotherm,Humic acid dissolution,Humic acid yield

ID ABS WEB: 135900

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

PROJECTED IMPACTS OF CLIMATE CHANGE ON RAINFALL EROSIVITY IN NORTHEAST OF IRAN

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Soil erosion is one the major factors affecting land degradation Modeling these effects is performed using different indices among which the rainfall erosivity index is widely used which is based on rainfall intensity and energy. Global warming and climate change cause significant consequences in rainfall amount and intensity pattern especially from extreme event point of view. The current study was performed aiming investigation the effects of climate change on rainfall erosivity index in northeast of Iran (Khorasan provinces) under RCP 4.5 and RCP 8.5 scenarios, using data of a network consisting 17 synoptic stations and 25 rainguages. Due to lack of rainfall intensity data for calculating R index, the widely accepted Fournier index (F.index) was chosen and used. The past and future period projections of rainfall (i.e. hindcasting and forecasting) of CanECM2 model downscaled by CanRCM4 regional model and also EC-Earth model till 2100 were retrieved and Fournier index was calculated using these datasets. The relation between observed and hind cast rainfall data were worked out and used for correction of future projections. The obtained values were applied for modified Fournier index calculation. The trend of these values was also examined in different time periods for each station. During the baseline period, the trend of F.index was decreasing in most of the stations. The F.index values showed higher sensitivity to rainfall amounts changes in north, northwest and western regions of Khorasan Razavi province. The future projections for synoptic and rain gauges observations were obtained from two different climate models which showed slightly different results in different regions and time periods. In general, in most of the central and southern parts of Khorasan provinces, the Fournier index showed an increasing trend in future, but in northern stations of Ghouchan, Bojnord and Golmakan a decreasing trend was observed. Further studies using other model and scenarios is recommended.

Keywords: Erosion, Rainfall, Fournier index, Climate Change, Scenario

ID ABS WEB: 136081

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

THE IMPACT OF VARIABLY LAYERED AND TEXTURED TOP SOILS ON THE PERFORMANCE OF RECLAIMED SANDY LAND

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China's arable land resources are extremely scarce due to huge population, and reclaiming degraded land is effective way to increase arable land. The Mu Us Sandy Land (MUSL) is an important resource that can be partially cultivated into new arable land. Owing to scare clay and silt particles and limited water and nutrients retention capacity, plant growth in sandy land is strongly restricted. In recent decades, various materials and methods have been adopted to improve the sandy land structure. However, challenges are still faced in searching for cheap and convenient methods to reclaim sandy land. The objective of this study was to evaluate the effect of reconstructed soil texture and layering on plant available water and consequently on plant productivity for reclaimed sandy land. Soft rock and sandy loess were used as the reclamation top soils, as well as a mixed soil with an optimized ratio of 25% soft rock and 75% sandy loess. Five layered profiles, including 30-cm soft rock (SR-S), 30-cm sandy loess (SL-S), 15-cm soft rock and 15-cm sandy loess (SR-SL-S), 15-cm sandy loess and 15-cm soft rock (SL-SR-S), and 30-cm mixed soil (MS-S) overlying 60-cm sandy soil, respectively, were packed into columns for the lab experiments of infiltration, drainage, evaporation and alfalfa growth. The available water holding capacity (AWHC) was used to identify soil water regime, while the dry biomass was used as the index of alfalfa productivity. The soil hydraulic parameters for four soils were calibrated and validated using the measured values and Hydrus-1D model was used to determine AWHC for each layered profile. The measured and simulated results indicated that AWHC values were larger for SR-S and MS-S treatments than for rest treatments, while the values of alfalfa productivity were in the order MS-S>SR-SL-S>SL-SR-S>SR-S>SL-S. The comprehensive results showed that the presence of 30-cm mixed soil overlying sandy soil would provide effective reclamation prescription to increase AWHC and plant productivity for sandy land.

Keywords: Reconstruced soil, Sandy Land, Reclamation, Layered soil, AWHC

ID ABS WEB: 136089

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

INTEGRATED MANAGEMENT OF FARMLAND SALINITY BARRIER UNDER WATER SAVING CONDITIONS IN THE HETAO PLAIN, CHINA

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The Hetao Plain in Ningxia, China is a region with prominent soil salinization problems in irrigation areas of western China. Water-saving demand in agricultural production makes soil salinity problem more complicated.
Field experiments of film mulching and interlayer measures were conducted in saline-alkali farmland and results showed, application of film covering increased soil moisture content of 0-10 cm by 120% compared to CK, while the soil EC was 39% lower. The interlayer measure at a depth of 40-50cm can also effectively increase the soil moisture of cultivated layer while suppressing soil salt accumulation. Compared to the traditional salt control measures, the combination of plastic film and composite barrier layer mixed with straw and water retaining agent can effectively block the upward movement of soil salt in the bottom layer and inhibit salt accumulation. At the same time, it can improve the moisture content of the cultivation layer throughout the entire crop growth period, increase soil moisture, reduce soil salinity barriers, promoting crop growth and productivity.
Field experiments of optimizing tillage and organic conditioning were carried out in saline alkali farmland and the results show, powder ridge tillage not only breaks down the hard and compacted soil in saline alkali farmland, but also makes soil particles fine and uniform, increases soil pores, and is conducive to forming a good aggregate structure. Under the conditions of powder ridge cultivation, the addition of organic materials can promote the strengthening of soil particle adhesion and effectively improve the stability of aggregates. Compared with traditional rotary tillage, the powder ridge tillage method effectively increases the proportion of larger aggregates in the soil, while the application of organic conditioning agents increases the content of larger aggregates. The combination of powder ridge and organic fertilizer application measures promotes salt leaching, inhibits the capillary rise of salt, effectively reduces soil salinity in the 0-40 cm layer, and has a significant effect on reducing severe salt alkali barriers.

Keywords: Salt-affected land, Remediation of soil salinity, Management of saline land, Straw interlayer, Optimizing tillage

ID ABS WEB: 136324

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

ARSENIC IN SOILS AND GROUNDWATER OF LOWER COURSE OF TRUJACA RIVER VALLEY

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The history of gold and arsenic exploitation in Zloty Stok began around the 13th century. Hundreds of years of ore mining and processing have resulted in significant contamination of water and soils with arsenic. Previous studies of Zloty Stok area were focused only in the upper part of the Trujaca river valley, where adits and ore processing facilities were located. In this study, we collected 14 soil samples along the river within the distance of 1500 m (in a straight line), in the lower course of the river. The samples were collected from the depth 0-15 cm. The pseudototal concentrations of As were determined by ICP-MS after microwave digestion in aqua regia. Potentially available forms of As were extracted from soil with 0.05 M EDTA, and actually soluble As species – with 1 M NH4NO3. The maximum As concentrations, that exceeded 8400 mg As kg-1, were found in the closest vicinity of tailings impoundment, in the upper part of the area. Those concentrations tended to decrease towards the mouth of the river, where they dropped to 1240 mg As kg-1. The percentage of easily soluble forms of As was generally low, below 1%. However, analysis of potentially soluble forms of As showed that up to 80% of the total As can be mobilized. In addition, the concentrations of As and its speciation: As (III) /As (V) /MMA / DMA, were determined in groundwater collected from five piezometers installed close to the river. For As speciation in water HPLC/ICP-MS technique were used. The maximum concentrations of As in groundwater was 225 ug L-1 and exceeded permissible limit for drinking water (10 ug L-1). In all piezometers, As (III), As (V) and DMA were detected. This fact indicates that As present in the soils and water under study can pose a high risk to living organisms and to the environment.

This research was supported by the National Science Centre of Poland (2021/05/X/ST10/00680).

Keywords: arsenic, historical mining sites, contamination, soil, groundwater

ID ABS WEB: 136333

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

SOIL AND WATER CONSERVATION AND ECOLOGICAL CONSTRUCTION ON THE LOESS PLATEAU

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The Loess Plateau region, covering 640,000 km2 and supporting 115 million people, experiences the most severe soil erosion in China. The efforts of soil and water conservation on the Loess Plateau can be summarized into three distinct stages: (1) control and disaster mitigation (1949–1980), (2) comprehensive management (1980–2000), and (3) ecological construction (post–2000). Main research achievements of soil and water conservation on the Loess Plateau are as follows: (1) sloping cultivated land was the primary source of human-induced soil erosion; (2) some strategies were proposed for the territorial rectification, such as 28-character strategy; (3) a theoretical and technical system for vegetation construction and restoration, a physical demonstration model for soil and water erosion control, a model for the reconstruction of degraded ecosystems, and a new model of rural revitalization based on ecological agriculture were established; (4) a scientific and technological support for the national policy of converting cultivated land back to forests and grasslands was provided; (5) the main sand-producing areas and the contribution of various measures to sand reduction was clarified. Over the past six decades, there has been a significant transformation on the Loess Plateau: (1) the vegetation index increased; (2) the sediment concentration in the Yellow River decreased; and (3) the per capita GDP increased. Therefore, compared with the past, there are greener mountains, clearer water, and wealthier people now on the Loess Plateau.

Keywords: The Loess Plateau,Soil and water conservation,Ecological construction

ID ABS WEB: 136393

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

EFFECTS OF PYROPHYLLITE APPLICATION ON THE CONTENT OF HEAVY METALS IN LETTUCE (LACTUCA SATIVA VAR. SHANGORE)

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The contamination of soil with heavy metals is currently a major issue in agriculture, significantly limiting the possibility of producing safe and healthy food on such land. As a result, the remediation of contaminated soil is becoming increasingly crucial. In recent years, numerous studies have been conducted with the aim of finding suitable techniques to remove heavy metals from the soil, reducing their levels to a point that poses no threat to the environment and human health. The use of aluminosilicate material - pyrophyllite emerges as a potential agrotechnical measure in the remediation of soil contaminated with heavy metals.
The objective of this study is to determine the effectiveness of pyrophyllite in immobilizing heavy metals (lead, copper, nickel, cadmium, chromium, cobalt, manganese, iron, and zinc) and its impact on the content of essential plant nutrition elements (phosphorus, potassium, calcium, and magnesium) in both the leaves and roots of lettuce (Lactuca sativa L. var. Shangore). The results indicate that there was no statistically significant effect of pyrophyllite on the presence of plant nutrition elements, but there was a significant reduction in the levels of cadmium, manganese, iron, and zinc in lettuce.

Keywords: heavy metals,pyrophyllite,remediation

ID ABS WEB: 136404

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

EEFECT OF HURRICANES IN THE SOILS OF HONDURAS

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Major hurricanes and tropical storms have affected Honduras throughout its history. In recorded recent history the ones occurring in 1934, 1954, 1974, 1998 and 2020 have affected severely the soils of the country and their potential to sustain biomass generation and storage. As deforestation, cultivation on slopes with >4% gradient take place severe soil erosion and sedimentation occurs. Soil erosion rates can be in the range of 34->300 MT/ha during hurricanes (as estimated during ETA and IOTA hurricanes) and sedimentation of flood plains can reach 2 m. The effect on soil physical properties is erosion of top soils on slopes, burial of top soils in flood plains, loss of soil structure and porosity, alteration of the drainage patterns and decrease in microorganism activity, On the chemical properties, in general there is a decrease in soil pH. Cation exchange capacity, organic matter content, Ca, Mg, K and P. The impact on micronutrient content has not been clearly determined, but there is the tendency of and increase on Fe and Mn. It has been estimated that the cost of soil rehabilitation in the aftermath of these events ranges between $20,000-35,000/ha. Rehabilitation practices include removal of sediments, liming, increase in fertilizer, crop rotation, organic matter addition (20-30 MT/ha) and deep tillage. A National Soil Conservation Program is vital for the rehabilitation and sustainability of the soils of Honduras.

Keywords: Hurricanes,Soils,Effect,Honduras

ID ABS WEB: 136415

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

A MODEL FOR PREDICTING TRACE ELEMENT ACCUMULATION IN SOILS – VALIDATION, SENSITIVITY, AND USE IN EXPLORING INTERNATIONAL TRACE ELEMENT FLOWS

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Most productive land receives some application of trace element (TE)-containing soil amendments to aid production (e.g., fertilisers, pesticides, composts). TEs may be present in amendments as active ingredients (e.g., Cu-fungicides) or as impurities (e.g., Cd in superphosphate). Over time, TEs may accumulate in soils and exceed threshold levels, resulting in reduced soil fertility, and potential endangerment to food safety and the health of humans and ecosystems on which multiple Sustainable Development Goals depend (including SDG2: zero hunger, SDG12: responsible consumption and production, SDG15: life on land, and others). Simple and robust tools are needed to determine the rates of TE accumulation and inform judicious amendment application rates. We have developed a mass-balance model that uses easily parametrised input variables to produce accurate estimates of TE accumulation rates in soils. This model is not specific to any given environment, production system or individual TE, and therefore is globally applicable. To verify this, we have validated the model with data from long-term field trials and have run sensitivity analyses for a range of TEs with varying input scenarios and climate conditions. This model has been applied to oil palm plantations in Indonesia, an intensive production system on soils with naturally low nutrient levels. Our modelling has shown that soil concentrations of F and Cu can be expected to surpass threshold levels for phytotoxicity within ten years given current management practices. These findings may help to explain the high Cu concentration that is found in palm kernel expeller, a palm oil by-product, that is exported as a supplementary stockfeed. The Cu concentration of palm kernel expeller has been noted by New Zealand's dairy industry, which utilises a substantial amount of this product. Management practices therefore need to account for the import of this TE to dairy systems. This case study provides an example of how this mass-balance model can be used to explore TE fluxes in agricultural systems, and cross-boundary TE flows.

Keywords: contaminants,heavy metals,mass-balance model,oil palm,sustainability

ID ABS WEB: 136467

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

ENERGETIC CROPS AND COMPOST FOR THE RECLAMATION OF CONTAMINATED SOILS FROM A MARGINAL URBAN AREA IN TARANTO (ITALY) BY PHYTOREMEDIATION: CHEMICAL AND MICROBIOLOGICAL SOIL QUALITY IN EX-SITU POT TRIALS

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Phytoremediation represents a highly important strategy for the enhancement and extensive management of contaminated sites. The facilities employing these technologies offer various ancillary benefits, such as employment opportunities, non-food agricultural production, urban renewal, and the creation of ecological protection areas, which compensate for the typical decontamination slowness. The plant species choice and soil preparation play a crucial role in influencing the rhizosphere ability to retain (phytostabilization), degrade, and remove (phytoextraction) contaminants. The use of amendments, compost, or manure can alter the solubility of contaminants, support microbial activity, and promote plant growth. Positive interactions between plants and soil microbiota are known to enhance nutrient uptake and improve tolerance to stress caused by pollutants.
In this study, Brassica juncea and Sorghum bicolor, energy crops employed in biomass production, were tested in ex-situ pot trials to assess the remediation potential of soil contaminated with polychlorinated biphenyls (PCB), heavy hydrocarbons, polycyclic aromatic hydrocarbons (PAH) and trace elements (Cu, Sn, Pb and Zn). Two different compost amendments were tested as biostimulant conditioners. At the end of the trial, the effect of different plant and compost combinations on pollutant removal, soil biochemical indicators, microbial composition, and biomass production were evaluated.
The results highlighted that adding compost increased the biomass of both plant species, although it slowed down the degradation of heavy hydrocarbons. Moreover, compost addition partially improved microbial biomass carbon (MBC) and altered soil microbiota composition and diversity, especially favoring Sphingomonadaceae and Nocardioidaceae to the expense of Bacillaceae. Finally, the presence of compost promoted the biomass yield of Sorghum, indirectly contributing to higher absolute removal and translocation of Pb and Cu.
Experimental evidence indicated that the choice of plants and the use of amendments have a significant impact on soil quality and microbial communities, as well as on the overall success of the phytoremediation, since it heavily relies on economic (biomass) and social outputs as the soil remediation per se is extremely time-consuming.

Keywords: Phytoremediation,Persistent Organic Pollutants,Potentially toxic elements,Soil microbiota,Biomass crops

ID ABS WEB: 136555

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

ENVIRONMENTAL PERSISTENCE AND FATE OF NEONICOTINOIDS INSECTICIDES IN BELGIAN AGRICULTURAL SOILS

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With the intensification of agricultural practices including the use of insecticides, a large proportion of pollinator species have seen their population decrease for a few decades. Thus, it is important to identify the underlying mechanisms of this pollinator decline for conservation purposes and maintaining healthy ecosystem services. Among common insecticide, neonicotinoids are high toxicity products for invertebrates that represented a 25% share of the global insecticide market in 2010. Due to their remanence and extended persistence in the soil, neonicotinoids pose a strong lasting risk for the ecosystem. Our project aims to assess the occurrence and persistence of neonicotinoids in the soil and identify the environmental factors that control neonicotinoids dynamics at the landscape scale. We measured concentrations of seven molecules of neonicotinoids in the top 30 cm of soils along different agricultural landscapes and crop rotations, in 83 samples representing 45 crop sites in Belgium. Our results showed concentrations of clothianidin and imidacloprid >0.5 ng kg-1 for 72 and 52% of samples measured, respectively, and up to 16.3 and 6.4 ng kg-1, respectively. Highest concentrations were found in beet and vegetables-legumes rotations. Surprisingly, both compounds were detected (i.e., >0.2 and >0.4 ng kg-1, respectively) in ca. 50-60% of grassland soil samples. Highest concentrations were not especially reached for samples where beet was recently grown. These results will allow further modeling of the assessment of potential pressures on pollinators using landscape and crop rotation data in Belgium. This work has the intent to better understand the trajectory of neonicotinoid-based insecticides within landscapes and to greatly contribute to future conservation and agricultural landscape decisions in Belgium.

Keywords: Neonicotinoids,soil,landscape,dynamics,pollination

ID ABS WEB: 136569

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

DESTRUCTIVE IMPACT OF MILITARY ACTIONS ON THE CHERNOZEMS OF UKRAINE

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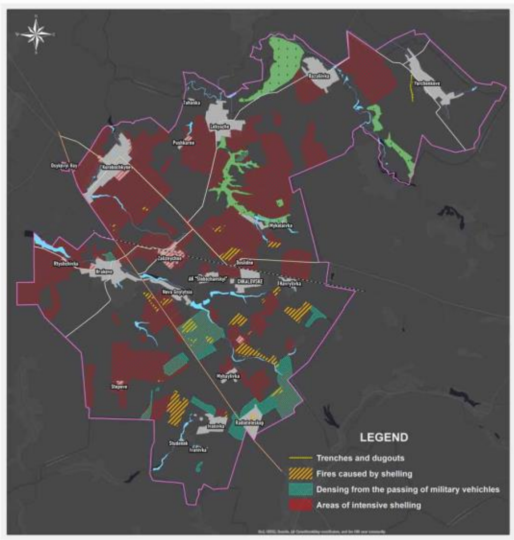
Ukraine has significant soil resources that have been and are being damaged by russian federation's armed aggression against Ukraine. This has a negative impact not only on the food security of the country, but also of the entire world. The largest part of Ukraine is presented by 'black soils', namely Chernozems. National Scientific Center «Institute for Soil Science and Agrochemistry Research named after O.N. Sokolovsky» has accumulated experience in researching the impact of military actions on soils and assessing soil damage.

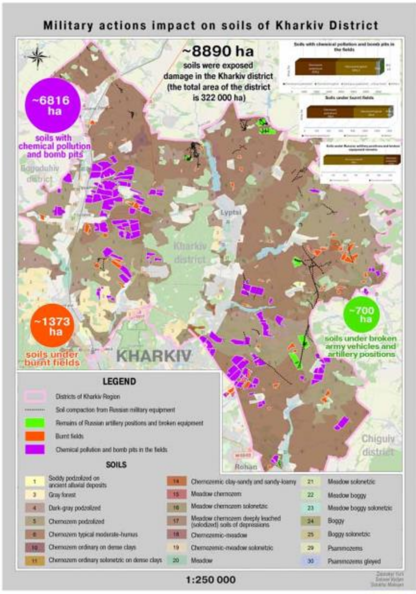
For today, the application of the traditional field survey of soils is complicated by the intensive battles or occupation of the territories. Therefore, it is necessary to widely use remote methods for researching the damaged soil cover. For the first time, was used and analyzed the images from Sentinel-2 satellites. This is the first, expert stage for assessing military degradation before refinement by field survey.

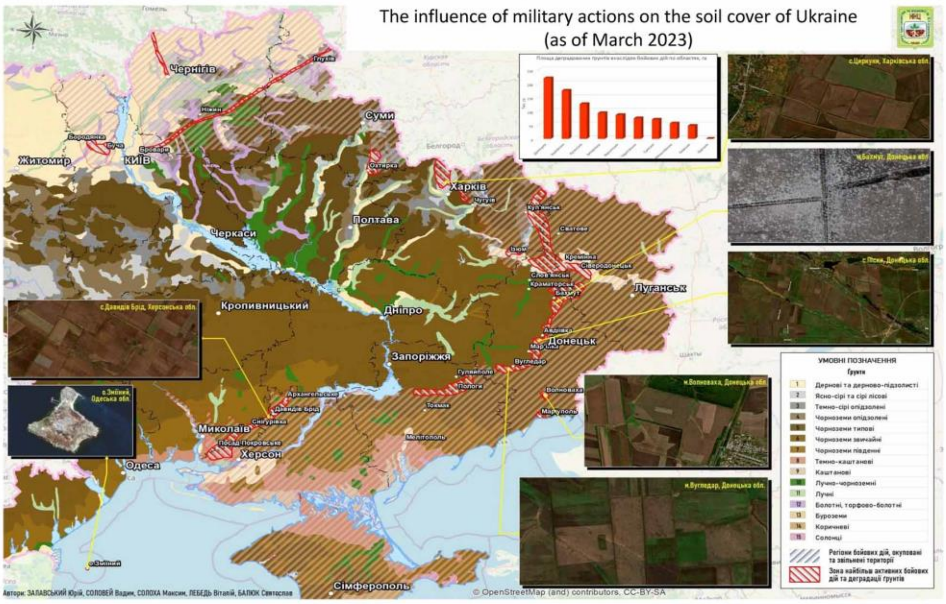
A total of 17 main kinds of military soil degradation were identified with a corresponding evaluation system according to the degree of manifestation with clear quantitative criteria according to the parameters of soil property changes. The Instruction on sampling of war-damaged soils was developed, the classification and assessment system of damaged soils was improved. Based on the soil maps and satellite data with selective verification by field survey, the maps of the impact of hostilities on the soils at the national, regional and local levels were created. They were used to display damage areas, assess condition of soils and calculate damages. At framework of the National Research Foundation Project, we started remote and field (after demining) survey the lands of Chkalovska community, where the zones of the greatest influence of hostilities were identified.

The amount of damage and losses caused to lands and soils of Ukraine as of February 24, 2023 was preliminarily calculated based on several indicators. The total amount of damage is estimated at 34 billion dollars and continues to grow.

Type of degradation	Subtype of degradation	Kind of degradation
Mechanical	Military	Decreasing profile depth
		Reducing of humus content
		Formation of craters, trenches, pits
		Embankment formation
		Anthropogenic skeletal structure
Physical		Deterioration of physical properties
		Stable changes in the granulometric composition
Chemical		Contamination with inorganic substances
		Contamination with toxic inorganic substances
		Contamination with toxic organic compounds
		Pyrogenic change in the content of nutrients
		The depth of the first salt horizon from the surface
Physical and chemical		Acidification, alkalization
		Degree of salinity of the upper meter layer
Biological		Soil toxicity
		Reduction of soil biological activity
		Reduction (narrowing) of biodiversity







Keywords: soil damage,military soil degradation,assessment,satellite data,soil map

ID ABS WEB: 137035

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

INTEGRATED CATALOGUE OF OPTIMIZED PRACTICES TO IMPROVE SOIL HEALTH

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The aim of the project Transforming Unsustainable management of soils in key agricultural systems in EU and China - Developing an integrated platform of alternatives to reverse soil degradation (TUdi) is, by others, to develop a set of decision support tools (DST), to assess soil health, based on simple on-site analyses. DSTs will be directly linked to the catalog of integrated control measures, practices and strategies, to prevent soil degradation for healthy soils and/or to start the effective remediation process for degraded soils.
The catalog will be structured according to individual characteristics of potential soil degradation processes by agricultural use (soil erosion, soil compaction, organic carbon content, soil biology, nutrient content and management, etc.) and will lead users according to the result of soil health analyses, through individual types of measures and practices. They will be characterized by definition, but also by principles and aims. Information about necessary technology, equipment, costs and efficiency, same as linking to EU and national policy and subsidy support are also included.
The catalog technically is linked to digital DSTs, where links to WEB and also PDF version can be found. Based on the result and classification of the soil health survey, the cluster of the most effective measures/practices is recommended, pre-selected and displayed. The user can then pick the most suitable ones for given conditions, and estimate efficiency and costs, based also on the state subsidy system. Also to select the optimum combination to maximize positive and synergy effects.
The catalog will be available in English, Chinese and in national languages of TUdi project states (Spain, Czech Republic, Austria, United Kingdom, Hungary, Bulgaria, Italy).
The structure, types of measures/practices, content and applicability of the tool by users will be presented at the congress.

This research has been supported by H2020 project TUdi - No.101000224

Keywords: best practices catalogue,decision support tools,interactive catalogue,integrated assessment

ID ABS WEB: 137308

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

REMEDIATION OF CADMIUM CONTAMINATED PADDY SOIL WITH A GIANT RICE

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Typical Cd hyperaccumulators are generally small and rather difficult to be cropped for phytoextraction. This study aims to identify the accumulation characteristics of Cd by a newly-developed giant rice and use this high biomass crop to remediate Cd contaminated soils. Soil column and lysimeter tests were conducted with giant and normal rice under different water conditions. The Cd accumulation in rice, chemical speciation and subcellular fraction in roots were examined. In column test, grain Cd concentration of giant rice was only 0.006 mg/kg under sustained flooding. However, the Cd concentration increased to 0.547 mg/kg under the semi-dry condition (drained after tillering stage). Cd content in giant rice straw and root was significantly higher than that of normal rice (cv. Simiao). By keeping soil moist after tillering stage in the lysimeter tests, Cd content in giant rice grain were 0.015~0.034 mg/kg. The translocation factor from root to straw and from root to grain were lower than those of Simiao rice under all water conditions. Concerning Cd in root, 37.9% was trapped on the root surface, 44.5% was fixed in the root cell wall, and only 17.6% entered the endoplast. The iron plaque content of giant rice root was 1.33 times of that Simiao rice and fixed 63.2% Cd on root surface. In addition, under semi-dry condition, the Cd phyto-extraction amount by the giant rice shoots was 269 ug/plant, and the phytoextraction efficiency of one crop were 4.81% of Cd in topsoil. The decrease rates of total and CaCl2-extractable Cd were 10.8% and 40.1%, respectively. Therefore, giant rice is an excellent cultivar with low Cd accumulation in grain, and under semi-dry condition, giant rice has a good Cd phyto-extraction ability. A production/remediation mode with early giant rice for normal production and a regenerated late giant rice for phytoremediation was then proposed, showing that the regenerated late giant rice under semi-dry condition do have a rather high Cd phytoextraction by shoots.

Keywords: Cadmium,Giant Rice,Phytoextration,Water condition,Root retention

ID ABS WEB: 137846

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

THE APPLICATION OF OLIVE POMACE DIGESTATE TO THE SOIL PROMOTES THE SORPTION OF PESTICIDES AND THE GROWTH OF THE LIGNINOLYTIC FUNGUS PLEUROTUS ERYNGII

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New products and byproducts are released from the technological conversion of waste biomass for bioenergy production. Due to their high organic carbon content, these materials, when used as soil amendments, can improve the overall quality and fertility of the soil. In a study carried out within the framework of the Agritech National Research Center Project funded by the EU, Next-GenerationEU (PNRR) – M4C2 Inv.1.4, we explored the potential of an innovative solid digestate (DG) obtained exclusively from two-phase olive pomace to regulate some chemical and biological processes that occur in a loam soil. The DG was characterized using several analytic techniques, such as SEM-EDX and FTIR techniques. In batch-type adsorption tests, the retention of the fungicide boscalid and the herbicide oxyfluorfen on non-amended soil (na-S) and soil amended with 1% (S-DG1), 3% (S-DG3) and 6% (S-DG6) DG (w/w) was quantified and modelled using the theoretical equations of Henry, Freundlich and Langmuir. At 20 °C, KF values of na-S increased significantly after the addition of DG, especially at the highest dose, being the increases of S-DG1, S-DG3 and S-DG6 of 84, 83 and 185% for boscalid and 2, 2 and 194% for oxyfluorfen, respectively. Hysteretic desorption of both molecules was observed from all samples, especially S-DG6. Pleurotus eryngii is an important soil-resident fungus involved in the soil carbon cycle due to its enzymatic equipment. In lab-scale experiments, the fungus was exposed to 0.02 and 0.1% (w/w) DG alone or preliminary interacted with 100 mg L-1 soil humic acid (HA). The latter treatments were adopted to simulate field conditions where DG likely interacts with the native organic matter of the soil. All treatments, especially DG0.1%-HA, significantly promoted the mycelium growth rate. In conclusion, the overall results obtained indicated that the addition of DG to soil can exert important effects, such as the control of the bioavailability of pesticides in soil and the stimulation of beneficial fungi.

Keywords: Soil,Pesticides,Adsorption,Digestate,Ligninolytic fungus

ID ABS WEB: 137938

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

THE EFFECT FIELD WHEELING OF ON SOIL WATER RETENTION AND ABOVE GROUND PART OF MAIZE DURING A GROWING SEASON IN NORTHEAST CHINA

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With the use of heavy machinery, soil compaction induced by wheeling process on farmland has become a serious problem in recent years of China. In this study the effects of wheeling on soil water retention and the above ground part of maize were revealed. The results showed that field soil gradually deformed with the increase of wheeling frequency. The vertical settlement after wheeling with 1, 3, 5, 21 passes (C0, C1, C3, C5, and C21) were 6.4 cm, 8.0 cm, 9.5 cm, and 13.7 cm, receptivity. The wheeling increased soil volume water content and reduced the soil matric suction, and this effect lasted for the whole growing period of maize in 2019. The fluctuations of volume water content with rainfall events under C21 treatment were not so obvious compared with those of C5 and C0 treatments. In heavy compacted soils under C5 and C21 treatments, soil shrank more and cracks were easily formed during dry period, and during the wet period water logging lasted in longer period compared with C1 treatment. With the increase of wheeling passes the total areas of cracks and duration of water logging gradually increased, respectively. The wheeling showed cumulative effects on reducing the above ground part of maize. Except maize height all the above-ground parameters of maize showed significant decreases when soil was permanently compacted (C21) by wheeling. Additionally, compared with maize parameters of height, stem diameter, leaf biomass per plant, and 100-grain weight, the wheeling effect was more obvious on the above-ground biomass per plant and yield. Wheeling after 1, 3, 5, and 21 passes on soil, the above ground biomass per plant of maize decreased by 14.5%, 36.9%, 37.0%, and 56.4% with yield losses of 9.7%, 30.7%, 38.4%, and 59.7%, respectively. Therefore the traffic load and frequency should be strictly controlled in order to mitigate the harmful effect of compaction and shearing on soil and maize.

Keywords: Soil compaction,wheeling,soil function,soil deformation,maize growing season

ID ABS WEB: 138124

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

EFFECTS OF RESIDUAL SLUDGES ON THE PHYSICOCHEMICAL PROPERTIES OF A DEGRADED AGRICULTURAL SOIL UNDER TUNISIAN SEMI-ARID CLIMATE

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The soils of arid and semi-arid regions are relatively poor in organic matter. The intensification of the agricultural practices, the light texture of these soils, and the non-return of crop residues to the soil accelerate this impoverishment. To improve the fertility and productivity of these soils, the application of organic amendments becomes indispensable. Among these organic fertilizers, residual sludges can potentially serve as an amendment, mainly for soils in arid regions.
In this context, we conducted a spreading trial of residual sludges on a clay loamy degraded saline soil of an agricultural plot situated in Foussena-Kasserine (Central West of Tunisia). The studied plot has an area equal to 4,22 hectares, and was treated with two doses of dry powder sludge 5 Ton/h. The soil sampling was carried out from February to July 2023. The selected control soil has a slightly alkaline pH = 8, high Electrical Conductivity (CE =16 mS/cm) and low organic matter, not exceeding 1%. Following six months of sludge spreading, five samples were taken at a depth of 30 cm. After spreading, the results showed significant improvements in several soil properties. Indeed, there was a notable increase in the percentage of assimilable phosphorus, exemplified by values escalating from 5,6 ppm to 57,2 ppm. Furthermore, organic matter content showed an enhancement compared to the control, with values rising from 0,78% to 2,29%. The level of certain metals, including lead, zinc, iron, and nickel, showed also significant increases, while remaining well below the standards. However, a slight decrease in pH was noted in the amended soils, with pH values declining from 8 to 7.
These findings highlight the significant potential of using residual sludge as organic fertilizer, offering a method for reusing organic waste materials beneficially. This practice helps reduce the volume of waste directed to landfills or incineration while simultaneously fostering improvements in soil fertility and promoting plant growth.

Keywords: Soil quality,Soil amendment,Tunisia,Sludges,Arid region

ID ABS WEB: 138140

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

EFFECT OF PHOSPHOGYPSUM ON SOIL PHYSICO-CHEMICAL PROPERTIES IN TUNISIAN SALT-AFFECTED SOILS

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Salinity is one of the most challenges for soil fertility, agriculture production and crop in arid and semi-arid regions, such as large area of Tunisia, soil affected by salts occupy an area of 1.5 million hectares, about 10% of the total area of the country. Therefore, Phosphogypsum (PG) could be a promising amendement to reduce the salinity affect and improve physico-chemical soil quality in salt affected soil. The present study aimed to evaluate the effect of PG on soil salinity and physico-chemical proprieties of soil collected from agriculture irrigated area in West Central of Tunisia. The treatment consisted of different rates of PG, PG+Manure (10t/ha PG, 20t/ha PG, 40t/ha PG, 10t/ha PG+Manure, 20t/ha PG+Manure, 40t/ha PG+Manure, Soil+Manure). The results revealed that PG application improve soil structure by promoting floculant action by calcium, positive effect of PG on other soil physical properties (soil hydraulic properties, total porosity, and bulk density). Compared to results revealed before amendement with PG, Electrical Conductivity (EC) was decreased from 14.49 mS/cm to 2.26 mS/cm in soil treated with 20t/ha PG+Manure, a clear decrease in pH values from 8.089 in soil without amendement to 6.96 in soil treated with 40t/ha PG+Manure. we noted an increase in the level of Organic Carbon (OC) which went from 3.27% in soil without any treatment to 4.79 in soil amended with 20t/ha PG+Manure to 5.17 in soil amended with just manure (1kg of manure in m2). This study supports the use of PG as an amendment for reclaiming salt-affected soils through monitoring agronomic and environmental impacts, but also the monitoring of other PG compounds (heavy metals, radioactive elements) is essential, so despite the importance of the results obtained in relation to salinity, advanced research studies must be carried out.

Keywords: soil salinity,soil sodicity,physico-chemical properties,PG amendement

ID ABS WEB: 138180

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

REAPPLICATION OF COMPOSTED SEWAGE SLUDGE FOR CONTINUE RESTORATION OF DEGRADED SANDY SOIL: EFFECTS ON SOIL ATTRIBUTES AND MYCORRHIZAL FEATURES

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Sewage sludge (SS) is a good soil amendment, due its high contents of organic matter and mineral nutrients. Reapplication of SS is a way to increase its disposal and at same time improving even more the soil fertility and its biological properties. This is particularly important for recovery of degraded soils, which requires large nutrient inputs to promote plant growth. Arbuscular mycorrhizal fungi are relevant in soil microbiota, being an indicator of soil biological activity. We aimed to assess the effects of SS reapplication on soil properties. In 2005 we conduct an experiment on sandy, impoverished and degraded soil in Southeastern Brazil, where rates of SS (2.5; 5; 10; 15; 20 Mg ha-1) and mineral fertilization (as recommended by literature) were utilized as treatment for soil recovery, as well a control without any intervention. Native tree species from Atlantic Forest biome were planted for vegetation cover. In 2016 the same treatments were reapplied in the area, but at this time we used composted SS at different rates (10; 20; 30; 40; 50 Mg ha-1). After four years we investigated its effects on soil fertility (moisture and mineral nutrients) and mycorrhizal status (root colonization and sporulation) at wet and dry season. The higher rates of SS application increased the contents of P, Ca, Mg, Cu and Zn in the soil. Independently of rate, the soil treated with SS had higher moisture, at both wet and dry seasons. This results reinforce the value of SS for use in soil recuperation and vegetation growth. The SS treatments resulted in root mycorrhizal colonization being 18% higher than mineral fertilization, with no difference between seasons. At dry season an increased sporulation was observed at control soil, possibly due grasses favored by reduced tree growth in this soil. By other hand, at wet season the sporulation was higher under the 50 Mg ha-1 rate, suggesting complexity on the factors controlling mycorrhizal ecology on soil.

Keywords: Degraded soil,Urban residue,Soil fertility,Soil biology,Atlantic forest

ID ABS WEB: 138194

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

EFFECT OF INCREASED SOIL SEALING EXTENT ON INCREASED RUNOFF ACROSS TWO SUBURBAN CATCHMENTS IN NORTHEAST SCOTLAND; COMPARISON OF COPERNICUS LAND MONITORING SERVICE AND BRITISH ORDNANCE SURVEY DATA

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Soil sealing can be defined as the destruction or covering of the ground by an impermeable material, which is directly associated with the degree of urbanisation. It is a major caus of soil degradation which often affects fertile agricultural land, puts biodiversity at risk, increases the risk of flooding and contributes to global warming. Additionally, polluted runoff is an effect of soil sealing which threatens water resources and degrades productive lands. In this study, two catchments with a total area of 3395.5 km2 around Aberdeen city in northeast Scotland were investigated as part of a project to evaluate socio-economic costs of land degradation and its effects on water resources. An evaluation of soil sealing extent change from year 2009 to 2018 and 2023 was conducted using Sentinel satellite images (Copernicus Land Monitoring Service of the European Union) and the British national Ordnance Survey (OS) MaterMaps® data for impervious surfaces. The study showed that the British OS maps can provide more accuracy and precision of details with less uncertainty of interpretation of imperviousness by providing higher spatial and temporal resolution in sealing maps. The impervious surface extent in the whole catchment (considering two sub-catchments) has increased from 49.3 km2 (in 2009) to 59.2 km2 (in 2023). The distribution and extent of sealed surfaces has impacted the expected runoff percentage. A high-resolution soil series map with associated Hydrology of Soil Type (HOST) classes overlaid with the imperviousness map of the study area was used to infer weighted standard percentage runoff for the catchment in 2009 and 2023. Then, we calculated the change in expected runoff using an urbanisation adjustment index. The results showed a 0.6% increase in the total weighted standard percentage runoff for the catchment. Outcomes of this study helps with suitable urban and rural land use planning and design.

Keywords: soil sealing,Land degradation,Hydrology of Soil Types,Copernicus imperviousness data,Ordnance Survey

ID ABS WEB: 138223

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

PRODUCTION OF LIGNOCELLULOSIC CROPS IN CONTAMINATED SOILS - OPPORTUNITIES AND CONSTRAINTS

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Dedicated crops represent an important feedstock to decarbonise the energy sector and to meet the no net emissions of greenhouse gases by 2050, as set by the European Green Deal. However, the greenhouse gas performance of biomass to energy can be negatively impacted by Indirect land use change (ILUC) effects. In fact, the increasing demand for biomass, increases the competition for land, threatening food security. Consequently, cultivation of industrial crops on contaminated land is repeatedly suggested as an approach to minimize land use competition with food crops and land use change controversies.
GOLD project (Bridging the gap between phytoremediation solutions on Growing energy crOps on contaminated LanDs and clean biofuel production) aims to produce clean low Indirect Land Use Change biofuels by growing selected lignocellulosic crops on contaminated land, and, in long-term, to return the polluted lands back to the agricultural production. Therefore, the objective of this work was to identify opportunities and constraints associated with the cultivation of miscanthus and switchgrass in contaminated soils. Effects of the cultivation of those crops in the contaminated soils were addressed towards impact on soil (nutrient status, soil properties, erosion). Results suggest that these perennials accumulate higher soil organic matter and provide structural enhancement, due to the continuous permanence in the soil, high inputs of residues and vigorous root development. Also, these crops are low input crops (e.g. fertilizers) and therefore a less intensive soil amendment is in place, contributing to minimize impacts and to lower pH variations. Concerning the erosion, these perennials reduce the risk due to the greater surface coverage over a long period of time, the continuous presence of an underground biomass and the greater interception of rainfall. Although yields are affected by the level of contamination, crop management options, such as the use of plant-associated microorganisms and a variety of bio-stimulants may reward the impact on the soil quality index, by greater reduction of soil contaminants.

Keywords: Phytoremediation,Contaminated soils,Impact assessment,Indirect land usechange,Industrial crops

ID ABS WEB: 138305

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

COMBINED BIOSTIMULATION AND BIOAUGMENTATION TECHNIQUES FOR THE REMEDIATION OF PENTACHLOROPHENOL CONTAMINATED FOREST SOIL

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Pentachlorophenol (PCP) is a recalcitrant compound that could persist in the environment causing serious pollution concerns. Bioremediation of PCP is demonstrating to achieve encouraging results compared to the common physical and chemical techniques.
The aim of this work was to assess different bioremediation processes as biostimulation and/or bioaugmentation approaches of artificially PCP (100 mg kg-1) contaminated forest soil (Sc). The biostimulation treatment provided phosphate and three different organic amendments, such as forest compost (FC), municipal solid waste compost (MC) or sewage sludge (SS). Two different microbial consortia B1 and B2 were used as bioaugmentation treatments. The combination of both biostimulation and bioaugmentation techniques was also assessed. Soil physical and chemical properties, PCP amount, soil microbial biomass carbon, soil respiration and some enzymatic activities at zero time (T0) and after 30 d incubation (T30) were evaluated.
No significant changes in terms of main chemical soil properties were observed, but an increment of organic carbon in all organic amendment-based treatments at T0 and T30 was observed. The PCP concentration at T0 was on average 82 mg kg-1 in all soil samples. After 30 days natural attenuation was responsible for the reduced PCP extractable in Sc (68.5 mg kg-1). The combined action of biostimulation and bioaugmentation led to a strong PCP reduction (71%) in Sc+B1+FC sample, whereas a depletion of only 52% and 41% occurred with the single application of FC or B1, respectively. The presence of PCP negatively affected soil microbial biomass carbon and the activity of dehydrogenase and fluorescein diacetate hydrolysis that recovered upon organic amendment also combined with microbial consortia B1 or B2. FC based biostimulation treatment also stimulated soil respiration. These results demonstrate that the simultaneous treatment of biostimulation and bioaugmentation showed a better performance in the PCP removal with more effectiveness than the single techniques.

Keywords: bioremediation,compost,sewage sludge,microbial activity,soil enzymes

ID ABS WEB: 136610

4. Soil health in achieving the Sustainable Development Goals
4.13 133539 - Development of efficient soil education scheme for tomorrow

LEARNING BY DOING IS MORE MEMORABLE: SOIL JUDGING AS AN EDUCATIVE TOOL IN NEW ZEALAND

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Soil scientists are increasingly working in a multidisciplinary world where they interact with professionals from different disciplines and diverse end user groups. The ability to communicate, and to be an effective team player are just as important skills as the ability to apply practical field skills and describe soil profiles. The kinaesthetic approach embodied in soil judging allows the student to also connect with pedological theory; and it is a pedagogically aligned style of learning.

At Lincoln University we first adopted innovative, experiential learning in the form of soil judging in 2016 to address these issues, and have worked collaboratively with the a Crown Research Institute in New Zealand (Manaaki Whenua Landcare Research) to develop this programme. Soil judging in New Zealand is in its infancy compared to other countries, but the undergraduate student soil science society and academic staff have been enthusiastic in practising soil description skills and land use interpretation, participating in soil judging contests in New Zealand and Australia.

Students report that they have become more confident in soil description and that it has stimulated their interest in learning about soil science. We designed a micro credential to recognise the academic work of the students. Several soil judging graduates have secured employment as pedologists at Crown Research Institutes or as soil resource specialists in local / regional government organisations. Soil judging may also be an effective recruitment pipeline into the discipline: offering those students with a practical and kinaesthetic aptitude who perform well at soil judging an insight into the academic side of the soil science discipline. We posit that soil judging competitions are an effective framework for students to acquire a valuable range of practical, field-based skills for a professional career in soil science or allied enterprises.

Keywords: soil judging,soil education,pedology,experiential learning

ID ABS WEB: 137003

4. Soil health in achieving the Sustainable Development Goals
4.13 133539 - Development of efficient soil education scheme for tomorrow

SIMPLE EXPERIMENTS PERFORMED IN THE SCHOOL YARD TO UNDERSTAND ECOLOGICAL SOIL FUNCTIONS: CELEBRATING A DECADE OF THE OUTREACH PROGRAM "TERRAMÓVIL"

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In 2013 the Institute of Geology of the National Autonomous University of México (UNAM) started the outreach program "Terramóvil" to promote Earth Sciences among children and adolescents and to provide teachers with tools to enforce

a) the protection from natural hazards
b) the importance of soil functions and conservation
c) the understanding of Global Climate Change

Terramóvil has designed sets of simple experiments carried out in the school yard, to learn by active participation about the different processes that govern the dynamics of our planet and the evolution of life. Each set of 4 to 5 experiments is designed to cover a specific topic during a regular school class. The children are divided in groups of maximum 15 to allow hands-on participation of all. All sets of experiments are linked to the local situation in order to promote awareness on how the personal life and surrounding of the participants is affected or involved. The different sets of experiments are adapted to the study plans of primary, secondary or high school education and thus foster the learning process and provide teachers with ideas on how to make the topics more accessible and attractive. Soil and its functions unfortunately is not explicitly considered in the study plans, but our activities show teachers where in the study plan soil knowledge is indispensable. The school visits are conducted by the person leading the outreach program and who is contracted by the university. Additionally bachelor students of Earth Sciences, Natural Sciences or Geography are recruited mostly as volunteers and up to five by offering a small scholarship. The students profit from the outreach project, since they learn how to translate specialized language into more simple words, improve pedagogical skills, and experience that their knowledge is appreciated and useful.

The strategy of the Terramóvil will be presented with examples and the 10-year experience of the project summarized.

Keywords: children,adolescents,teachers,soil functions,active participation

ID ABS WEB: 137702

4. Soil health in achieving the Sustainable Development Goals
4.13 133539 - Development of efficient soil education scheme for tomorrow

INCREASE SOIL AWARENESS AMONG PUPILS, STUDENTS, AND THE GENERAL PUBLIC IN AUSTRIA

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In order to increase awareness and understanding of the importance of soil, the ASSS, the Austrian Soil Science Society, together with other relevant Austrian institutions has developed concepts and materials and initiated a series of workshops to familiarise students and the general public with the importance of soil.

One format is the workshop series Boden macht Schule, a series of activities for children between the ages of nine and thirteen. To suit the situation in the classroom and to involve every child in the activities, the workshop comprises four stations with practical activities. Key elements include observing and identifying soil animals, simple science experiments and rummaging in the soil. Pupils and students are encouraged to use all their senses and touch, observe, smell, and listen to soil. Experiments include i) a filter experiment, ii) defining the texture of soil by touching it and iii) working with microscopes and binoculars. The children are asked to carry out the tasks themselves. At least 15 workshops are held in Vienna every year and are very popular with teachers, pupils and students.
National projects such as BOKLI and Futuresoils had the format of scientists working with students aged 10-14 for a whole year. In these projects, they learnt about the relationship between soil and climate and/or food production. Following a scientific approach, students collected and observed various parameters and learnt to grow, nurture and harvest vegetables and herbs in and outside their classroom.
In 2023, Soil talks - a project aimed specifically at initiating exchange in between young and retired persons was carried out. In Soil Talks these groups were introduced in soil health through workshops, interactive lectures, and walks.
Other activities include a regular Soil Festival on the premises of the Federal Forest Research Centre, as well as participation in events and presentations at the Vienna Zoo and regional thematic activities.
We also offer training workshops for key groups in environmental education.

Keywords: soil education,soil awareness,soil fertility

ID ABS WEB: 138103

4. Soil health in achieving the Sustainable Development Goals
4.13 133539 - Development of efficient soil education scheme for tomorrow

RAISING SOIL AWARENESS: A HOLISTIC APPROACH TO SOIL EDUCATION IN ESTONIA

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Awareness of the importance, diversity and multi-functionality of soils is a prerequisite for sustainable development. Although traditional soil science teaching has been in university programs for more than 100 years in many countries, there is a need to reach wider audiences. To achieve a faster breakthrough in society's attitude towards soil, it is necessary to simultaneously invest in teaching at the basic, vocational and higher education levels and provide information in an attractive format to the general public. The campaign of the Soil of the Year in Estonia since 2014 has proved to be a successful initiative to introduce the diversity of soils to the general public, which has also received more attention in the media. Our goal is to show how we have contributed to the promotion of soil education at all levels of education and popularized the field in Estonia over the past 15 years. We highlight the progress and challenges in developing and implementing new teaching materials and programs. In the modernization of soil education at both university and basic education levels, we have increased interdisciplinary, the share of practical work and involved interactive teaching methods (such as virtual tours).
Applied shorter program fosters a deeper understanding of soil as a dynamic and complex ecosystem, emphasizing its significance in supporting biodiversity, food production and environmental health. Through hands-on activities, interactive experiments, even sportive games and engaging lessons, pupils (also the students) will explore that physical, chemical and biological aspects of soils. The soil programs are designed to carter to various learning styles, ensuring inclusivity and promoting active participation. By incorporation real-world examples and case studies we provide practical insights to the applications of soil science in agriculture, forestry, conservation etc. The soil based study programs (sometimes small learning-bites) emphasizes the importance of responsible soil stewardship, encouraging learner to become environmental advocates and contributing to the well-being of the soil and surrounding environment.

Keywords: soil education,university curriculas,primary didactics,soil awereness,general publics

ID ABS WEB: 135980

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

SILVOPASTORAL SYSTEMS AS A STRATEGY FOR SOIL-RELATED ECOSYSTEM SERVICES RESTORATION IN THE COLOMBIAN AMAZON

A.M. SILVA OLAYA, F.A. ORTIZ-MOREA, D.A. MORA-MOTA, A. OLAYA-MONTES, M.P. LLANOS

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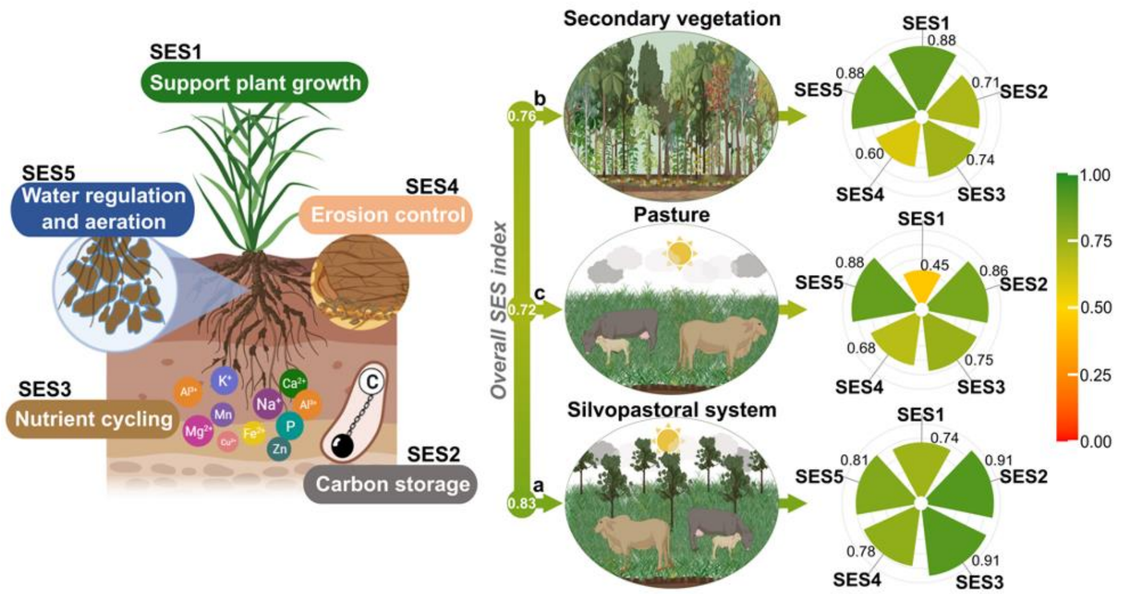
Soil performs a multitude of ecological functions and underpinning the provision of a wide array of ecosystem services (ES). However, the soil degradation due to land use change can affect the capacity of soil to supply these diverse ES. In the Amazon region, particularly in Colombian portion, the widespread conversion of forest into extensive pastures has led to degradation of soil's physical, chemical, and biological properties. This degradation has, in turn, impaired the ability of livestock systems to deliver essential provisioning services, including food production. To mitigate the negative effects of traditional pasture management practices, alternative systems, such as silvopastoral systems, have been introduced in recent years. Silvopastoral systems combine trees and shrubs with tropical grasses in an integrated approach to agricultural land management. Despite recognized benefits to soil and ecosystem from those integrated production systems, the specific impacts of such management practices on soil's ability to supply ES it is still poorly understood. In this study, we used a comprehensive assessment framework based on primary soil information to evaluate the influence of silvopastoral systems adoption in Colombian Amazon on the ability of soil to provide five soil-related ES: i) Support plant growth, ii) carbon storage, iii) nutrient cycling, iv) erosion control and v) water regulation and aeration. We also studied synergies and trade-offs among these ES. Our findings indicate an enhancement in four ES, particularly plant growth and nutrient cycling, with ES indices rising from 0.45 and 0.75 in pasture to 0.74 and 0.91 in silvopastoral systems, respectively. The overall soil-related ES index increased from 72% in pastures to 83% in silvopastoral systems, highlighting the clear benefits of these systems in restoring soil´s ability to supply ecosystems services. A significant interdependence among the ES was observed. Our results underscore the need to re-evaluate and adjust management practices to reduce the impact of livestock systems on soil-related ES in the Colombian Amazon.



Keywords: soil functioning,ecosystem services,tropical livestock systems,agroforestry systems,soil health

ID ABS WEB: 136388

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

UNDERSTANDING FOREST SOIL HEALTH

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Improving soil health is goal for all land managers, either in agriculture or forestry. Much research has been conducted to determine important metrics to assess agricultural soil health but there has been little research on assessing forest soils. Similar to agricultural soil health, maintaining forest soil health during management activities while drive future forest conditions. To test forest soil health metrics and develop a similar approach to the Cornell CASH (Comprehensive Assessment of Soil Health) framework we used CASH across a gradient of forest soils to a chronosequence of soils converted from forest to agriculture. Results indicate that forest soil health is greater than agricultural soil health, independent of years since conversion and that smaller sets of metrics that are not correlated such as those in the CASH framework, are able to predict soil health across the forest to agricultural conversion chronosequence. Those metrics include soil organic matter, soil pH, and wet aggregate stability and a several chemical nutrients with iron being the predominate important micronutrient. The metrics developed in CASH are better able to predict soil health with time since conversion indicating that other non-CASH soil health metrics should be considered when assessing forest soil health.

Keywords: Forest,Agriculture,Conversion,CASH Index,Carbon

ID ABS WEB: 136445

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

SOIL PROPERTIES AND NUTRIENT LOSSES BY EROSION IN ABANDONED AREAS WITH NATURAL VEGETATION COMPARED TO THOSE OF CROPLANDS

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The abandonment of cropland represents a land use change that has effects on soil quality. There may be some positive effects associated with increased soil cover, but there may also be changes in nutrient content and erosion processes, especially in mountainous environments. This research presents an analysis of the impact of cropland abandonment on soil properties, including texture, organic carbon, nitrogen and phosphorus in abandoned areas covered with natural vegetation compared to those of cropland. The study was carried out in an agroforestry catchment with a Mediterranean climate, located south of the Pyrenees (Aragon, Spain). The effects of erosive rainfall recorded in seven measurement campaigns over two years on the amount and composition of soil particles detached and subsequently exported under both land uses were assessed and compared. After abandonment, soil organic carbon increased significantly, reaching contents almost three times higher than in cropland. This contributed to a decrease in soil erodibility, resulting in less sediment generation after erosive rainfall events, which were on average three times lower in the abandoned areas than in the cropland. Soil nitrogen also increased on abandoned land, reaching values up to about twice as high as on cropland (0.26% versus 0.13%, on average). Phosphorus content, however, was higher on cropland than on abandoned land (416 vs. 217 mg/kg), representing a potential risk to water due to the higher erosion rates recorded on cropland. The results also confirmed the association of phosphorus to smaller particles and the link with SOC on abandoned land, as well as the effect of rainfall intensity on phosphorous mobilisation. Nitrogen losses, however, were mainly driven by the amount of rainfall recorded. This research contributes to identify impacts on agroforestry systems due to the current context of coexistence of conversion of natural areas into cultivated land while in other regions revegetated natural areas are developed from abandoned agricultural areas.

Keywords: Abandoned areas,Cropland,Nutrient changes and losses,Soil organic carbon,Soil erodibillity

ID ABS WEB: 136838

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

SOIL QUALITY AND SOIL CARBON MANAGEMENT INDEX UNDER DIFFERENT LAND USE SYSTEMS AND SOIL TYPES IN THE TYPICAL BLACK SOIL REGION OF CHINA

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Assessing soil quality and soil carbon (C) loss influenced by land use changes facilitates sustainable land use and soil management. Based on principal component analysis (PCA) and soil quality index method (SQI), a minimum data set (MDS) was established to systematically evaluate the soil quality with different duration (0, 10, 20, 30 years) of dryland-to-paddy conversion in two main soil types (meadow and albic soil). This study also investigates soil physicochemical properties, soil aggregates, and C management index (CMI) in three different LUSs (grassland, dryland, and paddy field) under two STs (meadow soil and albic soil) of the Sanjiang Plain in northeast China. The MDS was composed of soil organic carbon (SOC), available phosphorus (AP), nitrate nitrogen (NO3--N), available potassium (AK), fine sand (FS), coarse sand (CS), and pH; in meadow soil, the SQI raised significantly in the first 10 years and reached the lowest in the 30 years, and the SOC and AK were the main properties affecting SQI; for albic soil, the SQI was stable within 20 years and then declined significantly in the 30 years, and SOC was the main reason for the change of SQI; soil properties were affected by LUS and ST, especially soil chemical properties; ST had no significant effect on soil aggregates, while LUS had a significant effect on soil aggregates. The heterogeneity of grassland, dryland, and paddy field showed that different LUSs had particular effects on SOC and its active components because LUS had significant effects on C pool index (CPI) and CMI, but ST and its interaction had no significant effects on CPI and CMI. Overall, the results showed that LUS was an important factor affecting CMI in the Sanjiang Plain, rather than ST, and the paddy field CMI was optimal in the Sanjiang Plain. The finding can enable soil quality diagnosis and sustainable development of farmland related to LUS conversion in the typical black soil area in the future.

Keywords: Land use systems,Soil types,Soil organic carbon,Soil aggregates,Carbon management index

ID ABS WEB: 136990

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

TEMPORAL CHANGE IN MICROBIAL COMMUNITIES AND ACTIVITIES FOLLOWING A CHANGE IN CULTIVATION PRACTISE

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In a recent project, we found that hors-sol cultivation in greenhouses influences biological soil properties leading to decreased microbial activity and taxonomic shifts in bacterial communities. As crop rotation areas are protected in most parts of Switzerland, the question arises how quickly a soil restores the activity and microbial composition after cover removal and revegetation. To clarify this question, an area in a tree nursery that was previously covered with permeable plastic sheets and usually serve as a surface for potted plants was investigated. We analysed the soil microbial activities and bacterial composition changes. Freshly uncovered and vegetated plots were compared to control plots that remained covered and to reference plots in a nearby agricultural soil outside the tree nursery. The first three samplings were carried out two months apart after cover removal, followed by two further samplings with intervals of one year.
Microbial biomass, basal respiration and organic carbon content were significantly lower in the experimental and control plots compared to the reference plots. The metabolic quotient, which is an indicator of disturbance in the system, was significantly higher. A slight recovery of the microbial biomass, basal respiration, and metabolic coefficient in the restored areas was observed when comparing with the values of the reference plots outside. In contrast, the bacterial community composition did not converge to those of the reference area after two years (Figure below). We conclude that the new vegetation stimulated the activity and growth of the soil microbiome but did not lead to changes thereof. More detailed investigations of the bacterial composition should show whether, in addition to the coverage, the compaction and the associated restriction of water conductivity, observed at the tree nursery site, is a reason for unchanged bacterial communities and thus is an inhibitor for the recovery of the soil microbiome

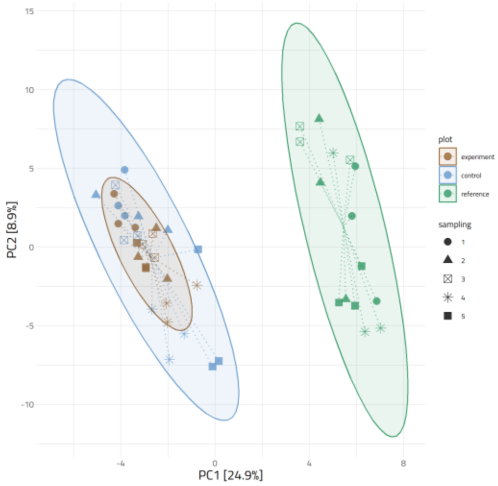

Figure: PCA for bacterial community composition for treatments and sampling times.

Keywords: microorganisms,greenhouse,hors-soil,biological activity,genomic sequencing

ID ABS WEB: 137096

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

LAND USE CHANGE CONSEQUENCES ON THE QUALITY OF DIFFERENT VOLCANIC SOILS OF CHILE

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Land use change (LUC) is one of the most frequent disturbances to which the volcanic soils of southern Chile have been subjected. Its consequences do not respond to the same pattern as soils of crystalline mineralogy, given their particular characteristics. Therefore, the objective of this work is to evaluate the changes in the quality of different types of volcanic soils in southern Chile. For this purpose, soils were collected in allophanic, non-allophanic and crystalline volcanic soils between La Araucanía Region (38.95°LS) to Aysén Region (44.03°), in each soil (LAS-Endoaquand, CNC-Hapludand, HUI-Duraquand, VAL-Hapludand, CUD-Hapludult, LO-Andisol, LN-Andisol) under different LU: native forest (NF), crop (C) and grassland (P). Indicators of physical quality: bulk density-Bd, available water pores-AWP, air capacity-AC and conductivity-Kl; and, chemical quality: SOC, pH-H2O, base sum-SB, Olsen-P, Al saturation and extractable Al, were measured. Some of the main results show that SOC ranged between (1.0 to > 20.0%), Bd varied between les than 0.40 to over 1.05 g cm-3, were in almost all cases the lowest Bd value was found under NF. The AC was higher in most cases in NF>P>C, varying between 5.0-25.8%. For the AWP, ranged between (less than 7.0 to over 25%. Base sum varied among soils being higher for C conditions due the agricultural use. The pH followed the same behavior as SB and Al saturation followed the opposite trend. For C uses, chemical indicators as soil pH, bases sum, Al saturation and P availability were improved and exhibits better values than NF, considering soil function of biomass production. In volcanic soils developed under temperate conditions of Chile, can be concluded that soil quality changes differentially for LUC, depending on the type of volcanic soil (allophanic, non-allophanic or crystalline). Thus the intrinsic characteristics of these soils determine that LUS does not always negatively affect soil quality.

Keywords: volcanic soils,land use change,soil quality

ID ABS WEB: 137116

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

OCCURRENCE AND HEALTH RISKS OF SOIL POLYCYCLIC AROMATIC HYDROCARBONS UNDER DIFFERENT LAND USE PATTERNS IN THE YANGTZE RIVER DELTA

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Identifying the health risks of soil PAHs may be beneficial for soil pollution. In the present study, the occurrence and health risks of soil PAHs under different land use patterns in the Yangtze River Delta were studied. The toxicity of PAHs was quantitatively evaluated based on the positive matrix factorization-toxic equivalent quantity model. The incremental lifetime cancer risk (ILCR) method was applied to assess the health risks. The results showed that the PAH concentrations varied between 142.26-9278.51 ng g-1. High molecular weight PAHs were found to account for more than 85% of the total. Significant variation under different land use types was observed. The mean soil PAH concentration: industrial area > traffic area > commercial area > residential area > park > farmland. The total predicted TEQ and ILCR values of PAHs were in the range of 15.71-867.35 ng g-1 and 0.13-9.13× 10-6, respectively. The dominant source of soil PAHs was vehicle emissions in the commercial area (89%) and the traffic (85%) area. Coal combustion contributed 43% to soil PAHs in the industrial area. Children experienced a higher cancer risk than adults due to their sensitivity to the carcinogenic effects of PAHs.

Keywords: Urbanization,PAHs,Soil,Health risk

ID ABS WEB: 137132

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

SOIL HEALTH INFORMATION AND MONITORING SYSTEM OF MEXICO (SHIMS)

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SHIMS aims to support public policies and community activities focused on reducing or reversing soil degradation in Mexico. SHIMS is an Evidence Convergence System constituted of three components:
1) An infrastructure of physical, physicochemical, and biochemical data obtained in 196 thousand study sites between 1968 and 2023, and data on factors of change such as deforestation, urban sealing, parcel fragmentation, and management practices reported in the Surveys, Censuses and Records of 2.2 million agricultural parcels.
2) A team of independent experts with a multidisciplinary approach who has debugged the data, calculated, and evaluated the impact of the change factors in the soil compaction, salinization, carbon losses, agricultural drought, and soil erosion through photointerpretation, numerical analysis, and remote sensing at different scaling levels, and
3) A cartographic platform for public feedback on these indicators that includes the participation of non-specialized citizens affected by the change phenomena.
The main challenge of SHIMS is to improve the representativeness, connectivity, and scaling of soil information. Recently, to overcome this, the SHIMS processes have been employing calibration systems and mathematical techniques that can synthesize and preserve the experience of producers and field specialists and that can represent metrics both in a static Euclidean way (e.g., SOC stocks) and dynamically, under multiple position-moment structures such as phase spaces (e.g., SOC losses and gains) through tools based on Bayesian inference and neural networks driven by AI technics.
One of the by-products resulting from SHIMS is the set of 28 national scale soil maps included in the "National Atlas of Mexico 2022", a historical document edited by the UNAM-Institute of Geography. The maps show a country deeply disturbed during the last two decades: 5 Mha deforested, 0.4 Mha with recent sealing, the increase to 0.4 Mha of agricultural land with accelerated hyper-salinity or hyper-sodicity (see image), 7.2 Mha with intense anthropogenic erosion and carbon losses 0.03% of national stock each year in Mexico. More information at:
https://nube.geografia.unam.mx/owncloud/index.php/s/lYMMntCvn0fbXw1?path=%2FX.1.2_Degradacion_Conservacion_suelo%2F100_IUSS

SHIMS. View of two cells (10m x10m) with environmental information, parcel management, and physical and biochemical variables for two different land uses at a given moment-position (p-q). The yellow lines represent changes due to ecological, thermodynamic, and gravitational differentials obtained by photointerpretation. The graphic representation of their evolution through Bayesian Models, Data Mining, and Neural Nets allows us to obtain more consistent indicators of productivity, exposure, sensitivity, and vulnerability.

Keywords: SOIL QUALITY,SOIL HEALTH,CARBON MONITORING,LAND USE CHANGE,LAND MANAGEMENT

ID ABS WEB: 137190

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

POTENTIAL OF AUTONOMOUS FIELD ROBOTS TO IMPROVE SOIL HEALTH IN DIVERSIFIED CROPPING SYSTEMS: A PROMISING TOOL TO BOOST SUSTAINABLE INTENSIFICATION OF AGRICULTURE

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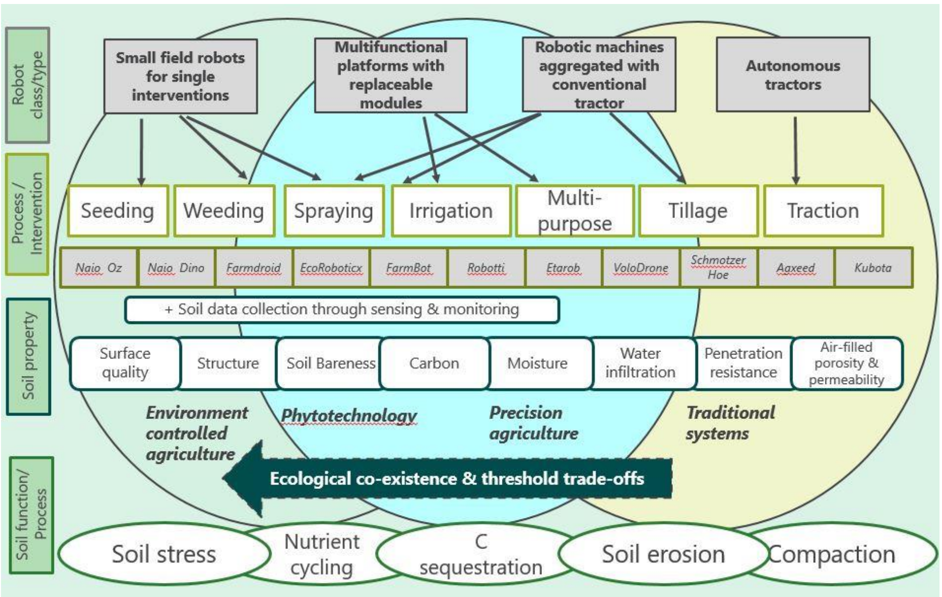
The increasing demand for spatial crop diversification, characterized by the presence of different crops within a single field, smaller field sizes and spot management, presents unique challenges for conventional farming. Agricultural diversification, and in particular crop heterogeneity, was found to effectively increase biodiversity and ecosystem services. Diversified cropping systems with new spatial field arrangements, wider crop rotations, and site-specific crop selection require innovative technologies to support management and decision-making. Autonomous field robots offer a promising solution by providing targeted and efficient management measures, tailored to the specific needs of each crop. By leveraging advanced sensing technologies and machine learning, field robots can optimize resource allocation and crop protection, leading to improved crop productivity and farm economy. However, it is yet unknown how the introduction of robots will affect soil conditions over time due to lighter weight, more frequent but slower overdrive, regular mechanical weeding, site-sensible behaviour and high precision compared to large machinery in conventional farming. Although their overall mode of mechanization will most likely not differ from a technical point, differences in workflow, operation procedure and intensity of use may change, as well as the cropping system itself in which field robots are introduced for regular crop interventions.
Therefore, this talk aims to summarize the existing knowledge about the effects of autonomous field robots on specific soil properties, such as compaction, soil structural changes, and aggregate composition for different field robot types and crops and to evaluate their potential for future healthy soil management. A literature review was conducted on studies assessing relevant soil property changes due to agricultural robots and revealed a very limited number of research.
The lack of knowledge on soil chemical, structural and biological changes caused by field robotics underlines the urgent need for comprehensive research in this respect to strengthen the potential of field robots towards sustainable agricultural production.



Keywords: robotics,agricultural divserfication,autonomous robots,digital tools,indicators

ID ABS WEB: 137193

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

DRIVERS OF SOIL HEALTH IN THE EUROPEAN UNION: A SCOPING REVIEW AND META-ANALYSIS

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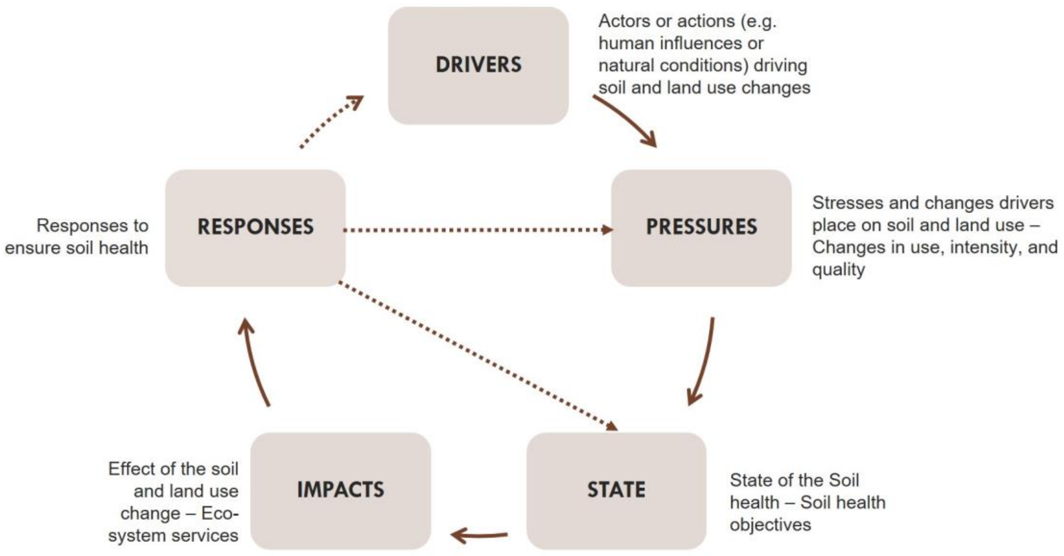
Soils are the basis for all life on land and are crucial for all natural and human processes. However, soil health in EU has reached a critical point: it is estimated that 60-70% of European soils are unhealthy, due to centuries of exploitation. Changes in land-use have a significant impact on soil health and thus, on the quality and quantity of ecosystem services soils can provide. The aim of this ongoing study is to investigate what is driving the changes in soil and land management in the EU in order to identify and understand the emerging opportunities and challenges related to soil health. The DPSIR (drivers, pressures, state, impact, response) framework was adapted to the context of soil and land-use change and used as an analytical framework for connecting drivers of changes in land-use to soil health objectives. A scoping literature review is conducted to identify the drivers which will further feed into the analysis of the links between pressures (changes in soil and land management), and states (soil health objectives) and the respective impacts (ecosystem services). The literature review is divided in four parts based on different land-uses (urban and industrial, agriculture, forest, and nature) and is conducted in accordance to the PRISMA protocol. Around 40000 references have been scanned to filter relevant studies and compile a list of drivers of soil health. The initial results show that climate change is a driver in all land-use types, triggering multiple changes in land use and management and impacting all soil health objectives in all areas of the EU. Urbanisation, changing consumption patterns, and EU policies and legislations have also been identified as drivers with the potential to significantly change land-uses in the EU in the future. This study is carried out as part of the EU Horizon project SOLO. The results of this analysis will feed into the development and establishment of think tanks for each EU soil mission objectives.



Keywords: Soil health,land use change,Soil management,DPSIR,meta-analysis

ID ABS WEB: 137644

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

INTERCROPPING ENHANCES SOIL HEALTH: EVIDENCE FROM LONG-TERM FIELD EXPERIMENT

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Intensive agriculture, featured as monoculture with high agricultural chemicals input, has led some problems with soil degradation, biodiversity losses, food production instability etc. Intercropping, growing at least two crops at the same time in the same field, can enhance productivity, and reduce year-to-year variation in productivity under changing climate. The objective of this study will investigate the soil health in decade time scale using a long-term intercropping field experiment.

The long-term field experiment, initiated in 2009, was a split-plot design with three replications, located at Jintan Experimental Station in Jinyuan county, Gansu Province, Northwest China. The main factor is three P application rates including 0, 40 and 80 kg P ha-1 yr-1, and the second factor is nine cropping systems consisting of 5 monocultures (faba bean, soybean, chickpea, oilseed rape and maize) and 4 intercropping systems (maize/faba bean, maize/soybean, maize/chickpea, and maize/oilseed rape intercropping). Physical, chemical and biological properties of soils were examined respectively in 2012 and 2020, soil health index was calculated.

Results showed that at 4th years (2012) after the experiment was established intercropping enhanced the proportion of soil macro-aggregate (> 2 mm dimeter) by average 10.1%, and increased soil total N by average 1.0 %, acid phosphatase, urease, nitrate reductase, and sucrose activities by average 6.9% - 105%, whereas maintained soil organic unchanged, compared with the matched monocultures across all four crop combinations. At 12th year (2020) after the experiment was established, intercropping enhanced the weighted mean diameter of soil aggregate by average 23.8 (ranged from 9.46% to 34.1%), soil organic carbon by average 1.61% (ranged from -0.87% to 4.73%), the four soil enzyme activities by ranging from 7.8% to 30.8%, and reduced soil Olsen-P, compared with matched monocultures across four crop combinations. Soil health index, in 2020, in intercropping was significant higher than those in matched monocultures regardless of crop combinations. These results indicated that intercropping enhanced soil health under long-term scale.

Keywords: Intercropping,Soil health,Soil aggregates,Soil carbon,Soil znzyme activity

ID ABS WEB: 137746

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

IMPROVE SOIL AND WATER HEALTH AND PRODUCTIVITY BY CHANGING LAND USE

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Many agricultural production regions in the world have been experiencing soil health degradation and groundwater resource depletion, which threaten water and food security and soil sustainable productivity if mitigation practices are not developed and implemented. Land, water and soil use changes can build soil and water health and productivity. We investigated soil health as affected by land use, crop rotation, cover crop (CC), soil amendments (biochar, manure, FGD, gypsum, lignite), no-till, and irrigation schedule in the southeast USA. The research identified nine indicators that can capture overall soil health information. Manure improved soil health more than CC under no-till. The combination of manure and gypsum can improve soil health under CC rather than no CC conditions. long-term application of biochar improved soil health in five commercial no-till fields. Soil carbon, N, P, K and pH were significantly increased from uncultivated native vegetation lands to organic farming system. However, the soil health showed a decreasing trend with increasing application years of organic farming, suggesting the need for changes in local organic farming management. Land use dataset showed 80% of the region is cropland. Corn, soybean, and rice consumed approximately 96% of the total amount of groundwater irrigation. irrigation scheduling based on plant water demand could save 47% of groundwater currently used by conventional irrigation. Converting grasslands to forests contributed to reducing groundwater declining. A critical range of soil organic carbon for plant available water content from 14 to 18 g kg-1 could significantly improve soil water holding capacity. The studies will benefit other regions with similar issues and conditions around the world.

Keywords: Cover crop,Cop rotation,Soil amendments,Soil health,Land use change

ID ABS WEB: 137848

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

RESPONSE OF SOIL ORGANIC CARBON STOCKS AND SOIL MICROBIAL BIOMASS CARBON TO GRASSLAND CONVERSION: A GLOBAL META-ANALYSIS

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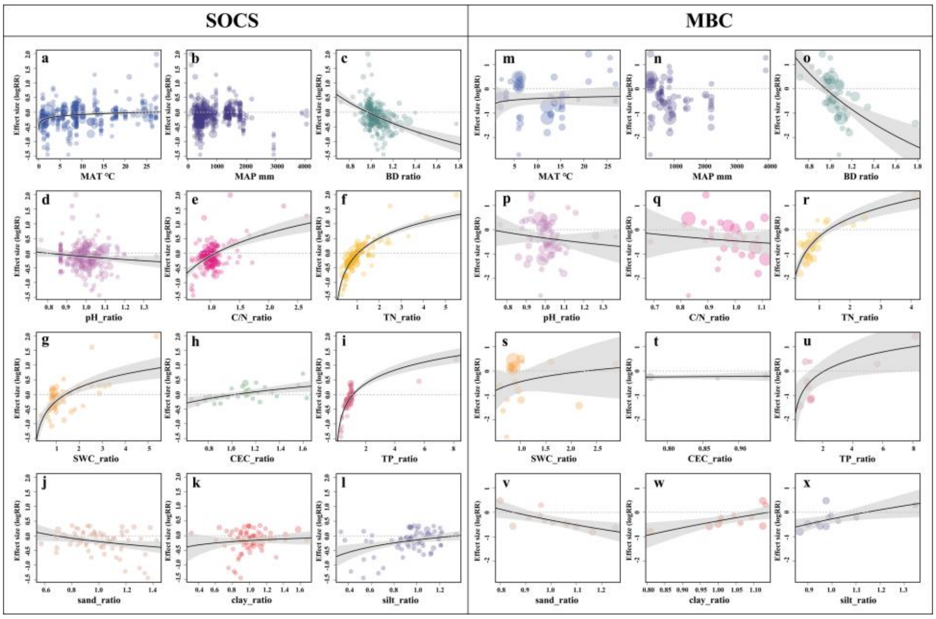
The conversion of grasslands to other land types, such as cropland and forest, alters the soil carbon cycle and thus affects carbon stocks. However, the potential impacts of grassland conversion to different land use types on soil organic carbon stocks (SOCS) and microbial biomass carbon (MBC) remain uncertain, as does the response to various environmental factors. Here, we performed a meta-analysis to quantitatively assess the effect of grassland conversion on SOCS and MBC based on 548 and 88 individual observations from 85 peer-reviewed articles, respectively. Overall, the conversion of grassland to other land uses significantly reduced SOCS and MBC by an average of 10.11% and 30.63%. Meanwhile, various land use conversion types had notable effects on both SOCS and MBC. In terms of SOCS, the conversion of grassland to forest, cropland and plantation significantly reduced SOCS by 7.69%, 16.47% and 20.55%, respectively, while conversion to managed grassland (artificial grassland, pasture, etc.) and abandoned land had no significant effect on SOCS. Regarding MBC, the conversion of grassland to cropland and abandoned land resulted in a significant reduction of MBC by 47.80% and 38.74%, whereas the conversion to forest, plantation and managed grassland had insignificant impacts on MBC. In addition, the screening of key factors revealed that climatic factors (Mean Annual Temperature (MAT) and Mean Annual Precipitation (MAP)) and soil properties (Soil Total Nitrogen (soil TN) and Soil Carbon to Nitrogen Ratio (soil C/N)) were the factors with the highest degree of influence. Among them, the lower the MAT, the higher the MAP, and the greater the loss of SOCS and MBC after grassland conversion. The smaller the soil C/N (< 10), the relatively stronger the sequestration capacity of soil organic carbon. Our results provide scientific evidence of how grassland conversion affects SOCS and MBC, offering new insights for enhancing the carbon sequestration potential of land.



Keywords: soil organic carbon stocks,soil microbial biomass carbon,grassland conversion,landuse change,global meta-analysis

ID ABS WEB: 137920

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

CHANGES IN GRAPE RHIZOSPHERE BACTERIAL COMMUNITY ALONG THE EFFECTS OF SOIL TILLAGE INTENSITY

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The bacterial community of vineyards’ rhizosphere has been subjected to a considerable amount of research, but it is still unclear how the applied soil cultivation methods change the structure, composition and level of diversity of their communities. Rhizosphere samples were collected from three neighboring vineyards with the same planting material.
Our objective was to examine the diversity of bacteria in vineyards that differ only in the methods of tillage procedure applied, namely Intensive, Extensive and Abandoned. For that we took samples from two depths (10-30 and 30-50 cm) of the grape rhizosphere in each vineyard and in laboratory immediately prepared the slices of the roots for DNA based analysis of the bacterial communities. The applied methods were first PCR and amplification of 16S rRNA gene, cloning sequencing and phylogenetic analysis. Based on band intensity and position on the results of the DGGE analyses, the diversity of the microbial communities was analyzed by Shannon-Weaver index (H').
Between of the Abandoned and Extensive vineyards at the samples from 10-30 cm the similarity of the community structure was 55% but at the samples from 30-50 cm was more than 80%, while the difference between of the Intensive and to other two was also more than 80%.
Based on our results we can conclude that intensive physical cultivation effect strongly the structure of the bacterial community and its diversity. The evaluation of farming practices should also take this parameter into account while looking for the sustainable alternatives for the future.

Keywords: Cultivation method,Bacterial community,Landuse,Viticulture,Rhizosphere

ID ABS WEB: 137994

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

FRAGILITY INDICES FOR SOILS OF CHILEAN PATAGONIA

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Soils are a non-renewable natural resource. Their maintenance depends on their natural properties (e.g. type of clay) and their management (e.g. fertilisation). The construction of soil indexes are useful tools to assess the interaction of these properties and to evaluate the state of the soil ecosystem functions. We used soil quality concepts to construct soil fragility index (SFI) for five land uses in Chilean Patagonia.
174 soil samples were collected from 43°41'8' S 72°19'60' W to 46°53'30' S 72°47'16' W to construct SFI for native forest (NF), grassland (G), exotic plantations (EP), cropland (C) and wetlands (W). Soil organic carbon (SOC), bulk density (dB), exchangeable aluminium (Al) and soil pH in NaF, CaCl2, KCl were determined in laboratory. Principal component analysis (PCA) was used to identify the main variables and the weight of these variables in the PCA. Standardised scoring functions were used to transform soil properties into values between 0 and 1 and construct the indices using a modification of the methods proposed by Andrews and Carroll (2001) (SFI-A) and Kuzyakov et al. (2020) (SFI-B).
SOC, dB and Al saturation were the main variables explaining PC1 with weight factor values of 0.335, 0.305 and 0.682 respectively. The SFI-A ranged from -0.71 to -1.10 while the SFI-B ranged from -2.02 to -5.29. Regardless the method used, soil fragility was W > NF > C > EP > G. The high SFI values in W and NF are strongly influenced by SOC and dB together, these properties, accounting for 66% of SFI. C, EP and G are influenced by Al saturation, accounting for 90, 80 and 50% respectively of the indices in these land uses. SFI-B reflected better the differences between land uses compared to SFI-A.

Keywords: Soil fragility index,Scoring functions,Land uses,Andosols

ID ABS WEB: 138029

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

LAND USE IMPACT ON SOIL RESPIRATION AND SOIL MICROBIAL ACTIVITY

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Changes in soil characteristics resulting from land use alterations have been a subject of increasing interest in environmental research. This phenomenon is often associated with the adaptation of pristine areas to various land uses, causing significant impacts on ecosystems. Notably, soil carbon stores and atmospheric CO2 emissions are directly influenced by these adaptations in land usage practices and management.
In contrast to existing scientific literature our study contributes to the understanding of carbon pool mechanisms by focusing on a terrestrial region of the Mediterranean with contiguous land uses: poor, fair, and good pasture lands, two agricultural areas fallow, larch pine and cedar afforestation areas and finally degraded oak and juniper forests. Measurements of soil and CO2 flux were conducted every month for a year in the fields and soil moisture and temperature values were recorded.
The study found that native oak and juniper forests, as well as larch and cedar plantations, exhibited higher levels of soil respiration, CO2 flux, and microbial biomass. Following the trend observed especially in forests, a noticeable decrease in soil respiration values was observed from pastures to fallow agricultural fields. Soil respiration values are 5.5 t ha-1 year-1 in oak forests, 5.4 t ha-1 year-1 in larch plantations, 5.3 t ha-1 year-1 in cedar areas, and 4.8 t ha-1 year-1 in cedar forests. 4.6 t ha-1 year-1 in juniper forests, and pasture areas, 4.1 t ha-1 year-1 are in fallow agricultural areas, respectively. There was also a positive correlation between CO2 flux and microbial biomass values and both soil respiration values and soil moisture levels.
It is thought that it would be beneficial to spread the observations made within the scope of the project to different land uses (agricultural areas where different crops are grown, orchards, mining areas, etc.) and for a longer period.

Keywords: soil respiration,microbial activity,land use,carbon emission

ID ABS WEB: 138073

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

THE IMPACT OF CHRONIC DISTURBANCE BY GRAZING ON SOIL PROCESSES IN SEASONALLY DRY TROPICAL FORESTS

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Seasonally Dry Tropical Forests (SDTF), constituting over half of the forest cover in tropical regions, have undergone significant anthropogenic deforestation in recent centuries. The impact of human activities on soil microbial communities in these forests remains poorly understood despite their crucial role in providing vital ecosystem services, such as organic carbon storage, nitrogen fixation, and nutrient cycling. One of the main human disturbances in these SDTFs is livestock grazing which has been barely studied. To address this knowledge gap, we conducted a field study in a SDTF in the province of Zapotillo, southern Ecuador. We identified five stages along a chronic disturbance gradient (as a result of goat grazing) and selected five replicate plots for each stage. In each forest plot, we collected composite soil samples and measured microbial respiration and its response to temperature, functional diversity by community-level physiological profiling (CLPP), total carbon and nitrogen, and nutrient concentrations. Our findings unveiled that the two most severely disturbed stages exhibited lower soil carbon and nitrogen concentrations, along with reduced soil carbon mineralization and lower temperature sensitivity. Additionally, phosphorus levels were lower in the more intensely disturbed areas compared to the less disturbed ones. These results suggest that low intensity goat grazing may be sustainable for microbial-related soil processes in these dry tropical forests. However, beyond a certain threshold, goat grazing can disrupt natural processes, leading to lowering of soil fertility and reduced carbon retention. This study emphasizes the potential consequences of goat grazing on ecosystem dynamics, the forest carbon cycle and ultimately, forest sustainability. These findings highlight the importance of sustainable land management practices to preserve the delicate balance of these unique ecosystems.

Keywords: grazing,soil microbial communities,soil carbon,soil respiration,tropical dry forests

ID ABS WEB: 138326

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

THE ROLE OF SITE PROPERTIES AND MANAGEMENT HISTORY FOR SOIL HEALTH

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Despite the fact that our study involved only 40 potato fields and must therefore be considered of limited size, we succeeded in identifying a number of soil conditions and management practices with the potential to affect soil health in potato fields
a) Our data suggest that soils in the order of aridisol have particularly weak defenses against the disease.
b) Mollisols seem to be better in suppressing the disease than aridisols, entisols and inceptisols.
c) The potato variety showed little correlation with Verticillium disease status. This result was unexpected since there are distinct differences in the susceptibility to disease among potato varieties.
d) Within the 5-year time frame of our study, it did not matter for disease suppressiveness how much time had elapsed since the last potato crop. With sclerotia being able to survive in the soil upwards of 10 years, this result was probably to be expected.
e) Soil moisture above a certain threshold seems to be a major factor in disease susceptibility. However, it was not the amount of water during potato years but the overall amount of water supplied to the field that was correlated with disease incidence. This means that irrigation practices between potato years may be of greater importance for disease susceptibility than the irrigation regime chosen while the crop grows!
f) The fact that diseased fields tend to have a history of significantly more frequent applications of agrochemicals seems to suggest that what is intended to be preventive care to control weeds, pests, and diseases may actually manifest itself as a serious stress factor for soil microorganisms.

Keywords: Management History,Potato production,Soil Health,Irrigation,Soil borne pathogens

ID ABS WEB: 138375

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

AN OVERVIEW OF THE ACIDITY OF AGRICULTURAL SOILS IN SLOVENIA

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Soil is an essential resource for the successful and sustainable production of high-quality food for the world's growing population. Climate change and a growing population expose soils to many threats and degradation processes, including erosion, salinisation and compaction, soil organic matter reduction, flooding, land development and soil pollution. Pressure on agricultural soils and food security are pushing for sustainable soil management. By definition, agriculture changes the acidity of the soil. This fact is unacceptable to some who call for nature-orientated agriculture, even though soil quality could be increased, not decreased, by liming. Farmers and experts recognise that maintaining topsoil acidity is essential for soil fertility. The aim of the study was to find out what is the acidity of the main types of agricultural land uses (arable land, orchards and vineyards) in Slovenia and to produce evidence based on measurements and maps reflecting the impact of agriculture on soil acidity; estimate to what extent the acidity of agricultural soils differs from the natural acidity of the same soil types, whether the acidity is higher/lower and if so, by how much. The old data on the natural acidity of different soil groups were merged with the soil data (acidity measurements) from 2004 to the present to create a map showing effects of agricultural use on soil acidity. The main output of this study is a temporal and geo-referenced database of agricultural and natural soil acidity in Slovenia, statistics of archived soil acidity data for agricultural land and the production of a map of agricultural soil acidity in Slovenia. The geo-referenced data and maps on soil acidity will help guide agricultural practises towards sustainable soil management, liming and fertilisation in order to achieve the optimal acidity of agricultural soils.

Keywords: soil pH,soil fertility,soil quality monitoring,soil acidity

ID ABS WEB: 135953

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

ROLE OF SOIL BIOLOGY FOR SOIL HEALTH ASSESSMENT

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Soil health places emphasis on the living component of the soil, and its contribution to soil processes and functions underpinning the delivery of ecosystem services. Various measures can be used to assess the soil biological community and its activity. However, few measures have targets for optimal populations or the knowledge to manage these, limiting the potential biological indicators available.

We investigate how additional tests of soil biology can be used to provide a more complete picture of soil condition, focusing on the impacts of regenerative management on soil health. A series of trials have been established on pastoral farms across different regions in New Zealand implementing regenerative practices (e.g. increasing pasture diversity and reducing fertiliser inputs). Biological measures are assessed across seasons in conjunction with soil chemical and physical properties. Biological measures include estimates of microbial biomass through commercially available tests (e.g. hot water extractable carbon) as well as field assessment of earthworms and pasture insect pest populations. These measures have target ranges specific to New Zealand. Further measures include nematode community analysis, microbial respiration, soil microbiome and relevant microbial functional genes, and soil disease pressure assays.

Indicators of soil biology (where target ranges available) were often at target in long-term pastures, but not necessarily in more recently converted pastures. Initial data shows that one year after establishing management treatments, differences in the soil biology, as well as soil chemical and physical properties remain limited. Some measures of soil biology, such as earthworms were variable through time and across seasons, while other measures, including hot water extractable carbon remained relatively stable. Soil type and previous land use influenced the soil biological community. We investigate factors driving changes in biological measures, with monitoring set to continue for several years. Only by assessing soil biology across a diverse range of sites using consistent methods, will our understanding improve and allow us to increase biological indicators available for routine evaluation of soil health.

Keywords: Soil health,Indicators,Earthworms,Nematodes,Microbial community

ID ABS WEB: 135990

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

SOIL ARTHROPODS IN BIOINDICATION AND ECOTOXICOLOGICAL APPROACH: THE CASE OF THE EXTREME ENVIRONMENT MEFITE (ANSANTO VALLEY, SOUTHERN ITALY)

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Soil arthropods play a critical role in sustaining soil health, moreover they can be used to detect soil alterations. The Mefite Geological Site (Campania, Italy) is a non-volcanic highly degassing site hosting a sulphurous lake, which exhalations affect vegetation in the vast 3km radius. The aim of this study was to evaluate the soil ecotoxicity of the site, and characterise soil arthropod community, underlining its bioindicator role and the taxa that can cope with this environment. Soil cores were sampled at 3 distances from the lake: A) 30m, B) 80m, C) 120m. On those soils were made: soil organic matter (SOM) and pH analyses, ecotoxicity tests on Folsomia candida (survival, reproduction), soil arthropods identification (order level, Collembola families, Protura species). Statistical analyses evaluated the impact of sulphurous emissions on soil chemistry and ecotoxicity, and on arthropods parameters (soil arthropods community structure, taxa associations; Shannon and Simpson biodiversity; soil biological quality index – QBS-ar). Results showed no differences in SOM, unlike pH, which were A(3.34 ± 0.15),B(5.18 ± 0.56),C(7.10 ± 0.32). The highest ecotoxic effect on F. candida was observed in A. Community composition, as well as QBS-ar, differed in A and B compared to C, and the poorest soil biodiversity was found in A. No orders were associated with A, while Acarina and Coleoptera were linked to B and C, and Tetramerocerata was associated to C. Collembola family composition did not change from one distance to another, however Hypogastruridae resulted clearly associated with A. Protura confirmed to be a sensitive group, absent in A. Given the lack of information on their presence in Campania (3 species registered so far), this study updated the available data providing the first record of 4 species. Arthropod community biodiversity and composition resulted effective soil bioindicators in extreme acidic conditions, reflecting soil ecotoxicity. QBS-ar index showed to be a sensitive tool in sulphureous environments; however, Collembola showed responses at family level, with Hypogastruridae being tolerant to the highest toxic environment investigated.

Keywords: Soil bioindicators,Soil biological quality,Soil ecotoxicity,Extreme environments,Arthropods biodiversity

ID ABS WEB: 136210

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

GLOBAL META-ANALYSIS OF SOIL FAUNA RESPONSES TO LAND USE INTENSIFICATION IN AGROECOSYSTEMS: A FOCUS ON EARTHWORMS

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The shift from extensive to intensively managed agroecosystems, leading to increased land use intensity, is often regarded as a major factor behind the global decline in biodiversity, particularly impacting soil biodiversity. Understanding the responses of soil biodiversity to diverse land use practices is crucial for effective land management in the context of future changes. Despite substantial evidence, uncertainties persist in predicting the consistent responses of different taxonomic groups to land use intensification.

We conducted a meta-analysis to evaluate the impacts of diverse land use intensification on soil organisms in global agroecosystems. Our study involved compiling a dataset with 3190 pairwise observations from 192 publications, comparing intensified land use to undisturbed ecosystems across 59 countries. Furthermore, we examined the influence of abiotic factors, including soil properties and climatic parameters, on these effects.

Our observations revealed a significant decrease in both the abundance (-34%) and species richness (-16%) of springtails. Conversely, earthworms exhibited a positive trend in abundance (+217%) but a reduction in species richness (-12%). Enchytraeids showed a negative impact on abundance (-32%) without affecting species richness. Mites demonstrated a positive increase in abundance (+129%) but with a notable reduction in species richness (-50%). Nematodes experienced a negative impact on abundance (-7%) without any effect on species richness.

In our assessment of earthworm responses, the impact varied based on specific intensification methods. Positive effects on earthworm abundance were observed in agroforestry (+60%), cover crops, low input cropping (+113%), managed grasslands (+52%), vegetable gardens (+52%), and pastures (+218%). Conversely, negative effects were noted in arable cropland (-24%), orchards (-35%), specialty crops (-61%), crop-livestock integration (-13%), and managed forests (-95%). Higher intensification effects were noted in areas with greater mean annual precipitation, higher soil pH, finer soil textures (clayey, loamy, and silty), and increased organic matter content.

Our results show the complex interaction between land-use intensification and soil fauna, offering insights into sustainable land management practices tailored to diverse ecological contexts.

Keywords: Soil biodiversity,Agricultural intensification,Soil invertebrates,Global synthesis

ID ABS WEB: 136314

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

TINY SOIL ENGINEERS BUT TREMENDOUS ACTIVITY: HOW CAN X-RAY MICROTOMOGRAPHY REVEAL HIGH IMPACT OF ENCHYTRAEIDS ON THE SOIL STRUCTURE?

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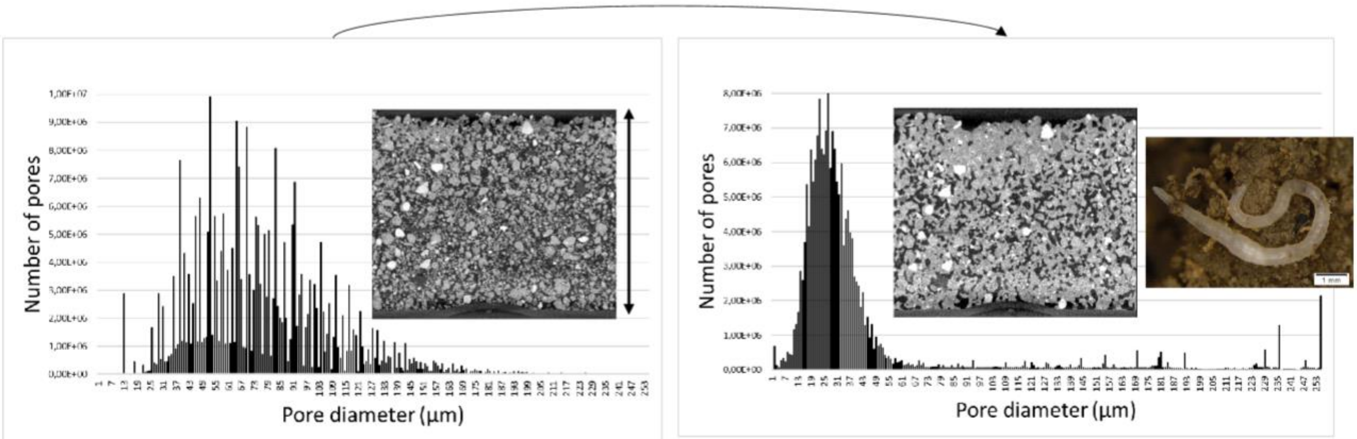
Enchytraeids are small, unpigmented Annelida Oligochaeta belonging to soil mesofauna (diameter between 100 µm and 2 mm, length 6-50 mm). They are anatomically and taxonomically close to earthworms but much smaller. Enchytraeids are abundant in various ecosystems, and they have a key role in organic matter dynamics. However, their influence on soil porosity through bioturbation activity is poorly understood, and the pore network created by these organisms has never been characterized.

Our study aimed to characterize the pore network created by two species of enchytraeids of different size (Enchytraeus albidus - length 30 mm, body diameter 0,6-1mm - and Enchytreus crypticus - length 10 mm, body diameter 0,18-0,30 mm) in two different soils using images obtained through X-ray microtomography with a voxel size of 20 µm. Soil columns were scanned before and after enchytraeid activity (at 30 days). 20 grams of a loamy soil or a silty clay loam soil (sieved at 2 mm) were placed in columns of 3.3 cm diameter and 4 cm height. The 2.5 cm of soil was compacted at two different densities (0.8 and 1 g.cm-3), and enchytraeids were introduced into the columns for one month. Control columns without enchytraeids were used to assess the effect of transport to the tomograph on porosity modification. Image processing was automated using Fiji and Avizo macros.

The total porosity was not influenced by enchytraeid activity, but the porosity profile over the 2.5 cm of soil was significantly modified, along with the distribution of pore sizes. In these experimental conditions, enchytraeids simplified the pore space by completely reorganizing the environment and creating bioporisity, so altering pore space connectivity, reducing isolated objects and ramifications. The majority of the pore diameters of the space worked by the worms correspond to the diameter of the animal's body. This could significantly impact water flow and particle transport in soils.



Keywords: burrowing activity,soil structure,potworm,connectivity index,porosity

ID ABS WEB: 136742

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

NEMATODE-MICROBE INTERACTIONS AND THEIR EFFECT ON PLANT HEALTH

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Nematodes, the most abundant and functionally diverse soil animals, establish intricate relationships with microbes and plants. While commonly recognized for their roles as ecological indicators in response to environmental disturbances and nutrient cycling, less attention has been given to understanding their influence on the microbial community and subsequent impact on plant health. In a series of experiments focusing on soil free-living nematodes, we investigated their interactions with pathogenic bacteria and resident microbes, exploring their collective effects on plant health. Contrary to the assumption that nematodes directly suppress plant pathogenic bacteria through consumption, our findings revealed that the plant pathogenic bacteria Ralstonia solanacearum not only cause damage to their host plants but also exhibit toxicity towards non-host soil animals. Instead, nematode predation contributed to an increase in Bacillaene production by antagonistic bacteria, enhancing the antagonists' ability to suppress plant pathogens. Furthermore, the presence of nematodes fostered diversity and co-existence within the resident microbial community, steering the resident bacterial community towards suppressing plant pathogens and promoting plant growth. Our study provides an initial insight into the intricate dynamics of nematode-microbe interactions and their profound implications for plant health.

Keywords: Nematodes,Microbes,Plant health

ID ABS WEB: 136773

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

FERTIMETRO AS A TOOL TO ASSESS THE RELATIVE EFFECTS OF ORGANIC MATTER AND EARTHWORMS IN VINEYARD SOILS

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Soil fertility is crucial for sustainable agriculture and the health of terrestrial ecosystems. Earthworms and bacteria play key roles in creating fertile soils due to their role on organic matter (OM) dynamics and soil structure. This work focuses on the interaction between earthworms and microbial communities in the soil. Understanding these relationships is essential for deepening knowledge about earthworms and developing soil management strategies to enhance fertility.
Experiments were conducted at INRAE Avignon under laboratory and field conditions to examine the contribution of various earthworm species and different types of OM on microbial activity. The analytical tool used was the Fertimetro, patented (WO2012140523A1) by the University of Padova, which quantifies microbial activity and plant nutrients deficiency by measuring the degradation of cotton and silk threads in plain or pre-treated versions with nitrogen, or phosphorus and potassium, which are buried for seven days into the soil.
Through their use, we aimed at verifying whether different species of earthworms and OM inputs could confer differences in thread degradation, and to possibly speculate on how this could be interpreted in judging soil fertility as well as the efficiency of its ecosystem services.
The results highlighted that in laboratory conditions, the presence of OM and, in some cases, earthworms can vary the fiber-degrading activity of soil microbes. Furthermore, some preferences of the different ecological categories for some OM conditions could be observed. In the field, higher microbial activity was measured over time in both inoculated and control conditions. Variations in microbial activity are hypothesized to be due to earthworm presence in particular conditions.
The study showed the effectiveness and the potential of Fertimetro in soil analysis providing valuable insights. Fertimetro can be a valid analytical tool, if based on the study context, for studying earthworms and their interaction with soil and organic matter components, and it can be used to further understand interactions among soil organisms.

Keywords: Earthworms,Microbial Activity,Organic Matter,Fertility,Interactions

ID ABS WEB: 137182

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

THREE-YEAR DYNAMIC OF COLLEMBOLA TAXONOMIC AND FUNCTIONAL COMPOSITION IN A POST-FIRE MEDITERRANEAN FOREST

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Frequent and intense fires in the Mediterranean basin cause significant damage to vegetation, litter, and the top humus horizon. The resulting heat, toxic smoke, and microhabitat destruction lead to changes in the abundance and community composition of soil microarthropods. Recovery time varies and depends on fauna groups, pre-existing vegetation, and soil properties. Collembola, being crucial for several environmental processes and sensitive to disturbances, represents good indicators of environmental changes. Their rapid colonization and reproduction rates make them pioneering organisms in the swift recolonization of disturbed soil.

This research addresses the variability in soil fauna reaction time to fire, which remains insufficiently documented. The study aims to fill this gap by comparing post-fire Collembola assemblages in soils covered by trees and shrubs. Surface soil were collected in spring 2021, 2022, and 2023 (3, 4, and 5 years after the fire) from 24 sites within the Vesuvius National Park (Southern Italy), with each season comprising 12 unburnt (NB) and 12 burnt (B) sites, divided further into 6 covered by trees (T) and 6 by shrubs (S).Collembola were extracted, identified at species level, and analyzed for taxonomical indices (density, species richness, diversity, and evenness) and functional traits (body length, furcula presence, eye presence, pigmentation, and reproduction type).

Three years post-fire, Collembola species composition significantly differed between NB and B areas covered by T and S. This difference persisted after 4 and 5 years, with a more pronounced effect under S soils. Three years post-fire, the highest taxonomical indices were observed in NB-T soils, and after 4 and 5 years, the lower indices persist only under B-S soils. Collembola with pigmentation, furcula, eye and sexual reproduction, linked to the surface environments and indicators of stressed conditions, decreased in both B-S and B-T soils and increased in both NB-S and NB-T soils.

The Collembola community's taxonomic and functional structure was significantly impacted by fire, and it has not fully recovered even after 5 years.

Keywords: Collembola,Wildfire,Recovery,Vegetation cover,Mediterranean area

ID ABS WEB: 137767

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

APPLICATION OF THE ARTHROPOD-BASED SOIL BIOLOGICAL QUALITY INDEX (QBS-AR) IN THE CONERO REGIONAL PARK: A COMPARISON BETWEEN THREE ORGANIC FARMING SYSTEMS

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Soil microarthropods are recognized as sensitive indicators of the impact of agricultural practices on soil functions. The arthropod-based Soil Biological Quality Index (QBS-ar) is a reliable method to assess soil health, avoiding the difficulties of taxonomic identification to species level.
The EU Biodiversity Strategy 2030 highlighted the significance of organic farming and land protection in halting biodiversity loss. On this point, the study aimed to evaluate the soil health in organic farms within a protected area, using the QBS-ar over a two-year period. The final objective to identify the most sustainable farming system and the best 'good agricultural practices' to preserve soil microarthropods and, more generally, to promote the conservation of soil biodiversity in different agroecosystem types.
Four arable lands, four olive groves, and four vineyards located within the Conero Park (Italy) were studied. The QBS-ar index, number of biological forms, density (ind/m3), total abundance, Acari/Collembola ratio, and percentage of Oribatid mites out of total mites were determined. Ordination analysis was used to analyse the soil microarthropod community composition across farming systems.
The results indicate that organic farming combined with land protection has a positive impact on soil health. Most farms demonstrated excellent soil quality, with the highest levels found in arable land. These findings support the “Intermediate Disturbance Hypothesis” (IDH), which suggests that slightly disturbed habitats exhibit higherorganism diversity than stable ones. The community structure of microarthropods in arable land differed from that in the more stable arboreal crops. Olive groves had a higher abundance and diversity of microarthropods compared to vineyards, which exhibited lower levels.
This study provides knowledge towards an informed use of microarthropods as bioindicators of soil health. It emphasizes the importance of monitoring biological soil health in protected areas and establishing thresholds for the prevalent farming systems, characterised by different agronomic practices. This is crucial for promoting the use of the QBS-ar index in national/international soil health monitoring.

Keywords: QBS-ar,Soil Health,Soil microarthropods,Organic farming,Protected areas

ID ABS WEB: 137771

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

SOILGUARD – EFFECTS OF LAND USE AND AGRICULTURAL MANAGEMENT ALONG SOIL DEGRADATION GRADIENTS ON NEMATODES, ACARI AND COLLEMBOLA IN EUROPEAN SITES.

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Soil health is defined as the capacity of a soil to function within ecosystem and land-use boundaries. Soil biota can sustain a wide range of functions and as such are intrinsically connected to soil health. Land use, soil management and land degradation can affect soil biodiversity and ultimately soil health. Soil fauna is an integral part of soil biodiversity connected at various levels of the food web with other important soil organisms such as bacteria and fungi. Nematodes are ubiquitous organisms that are sensitive to disturbances and can be divided into functional groups based on feeding preferences and life-history strategies. Mites and collembola are two groups of microarthropods that are sensitive to land use change and soil management. These different groups of organisms can be used as indicators of soil biodiversity and health. The objective of this study is to investigate the status of nematode, acari and collembola abundance and diversity upon various land uses, agricultural management, and land degradation levels. The final aim is to connect their abundance and diversity to soil multifunctionality and soil health. Nematodes, acari and collembola community characteristics have been assessed in seven European NUTS regions with different land use (forest, grassland and arable land), management (clearcutting vs continuous cover, grass monoculture vs grass-clover mix, organic vs conventional agriculture), pedo-climatic (texture, climate) characteristics, and land degradation levels (organic matter levels). Nematode, acari and collembola abundance and taxonomic diversity are currently being analysed with traditional morphological methods and the results will be presented during the congress.

Keywords: soil fauna,soil management,molecular methods,Morphological methods,methods comparison

ID ABS WEB: 137836

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

MICROARTHROPOD'S FUNCTIONAL INDICES TO ASSESS MYCORRHIZAE INOCULA ACROSS EUROPE

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The use of bacterial and fungal rhizospheral inocula and their consortia is important for sustainable crop systems when their use allows a reduction of chemical fertilizer inputs and plant protection products, and/or enhance soil biodiversity supporting soil health. Therefore, the identification of suitable ecological indices to assess soil health is crucial for monitoring the effects of those inocula on resident soil communities. In this work we evaluated two inocula i) different endophytic arbuscular mycorrhizal fungi (AMF, n=14) and ii) the AMF with the addition of bio-effectors (i.e., products showing biostimulating effects, AMF_Bf, n=12) in 16 sites across Europe. Three-year AMF effects on soil-dwelling microarthropod communities were compared to untreated control plots (UTC, n=16) on tomato, strawberry, and apple cropping systems, managed with integrated and organic methods. The microarthropod community was classified in biological forms (BFs) by their functional adaptation to soil life. In total, 4955 animals in 33 different BFs were extracted and identified from 129 soil samples. Seven biodiversity indices based on BFs were compared among the treatments. Results evidenced that the most effective biodiversity indices for the microarthropod community were those based on BF presence (QBS-ar and QBS-ar_BF) compared to those based on BF abundances (e.g. Acari/Collembola abundance, Shannon, QBS-ab). Overall, AMF treatments increased the arthropod diversity compared to UTC (by 57% cases and 71% cases for QBS-ar and QBS-ar_BF, respectively). Unexpectedly, the increase rate was less frequent when the bioeffector was added (QBS-ar: 42%; QBS-ar BF: 42%). Indeed, the treatments were more effective under integrated compared to organic management. In conclusion, the novel QBS-ar_BF index was useful in discriminating among treatments and management systems. In addition, results suggest that organically managed soils, which have a more complex and stable community, may benefit less from AMF treatment. Nevertheless, the inoculation with AMF fungi was beneficial for microarthropod diversity in most cases and encourages new perspectives to enhance soil health.

Keywords: Biostimulants,Arbuscular Mycorrhizal Fungi,QBS-ar,Diversity indices comparison,Soil health

ID ABS WEB: 138107

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

DIFFERENT APPROACHES TO NEMATODE, MICROARTHROPOD AND EARTHWORM ECOLOGICAL INDICES TO ASSESS SOIL HEALTH IN EUROPEAN LONG-TERM-EXPERIMENTS

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Farming practices can affect soil health, and soil fauna serves as effective indicator of these impacts, with different taxa experiencing greater or lesser effects depending on the specific nature of the impact. A comprehensive assessment should therefore consider several organism groups. The evaluation of the effect of farming practices on soil fauna is commonly carried out using several types of indices: (i) abundance indices, indicating the quantity of animals; (ii) taxonomical indices, evaluating taxa diversity; and (iii) functional indices, measuring the roles of taxa in ecosystems. Still, there is no clear evidence on which of these indices is more suitable for the detection of changes in the soil status.
The impacts of farming practices on soil fauna abundance and diversity were evaluated in nine European Long Term Agricultural Experiments (LTEs) across a gradient of pedoclimatic conditions, employing different tillage systems and fertilization practices. In autumn 2022, these LTEs were sampled to assess soil health using also fauna diversity indices, focusing on nematodes, microarthropods, and earthworms to represent micro-, meso-, and macrofauna biodiversity, respectively.
This work will compare the three categories of indices mentioned. The aim is to determine which type of indices are most sensitive in detecting differences in soil fauna communities when organic or mineral fertilization practices and standard, reduced or no tillage management are applied. The development and application of appropriate ecological indices not only will facilitate a more accurate and comprehensive evaluation of soil fauna communities, but it will even contribute to the formulation of targeted conservation and management strategies aimed at promoting long-term soil sustainability.

Keywords: Soil biodiversity,Tillage,QBS-ar,Nematoda,Annelida

ID ABS WEB: 138255

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

SOIL MICROARTHROPODS AS BIOLOGICAL INDICATORS OF PESTICIDE IMPACT ON HAZELNUT ORCHARD SOILS

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Conventional and organic hazelnut orchards were examined in a first two-year project period (2015-16) and in a second two-year period (2018-2019) in Central Italy. In the former, organic hazelnut farms not located in protected areas showed problems due to the choice of experimental fields to be compared. Therefore, 2015-16 results resulted influenced by the surrounding environment and other management characteristics. During this period, however, a rigorous set of covariates useful for the selection of the study areas was defined. This helped an accurate selection of the comparable crops in the second two-year period. In 2018-2019, the new selected study areas allowed to correctly compare the fields of each organic/conventional pair for all environmental variables considered. This led to statistically significant results comparing the two different types of agronomic management. Pesticide application in the conventionally integrated managed orchards produced substantial effects on soil microarthropod community structure, affected both in soil fauna groups richness and in the specimens' abundance. The results of this monitoring campaign show how effective and efficient can be soil microarthropods as biological indicators of pesticide impact on biodiversity. A series of comparisons illustrate the relative differences and proportions, highlighting the need to protect this fundamental key group and to use it into the monitoring activities, remarking the need for a severe pesticide regulation.

Keywords: Soil Microarthropods,QBS-ar,Biological Monitoring,Pestiocide Impact,Hazelnut

ID ABS WEB: 138371

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

EARTHWORM POPULATION IN THE EARLY TRANSITION PERIOD TO ALTERNATIVE TILLAGE SYSTEMS

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In temperate climate zones earthworms are important soil engineers affecting soil structural stability, porosity and nutrient cycling thus influencing agricultural production. The aim of our study was to examine the earthworm population in the early transition period to alternative tillage systems in arable fields in Slovenia by comparing conventional, conservation and no-till systems.
Sampling was carried out in three consecutive years (2021, 2022, 2023) of which 2022 was extremely dry and 2023 extremely wet with local flooding. Field experiment was established at the Infrastructure Center Jablje in central Slovenia in 2018, where a total of 2.8 ha with the same crop rotation have been managed under three tillage systems. In beginning of October each year, we sampled five 30x30 cm areas in each tillage system using a combined field collection method: hand searching of topsoil (0-20 cm) and application of allyl isothiocyanate (AITC) solution at the depth below 20 cm.
Overall, the highest number of earthworms was detected in conservation and no-till systems with conventional tillage supporting fewer individuals. Juveniles were mostly concentrated in the topsoil layer (0-20 cm) but adults were similarly distributed at both examined soil depths. Severe drought in the summer of 2022 importantly reduced the earthworm population with effect being most pronounced for juveniles and less for adults. Both extreme weather conditions (drought in 2022 and flooding in 2023) had the least effect on no-till system with the lowest variability in earthworm abundance between years for juveniles and adults. Conservation tillage induced the most pronounced variability in earthworm abundance between years, especially in juveniles.
Although our field experiment is at an early stage of transition to alternative tillage systems, the effect on earthworms was already evident. No-till systems offered stable conditions which reduced the negative effects of severe weather and supported the most stable earthworm population even in a very dry year.

Keywords: no-tillage,minimum tillage,extreme weather conditions,soil biota,sustainable agriculture

ID ABS WEB: 135386

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

REGULATION OF SOIL CARBON SEQUESTRATION IN WATER-LIMITED ENVIRONMENTS: A GLOBAL REVIEW AND EXAMPLES FROM THE SOUTHWESTERN UNITED STATES

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Healthy soil provides the foundation for sustainable and climate-resilient agriculture. Soil health degradation and lack of comprehensive information on strategies for improving soil health and increasing soil organic carbon (SOC) sequestration have challenged agricultural sustainability in water-limited environments, such as arid and semi-arid southwestern United States. We reviewed the literature on SOC sequestration in arid and semi-arid regions with the adoption of conservation and regenerative farming practices and studied their impacts on soil health, SOC and nitrogen (N) pools, and their relationship with sustainable crop production. Our review of published global data between 1990 and 2021 comparing SOC sequestration in arid and semi-arid regions revealed a mean SOC sequestration rate of 271 kg C ha-1 yr-1 and 235 kg C ha-1 yr-1 with cover cropping and diverse crop rotation in the upper 30 cm depth. Similarly, a four-year study evaluating SOC and N pools under no-tillage corn (Zea mays L.) – sorghum [Sorghum bicolor (L.) Moench] rotation with cover cropping demonstrated improvements in soil health, SOC storage, and nutrient cycling in semi-arid soils. The SOC was 12 to 43% greater under a diverse mixture than under no cover cropping at 0–60 cm, while total labile N was 27 to 35% greater under a grass-legume mixture than no cover crop at 0–20 cm depth. Similarly, soil potentially mineralizable carbon content with cover cropping was 85.5% and 70.5 % greater than without at 10–20 and 20–40 cm soil depths. The SOC stock under various cover crops ranged between 7 to 22% greater than under no cover crops, resulting in SOC sequestration of 1.5–2.3 Mg C ha-1 y-1 with cover cropping. Another long-term experiment (2015-2024) evaluating SOC sequestration with cover crops and compost application showed contrasting results of cover crops and compost on various SOC and N fractions in winter wheat (Triticum aestivum L.)–sorghum–fallow rotation. Results of these studies will be shared with a broader audience.

Keywords: soil carbon sequestration,nitrogen cycling,crop diversification,soil health,semi-arid regions

ID ABS WEB: 135902

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

GREENHOUSE GAS EMISSIONS IN LONG-TERM DRYLAND CROPPING SYSTEMS

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Information is needed on the effect of long-term cropping systems on greenhouse gas (GHG) emissions in dryland conditions. The effect of 34 years of dryland cropping system was examined on N2O and CH4 emissions, GHG balance (GHGB), crop yield, and yield-scaled GHG balance (YSGB) from 2016-2017 to 2017-2018 in the US northern Great Plains. Cropping systems were no-till continuous spring wheat (NTCW), no-till spring wheat-pea (NTWP), and conventional till spring wheat-fallow (CTWF). Gases were sampled twice a week to once a month throughout the year using a static chamber and flux determined. Soil C sequestration rate to a depth of 10 cm was determined from samples taken in 2012 and 2019. The N2O emissions occurred immediately after planting, fertilization, and intense rainfall from May to September in both years when the emissions was greater for NTCW and NTWP than CTWF. The CH4 emissions was minimal and mostly negative throughout the year. Carbon sequestration rate was greater for NTCW than NTWP and CTWF. As a result, GHGB was lower for NTCW than NTWP and CTWF. Crop yield was greater for NTWP than NTCW and CTWF in 2016-2017, but not different among cropping systems in 2017-2018. The YSGB was also lower for NTCW than CTWF in both years. Although NTCW reduced GHG emissions, increased infestation of weeds and pests and soil acidity reduced crop yield in this cropping system. Therefore, NTWP is recommended for reducing GHG emissions while sustaining long-term dryland crop yields in the northern Great Plains, USA.

Keywords: Greenhouse gas,Cropping system,Dryland agriculture,GHG balance,Carbon sequestration

ID ABS WEB: 135996

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

A SMART DYNAMIC WEB-BASED TOOL FOR THE IDENTIFICATION OF THE BEST MANAGEMENT PRACTICES: THE LANDSUPPORT BEST PRACTICE TOOL

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This work presents the LandSupport - best practice tool, which allows to dynamically identify optimized agronomic solutions to pursue the objective flexibly set by the user to enhance both agricultural production and environmental sustainability. The tool is dynamic and integrates the ARMOSA process-based model, which runs on the geospatial Decision Support System LandSupport (www.landsupport.eu), which associates soil properties and weather data to the agricultural fields of three European case studies (Marchfeld Region in Austria, Zala County in Hungary, and Campania Region in Italy).
In a user-defined region of interest, the best practice tool simulates the effect of local management practices (N fertilization, crop residue management, tillage, irrigation) on crop production, nitrate leaching, and SOCchange. The tool provides a synthetic “Best Practice index”, which combines the three model’s outputs, weighted according to the end-user objectives in a multi-criteria approach. By dynamically choosing these weights, the simulated combinations of management practices are ranked to obtain the best local option.
In the early future, the process-based modeling approach will allow to simulate site-specific conditions by assimilating weather and soil data. Moreover, further practices can be easily added.
The best practice tool can contribute to several CAP requirements such as the Conditionality Obligations (Art. 12), and to Schemes for the Climate and the Environment (Art.28). Furthermore, the tool concretely approaches some issues of land degradation as required by the Sustainable Development Goals, which can be effectively reached only if we act locally in a diffuse manner, by providing easy-to-use operational tools.

Keywords: Agronomic best practices,ARMOSA model,geoSpatial DSS,nitrate leaching,carbon stock

ID ABS WEB: 136193

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

THE RESISTANCE AND RECOVERY OF SOIL NITROGEN FERTILITY

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How crops response synthetic nitrogen (N) applied to soils of differing fertilities is a noteworthy scientific question that remains unclear. Here we investigated the resistance and recovery of soil nitrogen (N) fertility using a long-term plot (since 2006) with various N, straw and manure fertilization regimes. We found that the high fertility soils (balanced synthetic N and manure treatment) had a significantly higher fertilizer N use efficiency (56%) with lower residual fertilizer N in soil (47 kg N ha-1) than the medium fertility soils (optimum and conventional synthetic N; 46% and 64 kg N ha-1, respectively)1. High fertility soils could provide resistance to N fertilizer reduction and maintain high yield and soil fertility even after N fertilizer supply is ceased2. High fertility soils improved the assimilability of ammonium N, which could reduce the loss of active N in soils3. Conventional synthetic N soils with long-term excessive N application continued to maintain a comparable high yield and N uptake even after N fertilizer supply was stopped, also indicating a high resistance2, which means that residual N would be used by crops directly or mineralized4,5. This effect could be applied with less N fertilizer to reduce N losses1,6. Surprisingly, re-supplying N to low fertility soils significantly increased N use efficiency to 68% and reduced residual N (31 kg N ha-1) in the soils compared to medium fertility soils (46% and 64 kg N ha-1, respectively)1. This change was associated with a large increase in root mass and root length density in the soils2,7,8,9. This illustrated the strong recovery of soils to crop productivity when resupplying N fertilizer to the lower fertility soils and the different legacy effects from historic fertilization regimes. The combination of manure and synthetic fertilizers improves soil fertility while sequestering carbon and increasing yields, which is an ideal measure for sustainable N management.

Keywords: Crop production,Soil nitrogen fertility,Resistance,Recovery

ID ABS WEB: 136332

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

SOIL MICRO-FOOD WEB AS THE KEY BIOLOGICAL DRIVER OF VITAL ECOSYSTEM SERVICES FOR CROP PRODUCTION

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Soil nitrogen supply and carbon accumulation are essential ecosystem services that support sustainable crop production. The soil micro-food web, which includes multitrophic interactions among various biological groups, is vital for the delivery of soil functions that underpin these ecosystem services. However, the majority of studies have only focused on certain components of the soil micro-food web, such as bacteria and/or fungi. We estimated the responses of soil micro-food webs at the aggregate level to different fertilization strategies, with the aim of understanding the impacts of soil biota on nitrogen supply and organic carbon accumulation in cropland soil. This study was based on a long-term field experiment that included recommended synthetic fertilization regime, partial synthetic nitrogen replacement with organic amendments and a zero-fertilizer control (Ctrl). Beside bacteria and fungi, nematodes and protists at higher trophic levels are important to the co-occurrence networks of the soil micro-food webs. The community composition of the taxa that significantly correlated with nitrogen supply was responsive to fertilization and important to crop yield based on random forest regression. On the other hand, the relative abundance of taxa from bacteria, fungi, protists and nematodes that correlated with carbon cycle was significantly increased by fertilization. The network complexity of the soil micro-food webs at the aggregate level was also 1-4 time higher under fertilized treatments. Compared with the contributions of bacteria and fungi to the accumulation of organic carbon, those from nematodes, protists and network complexity were also high. In conclusion, organisms of the soil micro-food web at high trophic levels play a crucial role in nitrogen supply and carbon accumulation of cropland soil. Their ecological roles should be further investigated to better utilize the biological potential of soil through improve management practices.

Keywords: soil health,carbon sequestration,nutrient supply,crop yield,biodiversity

ID ABS WEB: 136338

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

OPTIMIZING NUTRIENT USE EFFICIENCY REDUCES THE POTENTIAL FOR SOIL CARBON SEQUESTRATION OF A TEMPERATURE GRASSLAND SOIL

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Grassland soils can potentially act as significant C sinks. Soil management practices play an important role in determining whether soil C stocks increase and net sequestration is achieved. Management effects ought to be evaluated in terms of nutrient efficiency to evaluate in a holistic manner both benefits and impacts from intensive grasslands. In this study we examine data from a long-term grassland experiment established in 1970 in Northern Ireland. This experiment has eight treatments which include an unfertilised control, inorganic fertiliser, and two types of slurry (cow and pig) at three different application rates. Common nutrient use efficiency indices were calculated and related to the soil C sequestration. The high cow slurry treatment had the largest observed soil C sequestration, however this corresponded with the lowest nitrogen (N) use efficiency (NUE). The NUE of inorganic fertiliser treatment was greater than all rates of the pig slurry and had the second highest soil C sequestered. Overall, there was a negative relationship between NUE and the soil C sequestered. Likewise, there were similar findings for the nitrogen utilisation efficiency. Efficiency indices were calculated for other nutrients (e.g. phosphorus and potassium) and related to soil C sequestration. These relationships indicate there are significant trade-offs between the efficiency of nutrient use and soil C sequestration. These results raise challenges for the management of grassland and have major implications on approaches to optimise management to achieve win: win scenarios. Indeed, this study provides information to minimise trade-offs and to sustainably balance production with climate change objectives.

Keywords: Nutrient use efficiency,Soil Carbon sequestration,trade-offs

ID ABS WEB: 136417

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

COMPLEMENTATION BETWEEN MICROBIAL NECROMASS AND PLANT DEBRIS GOVERNS LONG-TERM BUILD-UP OF THE SOIL ORGANIC CARBON POOL IN CONSERVATION AGRICULTURE

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Soil organic matter is primarily originated from plant residue but occurs as a continuum from relatively fresh plant tissue to highly humified components. Nevertheless, the dynamic contribution of plant residue versus microbial necromass to the long-term build-up of the soil organic carbon (SOC) pool is still uncertain in conservation agricultural system. A 12-year conservation tillage experiment with maize additions of zero, half and full harvest was conducted in Northeast China. Soil samples in the 0-10 cm depth were collected at 1-4 year intervals. The microbial residue biomarker amino sugar and plant component biomarker lignin phenol were quantified to trace the dynamics of microbial necromass and plant debris. Temporally, the content of amino sugar increased exponentially to 21-45% and approached steady-state equilibrium after 12 years of maize straw mulching, indicating the existence of "microbial carrying capacity" under repeated plant residue addition. With prolonged duration of conservation tillage and increasing rate of maize straw return, the ratio of amino sugar to lignin phenol decreased from 6.2 to 1.7, accompanied by a decreased degree of lignin side-chain oxidation, indicating that organic input enhanced the selective retention of fresh plant lignin to a larger extent than microbial necromass. The build-up of the SOC pool under conservation tillage was critically controlled by the functional complementation of microbial- and plant-derived components. Maize straw input was able to enhance the contribution of microbial necromass to SOC stabilization by increasing fungal necromass accumulation, while the retention of lignin-like plant debris enlarged the SOC pool capacity and potentially maintained the decomposability of SOC in the long term.

Keywords: Soil orgaic carbon,Microbial necromass,Plant lignin,Conservational tillage,Stability and availability

ID ABS WEB: 136419

4. Soil health in achieving the Sustainable Development Goals
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COST-EFFECTIVE ADAPTATION TO WARMING IN GLOBAL CROPLANDS

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Croplands serve as the primary nitrogen source for human and contribute to nitrogen loss in the environment. Warming poses a dual threat to global food security and environmental sustainability. However, there remains a lack of consensus regarding the impact of warming on the cropland nitrogen cycle. Here we synthesized 2,289 experimental observations from global croplands and found that warming alone would decrease crop yields by 21% (95% CI, 15-27%), while increasing multiple nitrogen losses to the environment by 54-169%. By 2050, the global nitrogen harvest is projected to decline by 16 Tg (10^12g) annually, and nitrogen use efficiency would decrease from 47% to 38% under the warming scenario relative to the baseline scenario, leading to a 29 Tg increase in nitrogen surplus. These changes would exacerbate food crisis and nitrogen pollution, deepening regional inequality, particularly for low-income economies in Africa, Latin America, and Asia. Implementing timely and robust adaptation strategies that optimize planting date, cultivar, irrigation, and fertilization could retrieve a loss of US$ 530 billion through avoiding damages to human and ecosystem health, with an estimated cost of US$ 73 billion.

Keywords: Climate change,Nitrogen cycle,Cropland,Adaptation strategy,Cost-benefit analysis

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THE SOIL MICROBIAL CARBON PUMP: FROM CONCEPTUAL INSIGHTS TO EMPIRICAL ASSESSMENTS

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Soil organic matter (SOM), as the largest terrestrial organic carbon pool, plays a pivotal role in soil organic carbon (SOC) storage and thus impacts atmospheric carbon and global climate. Our understanding of SOM genesis has shifted from the plant humus period to an ecological period emphasizing environmental and biological controls. The soil microbial carbon pump (MCP) concept emphasizes the active role of soil microbes in SOC storage by integrating the continual microbial transformation of organic carbon from labile to persistent anabolic forms. While the soil MCP concept is conceptually compelling, it lacks clear mechanistic understanding and sufficient empirical study evaluation that somewhat ineffectively link microbial necromass with SOC dynamics. Here, we interrogate the soil MCP concept by examining the asynchronous responses of microbial necromass and SOC to land-use change. Microbial necromass appeared to preferentially accumulate in the soil emerging as the dominant contributor to SOC accrual in diversified perennial bioenergy crops. Specifically, approximately 92% of the additional SOC enhanced by plant diversity was estimated to be microbial necromass carbon, and over 76% of the additional SOC resulting from the transition from annual to perennial crops was estimated to be microbial necromass. This suggests that the soil MCP was stimulated in diversified perennial agroecosystems. To assess the conversion of plant carbon into microbial necromass and the contribution of microbial necromass to SOC, we delineate two parameters: soil MCP capacity and efficacy, respectively. We hope these parameters serve as valuable metrics in evaluating SOC storage in global change studies.

Keywords: Soil microbial carbon pump,Soil organic carbon,Microbial necromass,Bioenergy cropping system,MCP efficacy

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4. Soil health in achieving the Sustainable Development Goals
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INVESTIGATING THE EFFECTS OF UREASE INHIBITORS AND NITRIFICATION INHIBITORS ON THE SOIL MICROBIOME

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Urease inhibitors (UI) and nitrification inhibitors (NI) are added to fertilizers to reduce emissions of ammonia, nitrous oxide, and nitrate leaching, and to increase N fertilization efficiency. However, little is known about whether UIs and NIs have unintended side effects on the soil microbiome. Here, we investigate how UIs and NIs affect the soil microbiome. Soil parameters (pH, NH4+, NO3-) and enzyme activities (dehydrogenase, urease, nitrification, arginine ammonification, glucosidase, acid phosphatase, arylsulfatase) were analyzed after application of different fertilization treatments in a lab incubation study. These comprised no fertilization, ammonium sulfate nitrate (ASS), ASS + NI, urea, urea + UI, urea + UI + NI. Additionally, the microbial community structure (via amplicon sequencing) and functional groups (via qPCR) will be analyzed. All experiments will be conducted with different soil types and each soil is incubated at 40% and 80% of maximum water holding capacity (WHC). At the time of abstract submission, the first results comprised the soil parameters and enzyme activities of a sandy soil at 40% WHC. It was found that the UIs reduced the activity of their target enzyme urease to about a third but also reduced the non-target process of arginine ammonification. Thus, UIs not only inhibited ammonium production from urea but also from other organic substrates. The NIs decreased the nitrate content by 18% (ASS + NI) and 21% (urea + UI + NI) in comparison to the soil fertilized without NI. The C-, P-, and S-cycle related enzyme activities were not affected by the inhibitors. The preliminary results showed that UIs and NIs have their intended effect. However, the reduced arginine ammonification rate after UI application indicated that other than the targeted soil processes might be affected. We will further investigate this in the currently ongoing project and check for unintended side effects on functional microbial groups and the microbial community structure in different soils.

Keywords: Nitrogen,Fertilization,Microbial community,Sustainable agriculture

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4. Soil health in achieving the Sustainable Development Goals
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EXPLORING NUTRIENT RECYCLING POTENTIAL OF STRUVITE AND ZEOLITES IN SOIL: INSIGHTS ON IMMEDIATE CARBON AND NITROGEN DYNAMICS

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Intensive farming diminishes soil fertility and health, while conventional fertilization poses challenges related with environmental pollution, greenhouse gas emissions and scarce efficiency. Enhancing nutrient recycling from waste materials is therefore crucial.
A noteworthy approach involves reclaiming nutrients from wastewaters via struvite (MgNH4PO4·6H2O) precipitation and N–enriched zeolites, providing new materials for crop nutrition with potential of slow–release.
In a three–day laboratory incubation experiment we investigated the effects of wastewater–produced struvite and two N–enriched natural zeolites on acidic sandy loam arable soil, whereas zeolites were also tested at natural state (devoid of N), as soil amendments in the presence of struvite. Treatments were compared with the same liquid digestate used for producing them (representing a traditional organic fertilizer), and the unfertilized soil, with the aim to elucidate the short–term abiotic and biotic (microbial) drivers in N cycling and organic C turnover in soil under innovative fertilization.
All the treatments distinctly increased soil pH, with major effects on soil biogeochemical properties. The struvite quickly solubilized due to soil acidity, stimulating nitrifying and denitrifying microorganisms. Labile organic matter was released as an effect of pH increasing, where pH also governed NH3 emissions, stoichiometric relationships for C–, N– and P–acquiring exoenzymes activities, as well as the C and N microbial stoichiometry, with potentials for N immobilization. Notably, zeolites showed promising potential for CO2 and NOx mitigation.
Struvite and zeolites enable waste revalorization and prove valuable in mitigating nutrient losses through waste treatment. This study highlights the importance of pH management, particularly when applying these materials in acidic soil, to effectively counteract losses and achieve efficient fertilization.

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-ECS_00000033-ECOSISTER-spk1

Keywords: zeolites and struvite,carbon farming,nitrogen cycling,microbial activity,greenhouse gases emissions

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4. Soil health in achieving the Sustainable Development Goals
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ENHANCING GLOBAL RICE PRODUCTION SUSTAINABILITY THROUGH CROP DIVERSIFICATION: A PATHWAY TO ACHIEVE THE UN 2030 SDGS

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Rice, as a primary calorie source, sustains approximately half of the global population, notably in regions grappling with malnutrition. Yet, contemporary rice cultivation systems encounter multifaceted environmental challenges, prominently nitrogen (N) losses and greenhouse gas (GHG) emissions. Concurrently, the demand for rice is anticipated to escalate from 480 million tons in 2014 to 550 million tons by 2030. To reach the United Nations' 2030 Sustainable Development Goals (SDGs) and feed the world, it necessitates a paradigm shift in rice agriculture, targeting enhanced yield outputs while concurrently mitigating environmental outflow. Compare with rice monoculture, crop diversification shows multiple advantages including increasing and stabilizing yield, and reducing environmental costs. Among them, diversified rice systems with inclusion of pulses/legumes are known to improve soil organic matter and reduce environmental N losses through biological N fixation, root exudates and higher below ground biomass. Furthermore, the low C:N ratio of legume residues bolsters the soil carbon sequestration capacity. The gaps between legume and non-legume crops in diversification rice systems suggest a noteworthy possibility for the improvement of rice-based systems. However, challenges exist in identifying globally viable croplands favor for diversified rice system and selecting optimal rotational crops suited to varied environmental conditions. Here, we endeavor to map potential lands amenable to rice rotation optimization and identify suitable rotational crops. By evaluating the environmental and sustainability benefits of these systemic alterations, we aim to furnish empirical insights into the global transition towards more sustainable rice-based cropping systems. Our findings hold the potential to guide policy and practice, contributing to the attainment of the SDGs and addressing global food security challenges.

Keywords: Diversified rice systems,Legumes,Soil carbon sequestration,Environmental nitrogen losses,Optimal rotational crops

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4. Soil health in achieving the Sustainable Development Goals
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CEMENT KILN DUST (CKD), DIGESTATE AND HUMIC ACID AFFECT GREENHOUSE GAS EMISSIONS AND CROP YIELD

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Cement kiln dust (CKD) is a byproduct of the cement industry and is often disposed of in landfills, which can be costly and environmentally unfriendly. We tested the effects of CKD (pH=12.65), a digestate (DG), and a humic acid (HA, extracted humin, humic and fulvic acids) as soil amendments on soil pH and nutrient availabilities, greenhouse gas emissions and crop yield in a wheat-canola rotation in a two-year field study on a Luvisolic soil. The following five treatments were studied: 1) Control, CK, application of conventional chemical fertilizers, 2) CKD: CKD+ chemical fertilizers, 3) CKD+HF: CKD+ 50 % of chemical fertilizers, 4) CKD+HF+DG : CKD+ 50 % of chemical fertilizers+DG, and 5) CKD+HF+HA : CKD+50 % of chemical fertilizers +HA. In year one, the application of CKD, regardless of whether applied alone or with DG or HA, increased soil pH, and had mixed effects on carbon dioxide emissions, where the application of DG increased carbon dioxide emissions, decreased nitrous oxide emissions, tended to increase methane oxidation, and increased crop yield (when CKD was applied with DG or HA). In year two, soil pH was higher in treatments where CKD was applied. All treatments increased carbon dioxide emissions but decreased nitrous oxide emissions as compared with the CK, but there were non-significant differences in methane emissions and crop yield among the treatments. The research will be conducted for two more years to assess the long-term effects of these treatments. The first two-year data suggest that CKD applied alone or in combination with DG and HA was beneficial for countering soil acidification that can result from long-term chemical fertilizer applications and reducing nitrous oxide emissions. Land application of CKD reduces waste production and has the potential to improve soil sustainability.

Keywords: Cement kiln dust,Greenhouse gas emission,Carbon cycling,Nitrogen cycling,Crop management

ID ABS WEB: 137100

4. Soil health in achieving the Sustainable Development Goals
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NET GLOBAL WARMING POTENTIAL INDEX RATHER THAN SOIL CARBON STOCK CHANGE COULD PROVIDE BETTER UNDERSTANDING OF THE CARBON BALANCE IN SOIL SYSTEMS

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This study was conducted to determine the soil organic carbon (SOC) stock change factor for green manure crops that was developed by the Intergovernmental Panel on Climate Change (IPCC) Tier 2 method and compare this with the net global warming potential (GWP) index that is used to evaluate the contribution of green manuring to global warming. Four treatments were barley (Hordeum vulgare L.; B), hairy vetch (Vicia villosa R.; HV), a barley/hairy vetch mixture (BHV) and a conventional treatment (C). The aboveground biomass of green manure crops was incorporated into the soil on 25 May 2018, 26 April 2019, 29 April 2020, 30 April 2021 and 2 May 2022. Maize was transplanted as the subsequent crop after the incorporation of green manures. SOC stock decreased with green manures, even though carbon input with green manures, including B, HV and BHV, was greater than that with C. The mean value of SOC stock change factor for green manure crops, including B, HV and BHV was 0.627 and was significantly lower than that of the C. However, the net GWP also decreased with incorporation of green manure crops and the mean value of the relative net GWP index across B, HV and BHV was 0.853. These conflicting results were caused by different estimation methods between annual SOC change (δSOC) and net GWP. The estimation of SOC stock change using δSOC suggested by the IPCC method may overestimate the contribution of green manure crops to global warming. The net GWP method with comprehensive input and output of carbon in the soil system could provide better understanding of the carbon balance in soil systems. In the current study, the comparison of δSOC and net GWP was conducted for at one site of upland soil for 5 years. Therefore, further research on estimating the effect of green manure crops on net GWP in various types of soil for longer years should be conducted.

Keywords: Global warming potential,Greenhouse gas,Net ecosystem carbon budget,Soil carbon,Upland crop

ID ABS WEB: 137112

4. Soil health in achieving the Sustainable Development Goals
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THE PROCESS AND MECHANISM OF 'CARBON FOR NITROGEN' EXCHANGE IN PLANTS UNDER CONTRASTING INTEGRATING DEGREE OF THE N FORM

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This study delves deep into a key theme in terrestrial ecosystem ecology: understanding how plant growth influences soil nutrient cycling. Focusing on the interactions between microbes, soil, and plants in regulating nitrogen (N) cycling, highlights how these dynamics vary with the integrating degree of N form, particularly between crop-preferred nitrogen and soil-dominated inorganic nitrogen. Despite its importance, these mechanisms have not been systematically unraveled by the prevailing paradigm.
To address this gap, this comprehensive study investigates the complex dynamics of soil nitrogen cycling, with a special emphasis on contrasting agricultural systems: acid soil-rice systems (High integrating degree of N form, HID) versus calcareous soil-rice systems (Low integrating degree of N form, LID). The research employs a dual 13C/15N labeling approach N labeling method in a glasshouse experiment, complemented by sophisticated 15N transformation modeling in both aerobic and anaerobic incubations.
The findings indicate that the LID system demonstrates a unique adaptation strategy, characterized by a greater allocation of photosynthetic carbon to the roots, a lower soil pH, specialized root architecture, and a distinct microbial community. These adaptations collectively expedite the mineralization-immobilization turnover and markedly decrease nitrogen nitrification and denitrification rates in the rhizosphere compared to the bulk soil. Consequently, this leads to an enhanced ability of the LID system plants to uptake nitrogen efficiently, directing more resources to above-ground growth. This biological strategy not only boosts photosynthetic efficiency but also mitigates ammonia volatilization and leaching losses, fostering accelerated plant growth. Moreover, these insights into the LID system's strategies highlight a crucial plant-soil carbon-nitrogen feedback mechanism, which is pivotal in sustaining plant nutrition under varying nitrogen integration conditions.
In summary, this study unveils new mechanistic insights into plant-soil carbon-nitrogen interactions under different nitrogen integration scenarios. These insights are pivotal in advancing our comprehension of nutrient cycling and microbial-soil-plant dynamics within the rhizosphere, offering valuable perspectives for sustainable agricultural practices and enhanced crop productivity in various agricultural environments.

Keywords: nitrogen cycling,Soil-Plant interaction,Photosynthetic carbon,Root exudate,dual 13C/15N labeling

ID ABS WEB: 137125

4. Soil health in achieving the Sustainable Development Goals
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BIOLOGICAL MITIGATION OF PLANT METABOLITES ON SOIL NITROUS OXIDE EMISSIONS

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Plant metabolites significantly affect soil nitrogen (N) cycling, but their influence on the potential nitrous oxide (N2O) emissions has not been quantitatively analyzed across global scales. We conducted a comprehensive meta-analysis of 173 observations from 42 articles to evaluate global patterns and controls of N2O emissions under the presence of root exudates and extracts. Overall, plant metabolites had a slight promoting effect of about 10% on soil N2O emissions. However, the changes of N2O emissions induced by plant metabolites varied with different experimental conditions and properties of metabolites and soils. Primary metabolites carbohydrates (sugars, amino acids and organic acids) remarkably stimulated soil N2O emissions by 79%, while secondary metabolites such as phenolics, terpenoids and flavonoids used as biological nitrification inhibitors (BNIs) and biological denitrification inhibitors (BDIs), reduced soil N2O emissions by 41%. The mitigation effects of BNIs/BDIs were closely associated with soil texture and pH, which increased with increasing soil clay content and soil pH under acidic and neutral soils, but with decreasing soil pH under alkaline soils. The soil incubation experiments showed that three BNIs reduced N2O emissions 32-45% while the other three carbohydrates all had a stimulatory effect by 56-63%, confirming the reliability of the meta-analysis. These results highlight the potential role and application range of specific secondary metabolites in precise bio-mitigation of global N2O emissions, and may provide new biological factor parameters for N2O emission models to improve the accuracy of model predictions.

Keywords: Plant metabolites,BNIs,Nitrous oxide,Soil pH,Soil clay content

ID ABS WEB: 137140

4. Soil health in achieving the Sustainable Development Goals
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MICROBIAL CONTROLS ON SUCCESSION PATTERN OF RESIDUE CHEMISTRY DURING NINE YEARS STRAW DECOMPOSITION ACROSS EAST CHINA

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Managing above-ground plant carbon inputs can pave the way toward carbon neutrality and mitigating climate change. Chemical complexity of plant residues largely controls carbon sequestration. There exist conflicting opinions on whether residue chemistry diverges or converges after long-term decomposition. Moreover, whether and how microbial communities regulate residue chemistry remains unclear. This study investigated the decomposition processes and residue composition dynamics of maize straw and wheat straw and related microbiomes over a period of 9 years in three climate zones. Residue chemistry exhibited a divergent-convergent trajectory during decomposition, that is, the residue composition diverged during the 0.5–3 year period under the combined effect of straw type and climate and then converged to an array of common compounds during the 3–9 year period. Chemical divergence during the first 2–3 years was primarily driven by the changes in extracellular enzyme activity influenced by keystone taxa-guided bacterial networks, and the keystone taxa belonged to Alphaproteobacteria, particularly Rhizobiales. After 9 years, microbial assimilation became dominant, leading to chemical convergence, and fungi, particularly Chaetomium, were the main contributors to microbial assimilation. Overall, this study demonstrated that keystone taxa regulate the divergent-convergent trajectory in residue chemistry.

Keywords: straw decomposition,microbial network,carbon chemical composition,enzyme activity,microbial necromass

ID ABS WEB: 137236

4. Soil health in achieving the Sustainable Development Goals
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DIVERSIFYING COVER CROPS HAD LIMITED SHORT-TERM IMPACTS ON SOIL MICROBIAL COMMUNITIES AND THE ASSOCIATED BIOGEOCHEMICAL PROCESSES

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Sandy soils often have low organic carbon content, pool soil structure, and meager soil fertility. Integrating cover crops is a promising practice to improve the soils for sustainable production. However, cover crops are different with diverse functional traits, which may make the desired management outcomes unpredictable. The objective of this study was to understand how cover crop functional trait diversity (e.g., biomass production potential, root exudates rates, N fixation capacity) affects soil biogeochemical processes in the context of improving soil health, microbial diversity, and C preservation while reducing nitrogen leaching and greenhouse gas emissions. The field experiment was established in 2017 with eight treatments of winter cover crops, i.e., cereal rye, crimson clover, hairy vetch, mixture of two cover crops, mixtures of three cover crops, and no cover crop controls. Summer crops were cotton-corn rotation. Soils were collected periodically for a range of physical-biogeochemical and microbial analyses. Cover crop biomass production, residue decomposition, and greenhouse gas emissions were quantified. The preliminary data suggested that cover crops were distinguished by their functional traits. However, their ability to improve the tested sandy soils is limited in the short term, likely due to their limited biomass production (i.e., organic C inputs) constrained by low soil nutrient availability.

Keywords: cover crop,microbial community,decomposition,greenhouse gases,soil carbon

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PREDICTING CO2 EMISSIONS IN MAIZE FIELDS: THE IMPACT OF TILLAGE AND CLIMATE ON SOIL USING NEURAL NETWORKS

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CO_2 emission from agricultural soil contributed significantly to the global carbon cycle, and climate change. The main aim of this research was to employ and evaluate the ability of two types of Artificial Neural Network i.e., Multi-layer Perceptron (MLP), and Radial Basis Function (ANN-RBF)) in predicting CO_2 emissions collectively from soil of two different climate regions. CO_2 emissions were measured from maize fields located in two different climate regions continental (Debrecen-Hungary), and semi-arid (Karaj-Iran)). Model were run by splitting the data randomly into 70% for training and 30% for testing under five scenarios (i.e., SC1, SC2, SC3, SC4, SC5). Each scenario is developed by a combination between input variables (i.e., soil temperature (T), soil moisture (M), date of measurement (SD), soil management (SM)), once as factors and once as covariate. Both algorithms MLP and RBF were able to predict CO_2 in a very good level, where the model performance (NSE) for MLP ranged between 0.62-SC5 (acceptable) and 0.87-SC2 (very good). While the NSE for RBF ranged between 0.62-SC1 (acceptable) and 0.71-SC2 (good). For both algorithms, the highest correlation (r) was recorded in SC2 (r MLP = 0.93, r ANN-RBF =0.84).

Keywords: GHGs,soil,carbon cycle,Iran,Hungary

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LONG-TERM EFFECTS OF NITROGEN FERTILIZER INPUT ON N2O AND N2 EMISSION IN NORTH CHINA PLAIN

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High nitrogen (N) input to soil could cause higher nitrous oxide (N2O) emission, i.e. a higher N2O/(N2O+N2) ratio, through an inhibition of N2O reductase activity and/or a decrease of soil pH. We assumed these two mechanisms were the immediate and long-term effects of N input on N2O emission, respectively. The immediate effect can be eliminated by decreasing N input, but not for the long-term effect. It is therefore important to separate these two effects for mitigating N2O emission. To this end, soil samples from surface to 5m depth soil profile were collected from a long-term N fertilization experiment field with two N application rates, i.e. 600 kg N ha-1 year-1 (N600) and no fertilizer N input (N0). An external N addition was conducted for each subsample in the laboratory incubation study to produce another two treatments, which were denoted as N600+N and N0+N treatments. The results showed that the combined immediate and long-term effects led to an increase of N2O/(N2O+N2) ratio by 6.8 percent, 32.6% and 67.4% of which could be explained by the immediate effect and the long-term effect of N input. Meanwhile, the long-term effects were significantly positively correlated to soil organic carbon (SOC). These results indicate that excessive N fertilizer input to soil could lead to increased N2O emission if the soil had a high SOC content. The long-term effect of N input on the N2O/(N2O+N2) ratio especially need to be taken into account when predicting soil N2O emission under the global environment change scenarios.

Keywords: N2O emission,Soil organic carbon,Denitrification,N2O/(N2O+N2) ratio,Global change

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4. Soil health in achieving the Sustainable Development Goals
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CARBON AND NITROGEN CONTENT AFTER 35 YEARS OLD TEA CULTIVATION IN WET TROPICAL REGION, WEST SUMATRA INDONESIA

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Research on aggregate fractionation as well as the carbon and nitrogen association on it was conducted under a tea plantation in a wet tropical region (100o36‘24.9”-100o39‘26.99” E and between 0o58‘19.11” – 1o1‘18.83”) in West Sumatra, Indonesia. The research aimed to determine organic carbon (OC) and total nitrogen (TN) content associated with different aggregate sizes. The soil was sampled from 3 soil depths (0-10, 10-20, 20-40 cm) at 5 different slope levels under a tea plantation 36 years old. The parameters analyzed were soil texture, bulk density, and total soil pore besides OC and TN. For OC and TN, the soil was fractionated into 3 different sizes (<250 μm = micro, 250-500 μm = meso, and >500-2000 μm = macro) aggregates. The results showed that soil texture in the area was classified into clay loam - silty clay loam, BD was < 0.9 g/cm3, and TSP was >70%. Based on aggregate fractionation, it was found that the percentage of macro > meso > micro aggregates. Soil OC was found to be the highest under micro- (5.16%) and then followed by macro- (4.88%) and meso- (4.74%) aggregates. Among the slopes, soil OC content tended to increase by increasing slope level from 0-8% to 15-25% and then decreased by continuing slope increase until >45%. As OC, soil N content was also found the highest within micro-aggregates, and then meso- and macro-aggregates. However, among the slopes, N content was not followed by OC content, it decreased with increasing slope levels. The N content was not significantly different between meso and macro aggregates. It can be concluded that either C or N was found the highest within aggregate <250 μm.

Keywords: aggregate fraction,organic-C,slope level,tea plantation,total-N

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4. Soil health in achieving the Sustainable Development Goals
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ENHANCED EFFICIENCY FERTILIZERS FOR SUSTAINABLE AGRICULTURE

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In the context of a growing global population, the increased reliance on synthetic nitrogen (N) fertilizers for global food production appears inevitable. Unfortunately, nearly half of the applied fertilizer N in agricultural systems is lost to the environment, posing significant threats to human health, environmental quality, and ecosystem services. Enhanced efficiency fertilizer (EEF) technology offers promise in mitigating N losses to the environment. EEFs regulate N release based on external stimuli (controlled-release fertilizers) and inhibit enzyme activities involved in processes that lead to N losses (urease and nitrification inhibitors). This presentation will explore the current limitations of EEFs and underscore the pressing need for breakthroughs in EEF development. Achieving this goal demands collaborative research efforts across multiple disciplines, including agronomy, soil science, synthetic chemistry, chemical engineering, plant physiology, and plant biochemistry. We argue that recognizing and quantifying the social costs avoided through EEF adoption are imperative to incentivize the use of innovative N fertilizers. This approach will not only prevent substantial expenditures on N pollution mitigation but also ensure global food security.

Keywords: enhanced efficiency fertilizer,nitrogen loss,nitrogen use efficiency,sustainable agriculture

ID ABS WEB: 138081

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

UNVEILING THE MECHANISM FOR THE DIVERGENT IMPACT OF NITROGEN FERTILIZATION ON CH4 EMISSIONS FROM RICE PADDIES

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Rice, a vital staple food for 3.8 billion, faces challenges due to population growth and environmental concerns related to nitrogen fertilizers (NF) and methane (CH_4) emissions from paddies. This study employs field experiments and a global meta-analysis to investigate the factors influencing greenhouse gas intensity (GHGI) in rice paddies, aiming to optimize NF application rates for sustainable rice production while reducing greenhouse gas (GHG) emissions. Cumulative CH_4 emissions in Hwaseong with NF application rates of 135 and 180 kg ha-1 (N1.5 and N2) were significantly lower than those with 0 kg ha-1 (Control, N0). However, in Miryang and Wanju, cumulative CH_4 emissions increased in response to all NF application rates. Compared to N1, N1.5 in all regions showed a decreased or no change in global warming potential (GWP) and exhibited a more significant reduction in greenhouse gas intensity (GHGI). Additional NF application of 45 kg ha-1 could reduce GHG emissions and improve crop yields. The methanogenesis ratio significantly increased with NF application rates in Miryang and Wanju, while in Hwaseong, it was considerably lower than N0 and N1 due to a significant increase in methanotrophs (pmoA) transcript abundance at N1.5 and N2. Cyanobacteria were a predominant microbial community in Hwaseong, occupying approximately 21-42% due to its relatively high concentration of initial total nitrogen (TN) (1.32 g kg-1) compared to the other regions (0.71 and 0.88 g kg-1, Miryang and Wanju, respectively). Cyanobacteria showed increased activity for photosynthetic function in high initial TN concentration, encouraging improved methanotroph activity. In a global-scale meta-analysis comprising 192 observations, CH_4 emissions from NF application significantly decreased as initial TN concentration increased ($P=0.004$). This study provides new evidence highlighting the determinant role of initial TN concentration in NF usage for reconciling global warming and food security.

Keywords: Methane,Rice paddies,Nitrogen fertilizer,Initial total nitrogen

ID ABS WEB: 138109

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

NUTRIENT RUNOFF AND SOIL STABILITY IN A LONG-TERM AGRICULTURAL EXPERIMENT IN CENTRAL-SOUTHEAST NORWAY

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We present soil property changes and differences in nutrient losses of six contrasting cropping systems in a 30 year long-term agricultural field experiment in central-southeast Norway. This includes three conventional systems with varying degrees of tillage intensity, use of cover crops and grass ley, as well as three organic systems that differ in the amount of grass ley in the rotation, from one in four years to three in fours years. The soil in this area is a Endostagnic Cambisol with loam and silty sand textures. The climate is humid-continental with a mean annual precipitation of 600 mm and temperature of 3.6 °C. Surface runoff and nutrient leaching is measured for each crop rotation and cropping system (n=48) on a monthly basis. Our results show that reduced tillage and high biomass inputs (cow manure in combination with grass ley rotation or no removal of stubble and use of cover crops) significantly improved aggregate stability and led to a long-term reduction of runoff losses for sediments and phosphorous. In contrast, losses of dissolved nitrogen were more dynamic and were influenced by year-to-year variation such as the amount of fertilizer inputs, establishment of cover crops or grass ley and precipitation patterns. When including the ratio of human consumable food produced to the amount of nutrient loss, the system with cover crops and reduced tillage outperformed both the most intensive cropping system with autumn ploughing and the systems that included grass ley in their rotations.

Keywords: Nitrogen use efficiency,Soil organic matter,Best management practices,Drainage,Food production

ID ABS WEB: 138244

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

AGRICULTURAL NITROGEN BALANCE IN OECD COUNTRIES: CAUSES AND IMPACTS ON NITROGEN EMISSIONS

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Excessive nitrogen (N) outflowing from agricultural land to surrounding environments can destroy the ecosystem balance and cause serious environmental pollution, endangering many living organisms. The Organization for Economic Co-operation and Development (OECD) developed a soil surface nutrient balancing system and made it mandatory for member countries to report annual nutrient budgets. Nitrogen balance varies across member countries and some have significant N balance. To evaluate changes in N balance in member countries and to figure out the reason for the changes, the 30-year N budget reports published by 35 OECD countries were reviewed and key factors consisting of N budgets were analyzed along with other N-related agri-environmental indicators. Among the three factors determining N balance (agricultural land area, N input, and N output), agricultural land area decreased in most OECD countries, negatively affecting N balance reduction. However, the OECD's average N balance highly decreased from 91 to 46 kg ha-1 over the last 30 years due to the significant decrease in N input through inorganic fertilizers and manure, especially in EU countries with high N input levels. Inorganic fertilizer and manure N inputs showed a strong positive relation with crop and forage N output, respectively. Nitrogen output did not meaningfully change. This decrease in N balance could have been achieved due to a significant improvement in N use efficiency. In comparison, in Japan and Korea, the N balance slightly increased and they became the highest N balance country recently. A higher N balance led to lower N use efficiency and higher ammonia (NH3) and nitrous oxide (N2O) emission intensities. More densely populated countries with smaller agricultural land per capita (ranging from 0.03 to 0.47 ha capita-1) showed a higher N balance (228–80 kg ha-1), presumably due to higher N input for more agricultural production on limited land. Therefore, highly populated countries with small arable land areas per capita might need multilateral efforts to alleviate agricultural N balance.

Keywords: nitrogen surplus,ammonia,nitrous oxide,nitrogen use efficiency

ID ABS WEB: 138195

4. Soil health in achieving the Sustainable Development Goals
4.17 133569 - Revitalization of mining residue deposits

CHARACTERIZATION OF MICROBIAL COMMUNITIES ASSOCIATED TO SOIL AND ROOTS OF PHYTOSTABILIZING PLANTS ON SARDINIAN ABANDONED MINING AREAS

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Abandoned mining areas are a crucial worldwide environmental problem posing serious risks for human health and ecosystems. The area of Sulcis-Iglesiente (South–West Sardinia) was one of the most important European mining district for centuries.
The physical, chemical, and biological constraints encountered in mine substrates severely limit plant colonization and growth. Moreover, the level of contaminations in these sites have been found to alter the structure of microbial communities and decrease their biodiversity.
Phytostabilization technology implies the creation of a vegetation cover for the long-term immobilization of metals within the plant rhizosphere, limiting the ecosystem exposure. Employing plant growth-promoting bacteria (PGPB) in phytoremediation processes is an effective technique that can enhance plant biomass production and stabilize metals.

The aim of this research is to improve the bioaugmentation assisted phytoremediation of these heavily polluted sites with the study of the interaction between plants spontaneously growing in mine area and microbial communities associated with.

In this study, the microbial communities and the enzymatic activity has been characterized. The analysis in progress to define the microbial communities and the toxicity of different sites are Next Generation Sequencing of rRNA genes, titre of heterotrophic bacteria and fungi, dehydrogenase assay and total metals.
Furthermore, we are selecting PGPBs for the improvement of the phytoremediation technology based on common traits such as production of indole acetic acid, ACC deaminase enzyme, siderophores, phosphate solubilization and metal tolerance.

Taking into account the metals contamination and the autochthonous plants present in these ecosystems chronically impacted by mining activities, this study allows us to enrich the knowledge regarding the microbial communities with a deepened analysis on PGPBs with the final objective of improving the phytostabilization technology.

Keywords: metal,bacteria,fungi,phytoremediation,metallophyte

ID ABS WEB: 138332

4. Soil health in achieving the Sustainable Development Goals
4.17 133569 - Revitalization of mining residue deposits

MONITORING OF CHEMICAL SPECIES IN SOILS, WATERS, AND PLANTS NEAR THE ACTIVE COPPER MINE TAILING DAM OVEJERIA (CENTRAL CHILE).

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Chile, the world's largest copper producer, generates massive amounts of mine tailings that are a source of ongoing environmental concern for local communities. The main objective of this work is to evaluate the concentration of As, Cd, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Zn and SO42- in soils, water, and vegetation in the communities surrounding the Cu Ovejería mine tailings dam, in central Chile. Soils, water and plants samples were collected from the towns of Chacabuco, Huechún, Huertos Familiares, Punta Peuco and Santa Matilde, which are located at 3 to 8 km from the mine tailings site, operated by CODELCO since 1999. The results showed that the levels of metals/metalloids and SO42- in water (pH 6.7-7.9) met both WHO limits and Chilean water quality standards for multiples uses. In soil (pH 7.7-8.4), total and available concentrations of metals/metalloids did not exceed international reference values. Plants with acceptable levels of metals and S were Citrus limon, Eucalyptus, Schinus molle, Prunus persica, Medicago sativa, Citrus sinensis, and Ficus carica. The only species with Fe content well above the reference value and with high concentrations of other metals (Cu, Mn, Mo, and Pb) was Acacia caven. The concentrations of chemical species determined between 2015-2018, in different media and locations near the active Cu tailings dam Ovejeria, in Central Chile, allow to conclude that in general the levels are comparable to national and international references and do not indicate contamination.

Keywords: mining tailing,Monitoring, water, soil, plant,copper

ID ABS WEB: 136124

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

OCCURRENCE, DISTRIBUTION PATTERNS AND RISK OF TRADITIONAL AND EMERGING ENVIRONMENTAL CONTAMINANTS IN FLUVISOLS

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Floodplain soils provide a wide range of ecosystem services including filtration, but they also face high anthropogenic pressure from economic activities. Emerging environmental contaminants (EECs) are gradually starting to appear alongside traditional such as heavy metals (HMs). The occurrence, fractions, potential ecological and human health risks of 4 HMs (Cd, Cu, Pb, Zn) and 3 EECs (Li, Ba, B) originating from historical mining in Fluvisols of various ecosystems (arable lands, grasslands, riparian zones) were investigated at 19 localities along the Štiavnica river in Slovakia. For all contaminants, we recorded at least one locality exceeding the limit value for total content. The contaminants partitioning in the different fractions revealed that Cd, Zn, and Pb were mainly associated with the exchangeable and reducible fractions, Cu with the oxidisable, and EECs residual fraction. The highest contamination factor was calculated for Cu (39.8), followed by Pb (27.4), Zn (18.2), Li (15.6), Cd (7.2), B (2.3), and Ba (2.0). We found out possible potential health risks associated with Pb and Li exposure for children. The highest hazard quotient was calculated in children group for Pb (9.51), followed by Li (1.48), Cd (0.31), Cu (0.17), Zn (0.13), Ba (0.12), and B (0.004). The soil properties were selectively correlated with the contaminant fractions. Based on the ANOVA results, the effect of different ecosystem types on HM and EEC fractions was revealed.
Acknowledgements: This work was supported by the Slovak Scientific Grant Agency – VEGA under the contract no. VEGA 1/0184/21.

Keywords: emerging contaminant,traditional contaminant,Fluvisol,ecological and health risk,BCR sequential extraction

ID ABS WEB: 136128

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

TOXICITY RESPONSES OF BRASSICA RAPA TO CERIUM, GADOLINIUM, AND YTTRIUM IN TWO ACIDIC SOILS WITH CONTRASTING TEXTURES

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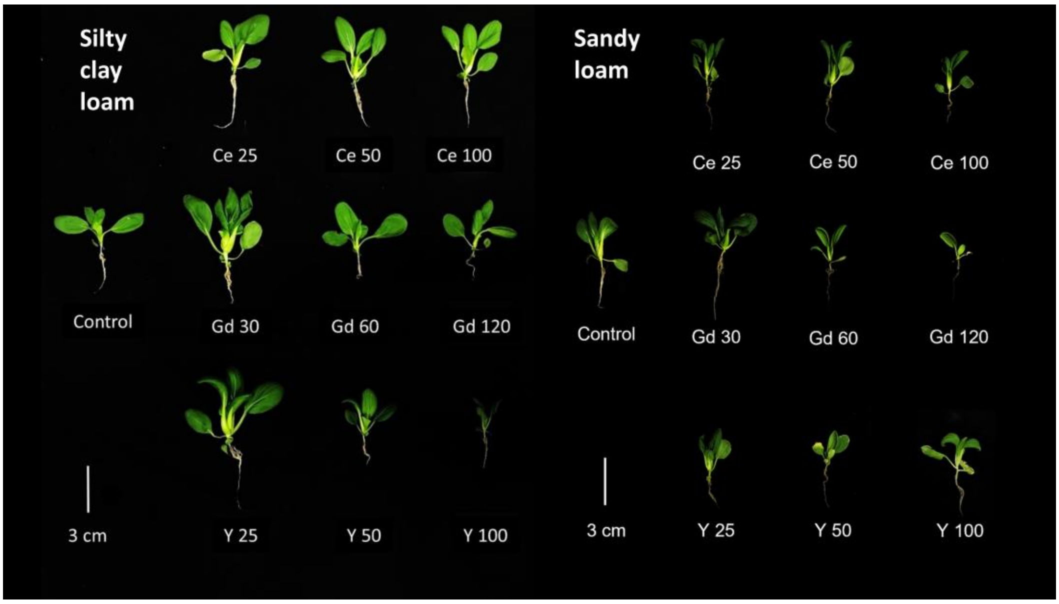
Rare earth elements (REEs) have been considered as emerging contaminants, but little is known about their bioavailability and physiological effects in soil-plant system. Therefore, the purpose of this study was to investigate the effects of different dosages of cerium (Ce, 0-100 mg/kg), gadolinium (Gd, 0-120 mg/kg), and yttrium (Y, 0-100 mg/kg) on Chinese cabbage (Brassica rapa), including biomass, REEs uptake, photosynthetic pigments (chlorophyll a + b and carotenoids), triphenyl-tetrazolium chloride (TTC) reduction, and proline content growing on two acidic soils with different textures (silty clay loam and sandy loam). The tested crops were grown for 35 days, and soil pore water was collected through the Rhizon moisture samplers. In the silty clay loam soil, the crop shoot biomass increased significantly ($p < 0.05$) at the dosages of 25 mg/kg Gd and 25 mg/kg Y but decreased at 120 and 100 mg/kg, respectively. Regardless of the dosage levels of Gd and Y, the crop biomass was consistent in the sandy loam soil with different REEs treatments. In addition, Ce had no significant effect on biomass in these two soils. All photosynthetic pigments decreased with increasing dosages of REEs in soils, suggesting that REEs reduced the functions of photosynthesis. The TTC reduction results indicated that the respiration of crop was significantly enhanced at the dosages of 30 and 60 mg/kg Gd in the silty clay loam soil, but was significantly inhibited at the dosages of 25, 50, and 100 mg/kg Ce in the sandy loam soil compared with the blank treatment. The change of proline concentration was corresponding to that of TTC reduction in all treatments. The concentration of REEs in roots and shoots increased with increasing concentration of REEs in the soils. Furthermore, the LA-ICP-MS analysis showed that the hotspots of REEs overlapped with those of Fe and Al. Hence, the toxicity responses of Brassica rapa to Ce, Gd, and Y depended on the dosages of REEs and soil textures.



Keywords: Bioavailability,Brassica rapa,Photosynthesis,Physiological effects,Rare earth elements

ID ABS WEB: 136228

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

AGRICULTURAL CARBON NEUTRALITY AND HEALTH REGULATION OF BLACK SOIL

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Black soil is a precious soil resource on Earth. As one of the only four major black soil regions in the world, the northeast region of China is an important base of grain production. However, due to the inappropriate use of agricultural inputs and unreasonable farming, the reduction of organic content, the aggravation of non-point source pollution, the degradation of soil function, and the thinning of the surface layer have been appeared in black soil of cold region, posing significant challenges for sustainable development of black soil. Therefore, it is urgent to carry out the health control of black soil in order to achieve the carbon neutrality. Herein, we created a variety of novel multi-functional organic fertilizers, which increased the content of soil organic matter by 15% and effectively reduced the application of chemical fertilizer. Meanwhile, a green and low-carbon in-situ directional restoration technology of agricultural chemical residues in black soil was established, and the concept of ' remediation while production ' was innovatively proposed. Moreover, we have developed the technology of black soil topsoil reservoir expansion to alleviate degradation of ecological function, effectively using agricultural waste and reducing gas emissions of agricultural greenhouse. Additionally, we broke through the limitation of low temperature environment and constructed decomposition bacteria of straw in the high cold area, exploring the synergistic way to rapid decompose rice straw and construct fertile soil layer. Finally, we studied the measurement technology of regional scale agricultural greenhouse gas emission and the quantification estimation of greenhouse gas carbon sequestration and emission reduction in farmland scale, which explored the carbon measurement method of agricultural industry activities oriented to carbon trading. The above-mentioned technologies were widely demonstrated and achieved excellent economic and social values. In this study, a series of control techniques for black soil were proposed, which provided promising strategies for ensuring black soil health in cold regions, strengthening food security, and promoting carbon neutrality in the world.

Keywords: black soil,carbon neutrality,soil health,cold region,sustainable soil use

ID ABS WEB: 136800

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

THE FATE OF MULTIPLE PERSISTENT ORGANIC SOIL POLLUTANTS INTRODUCED VIA BIOBASED FERTILIZERS SIMULTANEOUSLY ASSESSED BY NOVEL SCREENING METHODS

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The linear use of synthetic fertilizers has proven indispensable to provide sufficient food for a growing world population but suffers from serious issues including soil acidification and soil degradation. As a result, the last decade has seen an increasing attention for the use of nutrient rich waste streams, such as crop and animal remains, to produce biobased fertilizers (BBFs) as an alternative fertilizer source. In the EU funded LEX4BIO project we study the potentials and risks of large scale BBF application. A primary concern is the potential introduction of persistent organic pollutants to the soil via BBFs, as well as the effects of the introduction of BBFs on legacy persistent organic pollution in the soil. In both cases this concern potentially covers a wide range of chemical classes contained within complex BBF matrices. As a result, screening for pharmaceuticals and pesticides in BBFs themselves as well as in soils after BBF application poses a challenge. To overcome this, we developed an advanced screening method to simultaneously screen for a broad suite of pharmaceuticals and pesticides in BBFs and in BBF amended soils [1,2]. It consists of a combination of a QuEChERS-extraction followed by UHPLC-QTOF-MS/MS analysis. We successfully applied the new methodology using target analysis and suspect screening to scan for > 500 pharmaceuticals and pesticides in total, in 15 BBFs and several soils from field-trials. The results indicate a very limited presence of pollutants in the BBFs and soils [1,2]. Given the varied nature of the BBFs they provide a complex range of organic matrices with which those pollutants can interact, in addition to the soil matrix itself after BBF application. Indeed, we found that the introduction of the BBFs affected the bioavailability of organic contaminants introduced via the BBFs as well as those already present in the soil.

[1] Das et al., Chemosphere, 337, 139261 (2023).
[2] Dong et al., Journal of Hazardous Materials, 458, 131992 (2023).

Keywords: Soil,Biobased Fertilizers,Agriculture,Pollution,Circularity

ID ABS WEB: 137072

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

PFAS AND PPCP IN BIOSOLIDS FROM MUNICIPAL WASTEWATER RESOURCE RECOVERY FACILITIES IN THE USA

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Per-and polyfluoroalkyl substances (PFAS), and pharmaceuticals and personal care products (PPCP) are considered the major classes of contaminants of emerging concern frequently found in the soil environment, owing to their wide range of daily use in many products. These contaminants are commonly released to municipal wastewater resource recovery facilities (WRRF), and the current treatment processes cannot efficiently remove these contaminants from WRRF. Therefore, PFAS and PPCP could be concentrated in the biosolids of WRRF. The subsequent land application of biosolids for beneficial reuse could disseminate PFAS and PPCP to the soils of home gardens and agricultural lands. In this study, we collected biosolids samples from twelve WRRF across the United States, and conducted target analysis for 41 PFAS and 36 PPCPs in the biosolids samples (including both solid and liquid fractions) using liquid chromatography coupled to tandem mass spectrometry. The results showed that all biosolids samples contained both PFAS and PPCP with the concentration range from ng/g to ug/g levels. More than 72 % of the target PPCP and 51% of the PFAS could be quantified in the biosolids samples. For the PPCP and PFAS with highly hydrophilic nature, these contaminants were more frequently detected in the liquid fraction, rather than in the solid fraction. Most PFAS found in the biosolids were PFAS precursors. The removal efficiencies of PPCP and PFAS are examined for the specific biosolids treatment process.

Keywords: PFAS,PPCP,Biosolids,Wastewater treatment plants

ID ABS WEB: 137174

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

PER- AND POLYFLUOROALKYL SUBSTANCES (PFASS) IN THE SOIL–PLANT SYSTEM: SORPTION, ROOT UPTAKE, AND TRANSLOCATION

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Per- and polyfluoroalkyl substances (PFASs) are ubiquitous in the environment but pose potential risks to ecosystems and human health. The soil–plant system plays an important role in the bioaccumulation of PFASs. Because most PFASs in the natural environment are anionic and amphiphilic (both lipophilic and hydrophilic), their sorption and accumulation behaviors differ from those of neutral organic and common ionic compounds. In this study, we investigate processes affecting the availability of PFASs in soil after analyzing the potential mechanisms underlying the sorption and uptake of PFASs in the soil–plant system. We found that the root concentration factor of PFASs for plants grown in soil was not significantly correlated with hydrophobicity, whereas the translocation factor was significantly and negatively correlated with PFAS hydrophobicity regardless of whether plants were grown hydroponically or in soil. Further research on the cationic, neutral, and zwitterionic forms of diverse PFASs is urgently needed to comprehensively understand the environmental fates of PFASs in the soil–plant system. Additional research directions are suggested, including the development of more accurate models and techniques to evaluate the bioavailability of PFASs, the effects of root exudates and rhizosphere microbiota on the bioavailability and plant uptake of PFASs, and the roles of different plant organelles, lipids, and proteins in the accumulation of PFASs by plants.

Keywords: PFAS,plant uptake,soil adsorption,root uptake,plant translocation

ID ABS WEB: 137180

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

IMPACTS AND MECHANISMS OF RYEGRASS RHIZOSPHERE ON THE IN-SITU MICROBIAL DEGRADATION OF TRI(2-CHLOROETHYL) PHOSPHATE (TCEP)

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Tri(2-chloroethyl) phosphate (TCEP) is a typical chlorinated organophosphate widely present in soil, posing a potential threat to human health. Microorganisms play a crucial role in the remediation of soil organic phosphate contamination. The rhizosphere serves as a hotspot for microbial activity and holds advantages in removing soil TCEP pollution, but its role and potential mechanisms in TCEP microbial degradation remain unclear. This study utilized DNA stable isotope probing (DNA-SIP) to investigate the role of ryegrass rhizosphere in the microbial degradation of TCEP. The results showed that the rhizosphere could enhance the degradation efficiency of TCEP (1.8 times higher than in non-rhizosphere treatment). Through DNA-SIP, degradation microorganisms from 13 genera were identified, with 12 genera being linked to TCEP biodegradation for the first time. The alpha-diversity of TCEP degraders was significantly higher in the rhizosphere than in non-rhizosphere treatment. Further analysis of TCEP metabolic product suggested that TCEP could undergo hydrolysis of phosphate ester bonds, reduction, oxidative dechlorination, and methylation reactions. Based on gene abundance data, the phosphoric acid ester hydrolysis, oxidative dechlorination, and methylation pathways coexist in both non-rhizospheric and rhizospheric treatments, and rhizospheric environment plays a beneficial role in the enrichment of related genes. This study elucidates the role played by the rhizosphere in the in-situ remediation of TCEP in contaminated soils.

Keywords: Tri(2-chloroethyl) Phosphate,microbial degradation,rhizospheric effect,DNA-SIP,methylation

ID ABS WEB: 137429

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

NANO OR NOT, WHAT DIFFERENCE DOES IT MAKE? A STABLE ISOTOPE LABELING APPROACH TO ASSESS FATE AND BIOAVAILABILITY OF METALLIC ENGINEERED NANOPARTICLES IN SOIL

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By the time they enter soils, engineered nanomaterials (ENM) have undergone physicochemical transformations and may no longer resemble the pristine materials which have been thoroughly investigated during two decades of nanotoxicology research.

Is the behavior of environmentally relevant chemical forms of ENM different from that of other metallic species present in soils? Are they more available to soil organisms than their naturally occurring counterparts? The present study aimed at answering these questions, through the use of isotopically enriched ENMs, which could be traced at low concentrations in soil microcosms, despite high natural metallic background.

The relevance of the chemical forms was ensured by introducing isotopically enriched 109Ag, 68ZnO and 46TiO2 ENM to a wastewater treatment plant and using the resulting sewage sludge (final sink for most ENM) as amendment in soil microcosms with earthworms. The sludge application rate to soil was similar to that used in agriculture and the experiment lasted for a month. Protocols using inductively coupled plasma mass spectrometry were developed for determination of isotope ratios in complex matrixes, such as soil and organisms.

For 109Ag ENM, the dissolved fraction in soil (i.e. the most easily accumulated in organisms) was extremely low and comparable to that of Ag naturally present in soil, and transfer factors to earthworms were similar to those of natural Ag. For 46TiO2 ENM, the transfer to earthworms was negligible, similarly to what was observed for natural Ti. While no difference in behavior and bioavailability was observed between ENM and their naturally occurring counterparts for Ag and Ti, different results were obtained for Zn. The dissolved fraction for 68ZnO ENM was 3-5 times higher than for Zn forms naturally present in soil, and transfer factors to earthworms twice those of natural Zn.

Overcoming long-standing challenges related to environmental relevance of chemical forms and concentrations in nanotechnology studies, the approach provides valuable insight into behavior and impacts of environmentally relevant forms of ENM in soils.

Keywords: Engineered nanoparticles,Environmental fate,Bioavailability,Stable isotope labeling,Relevant exposure scenario

ID ABS WEB: 137477

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

EXPLORING THE INTERPLAY: MICROPLASTICS AND ANTIBIOTIC RESISTANCE ACROSS EUROPEAN SOILS

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Antibiotic resistance (AR) is now recognized by the World Health Organization as one of the major threats to human health. The root of AR can be traced back to the One Health link, that recognize that antibiotics use for human and animal health, and the environment, are interconnected and contributing to its spread. The soil is a sink for the selection of antibiotic resistance genes (ARGs) and bacteria, due to the continuous input of legacy and emerging contaminants. The increasing amount of microplastics (MPs) present in the environment raised further concerns regarding their role in promoting ARGs. Bacterial communities on the plastisphere are selected according to plastic properties; they colonize MPs surfaces and proliferate. In this work, the data from LUCAS dataset (885 soil sample from different EU countries) was re-elaborated using the Emu tool to characterize the microbial community at genus/species level. The functional annotation was performed through PICRUSt2 using a novel tool to format the Emu output. Interestingly, 96 ARGs and 6 MPs pathways was found and their correlations were explored. This study highlights how the fate of ARGs in the soil remains a central concern, and how the ever-increasing presence of MPs poses a risk of further exacerbating the severity of the AR problem. This study was funded by the Italian project SOIL-HUB (D.M. 37072/7303/18—28/12/2018, D.M. 35851—5/112019).

Keywords: antibiotic resistance gene,microplastic,microbial community,functional annotation,bioinformatic

ID ABS WEB: 137659

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

ENDOGENOUS BIOHYDROGEN FROM A RHIZOBIUM-LEGUME ASSOCIATION DRIVES MICROBIAL BIODEGRADATION OF POLYCHLORINATED BIPHENYL IN CONTAMINATED SOIL

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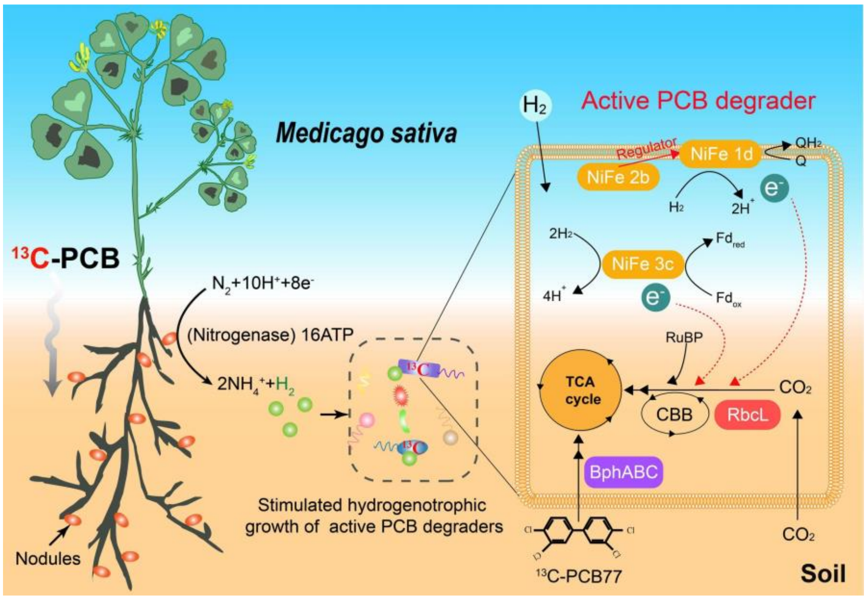
Endogenous hydrogen is produced through rhizobium-legume associations in terrestrial ecosystems worldwide through dinitrogen fixation. In turn, this gas may alter rhizosphere microbial community structure and modulate biogeochemical cycles. Symbiotic rhizobium-legume associations are also important in the elimination of environmental persistent organic pollutants (POPs) from soils. However, very little is understood about the role that this hydrogen leaking to the rhizosphere plays in shaping the POPs degrading microbes in contaminated soils. Here, we combined DNA-stable isotope probing (DNA-SIP) with metagenomics to explore how endogenous hydrogen from the symbiotic rhizobium-alfalfa association drives the microbial biodegradation of tetrachlorobiphenyl PCB 77 in a contaminated soil. The results showed that PCB77 biodegradation efficiency increased significantly in soils treated with endogenous hydrogen. Based on metagenomes of ^{13}C-enriched DNA fractions, active PCB degraders are diverse in polluted soil and endogenous hydrogen selected bacteria harboring PCB degradation genes. Functional gene annotation allowed the reconstruction of several complete pathways for PCB catabolism, with different taxa conducting successive metabolic steps of PCB metabolism. Key taxa growing hydrogenotrophically by using electrons derived from hydrogen for carbon fixation were demonstrated to play an important role in promoting the degradation of PCB77 by endogenous rhizosphere hydrogen. In particular, the enrichment of hydrogenotrophic Pseudomonas, Magnetospirillum and likely other taxa encoding biphenyl oxidation genes drives PCB biodegradation primarily through endogenous hydrogen in the rhizosphere. This study proves that endogenous hydrogen is a significant energy source for active PCB-degrading communities and suggests that elevated hydrogen can influence the microbial ecology and biogeochemistry of the legume rhizosphere. In a broader view, this work aimed to contribute new knowledge on the relationships between biohydrogen and specific functional soil microbes in the rhizosphere and inform future rhizobium-legume system biohydrogen metabolism efforts in the bioremediation of terrestrial environments.



Keywords: Legume-rhizobium symbiosis,Biohydrogen,Soil,Polychlorinated biphenyls,Biodegradation

ID ABS WEB: 137701

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

IS IT SAFE TO IRRIGATE CROPS WITH TREATED WASTEWATER? LONG-TERM MONITORING STUDY AND EXPOSURE ASSESSMENT

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Irrigation with treated wastewater is a growing agricultural practice. However, this practice exposes the agricultural ecosystem to organic pollutants that were not completely removed during the wastewater treatment. Once introduced into the field these pollutants may be taken up by plants and introduced into the food chain. The current study used Israel as a living lab (case study) to estimate the unintentional exposure of the population to organic pollutants originating from wastewater. We used up-to-date dietary data and measured the concentrations of organic pollutants in produce representing ~75% of the diet. Based on that exposure was calculated. Human health concerns were estimated using two approaches: the acceptable daily intake (ADI) and the threshold of toxicological concern (TTC).

Leafy vegetables exhibited the highest concentration of organic pollutants – pharmaceuticals and personal care products as well as industrial chemicals, thus the highest human exposure to the wastewater-born pollutants was for population subgroups consuming high amounts of leafy vegetables, such as vegetarians and vegans. For the extreme exposure scenario (calculated as maximum contaminant concentration times the 95th percentile consumption), the anticonvulsant drugs Lamisil (lamotrigine), Tegretol (carbamazepine), and a therapeutically active metabolite of Tegretol exhibited the highest human exposure levels of 29, 27, and 19 micrograms per person per day, respectively. For the general population and using an average exposure scenario, the above-mentioned anticonvulsant pharmaceuticals exhibited exposure levels below the ADI and TTC thresholds. However, for the extreme scenario, the exposure level of Tegretol was higher than its ADI level. In addition, the maximum exposure levels of Lamisil and the therapeutically active metabolite of Tegretol were higher than the TTC level for genotoxic compounds.

Keywords: wastewater,pharmaceuticals,exposure,risk assesment,irrigation

ID ABS WEB: 137854

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

THE ENVIRONMENTAL BEHAVIOR AND IMPACT OF MICROPLASTICS AT THE SOIL WATER INTERFACE

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Due to the persistence and potential biological toxicity of microplastics (MPs), MPs pollution has become a global environmental issue. The interaction between soil colloids and typical nano MPs (polystyrene, PS) were investigated as terrestrial ecosystems was the largest repository of MPs and the environmental behavior of MPs at the soil water interface was an important pathway for the input of MPs pollution from land to the ocean. It was found that, MPs aggregated onto different soil colloids to formed “microplastic-soil colloidal polymers” and the presence of soil colloids had an inhibitory effect on the migration of MPs. It mainly attributed to the steric hindrance of soil colloids and their adhesive effect. On the contrary, the presence of MPs promoted the migration of four soil colloids mainly because the hydrophobic-to-hydrophilic transition of soil colloid particles surface occurred in water. Three types of aged MPs with the same concentration were used to investigated their influences on the rhizosphere soil bacterial communities in the meantime. The surface roughness, porosity, the oxygen-containing functional groups of aged MPs were increased, the surface contact angle decreased simultaneously. Compared to the unaged MPs, the diversities of microbiota in three different rhizosphere soils were variously increased, but the relative abundance of some various phyla and genera related to pollution degradation were inconsistent with different soil, indicating that the aged MPs in different soil may have miscellaneous biodegradation pathways.

Keywords: Microplastics,Colloid,Transport,Rhizosphere soil,Microbial communities

ID ABS WEB: 137909

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

ABUNDANCE AND SPATIAL DISTRIBUTION OF MICROPLASTICS IN THE FLOODPLAIN SOILS ALONG THE RHINE RIVER IN GERMANY

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Microplastic pollution was first reported in the oceans, and the research focus shifted to terrestrial and freshwater systems only recently. Because most of the microplastics are produced on land, studying terrestrial systems is crucial to understand the microplastics transport. While agricultural soils have received relatively large attention recently, little is known about floodplain soil at the interface between terrestrial and freshwater systems. Rivers play a crucial role in transporting microplastics into the ocean, but they can also act as potential sinks due to microplastic deposition in riverbed sediments and adjacent floodplains. Floods, in particular, can (re)mobilize and relocate microplastics in floodplains based on their topography. However, there is limited knowledge about the input pathways, spatial distribution, and fate of microplastics in floodplains. To address this, we sampled soil at varying depths along three transects in Rhine floodplains and analyzed microplastic abundance and mass concentrations using FTIR and pyrolysis GC/MS. A hydrodynamic flood model was set up to study the influence of flood frequency on microplastic distribution. Results showed a consistent pattern of microplastic distribution, with the highest abundance and concentration in topographical depressions where floodwater is retained and thus more particles are deposited. The study emphasizes the relationship between microplastic distribution in floodplains and the combination of flood frequency and local topography, highlighting the need for further research on the long-term fate of microplastics in floodplain soils.

Keywords: microplastics,floodplain soils,FTIR analysis,pyrolysis GC/MS,Rhine

ID ABS WEB: 137987

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

CLAY MINERALS AS SORBENTS FOR HYDROPHOBIC ORGANIC CHEMICALS: ELUCIDATION OF INTERACTIONS THROUGH EXPERIMENTAL AND MODELING APPROACHES

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Hydrophobic organic compounds (HOCs), such as halogenated aromatic hydrocarbons, can be very persistent in the environment and lead to adverse effects on humans and other biota. Sorption processes are highly relevant for the assessment of their environmental fate and risk. In this context, especially the interactions between HOCs and organic matter are intensively studied. However, significant HOC adsorption can also occur on clay mineral (CM) phases [1].
For the mechanistic elucidation of HOC–CM interactions, laboratory experiments have been combined with molecular modeling, both for various HOC–CM systems [1, 2, 3].
This work presents results from HOC–CM interaction studies with five halogenated benzenes (hydrophobicity range of log KOW 2.6–6.5) as HOC representatives. Twelve pure phyllosilicate CMs and 20 smectite-rich bentonites were used as mineral phases in laboratory adsorption experiments. Molecular modeling of interactions was performed at the density functional theory (DFT) level for montmorillonite models of varying mineral structure and with explicit solvation.
Results showed a strong mutual influence of HOC and CM properties on the extent of adsorption. The hydrophobicity of the HOCs played a relevant role in the extent of adsorption, but to a lesser extent than the mineral properties.
In particular, the results: (i) indicate the general influence of CMs on HOC adsorption as well as it's wide variation (solid-liquid adsorption coefficients varied over several orders of magnitude, log Kd 0.9–4.5); (ii) provide mechanistic understanding of the influence of CM layer charge, exchangeable cations, particle size, and pore size distribution on adsorption; and (iii) elucidate the hydration state as critical for adsorption energies and the nature of interaction processes.
Overall, the results suggest a strong influence of specific HOC–CM interactions on the environmental distribution behavior of HOCs with potential relevance for their fate and transport in the environment, e.g. for long-term source/sink phenomena in soils and sediments.

[1] Böhm et al. (2023): https://doi.org/10.1007/s11356-022-24818-4
[2] Grancic et al. (2023): https://doi.org/10.3390/min13020280
[3] ClayHOC project: https://gepris.dfg.de/gepris/projekt/443637168?language=en

Keywords: Persistent Organic Pollutants,Adsorption and Distribution,Clay Minerals,Modeling,Risk Assessment

ID ABS WEB: 137996

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

ENHANCED SORPTION OF PERFLUOROOCTANE SULFONATE (PFOS) BY OPTIMIZED MODIFIED LAYERED DOUBLE HYDROXIDES: PERFORMANCE AND MECHANISMS

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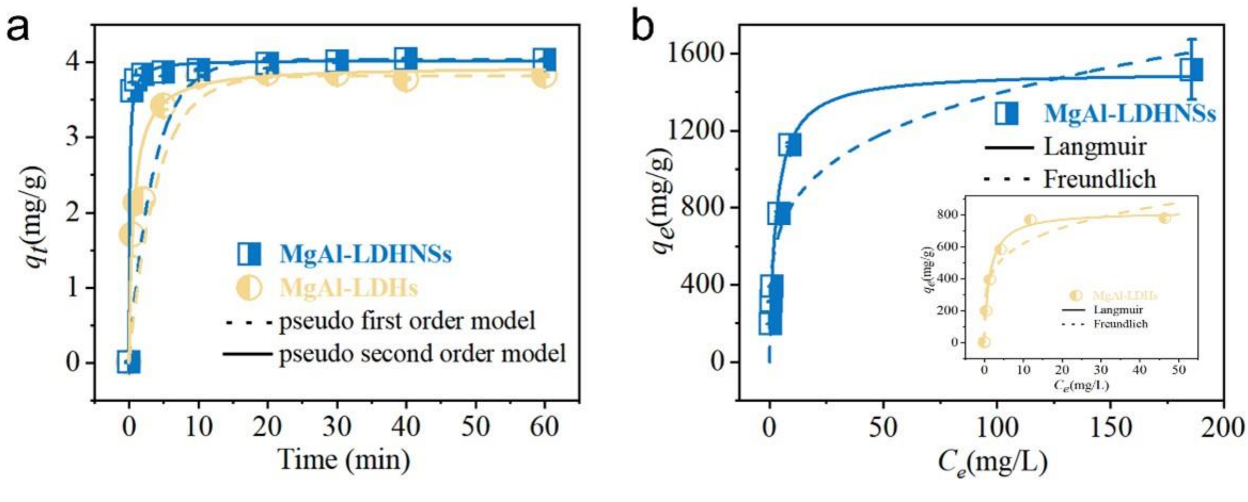
The detrimental effects caused by per- or polyfluoroalkyl substances (PFAS) in the aquatic environment have garnered significant attention. Sorption is a cost-effective and environmentally friendly technique for remediating PFAS. Batch sorption experiments were conducted to evaluate the removal of perfluorooctane sulfonate (PFOS) by layered double hydroxides (LDHs) and modified LDHs. We investigated the behavior and mechanisms of three types of LDHs for PFOS. Batch experiments showed a rapid sorption process, reaching equilibrium within 10-60 min. The nitrate-LDHs exhibited the maximum uptake capacity of 865 mg/g. The exfoliating of LDHs into two-dimensional nanosheets can maximize the utilization of single sheets, improving the surface area, exposing the hydroxyl groups, and eliminating the steric hindrance for PFOS. We achieved thermal exfoliation of LDHs into LDHs nanosheets (namely LDHNSs) at low temperature. LDHNSs exhibited a sorption capacity for PFOS of 1502mg/g, which is 82% higher than that of LDHs. Structural characterization results demonstrated that LDHNSs provides more sorption sites for PFOS, resulting in rapid and high-capacity removal of PFOS through electrostatic interaction, ion exchange and hydrogen bonding. LDHNSs showed superior regeneration ability in five regeneration cycles compared to LDHs. Additionally, LDHNSs maintain superior removal performance of PFAS in diverse water matrices. The sorption performance can be further enhanced by combining expanded graphite (EG) with LDHNSs to increase the material's hydrophobicity, owing to the hydrophobic and hydrophilic characteristics of PFOS. The EG-LDHNSs exhibited higher efficiency, attributed to the synergy between the positively charged structural layers of LDHNSs, which facilitate strong electrostatic interactions, and the EG, which enhance hydrophobic interactions for PFOS sorption. Our findings contribute to the understanding of utilizing modified LDHs for the removal of PFAS compounds from groundwater.



Keywords: PFAS,PFOS,LDHs,Adsorbents,Sorption

ID ABS WEB: 138049

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

ANTIBIOTICS MIGRATION IN SURFACE RUNOFF AND LEACHATE FROM A SLOPING ENTISOL OF CHICKEN-RAISING ORCHARD: A RESPONSE TO RAINFALL PROCESSES

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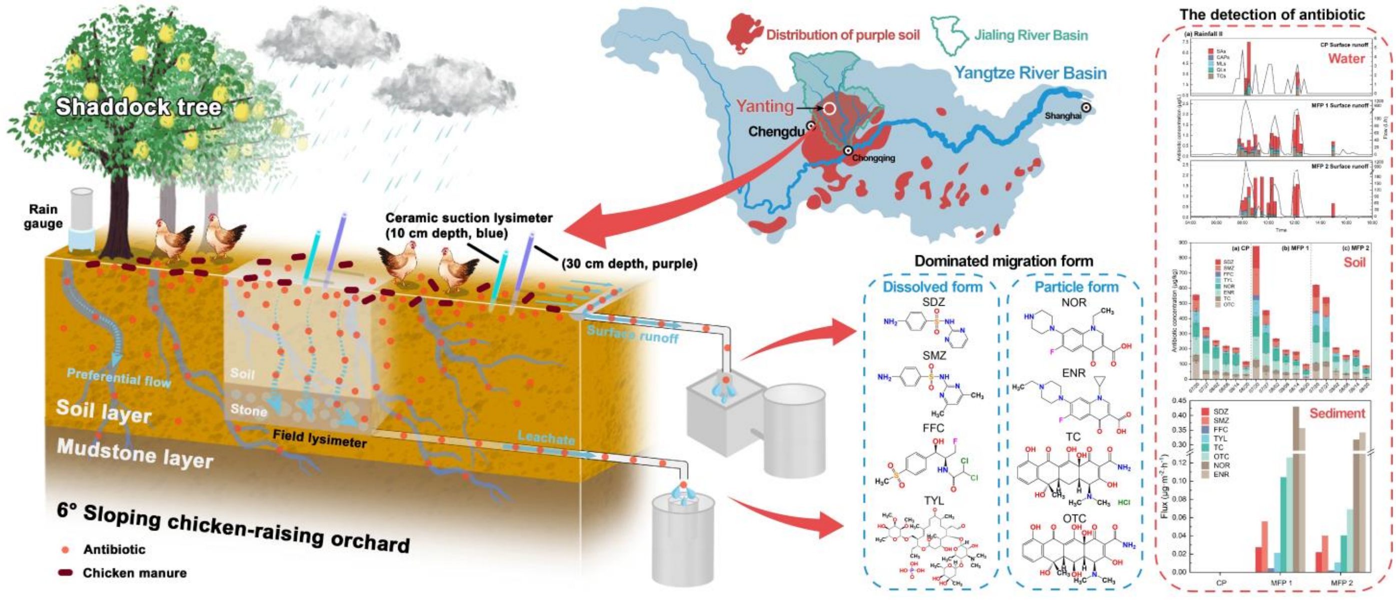
Knowledge on runoff transport of manure-sourced antibiotics from farmland soil to aquatic environment is limited due to complexity of hydrological regime and pathways. This filed study was conducted in the hilly area of Entisol in Jialing River basin of the upper reaches of the Yangtze River, southwest China. The study monitored natural rainfalls in 6° sloping orchard plots with free-range chickens, with an attempt to investigate the migration characteristics of typical antibiotics via surface runoff and leachate as well as the impact of manure presence. Results showed that rainstorms continuously carried away antibiotics in surface runoff and all target antibiotics including those with high affinities to soil were detected at the beginning of runoff production. Concentration of antibiotics was found to respond strongly to the instantaneous rainfall intensity, showing consistent fluctuations during rainfalls. Leachate collected at 50 cm depth responded ca.15 min late. Concentrations of sulfonamides and florfenicol were two orders of magnitude higher than that of tetracyclines and fluoroquinolones, while the latter mainly occurred in sediment particles. Compared to the control without raising chickens, antibiotics migration was considerably increased with the increased runoff production due to soil surface changes caused by chicken activities. Additionally, dynamics of antibiotic concentration significantly correlated with variations of chicken manure-derived colloids, indicating colloids-facilitated migration of antibiotics. Based on flow rate, the calculated flux of sulfonamides ranged from 0.03 to 1.51 microgram/(m2·h) for surface runoff and from 0.45 to 4.52 microgram/(m2·h) for leachate, respectively, indicating leachate is an important pathway for contaminant transport in the studied area where the soil is rich in preferential flow of macropores.



Keywords: Antibiotics,surface runoff,leachate,natural rainfalls,hilly area

ID ABS WEB: 138148

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

THE EMERGING THREAT OF DIFFERENT MPS FOR PLANT-SOIL SYSTEMS AND THEIR FATE IN AGRICULTURAL SOILS

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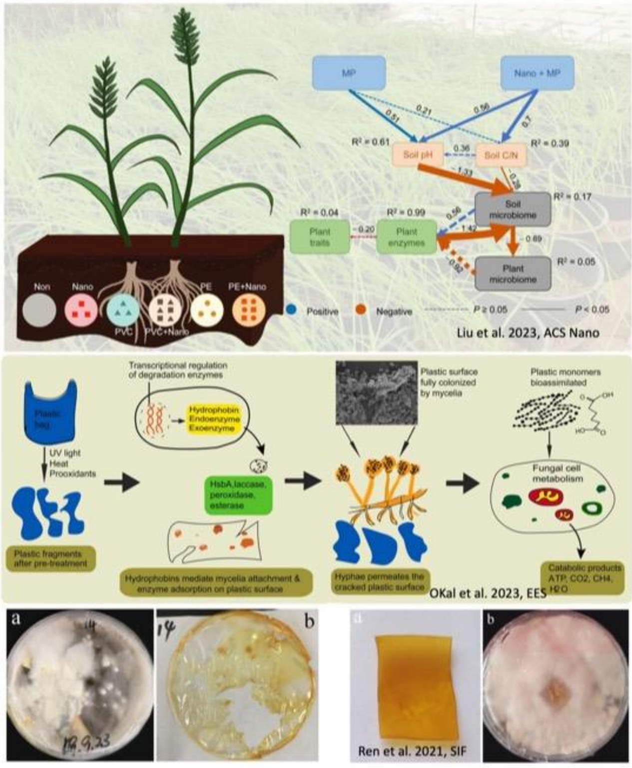
Plastics accumulating in the environment, especially microplastics (MPs, defined as particles <5 mm), can lead to a range of problems and potential loss of ecosystem services. Current research has demonstrated the significant impact of MPs on aquatic systems, but little remains known about their effects on terrestrial environments and their fate in soil, especially within agroecosystems. Therefore, we conducted a microcosm study to investigate how different types of MPs, including bio-degradable MPs, influence plant-microbe-soil interactions in agroecosystems. Combining 14C-labeling, zymography with substrate-induced growth respiration, and pyrosequencing techniques, we found that the addition of MPs in the soil can significantly alter a range of key soil biogeochemical processes by changing soil properties, forming specific microbial hotspots, exerting multiple effects on microbial activities and functions. We also introduced the positive influences of nano-Fe on the plant-soil system in MP-polluted soil and establish a method to alleviate the harmful effects of MP accumulation in soils. In addition, the fate of these microplastics in the soil remains unclear. We also isolated a polyurethane (PU)-degrading fungus from soils, and the fungus H14 was identified as Fusarium solani. The ability of F. solani H14 of degrading PU film and PUPB patches was confirmed via mass loss, scanning electron microscopy (SEM) and enzyme production ability. These studies can greatly enhance our understanding of the possible ways of alleviating MP pollutions in agricultural soil.



Keywords: MP pollution,Nano particles,plastic degradation,soil remediation,soil fungi

ID ABS WEB: 138182

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

FATE OF FLUOROQUINOLONES ASSOCIATED WITH ANTIMICROBIAL RESISTANCE IN CIRCULAR PERIURBAN AGRICULTURE

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Animal antibiotic use contributes to antimicrobial resistance (AMR) in humans. Agricultural benefits of animal manure can be overshadowed by its role as a hotspot for antibiotic-resistant bacteria, their genes, and antibiotic residues. Of particular significance are fluoroquinolones, a class of antibiotics crucial for human health according to the World Health Organization. In Buenos Aires periuban agriculture, intensive poultry farming administers enrofloxacin, a fluoroquinolone, to the flocks via drinking water, and horticulture uses poultry litter as soil amendment. Fluoroquinolones' fate and AMR dissemination resulting from these practices remain poorly understood. Our research addresses this gap by tracing fluoroquinolones trajectory from poultry to lettuce in circular periurban agriculture. The presence of biomarkers for AMR is also included. Our biological model includes poultry litter as a source of fluoroquinolones, a soil with no prior history of poultry litter application and, Lactuca sativa (lettuce). Lettuce was chosen as a receptor of fluoroquinolones, representing a possible pathway for human exposure. Fresh poultry litter (FPL) was stored for six months before application as stored poultry litter (SPL) in the horticulture field experiment. The experiment included control (CRL) and manured (MPS) plots where lettuce (L) was cultivated till harvest. Enrofloxacin, was detected in FPL, while its primary metabolite, ciprofloxacin, was found in SPL. These antibiotics can represent a selective pressure favouring AMR in the environment. No fluoroquinolones were detected in MPS; however, L-MPS samples exhibited high ENR and CIP concentrations, providing evidence of fluoroquinolone bioaccumulation in plants. Despite soil quality improved in MPS plots compared to CTR, sul1 gene abundance was 2.60 times higher reaching a relative abundance of -3.57 Log sul1 per 16S rRNA. A smaller, but significant effect was registered for intI1. Poultry litter static storage is not an adequate treatment to stop transmission of antibiotics and AMR in circular agriculture. Stored poultry litter application to the soil contributes to soil pollution with this emergent contaminants and risk of human exposure to antibiotics through vegetables.

Keywords: Circular agriculture,Poultry litter,Horticulture,Antimicrobials,Antimicrobials resistance

ID ABS WEB: 138259

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

FATE OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN THE VADOSE ZONE FOLLOWING LAND-APPLICATION OF BIOSOLIDS: IMPACT OF SOIL PROPERTIES

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Beneficial reuse of biosolids as organic fertilizers can introduce PFAS into agricultural soils. This study evaluates the impact of soil properties on PFAS transport in a site that received biosolids in 2023 after an eight-year pause on land application. The study site is dominated by three soil series: a deep and slowly permeable Acredale silt loam, a deep and moderately permeable Bojac sandy loam and Tomotley loam. There are seven deep and shallow groundwater monitoring wells generally located along the borders of the site. Prior to resuming biosolid application, groundwater, soils, and runoff were collected to establish the extent of legacy PFAS contamination within the site. Samples were processed with appropriate clean up steps and PFAS concentrations determined using isotope dilution and uPLC Zeno Time of Flight mass spectrometry (uPLC/ZenoTOF). Thirteen PFAS of the 57 targeted were detected in all groundwater collections. Individual PFAS concentrations were higher in the lower depth wells (35 ft vs 50 ft). The four most detected PFAS were short chain perfluoroalkyl acids (PFAAs) including PFPeA (98%), PFHxA (82%) and PFHpA (88%). PFBS, PFHxS, PFOS, and PFOA were detected in >60% of all samples. Other PFAS detected in at least one well included PFBA, PFNA, FBSA, PFHpS and 6:2 FTS. Of all the PFAS, PFOA had the highest maximum concentration in groundwater (221.4 ng/l), followed by PFPeA (92.9 ng/L), PFHxA (78.2 ng/L) and PFBS (71.1 ng/L). In runoff, 20 PFAS were detected in samples collected pre-2023 biosolids application. Predominant PFAS in runoff were long chain PFAAs, with PFOS found at the highest average concentration (686 ng/L). Similarly, PFOS and other long chain PFAS were abundant in the topsoil across the different soil series. Extraction and analysis of post-application soil cores and groundwater samples are ongoing. Available PFAS data for pre- and post-2023 biosolids application will be coupled with hydrologic and soil factors towards identifying key factors impacting PFAS retention and transport in the vadose zone.

Keywords: PFAS transport,Vadose zone,PFAS retention,PFAS distribution,Soil properties

ID ABS WEB: 135982

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

THE EFFECT OF PLANTAIN (PLANTAGO LANCEOLATA L.) IN PASTURE SWARDS ON GASEOUS NITROGEN EMISSIONS FOLLOWING CATTLE URINE DEPOSITION

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Plantain (Plantago lanceolata L.) has been shown to possess biological nitrification inhibiting (BNI) activity, which can reduce nitrous oxide (N2O) emissions from ruminant urine patches in pasture soil. However, plantain's effectiveness in mitigating emissions and the underlying mechanisms remain uncertain. In this lysimeter study, the 15N flux method explored the link between various plantain proportions in pasture sward and gaseous nitrogen loss (N2O and dinitrogen (N2)) after dairy cow urine deposition at 660 kg N ha-1 on two contrasting soil types (Allophanic and Gley). The findings suggest that plantain presence could reduce cumulative N2O emissions after urine deposition, but with no direct correlation between the nominal plantain sowing rate and its mitigation effectiveness. However, in the Allophanic soil, there was a reduction in cumulative N2O emissions with an increase in the proportion of plantain in the dry matter. There was no such correlation in the Gley soil, which suggests that soil type may play an important role in modulating the BNI effect on N2O emissions reduction. The heavy rainfall-induced high soil moisture during the experimental period resulted in 48-60% of the applied N being lost through N2 emissions. Plantain presence increased total N2 emissions in both soil types, possibly due to its BNI function, which would retain mineral N in the soil for an extended period, providing substrate for denitrifiers to produce N2 when conditions favour complete denitrification. The increase in N2 production with plantain presence was more pronounced in the Allophanic soil than in the Gley soil, which could potentially be attributed to deeper root distribution in the Allophanic soil, which could have further influenced soil denitrification at greater soil depths. However, further information on the impact of plantain on mineral N concentrations at greater depth is needed to better understand the observed variations in gaseous N emissions.

Keywords: Plantago lanceolata L,Denitrification,15N flux method,N2O,N2

ID ABS WEB: 135986

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

GREENHOUSE GAS EMISSIONS FROM RICE PRODUCTION IN ARKANSAS

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In the last decade, mitigation practices to reduce greenhouse gas (GHG) emissions [i.e., methane (CH4), nitrous oxide (N2O), and carbon dioxide (CO2)] and global warming potential (GWP) in rice (Oryza sativa) production systems in the United States, specifically Arkansas, have been evaluated in field conditions and greenhouse settings. The series of research studies has been conducted using the vented, non-flow-through, non-steady-state, closed-chamber approach. Environmental and agronomic factors assessed in the studies included soil texture (silt loam and clay), crop rotation (rice-soybean and rice-rice), plant variety (pure line and hybrid), nitrogen (N) source (urea, poultry litter, and ammonium sulfate), water regime (delayed-flood, mid-season drainage, and furrow-irrigation), tillage (conventional tillage and no-tillage), slow-release N (Environmentally Smart N) and slow-release phosphorus (P) (struvite) fertilizers. Results indicated that, regardless of water regime, decreased tillage intensity and/or frequency will contribute to reduced CO2 emissions. Results indicated that flood-irrigated rice production on clay compared to silt-loam soils, flood-irrigated rice production with a hybrid rice cultivar compared to pure lines, flood-irrigated rice-soybean compared to rice-rice rotation, flood-irrigated rice fertilized with inorganic nutrient sources compared to poultry litter, furrow-irrigation, and struvite material as P source in flooded and furrow-irrigated conditions will contribute to reduced CH4 emissions. Results indicated that furrow-irrigated rice production with no-tillage, maintaining uniform soil moisture conditions or avoiding large and frequent soil moisture fluctuations in furrow-irrigated rice production, and the use of ESN as N source in furrow-irrigated conditions will contribute to reduced N2O emissions. Results suggested that furrow-irrigation compared to flooded conditions can reduce GWP. Agricultural decisions involving which soil or plant characteristics and management practices to use can often be adjusted to reduce a single GHG. However, it is more challenging to prescribe a course of action that will simultaneously reduce multiple GHGs. The current level of knowledge regarding GHG emissions from rice production practices needs to be continually updated and extended with scientifically evidence to conserve valuable soil, water, and air resources.

Keywords: mitigation practices,rice production,greenhouse gasses,global warming potential,water regimes

ID ABS WEB: 136115

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

INCREASED NITROUS OXIDE EMISSIONS BY APPLICATION OF ORGANIC AMENDMENTS MAY LARGELY OFFSET THE CARBON BENEFITS

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Application of organic amendments increases soil carbon (C) sequestration but also affects the emission of the powerful greenhouse gas (GHG) nitrous oxide (N2O). However, effects of organic amendments on soil N2O emissions remain uncertain as long-term, multi-year measurements are mostly missing. Here we report on six years of measurements in a long-term field experiment in which we monitored N2O emissions from a subtropical wheat-maize rotation system under various managements. Soil N2O emissions were measured for a synthetic N fertilizer application treatment and three organic amendment application treatments. Soil N2O emissions showed great seasonal and inter-annual variations throughout the experimental period. The variations in soil N2O emissions across all treatments were correlated positively ($P<0.01$) with the temporal dynamics of soil temperature, soil water-filled pore space (WFPS) and soil NO3- and dissolved organic carbon (DOC)concentrations. Throughout the experiment of six years, on average, application of organic amendments (either manure or crop residues) increased soil N2O emissions by over 30% compared with the application of synthetic N fertilizer only ($P<0.01$). This multi-year field study indicates that increased soil N2O emissions must be carefully considered when organic amendment practices are proposed to maximize the climate change mitigation potential of arable lands, particularly in subtropical climates.

Keywords: soil nitrous oxide,soil organic carbon stock,organic amendment

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4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

SIMULATED HOT SPOTS AND HOT MOMENTS OF SOIL N2O EMISSIONS FROM AGRICULTURE ACROSS LAND USE, MANAGEMENT, AND CLIMATE IN CENTRAL EUROPE

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Agricultural ecosystems are the largest source for soil nitrous oxide (N2O) emissions and understanding their spatial and temporal variability, particularly in agricultural ecosystems, is crucial for effective climate change mitigation measures, aligning with the targets established by the European Green Deal. Model simulations are an important tool to quantify N2O emissions over several years across land use, agricultural management, and climate at local, regional, or global scales. Here, we systematically evaluate simulated soil N2O emissions from six different regions in Austria representing main cultivation areas located in two different European biogeographical zones (alpine and continental) with the process-based ecosystem model LandscapeDNDC. We present region-specific daily and annual N2O emissions from arable and grassland soils over a ten-year period considering more than 70% of land area and crops grown in the study regions. To identify hot moments of N2O emissions, we defined a threshold of extreme N2O peaks as daily emissions by the equation: Peak > 3rd Quantile + 3 * (3rd Quantile – 1st Quantile). The simulations show that specific crops and management activities have profound effects on daily N2O emissions. The share of N2O emitted as peak emissions ranges from 12% to 79% of total annual emissions. Overall, per hectare, the simulated mean annual N2O emissions are 69% lower from arable soils than from intensively managed grasslands, however, peak N2O emissions are higher and more frequent in the arable system. N2O peak events are mainly occurring between April and October from arable as well as grassland soils. N2O hotspots correlate to high soil organic carbon content or nitrogen fertilizer application rates, whereby the dominant controlling factors varied between regions and land use. The modelling results demonstrate potential environmental impacts and propose strategies for climate- and eco- friendly farming practices.

Keywords: N2O emissions,agriculture soil,hotspots,hot moments,landscapeDNDC

ID ABS WEB: 136281

4. Soil health in achieving the Sustainable Development Goals
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DIFFERENT NITROGEN FERTILIZER STRATEGIES TO REDUCE NITROUS OXIDE EMISSIONS ON A POTATO ROTATION IN A VOLCANIC ASH SOIL

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Southern Chile has the largest potato crop production in the country, with 50% of the national production, mainly under rainfed conditions. High nitrogen (N) fertilizer rates are applied, with risks of increasing soil N2O emissions. This study aimed to evaluate the effect of N rates and form of application on yield and N2O emissions of a potato-cover crop rotation. The experiment was carried out at INIA Remehue (40°52' S, 73°06' W), during 2016/17 and 2017/18, evaluating the application of 80, 150 and 300 kg N/ha (conventional N rate applied by farmers), applied 35% at planting (granular for all treatments) and 65% 45 días after planting (granular urea or foliar application, 2: 1 ratio of water: urea, for the 80 kg N/ha treatment). A control treatment with no N addition was also considered. In the first growing season, emissions varied between 1.4 ± 0.03 and 3.0 ± 0.35 kg N2O-N/ha, with higher emissions at the higher N rates applied ($p<0.05$), with no differences in yield production ($p>0.05$). In the second growing season a 43% less rainfall than an average year and 49% less than the previous season was registered, which reduced yields and emissions significantly, resulting in no differences between treatments ($p>0.05$). Emissions of N2O were related to NO3 soil availability only during the first year of evaluation. On average, reducing N fertilization to 150 and 80 kg N/ha reduced N2O emissions up to 31% with no differences among these two treatments, and emission intensity up to 34% in the 80 kg N/ha treatment, without detrimental impact on crop yield. On rainfed systems, N fertilization can be significantly reduced in below average rainfall years. This would also reduce direct cost in fertilizer application, favouring the economic and environmental sustainability of potato producers in Southern Chile.

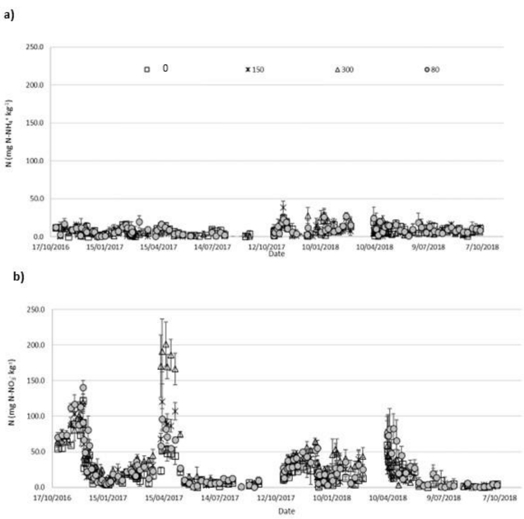

Figure 1. Dynamic of soil available N per treatment over the experimental period (0-20 cm) a) N-NH$_4$ (mg N-NH$_4^+$ kg^{-1} dry soil), and b) N-NO$_3$ (mg N-NO$_3^-$ kg^{-1} dry soil). Bars indicate standard error of the mean (n=3).

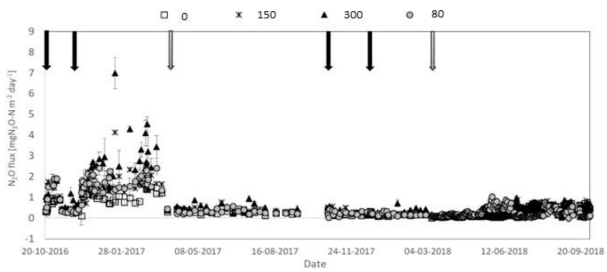

Figure 2. Flux of N$_2$O (mg N-N$_2$O m^2 d^{-1}) per treatment during two cropping seasons. Bars indicate standard error of the mean (n=3). Black arrows indicate N fertilizer application to the potato crop (30% and 70% for the first and second arrow, respectively), grey arrows indicate the date of the oat cover crop seeding. No N fertilizer was applied to the cover crop.

Keywords: Nitrous oxide emissions,Mitigation,Improved management practices,Foliar application,Cropping

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4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

SPATIAL AND TEMPORAL VARIABILITY OF SOIL GHG FLUXES OF URBAN GREENS

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Global urbanization has significantly affected land use, with former agricultural or forested land being used for human settlements and urban green spaces. How this urbanization may have affected the spatial and temporal patterns of soil greenhouse gas (GHG) fluxes, especially those of nitrous oxide (N_2O), remains largely unexplored, although a recent study indicated that urbanization accelerates GHG fluxes from soils.
In this study, we investigated soil GHG fluxes at Aarhus University Park (AU Park), a public park located in a hilly landscape with different use intensities. Soil GHG fluxes were measured 2-3 times per week over a period of 7 months using a fast chamber approach at about 55 sampling points with different management, vegetation, and landscape position (uphill, slope, foothill, ponds). Specifically, we focused on the identification of GHG flux hot and cold spots, and thereby investigated the temporal persistence of such spatial emission patterns.
Our results show that GHG fluxes were highly variable over the observation period, but that major GHG flux hotspots, such as those near a pond, were hotspots at all observation times. In addition, we were able to relate the spatio-temporal variations in soil GHG fluxes to landscape parameters such as slope and exposition, and to soil parameters such as soil organic carbon concentration, pH, and texture.
Our measurements show that there are significant spatio-temporal variations in GHG fluxes in urban parks and that these variations are strongly influenced by environmental and landscape parameters. This observation may allow a better scaling of GHG fluxes of urban green spaces and thus a better assessment of how urbanization changes landscape fluxes.

Keywords: N2O,N cycle,Isotopes,Experiment and Modeling

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4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

CONVERSION OF SUGARCANE STRAW INTO BIOCHAR: INSIGHTS INTO N2O EMISSIONS AND MICROBIAL FUNCTIONAL GENES

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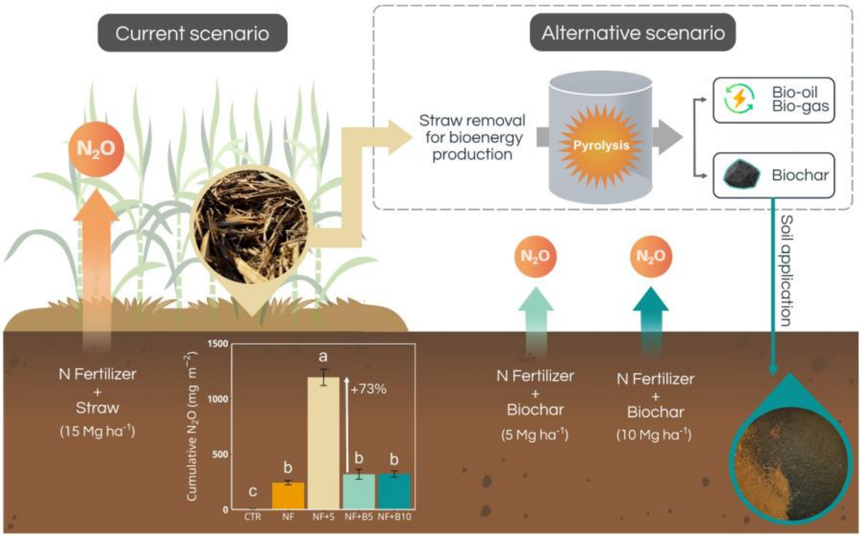
The conversion of sugarcane straw into biochar and its application in soils has been proposed as a potential strategy to mitigate N2O emissions resulted from the application of nitrogen fertilizers and agroindustry residues in sugarcane fields. However, little is known about the impacts of biochar on soil greenhouse gas emissions in tropical conditions. This study assessed the effects of sugarcane straw-based biochar on soil N2O emissions and its interaction with functional genes associated with N2O production and consumption. This study also evaluated the impacts of biochar on soil carbon content and biomass production. The experiment was conducted in pots filled with 8 kg of dry soil and cultivated with sugarcane plants. The experiment was conducted in a randomized design with five treatments and five replicates. The evaluated treatments were: control (CTR), N fertilizer (NF), NF+15 Mg ha-1 straw (NF+S); NF+5 Mg ha-1 biochar (NF+B5); and NF+10 Mg ha-1 biochar (NF+B10). Soil moisture was adjusted to 60% of water-holding capacity throughout the experimental period. Results showed that N fertilizer and straw significantly increased N2O emissions and high N2O emissions were observed in NF+S treatment. The application of biochar, on average, reduced N2O emissions by 73%. Soil N-NH4+ availability was reduced under NF+S but was greater in biochar treatments. The high N2O emission in NF+S was correlated the the abundance of AOB-amoA genes, suggesting that nitrification was the major N2O-producing pathway. Biochar effects on soil N2O emissions were not correlated with nitrification or denitrification genes. High soil carbon content was observed in biochar treatments. The NF+S treatment exhibited the highest yield-scaled N2O emission, indicating that more N2O was emitted per unit of sugarcane biomass produced. N2O-yield scaled emissions in biochar treatments were 62% lower than in NF+S. Thus, this study suggests that straw-based biochar can considered as a feasible strategy to reduce N2O emissions and increase soil carbon sequestration in tropical soils



Keywords: N2O emission,nitrification,biochar,sugarcane residues,functional genes

ID ABS WEB: 136632

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

EFFECTS OF ENVIRONMENTAL VARIABLES AND SEASONAL WEATHER CONDITIONS ON N2O FLUXES IN A THAWING PERMAFROST PEATLAND

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Nitrous oxide (N2O) is one of the most important greenhouse gases (GHG). Even though 60% of all N2O emissions are released from natural ecosystems, most of the N2O flux research has focused on agricultural soils. Whilst these managed, nutrient-rich soils have been relatively well studied, little is known about N2O fluxes in nutrient-poor ecosystems (e.g., the Arctic).

It has been generally assumed that Arctic soils are not a significant source of N2O due to a very low nitrogen amount available in these soils. Only recently, several studies have reported significant N2O emissions from organic-rich Arctic soils; however, due to methodological challenges, extensive investigations on N2O fluxes in Arctic soils have been limited. As a result, the importance of N2O fluxes from this region to the global budget remains highly uncertain.

The recent advances in portable GHG analysers enabled us to quantify the N2O fluxes which might help to improve the understanding of N2O budget over Arctic regions. Here, extensive chamber-based field measurements using a portable N2O/CO2 analyser were conducted in a thawing sub-Arctic permafrost peatland in northern Sweden (Stordalen Mire, Abisko) during different seasons; May (spring), July (peak growing season), and September (autumn) 2023. We measured carbon dioxide, methane and N2O concentrations on a dry-to-wet thawing gradient from palsa to bog to fen. Based on this data set, the N2O budget at different times of the year was analysed. In addition, the relationship between the N2O fluxes and environmental controls such as soil moisture, soil temperature, and photosynthetically active radiation (PAR) was investigated to better understand the processes underlying the N2O fluxes.

Keywords: N2O,flux chambers,sub- Arctic,nutrient-poor soils,PAR

ID ABS WEB: 136942

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

THE IMPACT OF SOIL N2O EMISSION ON THE CLIMATE-SMART POTENTIAL OF CROPPING SYSTEMS: A STUDY USING CONTINUOUS EMISSION DATA WITH EDDY COVARIANCE.

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Sorghum (Sorghum bicolor) holds a prominent position as a major biofuel feedstock crop in the United States, with 30 to 35% of grain production dedicated to ethanol manufacturing. However, accurate evaluation of the climate-smart potential of sorghum production systems is essential for estimating the carbon intensity associated with sorghum-based ethanol. For this purpose, an accurate assessment of soil greenhouse gas (GHG) emissions, including CO2, N2O, and CH4, is crucial to gauge the sustainability of sorghum as an ethanol feedstock. This study employs the eddy covariance method for continuous measurements of CO2, N2O, and CH4 fluxes from a 90-acre sorghum field in the U.S. Southern Great Plains, managed with minimum tillage. Three years of comprehensive data reveal insights into the diurnal and temporal dynamics of GHG emissions. A significant correlation between diurnal N2O emissions and soil heat flux during peak emission periods in the growing season was identified. The incorporation of these findings into modeling enhances our comprehension of the GHG budget within sorghum cropping systems, contributing to a more nuanced understanding of its impact on the overall carbon intensity of sorghum ethanol production.

Keywords: Eddy Covariance,GHG flux

ID ABS WEB: 137191

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

IMPACTS OF BIOCHAR ON NITROUS OXIDE EMISSIONS AND AMMONIA VOLATILISATION IN WHEAT AND MAIZE CROPPING SYSTEMS

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Agriculture and other land use practices are major contributors to greenhouse gas emissions, especially for N2O and NH3. Nitrous oxide (N2O) is a highly potent greenhouse gas and ammonia (NH3) can re-react with soil and forms N2O or can cause other environmental issues in the surrounding. Biochar is known for its carbon sequestration potential due to its high proportion of recalcitrant organic compounds, however, biochar can also positively influence soil properties like water holding capacity, nutrient leaching and mitigation of nitrous oxide emissions and ammonia volatilisation. However, these effects depend on pedoclimatic conditions, the properties of the applied biochar, and other agricultural practises. Therefore, it is necessary to expand the knowledge of these effects, especially under field conditions, to generate valid estimates on biochar's mitigation potential for N2O and NH3 emissions. A good and extensive data basis is essential for recommendations and a large-scale application in agriculture. In a two-year field experiment in Grabenegg (Lower Austria) we cultivated silage maize (Zea mays) in 2022 and spring wheat (Triticum aestivum) in 2023 with different organic (external organic matter, EOM) and inorganic (NPK) fertilisers. For the biochar treatments we applied 7 t/ha hardwood biochar additionally. The original soil was loamy, low in organic carbon and slightly acidic. We found substantial reductions with 36% (NPK) and 53% (compost) for N2O and 56% (NPK) and 40% (compost) for NH3 emissions. There are several factors discussed in literature how biochar mitigates N2O and NH3 emissions. We suggest that the immobilisation effect of biochar on NH4+ and NO3- (which was observed in the soil) and possibly an increased dinitrogen monoxide reductase activity are responsible for this reduction. Our data support that biochar can be a suitable amendment for highly productive agroecosystems where high amounts of fertiliser are needed and often applied at one timepoint. Still, further investigations on the long-term effect on emission mitigation of biochar and the mechanisms behind are necessary.

Keywords: N2O,NH3,biochar,soil management,external organic matter

ID ABS WEB: 137332

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

A META-ANALYSIS OF EUROPEAN FIELD EXPERIMENTS ON THE EFFECT OF ORGANIC MATTER INPUTS ON N2O EMISSIONS IN ARABLE LAND

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The application of organic matter (OM) inputs to agricultural soils can increase soil carbon storage but may also lead to an increase in non-CO2 greenhouse gas emissions. By using a weighted meta-analysis, we quantitatively synthesized the results of 53 field studies, which explore the effects of adding different OM inputs (crop residues, green manure, livestock manure, slurry, digestate, compost or biochar) to soil on N2O emissions in 15 European countries. Diverse arable crops, mainly cereals, were cultivated in monoculture or in crop rotations on mineral soils. Cumulative N2O emissions were monitored during periods from 30 to 1070 days in field experiments, which received OM inputs, alone or in combination with mineral N fertilizers, while mineral N fertilizers served as a control.
The overall effect of OM inputs on N2O emissions had a slight tendency to reduce emissions by 10%, and this effect became more pronounced with increasing carbon-to-nitrogen ratio of the OM inputs. Compost and biochar significantly reduced N2O emissions by 25% and 33%, respectively. However, the mitigation effect of biochar and compost declined with increasing soil pH or sand content. In addition, climate was an important moderator governing the N2O emission reduction, with a smaller effect observed under warmer or drier climatic conditions.
The effect of other OM inputs, such as green manure, crop residues, livestock manure, slurry and digestate on N2O emissions varied from −18% to +15% compared to mineral N fertilizers, but their effects were not statistically significant. Our meta-analysis also showed that the co-application of green manure, livestock manure, slurry and digestate with mineral N fertilizers increased N2O emissions by 30% compared to the use only mineral N fertilizers. However, substitution of mineral N fertilizers with organic fertilizers tended to reduce N2O emissions by 16%.
Our meta-analysis recommends establishing experiments, particularly, with livestock manure, green manure, slurry and digestate, which currently show either highly variable impact on N2O emissions or have a scarce number of studies.

Keywords: climate change mitigation,EJPSOIL,field studies,nitrous oxide,pedo-climatic characteristics

ID ABS WEB: 137391

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

QUANTIFICATION AND PARTITIONING OF THE CONTRIBUTION OF ABIOTIC AND BIOTIC PROCESSES TO SOIL N-OXIDES EMISSIONS IN THE DEAD SEA VALLEY, ISRAEL

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Wetting of dry soil after prolonged drought triggers emissions of N-oxides (nitric oxide; NO and nitrous oxide; N2O) which may contribute disproportionately to annual soil N-oxides emissions in drylands. During the wetting, microbial processes were shown to be the major sources of soil N-oxides emissions. Abiotic reactions, however, may also contribute to the production of N-oxides in soils. The contribution of abiotic reactions despite potential importance is not well quantified. To quantify and partition the contribution of abiotic and biotic processes to post-wetting N-oxides emissions in drylands, we measured soil NO and N2O production in a laboratory with live and gamma-irradiated soils collected under canopies of dominant local (Acacia tortilis) and invasive (Prosopis juliflora) trees, as well as from bare soils outside the canopy cover.
We found that gamma-irradiated soils under A. tortilis canopies after eight hours' incubation, emitted ~10 times less NO (~5 ng N g-1) and ~4 times less N2O (~10 µg N g-1) compared to the live soils. While gamma irradiated soils under P. juliflora canopies emitted ~2 times less NO (~7 ng N g-1) and similar N2O (~7 µg N g-1) compared to the live soils, and in the soil from the bare area, ~9 times less NO (~5 ng N g-1) and similar N2O (~10 µg N g-1). Our findings suggest that both biotic and abiotic pathways contribute to N-oxides production following dry soil wetting, however, the relative contribution is dependent on the landscape position and affected by plant presence and species. In soil beneath A. tortilis abiotic processes contributed 10% to soil NO and 25% to N2O production. In soils soil under P. juliflora abiotic processes contributed 50% to NO and 100% to N2O production. In bare soils abiotic processes contributed 10% and 75%, for NO and N2O production, respectively.

Keywords: abiotic emissions,invasive species,desert soil,rewetting

ID ABS WEB: 137639

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

EXPLORING N2O EMISSIONS AS EARLY WARNING INDICATORS FOR TIPPING POINTS IN AMAZONIAN SOILS

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The Amazon is a global tipping element, with the potential to affect not only the global climate system but also the entire social-ecological system of Earth. Some of the human-induced myriads of environmental problems include forest conversion and climate change. Local stakeholders and researchers have identified droughts as one of the most urgent concerns: dry seasons have become longer and more intense, negatively affecting regional water budgets. Water scarcity is by far more critical in humid environments which are not adapted to these conditions at all. In the Amazon forest, the high soil microbial biodiversity serves as a safety net, providing functional redundancy to support the ecosystem in the face of stressors such as floods, fires, or intense droughts. The question is whether the functional biodiversity of the microbial heroes is lost due to forest conversion and if so, at what point in time, as well as if they return with natural regrowth as secondary forests. Greenhouse gas fluxes have proven to be potential indicators for early warning before crossing ecological tipping points in pasture's soils and therefore were used in this study to explore the effects of forest conversion on functional biodiversity within the N-cycle. In a field experiment in the Amazon, rainout shelters were installed on an aboveground biodiversity gradient ranging from primary and secondary forests to pastures and abandoned pastures. In sites, where all four aboveground biodiversity levels were in close proximity, field N2O measurements and soil sampling were conducted. In future, also functional gene-based amplicon sequencing is aimed. This study elucidates the intricate connections amongst forest conversion and N2O emissions in Amazon soils, and will underscore the critical need to comprehend the sources of N2O emissions within natural tropical ecosystems. In the quest to avoid crossing a tipping point, it is crucial to identify and understand pivotal system thresholds at an early stage to improve early warning identification tools and monitoring strategies.

Keywords: forest conversion,Amazon,N2O emissions,tipping points,microbial biodiversity

ID ABS WEB: 137889

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

CROP RESIDUE MANAGEMENT IMPACT ON N2O EMISSIONS: RESULTS FROM 10-YEARS-8-CROPPING-SYSTEMS FIELD EXPERIMENT

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Nitrous oxide (N2O) is one of the main problematic greenhouse gases (GHG). Between 2007 and 2016, 43% of the global N2O emissions were anthropogenic and half came from agriculture. Complex redox systems and multiple drivers effects challenge predicting N2O emissions. For example, crop residue removal has been shown to have either positive, negative or neutral effects on N2O emissions. Although meta-analysis show sthat crop residue return tends to increases N2O emissions in temperate climates, they also indicate that this trend is dependent on soil properties or other management practices. Regarding how crop residue influence N2O emissions, recent studies stress the major influence of residue quality. Despite numerous existing work, how crop residue globally influence cumulatived emissions, with a GHG perspective remains difficult to evaluate due to the short duration of most studies. We hypothesized that using the whole time scale of a long term experiment covering a wide range of practices would allow to unravel the relative weight of crop residue management on N2O emissions. We compiled 1-site-10-years-8-cropping-systems experimental data and defined joint restitution cycles (109 days to 646 days) for which both cumulative emissions and key driving variables, including measures of crop residue return and quality, were defined. The analysis of the 158 restitution cycles indicated that nitrogen fertilizer rate and length of the period were the main variables explaining N2O emissions while the C:N ratio of residue was the main driver of crop residue infuence, although that influence remains limited. The weight of crop residue influence was inversely proportional to the period length, supporting the importance of considering the timescale of measurements to evaluate how crop residue influence GHG emissions.

Keywords: climate change,crop residue,cropping system,nitrous oxide,machine learning

ID ABS WEB: 137964

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

THE SOMMIT WEB DASHBOARD FOR EVALUATING SUSTAINABLE AGRICULTURAL MANAGEMENT STRATEGIES TO REDUCE NITROUS OXIDE EMISSIONS

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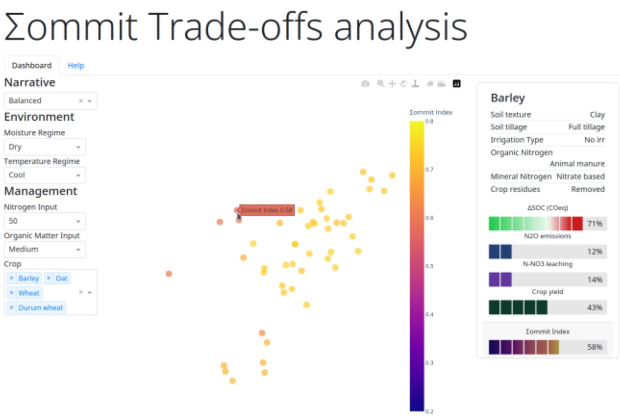
The atmospheric concentration of nitrous oxide (N2O) has escalated from about 270 parts per billion (ppb) in the pre-industrial era to 336 ppb in 2022, primarily due to agricultural activities, which account for over 60% of anthropogenic N2O emissions. These emissions are significantly influenced by agricultural practices like fertilizer application, soil tillage, irrigation, harvesting, and managing crop residues, all of which impact the nitrogen cycle. Optimizing agricultural practices to lower N2O emissions while also considering their impact on other greenhouse gases and crop yields is a complex challenge.
The SOMMIT project, supported by the European Joint Programme for Soil, has developed the SOMMIT index (Si), a fuzzy logic-based trade-off analysis system. This tool is designed to assess alternative farming strategies quantitatively, examining the trade-offs between reducing N2O emissions and potential adverse impacts on soil carbon sequestration, crop yield, and nitrate leaching. The SOMMIT index has been applied to an extended dataset comprising around 2 million agronomic case scenarios (CS) from Italy, where multiple combinations of crops, farming practices, and pedoclimatic conditions are tested.
The analytical methodology has been implemented in a user-friendly, web-based dashboard, enabling access to this extensive CS dataset and facilitating the exploration of the Si values. The interface features a 3D scatterplot visualization based on a Multiple Factor Analysis, where each dimension is correlated with the CS's environmental, management, and trade-off components. CS are represented as points. Greater distance between points indicates greater differences in the agronomic CS, and their colours represent the Si ratings, with darker colours indicating lower Si values (worst CS) and lighter ones higher Si values (best CS). Hovering over a point reveals CS details, including N2O emissions, soil organic carbon changes, crop yield, nitrate leaching, and the Si.
This visualization tool is especially valuable for non-experts, simplifying complex data into an accessible and easy to interpret format. It assists in comparing and identifying optimal agronomic strategies, promoting informed decision-making in sustainable agriculture.



Keywords: Trade-off analisys,Composite index,Online dashboard,Soil organic carbon,Crop yield

ID ABS WEB: 138239

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

IMPACTS OF MULCHES USED AS A MANAGEMENT PRACTICE TO REDUCED SOIL EROSION ON MICROBIAL COMMUNITIES AND N2O EMISSIONS

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Agricultural organic soils are an economically important non-renewable resource with a vital role in Canadian vegetable production, however, these soils are highly susceptible to wind erosion and microbial decomposition. Conserving these soils is essential for food security as well as protecting the livelihoods of the landonwers and their employees. Applying plant residues as mulches has been proposed to reduced soil erosion, however, these can change soil physicochemical environment to stimulate microbial activity and increase nitrous oxide (N2O) emissions. This project determined the effects of residue type on soil N2O emissions from an organic soil under lettuce production in south-western Québec (Canada), and evaluate some of the factors driving changes in N2O flux. During a two-year experiment, N2O emissions from soil mulched with switchgrass (Panicum virgatum), miscanthus (Miscanthus sinensis), ash (Fraxinus pennsylvanica), larch (Larix laricina), or willow (Salix) residues were compared to those from the same soil with a cover crop residue (fall-seeded rye; Secale cereale), and the absence of mulch, under either conventional tillage (control) or under no-till. In both years, the willow mulch treatment exhibited the lowest cumulative N2O emissions, a rate similar to the control soil. Compared to the control, soil mulched with ash, larch or willow residues showed no significant difference in CO2 or CH4 emissions. Peaks in N2O fluxes consistently followed peaks in soil NO3- concentrations. A roughly 5-fold decrease in soil NO3- and N2O emissions from 2021 to 2022 was attributed to the incorporation of the plant residues remaining at the end of the season possibly increasing N immobilization by microbes. Soil bacterial and fungal community structure and quantification of genes involved in the nitrification-denitrification pathways were also analysed to determine their impacts on reduced soil NO3- concentrations and N2O emission. We conclude that wood-based mulch does not significantly increase greenhouse gas emissions from an organic agricultural soil and offers a promising option for producers interested in preventing soil erosion without increasing greenhouse gas emissions.

Keywords: N2O emissions,mulches,microbial communities,organic soils,soil management strategies

ID ABS WEB: 138281

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

HOT, HOTTER, HOT MOMENTS? THE IMPACT OF SOIL TEXTURE ON SIMULATED N2O EMISSIONS AMIDST CLIMATE CHANGE

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The consensus in the scientific community is that N2O emissions are expected to increase with climate change. A warmer and wetter climate, characterized by prolonged dry spells and increasing intensities of precipitation, fosters the emergence of 'hot moments' – short term emission pulses considerably contributing to annual N2O emissions. Due to the inherent high spatiotemporal variability of N2O, these hot moments are difficult to predict and, therefore, challenging to model. The complexity of modelling is further compounded by the influence of soil texture. While climatic change plays a key role in the potential emergence of hot moments, soil texture determines the likelihood that aerobic or anaerobic conditions will prevail, affecting the fundamental mechanisms of N2O emissions.
In this study we aim to explore how different soil textures impact the simulation of N2O emissions, taking precipitation intensity and dry spells induced by future climate change into account. This calculation exercise is based on climate projections from the multi-model ensemble of the EURO-CORDEX initiative and the biogeochemical models CANDY, LDNDC, DNDC and DayCent. Given the differences in the algorithms of these biogeochemical models, which are crucial for N2O simulations, and the critical role of soil texture linked with climate change, we expect to reveal both strengths and shortcomings in depicting hot moments of N2O. We aim to identify where and how much improvement is needed to simulate N2O emissions associated with hot moments, climate change, and diverse soil textures. Specifically, our ultimate goal is to enhance the simulation capabilities of biogeochemical models and their ability to depict dry-wet cycle induced hot moments in the context of climate change with a possible reinforcing effect by soil texture.

Keywords: N2O,biogeochemcial models,soil texture,hot moments,climate change

ID ABS WEB: 135946

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

EVALUATING THE IMPACT OF DIFFERENT FARMING SYSTEMS FOR SOIL HEALTH IMPROVEMENT AT REGIONAL AND FARM SCALE BY A GEOSPATIAL APPROACH IN PO VALLEY, ITALY.

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Soil organic matter (SOM) is an essential factor for soil health and functionality assessment, as well as for climate regulation, through carbon sequestration and greenhouse gases emissions regulation. An accurate estimation and monitoring of the SOM content is crucial for sustainable land management and climate change mitigation strategies through the adoption of tailored carbon farming practices. In recent years, there has been a growing consciousness of the need to better understand the dynamics of SOM in time and space in relation to different agronomic practices.
In this context, this study aims to improve our understanding and get some insights about the relationship between SOM and the main farming systems adopted in Italy: conventional, organic and regenerative farming. The three farming systems were compared collecting a large dataset consisting of SOM values and environmental and farming information collected in 593 locations representative of the whole agricultural area of Po Valley in Italy. This large dataset was analyzed by a geospatial analysis using a geostatistical approach for modelling and understanding the SOM spatial variability over the different fields characterized by irregular shapes and different farming systems.
Clear evidences of the spatial correlation between SOM, farming systems and soil types were detected. More in detail, Cambisols and field managed according regenerative agriculture principles showed higher SOM contents as compared to other farming systems and soil types. Moreover the study demonstrated how the inclusion of fodder crops in the rotation and the use of no-tillage are two of the most effective practices for increasing and preserving SOM according.
Spatial information, such those provided in this study, could contribute to the delineation of tailored solutions for each EU Member State to guide future actions related to carbon farming, and offer crucial insights to support agriculture progress for enhancing soil fertility and health and fostering sustainable agricultural practices.

Keywords: soil organic matter,Regenerative agriculture,Farming system,soil type,croplands

ID ABS WEB: 135979

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

IMPACT OF LONG-TERM CONSERVATION PRACTICES ON ECOSYSTEM SUSTAINABILITY AND FOOD SECURITY IN A CHANGING CLIMATE

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The world is facing unprecedented environmental and food security challenges. Agricultural production must be resilient and adapt to the changing climate to meet the growing demands for food and energy. Sustainable agricultural practices have been important in meeting this challenge and aims to increase crop yield and livestock productivity thereby increasing farm profitability while maintaining or enhancing soil, water resources and other ecosystem services. In this regard, conservation practices can provide multiple soil health, agricultural production, and environmental benefits. In addition, it can enhance the resilience of soil and cropping systems to climate variability and change induced risks while also mitigating climate change by reducing emissions and/or enhancing soil organic carbon sequestration. Here, we present the USDA ARS led Long-Term Agroecosystem Research (LTAR) Network research effort on several aspects of sustainability; review other published research results on sustainability and resilience, its impact on soil and crop system and the link with food security and ecosystem sustainability. We also evaluate the past achievements, future challenges and indicate research priorities.

Keywords: climate change,conservation practices,soil and crop systems,food security,ecosystem sustainability

ID ABS WEB: 135988

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

CARBON STOCKS AND BIOCHAR PRODUCTION IN ABANDONED BAMBOO FOREST, JAPAN

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Abandoned bamboo forests have expanded into timber forests and abandoned fields in Japan, leading to biodiversity degradation and increased risk of landslides. Moso bamboo (Phyllostachys pubescens) is faster growing than trees, and reproduces via an extensive underground rhizome network. Biochar is recognized as an effective method for long-term sequestration of photosynthetically fixed carbon, and may therefore be an effective use of bamboo biomass. The objectives of this study are 1) clarify the carbon stock of soil and biomass in abandoned bamboo forest and 2) estimation of the amount of biochar production by bamboo in the northern part of Japan.

The study was conducted at an abandoned bamboo forest in Eastern Japan. The site was dominated by a bamboo stand for at least 17 years judging from aerial photographs. Two adjacent study plots (10 m x 20 m) were established, with a slope angle of about 42.6 degrees. We investigated the living and dead culm density, the weight of downed culms (woody debris), and the amount of living biomass. Additionally, we calculated the biochar production rate from living and dead culms using a simple on-site carbonization method.

Total stem density of bamboo stand (both of living and dead) was estimated 13,600 culms ha-1. The standing biomass and fallen bamboo were estimated at about 243 and 373 t dry weight ha-1, respectively. Because bamboo has a high water content after cutting, it is usually left to dry for two to three months before being carbonized. Carbonization rate of living and fallen bamboo were about 12.8 and 15.9%, respectively, because high water content of culm decreased efficiency of carbonization. Therefore, biochar production by living and fallen bamboo was estimated about 31 and 72 t C ha-1. Next year we will research the decomposition rate of bamboo, and then plan to consider the carbon cycle including management and biochar production at regional scales.

Keywords: Biochar production,Bamboo forest,Soil organic carbon

ID ABS WEB: 136851

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

CO-COMPOSTED BIOCHAR IMPROVES BARLEY YIELD, MANURE USE EFFICIENCY AND OFFSETS CHEMICAL FERTILIZER DEMAND IN ORGANIC AGRICULTURE UNDER LOW RAINFALL CONDITIONS

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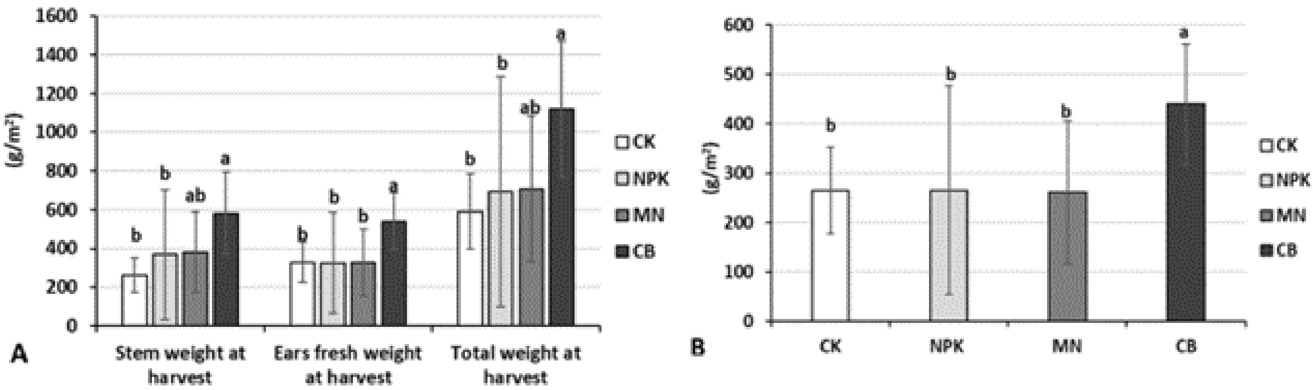
Composting is a common practice to aerobically convert and recycle organic waste biomass from different origins into a new agronomic input. The use of on-farm compost has increased in recent years, providing an alternative to commercial compost. The use of biochar in composting operations has attracted interest due to the multiple potential benefits arising from such practice, including improved C/N ratio, faster composting operations, ameliorated quality of the composted material, reduction of emissions and higher nutrient retention.
This work presents the results of an open field experiment which investigated the effects of the application of co-composted biochar with manure (CB), compared with stabilized manure without biochar addition (MN), NPK-based inorganic fertilization (NPK) and control treatments (CK) (no fertilization or amendment) on spring barley growth and yield. Several soil chemical parameters were analyzed in soil to determine significant variations among treatments. Barley biomass was evaluated at the phenological stage of milky caryopsis ripening (May) and at the vitreous caryopsis stage (June). The growing season was characterized by low rainfall and prolonged dry spells. Significant effects have been observed on barley biomass and seed yield for co-composted biochar, compared to all other treatments, including NPK. Plants amended with CB showed the highest biomass value (Figure 1A) at harvest. Furthermore, the same statistical trend was observed for the grain yield parameter (Figure 1B). In detail, the grain yield of the plants cultivated with CB showed a significant increase of about 40% compared to CK, MN, and NPK treatments.



Moreover, co-composted biochar and manure (CB) proved to be a valid treatment to preserve the initial soil organic carbon (final TOC=23.3), providing a common C/N value for agricultural soil. These findings suggest that biochar can improve the agronomic efficiency of manure, providing a valid alternative to common on-farm handling of manure, and contributing to the offsetting of inorganic fertilizer demand in organic agriculture with low rainfall.

Keywords: Biochar,Soil Organic Carbon,Soil Organic Matter,Organic Agriculture,Carbon Farming

ID ABS WEB: 137225

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

SIMULATION OF THE LONG-TERM EFFECT OF CARBON FARMING PRACTICES UNDER FUTURE CLIMATE

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For 6 long-term field experiments with fertilizers located in the European Russia on retisols, podzols and chernozems, the observed and predicted dynamics of soil organic carbon stocks in the arable layer was studied for the contrasted treatments. RothC dynamic model was used to assess the impact of climate change until the end of the century on the ability to enhance carbon sequestration after modification of agricultural practices. The impact of such carbon farming practices as elimination of the fallow field; changes in crop rotation; rates of applied manure; replacing manure with alternative organic fertilizers and minimum tillage was simulated. For almost all the experiments studied, the forecast of soil OM dynamics under future climate makes it possible to achieve the goal of 4 ppm. The period until 2055-60 is more favorable for sequestration of C. For chernozems, the accumulation period is limited to 2040, after which it is possible to maintain previously accumulated C stocks until 2070-80, after which losses are expected to accelerate. In this period RCP4.5 climate scenario tends to be more favorable compared to the RCP8.5 when soil C stock is less than 30 Mg/ha, an additional accumulation of about 2 ppm is provided. The average C rate accumulation does not exceed 10‰, although for podzols it can be as high as 20‰. For SOC stocks more than 60 Mg/ha, no differences are observed between the two climate scenarios. The most promising carbon farming practices are correct rate of organic fertilizers as well as perennial grasses in crop rotation. The application of alternative sources of organic fertilizers made it possible to accumulate additional C, while the efficiency decreased in the series compost and peat mixtures>biochar >manure>green manure in equivalent C rates. Changing the manure rates and replacing manure with alternative organic fertilizers is considered as a short-term effect, manifested mainly in the accumulation of additional C stock, without changing the time of saturation.

Keywords: soil organic carbon,sequestration,long-term field experiments,carbon farming practices,dynamic modelling

ID ABS WEB: 137418

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

INFLUENCE OF DIFFERENT AGRICULTURAL MANAGEMENTS ON SOIL ORGANIC MATTER DISTRIBUTION AND STABILITY IN TOPSOIL AND SUBSOIL

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The aim of the study was to investigate how agricultural management affected the functional SOC pools in topsoil and subsoil of a Typic Haplustept developed from fluvial-lacustrine sediments in Umbria region, Italy. The research was conducted in a mid-term trial [11 years - wheat-tomato rotation (first 4 years) and wheat-maize rotation (last 7 years)] where three managements were implemented: CONV - integrated management with no cover crop and conventional tillage, ORG - organic management with cover crop and conventional tillage, NOT - integrated management with cover crop and no-till. Within each plot, soils were sampled by horizons, and the samples were fractionated obtaining the following SOC fractions: labile (WEOM and POM), stable (aggregates of size 2-0.05 mm, SSA, and < 0.05 mm, SCA) and resistant to NaClO oxidation.
Although TOC content did not change among managements, except for NOT topsoil (0-20 cm), the ORG and NOT soils showed greater proportion of OC associated with SSA throughout the soil depths. Lower phenols concentration was also found in the upper layer of ORG and NOT, that was attributed to the incorporation of lignin-poor material (legume cover crops). Regarding the δ13C and δ15N determined in the different fractions, whereas δ13C showed a wide variability due to the presence of C3 and C4 plants in the rotation, the high δ15N in ORG and NOT suggested the occurrence of intense mineralization, likely due to a priming effect promoted by the green manuring with legume cover crops. This hypothesis would be supported also by the larger C-CO2/Cmic and C-CO2/Clabile ratios in the subsoil of ORG and NOT compared to that of CONV. Considering the whole profile, the three managements had similar organic C stocks. For NOT management the highest C stock was in the topsoil, mostly as labile C and in the SSA. For CONV and ORG managements the highest C stock occur in the 20-40 cm layer, mostly in the stable pool.

Keywords: organic carbon pools,soil organic matter quality,stable isotopes,cultivated soil,cover crops

ID ABS WEB: 137861

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

REDUCING N2O EMISSIONS IN AGRICULTURAL SOIL BY INCORPORATING THREE TYPES OF BIOCHAR INTO CATTLE MANURE-BASED FERTILIZERS

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To address the adverse effects of agriculture on climate change, it is imperative to adopt soil management practices that minimize greenhouse gas (GHG) emissions. A promising approach involves incorporating biochar into fertilizers to enhance carbon sequestration in the soil while simultaneously reducing N2O emission. Although previous studies have explored the impact of biochar on reducing soil nitrous oxide (N2O) emissions, the specific effects of blending biochar into manure-based fertilizer remained understudied. In this field experiment, we compared soil N2O emissions during lettuce cultivation across six treatments: chemical pelleted fertilizer (CF), cattle-manure-based pelleted fertilizer (CT), cattle-manure-based agglomerated fertilizers blended with biochar made from three different feedstocks (rice husk (RB), poultry manure (PB), and coffee grounds (CB)), and no fertilizer (NF). Cumulative N2O emissions were significantly lower in CT and biochar-blended fertilizer (RB, PB and CB) treatments compared to CF treatment. Biochar-blended fertilizers, particularly those incorporating rice husk biochar, tended to reduce N2O emissions immediately after fertilizer application when compared to CT. Soil inorganic nitrogen and lettuce yield did not show significant differences among the treatments, except in the case of no fertilizer control (NF). This suggests that the reduction in N2O emissions with all fertilizer treatments may not be attributed to a decrease in inorganic nitrogen concentration but rather to alterations in the activities of nitrifying and denitrifying bacteria responsible for N2O production from inorganic nitrogen. Our findings support the use of cattle-manure-based agglomerated fertilizers blended with biochar as an effective approach to mitigating N2O emissions from agricultural soils, concurrently enhancing soil carbon through biochar incorporation.

This work was supported by the MAFF Commissioned Project study on “Enhancing Carbon Sequestration Capacity in Agricultural Soils through Biochar Development” (Grant Number JP J008722).

Keywords: Nitrous oxide,Agricultural soil,Biochar,Pellet,Carbon farming

ID ABS WEB: 137891

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

APPLICATION OF ORGANIC AMENDMENTS IN INFERTILE SANDY SOILS DOES NOT ALWAYS FOLLOW “MORE IS BETTER”: CARBON SEQUESTRATION AND ECONOMIC EVALUATION PERSPECTIVES

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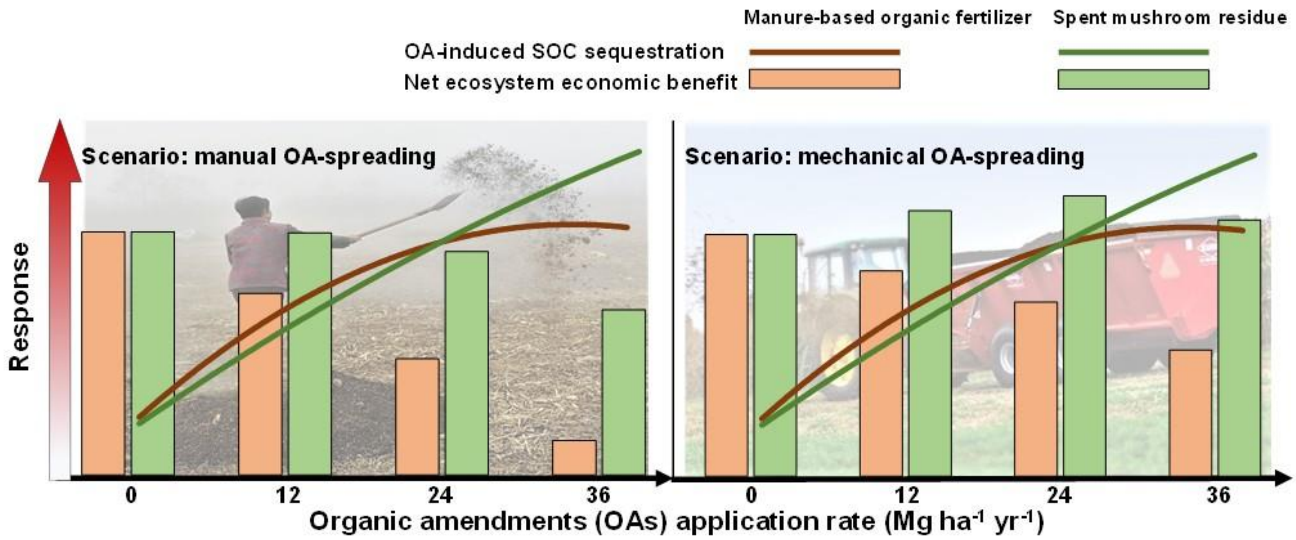
A thorough understanding of the agricultural, ecological, and economic benefits of organic amendment (OA) application in infertile soils is crucial for facilitating agricultural sustainability. We conducted a three-year field study to evaluate the effects of OA application on fractions and sequestration rates of soil organic carbon (SOC), crop yield, and net ecosystem economic benefit (NEEB) in a typical infertile sandy soil of the ancient Yellow River alluvial plain. In addition to CK (non-OA application), two types of OAs, i.e., manure-based organic fertilizer (M) and straw-based mushroom residue (S) were each applied at 12, 24, and 36 Mg ha-1 yr-1. Two scenarios of OA application practices, conventional manual OA application (AMA) and mechanical OA application (AME), were considered in the economic evaluation. An increase of 1 g kg-1 SOC content could improve the crop yield by 2.25 Mg ha-1 yr-1. Compared with CK, OAs application increased SOC content by 5.94%-35.4%, easily oxidizable SOC by 17.6%-40.9%, light fraction by 24.3%-102%, and heavy fraction by 75%-137%. However, SOC sequestration efficiency of the OAs tended to decrease under high rates of OA application. S was observed to have more potential in sequestering SOC among the treatments. Owing to SOC sequestration, OA application reduced the global warming potential cost by 28%-119% compared with the CK. Nevertheless, the benefits of OA application on yield and SOC sequestration were substantially covered by the increased material and labor costs when evaluating the NEEB. Compared with AMA, AME could save 10%-27% of agricultural costs. AME of B at a rate of 24 Mg ha-1 yr-1 achieved the highest NEEB. This study implied that the strategy of “the right OA, right application rate, and right spreading practice for the right soil” should be proposed to achieve a sustainable solution for promoting crop productivity, enhancing SOC sequestration, and ensuring farmer income in infertile farming regions.



Keywords: Organic amendment,Infertile sandy soil,Soil organic carbon,Net ecosystem economic beneft,Economic evaluation

ID ABS WEB: 137914

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

THE EFFECTS AND PERCEPTIONS OF SPONTANEOUS COVER CROPS ON SOIL QUALITY IN MEDITERRANEAN ORCHARDS: A CASE STUDY CONDUCTED IN SOUTH-EAST SPAIN

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Intensification of farming systems normally leads to soil degradation, which nowadays poses a severe risk in sustainable food production. To mitigate soil degradation, sustainable land management practices (SLM) are implemented. A SLM practice that has been getting much attention lately, is the adoption of cover crops. This is also the case in orchards in South-East Spain, where soil degradation is severe, and the farming conditions are aggravated due to the semiarid climate. This study examined the perceptions and effects of spontaneous cover crops on soil quality in Mediterranean orchards (olive and fruit). Twelve farms in South-East Spain, six using cover crops (CC) and six not using cover crops (TR), were analysed for aggregate stability, water holding capacity, unsaturated hydraulic conductivity, dry bulk density, soil moisture, pH, electrical conductivity, cation exchange capacity, organic carbon, total carbon and nitrogen and bioavailable phosphorus. Additionally, regional farm advisors were interviewed, and farmers surveyed regarding (spontaneous) cover crop implementation. The results indicated that solely total carbon was significantly higher in CC-treated soils (P= 7.02E-5). However, unsaturated hydraulic conductivity and available water holding capacity were significantly lower (P-values 2.45E-4 and 1.02E-2, respectively). Other soil parameters showed no significant differences. The principal component analysis suggested minimal variation between CC and TR treatments, indicating limited impact of spontaneous cover crops on soil quality in these orchards. Analysis of the perceptions of farm advisors and farmers highlighted the difficulty of adopting cover crops in the study area: all stakeholders indicated that the implementation of (spontaneous) cover crops is, to some extent, inconceivable. Stakeholders fear that cover crops limit water availability for the main cultivating crop. Consequently, the endorsement of implementing spontaneous cover crops is insufficient. These results highlight the urgent need for further research of (other) conservation practices to successfully mitigate soil degradation in Mediterranean orchards.

Keywords: cover crops,soil degradation,soil quality,olive orchards,semi-arid conditions

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4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

SOIL CARBON SEQUESTRATION AND SUSTAINABILITY IN ENSET HOMEGARDEN SYSTEMS IN SOUTHWESTERN ETHIOPIA

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Healthy soils are key to ensure sustainable food production. However, many agricultural soils, particularly in the tropics, are highly degraded and a major limiting factor for crop production. Improved crop and soil management practices have the potential to increase crop yields and soil carbon and nutrient storage, but pedoclimatic conditions are constraining factors that need to be considered when recommending crops and management. In this study, we sampled 427 fields across 80 sites along eight elevational transects in the southwest of Ethiopia to investigate the influence of crop type and management on soil properties. At each site, soil samples were collected from homegardens with enset and coffee, annual-crop rotation fields, woodlots with eucalyptus, and pasture land. Thirteen soil properties were analysed for each sample, including total carbon, nitrogen and phosphorus, and available phosphorus and potassium. While geographic factors such as elevation had a significant effect on most soil properties, differences between crops within sites was the main source of variability. In general, homegarden fields (with enset and coffee) had higher soil fertility and soil carbon than the annual-crop fields, eucalyptus plots and pastures. In addition, homegarden fields and annual-crop fields with organic amendments (mainly cow manure) were found to have higher active carbon, and available phosphorus and potassium. Overall, differences in soil fertility between crops appeared to be both due to specific management and practices, in particular organic inputs, and to inherent differences between crops. Thus, the extent of the more productive and fertile homegarden crops is likely to be limited by the availability of organic amendments. This study suggests that promoting the expansion of intensive systems such as enset homegardens with the aim of improving production, soil fertility and carbon sequestration is a viable route only if management and production constraints are also taken into account.

Keywords: soil organic carbon,carbon sequestration,crop management,cropping practices

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4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

EFFECTS OF THE APPLICATION OF OLIVE WASTE BIOCHAR AND GREEN COMPOST ON SOIL QUALITY, CARBON DYNAMICS, AND PLANT PHYSIOLOGY IN A SUPER-INTENSIVE OLIVE ORCHARD

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Modern agriculture faces the dual challenge of meeting the escalating global food demand amid the degradation of more than 40% arable soils, which elevates dependence on mineral fertilizers. An alternative solution is proposed through the valorization of agricultural residues, serving as soil substrates or supplements [1,2]. Biochar, a carbonaceous product from residual biomass pyrolysis, has emerged in the last decade as a promising soil amendment. It enhances soil physical properties, promotes plant productivity, and contributes to C sequestration [3,4].
This study evaluates the effects of olive waste biochar and traditional green compost as organic amendments on soil properties, crop productivity, plant physiology, and soil respiration in a super-intensive arbequina olive plantation under deficit irrigation. Ninety-six 1m² plots, each surrounding an olive tree, were established with treatments including olive-waste biochar, green compost, a biochar-compost mixture (50% w/w), and un-amended controls (24 plots per treatment). Biochar significantly increased soil water holding capacity, reduced compaction, and improved photosynthesis, water-use efficiency, and electron transport rate, resulting in a 15% increase in olive fruit yields. However, the net oil yield per tree remained similar due to higher moisture content in olives from biochar-amended trees. Biochar application notably increased soil organic C content, particularly recalcitrant C, while soil respiration rates varied seasonally with temperature, with compost treatment showing the highest rates. The compost+biochar amendment disrupted this trend.

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Keywords: Soil quality,Organic amendments,Sustainable agriculture,Waste valorization,Carbon sequestration

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4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

DIVERGENT ACCUMULATION OF MICROBIAL NECROMASS CARBON AND LIGNIN MEDIATED BY MICROBE IN PARTICULATE AND MINERAL-ASSOCIATED FRACTIONS UNDER LONG-TERM FERTILIZATION

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Fertilization impacts the conversion of microbe-derived and plant-derived carbon in particulate organic matter (POM) and mineral-associated organic matter (MAOM), affecting the storage and stability of soil organic carbon (SOC). However, how fertilization influences the microbial mechanisms underlying this conversion in paddy soil is unclear. Thus, amino sugar, lignin and enzyme activities were determined in a 12-year field experiment. Organic fertilizer increased the SOC content by 33.01%, and combined organic and inorganic fertilizers increased SOC stability by 7.07%. Specifically, organic fertilizer increased the lignin content by 17.09% (particularly in POM) and decreased the (Ad/Al)v, indicating the selective preservation of lignin. The increased bacterial PLFA/fungal PLFA and Ln(cellulase)/Ln(ligninase) demonstrated a shift of microbial communities towards bacteria and a decrease of lignin utilization. The microbial necromass carbon (MNC) content increased by 46.75% (particularly in MAOM), and the GluN/MurN decreased, showing organic fertilizer increased the contribution of MNC to SOC (especially bacterial necromass). The increased microbial biomass carbon (MBC) and r-strategy bacterial relative abundance indicated the promotion of fast-growing microorganisms. Therefore, SOC sequestration was improved with the increase of lignin and amino sugars under organic fertilizer. Combined organic and inorganic fertilizers decreased the lignin content by 11.20% (particularly in POM) and increased the (Ad/Al)v in MAOM, indicating the acceleration of lignin decomposition. Compared with other fertilization treatments, the increment of Ln(cellulase)/Ln(ligninase) and bacterial PLFA/fungal PLFA were smaller, showing a stronger promotion on fungi and lignin use. The MNC increased by 45.26% (particularly in MAOM), but the GluN/MurN was lower than that of other fertilization treatments, showing combined organic and inorganic fertilizers increased the contribution of MNC to SOC (especially fungal necromass). The increased MBC and relative abundance of r-strategy bacteria and k-strategy fungi, indicating the promotion of both fast-growing and slow-growing microorganisms. Therefore, the increase of MNC and the decrease of lignin improved the stability of SOC. Overall, fertilization regulated the conversion of plant-derived and microbial-derived carbon affecting the storage and stability of SOC.

Keywords: Fertilization regimes,Lignin,Amino sugar,Particulate organic matter,Mineral-associated matter

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4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

EFFECT OF FOREST SPECIES ON SOIL CARBON BALANCE: A CASE STUDY IN THE MONT BEUVRAY, FRANCE

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Soils play a key role in regulating atmospheric concentrations of greenhouse gases and specially forest soils, which store around 20% of the continental organic carbon stock. Ongoing climate change could alter the balance of this stock, and the effect of temperature on soil carbon fluxes remains an important question. Q10 parameter was calculated for 4 different forest stands (beech, spruce, douglas fir and silver fir) to estimate the soil organic matter sensitivity to temperature. Soil organic carbon stocks and forestry data (volume, basal area and dead wood) were also estimated.
The mont Beuvray site (Morvan, France), a 1,000 ha mid-mountain area, homogeneous in geology and pedology, was selected. In mont Beuvray, beech correspond to historical stand, while softwood forests have been introduced over the past 70 years. Twelve soil samples per tree species (0-20 cm) were collected and the main physicochemical characteristics were determined. The Q10 was calculated for a temperature range of 5 to 25°C at laboratory.
Results show that soil organic carbon and water-extractable organic carbon contents are higher in silver fir and beech soils than in Douglas fir soils. However, the average soil carbon stocks are not statistically different between the stands. Q10 values are higher for beech (2.8 ± 0.1) than for the softwood species (2.6 ± 0.1), suggesting that CO2 emissions from soil in beech stands would increase strongly with temperature than in other species.
In conclusion, several decades after the introduction of softwood species, we did not measure significant difference in carbon stocks. However, CO2 emissions and Q10 values are different and related to forest species. Hence, beech soils could see their CO2 emissions increase as they are the most sensitive to temperature. Conversely, silver fir stands, with their lower sensitivity to temperature, could be of interest in mitigating emissions. These results need to be confirmed by field data on soil respiration and compared with above-ground forest biomass and stand health.

Keywords: Forest soil,soil organic carbon stocks,soil organic matter reactivity,climate change,forest species

ID ABS WEB: 136843

4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

SOWING SUSTAINABILITY: A CASE STUDY ON THE IMPACT OF SUSTAINABLE LAND MANAGEMENT ON SOIL CARBON SEQUESTRATION AND CARBON FARMING IN TRIBAL REGION OF ARAKU IN THE EASTERN GHATS OF INDIA

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India, with its diverse agro-climatic zones, is a microcosm of the global agricultural land-scape, facing the dual challenge of ensuring food security for its burgeoning population while mitigating the environmental impact of farming practices. This case study investigates the adoption and impact of sustainable agricultural land management practices (SALM) in the tribal hilly region of Araku (Eastern Ghats of India), shedding light on the intricate balance required to achieve both productivity and environmental conser-vation.
The case study investigates the impact from diverse SALM practices on the sequestra-tion of carbon in the soil. These practices include agroforestry with fruit and shade cof-fee systems, intercropping of legumes and millets, green manuring, and the use of mulching and organic composting techniques. The implementation of these activities will achieve multiple objectives, including increased carbon sequestration, improved soil fertility, increased biodiversity, and food security, thereby improving the livelihoods and well-being of indigenous landowners. SALM supports biological investments in the soil to make it more dynamically fertile and nutrient-rich so that external input requirements each year keep decreasing; it nurtures water retention and other natural resources in the environment.
Another component of this case study is the formation of a new topsoil by aggregating local biomass, composting it with microbial starter inoculants, and incorporating natural nutrient additives tailored to the regional soil physiology, such as rock phosphate, rock dusts, and oil cakes. These inoculants, when seasonally applied to the soil, introduce beneficial microbes and transform soil microbiomes.
The findings of this case study aim to contribute valuable insights for policymakers, agri-cultural practitioners, and researchers working towards the global goal of sustainable agriculture. By unravelling the intricacies of sustainable agricultural land management and its impact on soil carbon in the Indian context, this research aims to provide practi-cal recommendations. These recommendations can be flexibly adapted and imple-mented in diverse agricultural settings around the globe, contributing to a more resilient and sustainable future for global food production.

Keywords: Carbon Farming,SALM,Soil Organic Carbon,Carbon Sequestration,India

ID ABS WEB: 137812

4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

DO POPLAR PLANTATIONS ENHANCE SOIL ORGANIC CARBON IN THE MEDITERRANEAN ENVIRONMENT?

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European policies are actively promoting the adoption of Carbon farming practices aimed at sequestering CO2 from the atmosphere and improving soil organic carbon (SOC) stocks in agricultural soils. Within this context, changes in land use, toward ecosystems with higher carbon (C) stock, could positively impact the global C cycle. For this purpose, we investigated the impact of the land use change from cropland (CR) to poplar plantations (PP), on the SOC stock at 0-10 cm and 10-30 cm soil depths. The time-for-space substitution method (i.e., paired comparison) was used to investigate the effect of land use change on SOC, while a spatial survey approach (i.e., SOC stock difference method) was used to evaluate the effect of thirty years of PP on SOC stock levels. This aspect was evaluated by resampling the same PP sites after a time interval of 30 years. Six farms cultivating poplar, all located in North Italy, for a total of fifteen sites, were selected for this study. Results of the land use change analysis displayed how PP maintains a larger SOC stock than CR sites, at both depths, despite a large uncertainty on the estimates. The impact of three decades of PP on SOC stock results in a positive trend, with the SOC stock increasing over time. Clustering the PP sites according to the age suggests an initial C loss occurring in the early stages after conversion of CR to PP (1-5 years) probably due to site preparation, and then the SOC increases until the end of the rotation period, overtaking the initial SOC levels. Overall, this study will pave the way for establishing an efficient management system within the framework of PP for the long-term storage of carbon in soil, thereby aiding in the mitigation of the impacts of climate change.

Keywords: Carbon farming,Soil organic carbon,Poplar plantations,Agricultural soils,Climate change

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4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

CARBON-FARMING PRACTICES FOR EUROPEAN CROPLAND: A REVIEW ON THE EFFECT ON SOIL ORGANIC CARBON

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Carbon farming has been recently proposed as an effective measure for climate change (CC) mitigation through carbon (C) sequestration or C emissions reduction. To identify and estimate the CC mitigation potential of Carbon-farming practices on European croplands we conduct a systematic review of both relative and absolute annual soil organic carbon (SOC) stock change (δSOCREL; δSOCABS) related to sole and combined agroecological practices tested on mineral soils at 0-30 cm and >30 cm soil depths. We compiled a dataset with 513 δSOC rates expressed as Mg C ha-1 yr-1, obtained from 105 experimental studies and representing 10 C-farming practices: cover crops (GM/Mu), organic amendments (OA), crop residue maintenance (R), improved rotations (IR), establishment of hedgerows (HEDGE), silvoarable systems (SLA), reduced soil disturbance (RSD), organic (ORG) and conservation agriculture (CONS) and set-aside (SET-ASIDE) or conversion of cropland into permanent grassland (G/P). Our analysis reveals a median δSOCREL of 0.16, 0.17, 0.25, 0.26, 0.33, 0.33, 0.38, 0.70, 0.77, 0.82, 1.08 Mg C ha-1 yr-1 at 0-30 cm for R, RSD, IR, SLA, OA, GM/Mu, CONS, G/P, ORG and SET-ASIDE respectively. SOC sequestration was detected only for OA, GM/Mu, CONS, ORG, and combined C-farming practices for which we estimated a median δSOCABS ranging between 0.32 and 0.96 Mg C ha-1 yr-1 at 0-30 cm. Permanent grasslands and pastures were negatively affected by any type of land-use change, at least in topsoil. Natural ecological successions after cropland abandonment (20-year set-aside), are promoting a relative SOC stock annual increase by 1.08 Mg C ha-1 yr-1, while the net CC mitigation remains unclear when the subsoils are included in the assessment. In conclusion, whole soil profile SOC measurements, long-term experiments, and the SOC stock difference method should be encouraged within experimental protocols aimed at identifying C-farming practices and estimating their SOC sequestration or SOC emission reduction potential.

Keywords: Agriculture,Climate change mitigation,Conservation agriculture,Soil organic carbon,Sustainable practices

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4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

EFFECT OF BIOCHAR ON SOIL RESPIRATION IN A CULTIVATED SOIL UNDER CONVENTIONAL AND MINIMUM TILLAGE IN ZAMBIA

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Increasing soil organic carbon (SOC) and reducing its loss through soil respiration (SR) is a major challenge in African soils and globally. Biochar has been reported to have the potential to increase SOC through direct carbon addition and the reduction of the decomposition of pre-existing SOC, heterotrophic respiration (RH). However, the effect of biochar in combination with other soil management practices such as fertilization and tillage is not well known. Further, there is a scarcity of data in Africa on the impact of biochar and other management practices on soil C dynamics such as carbon dioxide (CO2) emissions. In this study, we assessed the effect of biochar (2 tons/ha) on RS and RH in a winter wheat field with and without NPK fertilization and under conventional tillage (discing) and minimum tillage (direct seeding) in Zambia. Fluxes of CO2 were measured weekly over a 3-and-a-half month growing season using the EGM5 carbon dioxide analyzer in planted (for RS) and bare (for RH) plots. Furthermore, substrate-induced respiration (SIR) was measured in unfertilized plots for 5 hours after application of sucrose under field conditions.
Results showed that the response of RS to biochar was dependent on both the tillage method and fertilization. Biochar reduced both RS and RH under conventional tillage in the fertilized plots by 12-20%. However, without fertilization, biochar marginally increased RS and RH. Under minimum tillage, the effect of biochar on RS and RH was not significant with or without fertilizer application. Substrate-induced respiration was higher in biochar amended soils under minimum tillage, but not under conventional tillage. Our results suggest that the effect of biochar is influenced by the tillage practice and nitrogen fertilization. Further studies are needed to validate these results in different soil types and also under different agroecological zones in Zambia.

Keywords: Biochar,Soil Respiration,Tillage,Africa

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4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

ARE SOIL-BASED CARBON CERTIFICATES A SUITABLE TOOL FOR CLIMATE CHANGE MITIGATION?

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Increasing soil organic carbon (SOC) stock in agricultural soils contributes to mitigating climate change and to achieving climate neutrality goals. Furthermore, higher SOC levels may improve resilience against climate change impacts by increasing biological activity, nutrient turnover rates, infiltration rates, and water holding capacity.
However, carbon farming measures are associated with direct and indirect costs, which hamper large-scale implementation. Soil carbon certificates sold as voluntary emission offsets have emerged as a private governance tool that could offer a way to overcome these barriers and motivate sustainable transformation. In spite of a high interest from industry and farmers, the suitability of these certificates as a tool for climate change mitigation is currently under debate. To address the existing knowledge gaps, we assessed the suitability soil carbon certificates for mineral soils from the perspectives of soil science, agriculture, and governance. With regards to the policy framework, we focused on Europe while for examples of certification providers, we used Germany as a test case.
We found that the analyzed soil carbon certificates are unsuitable to offset greenhouse gas emissions, as the permanence of carbon removals can not be guaranteed by the certification providers, and re-emission of unspecified amounts of CO_2 after the contracting period is highly likely. Furthermore, long-time monitoring is typically lacking, additionality is not ensured, and safeguards against leakage effects are insufficient. We conclude that current soil carbon certificates are unlikely to provide the climate change mitigation they promise and that funding for emission offsets should be used more effectively elsewhere. Finally, we compare the analyzed schemes with certification schemes based on the rewetting of organic soils and discuss if and how the planned European framework for carbon removal certification could remedy the shortcomings we identified.

Keywords: Carbon farming,Certification,Private Governance,Assessment,Additionality

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4. Soil health in achieving the Sustainable Development Goals
4.22 133580 - Sustainable grassland management for healthy soils and vice versa

SOIL MICROBES EXHIBIT RESILIENCE TO LONG-TERM SAVANNA FIRE REGIMES

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Fire significantly influences the structure and functioning of savanna ecosystems and the aboveground vegetation dynamics, however the impact of fire on belowground processes is much less understood. Fire intensity and frequency is increasing with global change and thus it is vital to understand the effect of changing fire regimes on soil microbes and biogeochemical cycling in savanna ecosystems. Here, we studied the impact of different long-term fire regimes on microbes in sandy soils using the Experimental Burn Plots in Kruger National Park, South Africa. We determined how soil abiotic and biotic properties varied across differing fire intensity and frequency regimes. Our results show that fire regime had no effect on soil carbon, nitrogen or pH and limited impact on microbial community composition and biomass. Given that there were negligible differences in soil properties between fire regimes and very low concentrations of soil microbes across all soils, we also investigated whether soil microbial function was affected. This was quantified using assays of moisture and carbon limitation on microbial activity. Whilst increasing water availability had no impact on soil respiration, substrate-induced respiration rates were significantly greater with higher intensity fires than lower intensity fires and fire suppression, suggesting potential differences in the microbial functional groups contribution to rapid carbon-cycle responses between fire regimes. Overall, our findings highlight the resilience of this system to prescribed fire variance and provide understanding on microbial interactions with fire in savanna ecosystems. This is an essential study for informing long-term fire management strategies and savanna biome conservation.

Keywords: Soil Resilience,Substrate-induced respiration,Microbial Community,African savnna,Fire

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4. Soil health in achieving the Sustainable Development Goals
4.22 133580 - Sustainable grassland management for healthy soils and vice versa

CHANGES IN SOIL FUNGAL AND BACTERIAL COMPOSITION AFTER PYRIC HERBIVORY IN TEMPERATE MOUNTAIN GRASSLANDS

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Grasslands biomes are globally threatened by woody plant encroachment. Pyric herbivory -the combination of prescribed burnings and targeted grazing- is an efficient tool to restore open habitats and to promote diversity. However, how pyric herbivory practices affect belowground biodiversity is less well understood. We assessed the midterm effects on soil bacterial and fungal populations of prescribed burns and targeted horse grazing applied as restoration measures against gorse expansion (Ulex gallii Planch.). We set up three treatments in two shrub-encroached grasslands in the western Pyrenees: burning but no grazing, burning and grazing, and no burning and no grazing as control. We collected topsoil samples (0-3 cm) at two dates: D1, immediately following the burning (n=20, 10 not burned + 10 burned), and D2, 1.5 years later, following two periods of horse-targeted grazing (n=24, 8 not burned not grazed + 8 burned not grazed + 8 burned and grazed). Soil DNA was isolated and DNA metabarcoding was performed targeting an ITS genomic region for fungi and a 16S genomic region for bacteria. Bacterial and fungal populations responded differently to burning. Heat maps and hierarchical clustering from D1 showed that bacterial populations at the two sites were grouped together and that they evolved differently after the burning. On the contrary, fungal composition was initially different at the two sites but evolved to a more similar fungal community after the burning. Heat maps and hierarchical clustering from D2 showed that grazing after burning lead to a similar bacterial and fungal composition in both sites. Following the fire, the prevalence of the fungi Pezoloma and Phomatospora surged in the burned plots. However, after two grazing periods, equivalent to 1.5 years, a different set of fungi - Conochieta, Nadsonia, and Pochonia - along with the bacteria Sphingomonas and an unclassified Rizhobiales, showed an increase in the burned + grazed plots.

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Keywords: pyric herbivory,fungi,bacteria,soil diversity,mountain grasslands

ID ABS WEB: 136691

4. Soil health in achieving the Sustainable Development Goals
4.22 133580 - Sustainable grassland management for healthy soils and vice versa

EVALUATION OF SOIL QUALITY INDICES UNDER DIFFERENT TYPES OF DAIRY SYSTEMS IN COLOMBIA

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Livestock in Colombia is developed over large areas; in 2022, nearly 29,301,392 animals distributed in 633,841 farms were reported. Traditional livestock systems with low technological implementation generate negative impacts on soils, by affecting their physical and chemical properties, which leads to the need to develop and implement sustainable livestock farming. Considering the above, this research evaluated the effect of three plots (treatments) established under a split-plot design with different grazing practices for dairy cattle farming (pasture renewal, silvopastoral, and traditional) on the physical and chemical properties of soil located in the municipality of Saboyá (Boyacá, Colombia). Soil sampling was carried out during 2015 (baseline), 2016, 2017, and 2022 to determine their physical and chemical characteristics. The laboratory results were used for the design of soil quality indices (SQI), which required the selection of a minimum set of properties through principal component analysis (PCA), the application of the method known as an expert opinion (EO) to validate the PCA results, and the calculation of the additive and weighted indices. The indices obtained were subjected to a least squares test with multiple comparison adjustments according to Tukey of the SAS Enterprise 8.3 software, in order to evaluate the effect of different types of dairy systems and their interaction with the years evaluated. Finally, using geostatistical tools from ArcGIS® Pro 2.9.0 (ESRI®) software, the deterministic spatial interpolation method IDW (Inverse Distance Weight) and Moran's Index, the obtained indices were cartographically represented. The indices from 2015 to 2017 were high compared to those of 2022, which were moderate, showing the impact of livestock farming on the soil and confirming the importance of sustainable livestock practices. Similarly, preparing maps using soil quality indicators built from different physical and chemical properties becomes a valuable tool to identify areas with the greatest need for intervention.

Keywords: Extensive livestock production,Sustainable soil management,Soil health,Pasture renewal,Silvopastoral

ID ABS WEB: 137202

4. Soil health in achieving the Sustainable Development Goals
4.22 133580 - Sustainable grassland management for healthy soils and vice versa

HOW DOES GRASSLAND PRODUCTIVITY RELATE TO SOIL CARBON SEQUESTRATION: THE EFFECTS OF FERTILIZER DRIVEN DIFFERENCES IN YIELD ON MOUNTAIN GRASSLAND C STOCKS

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We generated six distinct productivity levels in a mountain hay meadow at 1200 m asl. in the Swiss Alps, using non-N mineral fertilizer applications. This grassland field experiment was continuously under the same management for 32 yrs. Applying both a carbon (C) stocks analysis and a C fluxes analysis, we investigated the effect of aboveground yield on the ecosystem organic carbon (OC) budget.
Fertilization promotes plant growth and plant growth provides the OC that may become stabilized in the soil. We hypothesized that harvested yields are a valid proxy for the amount of plant derived OC that enters the grassland ecosystem. Everything else being equal, this would result in larger soil organic C (SOC) stocks, increase the terrestrial sink for CO2 and thus reduce the [CO2] increase rate in the atmosphere.
We found that between fertilization categories grassland yields differed by factor 1.4- 2.0, depending on the reference period (30 yr. mean vs. single year). Surprisingly, SOC stocks did not differ between fertilization categories.
Paralleling a 1.5°C mean annual warming, grassland yields have decreased by ca. 25% over the 32 yrs. period, while the yields were reduced further in years with pronounced summer heat, despite the high altitude of the site. During the same time, SOC stocks decreased by 15% on average.
Parameterization of the net ecosystem C flux balance, based on year-round CO2 gas exchange measurements, closely matched the C stock based balance. It suggests proportionally higher respiration rates in high yield fertilization treatments. Thus, in high yield grasslands the higher ecosystem OM input is apparently driving a higher decomposition rate, rather than increasing the SOC stock.
We conclude that yield increases of agricultural grasslands do not serve as good proxies for a concomitant increase in SOC stock. Analogously, agricultural management practices, aiming at increased soil C sequestration rates, may focus rather on lower OM decomposition rates (C output) than on higher OM production rates (C input).

Keywords: Grassland C storage,Grassland productivity,Greenhouse gas mitigation,Net ecosystem carbon balance,Longterm field experiment

ID ABS WEB: 135433

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

WILL CONSERVATION TILLAGE COMBINED WITH THE LAND APPLICATION OF BIOCHAR 'SEQUESTER' CARBON IN THE TROPICAL SOILS OF SOUTHERN GUAM?

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In our previous studies we have reported that soil organic carbon depletion caused by soil degradation as the result of mismanaged cultivation, and soil disturbances negatively impacts soil health and soil quality thus reduces soil productivity and threatens the agricultural sustainability. Furthermore, carbon dioxide (CO2) which is also produced by soil carbon reaction to the atmospheric air as the soil surface becomes exposed to air due to disturbances such as extensive tilling could possibly contribute to climate change scenario. On the other hand, a larger portion of soil carbon can be stored in the soil via land-based management techniques and by implementing carbon 'sequestration' practices thus reducing the effect of carbon dioxide (CO2) emission on global warming.
Adoption of any conservation practices that retain the organic carbon in the soil, hence reducing the risks of carbon loss into the atmosphere in the form of CO2 emission must be considered seriously. Additionally, adoption of practices such as the application of 'biochar' as a soil amendment that may potentially 'Sequester' carbon in the soil biota must also be considered as a management strategy to reduce the amount of CO2 coming off the soil upon soil surface disturbances. Therefore, in addition to practicing conservation tillage practices, we are also evaluating the effect of 'biochar' application as a soil amendment for improving the carbon storage capacity of the soils under study.
In this presentation, we will report the result of the land management practices including the land application of 'biochar' and its effect on the dynamics of soil carbon content and the soil carbon storage capacity on severely degraded soils of Guam. We also report the carbon loss from the soil under the conventional tillage as compared to the conservation practices (i.e., no-till) and their effect on soil carbon and for reducing the CO2 emission into the atmosphere.

Keywords: Soil carbon dynamics,Biochar,Carbon dioxide emissio,Carbon sequestration

ID ABS WEB: 136241

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

A GLOBAL META-ANALYSIS OF SOIL ORGANIC CARBON IN THE ANTHROPOCENE

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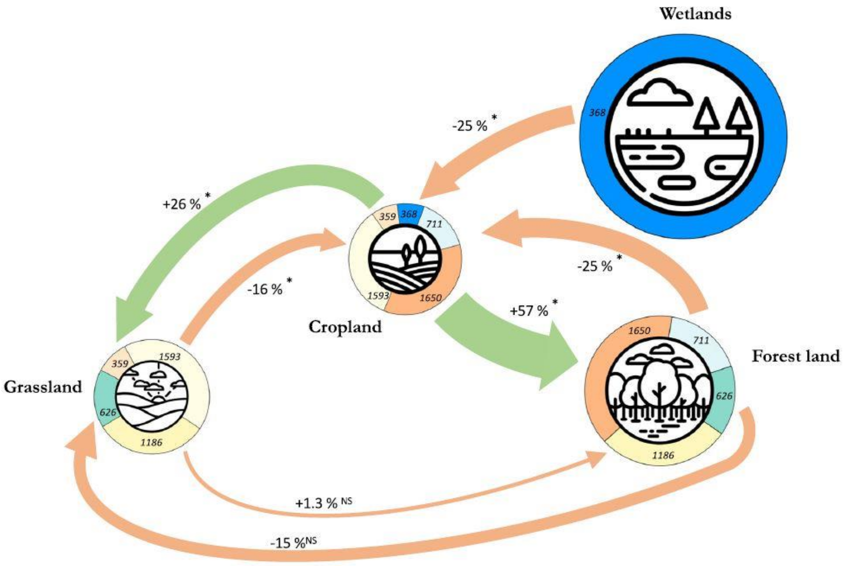
Anthropogenic activities profoundly impact soil organic carbon (SOC), affecting its contribution to ecosystem services such as climate regulation. Here, we conducted a thorough review of the impacts of land-use change, land management, and climate change on SOC. Using second-order meta-analysis, we synthesized findings from 230 first-order meta-analyses comprising over 25,000 primary studies.We show that (i) land conversion for crop production leads to high SOC loss, that can be partially restored through land management practices, particularly by introducing trees and incorporating exogenous carbon in the form of biochar or organic amendments, (ii) land management practices that are implemented in forests generally result in depletion of SOC, and (iii) indirect effects of climate change, such as through wildfires, have a greater impact on SOC than direct climate change effects (e.g., from rising temperatures). The findings of our study provide strong evidence to assist decision-makers in safeguarding SOC stocks and promoting landmanagement practices for SOC restoration. Furthermore, they serve as a crucial research roadmap, identifying areas that require attention to fill the knowledge gaps concerning the factors driving changes in SOC.



Keywords: climate change mitigation,land-use change,land management practices,soil organic carbon,global meta-analysis

ID ABS WEB: 136503

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

EVALUATING THE CARBON STORAGE POTENTIAL AND ACTUAL STAGE OF SOILS FROM THE AYSEN REGION OF CHILEAN PATAGONIA

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Based on the proposal of Vogel et al. (2019) separating the C content in potential and actual state, we have adapted the quantification of this function using a soil reactivity index (aluminum extracted with 1M of ammonium acetate pH 4,8; 1:10 soil extractant ratio) instead of clay plus half of silt content. The modeling was based on the relation of soil reactivity index and C content of 1660 soil samples data collected from agricultural and grassland soils throughout all the country. To evaluate Chilean Patagonia from the Aysen Region were used (173 superficial soil samples) from Entisols, Mollisol, Spodosols, Andisols, Inceptisols and Organic soils. For each point the potential capacity to store organic C was estimated (Cp; kg C m-2) and a relative index of this capacity (Isoc; 0 to 1) to compare among individual sampled points. Also, we estimate the actual state (Cs; kg C m-2) with a relative index (Îsoc). We categorized. Isoc values greater than or equal to 0.5 as moderate to high storage potential, while those lower indicate lower storage potential. Îsoc values greater than 1 denote fragile soils (Clunes et al. 2022), while those between 0 and 1 were characterized relative to C saturation levels as very low, low, medium, high or very high.
Results showed that the Aysen region has an Cp average 52.5 kg m-2 of C, with an Isoc value of 0.6 on average. The Cs reached only 28.9 kg m-2 of C, with an Îsoc average value of 1.3. Of the total samples evaluated 24 % were considered in a fragile condition because the accumulate an average of 11.8 kg m-2 above the estimated saturation level meaning that C was accumulated as residues or fibric C as peats and bogs, while 55% of the non-fragile soils were in a high and very high condition respect to its estimated saturation level.

Keywords: Carbon store capacity,Chilean Pagonia soils,Volcanic soils

ID ABS WEB: 136746

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

IMPACTS OF OIL PALM PLANTATION ON GREENHOUSE GAS EMISSION AND SUSTAINABLE MITIGATION ON YIELD OF OIL PALM, SOIL PROPERTIES AND NUTRIENT DYNAMICS

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Rapid increase in oil palm cultivation has caused environmental pollution and greenhouse gas (GHG) emissions, such as carbon oxide (CO2) and nitrous oxide, due to land use change and fertilization. Burning empty fruit bunches (EFB) as fuel in oil palm mill has negative impacts on air quality and boiler because of high content of potassium (K) and other components. Thus, alternative means on effective EFB utilization are necessary for carbon-neutral systems. Washed EFB can be processed as fuel pellets for biomass power generation and EFB washing water (ww) can be used as liquid fertilizer. EFB ww has high soluble C and K levels which can enhance palm growth and soil microbial activity. Effect of EFB ww on microbial activity and CO2 production, emissions and palm yield were evaluated for sustainable soil management.
Trenches were dug in an oil palm plantation near Kuantan, Malaysia. Soil layer samples (0-40 cm+) were collected along its cross section and measured for three-phase analysis and total C after 2 years of EFB ww application comparing to tap water (control). Soil microbial ATP and its activity, CO2 respiration rate were measured. CO2 fluxes was also measured from soil surface and the soil bottom of trenches by chamber method.
Three-phase analysis showed that the liquid phase decrease and the solid phase increase toward the lower layers. Soil ATP was higher with EFB ww than the control. CO2 flux from the soil surface was higher than that from the bottom of trenches. CO2 flux from EFB ww plot was higher than the control, possibly because soil microorganisms are more active with EFB ww. Porosity and respiration rates increased in the surface layer compared to before the EFB ww was poured, indicating that microbial activity was promoted by application of EFB ww. Oil palm yield had no decline in dry season, where soil C increased in the lower layer, suggesting a carbon sequestration effect.

Keywords: Greenhouse gas emission,Sustainable mitigation,Oil palm plantation,Nutrient dynamics,Soil microbial activity

ID ABS WEB: 136825

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

URBAN SOILS AS SOCIAL AND ECOLOGICAL PHENOMENA: WHO AND WHAT DRIVE THE SPATIO-TEMPORAL VARIABILITY OF SOIL CARBON IN URBAN AREAS

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Carbon neutrality is considered as the key strategy for climate mitigation. Cities which are responsible for a major part of anthropogenic C emissions invest in development of urban green infrastructures (UGI) to compensate these emissions by C sequestration in biomass. The role of urban soils in UGI C balance remains overlooked resulting in uncertainty in the estimated capacity of UGI to accumulate and store C. In fact, urban soils can be considered a social-ecological phenomena since direct and indirect anthropogenic drivers have the main impact on soil functionality and ecosystem services including C sequestration.
The research integrates two case studies, where direct and indirect anthropogenic effects distinguished spatio-temporal patterns in C stocks in and CO2 emission from urban soils. The first case study focused on the effects of urban mesoclimatic anomalies and soil construction practices in Murmansk (polar zone) and Moscow (temperate zone) cities in Russia. In both cities, urban heat island (UHI) effect accelerated CO2 emissions from urban soils. In Moscow city center, where implementation of peat-sand mixtures coincided with the strongest UHI, CO2 emissions increased up to 30-40% compared to the reference cites. The second case study compared environmental and social drivers of spatial variability in soil C stocks in Wageningen, the Netherlands. The study included several scales. First, a random stratified soil survey (n=56) was done for the whole city to capture the effect of parent materials, land cover and land-use history. Afterwards, effect of the social factor was studied by expert interviews with the owners of the green areas (key plots, n=10), where detailed soil survey was done. Finally, the effects of UGI maintenance practices were studied for the case of university campus. Land-cover and land-use history distinguished spatial patterns in soil C at the city level, whereas at the local scale social factors dominated.

Keywords: urbanization,spatial variation,temporal dynamics,multiple scales,ecological and social factors

ID ABS WEB: 136874

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

TILLAGE EROSION AS AN UNDERESTIMATED DRIVER OF CARBON DYNAMICS

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Arable soils were seen as essential for global food security, but now other functions, particularly their potential to store large amounts of carbon (C), are receiving more attention. Recently, there have been increasing efforts to increase soil organic C sequestration as climate change mitigation effort, as prominently promoted by the 4per1000 initiative. However, to evaluate soil C sequestration in hilly terrain, it is necessary to consider lateral soil redistribution in addition to changes in vertical C fluxes (C input and/or reduced mineralisation). Tillage erosion has been found as an important contributor to soil redistribution and modulator of C dynamics. Nevertheless, most studies dealing with SOC redistribution still focus on water erosion. This study investigates the impact of tillage erosion on C fluxes in an intensively cultivated loess region in the Czech Republic. The coupled water and tillage redistribution and C turnover model SPEROS-C was used to analyse the effect of six decades of erosion upon C fluxes, whereas a specific focus was set to the analysis of the importance of tillage erosion.
Our results show that tillage erosion is a major contributor to C dynamics in our area, particularly on slope shoulders where a substantial decline in C was modelled and monitored. Even if water erosion is the dominant process in the region, the model results reveal that tillage erosion increased the cumulative, erosion-induced C sequestration potential by about 37%. Furthermore, it is interesting to note that tillage erosion reduced the total sediment delivery from the monitoring site via a change in topsoil C patterns and hence, water erosion induced sediment transport. In the highly productive loess region, tillage erosion led to substantial C sink since agricultural mechanisation substantially increased about six decades ago. The climate mitigation measures based on adapted agricultural management to increase C sequestration are often in-line with soil conservation measures. This indicates that it might be less effective as the erosion-induced C sink effect declines.

Keywords: carbon dynamics,tillage erosion,water erosion,spatial modelling

ID ABS WEB: 137361

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

COMPARING DIFFERENT MODELING APPROACHES TO ESTIMATE ORGANIC CARBON DYNAMICS IN SEMIARID MEDITERRANEAN AGRICULTURAL SOILS

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Soil is a vital, limited, and non-renewable resource. The significance of healthy soils is widely recognized to increase our resilience to withstand the impacts of climate change and extreme weather events, including droughts and floods. Overall, healthy soils play a fundamental role in underpinning our well-being. The decline of organic carbon (OC) is considered as a primary 'threat' to soil health, a concern that is especially pronounced in the Mediterranean region. The role of OC in soil quality and functioning, as well as in the ability of agriculture to adapt to climate change are well-documented. These aspects are integral components of programming tools for shaping regional agricultural policies, which include measures to promote resource-conserving agronomic practices. In this regard, the availability of estimates of OC dynamics offers valuable insights for comparing different spatial planning strategies, at the regional level. Depending on the accessibility and level of accuracy of the input data, different procedures can be adopted to assess OC dynamics in relation to soil, climate, land use and land-use change. This study presents an example of applying the RothC10N model to simulate OC dynamics in a ten -year period window (2004-2013) at the local detailed scale in Apulia region (southern Italy). RothC10N was chosen due to its reliability and robust outputs with minimal input data, distinguishing it from other predictive and more complex models. RothC10N requires point-specific basic and physical pedological data, information upon climate and crop succession along with soil management. In addition, the model's batch mode capability allows for large-scale processing of spatialized input data. Here, we discuss OC dynamics simulations produced by both point specific and recursive RothC10N spatial applications, highlighting the pros and cons of these two methodologies. Identifying the most suitable modeling approach is crucial for accurately mapping and estimate the potential of OC sequestration for different soil-climate-crop-management systems and providing to the stakeholders an essential tool to take informed and sustainable management decisions.

Keywords: Land-use change,RothC10N Model,Potential Carbon Sequestration,Sustainable management

ID ABS WEB: 137367

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

DOES SLOVENIA'S AGRICULTURAL LAND HAVE THE POTENTIAL TO SEQUESTER ORGANIC C AND ACHIEVE THE 4PER1000 TARGET?

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Enhancing soil management practices is a key strategy to address future climate change impacts, as soil is a significant reservoir of organic carbon. Maintaining or increasing soil organic carbon (SOC) can help mitigate climate change by sequestering carbon from the atmosphere. The aim of our study was to assess SOC stocks in different Slovenian agricultural soils and to investigate potential sequestration in fine soil fractions (<20 μm) and total soil mass at 0-10, 10-20 and 20-30 cm depth. From 2016 to 2020, as part of the MAFF-funded initiative, soil sampling campaigns were conducted covering different agricultural lands such as cropland (CR), vineyards (VI), intensive orchards (IO), extensive orchards (EO), grassland (GR), overgrown grassland (OG) and areas densely covered with trees and bushes (TB). Using Hassink's (1997) model, we determined the carbon sequestration potential (SCS) of the fine fraction (Csd), incorporating soil texture data and factors from Chen et al. (2018). The total SCS potential of soil mass was calculated using the IPCC Tier 1 method considering different soil management scenarios. The average SOC stock in Slovenia based on land use data for 2019 is 94.7 t ha-1 in the 30 cm layer. It is noteworthy that CR, IO and VI have the highest Csd in the top 10 cm, while GR, OG and TB have the lowest values. To meet the 4per1000 initiative, we recommend the transition from full inversion to no-till in cropland, the adoption of organic farming principles and/or the use of conservation agriculture. For plantations such as VI, IO and EO, maintaining permanent vegetation cover in interrows, avoiding deep tillage and leaving grass and prunings on the soil surface or incorporating them superficially into the soil is recommended. Sustainable management practices for GR include light to moderate grazing or cutting, coupled with improvement measures. Implementing these practices could increase the average SOC stock by 19.6 t ha-1 over 20 years, a commendable annual improvement of 10.3per1000.

Keywords: soil organic carbon,sequestration potential,conservation agriculture,sustainable management,Slovenia

ID ABS WEB: 137838

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

MODELING SOIL ORGANIC MATTER DYNAMICS IN COCOA FARMS

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Improving our understanding of soil organic matter (SOM) dynamics is crucial for enhancing soil fertility and mitigating climate change. Modeling can help us understand SOM variations over time, especially in understudied systems like cocoa farms. This study aims to model SOM dynamics in Indonesian cocoa farms, hypothesizing that the general trend is an initial rapid SOM decline post-planting followed by a gradual long-term accumulation. To test this hypothesis, we adapted the AMG soil model (Clivot et al., 2019) to a cocoa perennial system calibrated using data from 13 Sulawesian cocoa farms. The model was used to quantify organic inputs required to counteract SOM losses, considering a significant SOM mineralization coefficient (0.125 yr-1) in the local context. The outputs showed a marked SOM decrease in the initial years after planting, underscoring the critical need for substantial organic inputs to mitigate SOM depletion during this period. The model's accuracy was affirmed by a reasonable fit with farm dataset observations (0-20 cm depth) exhibiting a root mean square error (RMSE) of 19.22 Mg SOM ha-1. The study suggests that immediate post-planting years are pivotal for SOM management in tropical cocoa farms. While the model offers a promising approach to simulate SOM dynamics in tree crops, further validation with true-time chronosequences is essential. Opportunities for enhancing the model's representativeness are also discussed.

Keywords: Soil organic matter,Perennial systems,Cocoa farming,AMG soil model,Organic inputs

ID ABS WEB: 137992

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

THREATS TO SOIL SECURITY IN MOUNTAIN CLOUD FOREST ECOSYSTEMS AND AGROECOSYSTEMS

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The main characteristic of the Mountain Cloud Forest (MCF) soils is the depth of their surface horizons that characterize them. The soils of these forests have been recognized for their high potential to store and stabilize organic carbon, with the consequent formation of clay-humus complexes in their aggregate structure. However, there are few studies focused on understanding the interaction that soil organic carbon (SOC) has on the stability and formation of soil aggregates in these ecosystems. In light of the above, the transformation and mineralization of soil organic matter was studied, evaluating the SOC fractions in the macro, meso and micro aggregates and relating them to the structural stability and their micromorphological arrangement through their degree of evolution, in MCF's. of the "Sierra Gorda" Biosphere Reserve in the municipality of Jalpan, Querétaro. The SOC stabilization processes and storage were obtained through the humification degree indices (HDG), the proportion of free and bound organic carbon (OC), separation of intra-aggregate particulate organic matter (i-POM), aggregate stability (AS). The transformation processes of the different carbon fractions are described, and their relationship with the soil aggregation process in epipedons, describing the structure based on chemistry and micromorphology in thin sections. The data obtained were analyzed in one-way ANOVA in R statistic, non parametric Wilcox and au b Kendall test in SPSS 2.5, to find differences in aggregation and OC for each of the sites and horizons. The proportion of the i-POM is microaggregates > mesoaggregates > macroaggregates and the C fulvic acid fraction was the dominant one in the humic substances. The high stability of the aggregates of the three mollic epipedons is related to the physical protection of i-POM and the SOC store in fulvic acids that, together with the high clay content, favor its stabilization.

Keywords: humic substances,clay-humus,organic carbon sequestration

ID ABS WEB: 138050

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

THINNING EFFECTS ON CARBON STOCKS AND SOIL PROPERTIES IN BLACK PINE PLANTATION

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The possibility of combating global warming and climate change increases interest in terrestrial carbon sequestration. Forests stock more than 80% of terrestrial aboveground carbon and more than 40% of terrestrial subsoil carbon. The purpose of this study was to determine the effect of thinning on carbon sequestration, soil and litter properties in Black pine (Pinus nigra Arnold.) plantations. The study was conducted, within the borders of Akdag National Park; different thinning intensies -unthinned (control), light (15% BA), moderate (25% BA), and heavy (35% BA) were applied with three replications. Before thinning and after 5 years, breast-height diameter (DBH) and tree height measurements were conducted, soil and litter sampling was carried out in each parcel. Single tree mass equations and carbon ratios were used to calculate the tree carbon stocks in the experimental parcels. Soil (0-10, 10-20 and 20-30 cm) and litter (25x25 cm) sampling was carried out from four different points representing the experimental parcels. Litter and soil properties were determined for each experimental parcel. According to the findings, tree and ecosystem carbon stocks showed significant differences between treatments ($P<0.05$). The highest amount of C stocks in trees is 223.1 t/ha in the control treatment, and the lowest is 145.6 t/ha in the heavy treatment. The litter and soil carbon stock were found to be insignificant ($P>0.05$). Tree and ecosystem carbon stocks decreased as the thinning intensity increased. The nutrients in the litter and soil, and other soil properties, were not significantly different among thinning parcels. When examined in terms of nutrient stock in the soil and litter, a difference was detected only in the Na stock in the soil, while a significant difference was found in the N, P, K, Mg, Fe, and Mn stocks in the litter. When carbon-focused planning is considered, moderate interventions in similar areas afforested with black pine may be a better practice in forest management.

Keywords: carbon,ecosystem,soil,litter,black pine

ID ABS WEB: 138372

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

QUANTIFICATION OF SOIL ORGANIC CARBON STOCKS OF AGRICULTURAL SOILS IN SLOVENIA

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In the face of increasing concern about climate change, agricultural soils are recognised as important store of atmospheric carbon with twofold benefits: They sequester CO2 from the atmosphere and improve soil quality by providing a range of ecosystem services.
The main objectives of the research were: i) to assess and map the SOC stocks of Slovenian agricultural soils, ii) to estimate the carbon sequestration potential of Slovenian agricultural soils.
Between 2016 and 2022, soils were sampled from 485 sampling sites, divided into eight different types of agricultural land use. The soils were sampled at depths of 0 – 10, 10 – 20 and 20 – 30 cm. SOC was determined using the wet oxidation method, from which SOC was calculated according to the FAO and GSP approach for calculating SOC. For SOC mapping, geostatistical modelling was performed using the regression kriging method, integrating the measured SOC data collected in the field and prediction covariate data.
The result of the GIS modelling was the SOC map of Slovenian agricultural soils at a resolution of 20x20 m. Using the stepwise method in the regression kriging approach, 11 out of 35 covariates were found to be significant for the SOC inventory. The model was able to predict 54.8 % of the variance in SOC stocks. SOC stocks in Slovenia range from 31.0 t/ha to 329.0 t/ha, with an average value of 87.2 t/ha, which means that 54.9 Mt of organic carbon is stored in the first 30 cm of agricultural soils in Slovenia. The study confirms that SOC stocks in Slovenian soils are relatively high compared to some neighbouring countries. However, with notable geographical differences.
Georeferenced data on SOC stocks provide important information where to focus on agricultural practises for sustainable soil management, soil quality protection and carbon management. The results of the study will facilitate targeted agricultural intervention measures and subsidies for carbon-emphasised soil management and carbon accounting at the national level.

Keywords: soil monitoring,carbon,geostatistical modelling

ID ABS WEB: 138374

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

SOIL ORGANIC CARBON CONTENT IN RELATION TO AGRICULTURAL LAND USE IN SLOVENIA

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Among a number of soil physical, chemical and biotic parameters, the soil organic carbon (SOC) content is considered to be the key parameter. In Slovenia, the SOC content was comprehensively monitored until 2016. Since then, the Ministry of Agriculture, Food and Forestry has invested considerable resources to obtain information on the state of SOC content in agricultural soils of Slovenia. The aim of the study was to review legacy SOC data from the soil fertility monitoring programme and to summarise recently measured data on SOC content collected within the harmonised sampling of the new national agricultural soil monitoring programme (ASMP). Seven agricultural land uses were analysed in the study: Arable land, vineyards, intensive orchard, extensive orchard, overgrown areas, trees and shrubs. The old SOC data came from topsoil samples taken at random from farmers. As part of the ASMP, the soils were sampled, depending on the agricultural use. 999 soil samples were taken at 465 locations from two or three different depths. The SOC content was determined using the ISO XXZ method. Both SOC datasets were statistically and geospatially analysed to assess the SOC stocks in different agricultural uses. The SOC data are stored together with other soil parameters in a soil information system. The mean SOC content of arable soils is 92.3 ± 51.27 t/ha, of vineyards 59.9 ± 19.24 t/ha, of intensive orchard 71.3 ± 14.81 t/ha, of extensive orchard 90.6 ± 23.68 t/ha, of grassland 96.6 ± 32.70 t/ha, of overgrown areas 93.5 ± 38.61 t/ha and of trees and shrubs 107.2 ± 48.45 t/ha. The SOC stocks in Slovenian soils are relatively high compared to some neighbouring EU countries. Nevertheless, they vary considerably depending on soil types and soil-climatic conditions in the Mediterranean, Alpine and continental climate zones of Slovenia. The results provide a solid basis for reporting on the national carbon balance and for the introduction of sustainable agricultural practises, conservation tillage and carbon farming.

Keywords: SOC,soil carbon stocks,soil quality monitoring

ID ABS WEB: 136007

4. Soil health in achieving the Sustainable Development Goals
4.24 133598 - Anthropogenic drivers of soil biodiversity, its function and feedback to changes

THERMAL ADAPTATION OF MITES DRIVES THE COMMUNITY, MORPHOLOGICAL, AND PHYSIOLOGICAL RESPONSES TO URBAN HEAT ISLAND ACROSS MAJOR CITIES IN CHINA

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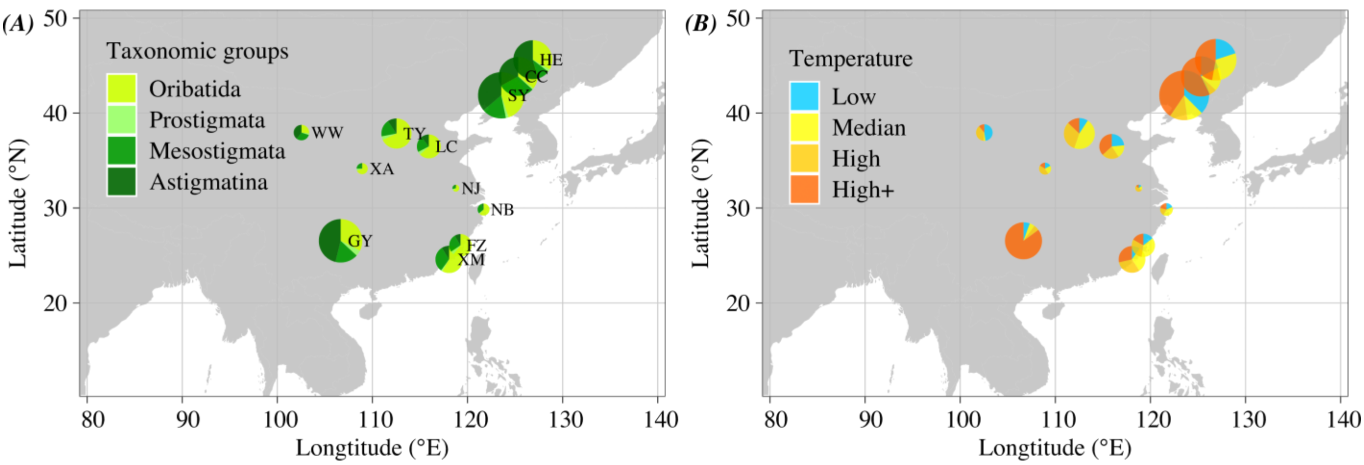
Urban heat-island-induced thermal stress is one of the most important nonbiological factors that drives biodiversity decline and functional homogenization of arthropod assemblages in urban soil. Yet, arthropods, which account for approximately 75% of animal species and consist of a variety of phenotypic traits, have never been extinct from urban green spaces, phenotypic and physiological adaptation within and across the communities might be a solution to cope with the detrimental effects of thermal stress, especially for fast-developing arthropods with limited dispersal abilities, such as acarid mites. However, this subject is poorly addressed. In the present study, we investigated whether urban heat-island affects the community composition, morphological traits, and metabolic rates of acarid mites, by collecting mites along heat-island gradients in twelve cities in tree climatic zones (subtropical, warm-temperate, temperate areas) in China. We in total collected and measured 23,130 individual mites across twelve cities, the density of mites across all cities showed a negative correlation with ground surface temperature, on the contrary, the density of mites in subtropical cities showed a strongly positive correlation with ground surface temperature, implying a stronger thermal tolerance of mites in subtropical cities than in temperate cities. Similarly, the density of all functional groups in subtropical consistently showed a positive correlation with the relative thermal intensity to urban heat island (δUHI), especially for oribatida, mesostigmata, mutualistic and phoretic mites, whereas the correlations were negative for functional groups in temperate cities. In conclusion, our results suggest that urban heat-island may strongly influence the urban soil systems by shaping community composition, phenotypic traits and physiological activities of mites, which will have far-reaching consequences for the nutrient cycling and energy fluxes in urban systems.



Keywords: Urban heat-island,acarid mites,community composition,body size,metabolic rates

ID ABS WEB: 136637

4. Soil health in achieving the Sustainable Development Goals
4.24 133598 - Anthropogenic drivers of soil biodiversity, its function and feedback to changes

EARTHWORM INTRODUCTION AND MASSIVE ORGANIC MATTER INPUTS TO IMPROVE SOIL FERTILITY IN MEDITERRANEAN VINEYARDS.

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Soil fertility is a key concept in agronomy and agroecology, resulting from the physical, chemical and biological parameters of the environment. Biological fertility is closely linked to soil biodiversity which can promote several biological functions, especially soil engineers such as earthworms. Earthworms are able to improve soil porosity, incorporate and fragment organic matter (OM) particles and enrich soils with the production of their casts. Mediterranean vineyards soils were often found to be depleted in soil biodiversity, possibly due to low soil OM contents, contamination with copper through Cu-based fungicide, soil tillage and lack of soil cover.

An ecological engineering study was designed in 2021 with the introduction of earthworms coupled with massive inputs of OM (composted or non-composted) in French Mediterranean vineyards. Several earthworm species (i.e., Lumbricus terrestris, Aporrectodea caliginosa, Aporrectodea nocturna and Allolobophora chlorotica) were introduced and the populations have been monitored since then in the different OM treatments.

We will present the results of our field monitoring on the survival and dispersal of the introduced species in the different OM treatments. One year after earthworm introduction, one species appears to be the best candidate for vineyard soil restoration perspectives and these results were confirmed in the second year. Moreover, the uncomposted OM increased strongly earthworm density compared to the control and the others OM treatments (at least 14 times more after 2 years).

Moreover, the effects of the different OM treatments on soil parameters (i.e., copper bioavailability, soil OM content and water retention) will be shown. For instance, copper bioavailability was measured in relation to a depth gradient in order to assess how this parameter will be modulated by OM inputs on the soil surface. Benefits and drawbacks of earthworm introduction and massive organic inputs for soil fertility improvement will be discussed, as well as methodological aspects and future perspectives.
Example of massive organic inputs in French Mediterannean vineyards:

Keywords: Copper bioavailability,Earthworm introduction,Organic amendments,Soil fertility,Vineyards

ID ABS WEB: 138159

4. Soil health in achieving the Sustainable Development Goals
4.24 133598 - Anthropogenic drivers of soil biodiversity, its function and feedback to changes

UNRAVELLING SOIL MICROBIAL DIVERSITY AND FUNCTIONALITY IN A TRANSDISCIPLINARY FRAMEWORK: URBAN AND RURAL SOILS NARRATING HUMAN FOOTPRINT

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While little is still unknown about the relationship between soil physicochemical properties and soil microbial community structure, diversity and functionality, and while the effect of plethora of land uses on them have been widely dissected, the complex interactions between soil microbial properties and functionality and the human environment factors remain definitively unexplored.
Soil physicochemical properties are deeply affected by human activities, and they have been confidently recognised as the main drivers of soil microbial communities, however no data is still available on the direct effect of the "human diversity" on soil ecology. Several studies compared soil microbial ecology metrics, computed for urban, agricultural and natural forest soils but they rarely, or fairly never, pinpoint the effect of the same land use practised by different human actors neither in urban nor in rural areas.
In the context of a social research project we aimed to unravel the relationships between human communities aboveground and microbial communities underground, both taking care of the same soil types. We conducted participative research practices, involving researchers from different disciplines and common citizens to explore soil microbial communities structure, diversity and functionality. Four main agro-ecological land management types have been studied from a multiple transdisciplinary point of view and experimental sites selected to maximise their representativeness of the human environment of the study area. We practised soil metagenomics to analyse microbial diversity and litterbags NIR sage to study microbial functionality.
The same regenerative agricultural practices carried out by researchers in a "research residence" located in a marginal ancient rural area and by citizens in a metropolitan urban area were considered, unravelling their effect on the one hand on soil functional biodiversity, on the other hand on human wellbeing both for researchers and for citizens.
Soil health, a widely debated topic within both the general public and academia, is here taken as a meeting point, pursuing the ambitious objective of building bridges between researchers and citizens.

Keywords: Soil metagenomics,Microbial diveristy,Human diversity,Regenerative agriculture,Litter bags

ID ABS WEB: 136029

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

SUSTAINABLE MANAGEMENT OF BLACK SOILS IN THE EASTERN ISSYK-KUL (KYRGYZSTAN)

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Dark chestnut and chernozem soils of Eastern Issyk-Kul are characterized as the most fertile soils of Kyrgyzstan, where high yields of grain and row crops were grown and obtained. Agricultural utilization of secured rainfed and irrigated soils by farmers and peasants after disbanding of large collective farms experienced certain difficulties. Modern study of these soils with agrochemical indicators gives an idea about their state of nutrient element supply and plan certain methods of farming system, such as soil-protective and energy-saving technologies. Agrophysical and agrochemical indicators of chernozem soils allow to apply minimal, surface tillage with observance of basic principles of soil-protective technology.
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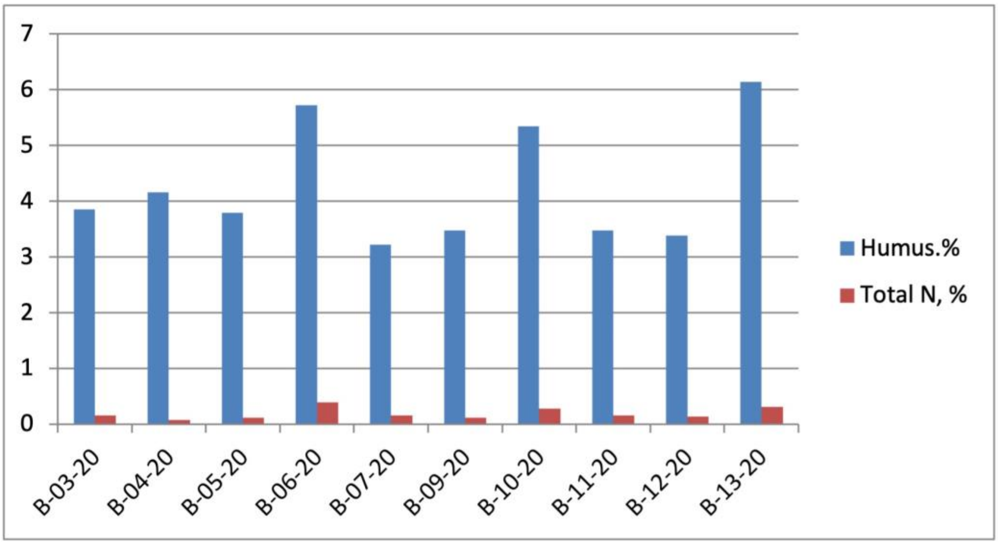
When mountain-valley dark chestnut and chernozem soils are used in farming, the input of biomass of agrocenoses (crop residues and roots) compared to natural conditions is sharply reduced, especially in case of repeated sowing of potatoes and row crops, which negatively affects the indicators of soil organic matter.
With additional input of post-harvest crop residues favorable factors of soil formation in the region of distribution of mountain-valley dark-chestnut and chernozem soils of Eastern Issyk-Kul region favorably affect the fertility of arable land.



Keywords: Chernozem soils,Soil fertility,Soil profile,Plant biomass,Soil-protective technologies

ID ABS WEB: 136272

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

ARE THERE BLACK SOILS IN BRAZIL? UNDERSTANDING THE BLACK SOILS FORMING FACTORS UNDER A TROPICAL CLIMATE

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According to the International Network of Black Soils (INBS) and the FAO report on Black Soils (FAO, 2022a, 2022b), these mineral soils are characterized by dark colors, thick surface horizon, high levels of organic carbon and high natural fertility. The Black Soils cover approximately 725 million hectares worldwide, playing an important role in food production and carbon sequestration. In Brazil, these soils are present in specific environments and they occupy small areas, with great climatic variation and parent materials predominantly of mafic (e.g. basalt or diabase) or limestone rocks or the sediments from their weathering, under relief that vary from flat to strongly wavy. Fitting the definition of Black Soils, the soils identified in this study present a thick surface horizon with a structure varying from granular to angular and subangular blocks with a strong degree of development, high saturation by bases, predominance of calcium and magnesium, and content of organic carbon above 6 g kg^{-1}, with a large part of these soils having high activity clays. The profiles are located in four different regions of Brazil, with a wide diversity of phyto physiognomies of the vegetation, including: sub-deciduous and deciduous tropical forest, riparian palm tree (carnauba, Copernicia prunifera) forest, Cerrado biome (savanna vegetation from grasses to bushes and low trees), and the more subtropical Pampa biome, with open grasslands. The soils are mainly included in the classes of Vertisols and Mollisols, according to the Soil Taxonomy. In all these environments, the Brazilian Black Soils are highly susceptible to erosion processes, especially when the slopes are higher, and degradation, when used for livestock without proper management or agriculture without conservation practices. Strategies for sustainable management of the tropical Black Soils require appropriate agricultural practices and cultivation systems. These approaches must be complemented by formulation initiatives toward soil education, extension and specific protection policy, ensuring the sustainable use of this vital resource for food security and climate change mitigation.

Keywords: Tropical black soils,Brazilian biomes,Chernossolos,Vertissolos,Soil forming factors

ID ABS WEB: 136418

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

THE MAIN CHARACTERISTICS AND PROTECTION AND UTILIZATION COUNTERMEASURES OF DIFFERENT TYPES OF BLACK SOIL REGIONS IN NORTHEAST CHINA

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The black soil region of Northeast China is one of the main black soil belts in the world. It is the main grain producing area in China and has made great contributions to ensuring national food security. In recent decades, the degradation of cultivated land quality such as thin, barren and hard in black soil region has seriously restricted the improvement of grain production capacity. A reasonable and scientific understanding of the black soil resources and taking effective measures to protect and utilize the black soil have become the key to the sustainable development of agriculture. However, the complexity of the geographical location, natural environment, agricultural production, and soil resources in Northeast China has hindered the scientific formulation and smooth implementation of soil protection and utilization policies. In this text, we divided the black soil region into six types: songnen plain region, sanjiang plain region, daxing'an and xiaoxing'anling region, liaohe plain region, changbai mountain-eastern Liaoning region, and western sandy region. The characteristics of geography, climate and soil composition in different types of regions were summarized, respectively. The main problems faced by different types of regions were discussed from the aspects of climate, agricultural production and soil limiting factors. The protection and utilization modes applicable to different types of regions were analyzed and summarized to provide reference for coordinating the contradiction between black soil protection and capacity improvement.

Keywords: Black soil region of Northeast,Type region,Characteristics,Protection and utilization

ID ABS WEB: 136604

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

US BLACK SOILS, SOIL SECURITY, AND CURRENT EFFORTS ON MANAGING SOIL CARBON FOR CLIMATE CHANGE MITIGATION

R HODGES

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Black soils—likened to Mollisols of the United States Soil Taxonomy system—while more restrictive in classification, are extensive throughout the contiguous United States. Black soils generally infer fertile soils and are a major contributing factor to soil and food security. The US Department of Agriculture has a suite of research programs intended to supplement and further the soil survey program and region-specific land use recommendations including Dynamic Soil Properties for Soil Health, the Long-Term Agroecosystem Research network, and the USDA Climate Hubs. Comparative examples of black soils between regions demonstrate the importance of agricultural management systems and the effects of these systems on soil carbon. Inherent soil forming factors and site-specific complexity such as historical land use both play powerful roles in understanding the ecological potential of black soils of the United States. Efforts regarding a Soil Carbon Network and the importance of Dynamic Soil Survey will also be discussed.

Keywords: Black soils,soil security,climate change mitigation,soil carbon network

ID ABS WEB: 137197

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

CARBON ACCUMULATION PROCESSES IN NORTHERN PEATLANDS AND BLACK SOILS

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Peatlands (Histosols, or organic soils)—mostly distributed in the boreal and subarctic regions—contain the largest carbon stock among all terrestrial ecosystems and have the highest soil carbon density. On the other hand, black soils (Mollisols, or Phaeozems and Chernozems)—often developed under grass-dominated vegetation in temperate semi-arid regions—are among the most carbon-rich mineral soils. Here we discuss carbon accumulation processes of both soils types in terms of soil forming factors. We systematically examined the climate spaces of northern peatlands and black soils regions and found that, compared to peatlands, black soils have a narrow range of precipitation. Peatlands are waterlogged peat-accumulating wetland ecosystems often situated on flat terrains, while black soils often distributed on gentle sloping terrains to avoid excess soil moisture and waterlogging. Black soils often formed on unconsolidated parent materials—most commonly eolian loess—to facilitate water infiltration and root penetrations, while impermeable mineral base layers are often favor waterlogging and peat formation. Biomes with abundant grasses seem to be the dominant vegetation favor the formation of deep black soils. Dense grass roots, especially at the subsurface layer, can directly transfer a large amount of organic matter to loess parent materials to form characteristic upper black horizons. Furthermore, frequent wildfires are an important and necessary ecological disturbance to maintain grassland ecosystems by preventing tree colonization, so black carbon could be a significant decay-resistant carbon fraction in some black soils. Both peatlands (with at least 30-cm peat) and black soils (with 25-cm upper black horizons) would require multi-millennial timescales to develop. In summary, low decomposition—through soil organic matter protection associated with waterlogging and anaerobic conditions, cold or freezing temperature, and low substrate decomposability—is key for organic carbon accumulation in peatlands. For black soils, dense and deep grass root penetration in favorable loess parent materials appears to be the key pedogenic process to increase soil carbon content in the mineral horizons, along with black carbon and organic carbon-mineral association protection.

Keywords: Mollisols,Histosols,Carbon accumulation,Soil genesis,State factors

ID ABS WEB: 137360

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

GULLY EROSION IN THE MOLLISOL REGION OF CHINA – A CASE STUDY ON HISTORY, EROSION RATES AND CAUSES

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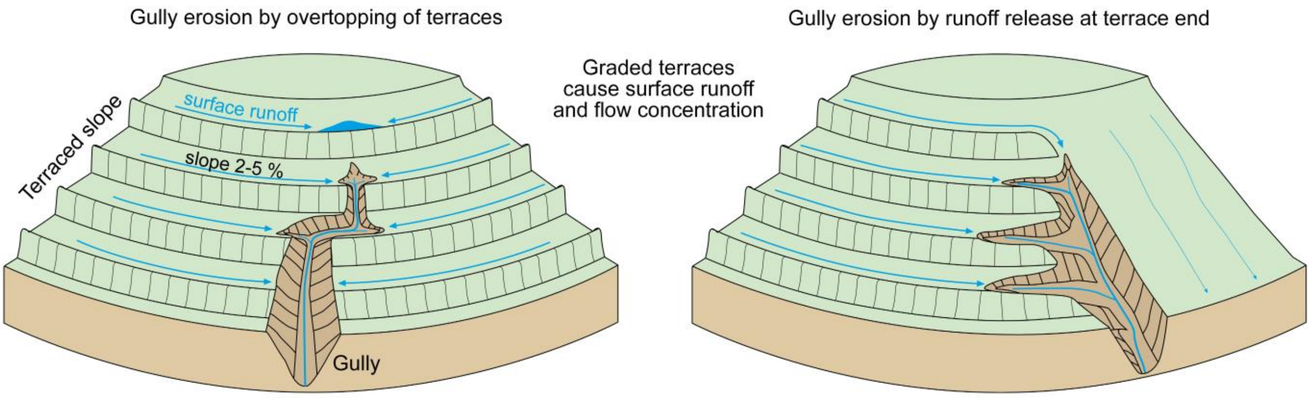
Mollisols are of major importance for food security worldwide but are increasingly degraded by soil erosion. Mollisols in Northeast China have been converted into agricultural use only since the 19th century, but gullies are widely distributed. Gully erosion history, rates, and causes in this region remained unclear. We chose a study area with landforms and land-use history typical for the central Mollisol region of Northeast China to estimate the initiation years and rates of gully erosion from 1968 to 2018 using aerial and satellite imageries. The outlet fan deposits of a large gully system were dated by Cesium-137 (137Cs) and artifacts. Local farmers were interviewed to verify the results. Gully volumes were measured by a structure-from-motion technique using photos taken from an unmanned aerial vehicle. Our results showed that gully systems had already appeared on the steep slopes and along unpaved roads in 1968. They had become larger and more complex in 2018 by the upslope retreat of the main gullies and side gully formation. Gully incision started in the 1950s and 1960s when the original grassland and forest were completely converted into arable land. The soil loss from gully erosion ranged from 25.7 to 44.7 Mg yr^1 ha^1. Moreover, we showed that several gullies developed after terracing. Improper terrace design caused runoff concentration along terraces and ridges with mean inclination of 3.8%, which resulted in gully incision due to overtopping of terraces at low spots or due to the uncontrolled release of concentrated flow to adjoining unterraced hillslopes. The same processes are responsible for the persistent gully activity after abandonment and vegetation recovery. Finally, we suggested appropriate countermeasures to stop further soil loss and land degradation on abandoned terraced hillslopes in NE China.



Keywords: Soil erosion,Gully erosion,Remote sensing,Radioisotope dating,Northeast China

ID ABS WEB: 137458

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

PROJECT FOR SUSTAINABLE LOW CARBON CROP AND GRASSLAND MANAGEMENT IN BLACK SOILS OF ARGENTINA

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Argentina is one of the countries with larger surface (more than 60 million hectares) covered by black soils in the World. During most of the 20th century black soils of Argentina were managed in a rather extensive manner and with aggressive tillage systems, which caused widespread declines (30 to 60%) in the organic matter content. This work shows how several producers dedicated to extensive agriculture (corn, soybeans, wheat, sunflower, cotton, and other crops), and extensive cattle ranching, mostly cattle and grazing grasslands, pastures, agropastoral, and silvo-pastoral make efforts to reduce GHG emissions through the adoption of better nitrogen fertilization technologies, the intensification of agricultural rotations with greater incorporation of winter crops, nitrogen fixing species and cover crops, and improved grazing management in livestock, which increase carbon stocks and with improvements in digestibility that reduce methane (CH_4) emissions due to enteric fermentation. The project is expected to mitigate emissions by fostering carbon sequestration in soils, through increasing the area and biomass production of cover crops, increasing the participation of perennials in rotations with annual crops, improving crop rotations with crops with higher residue returns, the application of in-farm generated compost, and increasing grassland and pasture residue returns with improved grazing management techniques. It is estimated that with these improvements, which are not currently widespread even among producers, it will be possible to reduce between 0.5 and 3 tons of CO_2e/ha/year. This area is expected to reach more than 160 thousand hectares. If this is so, it is expected to mitigate almost 2 million tons CO_2e at the end of this project. Average emissions reductions or removals of the first ten years is: 61,506 tons of CO_2e per year. And the average annual mitigation and removal rate is estimated in 602 kilos per hectare per year of CO_2e for the twenty-year period. This projects shows the agricultural sector of Argentina to be a key to climate change mitigation using nature-based solutions.

Keywords: BLACK SOILS,SOIL DEGRADATION,SOC SEQUESTRATION,CLIMATE MITIGATION

ID ABS WEB: 137633

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

AFFECTS OF SOIL EROSION-DEPOSITION ON CORN YIELDS IN THE CHINESE MOLLISOL REGION

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Soil erosion is a major challenge for crop production maintenance and improvement in agricultural regions worldwide. However, quantifying the impacts of soil erosion grade on crop yield is still weak, and how soil deposition affects crop yield is less reported, especially in the Chinese Mollisol Region. Thus, this study quantified soil erosion-deposition rates (SEDRs) at three agricultural catchments in the Chinese Mollisol region using the 137Cs technique and assessed soil erosion-deposition impacts on corn (Zea mays L.) yield. The results showed that SEDRs varied from -5471.7 (deposition) to 9956.0 (erosion) t/(km^2 yr^1). The distributions of both soil erosion and deposition in the three catchments were in coexistence, but soil erosion was dominant. In addition, above 2500 t/(km^2 yr^1) of soil erosion rates (larger than moderate erosion grades) in the three catchments accounted for 41.0%, indicating that soil erosion was severe. Moreover, corn yields in the three catchments ranged from 1.9 to 14.6 t /ha. Compared with deposited sites, corn yields in eroded sites were 19.2% - 40.6% lower. Furthermore, when soil erosion grade was moderate (soil erosion rates > 2500 t/(km^2 yr^1)), corn yields were 32.4% lower than those in non-eroded sites. The spatial distribution of corn yield was opposite to that of soil erosion rate at catchment and slope scales. The relationship between corn yields and soil erosion rates had a negative linear relationship ($p < 0.01$), which was validated with acceptable accuracy. And there was a positive linear relationship between corn yields and soil deposition rates without statistical significance ($p > 0.05$). These findings are valuable for assessing how soil erosion-deposition affects crop yields to implement countermeasures for controlling soil erosion and maintaining sustainable agricultural development.

Keywords: Soil erosion,Crop yield,Soil erosion-deposition rates,The 137Cs technique,The Chinese Mollisol region

ID ABS WEB: 137873

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

LONG-TERM GULLY DYNAMICS OVER CROPLAND IN THE BLACK SOIL AREA OF CHINA BASED ON SYSTEMATIC SAMPLING

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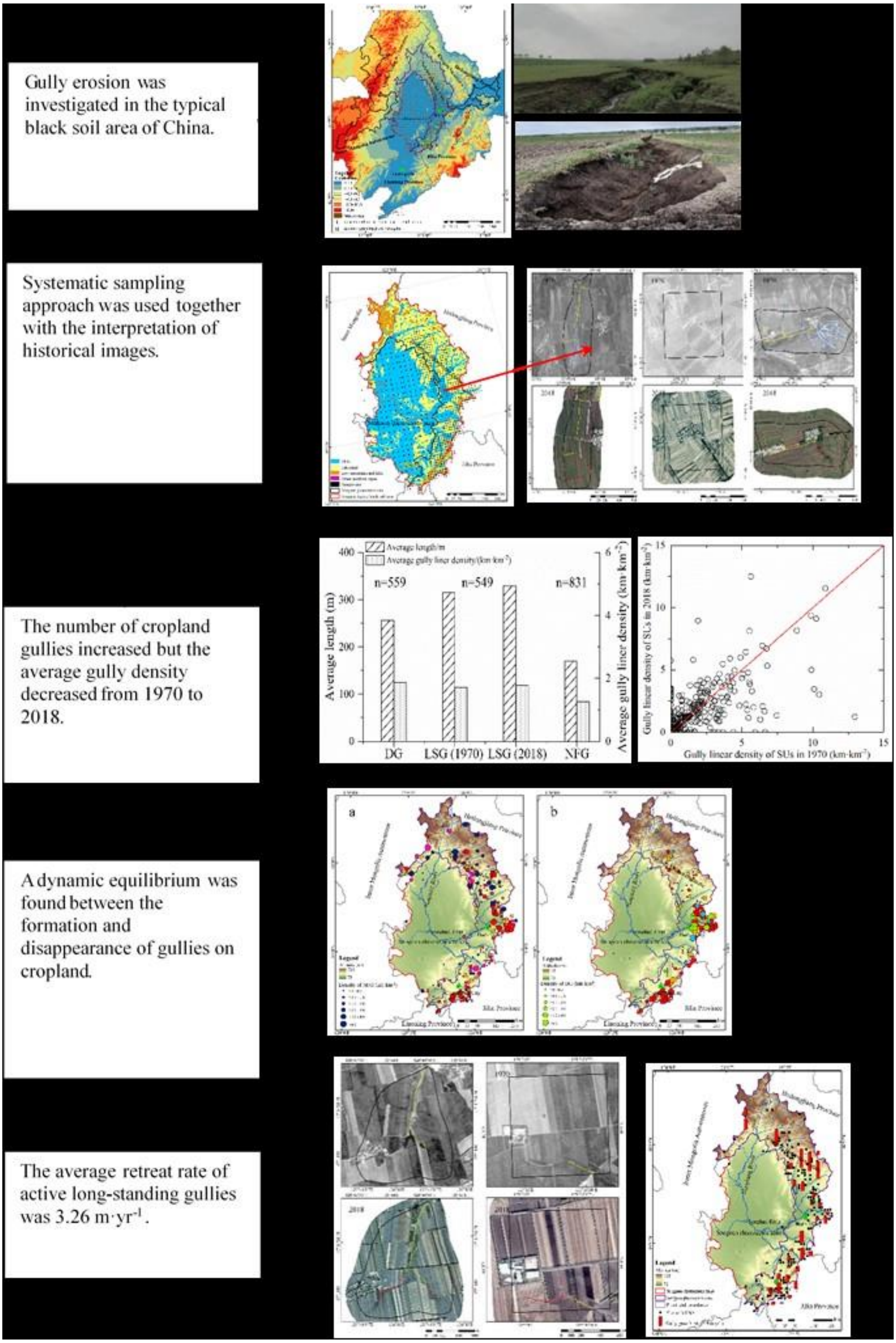
Understanding the large-scale spatial distribution characteristics of gully development dynamics, particularly over long periods, can help to accurately identify gully erosion sensitive areas and so be crucial for targeted gully prevention and rehabilitation efforts. This study aims to investigate the long-term dynamics of classical gully on cropland in the Songnen black soil region, which is the most important commercial grain production area in China, covering an area of 212,000 km^2. For this purpose, 998 sampling units selected using the systematic sampling method were considered. Based on Corona KH-4B images from 1970 and Google images from 2018, all gullies within each sampling unit were visually interpreted. In the past 50 years, the number of classical gullies on cropland in the Songnen typical black soil region increased by 24.55%, while the average linear density of gullies in the cropland sampling unit decreased by 0.4 km/km^2. While 50.50% of gullies found in 1970 disappeared from the images of 2018, more gullies formed and were widespread in the east part of the study area characterized with the topography of rolling hills. Affected by human intervention, a widespread process of erosion-infilling cycles and a dynamic equilibrium may exist between the formation and disappearance of classical gullies on cropland. In particular, 81.74% of gullies were found to be active, including newly formed gullies and some long-standing gullies, and the average retreat rate of active long-standing gullies was 3.26 m/yr, indicating the severity of gully erosion and limited effectiveness of efforts made to control gully erosion in the black soil region of China. The findings highlight the need for studies on more effective and targeted measures for gully control and their wide application in order to ensure the sustainable utilization of the valuable black soil resources.



Keywords: Gully erosion,Black soil region,Cropland,Spatial variation,Long term

ID ABS WEB: 136203

4. Soil health in achieving the Sustainable Development Goals
4.26 133608 - Developing new models of urban soils

TAILOR-MADE ARTIFICIAL SOILS FOR THE RESTORATION OF DEGRADED LAND AND ENHANCED CARBON DIOXIDE REMOVAL. A CASE STUDY: C-SINK PROJECT

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Tailor-made artificial soil is a nature-based solution that can be employed to rehabilitate degraded soils, as it enhances their physical, chemical, and biological conditions. Artificial soils are classified as Technosols by the FAO due to containing over 30% anthropogenic materials. In contrast to compost, these Technosols include inorganic materials, mimicking the composition of natural soils.
Due to a lack of data on carbon dioxide removal (CDR) by AS, field trials were conducted with various AS in a dunite mine in NW Spain under the C-SINK project. These soils were formulated to maximize carbon sequestration from CO2 while fostering plant growth, ensuring a high CDR rate and facilitating the successful growth of forest plantations.
Four different AS formulations were created by blending inorganic and organic wastes. Post-mixing, they were applied to the surface of the dunite mine soil in 300 m2 plots. Seeds of various plant species were hydroseeded onto the AS surface.
Various soil variables, including soil carbon in different chemical forms, are being monitored over 24 months in the four experimental plots, along with a control and a revegetated plot (business as usual). Unmanned Aerial Vehicle Remote Sensing (UAV-RS) technologies will be utilized to establish correlations between chemical measurements of different organic carbon fractions and multispectral images acquired. The data collected during monitoring will enable the calculation of CDR in AS under field conditions. Additionally, a comprehensive biological evaluation will be undertaken to examine changes in microbiota and soil enzymatic activities. Differences in biodiversity will also be observed by considering both planted and spontaneously growing vegetation.
The present case study is in the framework of the European project C-SINK, which aims to boost large-scale atmospheric CO2 removal through seven technologies (CDR-T). The purpose of the C-SINK project is to deliver to the EC a complete package of proposals elaborated to support a new or amended European legal/regulatory framework to bring high quality CDRs to the market.

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Keywords: Soil carbon sequestration,Technosol,Waste valorization,Soil health,Nature-based solutions

ID ABS WEB: 136330

4. Soil health in achieving the Sustainable Development Goals
4.26 133608 - Developing new models of urban soils

URBAN SOILS AND ECOSYSTEM SERVICES IN CITIES: ASSESSING WATER AND HEAT REGULATION POTENTIAL

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Urban green spaces supply several ecosystem services (ESS) key to human well-being, especially in the context of increasing extension of cities. Soils in urban areas have multiple functions that are becoming more valued by urban communities. Among them, soils favor carbon storage and climate regulation, biomass provision for food and water flow regulation, and can lower temperatures locally. However, the potential to enhance these ESS via targeted urban soil management remains largely untapped. The main challenge is considering the variability of urban soils due to the inherent heterogeneity of urban environments, intensifying natural soil variability. For instance, due to management practices, urban soils have different degrees of compaction, soil structure alteration, and biological activities. These differences lead to fundamental comprehension gaps in water and heat soil pathways.
Our research aims to study urban soil properties to improve our knowledge of these highly managed environments that influence water and heat regulation. Large herbaceous areas, e.g. urban parks, are ideal research fields, as they allow sampling over large areas away from trees, limiting evapotranspiration effects. The city of Lausanne offers multiple park areas differing in their management and land use. The geographic and geological history of the town provides an excellent opportunity to analyze contrasting environments.
A prospecting campaign is currently made to discriminate and classify the soil types. We identify patterns and variables that help us a better understanding of soil water regulation function: soil depth, structure, porosity, texture, etc. Computer tomography analysis provides better insights into pore networks. The preliminary findings highlight that urban soils exhibit expected heterogeneous features relative to their pedogenesis processes. As a complement, several experiments will quantify the links between infiltration and temperature dynamics to understand urban soils' water and temperature dynamics.

Keywords: Urban soil,Heat mitigation,Water regulation,Ecosystem services

ID ABS WEB: 136955

4. Soil health in achieving the Sustainable Development Goals
4.26 133608 - Developing new models of urban soils

PROMOTING CARBON STORAGE AND HEALTH IN URBAN SOILS THROUGH SUSTAINABLE MANAGEMENT PRACTICES

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Sustainable urban soil management is becoming increasingly important because of its critical function in regulating the climate and water and its enormous potential to store soil organic carbon (SOC). Researchers still know little about the amount of urban SOC and the effects of urban soil management practices on soil health and carbon storage. Therefore, we investigated how management practices in urban green spaces affect soil carbon storage and health. The Bonn-Rhein-Sieg region served as the study's area, with a high population density (Rhein-Sieg district: 338.4, Bonn: 520.9 inhabitants/km2) in Germany. Managers and owners of urban private (e.g., backyard gardens and allotments) and public green spaces participated in a survey that concerned the practices for the most common vegetation types (e.g., lawn, vegetable, and ornamental). Two hundred forty-eight soil samples (0–20 cm depth) were collected in the autumn and winter of 2022, and their physiochemical and biological characteristics were examined. A multivariate analysis of variance (MANOVA) was carried out to evaluate the effects of various management practices on soil parameters.

According to our findings, public green spaces have an average SOC stock of 94.67 Mg ha-1, which is much greater than private ones (home gardens, 67.72 Mg ha-1 and allotment gardens, 73.15 Mg ha-1). When comparing vegetation types, ornamentals (85.05 Mg ha-1) and vegetables (91.66 Mg ha-1) exhibit higher SOC stock levels than lawns (62.48 Mg ha-1). Significant variations in SOC are also observed when comparing the monthly (127.37 Mg ha-1) vs. annual (76.88 Mg ha-1) fertilization regimens. In the examined urban green spaces, the average SOC stock (85 Mg ha-1) was higher than the average SOC stock (47.30 Mg ha-1) in Germany's arable soils. The region's greater SOC could result from the types of vegetation and fertilization frequencies, both of which have statistically significant effects (p-value <0.001). Our findings highlight the critical role that soil management plays in influencing urban SOC, particularly in selecting vegetation types and determining fertilization schedules.

Keywords: Urban soil,Soil management prctices,Soil organic carbon, SOC,Soil health,Urban green spaces

ID ABS WEB: 137849

4. Soil health in achieving the Sustainable Development Goals
4.26 133608 - Developing new models of urban soils

APPLICATION OF VIS-NIR SPECTROSCOPY AND SEM-EDS MICROSCOPY FOR DEVELOPING MODELS OF URBAN SOIL MANAGEMENT

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Urban soils are extremely heterogenous as they include a variety of anthropogenic and natural materials. Manufactured or constructed soils (MSs) are created using a wide range of materials and are generally referred to as Technosols. MSs can play key roles in providing ecosystem services including carbon (C) sequestration as part of efforts related to the mitigation of climate change. Plant cover drives the development and functioning of MSs influencing soil organic matter turnover due to organic carbon (SOC) quality and stabilization processes. Challenges in defining and measuring different SOC pools has increased interest in sensitive and non-destructive techniques such as Vis-NIR diffuse reflectance spectroscopy (DRS) and scanning electron microscopy with energy dispersive X-ray spectrometer (SEM-EDS). In the development of new models that encompass the anthropogenic influences on ecosystem service provision, these methods can help to highlight the heterogeneity of MSs and incorporate these factors into models related to urban soil management. In this research DRS was used to analyze the soil organic fraction of MSs made of sand and compost (2/3 and 1/3, respectively) planted with different vegetation (bare, sunflower, edible, cover crops, sunflower+edible, sunflower+cover crops, edible+cover crops and all) at different times (at 5, 12, 15 and 21 months since the plots construction) in the frame of the Carbon Sponge project. In addition, particle aggregation, which is important for SOC stabilization processes, was evaluated by SEM-EDS. The DRS reflectance spectra showed clusters based on times and vegetation that converged after the application of the Smoothing Savitzky-Golay algorithm and spectral conversion into absorbance. Surprisingly, in principal component analyses (PCAs) some plant covers were closer to the initial sand suggesting a rapid utilization of the organic resources by soil microbiota. However, the SEM-EDS showed bigger aggregates in the presence of more complex vegetation highlighting diverse plant contribution to soil. These models can help to better clarify the dynamics of C sequestration and improve management and use of MSs in urban areas.

Keywords: Technosols,Manufactured soils,Carbon sequestration,Reflectance spectroscopy,Microscopy

ID ABS WEB: 136546

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

COMPARING SOIL PROPERTIES BETWEEN LUCAS SOIL AND NATIONAL SOIL INFORMATION MONITORING SYSTEM (N-SIMS): MAJOR DIFFERENCES AND IMPLICATIONS FOR FUTURE POLICIES TO EVALUATE SOIL QUALITY

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A recent assessment states that 60-70% of soils in Europe are considered unhealthy. To protect this valuable resource, we need to acquire knowledge about it through soil monitoring to assess the soil status and detect soil changes over time.
In Europe, different types of monitoring networks currently exist in parallel. Many EU Member states (MS) developed their own soil information monitoring system (N-SIMS), some being in place for decades. In 2009, to develop a homogeneous dataset for EU, the European Commission extended the periodic Land Use/Land Cover Area Frame Survey (LUCAS) led by EUROSTAT to sample and analyse the main properties of topsoil in EU.
To support European policies, there is a clear need to evaluate soil quality and establish reference values to assess soil health. However, a question remains whether the assessment obtained by using soil properties from both monitoring programs (N-SIMS and LUCAS Soil) are comparable, and what could be the limitations of using either one dataset or the other.
In the context of EJP Soil, a comparison of three soil properties (organic carbon, pH and clay content) has been conducted among 12 different EU countries including BE, DE, DK, EE, ES, FR, DE, HU, IT, NL, PL, SE and SK. In addition, a comparison of two indicators including (i.e. OC/Clay and pH classes) using each programs dataset has been conducted. The results underlined substantial differences in soil properties statistical distributions between N-SIMS and LUCAS Soil in many countries, particularly for woodland and grassland soils, affecting the evaluation of soil quality using indicators. Such differences might be explained by both the monitoring strategy (spatial distribution of sites) and sampling protocols exposes the potential effect data source on European and national policies. Those results advocate for a dialogue between national institutions conducting soil monitoring and LUCAS Soil to harmonize the data and strengthen future soil monitoring to provide reliable data for reaching the objectives of healthy soils.

Keywords: Soil monitoring,LUCAS Soil,policy,organic carbon,soil sampling

ID ABS WEB: 137176

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

THE IMPLEMENTATION PHASE OF THE NORWEGIAN AGRICULTURAL SOIL MONITORING PROGRAMME

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In 2022, the Norwegian Agricultural Agency granted the implementation phase of a national soil monitoring programme for Norwegian agricultural land. The aim was to establish the systems and protocols needed to ensure data collection, data management and analyses, develop a strategy for communication and acquire the necessary equipment. The programme will monitor a set of indicators selected to measure the state and development of five main threats to Norwegian agricultural soil: loss of organic matter, soil erosion, soil compaction, soil contamination and loss of soil biodiversity.
Norway has a small share of agricultural land compared to its total land area (approximately 3%, National Land Resource Map, 2022, NIBIO). However, the programme plans a dense sampling grid to ensure sufficient coverage of the heterogeneous Norwegian agricultural soil. The programme will use a square 1x1km grid from which points under agricultural use have been randomly selected. In a cycle of 10 years, more than 800 sites are expected to be visited. Approximately 10% of these sites will be monitored for biodiversity and contamination and this will be done every 5th year to capture the faster dynamics of those indicators. The programme plans to use high-precision positioning systems to ensure that resampling is done at the exact same place, since the relocation of plots has been pointed out as an important source of uncertainty in monitoring programmes. A questionnaire to collect the most relevant information about management practices on the plots has been developed in collaboration with farmers and farmer's associations in Norway. Overall, the set of indicators, field protocols, and analytical methods selected during the implementation phase are closely aligned with that proposed by the Directive for Soil Monitoring and Resilience launched by the European Union in July 2023 (COM(2023)416). The program will continue with further testing during 2024 until the start of its full operational phase.

Keywords: soil monitoring,Norway,agricultural soils,soil health

ID ABS WEB: 137629

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

THE GLOBAL SOIL BIODIVERSITY OBSERVATORY: IMPLEMENTATION PHASE

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Soil biodiversity loss is one of the greatest threats in many regions of the world and is likely underestimated due to the lack of data. Although aboveground biodiversity has been promoted and protected for decades, little attention has been given to belowground biodiversity.

As part of the post-2020 Plan of Action of the International Initiative for the Conservation and Sustainable Use of Soil Biodiversity adopted at the 2022 Conference of the Parties to the United Nations Convention on Biological Diversity (CBD COP15), the Food and Agriculture Organization of the United Nations (FAO) was mandated to implement a global soil biodiversity and ecosystem function monitoring framework. The Global Soil Biodiversity Observatory (GLOSOB) aims to provide information to guide evidence-based decision-making by measuring, mapping, and monitoring soil biodiversity in a harmonized way. The outcome will be to provide soil biodiversity insight to conservation and restoration practices for sustainable agriculture.

Soil biodiversity (microflora, microfauna, macrofauna, and biological processes) will be measured, and monitored using standardized methods that complement Essential Biological Variables (EBVs) established by other initiatives (e.g., SoilBON). Here we outline EBVs for GLOSOB and their implementation.

We also lay out a framework for a country-driven adoption of GLOSOB in compliance with the COP15 decision. FAO technical networks will help establish sampling and monitoring efforts where requested and will work to complement and reinforce ongoing or planned soil biodiversity observatories or initiatives. To mainstream soil biodiversity measurements, we recommend they become a standard in the revised FAO Guidelines for soil description as part of national soil surveys and in assessments of agricultural sustainability.

Keywords: biodiversity,monitoring,assessment,global,COP15

ID ABS WEB: 137726

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

MONITORING PH AND P K MG LEVELS IN FRENCH SOILS BETWEEN 2003 AND 2020 USING THE FRENCH SOIL ANALYSIS DATABASE (BASE DE DONNÉES DES ANALYSES DE TERRE)

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The continuing rise in energy prices is affecting fertilizer prices, and is accompanied by a general reduction in phospho-potassium fertilization of agricultural plots nationwide. In France, since 1990, the Base de Données des Analyses de Terre (BDAT INFOSOL INRAE Orléans) has brought together the results of soil tests of cultivated topsoil carried out throughout mainland France, at the request of farmers, by laboratories approved by the Ministry of Agriculture. This database contains over 3 million phosphorus (P) determinations and an equivalent number of exchangeable potassium (K) and magnesium (Mg) determinations. These data were mobilized as part of a spatio-temporal diagnosis to provide information on the spatio temporal trends of these three fertility parameters over the period 1990-2020, and to identify the consequences on the availability of these elements for crops.
General trends in the evolution of agricultural soils in mainland France show an increase in pH and Mg content, and a decrease in K, but especially P, content. The spatial distribution of exchangeable P Olsen, K and Mg contents in soils seems to depend mainly on soil characteristics (texture, mineralogical nature of parent materials). The temporal trends observed for Olsen P and exchangeable K, on the other hand, seem to depend on economic factors (rising energy and fertilizer prices), the presence or absence of livestock farming, and recommendations for lower dose calculations as part of a rational fertilization approach.
This work demonstrates the importance of collecting and collating this information, produced in an individual context for plot management, in order to reuse it in a general context and produce results on the statistical distributions of agricultural soil fertility indicators. However, these preliminary results should be treated with caution and should not be used for the fertilization of agricultural plots.

Keywords: Soil tests,spatio temporal monitoring,pH,phophorus,france

ID ABS WEB: 137918

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

DIFFERENT APPROACHES TO SOIL MONITORING: COMPARISON BETWEEN NATIONAL SOIL INFORMATION MONITORING SYSTEM (N-SIMS) AND LUCAS SOIL

E TONDINI [1], C FROGER [2], D ARROUAYS [2], K OORTS [3], C POEPLAU [4], J WETTERLIND [5], E PUTKU [6], N SABY [2], M FANTAPPIE' [1], C CHENU [7], J SALOMEZ [3], S CALLEWAERT [3], F VANWINDEKENS [8], B HUYGHEBAERT [8], J HENRICKX [8], S HEILEK [4], L. S. HARBO [9,4], L DE CARVALHO GOMES [9], A L LÓPEZ [10], J. A. RODRIGUEZ [10], S PINDRAL [11], B SMRECZAK [11], A BENÕ [12], Z BAKACSI [12], K TEULING [13], F VAN EGMOND [13], V HUTÁR [14], B PALKA [14], D ABRAHAM [14], A BISPO [2]

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The EU Soil Strategy for 2030 and the Proposal for a Directive on Soil Monitoring and Resilience aim to achieve healthy soils by 2050. This information is currently provided at European level by LUCAS soil survey and nationally through monitoring networks (N-SIMS) developed individually by each member state with different approaches. In this context, integrating data from diverse sources (i.e. LUCAS soil and N-SIMS) is essential.
Under the EJPSOIL programme, twelve countries employed a common methodology to compare their N-SIMS to LUCAS Soil in terms of sampling strategy and representativeness of land use and soil types. This analysis revealed significant disparities in monitoring strategies, including variations in sampling design, monitored land cover, and sampling depth. While most N-SIMS and LUCAS Soil used a stratified random sampling design, some N-SIMS employed a regular grid approach. Sampling depth varied across countries, with some using fixed depth intervals and others opting for soil horizons sampling, while LUCAS Soil sampled topsoil at 0–20 cm depth (0-30cm in LUCAS 2022). Site density was generally higher in N-SIMS than in LUCAS Soil, with some cases exhibiting a difference of one order of magnitude. The significant increase in the number of sites in the LUCAS Soil 2022 campaign partially filled this gap. The spatial distribution of N-SIMS appeared more homogeneous than LUCAS Soil, especially in countries like France and Spain where N-SIMS followed a grid-based system and in regions with extensive mountainous areas systematically excluded by LUCAS Soil.
Comparisons of site proportions in different soil types or land cover classes indicated that N-SIMS results were more aligned with the current estimated proportions (calculated by using Corinne Land Cover and WRB, respectively) compared to LUCAS Soil. However, both methods exhibited significant variations from current estimated proportions. This work underscores differences in sampling protocols and representativeness among N-SIMS and between N-SIMS and LUCAS Soil. This is a preparatory work towards the soil properties comparisons among soil monitoring programs.

Keywords: Soil monitoring networks,LUCAS soil survey,Sampling strategies

ID ABS WEB: 138169

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

A FRAMEWORK FOR SETTING SOIL HEALTH TARGETS AND THRESHOLDS IN AGRICULTURAL SOILS

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Soil health is a key concept in worldwide efforts to reverse soil degradation, but to be used as a tool to improve soils, it must be definable at a policy level and quantifiable in some way. Soil indicators can be used to define soil health, and both quantify and monitor the degree to which soils fulfil expected functions. Indicators are assessed using target and/or threshold values, which define achievable levels of the indicators or associated soil functions. However, defining robust targets and thresholds is not a trivial task, as they should account for differences in soil type, climate, land-use, management, and history, among other factors. We assessed (through theory and stakeholder feedback) four approaches to setting targets and thresholds: fixed values based on research, fixed proportions of natural reference values, values based on the existing range (e.g. lower quartile of the observed distribution), and targets based on relative change (e.g. a 20% increase of the indicator's value). Three approaches (not including relative change) were then further explored using case study examples from Denmark, Italy, and France, which highlighted key strengths and weaknesses of each approach. Here, we present a selection of the assessment and case study results, as well as a framework, which facilitates both choosing the most appropriate target/threshold method for a given context and using targets/thresholds to trigger follow-up actions to promote soil health.

Keywords: soil health,indicators,targets and thresholds,framework,monitoring

ID ABS WEB: 138233

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

INTER-LABORATORY PROFICIENCY TESTS (PTS) AND THE RELIABILITY OF SOIL LABORATORY MEASUREMENTS WORLDWIDE: THE CASE OF GLOSOLAN

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High-quality soil data are essential in monitoring changes in soil properties and the impact of sustainable soil management practices. From this perspective, soil laboratories play a key role as these might be considered the originators of soil data from bulk material. Therefore, there is a need to assess the performance of laboratories analyzing soils for what concerns both precision and accuracy. To do so, inter-laboratory proficiency tests (PTs) are organized by various institutes worldwide. However, accessibility to such external quality control exercises is often challenging for laboratories operating in developing countries with limited available resources. Since its establishment in 2017, the Global Soil Laboratory Network (GLOSOLAN), established under the framework of the FAO's Global Soil Partnership (GSP), engaged over a thousand soil laboratories operating in around 170 countries.
To monitor the performance of soil laboratories worldwide and to later suggest actions to reduce the uncertainty of soil laboratory results, GLOSOLAN organized several regional PTs and two global PTs involving 80 participants from 60 countries (in 2019) and 240 participants from 110 countries (in 2022).
All PTs targeted essential soil parameters for optimal plant growth, used as main indicators to assess sustainable soil management practices (FAO-ITPS, 2020). Most of the time, precision was assessed using replicates, while participants results were converted into Z-scores and their performance evaluated based on the standard deviation of the mean value of the Z score for each of the replicates.
Results showed that most of the laboratories worldwide have issues with both accuracy and precision. Therefore, to reduce uncertainty of soil data worldwide and hence increase the efficacy of decisions based on those data, it is essential to raise the awareness on the role of soil laboratories and encourage global investments in training soil laboratory staff and managers. This can be achieved through the collaborative system promoted by GLOSOLAN, which mobilizes support from high performing laboratories to improve the consistency of global soil data.

Keywords: Soil data quality,Inter-laboratory comparison,Reliability of measurements,Global Soil Laboratory Network

ID ABS WEB: 136359

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

QUANTIFYING SOIL HEALTH UNDER GLOBAL WARMING SCENARIOS BASED ON INTEGRATED ECOSYSTEM SERVICES IN AGRICULTURE.

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Although a precise definition and quantification of soil health has not yet been established, there is a general agreement that the soil's ability to provide ecosystem services is closely linked to its state of health.
Assessing ecosystem services (ESs) in an integrated manner remains a challenge. Simple indicators, such as those based on a single time-invariant soil parameter like clay content or AWC, are often used as proxies for evaluating ESs. However, these indicators do not fully capture the complexity of the many integrated ecosystem services (ESs) provided by soil.
Furthermore, it is crucial to evaluate the effects of global change on the provision of ESs in agriculture. Therefore, it is important to develop reliable scenarios for resilience, adaptive capacity, and future risks under different climates and landscapes.
We propose an integrated assessment of multiple potential soil-based ecosystem services through the use of process-based modeling. This will simulate water, heat, nutrients, and crop growth in the soil-plant-atmosphere system, according to global climate change scenarios.
The evaluation focuses on the soil's contribution to i) food provision, estimated through biomass; ii) retention and release of nutrients and pollutants, estimated through soil filtering capacity; iii) water regulation, including runoff potential and flood control; iv) water storage in the soil; v) groundwater recharge; and vi) microclimate regulation, measured by total evapotranspiration.
These ESs are combined into integrated indicators of soil health, to immediately obtain comprehensive information on the potential soil health status at specific locations and for global climate change scenarios. Results obtained by using the proposed approach are shown for the Campania Region (Italy) case study, where several land degradation processes (such as the loss of organic matter and/or soil erosion) have been simulated, according to the specific local pedoclimatic conditions.

Keywords: soil-plant-atmosphere,process-based modeling,ecosystem services,climate change

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4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

FACILITATING SOIL RESTORATION; THE ROLE OF SOIL BIOLOGY INDICATORS IN MONITORING AND ASSESSING SOIL HEALTH

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Soil degradation is a serious side effect of mismanaged agricultural systems, that inevitably compromises soil health. When attempting to reverse degradation in a complex system such as the soil, having indicators of successful restoration suitable for monitoring are important for adaptive management. Soil biological properties potentially offer the most dynamic and sensitive indicators of soil health allowing regular monitoring to provide relatively fast feedback on the consequences of management decisions, both in the short- and long-term. Decision support tools (DST) are becoming increasingly common as a way to assess soil health and functions on-farm. However, soil biological indicators are still under represented in these assessments. The TUdi project aims to address this shortcoming by developing and validating stakeholder-oriented solutions to evaluate soil status at farm level, tailoring the management techniques to local conditions. The Tudi DST has incorporated a set of soil biological indicators which are designed to facilitate a simple, evidence-based monitoring and assessment as well providing tools for on-farm decision making.
Monitoring involves visual field and soil observations, as well as soil testing. Soil biological indicators are grouped into six categories: soil management, surface cover, root system, soil biodiversity, soil tests and additional information. These are then allocated a numerical score which indicates the impact of indicator inputs on soil biology. The results are reported with traffic light scorecards which indicates whether the soil system is in very poor, poor, neutral, good or very good health status. Recommendations to facilitate decision making on soil management are provided by each, above mentioned six categories. With this tool TUdi aims to facilitate the uptake of soil healing strategies in three major agricultural systems and farm typologies across Europe, China and New Zealand.

Keywords: Soil health,Soil biology,Soil restoration,Soil monitoring,Decision support tool

ID ABS WEB: 136780

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

AGROECOLOGICAL TRANSITION OF OIL PALM CULTIVATION IN THE TROPICS: IMPORTANCE OF SOIL HEALTH MANAGEMENT TO ACHIEVE HIGH YIELD.

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Oil palm cultivation is a key component of agriculture in most tropical countries. It involves millions of farmers in the 3 continents of Southeast Asia, Africa, and South America, as well as large plantation companies, often in an integrated system organized by governments.

Soil health is a major objective of agroecological approach for the transformation of agriculture. While soil health status and importance are well identified and documented in temperate agriculture, relative few studies and initiatives for transformation have been developed in tropical agriculture, especially on an "industrial" crop such as the oil palm, which carries a significant level of controversy due to its recent development, often on natural ecosystems.

Here we report the results of a large preliminary study implemented in oil palm plantations in Indonesia, aiming at identifying the components and variables for the characterization of soil health as the basis for the transformation of oil palm cultivation.

The importance of soil health management is demonstrated, and the variables for the assessment of soil health status, and subsequently the required agronomic recommendations for improvement are identified. Half of these variables measured (from more than 20) shows a significant relation with the yield of the palms, including most variables representing the biological and physical components of soil health status, together with agricultural practices (especially biomass recycling and soil natural vegetation cover) driving the level of these variables. On the other hand, most variables related to the chemical component of soil health do not show significant positive impact, most probably because they have been transformed by the fertilizer management approach adopted by farmers.

These results have been used to propose best agricultural practices for the agroecological transition of large areas of the oil palm landscape, including both small farmers and large plantations, with conservation agriculture approach recommended in area showing good soil health status, while the regenerative agriculture approach is recommended for these areas showing some level of soil degradation.

Keywords: soil health,tropical agriculture,oil palm,Agroecology

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4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

MATCHING SOIL PERFORMANCE INDICATORS TO AUSTRALIAN FARMING SYSTEMS

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Soil indicators in the form of tests, assessments and observations provide vital measures of soil performance and important information to farmers about soil health. Use of soil indicators within agriculture is widespread, however less is known about the factors that influence the choice of indicators for Australian farms that support their farming practices. Research was undertaken to investigate (i) what tests and assessments are being used in grains, sheep and cattle enterprises, (ii) how frequently these tests and assessments are conducted, (iii) why are these tests and assessments chosen, and (iv) what factors influence their soil indicator choices? A survey was distributed to 10 farmer groups across Australia with 228 surveys being collected from farmers, advisors and researchers. The data revealed that plant growth or yield was the highest used observation by the grains (95.7%), cattle (85.2%), and sheep (89.1%) enterprises, followed by field walk or drive. For chemical testing, available phosphorus was widely used across grains (76.8%), cattle (76.5%) and sheep (81.5%) enterprises. Out of the physical tests, stability of aggregates in water was most frequently used test by grains (53.7%), cattle (50.6%), and sheep (53.3%) enterprises. Root health/rooting depth is the most widely used of all the biological tests presented. Over half of the survey respondents' choice of soil tests was based on the relevance to their production decisions and farming enterprise and for their ease of sampling, observation and assessment. Respondents identified field days and farms walks as important sources of information that influenced their soil indicator choices. The research findings indicate that no single soil property or group of properties can universally indicate soil performance across the variety of Australian farming systems. This study indicates that soil indicators must be matched to their purpose, in the context of when and where they are measured and how the indicator value relates to a baseline and the threshold values of the measure for that purpose.

Keywords: Soil Health/Quality,Indicators

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4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

ON-FARM ASSESSMENTS OF SOIL HEALTH AND SOIL FUNCTIONS IN SOUTHEAST NORWAY

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Soil health is defined as "the ability of the soil to sustain the productivity, diversity, and environmental services of terrestrial ecosystems". Practices entailing minimum soil disturbance, soil cover and crop diversification have been highlighted for improving soil health, and thereby improving soil functions and the delivery of ecosystem services. However, evidence on the effect of these practices, such as conservation agriculture, on soil health, is limited in Norway, mainly due to unfavourable conditions for practicing no-till and establishing cover crops in cold climate conditions. This paper presents results on the effects of long-term conservation practices compared to conventional farming on soil health and soil functions on loam soils in Southeast (SE) Norway. We measured physical, chemical and biological soil indicators on two neighbouring farms, one with no-till, diverse crop rotation and cover crops (Conservation) and one with harrowing and ploughing and low crop rotation (Conventional). Soil indicators measured included aggregate stability, bulk density, cohesion, soil roughness, saturated hydraulic conductivity (physical), total organic carbon (TOC), total nitrogen (TN), C/N-ratio and pH (chemical), and permanganate-oxidizable carbon (POXC), earthworm count, and plant coverage (biological). Results show higher aggregate stability (%) in the conservation field (91.3±4.2) compared to the conventional field (56.9±6.9). Higher TOC was found in the 0-15 cm depth in the field with conservation practice compared to the conventional field, while the opposite trend was measured for the 15-30 cm depth. POXC was higher in the conservation field compared to the conventional field for both soil depths. Significantly different ($p<0.001$) earthworm count was found in the field with conservation practice (24.7±6.4) compared to the conventional field (6.0±3.2). Finally, we compare the effects of the two farming practices on different soil functions expressed by the measured soil indicators.

Keywords: Soil health,Soil functions,Indicators,Conservation agriculture

ID ABS WEB: 137240

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

DESIGNING MONITORING REPORTING VERIFICATION FOR PROMOTING HEATHY SOILS

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Integrating soil health considerations into the activities of soil stakeholders is a requirement for sustainable soil management. In addition to regulations and incentives, pertinent, reliable and scalable information on drivers, states and trends in soil health are needed. For this, Monitoring, Reporting and Verification (MRV) frameworks must be developed at various scales and based on 1) standardized, sound and economic sampling designs for assessing soil health indicators (Monitoring), 2) a reproducible and transparent way to report results (Reporting) and 3) a reliable verification process conducted by an independent structure (Verification).

So far, MRV frameworks for soil management have mainly been applied in the context of carbon sequestration. Expanding such frameworks to multiple soil indicators and the far more complex issue of soil health is a major challenge. They must account for the requirements of different land uses and of different spatial scales. To achieve trust and widespread implementation by diverse stakeholder groups, they need to reconcile scientific robustness with economic and logistic limitations of real-life applications.

The Horizon Europe project BENCHMARKS funded under the Soil Mission, started in 2023 and will run for five years. Its objectives are 1) to test and define indicators for soil health and 2) support their implementation with different tools, across various scales and land uses and by intensive stakeholder involvement and co-design. Among these tools, MRV frameworks will be defined from 2024. The involved stakeholders will work in connection with different land uses (forests, agriculture or/and urban areas) and at different spatial scales (local, national, European or/and Global scale). Numerous outcomes are possible. For example, the final designed MRV could be integrated in the product value-chain of a company, in certification labels or in large-scale soil monitoring, supported by European and national institutions.

In this communication, we will present an analysis of the challenges related to setting up MRV frameworks for soil health and the early results for MRV co-design with the stakeholders.

Keywords: soil indicators,stakeholders,co-design,multi-scales,multiple land uses

ID ABS WEB: 137679

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

IMPROVING BASELINE MAPPING OF SOIL ORGANIC CARBON USING LOCAL GEOSTATISTICS: AN APPLICATION AT REGIONAL SCALE IN TUSCANY (ITALY)

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The status and change of soil organic carbon (SOC) concentration are fundamental for assessing soil health, its functionality and contribution to climate regulation. Organic matter decline is one of eight soil threats identified in the EU Thematic Strategy for Soil Protection (EU 2006). The indicator for assessing SOC loss threat is based on SOC change but measuring any change in SOC content requires establishing a SOC baseline. Geostatistical methods are commonly used both for predicting SOC concentrations at unsampled locations and their mapping. However, most geostatistical algorithms rely on variograms, which are usually assumed to remain unchanged through the area of interest. Therefore, it is assumed the stationarity of data and its spatial structure (variogram) over this area. That is a strong assumption, which may not hold. Local geostatistics (LGS) approach allows the local optimization of geostatistical parameters involved in variogram-based models ensuring a better adequacy between the geostatistical model and the data. Particularly, LGS considers locally varying parameters to address non stationarity and local anisotropies and allows to focus on local particularities. The study was aimed at improving baseline mapping of soil organic carbon (0.30 m) using local geostatistics at regional scale in Tuscany (Italy). It was developed within the SERENA project (European Joint Programme on Agricultural Soil Management, EJP SOIL, European Union's Horizon 2020 R&I programme, grant agreement N° 862695) using the SOC dataset of Tuscany Region presented in Gardin et al (2021). To improve the estimation of SOC concentrations by kriging, the elevation, being exhaustively available over the whole area of the Tuscany region, was used as an external drift. To assess the improvement of SOC prediction, the dataset was split into calculation and validation sets. The performance of the LGS approach was assessed by error statistics and compared to the results obtained using a global variogram model. Finally, the baseline map of SOC was complemented by the assessment of the spatial uncertainty using sequential Gaussian simulation.

Keywords: Soil organic carbon,Baseline,Local geostatistics,Spatial uncertainty,Tuscany

ID ABS WEB: 137729

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

BUNDLES OF SOIL-BASED ECOSYSTEM SERVICES IN THE EUROPEAN UNION AND THEIR EVOLUTION BY 2050

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Ecosystem services are the direct and indirect contributions of an ecosystem to human well-being. Most ecosystem services required to maintain terrestrial environmental and ecological systems arise from the soil, known as soil-based ecosystem services (SESs). SESs are directly and quantifiably controlled or provided by soils and their chemical, physical and biological properties, processes and functions. SESs do not occur separately in the environment, but simultaneously. They should thus be evaluated together as SESs bundles. In addition, these services are threatened by global changes, such as climate change and changes in land use, which will affect their provision. This work is aimed at defining SESs bundles at the European Union (EU) level, and at evaluating the effect of climate and land use changes on their evolution by 2050. The SESs assessed are hydrological control (HC), soil erosion control (SEC), greenhouse gas and climate regulation (GHG) and primary biomass production (PBP). To assess HC, the digital soil mapping approach was used. SEC was quantified through the Revised Universal Soil Loss Equation (RUSLE). For GHG and PBP, dynamic global vegetation models (DGVMs) produced by UK Earth system models (UKESM) were used. The impacts of climate change were assessed using two Shared Socioeconomic Pathways (SSP1-2.6: sustainable scenario and SSP5-8.5: high-emission scenario with significant climate impacts). Concerning land use change, we used the projections provided by the LUISA (Land Use-based Integrated Sustainability Assessment) modeling platform. The assessment offers a comprehensive analysis of the spatial distribution and projections for the SESs bundles in the current state and by 2050. Clustering methods, specifically k-means, were employed to identify SESs bundles at EU scale. The proposed approach allowed us to identify hotspots with high or low provisions of SESs and how they will be evolved by 2050 under the pressure of climate and land use change. Moreover, it could provide guidance for sustainable agriculture in the framework of the EU Green Deal and the Soil Strategy for 2050.

Keywords: Soil-based ecosystem services,Bundles,Climate change,Land use change,Scenarios

ID ABS WEB: 137784

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

SUSTAINABILITY OF SOIL QUALITY INDICATORS OF EPICALCIC CHERNOZEM UNDER SOIL EROSION CONTROL TECHNOLOGIES

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Water erosion and loss of organic matter are interrelated soil degradation processes that lead to a decline of soil fertility on sloping arable lands. A three years' field experiment with wheat and maize in rotation was conducted on Epicalcic Chernozem on slope of 5o, including conventional tillage along the slope (T0), conventional contour tillage (T1) and minimum tillage (T2), with the inclusion of a cover crop. The aim of the study was to assess the influence of constant application of these technologies on soil quality indicators. The soil microbial, chemical and physical properties were measured at two depthsin April and October each year. A higher amount of total organic carbon (TOC) was reported in T1 and T2 in the second and third year. The soil microbial biomass carbon content increased in T2 in the second year (by 0.67 mg 100 g-1 under wheat) and in the third year (by 3.74 mg 100g-1 and 4.80 mg 100 g-1 under wheat and maize, correspondingly). An increase in the activity of peroxidase and polyphenol oxidase was reported even in the first year, while the activity of protease, urease, alkaline phosphatase and ß glucosidase increased more significantly in the third year. Under T2, the available forms of macroelements and electrical conductivity slightly decreased in some periods, due to including of cover crop. The water stability of soil aggregates had a well pronounced seasonal dynamic. An increase of the plant available capacity (PAWC) under T2 was observed in 0-10 cm soil layer in April under maize. In autumn, the erosion control technologies prevented the subsoil compaction and decrease of PAWC. In conclusion, the applied erosion control technologies lead to a stable increase in enzyme activity, microbial biomass and TOC and soil physical parameters compared to the conventional crop cultivation along the slope.
Acknowledgements The authors acknowledge funding from the BNSF (K -06-H76/2 2023)

Keywords: soil water erosion,soil microbial properties,soil structure,soil organic carbon,crop rotation

ID ABS WEB: 138265

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

IS THE ORGANIC CARBON-TO-CLAY RATIO A RELIABLE INDICATOR OF SOIL HEALTH?

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Soil health refers to the ability of the soil to sustain the productivity, diversity, and environmental services of terrestrial ecosystems. The European Union is targeting to improve soil health and soil-based ecosystem services, and as part of the proposed Soil Monitoring Law, the European Commission recommends the monitoring of the soil carbon loss indicator among other soil health indicators.

This main objective of this study was to evaluate the feasibility of the proposed soil carbon loss indicator by assessing its performance using the EU-wide 2009 LUCAS soil survey data in combination with other datasets for soil class, climate zone, and mineral soil carbon stock changes. The proposed indicator for soil carbon loss is soil SOC:Clay ratio, with a threshold value of 1:13. The results of this study are also compared with the carbon stock changes reported by countries to the climate convention (UNFCCC).

Our results reveal that the variation in SOC and clay content at European scale exceeds that of the data used to develop the proposed soil carbon loss indicator. We also found that the variation in the SOC content was influenced not only by clay content but also by climate and land-use reflecting carbon input levels. Therefore, the defined threshold value 1:13 of SOC:clay ratio is inadequate for detecting degraded soils if the SOC and clay content are beyond the conditions used to establish the criteria. Furthermore, major discrepancies were observed between the soil carbon stock changes reported by the national GHG inventories and the proportions of degraded soils identified by using the soil carbon loss indicator. We conclude that using a single indicator such as SOC:Clay ratio with one threshold value for all soils across various land uses, management practices, and climatic conditions, as defined by the European Commission for the Soil Monitoring Law, is inappropriate for monitoring soil carbon loss.

Keywords: Soil organic carbon,SOC:Clay ratio,European mineral soils,LUCAS soil survey,Soil monitoring

ID ABS WEB: 138327

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

DIFFERENTIAL EFFECTS OF AGRICULTURAL INTENSIFICATION ON THE DIVERSITY OF PROKARYOTES, FUNGI, AND PROTISTS ACROSS AGRICULTURAL SOILS IN QUÉBEC, CANADA.

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The intensification of agriculture has negative effects on soil health and crop productivity. As a result, chemical inputs and soil tillage are being used more, which further impacts soil biodiversity and soil health. Although new sustainable practices are emerging, it is still difficult to evaluate their short-term impact on soil functions and soil health. To develop new biological indicators that can respond to management practices, we need to increase our knowledge of the effects of different cropping systems on the complete range of microbial groups present in agricultural soils. Furthermore, we need to evaluate the effects of environmental co-variables on soil microbial diversity and their impact on soil-plant interactions.
A total of 1700 soil samples were collected to represent the diversity of agricultural soils in the Province of Québec, Canada. For each soil series, four cultivated sites and two control sites were studied to determine the soil microbial diversity. A range of physico-chemical characteristics was also analyzed, along with pedological description, tillage, fertilization management, and cropping systems histories. We evaluated the diversity of prokaryotes, fungi, and protista in two soil layers using MiSeq amplicon sequencing. The diversity was assessed with the Shannon's index and Aitchison distance. Differential analysis was performed with ANCOM-BC to assess the impact of agricultural intensification on microbial diversity.
Soil's microorganism composition is shaped by agricultural intensification and parent soil material. Bacteria diversity is mainly affected by parent material and pH level, while fungi and Protista diversity are more impacted by crop system intensification. Control and grassland sites have lower bacteria Shannon index values, but those for fungi are higher. There is no discernible impact on bacteria to fungi ratio.
Studying microbial diversity globally is important to better understand the impact of agricultural management on soil and plant interactions. However, integrating microbial groups and microbiome data into new models remains challenging to accurately predict soil health and the effects of agricultural management practices.

Keywords: Microbiome,Soil health,Cropping systems,Tillage,Microbial diversity

ID ABS WEB: 136234

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

NATURE-BASED SOLUTIONS AND RESTORATION ACTIONS FOR THE SOIL QUALITY RECOVERY IN URBAN AND NATURAL AREAS: THE RESEARCH ACTIVITIES OF NATIONAL BIODIVERSITY FUTURE CENTRE (ITALY)

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The Italian National Recovery and Resilience Plan (NRRP), funded by the European Commission-Next Generation Europe, aims to create a more equitable, sustainable, and inclusive society in Italy. For this purpose, NRRP has supported the creation of the National Biodiversity Future Centre (NBFC) for promoting the sustainable management of Italian biodiversity. One of the main goals of NBFC is to improve the application of Nature-Based Solutions in anthropized and natural areas to mitigate global climate changes and to support ecosystem services.

In this work, some of the research activities carried out by NBFC are presented: 1) design, application, and management of restoration actions for degraded land recovery; 2) evaluation of the impact of urban forestry on supporting and regulating ecosystem services in urban areas.

For the natural areas, the application of restoration actions through different forest practices is currently being tested in areas degraded and subjected to abiotic disturbances. The efficacy of such environmental restoration is deepened in post-fire sites of Monte Pisano (Italy), and riparian sites frequently subjected to flooding events. The main soil indicators are monitored to detect the effect of restoration activities on soil quality, with a focus on microbial nutrient limitation and soil nutrient cycles.

In urban areas, the capacity and efficiency of urban forestry in providing ecosystem services, including air pollutant mitigation and soil carbon sequestration, have been studied. For this purpose, in several Italian cities characterized by different climatic conditions and urbanization degree (e.g., Torino, Milano, Firenze, Pisa, Livorno, Roma, Napoli, and Campobasso), sampling areas have been selected based on green cover and fragmentation. Soil enzyme activities, soil microbiome, soil and plant isotope signature, plant functional traits, and air quality were investigated to identify specific indicators of the soil-plant-atmosphere system.

The NBCF activities will provide strategies and guidelines as well as databases and tools for the designing of NBS aimed at promoting biodiversity, preserving and recovering soil health and resilience in urban and natural areas.

Keywords: degraded area,urban soil,soil indicators,ecosystem services,soil quality

ID ABS WEB: 136609

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INSIGHTS INTO MACHINE LEARNING-BASED PREDICTIVE MODEL OF RICE GRAIN ARSENIC ACCUMULATION: INTERPLAY OF RICE CULTIVATION SYSTEMS AND SOIL ENVIRONMENTAL FACTORS

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Behaviour of Arsenic (As) in paddy soils is of great interest, where As transfer to rice significantly impacts increasing As levels in rice grain. The study explores an efficient predictive model for rice grain As accumulation using ensemble machine learning algorithms. We collected seasonal flooded paddy-field soil samples from thirty locations in a rice-growing district of West Bengal (India). The field plots were categorized into monsoon and post-monsoon cultivated rice-growing conditions. The monsoon rice is grown under rainfed cultivation, while the post-monsoon season requires intense use of As-contaminated irrigation water. From the field collecting data, the model validation was performed by measuring soil characteristics, which include pH, organic carbon, total concentrations of As, Zn, Cu, Fe, Mn, Ni, geochemical fractions of As (exchangeable and amorphous iron oxide bound As), considered as predictor variables. The model accuracy was determined by using ten-fold cross-validation. Multivariate prediction models show that the random forest performed well in predicting rice grain As concentrations (RMSE=11.98) over the generalized linear model (RMSE=12.70). We further converted grain As into categorical (rainfed and irrigated) for binary predictive classification and compared the accuracy of random forest and logistic regression based on sensitivity, specificity, F1 scores. Random forest showed better performance matrices where exchangeable As was determined to be the most important variable. From the cut-off accuracy plot, the limiting values of 162 µg kg-1 and 1690 µg kg-1 were estimated for exchangeable and amorphous iron oxide bound As in soil, respectively, under the study conditions. In addition, the pollution status in collected soils was interpreted by the various geochemical indices, which demonstrate that the soils of the study sites are moderately polluted. This study helps to propose careful soil management practices that can minimize rice As transfer and proves the usefulness of machine learning model validation with a better understanding of soil environmental quality and biogeochemical health.

Keywords: Paddy soils,Arsenic,Trace elements,Soil health,Machine learning

ID ABS WEB: 137333

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environment

SOIL BIOTA EFFICIENCY IN ORGANIC MATTER UTILIZATION UNDER DIFFERENT VEGETATION AND SOIL CONDITIONS IN THE MEDITERRANEAN AREA: PRELIMINARY RESULTS FROM PIANOSA ISLAND (TUSCANY, ITALY)

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Aboveground environment and soil diversity can be used to understand belowground resource use efficiency of the soil biota and organic matter persistence in soil. This contribution reports preliminary results of a study settled in Pianosa Island (Tyrrhenian Sea), with an extension of 10.3 km2, belonging to the Tuscan Archipelago National Park (Italy). Thanks to its geographical position, coupled with its peculiar history, Pianosa can be considered an excellent natural open-air laboratory for studying soil functions under typical Mediterranean climatic conditions. In fact, Pianosa has been cultivated since long time, and had been an agricultural penal colony for more than one century. Since the beginning of the 90's, the agricultural fields were abandoned, and thereafter, the natural vegetation started expanding, without anthropic influences. This allows studying the effect (impact) on all the environmental compartments of a natural recolonization process in past agricultural soils. Four main ecosystems were identified: abandoned agriculture fields, abandoned pastures, natural Mediterranean macchia and planted coniferous forests. These ecosystems were studied in terms of environmental (main physiographic and vegetation cover aspects) and pedological characterization, considering several soil parameters (chemical, physical and functional) and the soil mesofauna diversity. The aim of this study was to evaluate which soil properties, aboveground aspects, or different past utilizations, have mainly affected soil activity and carbon mineralization, under the ongoing natural process of recolonization in Mediterranean condition, where the main driving force is climate.

Keywords: Soil health indicator,Soil function,Landuse change,Natural recolonization,Carbon mineralization

ID ABS WEB: 137397

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ENVIRONMENTAL RESTORATION THROUGH SOIL CONSERVATION. A CASE STUDY OF MONTE GIBRALFARO (MALAGA, SPAIN)

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Soil conservation in natural areas within urban settings is essential to ensure environmental sustainability. These spaces act as green lungs, providing crucial ecosystem services such as carbon sequestration, water regulation and habitats for biodiversity. Proper land management in these urban areas contributes to air quality, human health and resilience to extreme weather events, promoting a balance between urban development and environmental preservation. In a context of climate change, especially in highly vulnerable areas such as the Mediterranean, land degradation processes are one of the main threats. Therefore, the development of sustainable strategies for the evaluation and characterisation of soils, as well as the conservation, restoration and renaturalisation of these spaces is a key factor in land management. Under these premises, the current work focuses on an urban forest area in the city of Malaga (Spain) - Monte Gibralfaro - characterised by low biodiversity and a lack of territorial connection with the natural matrix, which makes it more vulnerable to the effects of climate change. The objectives of this research are: (i) to determine soil erosion rates using the RUSLE model; (ii) to estimate SOC stocks as an indicator of soil health; (iii) to evaluate the dynamics of vegetation cover in recent years using spatial remote sensing techniques; and (iv) to promote strategies and actions for soil conservation and the improvement of ecosystem services. In short, the work aims to provide a general characterisation and diagnosis of the state of soil health and, subsequently, to design different actions focused on the restoration of soils as an essential component of environmental dynamics.

Keywords: DEGRADATION,ECOSYSTEM SERVICES,SOC STOCKS,ENVIRONMENTAL RESTORATION,SOIL CONSERVATION

ID ABS WEB: 137419

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TEMPERATURE EXACERBATES THE INFLUENCE OF VEGETATION TYPE ON SOIL ORGANIC CARBON DECOMPOSITION

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This study aimed at understand the role of climate and plant species on soil organic carbon (SOC) decomposition. Along an altitudinal transect ranging from 500 to 1000 m a.s.l. on a limestone massif in central Italy, we selected two adjacent toposequences, one covered by pine forests and the other by oak (500 m) and beech (1000 m) forests. Twice a month for one year, soil samples (A horizon) were collected and analysed, and CO2 efflux and forest floor thickness were measured. SOC content did not differ between the deciduous forests, while it showed larger content at 1000 than at 500 m for the pine forests. The fact that SOC content at both altitudes was significantly different between deciduous and pine forests indicated the importance of the quality of the plant residue for SOC decomposition. Indeed, the increase of delta13C in spring and summer for the deciduous forest at 500 m and the lack of seasonal changes of the isotopic signatures for both forests at 1000 m a.s.l., would indicate that temperature most affects SOC decomposition when the substrates are easily degradable. The highest WEOC content observed for all forests in winter season can be ascribed to the lowest C mineralization by soil microbial community (supported also by the lowest CO2 efflux). This fact, alongside with the similar seasonal trends of the CO2 efflux recorded in all forests, confirmed the role of temperature on the mineralization processes. The influence of the quality of the plant residue on SOC mineralization was highlighted during the spring and summer seasons, when higher temperatures occurred. Unlike the mineral layer, the forest floor seemed to be mostly affected by temperature, showing the lowest thickness in the warmest month in all forests. Finally, in the investigated temperate forest soils, temperature would be the most important driver in SOC dynamics, although at lower elevation and higher temperature the quality of plant residues could affect the mineralisation processes.

Keywords: Forest soil,Temperature change,Mountain area,Soil organic matter,Soil-plant interaction

ID ABS WEB: 137660

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

BIOCHAR BOOSTED HIGH OLEIC PEANUT PRODUCTION WITH ENHANCED ROOT DEVELOPMENT AND BIOLOGICAL N FIXATION BY DIAZOTROPHS IN A SAND-LOAMY PRIMISOL

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Peanut yield and quality are severely threatened by climate change and soil degradation. How biochar technology could help to tackle this challenge is unanswered though biochar is known to improve soil microbial community and plant N supply. A field study with oil peanut in a sand-loamy Primisol receiving organic amendment at 20 Mg ha-1 in 2021. The treatments included amendment of biochar respectively from poultry manure (PB), rice husk (RB) and maize residue (MB) as well as manure compost (OM) amendment, compared to no organic amendment (CK). In 2022, the 2nd year following amendment, samples of bulk topsoil, rooted soil and plants were collected at peanut harvest. Soil quality, peanut growth traits and microbial community with nifH gene abundance and biological N fixation (BNF) rate were analyzed. Compared to CK, the OM treatment increased peanut kernel yield by 8% but unchanged the kernel quality regarded with oil production. However, treatments of PB and MB increased (both by 10%) while that of RB unchanged the kernel yield. Moreover, all biochar amendments significantly (by 10-25%) improved oilseed quality, particularly with the proportion of oleic acid increased up to 70%. Similarly, OM amendment slightly decreased but all biochar treatments significantly and strongly (by over 80%) increased peanut root development. Furthermore, nodule number and fresh weight per plant as well as the nifH gene abundance of rooted soil were all unchanged under OM and PB treatments but significantly enhanced under RB and MB treatments, compared to CK. Relevantly, all biochar amendments but not OM treatment increased the biological N-fixation rate and the activity of N-acetyl-glucosaminidase. These changes were linked to soil aggregation, moisture retention and P availability affected by the biochars varying in physical and chemical properties. Overall, crop residue biochar boosted peanut yield and quality potentially through the improved root development, diazotrophs community and biological N fixation in line with soil nutrient supply.

Keywords: soil amendment,moisture retention,nifH gene,drought stress,P availability

ID ABS WEB: 137724

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

POSTFIRE EFFECTS ON PLANT-SOIL INTERPHASE AFTER SALVAGE LOGGING IN MEDITERRANEAN PINE FORESTS

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Wildfires are natural in Mediterranean forest ecosystems, but fire regimes changed due to LULUC. Salvage logging is used as emergency tool to restore ecosystem functions in the short-term, but its ecological implications are misunderstood. To improve ecosystem resilience, we propose tools for adaptive management in the Mediterranean basin. Soil provides ecosystem services and is an essential component of the environment as result of a complex set of interacting processes, such as those in the plant-soil interphase. Inappropriate management could induce soil degradation and the reduction of soil functions.

In July 2017, a wildfire affected 3,200 hectares (YESTE2017) in SE Spain and six months after (winter 2018), salvage logging was carried out. One and two years after fire (spring 2018, 2019), we conducted an experimental study to monitor soil dynamics depending on the soil burn severity (SBS): unburnt mature, low SBS, high SBS and high SBS with salvage logging.
The ecosystem dynamics were related to the habitat type 9540 (Directive 92/43/EEC, Mediterranean pine forests with endemic Mesogean pines) focused on Pinus halepensis Mill. and Pinus pinaster Aiton. We set up 72 circular plots (9 plots for 4 SBS and 2 species) to collect soil samples (0-3 cm depth) to analyze enzymatic activity, soil organic matter content (SOM) and thermal properties and calculate the vegetation indices (linear transect method) to evaluate the effect of SBS and salvage logging.

We found differences in the reproductive strategies and biological soil enzymatic activities (phosphatase and glucosidase) in post-fire natural regeneration. The high SBS increased the pyrorecalcitrance of SOM increasing the impact of the fire, showing the highest values in salvage logging. The changes in soil-plant interphase pointed to highlight burn severity and postfire treatment as negative effects.

To improve ecosystem management and maintaining soil health (adaptive management). the salvage logging should be avoided, mainly in high burn severity areas, to prevent reduction of the biological soil quality, and improve the resilience of vulnerable ecosystems.

Keywords: Post-fire management,Global change impacts (fire),Soil ecosystem services,Soil burn severity,Soil-plant interphase

ID ABS WEB: 137737

4. Soil health in achieving the Sustainable Development Goals
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CYANOBACTERIA INOCULATION AND SEWAGE SLUDGE AS SYNERGISTIC STRATEGIES FOR DRYLAND RESTORATION

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Drylands, covering more than 40% of the Earth's surface, are highly susceptible to climate variations and human activities, which have led to the degradation of 25-35% of these regions. Since the recovery of ecosystems may need a long time, accelerating the process through restoration activities becomes essential. Traditional restoration efforts often produce unsatisfactory results in drylands partly because they primarily focus on reintroducing vegetation, neglecting other ecosystem components and the importance of vegetation spatial distribution, which often consists of plant patches and biocrust in open areas among plants. Recently, biocrust-forming cyanobacteria have shown promising results as restoration agents in laboratory experiments, but few field studies are available, and many of them demonstrate limited success. On the other hand, sewage sludge (SS) has gained widespread recognition as a soil amendment due to its abundant reserves of organic matter and essential nutrients.
The objective of the present study is to combine these two strategies in an outdoor experiment to determine the optimal dose of SS for improving the effectiveness of cyanobacteria inoculation. This enhanced strategy aims to be applied in subsequent small-scale restoration actions alongside the introduction of native vegetation.
Our findings revealed increased cyanobacteria growth in soil amended with the lowest SS concentration (5 t/ha, at a depth of 2 cm), while at higher SS concentrations, inoculum growth decreased, attributed to competition with the indigenous SS bacterial community. Additionally, SS amendment significantly increased soil organic carbon gain, and the content of tightly-bound exopolysaccharides while cyanobacteria inoculation notably improved soil surface stability, reducing wind erodibility.
In summary, the combined approach of cyanobacteria inoculation and the application of the optimal SS dose emerges as an effective strategy for enhancing carbon acquisition and surface stability in degraded dryland soils.

This work is part of TED2021-132332B-C21 project, funded by MCIN/AEI/10.13039/501100011033 and UE “NextGenerationEU”/PRTR”

Keywords: Biological Soil Crust,Cyanobacteria,Inoculum Growth,Organic Amendment,Soil Organic Carbon

ID ABS WEB: 137815

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SOIL SHAPES THE HABITATS OF TUBER SPP SPECIES (TRUE TRUFFLES). ESTABLISHED KNOWLEDGE AND CHALLENGES IN HABITAT MANAGEMENT: WHEN SUSTAINABILITY MEETS MULTIDISCIPLINARITY.

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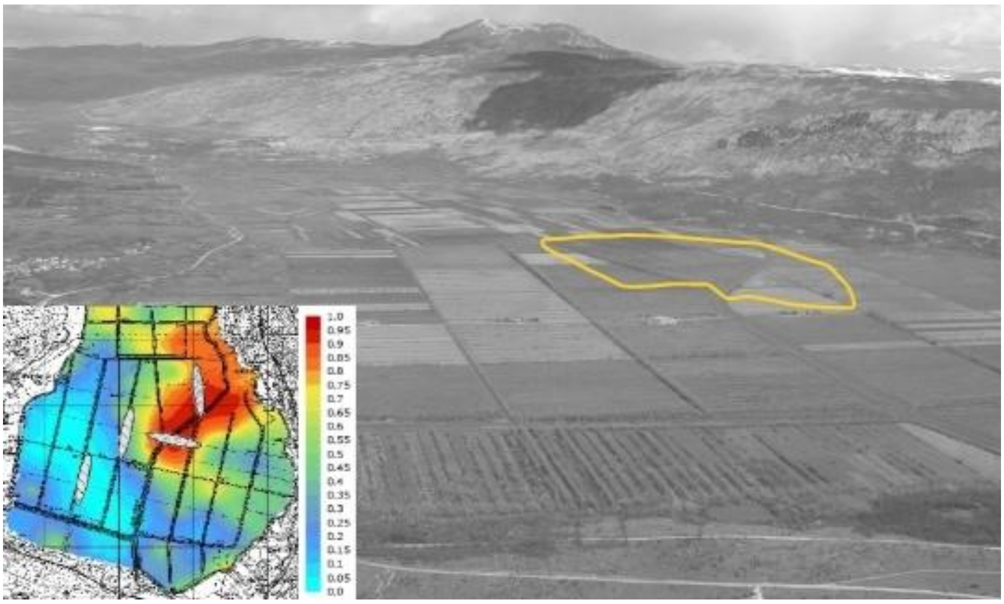
Research on the five main true truffle species (genus Tuber) of economic interest has consolidated knowledge on their habitats, which require the presence of a symbiont tree and a neutral to sub-alkaline soil with a sufficiently high content of exchangeable calcium. Given these requirements as mandatory, the soil structure has proven to be the key to truffle habitats, both in terms of aggregation - single-grained, granular or small sub-angular blocky - and porosity - more than 10% macropores, preferably elongated and in any case interconnected. It is so important for truffle habitats that some species have modified their biological cycle to fruit in sandy soils and in soils with subangular blocky aggregation.
The present report will illustrate the pathways followed by soil-forming processes to achieve the optimal conditions - different for each truffle species - that link the architecture of truffle soils on one side to hydrological and biochemical cycles, on the other to specific soil-landscape units located in fluvial (T. magnatum) and dunal landscapes(T. Borchii), in slope landscapes with a higher (T. melanosporum) or lower content of coarse limestone fragments (T. aestivum), and in mountain landforms on limestone and dolomite that favour the accumulation of organic matter in the A horizon and limit the thickness of the overlying organic horizons (T. mesentericum).
Despite the advances made by biology and genomics, which have made the cultivation of truffle species increasingly reliable, truffle habitats and productions have continued to decline over the past two decades. It is now clear that reversing the trend can only be achieved through a multidisciplinary approach with strong involvement of soil science. Some of the topics to be addressed would be in-depth studies on the hydrology of truffle soils; the hydraulic uplift with which symbiont plants could hydrate mycorrhizae during drought periods; the relationship between truffle species and soil microbial communities; the preservation of the fertility of truffle grounds through appropriate management of soil organic matter.



Keywords: truffle species,soil environment,habitat,multidisciplinary approach

ID ABS WEB: 137858

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

MICROBIAL LANDSCAPES: UNRAVELING THE IMPACT OF NATURAL SURROUNDINGS ON ORCHARDS

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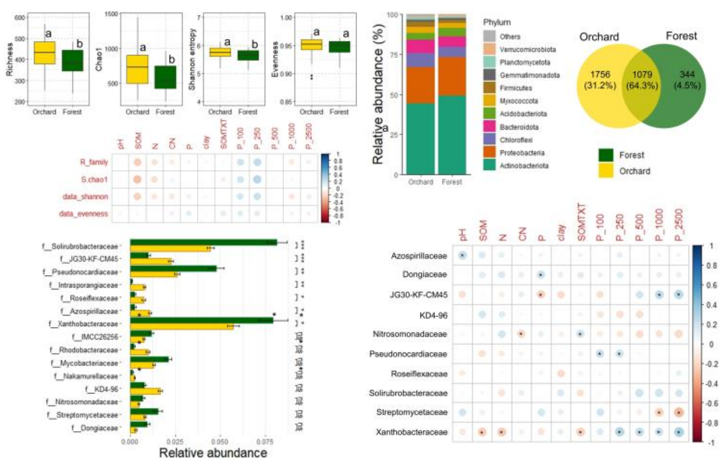
The significance of the soil microbiome in agriculture is growing due to its role in nutrient cycling, plant growth, and plant disease suppression. Processes like dispersal and environmental filtering influence the soil microbiome, but their real-world impact, especially in underrepresented areas like Chile, the southernmost country, remains unclear. In this study, the influence of natural surrounding areas (shrubland and forests) on orchard soils were explored. Moreover, we hypothesized that the more resemblance in the soil biogeochemical properties the higher similarity of the soil microbiome from orchards to that of forests. We analyzed six basins from Central Chile. In each one, we took 6 soil samples of natural areas (references) and 18 soil samples from orchards at varying distances from natural areas. The analyses of these samples showed that orchards exhibited higher bacterial but lower fungal richness than natural areas. Bray-Curtis analyses revealed significant differences in bacterial and fungal composition, with specific Taxonomical Families displaying distinct patterns. For instance, Solirubrobacteriaceae, Pseudonocaridaceae, and Xanthobacteriaceae were more abundant in forest soils, while Intrasporangiaceae, Roseiflexaceae, and Azospirillaceae dominated orchard soils among bacterial groups. Regarding fungi, Teratosphaericeae, Pannariaceae, and Aspergillaceae were prevalent in forests, whereas Pleosporaceae, Bulleribasidiaceae, and Coniochaetaceae dominated orchards. Functional analysis predicted higher bacterial denitrification in forests and increased chitinolysis and fermentation in orchards. Fungal functional predictions indicated a prevalence of plant pathogenic fungi in orchards and a higher occurrence of endo- and ecto-mycorrhizae in natural soils. The study identified a correlation between the percentage of natural surrounding areas around orchards and microbial diversity, microbiome similarity, and compositional differences. However, there is also an interplay between surrounding areas and the soil biogeochemical properties. In conclusion, this research sheds light on soil microbiome dynamics in real-world environments, providing insights for optimizing microbiome management in agriculture. The findings emphasize the importance of considering both farm-level practices and regional landscape factors for informed decision-making by stakeholders.



Keywords: soil microbiome,natural areas,ecosystem services,spillover effect,agriculture

ID ABS WEB: 137886

4. Soil health in achieving the Sustainable Development Goals
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A SYSTEMATIC LITERATURE REVIEW OF SOIL ECOSYSTEM SERVICES (SES) IN THE SUB-SAHARAN AFRICA

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Soil provides foundational services for human well-being. Over-exploitation of soil resources has elicited continuous land and environmental degradation challenges. This has led to a growing interest amongst scholars to understand and produce relevant knowledge to tackle the challenges. Therefore, this review aimed to assess the scope of soil ecosystem services (SES) studies in Sub-Saharan Africa. Using systematic quantitative content analysis (SQCA) in MAXQDA 2020 software, we reviewed 51 studies on soil-related ecosystem services. SQCA was executed by a combination of deductive and inductive content analysis to derive different categories (criteria) from the studies. The categories were; SES types, case studies' geographic scales, modelling tools, analysis perspectives, and drivers of change. From the results, all studies quantified different SES. Only 12, 6, and 3 studies conducted spatial mapping, temporal analysis and stakeholder participation respectively. None of the studies provided a valuation of SES. Forty-two (42) studies analyzed regulating services (81% were on carbon storage), 23 analyzed supporting services, 12 studies assessed food provisioning and 8 studies assessed other SESs. Based on the studies' geographic coverage, 71% focused on local/specific landscapes, 14% on a national scale and 15% on a regional scale. Based on the multi-perspective analysis, 42 studies concentrated on a singular perspective like ecological, economic or social. Only 7 studies analyzed all three perspectives together. There is little application of multi-data integration tools such as Artificial Intelligence for Environmental Sustainability (ARIES), Integrated Valuation of Ecosystem Services and Trade-offs (InVEST) or machine learning algorithms, thus limited multidimensional analysis. Land management practices, climate changes and land use changes were the predominant drivers studied, leaving behind other drivers such as road development. The global focus is to integrate SES into policy analysis and sustainability governance. Therefore, this review contributes to understanding and supporting the existing knowledge base for policy development and implementation.

Keywords: Systematic Content Analysis,Drivers of change,East Africa

ID ABS WEB: 138001

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A LOOK AT THE SOIL, AS A COMPONENT OF GEODIVERSITY AND GEOHERITAGE, THROUGH VITICULTURE.

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This paper focuses on pedodiversity within the Shouf Biosphere Reserve, specifically in vineyards, exploring sustainable development opportunities in sectors such as viticulture and ecotourism. The study characterizes and determines the oenological potential of the diverse terroirs across the 300 km2 region. It suggests conservative viticulture practices to enhance sustainability in vineyards and proposes showcasing soil profiles in wineries to promote ecotourism.
The research contributes to responsible soil management by conducting an inventory of soil categories and subcategories in vineyards and understanding the specific base element of geology as a main contributor to soil pedodiversity. The study also considers climate change and possible adaptation measures.
The research offers agricultural techniques to preserve soil productivity, nutrients, and biodiversity. It identifies various soil types such as Arenosols, Regosols, Leptosols, Cambisols, Luvisols, Anthrosols, Fluvisols, Gleysols, and Calcisols, showing their influence on farmer decisions regarding tillage, variety choices, and planting practices. Furthermore, the study tackles the intrinsic relationship with the substrata and the sourcing of minerals through weathering and dissolution to complement the organic components. It also refers to the contribution of physical and chemical influencing factors of groundwater and surface water.
The paper emphasizes the traditional ecological knowledge for a complete approach to sustainable agriculture. It suggests valorizing pedodiversity in ecotourism to enhance sustainability and exploration.
In conclusion, this study not only enhances the understanding of pedodiversity in the Shouf Biosphere Reserve but also proposes practical strategies for responsible soil management. By integrating indigenous knowledge, historical insights, and forward-thinking practices, the research aims at fostering sustainable agriculture, supporting biodiversity, and addressing climate challenges while incorporating pedodiversity into ecotourism initiatives.

Keywords: Pedodiversity,Viticulture,Ecotourism

ID ABS WEB: 138037

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

MAPPING SOIL WATER REPELLENCY IN DENMARK

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Soil water repellency (SWR) is a phenomenon that occurs at the microscale and has profound impacts on the hydrological functioning of ecosystems. However, the spatial assessment of SWR occurrence is still underdeveloped at a national scale. Our study used digital soil mapping techniques to map SWR in Denmark at high resolution (10m). We measured SWR in 7,300 soil samples from various locations across Denmark using the molarity of an ethanol droplet test. The SWR observations were associated with spatial covariates related to soil properties (soil organic carbon – SOC, soil texture), vegetation (Sentinel 2), agricultural management (Cropland only/Cropland in rotation), and terrain attributes (slope, saga wetness index). We used a Quantile Random Forest model to train and predict the median SWR values as well as the upper (90 th) and lower (10th) quantiles for the whole of Denmark. Soil organic carbon, soil texture, and vegetation indices were the main factors driving the spatial distribution of SWR. Areas with coarse soil texture and high SOC presented the highest degree of SWR, while the agricultural areas in fine-textured soils were mostly hydrophilic. When analyzing the influence of plant cover, coniferous forests and heath areas presented the highest degree of SWR, whereas deciduous forests exhibited comparably lower values. The combination of soil properties and satellite images allowed us to visualize the difference in SWR between forest species at high resolution. This might be beneficial for predicting and monitoring a wide range of hydrological facets of ecosystems, such as the water erosion risk and plant drought resistance. Overall, these results can help with, e.g., locating areas where SWR can cause problems and areas where SWR may be beneficial for soil water regulation dynamics of the vegetation.

Keywords: Soil Water repellency,Water dynamics,Tree species,Soil mapping,Drought

ID ABS WEB: 138106

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

EXPLORING THE SYNERGIC EFFECTS OF SALINIZATION AND WARMING ON SOIL ORGANIC CARBON FRACTIONS, AVAILABLE NUTRIENTS, AND SOIL AGGREGATION

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Climate change is a global phenomenon, manifesting in various environmental alterations with profound implications for ecosystems. One major outcome is soil salinization in irrigated croplands, with direct impacts on soil functioning. However, understanding the interactions between soil salinization and global warming and their effect on soil functioning proves difficult due to the highly variable environmental conditions. Hence, we conducted a microcosm experiment under controlled conditions, at two different temperatures and three different salinity levels, using soil samples from a semiarid area in northern Tunisia. Our objective was to assess if an increase in temperature can have a synergic effect on soil salinity with negative effects on soil organic carbon, nutrients, and aggregation. We used two factors: soil electrical conductivity (salinity factor; three levels: 1 mS cm-1, 5 mS cm-1 and 10 mS cm-1) and air temperature (two levels: 19°C, as current mean annual T of the area, and 21°C, as IPCC projections for 2030-2050). Treatments were randomly distributed in an incubator with five replications per treatment. Soil moisture was gravimetrically kept at 60% of water holding capacity. Soil sampling was performed on days 0 (beginning of the experiment), 10, 20, 40, 60 and 90 for physicochemical analyses and CO_2 and N_2O emissions. In soil samples we measured soil pH, electrical conductivity (EC), total organic carbon (TOC) and nitrogen, particulate organic carbon (POC), soluble carbon, available nutrients, stable aggregate fractions and aggregate weight diameter. Our results revealed a strong negative relationship between EC and soil pH ($R = -0.87$, $p < 0.05$). These changes in soil salinity and pH were associated to changes in the labile fractions of soil organic carbon and soil aggregation. In conclusion, this research provides valuable insights into the dynamics of soil properties under increasing saline conditions and foreseen global warming. Such knowledge is pivotal for the development of sustainable agricultural practices and effective ecosystem management strategies in salt-affected areas.

Keywords: Soil salinization,Soil pH,Organic carbon,Global warming,Soil aggregation

ID ABS WEB: 138108

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

USING BIOCRUST INOCULANTS IN DRYLANDS RESTORATION

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The harsh environmental conditions that govern drylands, including water scarcity, high salinity or nutrient poor soils, often result in slow recovery rates after a disturbance. Application of soil microbiome inoculum arises as a promising tool to enhance the success of ecosystem restoration. Specifically native biocrust microbiomes, which are encompassed by many microorganisms including cyanobacteria and bacteria, are considered an interesting biotechnological niche of bioinoculants for soil restoration. Here, we present key results related with the use of native bioinoculants from biocrusts in the restoration of soil functions and seedling growth obtained during more than 8 years by laboratory and field experimentation. Under laboratory conditions, the inoculation of different degraded soils with native biocrust-forming cyanobacteria significantly increased soil organic carbon (SOC) and total nitrogen in up to 10 and 2 g/kg soil respectively, after three months and rapidly promoted soil surface stabilization. Under field conditions cyanobacteria colonization rates were slower, but inoculations also increased SOC in between a 35 and 42% after one year. The application of reducing environmental stress strategies, under field conditions, favoured the establishment and growth of cyanobacteria inoculum, leading to the formation of a biocrust. The combination of biocrust forming cyanobacteria and bacteria not only promoted an increase in the biomass production of heterocistous cyanobacteria but also higher EPS secretion that led to higher soil organic matter content. Moreover, seed biopriming with biocrust-cyanobacteria showed a positive effect on the germination of native annual plants and increased seedling radicle growth, although this effect was species-specific. All these results point the beneficial effect of biocrust inoculants as nature based solutions to facilitate dryland degraded ecosystem restoration. This work is part of TED2021-132332B-C21, project funded by MCIN/AEI/10.13039/501100011033 and UE “NextGenerationEU”/PRTR”

Keywords: biocrust,soil restoration,cyanobacteria,inoculation,arid zones

ID ABS WEB: 138146

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

BIOGEOCHEMICAL NICHE BUILDING OF INVASIVE FALLOPIA JAPONICA: INSIGHTS FROM STABLE ISOTOPE PROBING

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Studying invasive plant species, in this case Fallopia japonica, has become pivotal in understanding their biogeochemical implications. Based on previous research that has shown that F. japonica inhibits soil nitrification by means of polyphenols, our study employs stable isotope analysis to delve into the biogeochemical niche-building mechanisms of this invasive species. We employed stable isotopes, 13C-CO2 and 15N-NO3 and -NH4, to shed light upon the biogeochemical dynamics associated with the invasive prowess of F. japonica and find whether it exhibits a higher affinity for ammonium than nitrate when compared to a native species (Urtica dioica) and whether it allocates resources predominantly to root growth. If this is indeed the strategy of F. japonica, it may indicate a niche-building strategy. It would suggest that F. japonica could be carving out ecological niches characterized by specific nitrogen forms and soil conditions, potentially influencing the competitive landscape and ecosystem dynamics in invaded habitats.

Contrary to our hypotheses, our results challenge the belief that F. japonica exhibits a higher affinity for ammonium than nitrate compared to native species. Through our labelling experiments on young F. japonica and U. dioica plants, we discovered that F. japonica displays a lower affinity for ammonium than U. dioica. Additionally, F. japonica showed higher nitrogen-use efficiency and preference for allocating resources to root biomass, underlining its ability to efficiently utilize nitrogen resources. These findings shed light on the intricate mechanisms behind the ability of F. japonica to disrupt ecosystems and appears to contribute to its success in shaping and potentially dominating distinct ecological niches within invaded ecosystems. Our work contributes to the ongoing efforts to foster sustainable and efficient agricultural systems in the face of global change.

Keywords: Stable Isotopes,Biogeochemical niche,Nitrogen Use Efficiency,Invasive Species,Nitrogen Cycle

ID ABS WEB: 138200

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

CHALLENGES TO SUSTAIN SOIL FUNCTIONS AND BIODIVERSITY IN HEROIC VITICULTURE IN THE CAPRAIA ISLAND (TUSCANY, ITALY)

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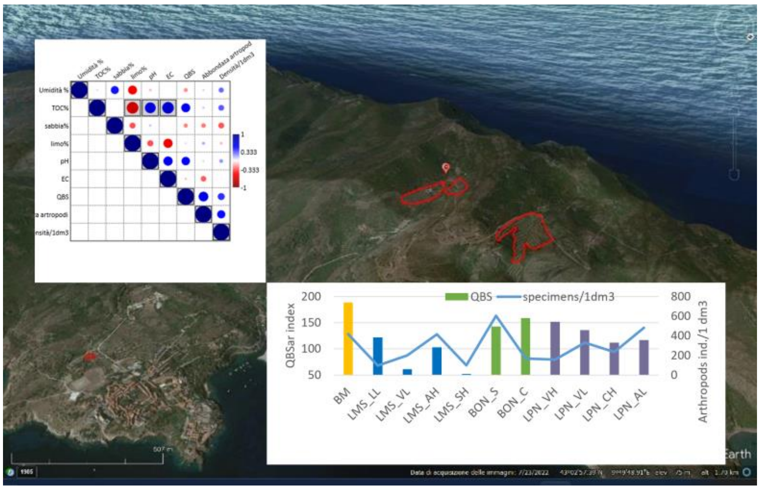
Recently in the Tuscan Archipelago, young winemakers recovered the historical terracing through the restoration of dry-stone walls and planting new vineyards with various cultivars (e.g., Ansonica). The risks that soil management practices could alter ecosystem services with negative implications on nutrient cycles, pH and water availability thus affecting vine health and productivity.
This study aimed to evaluate the capability of the agricultural practices adopted in terraced vineyards for maintaining natural soil functionality. In October 2022, ten different sites were selected in vineyards and one with Mediterranean shrubs as benchmark (BM).
Soil samples were collected in the vineyard inter-row, at 10 cm depth, for analyzing total organic carbon content (TOC); pH; electrical conductivity; micro- and macro-elements, texture; moisture and microarthropod abundances and Biological Soil Quality index (QBS-ar).
Since the sites are particularly rich in sand (42-70%), with a dominant Sandy Loam texture class (SL), all the soils have scarce available water capacity around 38 mm in the upper 30 cm. In 2022 the climate was extremely dry with precipitations of 350 mm, so even in October soil moisture and TOC averages were very low (<2%). This condition negatively affects the availability of nutrients for soil biota. Over 9,400 microarthropods were collected: the most abundant groups were Acari (74%) and Collembola (17%). The highest QBS-ar value (189) was in BM. The microarthropods' abundance was positively correlated with TOC and negatively with the silty soil component (Pearson similarity index; $p<0.05$). Conversely, soil moisture did not significantly influence arthropod communities, largely represented by xerophilic or mesophilic species. Moreover, the two-year vineyard sites negatively impacted the arthropod abundance and biodiversity. Vineyard plantation techniques in terraced landscapes need to be more conservative to preserve soil functionality and its ecosystem services. Improving soil functional biodiversity can help vine plants to naturally face climate change and times characterized by drought and high temperatures.



Keywords: terraced vineyards,microelements,QBS-ar,edaphic micro-habitat

ID ABS WEB: 138205

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

RESTORING SOIL ECOSYSTEM SERVICES WITH ENGINEERED SOILS

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Soil is a natural resource threatened by human activity. The process of soil restoration is expensive, time-consuming and requires careful planning and cooperation between different stakeholders and sectors. In densely populated regions such as Central Europe, there are two important types of artificial soil ecosystems: the restoration of landfills or mining pits and urban green infrastructure. The need for green spaces in urban areas, e.g. to mitigate the urban heat island effect, requires suitable engineered soils with specific chemical, physical, biological and geotechnical properties.

Engineered soils, made from excavated material and other waste, provide a solution for building the top layer that allows the restored ecosystem to function. These soils provide suitable conditions for plant growth and other ecosystem services. The study gives an overview of the application of engineered soils for the restoration of degraded land. The focus is on the different methods to ensure the proposed hydrological functionality of the soil. The application of engineered soils to target areas is a measure that restores soil functions and enables environmental protection by restoring top layer ecosystem services such as climate regulation, water filtration and storage, and food production.

Keywords: Engineered soils,Soil ecosystem services,Soil functions

ID ABS WEB: 138344

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

EFFECT OF BIOCRUSTS ON CARBON AND NITROGEN TRANSFER FROM WATER EROSION AND IMPLICATIONS FOR PLANT PERFORMANCE IN DRYLANDS

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Biocrusts are the living skin of dryland soils and frequently occupy the soil surface among vascular plants. Biocrusts control carbon (C) and nitrogen (N) fixation and nutrient transformations during large periods of the year in which vegetation remains inactive, thus playing a major role in C and N cycling in drylands. Nutrients fixed by biocrusts can be transferred to nearby plants through runoff redistribution processes and provide an extra contribution of resources that can be essential for vegetation in these water- and nutrient-limited environments. However, little is known about C and N transfer from biocrusts through water erosion and how this water and nutrient supply may affect vegetation performance. The objective of this study was twofold: i) examine biocrust effect on C and N transfer via water erosion; and ii) evaluate the effect of biocrust run-on (water and associated nutrients) on plant performance. Runoff was monitored after different rainfall events in bare- and biocrust-covered plots in a semiarid ecosystem from SE Spain (Tabernas desert), and total organic C and N exported in water and sediments were quantified. In addition, the effect of biocrust run-on on plant performance was evaluated by comparing plants (Machrochloa tenacissima) receiving and excluding this water and nutrient input. Our results show that dissolved organic C and N were higher in runoff from biocrust-covered plots, however total organic C and N losses were higher in bare plots due to the greater erosion rates recorded in these soils. Runon contribution from biocrusts had an important role in plant productivity. Plants which received water and nutrients from biocrust runon had greater photosynthetically active biomass and net C uptake rates than plants under runon exclusion. Our results highlight the importance of the resources provided by biocrusts (water, C and N) through water redistribution processes in the performance of vegetation from drylands.

Keywords: runoff redistribution,erosion,biological soil crust,nutrient export,semiarid

ID ABS WEB: 138348

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

THE NEED FOR SUSTAINABLE SOIL RESOURCES MANAGEMENT

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According to its natural characteristics, Serbia is predisposed to erosion processes. However, both worldwide and in Serbia, a large percentage of erosion processes are contributed by anthropogenic factors. The activity of man can be both negative and positive, depending on the degree of awareness of the importance of using natural resources on the principles of sustainability.

Preventing the degradation of torrential floods and erosion processes contained in the sustainable management of land resources, which includes the use of participatory methods. The paper presents the participation of the community in the management of natural resources (CBNRM – Community-Based Natural Resources Management), according to which the community becomes the primary implementer, with the assistance and under the supervision of professional services. The case of public participation in the sustainable management of land resources of Grdelica Gorge (South Serbia), shows the socio-economic and ecological approach of the local population.

This paper also presents a model of sustainable management of land resources, adapted to the conditions of hilly areas of Serbia, which includes the planning of production on sloping terrain from the aspect of land resources, then the needs of the population for certain localities particular production, and profitability of planned production. Regarding the ecological effects of the model of SLM, soil loss is reduced under the level of tolerance in the researched area. The economic effects of the established model of SLM, proved by Benefit-Cost Analysis, are on satisfactory to a significant level. These reasons are enabling people to stay and survive in these regions.

Keywords: degradation,sustainable management,environmental effects,economic effects,population necessity

ID ABS WEB: 136168

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

LINKING SOIL ORGANIC CARBON CONTENT TO SOIL COMPONENTS IDENTIFIED USING NONNEGATIVE MULTIVARIATE CURVE RESOLUTION OF MID-IR SPECTRA: A PHYSICOCHEMICAL MODEL

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Soil organic matter (SOM) is recognized to control soil properties and functioning. Accounting for SOM content and its compositional characteristics is essential for developing soil health indices. Mid-infrared (IR) spectroscopy is commonly used for relating soil IR spectral fingerprints to soil organic carbon (SOC) content, employing different mathematical techniques, in particular, such as partial least square regressions. Generally, developed mathematical models that link soil IR spectra and SOC content are empirical, and their interpretation is not necessarily simple. In this presentation, a new approach is proposed, whereby a physicochemical multi-component model, extracted from mid-IR spectra using nonnegative multivariate curve resolution (MCR), is linked to SOC content. This model explores (i) the potential of the nonnegative MCR to decompose IR spectra into contributions of chemically meaningful soil components each associated with a specific organic carbon (OC) content, and (ii) the Bouguer-Beer-Lambert law. Soil samples (216) were collected from different regions of Israel under different land uses and from two depths (0-10 and 30-60 cm). Mid-IR absorption spectra of each soil sample determined in KBr pellets were decomposed into the contributions from four components. Each component of the four identified represents an organo-mineral complex, such that the four components allowed reasonable representation of SOC content for SOC<1% w w-1. Above this threshold, a distinct failure of the model in representing SOC content was detected. The failure was interpreted as an indication that SOM becomes either enriched by a particulate fraction or the links between SOM molecules and mineral surfaces become more elusive, such that mineral fingerprints in IR spectra are less effective in indirectly representing SOM contribution. The underlying assumptions of the model and further perspectives of its use are discussed. An observed severe failure in the ability to predict SOC content above a certain SOC threshold can be very useful for detecting different fractions of organic matter in soil, with potentially different stability and contribution to SOC storage capacity.

Keywords: mid-IR spectra,multivariate curve resolution,SOC modeling,SOM storage capacity,decomposition

ID ABS WEB: 136298

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

THE MINERALOSPHERE – INTERFACE FOR MICROBE, MINERAL AND ORGANIC MATTER INTERACTIONS

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Interest in soil microhabitats has increased considerably leading to a better understanding of the interaction of soil microorganisms with their local environment. While the rhizosphere and detritusphere have already been very well studied, a microhabitat that remains largely unexplored is the mineralosphere. This microhabitat is the specific interface comprising mineral surfaces and the surrounding soil, which is physically, chemically and biologically influenced by minerals. In the frame of the Biodiversity Exploratories project (https://www.biodiversity-exploratories.de/en/) we performed a series of mineral exposure experiments to study the microbial colonization of goethite and illite in grassland and forest ecosystems under different land-use intensity for up to five years. In grasslands, fungi colonized minerals faster than bacteria and incorporated 13C labelled substrates into their biomass to a greater extent than bacteria. In forest soils, the fungal colonization of the mineral habitat was driven by taxa-specific preferences for the C- and nutrient-poor microhabitats. Fungal trophic guilds responded differently to the different types of secondary minerals with the ectomycorrhizal community being less affected by differences in organic matter (OM) sorption capacity between goethite and illite than the saprotrophic fungal community. Fungi likely contributed to the formation of mineral-associated organic matter. Land use influenced the input of OM and nutrients into the mineralosphere, and thus, the biomass, community structure, and functionality of mineral-associated microorganisms.

Keywords: mineral-associated OM,land use,microorganisms,ecoenzymatic stoichiometry,mineralosphere

ID ABS WEB: 136354

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

METHODS OF SOIL ORGANIC MATTER ANALYSIS IN FOREST SOILS

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The forest soils represent a useful reference system to test the analytical protocols aimed at analyzing the soil organic matter (SOM) characteristic and dynamic, based on the larger organic carbon (OC) content and the variable composition of organic inputs. The present study combines two different extraction methodologies with the detailed characterization of SOM fractions applied on two forest systems represented by Quercus ilex L. and Fagus sylvatica L.
The first approach is based on the conventional alkaline extraction of humic substances followed by the characterization of OM fractions performed by solid state 13C NMR and off-line pyrolysis GC-MS. A complementary extraction procedure relies on the sequential fractionation of SOM with the preliminary selective removal of various lipid fraction identified as an essential pool for the progressive stabilization of SOC and a useful tool to identify the main origin of SOM components. The main differences were related to a larger content of free lipid molecules of ilex-forest soil, while the beechwood samples revealed a larger amount of lignin derivatives and recalcitrant hydrophobic alkyl compounds The 13C-CPMAS-NMR spectroscopy of humic fractions indicated a selective incorporation of aromatic and alkyl compounds in soil under Fagus sylvatica, while the alkaline extracts from soil of Ilex systems showed a prevalence of polysaccharides and peptidic derivatives. The results of sequential fractionation showed that 33% of extractable OC from the system under Quercus ilex is concentrated in the free or unbound lipid fraction, while in the beechwood soil about 32% of total OC is represented chemically bound long chain aliphatic molecules from biopolyesters originated from root tissues. The predominance of recalcitrant aromatic and aliphatic organic molecules in Fagus system may be associated to the observed slower SOC turnover. The application of two complementary methodologies improves the evaluation of SOM composition and may provide a useful support to understand the SOC dynamic in agro and forest ecosystems.

Keywords: SOIL ORGANIC MATTER,ORGANIC CARBON,FOREST ECOSYSTEM,SEQUENTIAL FRACTIONATION OF SO,SOIL ORGANIC CARBON TURNOVER

ID ABS WEB: 136485

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

LAND RESOURCES DEGRADATION IN BANGLADESH: AN EMERGENCE ON CARBON-SMART FARMING

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Soil organic carbon (SOC) is an essential component for soil health and quality maintenance. To counteract nutrient mining, soil health should be prioritized to provide food security and ecosystem restoration. However, the level of SOC has been falling rapidly in Bangladesh's high and medium high land areas as a result of intensive farming methods and poor management. In Bangladesh, high and medium high land account for approximately 50% of agricultural areas utilized for intensive crop production, housing, settlements, brick fields, fishponds, settlements, and other facilities. As a result, higher lands are disappearing at an alarming rate, whereas SOC are also declining due to low residual input and greater cropping intensities with no fallow periods. Furthermore, most agricultural soil becomes excessively acidic due to overuse of chemical fertilizers and pesticides. Consequently, the physical fertility of the soil is deteriorating the agricultural production scenarios. Given these concerns, a study was carried out to compare the impacts of peanut residues on soil quality and bio-resource management to other green residues. It was found that over the course of a year, SOC and pH levels in peanut-treated soils increased to the required level. Thus, peanut residues are a valuable and necessary solution for enhancing soil quality in agricultural fields in Bangladesh or similar climatic zones. Therefore, sustainable soil management strategies, such as C-smart farming, should be considered as an essential option through conservation agriculture, the use of organic amendments, climate resilient cropping patterns, and soil intelligent approaches.

Keywords: land resources degradation,Smart-C farming

ID ABS WEB: 136725

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

SOIL ORGANIC MATTER QUALITY AND STABILITY IN AN OLIVE ORCHARD SUSTAINABLY MANAGED FOR 21 YEARS: INSIGHTS INTO LAND USE STRATEGIES AND CLIMATE CHANGE MITIGATION

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Among the current global challenges, the research of new practices aimed at mitigating soil impoverishment, exacerbated by the pressing climate changes, is the most urgent. Studying soil organic matter (SOM) dynamics and comparing the conventional intensive farming practices with the emerging alternative sustainable ones can represent a key indicator in soil health investigation, helping to find new guidelines for conservative agroecosystem management. In this study, the soil from a Mediterranean olive orchard, with both sustainable (Smng) and conventional (Cmng) land use for 21 years, was investigated for its physicochemical properties, with particular attention to OM from aggregates and its interaction and distribution in aggregates and depths. A higher amount of total carbon (+50.7%) and nitrogen (+74.9%), as well as of OM aromatic component (+76.0%), was detected in the first analyzed layer (0-5 cm) in the sustainably managed soils compared to the conventional one, a sign that the organic matter from surface deeply penetrates very slowly. This evidence was highlighted especially in micro-aggregates (<0.063 mm) (C = +59.3%; N = +86.7%; OM aromatic component = 87.7% in the Smng), likely due to their capacity to bond more easily the smaller colloidal particles with a higher specific surface. This trend is also reflected in an increase in bacterial abundance and in a different accumulation of organic compounds deriving from microbial fermentation processes in Smng soils, as highlighted by the OM qualitative characterization. The soil mineralogical analysis showed that minerals maintained a higher crystallinity in Smng than in Cmng, where soil tillage promoted their alteration. Moreover, Fourier-transform infrared (FTIR) spectroscopy analysis highlighted that soil disturbance due to the Cmng can affect SOM stability, also creating different spatial distributions in the particle aggregates and soil depths. Distinguishing SOM quality, stability and interaction with mineral components can help to understand its degradability and dynamics, both essential for mitigating the effects of climate change and promoting land protection.

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Keywords: Carbon storage,Land use,Soil metabolomics,Soil mineralogy,Soil sustainable management

ID ABS WEB: 136827

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

CONTRASTING SEQUESTRATION CHARACTERISTICS OF SOIL ORGANIC CARBON IN PADDY AND UPLAND SOIL FROM SOUTHERN CHINA TYPICAL RICE TERRACES

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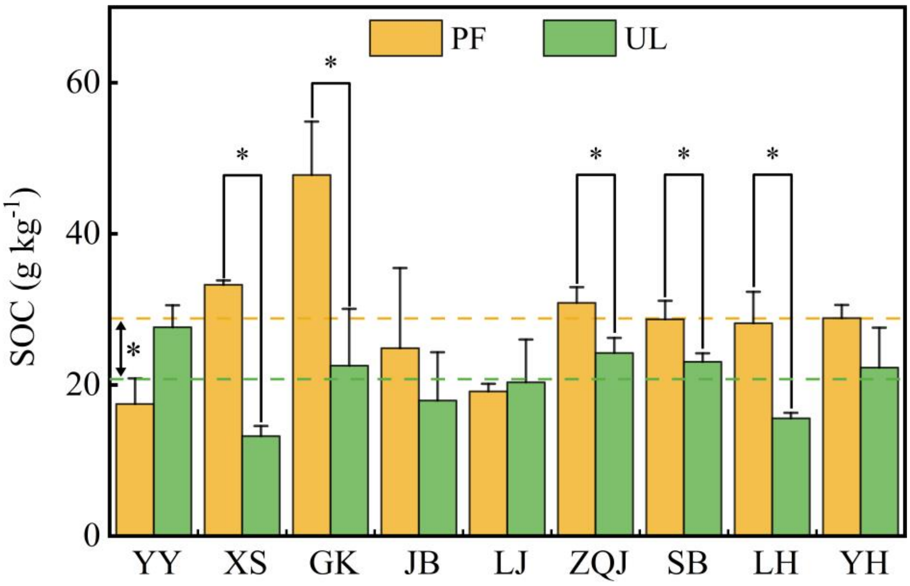
Soil organic carbon (SOC) sequestration capacity and the underlying mechanism under long-term sustainability agro-management is the frontier of basic research of sustainable agriculture. Rice terraces in the mountainous areas of southern China have been recognized as globally significant agricultural heritages. Investigating their SOC accumulation under rice cultivation over a millennium scale would be advisable for establishing nature-based solutions for SOC sequestration in rice agriculture. This study selected nine representative rice terrace systems from mountainous areas in southern China. Undisturbed topsoils (0-20 cm) from three paired adjacent paddy and upland fields were collected respectively from these nine terrace paddies. By quantifying the plant (lignin phenol)- and microbial (amino sugar)- derived C in soils, we identified that SOC accrual was achieved via contrasting pathways in paddy and upland soils. Paddies were 27.9% more efficient in SOC sequestration than their adjacent upland counterparts, with greater differences in clayey soil than sandy soils. Upland soils were more enriched by microbial-derived C, whereas paddy soils were replenished with a greater proportion of plant-derived C. Moreover, the composition, community structure, and activity of microorganisms differed between paddy and upland soils, due to the anaerobic conditions induced by the waterflooding in paddy soil, which affected the decomposition and sequestration efficiency of organic carbon by microorganisms in the two soils. Hence, as anthropogenic wetlands, rice terrace systems play a vital role in preserving global soil carbon stocks and alleviating climate change by conserving and enhancing their carbon storage.



Keywords: soil organic matter,SOM molecular composition,SOM pool distribution,ancient rice terraces

ID ABS WEB: 137516

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

SOIL ORGANIC CARBON DYNAMICS AND P LEGACY IN LONG-TERM MANAGED AGRO-ECOSYSTEMS ACROSS EUROPE

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The assessments of soil organic carbon (SOC) in agro-ecosystems is crucial to evaluate carbon (C) sequestration potential in agricultural soils and guide management strategies. The interaction among soil C, nitrogen (N), and phosphorus (P) plays pivotal role in soil organic matter (SOM) dynamics, but also the nutrient availability in agro-ecosystems influence SOM cycling and C storage. Despite this, the impact of P fertilizer addition on C and N cycling remains largely unexplored.
Hence, to determine the influence P fertilization has on SOC stabilizations in agricultural systems, ICONICA project is investigating a unique set of long-term P fertilizer experiments (LTEs) across Europe, including a range of P treatments to establish relationships between P legacy and C sequestration. In this study, soils up to 50 cm depth were collected from six LTEs distributed across Europe including different soil types, land uses and agricultural management regimes. The objective of the work was to provide initial reference value of soil C stored at depth across P treatments. Furthermore, this study investigated C pools partitions within soil particles across managed sites to assess the C stored in mineral-associated soil fractions (MAOM). The average SOC stocks in arable (AR) sites ranged between 21.22±1.19 to 18.60±2.35 (tC/ha). Higher SOC stocks occurred in the grassland (GR) sites ranging from 54.76±6.65 to 43.07±5.71 (tC/ha). The majority of SOC was associated to the subsoils (10-30 cm) in AR and to the top soils (0-10 cm) in GR. For both AR and GR sites, the MAOM fraction accounted for higher associated SOC compared to particulate organic matter (POM) within coarse (cPOM) and fine (fPOM) fractions, perhaps with indicative differences among land uses. Overall P legacy has a variable effect on C storage across different land uses. Preliminary results will be presented to elaborate the role of P management in different agro-ecosystems and to understand its effects on C cycling, highlighting the optimal soil and P management scenario for SOC storage.

Keywords: Soil organic carbon,Soil organic matter,Carbon sequestration,Agriculture management,Soil fractions

ID ABS WEB: 137735

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

EFFECTS OF LONG-TERM SOIL ORGANIC MATTER DECLINE ON SOIL NUTRIENT STATUS AND ORGANIC MATTER COMPOSITION IN ORGANICALLY MANAGED GRASS-CLOVER LEY AND PERMANENT PASTURE IN NORWAY

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Grasslands are often seen as a beneficial measure to increase soil organic matter (SOM) content in croplands and reduce GHG emissions. In permanent grassland continuous ground cover and high root density protect the soil against erosion, leading to an accumulation of SOM. In cultivated grasslands, such as grass-clover leys, the nutrient cycle encompasses an accumulation phase during the ley period, followed by a rapid decomposition after ley termination. Upon ploughing the grass-clover ley, there is an increased mineralization of nutrients, contributing to soil fertility buildup. As part of the global C-arouNd project, which aims to investigate how short and long-term agricultural management practices affect SOM persistence, we want to investigate how long-term SOM decline affect the soil nutrient status and organic matter composition in a permanent and cultivated grassland in West Norway.
At Tingvoll experimental farm, organic milk production was established in 1986, replacing the previous conventional sheep farming. Since 1990, soil samples (0-20cm) have been taken every 5–7-year for determination of SOM and soil fertility status. Grass-clover yields have been annually measured since 1991. Preliminary analyses show a decline of SOM (ignition loss) in the 0-20cm toplayer. On average in the cultivated grassland, SOM concentration declined from 14.0% and 7.9% in 1990 to7.4% and 6.4% in 2021. In the permanent pasture the losses of SOM content were smaller: on average SOM decreased from 10.2%to8.0%.
We hypothesize that fields with the largest decline in SOM over the past decades will contain relative more stable carbon components while also being richer for most macronutrients. Nutrient imbalances can lead to stronger SOM turnover, meaning that there have not been reached a steady state yet and a further decrease in SOM content can be expected. To test these hypotheses, soil samples will be taken in 2024 to study macronutrients and SOM composition in more detail. SOM composition will be examined using a thermal fractionation method on the different size fractions of the soil.

Keywords: Grasslands,SOM decline,Nutrients

ID ABS WEB: 137898

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

ENCAPSULATION OF HAZELNUT BIOWASTE LIGNIN/HYDROXYAPATITE ORGANO-MINERAL NANOPARTICLES INTO ELECTROSPUN NANOCOMPOSITES FOR THE FABRICATION OF STABLE SOIL-LIKE (MICRO)AGGREGATES

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The depletion of soil organic matter (OM) is a pressing issue affecting many cultivated areas due to changes in land use and intensive farming methods. These changes lead to carbon level reduction, driving soil degradation, decline in soil quality, and erosion. They also influence soil greenhouse gas emissions/absorption, depending on soil management, thus affecting global warming. Hence, it is imperative to mitigate carbon losses.
Using biowastes as OM amendments is a promising approach for restoring degraded soils that aligns with the bioeconomy concept of transforming waste material into valuable resources. However, typical OM amendments undergo short or medium-time degradation, even when organic C is stabilised (compost). Consequently, they often fail to increase soil C stock stably. Hence, more stabilised and protected forms of organic-C are required.
In natural soils, OM stabilisation and protection from decomposition occur by two mechanisms based on the combination of an organic phase with an inorganic component: i) physical exclusion upon aggregate formation of organic and inorganic particles held together mainly by biopolymers, thus hampering the access of microorganisms to OM and ii) chemical bonding of OM with soil minerals causing mineral-associated organic matter (MAOM) formation.
In this study, we aimed to recreate stable organo-mineral aggregates by mimicking both the strategies above and the particulate and fibrous characteristics of the natural organo-mineral aggregates. In detail, organo-mineral complexes based on hydroxyapatite-lignin (HPL) nanoparticles obtained by the wet-chemistry route were then encapsulated into polymer nanofibrous networks through electrospinning nanotechnology. Besides, such nanostructured hybrid composites recruited lignin obtained from agro-industrial biowastes. Nanofibrous architectures of tunable size from the nanoscale to the macroscale were finally generated to form aggregates for OM amendments.
The novelty of this study resides in employing a technologically advanced approach that, hiring agro-industrial biowaste, recreates artificially soil-like micro- to macro-aggregates characterised by prolonged stability of the organic moiety used, thus reliably increasing soil C stock, mitigating carbon losses, improving soil quality in sustainable agriculture.

Keywords: Soil Carbon Sequestration,Organo-Mineral Associations,Advanced Technologies to SOM,Soil Stability Mechanisms

ID ABS WEB: 137905

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

REVEALING THE STABILITY OF ENHANCED SOIL CARBON POOLS BY PERENNIAL GRASS AND LEGUMES AND THE CONTRIBUTION OF MICROBIAL NECROMASS

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Perennialization and integrating legumes in cropping systems are believed to be effective strategies for agricultural soil carbon (C) sequestration. In alignment with this, based on a 10-year experiment in Denmark we previously found increased topsoil C stocks in perennial grass festulolium (PG) and grass-legume mixture (GL) compared to maize monoculture (MM). However, the stability of the increased C and the underlying mechanisms remain unrevealed. Particulate organic matter (POM) mainly includes partially decomposed plant litter and exudates and is usually considered a labile C pool, while mineral-associated organic matter (MAOM) consists of a large proportion of microbial residues (e.g., necromass) that can persist for decades to centuries with multiple protection mechanisms. To further identify the dynamic of different C pools (i.e., POM and MAOM) and reveal the contribution of microbial necromass carbon (MNC), we examined the distribution of C between POM and MAOM and quantified the MNC in POM and MAOM in the three cropping systems (PG, GL, and MM) across 1 m soil depth. We hypothesize that: 1) PG and GL increase POM-C over MM in topsoil (because of less soil disturbance) and subsoil (because of high plant organic inputs); 2) MNC contributes to half of the MAOM-C but occupies little proportion in POM-C; 3) GL increases MNC over PG across 1 m depth (because of the inputs with lower C:N ratio). Our study aims to enhance the current understanding of the role of microbial necromass in soil C sequestration and provide new insights into agricultural soil C sequestration by regulating plant C input and microbial turnover.

Keywords: soil organic carbon,microbial necromass,POM,MAOM,perennial grass

ID ABS WEB: 137916

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

THE ROLE OF THE SOIL ORGANIC MATTER STABILITY ON THE SORPTION PROCESSES OF ORGANIC MICROPOLLUTANTS

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The continuous accumulation of organic micro-pollutants (OMPs) in the agricultural environment can increase environmental impacts. Their behaviour in soils is mainly affected by soil organic matter (SOM). Since these compounds have an influence on soil microbiota, these also have a feedback effect on SOM.
Therefore, our research aims to reconstruct the competitive adsorption and desorption processes of three PhACs and their metabolite (Carbamazepine (CBZ), Trans-carbamazepine (TCBZ), 17L-ethynylestradiol (EE2), 17B-estradiol (BE2), 17L-estradiol (LE2), Estrone (E1), Estriol (E3), Diclofenac-sodium (DFC), 5-Hydroxydiclofenac (5-HDFC)), considering the transformation of SOM. We supposed that PhACs as substrates would increase microbial enzyme activity, whereas the DKL and CPX would decrease it as incubation progresses.
A series of 90-day incubation experiments were performed, in which soils were pretreated with defined concentrations of OMPs (listed pharmaceuticals, fungicide (difenoconazole (DCL)) and antibiotic (ciprofloxacin (CPX)). The adsorption and desorption processes were modelled on pretreated samples at different time points using continuous fixed-bed column experiments. Microbial activity and soil parameters were also monitored.
Experimental results show that enzyme activity increases in the initial incubation phase in soil samples treated with PhAcs, PhACs+DKL and PhACs+CPX. However, enzyme activity decreases in all treatments at the end of incubation. The sorption results also show similar dynamics, with a decrease in the adsorbed amount at the end of the incubation period (e.g. EE2 at 14. days 0.858 μg/g to EE2 at day 48 days 0.370 μg/g). By reducing the activity of some microbial and fungal strains, the activity of other strains increased during the initial incubation phase, which promoted the transformation of OM and thus reduced potential sorption sites. OMPs in the environment can, therefore, increase microbial activity, which can accelerate the transformation of OM in the soil.
The study was funded by Hungarian Scientific Found (project no. K142865) and ELKH (Project no SA41/2021).

Keywords: Micropollutants,Difenoconazole,Ciprofloxacin,Fix-bed experiment,Phaeozem

ID ABS WEB: 137959

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

UNSTABLE GEOGENIC CARBON CONTROLS ORGANIC CARBON STOCKS AND DYNAMICS IN MEDITERRANEAN CROPLAND SOILS

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Although soil organic carbon (SOC) is a key element for soil health and climate change mitigation, our understanding of its dynamics is still incomplete. In general, it is thought that the vast majority of SOC in deep soils comes from roots and plant litter and that it is very stable because it is preserved in the mineral phase. The present study aimed to investigate the common paradigm of high stability of SOC in deep soil horizons in semiarid Mediterranean cultivated environments. Here we show that, contrary to expectations, SOC biodegradability increased with depth, indicating that subsoil SOC is potentially less stable than topsoil SOC. We further observed that SOC biodegradability was strongly positively correlated with its radiocarbon age, implying that SOC stability decreases with increasing mean residence time. We explained these original counterintuitive results by a significant contribution of geogenic organic carbon, which proved to be both very old and highly biodegradable, in a context of very low inputs of organic carbon via net primary productivity and amendment restitution. This study highlights the great vulnerability of the millennia-old organic carbon pool stored in deep Mediterranean soils and, more broadly, the key role of geogenic organic carbon in carbon cycle studies.

Keywords: Soil organic carbon (SOC), Carbon biodegradability, Radiocarbon age, Geogenic carbon, Mediterranean soils

ID ABS WEB: 138024

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

HYDROXYL GROUPS PROMOTE THE STABILIZATION OF SOIL LIPIDS: INSIGHTS FROM CASE STUDIES TO THE GLOBAL SCALE

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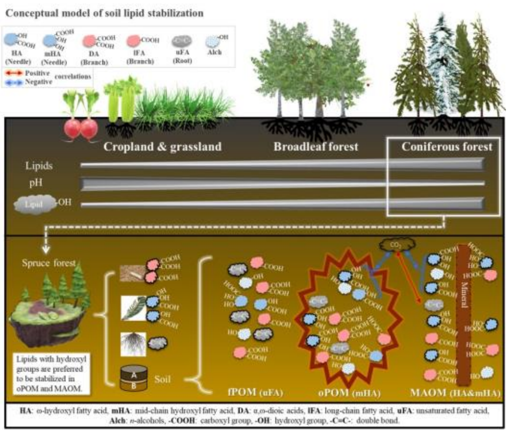
Soil lipids are an important fraction of organic matter (OM) and play a crucial role in soil organic carbon (SOC) sequestration. However, the origin, fate, and molecular properties of soil lipids are not yet well understood. Such insights are crucial to constrain SOC cycling under changing climate and/or land-use conditions, as well as the information gathered from lipids as biomarkers. For this, we performed a global synthesis of lipid distribution regulated by environmental factors using published nuclear magnetic resonance (NMR) data, as well as case studies to investigate stabilization mechanisms of soil lipids at the molecular level using a combination of density fractionation and pyrolysis-gas chromatography/mass spectrometry (Py-GC/MS).

Based on the collected data, coniferous forests had a greater portion of soil lipids than grassland or cropland. The lipid distribution patterns among different land-use types seemed to be regulated by soil pH values. In a case study of coniferous soils (lipid-rich), compounds with hydroxyl groups were more likely distributed in aggregate-occluded OM and mineral-associated OM than in free particulate OM, whereas weighted abundances of the hydroxyl group in aggregate-occluded and mineral-associated OM were negatively correlated to SOC mineralization rates. This suggests that the hydroxyl group is likely to promote lipid stabilization in aggregates and associated with mineral surfaces. This finding was further supported by a smaller contribution of hydroxyl lipids in a case study of grassland/cropland soils (lipid-poor). The results suggest that the presence of hydroxyl groups promotes lipid stabilization in coniferous forests, and may explain the lipid accumulation among different land-use types at the global scale. We also propose that plant-derived lipids rich in hydroxyl groups can be directly stabilized by interacting with soil aggregates and minerals, in addition to the current paradigm that microbial necromass is preferentially stabilized with mineral surfaces.



Keywords: global synthesis,molecular composition,functional group,aggregate,mineral surface

ID ABS WEB: 136250

4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

RECOVERY RATE AND SURFACE PROPERTIES ASSESSMENT OF UV-AGED AND PRISTINE MICROPLASTIC FROM SILT LOAM AND SANDY SOILS IN GERMANY

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Numerous approaches exist to sample, extract and detect microplastics (MP; 0.001- 5 mm) from the soil environment. However, knowledge about the recovery rates of aged particles, as the most abundant plastic particle type in soil, is still very limited. Besides, pristine and UV-aged MP are likely to behave differently in the environment due to their different surface properties. Therefore, we aimed to set up a systematic laboratory protocol to detect and compare the recovery rate of UV-aged and pristine MP and assess the associated changes in physicochemical properties of the MP particles related to ageing and sample treatment. For this purpose, an experiment was conducted by adding pristine and UV-aged MP particles (exposure time 35 d) of polyethylene terephthalate (PET) and polystyrene (PS) at three sizes (S: <500 µm, M: 500-630 µm, L: 630 µm-1000 µm) to a sand and a silt loam soil at a concentration of 0.5 % w/w. The MP particles were extracted from soil samples by filtration using high-density solutions, followed by an H_2O_2 treatment to remove organic matter from the samples. The recovered MP was quantified gravimetrically. The recovery rates of pristine and UV-aged particles were the same for both PS and PET, with no significant differences between the different soil types. The changes in physicochemical properties after UV-treatment and after subsequent recovery were analyzed by Fourier-transform infrared (FTIR) spectroscopy, Nile red staining, and contact angle measurements to examine to which degree ageing and extraction altered the polymer properties. An increase in contact angle of MP particles after recovery in UV-aged samples was observed, highlighting the need to consider the ageing effects when assessing their environmental interactions (e.g., mobility). The impact of H_2O_2 treatment varied between UV-aged and pristine ones, in which the surface properties of recovered UV-aged samples were re-altered. In conclusion, the examined recovery method proved effective for both pristine and UV-aged MP across all size fractions and textures.

Keywords: Pristine MP,UV-aged MP,Recovery,Quantification,Physiochemical properties

ID ABS WEB: 136476

4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

DETECTING EARLY LDPE BIODEGRADATION BY USING FT-IR AND RAMAN SPECTROSCOPIES

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Low-density polyethylene (LDPE) mulch films are widely used in agriculture, accounting for over 40% of all plastics used. However, their large-scale use and improper disposal have resulted in a high residue quantity in the soil, ranging from 72-259 kg/ha. The plastic residues degrade at an extremely slow rate, leading to their accumulation in all environmental compartments. This study aimed to evaluate the ability of the fungal species isolated from plastic debris collected in two distinct agricultural fields to grow and decompose LDPE in a laboratory setting. The degradation of LDPE was evaluated using micro ATR-FTIR, Raman, and SERS spectroscopies, as well as SEM.
Our results showed that out of the 47 fungal isolates obtained, only 11 were able to grow and colonize the LDPE film. After a 90-day trial, only one isolate of Cladosporium cladosporioides (Clc/1) was able to initiate the degradation of the LDPE film. The FTIR and Raman spectra showed a significant decrease in the relative intensity of the methylene group bands after Cladosporium cladosporioides Clc/1 growth. Similarly, the SERS spectra of LDPE confirmed the decrease in methylene group bands and the emergence of other bands associated with the LDPE polyphenolic mixtures. Finally, SEM analyses revealed the presence of small cavities and circular-shaped depressed areas in the tested LDPE samples, confirming the early degradation process of this material. In conclusion, the early stages of LDPE degradation can be explored using ATR-FTIR, Raman, and SERS spectroscopies in combination with SEM techniques, without the need for any sample pretreatment.

Keywords: Microplastic,LDPE,biodegradation,Vibrational spectroscopy,fungal degradation

ID ABS WEB: 136630

4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

RETENTION AND ABRASION OF MICROPLASTIC FIBERS IN POROUS MEDIA

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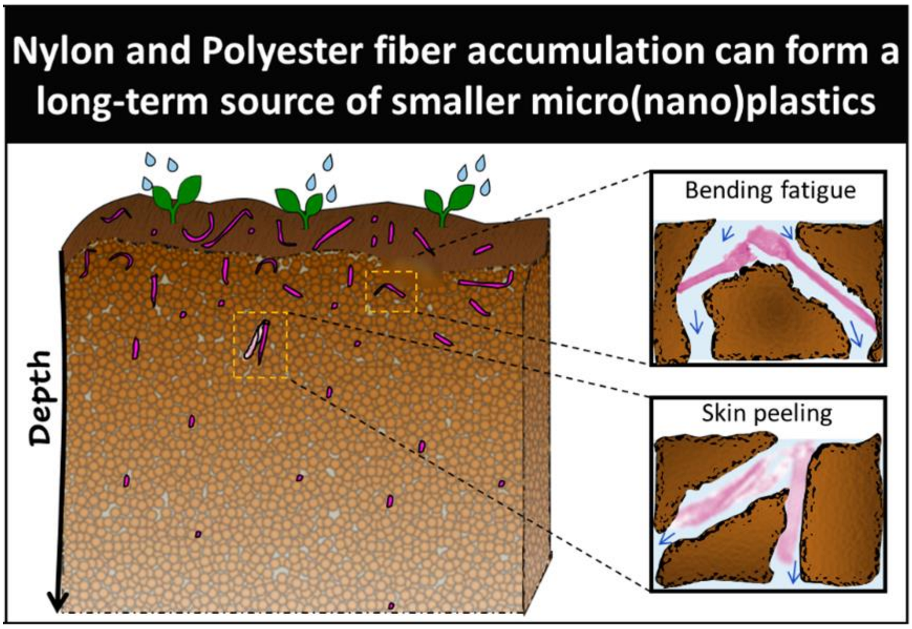
The reuse of sludge in agriculture practices introduces high amounts of microplastic (MP) fibers originating from synthetic textiles; however, little information is available on their fate in soils. In this study, we established a novel protocol enabling precise slicing of common textile fibers, polyester and nylon, to relevant environmental sizes and characterized their transport in sand columns. The fibers were highly retained even under unfavorable retardation. Smaller fibers were slightly more mobile, and nylon showed marginally higher mobility than polyester fibers. Some fibers peeled and split as they flowed through the soil pores, forming thinner, shorter and more mobile fibers.
We then delved deeper to characterize the transport and retention behavior of polypropylene fibers from an N95 mask using a porous microfluidic cell under a microscope. We discovered that not only fiber length but also its curvature influences its ability to move and tumble through a porous medium. Additionally, retained fibers at pore throats caused significant changes in the flow paths.
Overall, our results suggest that in agricultural settings, the mobility of microplastic fibers is negligible and will lead to their continuous accumulation in the soil. However, MP impacts on the soil environment may change with time due to MP fragmention, which will increase their mobility and may lead to ground water pollution.



Keywords: microplastics,microfibers,transport,retention,abrasion

ID ABS WEB: 137218

4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

INNOVATIVE BIO-BASED MULCHING FILMS AFFECT SOIL MICROBIAL BIOMASS, ACTIVITY AND NUTRIENT DYNAMICS

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Plastic mulching films are widely used in agriculture for enhancing crop productivity and weed control. However, their impact, due to non-biodegradable materials like polyethylene, is of growing environmental risk. Indeed, these films can persist in the soil for several years after use, contributing to plastic pollution and contrasting sustainable agricultural. Therefore, the development of biodegradable, eco-friendly alternatives is critical. The PRIN Mulching+ project aiming to make innovative bio-based mulching films using carboxymethyl-cellulose, chitosan, and sodium alginate, and enriched it with N and P salts acting as slow-release fertilizer. The purpose of this study was to evaluate the degradation of these innovative films after burial in the soil,i.e. their impact on the dynamics of available N and P, and on the microbial biomass, community and activity, in order to evaluate their suitability as alternatives to conventional plastic films. Four film types, varying in chitosan-cellulose ratios and $NH_4H_2PO_4$ addition, were tested. The experiment involved burying 0.1%(wt%) of the film in pre-wetted soil, to simulate the field conditions. Soil samples were collected 30, 60, 90 and 120 days after burial to estimate soil MBC and MBN, inorganic N and available P, as well as the composition and abundance of the main microbial groups and 5 enzymatic activities. The ammonium, nitrate and phosphate levels were influenced by the presence of $NH_4H_2PO_4$.A notable increase in MBC and MBN was observed 30 days post burial. Lipase activity, indicative of polymers degradation, increased with films presence. Carbon cycle-related enzyme activities rose proportionally to MBC increases, and increased levels of N-acetyl-ß-glucosaminidase in soil were observed in correlation with the use of films containing higher amounts of chitosan. Notably, films addition, especially those $NH_4H_2PO_4$-enriched ones, led to increased fungal relative abundance and reduced gram-positive bacteria by the incubation end.
These results are promising for the use of these innovative films in agriculture. Ongoing work aims to trace soil C fate and identify the degrading microbial groups using 13C-labeled films.

Keywords: Bio-based mulch,Sustainable agriculture,mulching films,Microbial community,Soil nutrient dynamics

ID ABS WEB: 137322

4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

SOURCES AND FATE OF BIODEGRADABLE PLASTICS IN AGRICULTURAL SOILS

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Since the 1950s, the use of plastics in agriculture has helped solving many challenges related to food production, while its persistence and mismanagement has led to the plastic pollution we face today. Soils are no exception and concentrations of polyethylene mulch debris up to 380 kg/ha have been reported in Chinese agricultural soils. Biodegradable plastic products have thus been developed to solve plastic pollution through complete degradation after use. But the environmental conditions for rapid and complete degradation are not always fulfilled, and the risk that biodegradable plastics could also contribute to plastic pollution must be evaluated.

Here, we want to share the knowledge gained through research projects on biodegradable plastics, where we studied the degradation of biodegradable mulch under Nordic soil conditions, and the fate of biodegradable plastics in two major soil amendments: compost and biogas digestate.

A two-year field experiment with biodegradable mulch buried in soil in mesh bags showed that also under colder climatic conditions does degradation occur, involving fragmentation already after 2 months, but that complete degradation may take 3 to 9 years, depending on soil temperature and soil organic matter content (both correlate positively with degradation rate). Accumulation is therefore likely to happen when biodegradable mulch is repeatedly used every year.

A full-scale experiment with compostable plastic cups at an industrial composting plant, where we followed their fate and conducted metagenomic analysis over 13 weeks, demonstrated the major role played by fungi during degradation. However, the successful management of biodegradable plastic products largely depends on existing waste management infrastructure. Most biodegradable plastic bags, labelled as compostable and used for food waste collection do not end up in industrial composting plants in Norway, but in biogas production plants. Here, we showed that these plastic bags are only marginally degraded during biogas production, and likely to end up in biogas digestate and then in soils, unless digestate is treated to remove plastic residues.

Keywords: Agricultural soils,Biodegradable plastics,In-situ degradation,Compost,Biogas digestate

ID ABS WEB: 137363

4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

EFFECTS OF OF HIGH-DENSITY POLYETHYLENE (HDPE) MICROPARTICLES ON PHYSICAL, CHEMICAL AND BIOCHEMICAL SOIL PROPERTIES IN 2-YEARS FIELD TRIAL.

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Microplastic contamination, an emerging problem affecting both aquatic and terrestrial ecosystems, is due to the difficult degradation of plastic materials and their progressive fragmentation driven by various environmental agents. Since the impact of microplastics on soil is still unclear, this work aimed at evaluating the impact of different quantities [0 (CTR), 1, 2 % v/v] of 1-0.25 mm HDPE particles on physical, chemical, and biochemical properties of the A horizon of a soil developed from fluvio-lacustrine sediments and classified as Typic Ustorthent (Soil Survey Staff, 2014). A field experiment was arranged in the experimental station of the DSA3-University of Perugia (Italy), according to a randomized complete block layout with four replicates for each treatment. The monitoring lasted about 2 years, during which the CTR and treated plots were sampled periodically and CO_2 fluxes from the soil to the atmosphere were measured. The CO_2 soil emissions in the treated soils with 2% microplastics were generally lower than the soils treated with 1% and CTR from about 3 months after the addition of microplastics to the end of the trial. This trend could be attributed in the short term to a decrease in microbial abundance, expressed as the sum of all EI-FAME biomarkers, and in a longer period (6 months after HDPE addition) to an improved energy resource use efficiency by the microbial community of the soil treated with the highest dose of microplastics, as suggested by CO_2-C:Cmic and CO_2-C:Cext ratios. Among the tested enzymes involved in the C cycle, β-cellobiohydrolase, α-glucosidase, and β-xylosidase activities have shown a significant increase between treated and CTR soils in the latest samplings carried out.
The results of this 2-year field experiment would indicate that the physical and chemical properties of the soil did not change significantly after the HDPE particle addition, while the activity and abundance of the microbial community seem to be affected by the presence of microplastics.

Keywords: HDPE particles,CO2 emission,field trial,enzymatic activities,EI-FAME analysis

ID ABS WEB: 137684

4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

EFFECT OF BURNINGS ON MICROPLASTICS COMBUSTION AND FRAGMENTATION IN A MEDITERRANEAN FOREST ENVIRONMENT

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Microplastics (MPs) accumulation is recognized as one of the main environmental issues in terrestrial ecosystems and in soil, which is considered the largest global pool of MPs. However, scientific evidence on the abundance, distribution and characteristics of MPs in soil are still insufficient, particularly in forest soils, which are less investigated by far than agricultural and horticultural sites. Mediterranean forests frequently experience wildfires; therefore, MPs deposited on the forest floor are likely to be subject to them. MPs subjected to high temperatures may be combusted and fragmented into smaller pieces. Furthermore, thermal processes can change the properties of plastics that may react differently within soil matrix.
This study aims to evaluate the effect of fire burning on the mass loss and composition of MPs particles (<5 mm) lying on the forest soil surface. To this end, we simulated several fires under controlled conditions by placing 10 plastics polymers, different in composition or shape, inside metal meshes placed under the litter of a typical Mediterranean pine forest. The residual ashes were further analyzed using 10 different techniques to find the most promising digestion and separation methods to isolate MPs.
The results showed that some polymers and shapes were more sensitive to fire. Polyethylene terephthalate (PET) pellets lost over 70% of their mass, while polyethylene (PE) pellet and fibers lost 59% and 75% of their mass, respectively. The greatest resistance to combustion was showed by styrene-butadiene rubber (SBR), which lost 27% of its mass. The second step of the experiment aimed to assess how much of the polymers were combusted and how much was fragmented into ash. However, none of the methodologies used were sufficiently effective in isolating the MPs as the organic fraction of soil interfered with both the density separation and oxidation techniques. In conclusion, wildfire could be both a driver in the MPs removal from soil and/or a driver of MPs spreading into smaller particles within the soil matrix.

Keywords: Microplastic degradation,Mediterranean forest soils,Wildfires,FTIR spectroscopy

ID ABS WEB: 137972

4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

DOES THE PRESENCE OF MICROPLASTICS IN SOIL INCREASES THE UPTAKE OF INORGANIC POLLUTANTS BY CROP PLANTS?

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As one of emerging contaminants, microplastics (MPs) can enter the environment and adsorb toxic compounds thereby causing potential environmental and health risks. One of the concerns about microplastic presence in soil is that MPs can act as vectors of heavy metals modifying their mobility and bioavailability to soil organisms and plants. Due to increasing deposition of plastic into the environment the risk related to presence of microplastic and its impact on crop quality and yields should not be omitted. In the present study we investigated the interaction between four types plastic wastes found in the soils as microplastics (fibers, glitters, fragmented plastic bottles and plastic bags) on the uptake and accumulation of six potentially toxic elements (Cd, Co, Zn, Cu, As, Pb) by lettuce (Lactuca sativa L.). Soil for the experiment was collected from 50-100 cm depth, from the area of the copper smelter in SW Poland. Research was conducted under controlled conditions in the phytotron to minimize the risk of additional soil and plant pollution from air. Results of the study showed a very diverse effect of microplastics presence in soil on heavy metal uptake by lettuce. The effect depended on MPs' form. The presence of smaller particles like glitter and fiber (~1mm) had a greater impact compared to larger microplastic fragments derived from plastic bottles and bags, more often indicated in increased/decreased uptake of the tested metals. The effect also depended on metal e.g. for Cu indicated content in lettuce was lower when MPs was present in soil, opposite for Pb, Cd and As showing increase of metal(oid) content in plants. Moreover microplastic presence had greater impact on the root system and more significant changes were observed for the root zone, suggesting that MPs presence in soil may bring a bigger risk of root crops contamination.

Keywords: microplastics,pollutant vectors,soil health,heavy metals,crop safety

ID ABS WEB: 136320

4. Soil health in achieving the Sustainable Development Goals
4.32 133791 - Soil Research Towards Disaster Risk Reduction

NEW APPROACH TO DESIGN DISASTER RISK MANAGEMENT POLICY OF DEBRIS FLOW AND FLASH FLOOD IN THE MOUNTAIN REGION

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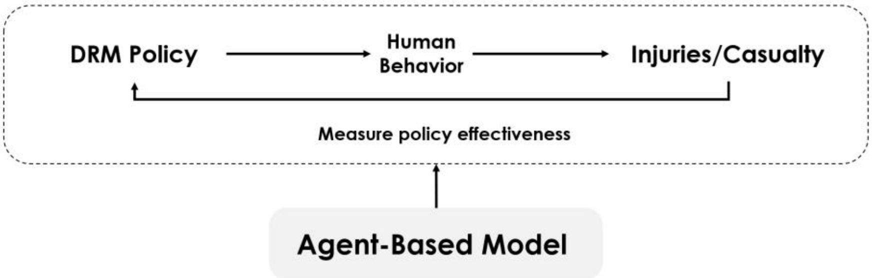
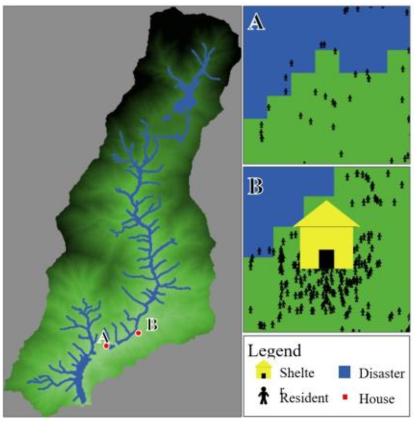
Debris flow is one of the most problematic soil-related hazards that could lead to catastrophic events when they occur near human settlements. Various DRR (disaster risk reduction) policies have been set up to reduce its negative impact. However, DRR policy design and implementation lack an evidence-based evaluation process. This study aimed to evaluate the effectiveness of some of the most adopted DRR policies, including setting up early warning systems, constructing disaster shelters, and providing incentives for evacuation. A policy evaluation model was developed by integrating debris flow processes and human behavior by coupling Flo-2d with agent-based modeling (ABM). The model was calibrated to simulate the DRR policy implementation in a real debris flow event in China. The main findings are: 1) setting up an early warning system was the most effective measure and fundamental of community-based disaster risk management as the system had contributed to a 30.06% casualties reduction in this case; 2) individual perception of DRR policies was at large variance which influenced the policy effectiveness; 3) marginal benefits of policies to raise public willingness might decrease quickly. Therefore, individual perceptions and behaviors significantly impact the effectiveness of DRR. This study provided an evidence-based approach to the policy-makers to formulate the most cost-effective DRR policies.





Case No.	Scenarios	Parameter		Casualties
1	**813 event (Baseline)**	Without EWS (situation in 2013)		481
2		With EWS		337
3	**EWS**	EWS credibility	1	368
4			2	343
5			3	339
6			4	328
7			5	321
8	**EWS + Shelters**	Walking distance to shelter	< 10min	315
9			< 30min	337
10			< 60min	324
11			> 60min	335
12		Facilities conditions (attraction)	no	346
13			few	354
14			some	335
15			many	320
16	**EWS + Incentive plans**	Allowance	5 CNY	330
17			20 CNY	328
18			50 CNY	323

Keywords: debris flow,disaster risk reduction,policy evaluation,risk management

ID ABS WEB: 136475

4. Soil health in achieving the Sustainable Development Goals
4.32 133791 - Soil Research Towards Disaster Risk Reduction

MULTIDISCIPLINARY STUDY OF SOIL FEATURES AS POTENTIAL TRIGGERING FACTORS OF SHALLOW LANDSLIDES. A CASE STUDY IN CENTRAL CALABRIA, SOUTHERN ITALY

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In this work we aimed at assessing whether and how key soil properties may act as control factors of shallow landslides (flows and complex slumps/slides-flows) on marly and silty clay terrains of a stream catchment in Calabria, southern Italy. We applied a multidisciplinary methodological approach, including geological, geomorphological, pedological and geophysical surveys, drone acquisition of relief features, multitemporal analysis of satellite images, mapping of major landslides occurred during the last twenty years using GIS, morphological field description and horizon-wise sampling of representative soil profiles for subsequent laboratory analyses. Laboratory activities included traditional pedological analyses for the determination of physical and chemical soil properties (particle size distribution, organic and inorganic carbon, pH, electrical conductivity, cation exchange capacity, exchangeable bases, soluble salts, clay mineralogy), coupled with some geotechnical analyses (bulk density, specific gravity, total porosity, Atterberg limits). The soils of the study area are Regosols and Calcisols, in places showing stagnic properties (due to transient waterlogging conditions) or protovertic properties (caused by cyclical shrink-swell dynamics). They are poorly developed soils, truncated by water-driven erosion and shallow landslides, as confirmed by the lack of surface A horizons, dominance of BC and CB horizons, low organic matter content, alkaline to strongly alkaline soil reaction. The liquid limit was mostly in the range of 40-60% and the plasticity index between 10%-20%, which are consistent with a dominance of illite, kaolinite and/or smectite clay minerals, and occasionally traces of chlorite or vermiculite. Based on the values of soluble salts and exchangeable bases, where Ca or Na cations prevailed, the sodium adsorption ratio and the exchangeable sodium percentage were calculated and used as indicators of clay dispersivity. They interestingly showed higher values in deep horizons than in corresponding topsoils (similar to other chemical and rheological properties), suggesting that such subsoil layers might have been affected by an easier mobilization directly caused by their higher dispersive, liquid, and plastic behavior, thus leading to the triggering of shallow landslides.

Keywords: Shallow landslides,Soil features,Pedogenic processes,Pedological analyses,Geotechnical analyses

ID ABS WEB: 136973

4. Soil health in achieving the Sustainable Development Goals
4.32 133791 - Soil Research Towards Disaster Risk Reduction

SHALLOW LANDSLIDING OF ABANDONED AGRICULTURAL TERRACES

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Agricultural terraces in the form of cut-off ditches, hillside ditches, intermittent terraces, bench terraces, broad-based terraces, vineyards, and orchard terraces, were built to protect steep sloping lands against soil erosion and produce soil and drainage conditions for vegetation. Historically these modifications were the ones that provided one of the most consistent soil conservation measures on extended areas. In the Moldavian Plateau, Northwestern Romania, these agricultural terraces were built extensively after 1950, especially in the low hilly areas, as the main soil conservation measure. After 1990 these agricultural terraces were abandoned, not being maintained anymore, very often with their land cover changed to pasture. Although the national regulation did not allow their construction over landslide areas, there are many areas where these terraces were built over old or recent, small or big landslides. We investigated using old aerial imagery and LiDAR data the landslides that appeared after terrace construction and we tested several scenarios regarding their triggering. Because the agricultural terraces are shallow, also the landslides are predominantly shallow, and their density is higher for the areas where the terraces were built over previous landslides. The unavailability of multitemporal historical aerial imagery does not allow us to build a multi-temporal landslide inventory and establish if there are temporal frames when the frequency of landsliding was higher. In the context in which these landslides were predominantly triggered by rainfall events that generated water saturation in the shallow layer of disturbed material used for terrace building, we also used numerical modeling for establishing rainfall thresholds that will be tested in the future. At the present level of knowledge about the shallow landsliding of agricultural terraces, we show that the hot spots are represented by the abandoned terraces built over older big landslides.

Keywords: shallow landslides,agricultural terraces,abandonement,LiDAR,landslides inventory

ID ABS WEB: 137626

4. Soil health in achieving the Sustainable Development Goals
4.32 133791 - Soil Research Towards Disaster Risk Reduction

HYDROGEOLOGICAL CHARACTERIZATION OF VINEYARD STEEP SLOPES TROUGH A MULTIDISCIPLINARY SURVEY, FOR SHALLOW LANDSLIDES SUSCEPTIBILITY ESTIMATION.

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Vineyards cultivated in steep terrains are widespread all over the world and they are the main landscape element as well as the main economic activity of many territories. Steep vineyards can be affected by several problems, as well as shallow slope instabilities, triggered by very intense thunderstorms or prolonged rainy periods. Shallow landslides can provoke severe damages to vineyards, leading to a general loss of fertility and biodiversity in the soil horizons. A characterization of the slopes where vineyards are cultivated becomes fundamental, in order to assess potential unstable conditions and to better understand the possible effects of different inter-row managements, in the probability of occurrence of slope instabilities. The aim of this work is to present a multidisciplinary method for shallow slope instabilities susceptibility estimation in steep terrain vineyards, performed following different steps: i) preliminary characterization of the slope geological, geomorphological and hydrogeological settings through UAV surveys, electrical resistivity tomography, soil trenches and soil water content monitoring ; ii) assessment of grapevine root density and reinforcement in inter-rows with different soil management (e.g. conventional tillage or sustainable solutions); iii) application of a simplified probabilistic model for the assessment of the probability of occurrence of shallow slope instabilities in correspondence of different soil managements. This approach was applied in different test-sites located in Oltrepò Pavese and Piacenza Province (northern Italian Apennines), two important Italian wine districts very prone to water stress and slope instabilities. The results of this work can allow to recognize conditions leading to shallow failures in vineyards cultivated in steep terrains, highlighting the positive role of soil managements.
This conference abstract is part of the project NODES which has received funding from the MUR – M4C2 1.5 of PNRR funded by the European Union - NextGenerationEU (Grant agreement no. ECS00000036).

Keywords: Hydrology,UAV_survey,Shallow_landslides,Geophysical_investigatons,Geotechnical_analyses

ID ABS WEB: 136318

5. Soil in the circular economy
5.01 133614 - Soil needs in industrial agriculture and highly populated areas

FERTILISING POTENTIAL OF DRIED ANAEROBIC DIGESTATE FROM SLAUGHTERHOUSE BY-PRODUCTS

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Circular economy models aim at minimizing the resource consumption through recycling, remanufacturing and reusing materials. Thus, converting biodegradable organic wastes into renewable energy would keep the highest utility and value of the productive processes. The slaughterhouse and meat industry are worldwide rapidly growing and generate billions of tons of biological wastes annually. These excess materials can be used to produce biogas in digesters and the resulting anaerobic digestate represent a potential source of organic carbon and nutrients that could be applied to the soil as organic fertiliser.
The present work aimed to evaluate the fertilising potential of a dried anaerobic digestate (DD) produced from beef slaughtering waste. DD was firstly characterized and compared with other organic fertilisers, indicating its potential application to the soil. Further, a short-term soil incubation experiment was performed on two different soils, with a dose based on 100 mg/kg of nitrogen (N) for each fertiliser. After the incubation DD released 10-26% of their total N and 13-16% of total phosphorus (P), with different kinetics depending on the soil that had different physico-chemical characteristics and responded differently to the treatments. Biochemical indicators such as extractable carbon (C) and N, microbial biomass C(MBC) and enzymatic activities were analysed after the incubation. DD increased extractable N of 20-30% in each soil, more than the other organic fertilisers even with minor effects on extractable C or MBC. However, DD also increased chitinase and phosphatase activity, indicating a stimulated microbial activity regarding N and P cycling. Moreover, the presence of recalcitrant C forms, in spite of soluble C, indicated the higher stability of DD after digestion instead of the other organic fertilisers.
These findings suggested a positive effect on the soil fertility of DD application, raising the concrete possibility to use these by-products as organic fertilisers. Moreover, this work states that the characterization and the evaluation of chemical and biochemical soil parameters would allow the prolific recycle of slaughterhouse by-products.

Keywords: Soil, Soil Enzymatic Activity, Anaerobic Digestate, Slaughterhouse Wastes, Sustainable Fertiliser

ID ABS WEB: 136869

5. Soil in the circular economy
5.01 133614 - Soil needs in industrial agriculture and highly populated areas

BIOCHAR AND CAMELINA SATIVA (L. CRANTZ) IN MARGINAL LAND FOR LOW-ILUC BIOFUEL PRODUCTION

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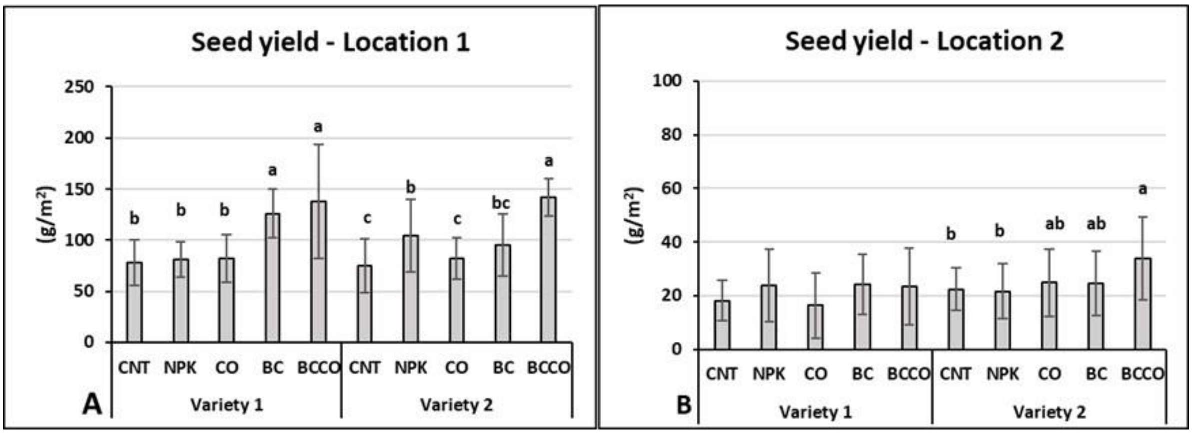
Biochar is recognized as a sustainable agricultural management practice by the EC Implementing Regulation 2022/996 on low-ILUC requirements for sustainable biofuels. In this experiment, biochar was used as a soil amendment (alone or mixed with compost) for the cultivation of Camelina (Camelina sativa L. Crantz), a promising alternative crop for sustainable oil production, well adapted to grow under low rainfall and in marginal soils. Hence, the combination of Camelina and biochar presents several desirable traits for deployment in regions prone to desertification.
The experimental design involved the comparison of different treatments, in 2 locations: i) only biochar (3 ton/ha) (BC); ii) only compost (20 ton/ha) (CO); iii) compost (20 ton/ha) + biochar (3 ton/ha) (BCCO); iv) only NPK fertilizer (133 kg/ha) (NPK); v) control treatment (without fertilizer or amendment) (CNT). All plots except CNT were equally fertilized with NPK (with 133 kg/ha).
The effect of soil amendments varied depending on the location. In Location 1, an improvement in physical characteristics (bulk density, porosity, and water availability) was observed in plots amended with biochar-based treatments. Also, despite the low nitrogen introduce in the BC treatment, soil solution explored by plant roots in these plots was richer in nitrates, suggesting a lower nitrogen leaching rate.
The highest seed yields were obtained in the presence of the biochar and compost mix (BCCO) for both varieties in the two locations (Figure 1). In detail, the use of biochar and compost produced an increase in seed yield of 54% and 34% at locations 1 and 2, respectively, compared to all other treatments.
These results show that 3 tons/ha of biochar (with mineral fertilization) may be sufficient for enhanced seed and oil yields compared to the use of 20 tons/ha of compost, especially in fields characterized by light and sandy soil.
Therefore, it is crucial to optimize the biochar usage protocol (alone or in combination with compost), considering soil initial characteristics.



Keywords: Biochar, Camelina sativa, Low-ILUC biofuels, Marginal lands, Nature Based Solutions

ID ABS WEB: 137110

5. Soil in the circular economy
5.01 133614 - Soil needs in industrial agriculture and highly populated areas

SURPLUS SOILS: REALISING BENEFICIAL CHARACTERISTICS TO ENABLE SUSTAINABLE REUSE

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We defined ‘surplus soils’ as soils that have been disturbed through land and infrastructure development or natural processes (e.g. slips, silt/sediment), and are unable to be beneficially reused on-site. In New Zealand, these soils are often ‘lightly contaminated’, meaning contaminant (namely trace element) concentrations exceed background soil concentrations, but are below applicable human health or environmental protection thresholds. These soils present a low risk to human health and environmental quality, although their reuse is challenged by current regulations, and a lack of data on their nature and quantity . Surplus soils management in New Zealand currently has a lack of soil science/scientist involvement. Instead, management is dominated by geotechnical and contaminated land practitioners. Consequently, onsite use and reuse considerations typically focus on structural qualities and contaminants, and overlook many beneficial characteristics of these soils. As a result, most surplus soils are disposed of in landfill without consideration of opportunities to minimise their generation or beneficial reuse, leading to negative environmental outcomes and incurring high disposal costs. Drawing on international examples of sustainable management of ‘surplus’ or ‘excess’ soils, we have produced a guidance document that recommends steps to improve management of these soils. At the heart of the recommendations presented are the needs for enhanced soil science input, and the incorporation of te ao Maori (indigenous) perspectives, into surplus soils management. Practical next steps include filling information gaps on surplus soils being generated, establishing principles for a surplus soil sustainable management framework, and addressing regulatory and logistical challenges associated with the sustainable management of these soils. Ultimately, urban soils hold cultural and productive/life-supporting values that are currently not recognised, and consideration of soil resources is absent from current land and infrastructure development processes. Redesigning and rethinking current design and development pathways, adopting a circular economy approach, would lead to improved outcomes for both stakeholders and environmental quality.

Keywords: urban development, beneficial reuse, indigenous perspectives, trace elements, excess soils

ID ABS WEB: 138310

5. Soil in the circular economy
5.01 133614 - Soil needs in industrial agriculture and highly populated areas

RESTORING SOILS WITH ORGANIC SOIL AMENDMENTS; A CASE STUDY IN GEITASANDUR, SOUTH ICELAND.

P. GUPTA

University of Iceland, Reykjavik, ICELAND

Soil is a limited global resource, and it is threatened by anthropogenic activities like erosion, infertility from excessive use of chemical fertilizers and desertification that is amplified by climate change. This research analysed soils and subsequent data from a revegetation study by the Soil Conservation Service of Iceland and aimed to address the effects of various soil amendments on soil properties and vegetation cover. Four organic soil amendments including municipal waste, bokashi, chicken manure, and bonemeal were compared to two application rates of chemical fertilizers and a control. Methods involved i) analysis of soil samples for pH, soil organic matter, C/N, and available carbon; ii) vegetation surveys measuring vegetation height and vegetation cover in 2021 and 2022; and iii) a tea-bag index study to investigate decomposition rates in soil. Soil pH was significantly higher in bonemeal plots than in plots where higher dose of chemical fertilizer was applied. For 2021, grass cover and vegetation height were significantly greater in chemical fertilizer plots than the control. Two years post application (2022), vegetation cover was significantly higher for plots with chemical fertilizer, bonemeal, and chicken manure than the control. Decomposition rates did not vary among the treatments, but the litter stabilisation factor was significantly higher for chicken manure than in the control and bokashi plots. Organic soil amendments like chicken manure and bonemeal can be alternatives to chemical fertilizers. This study is an important step for reducing waste and achieving circular economy by restoring soils using locally sourced organic soil amendments.

Keywords: organic soil amendments, soil restoration, waste reuse, circular economy, Icelandic soils

ID ABS WEB: 136175

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

SOIL MAPPING WITH A LIMITED NUMBER OF SAMPLES BY COUPLING EMI AND NIR SPECTROSCOPY IN HAZELNUT TREE ORCHARD

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Precision agriculture relies on high-detail soil maps to optimize resource use. Traditional soil proximal mapping methods, such as EMI sensing, require a certain number of soil sampling and laboratory analyses to predict maps of soil characteristics. VIS-NIR and NIR diffuse reflectance spectroscopy offer rapid and low-cost alternatives, allowing for increased datapoints and better map prediction accuracy.
The aim of this work is to test and optimize a methodology for high-detail soil mapping in a hazelnut grove of approximately 4 ha, located in Corte Migliorina farm (Southern Tuscany, Italy), using both EMI proximal sensor and NIR handheld spectrometer. The maps of ECa obtained by EMI provided the pattern of soil spatial variability. Only 5 topsoil samples (Ap horizon, 0-30 cm) were collected for laboratory analysis, following the maximum variability of ECa and elevation. In addition, other 40 topsoil samples (0-30 cm) were collected by a regular grid and used for NIR spectroscopy to increase the number of datapoints within the study field.
The spectrometer used for this work was the Neospectra Scanner (Si-Ware Systems, Menlo Park, USA), a low-cost NIR spectrometer (1350-2500 nm) based on MEMS (micro-electromechanical systems) technology.
Partial Least Square Regression (PLSR) using a national spectral library, augmented by the 5 local samples analyzed, was used to predict clay, sand, organic carbon (SOC), total nitrogen (TN), and cation exchange capacity (CEC). The 40 datapoints with predicted soil variables were used for spatial interpolation, using ECa map, elevation, and DEM derivatives as covariates. Two methods of interpolation were tested: Universal Kriging (UK) and Regression Kriging (RK). The errors of predictive maps were calculated by 5 additional points analyzed by conventional laboratory analysis. RK and UK showed similar accuracy, with lower prediction errors for SOC and clay ($R2>0.8$) and slightly lower for TN ($R2>0.5$). Low accuracy was calculated for sand and CEC mapping.

Keywords: Spectroscopy, Precision Agriculture, Clay, Soil Organic Carbon, Electrical Conductivity

ID ABS WEB: 136221

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

CAPSURE VS SCIENTISTS: SOIL COLOR IN HUMAN PERCEPTION AND AUTOMATIC DEVICE RECOGNITION

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The development of remote sensing technologies started a new stage of research on the diversity of soil cover on a local scale. Low-altitude photogrammetry carried out with unmanned aerial vehicles (UAV) is a modern attempt to determine the extent and degree of erosional alteration of soil cover based on soil color and landform.
The study focuses on the color of soil samples of surface horizons of soils from young glacial areas of northern Poland and aims to compare the classical manual soil color tests, the results obtained from orthophotomaps and the tests of soil samples in the laboratory conditions using the Munsell CAPSURE Color Matching Tool Portable Spectrocolorimeter which automatically determines the color of a given surface. Presented results are intended to compare the possibilities of soil color determination, their validity and objectivity.
Determination of colors according to the Munsell Scale has so far been carried out manually, which involves the risk of error due to subjective feelings towards the color. In addition, the color measurement is influenced by the light source (natural - the angle of incidence of sunlight, artificial - the power and shade of light), air pollution and other weather condition. The study aims to check the variability of color perception among employees and students of universities with varying degrees of soil science knowledge. The color of identical soil samples was determined by professors, doctoral students and groups of first-cycle students.
Implementation of the CAPSURE device on an academic scale requires a series of tests to establish the compliance (or non-compliance) of the obtained results with field measurements, determination of the soil color in a subjective manner and calculation of the pixel colors of a given resolution on the orthophotomap. Comparing the results of soil color from three different sources involving CAPSURE device is an innovative approach to research on soil color and soil properties.

Keywords: soil color, soil erosion, soil spectrocolorimeter, UAV photogrammetry, Munsell CAPSURE

ID ABS WEB: 136698

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

PREDICTING SOIL FERTILITY WITH INTEGRATED USB MICROSCOPE-BASED SOIL IMAGING, AUXILIARY FACTORS, AND PORTABLE X-RAY FLUORESCENCE SPECTROMETRY

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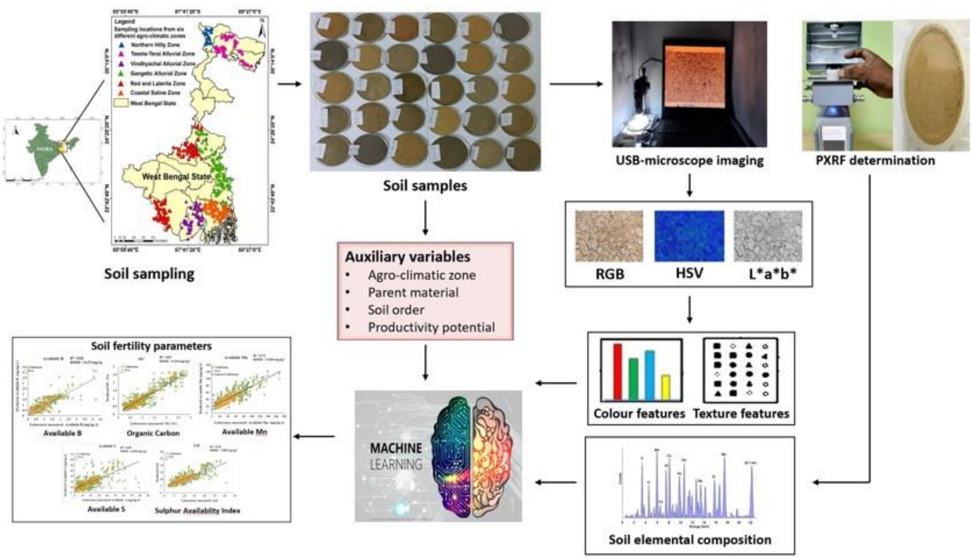
The potential of portable X-ray fluorescence (PXRF) spectrometry sensor for rapid assessment of plant-available soil nutrients remains underexplored, as critical parameters like organic carbon (OC), available S, available B, and sulfur availability index (SAI) cannot be directly measured by PXRF. In contrast, soil image analysis has mainly focused on differentiation of soil texture and organic matter. This study encompassed 1133 samples across Eastern India's diverse agro-climatic zones, and utilized the combined power of color and image texture features from USB microscopic soil images (IFs), PXRF data, and auxiliary soil variables (AVs), deploying random forest (RF) modeling to predict five important soil fertility parameters (OC, available S, available B, available Mn, and SAI). In total, 231 IFs were extracted, comprising 204 textural and 27 color features. Textural features were extracted from the gray level co-occurrence matrix and gray level run-length matrix of individual color channels [Red (R), Green (G), and Blue(B)] while color features were derived from the hue, saturation, and value (HSV) and L*a*b* color spaces, along with RGB images, yielding mean, median, and standard deviation values for each channel. Principal component analysis revealed links between soil color variables, agro-climatic zones, and parent materials. Notably, integrating AVs with IFs greatly improved prediction accuracy, as demonstrated by robust R^2 values of approximately 0.80 for available B and 0.88 for OC. Available Mn and SAI benefited from a data fusion approach (IFs + AVs + PXRF), yielding R^2 values of 0.72 and 0.70, respectively. The correlation between residuals of RF predictions using (IFs + AVs) and RF-predicted values from PXRF data alone indicated improved prediction results, especially for available Mn. These findings underscored the potential of this proposed approach for rapid soil testing, offering cost-effective alternatives to traditional analyses and promising advances in soil health and fertility understanding.



Keywords: USB Microscope, Image Processing, PXRF, Random Forest, Soil Nutrients

ID ABS WEB: 137119

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

RAPID AND COST-EFFECTIVE SOIL ELEMENTAL ASSESSMENT USING NIX PRO COLOR SENSOR

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This study explores a rapid and economical approach to assess soil elemental content utilizing the Nix Pro colorimetric sensor. The research involved collecting representative soil samples from diverse agricultural fields within the Southwestern USA (New Mexico), establishing and validating predictive models for soil iron content. The Nix Pro color sensor, known for its cost-effectiveness, was employed in conjunction with color space models to create three distinctive parameter sets for iron prediction. The investigation resulted in the development of three new predictive models for soil iron content, with each model based on a different color space representation—CIELab, RGB, and CMYK. These models were compared against lab-based inductively coupled plasma analysis of iron content. Key performance metrics, including the coefficient of determination, root mean square error, and model p-value, were used to assess the predictive capabilities of each model. Notably, the CIELab, RGB, and CMYK models exhibited significance in predicting iron content, achieving coefficient of determination values ranging from 0.79 to 0.81. To validate the models, mean square prediction error (MSPE) and Kling–Gupta efficiency (KGE) Index were computed. The CMYK model emerged as the superior performer, with an MSPE of 0.13 and a KGE of 0.601, surpassing the CIELab and RGB models. The findings underscore the efficacy in rapidly and inexpensively predicting soil total iron content using NixPro. The use of colorimetric variables, especially with the CMYK model, highlights the potential for practical applications in soil analysis. The research contributes for generic investigations into soil properties, demonstrating the broader implications of this cost-effective technology in the field of soil assessment.

Keywords: prediction model, in-situ measurement, colorimetric, spectral sensing

ID ABS WEB: 137316

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

ADAPTATION OF VEGETATION INDICES FOR VINEYARDS USING REMOTE SENSING AND GROUND-TRUTH MEASUREMENTS

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Vegetation indices from remote sensing provide rapid and diverse information on the health and condition of vegetation. The aim of the present study was to investigate the usability of vegetation indices for vineyards while using ground-truth measurements for comparisons. The study sites were two vineyards one with silt loam (BCS) and one with clay soil texture (GB), located on 8-15% angled slopes in a small agricultural catchment in Balaton Upland, Hungary. Both vineyards were covered with perennial grass between rows.
The field monitoring system worked in 2020 and 2021. The monitoring system collected Soil Water Content (SWC), Normalized Difference Vegetation Index (NDVI), Photochemical Reflectance Index (PRI), and Photosynthetically Active Radiation (PAR) data at the upper and lower positions of both vineyard slopes. Leaf Area Index (LAI) was measured every two weeks during the vegetation periods. Concurrently with the field measurements we collected spectral data from Sentinel-2 (S2) and used to calculate different spectral indices.
The two different vineyard sites with grass inter-row allow us to compare the applicability of the vegetation indices. A moderately strong correlation was found between NDVI of field measurement and satellite NDVI ($r=0.62$). We found a stronger correlation between different sources of NDVI data for BCS than GB. Both sources of NDVI were significantly different for GB and BCS samples ($p<0.05$). PRI values for all study sites were weakly correlated, while LAI showed a moderate correlation with Red Edge bands in GB measurement points. SWC data was significantly different for GB and BCS ($p<0.05$). Overall, we found that the reliability of vegetation indices can be significantly improved by regular ground-truth measurements.

Acknowledgments: This material is based upon work supported by the Hungarian National Research Fund (OTKA/NKFI) project OTKA FK-131792. The research presented in the article was carried out within the framework of the Széchenyi Plan Plus program with the support of the RRF 2.3.1 21 2022 00008 project.

Keywords: remote sensing, vegetation index, viticulture, monitoring, ground-truth measurement

ID ABS WEB: 137337

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

UNDERSTANDING WITHIN-FIELD NITROGEN USE EFFICIENCY VARIATION USING PROXIMAL SENSING, FIELD OBSERVATIONS, AND MACHINE LEARNING

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Nitrogen (N) fertilizer input is a major decision farmers make to boost their crop yield. A better understanding of N use efficiency (NUE) can help farmers reduce N loss and off-site environmental impacts, and potentially increase farm income. N-fertilizers and their crop yield response have been studied but less has been understood about within-field NUE variations. Our objectives were to (i) quantify grain protein content using a NIR spectrometer (ii) derive NUE using yield, grain protein, and field observations, (iii) map NUE using apparent electrical conductivity (ECa), topography, and machine learning, and (iv) divide the field into NUE zones for precision management decisions. The study was conducted in nine corn fields in Riesel, Texas in 2023. Corn yield and grain protein content were measured using a combine equipped with an NIR spectrometer to monitor grain protein content. NUE was calculated from grain yield and its N content, N-fertilization, and soil N observations. A random forest model was trained to predict NUE where ECa and terrain attributes were used as covariates, and the model was evaluated on 25% of data not used in model training. Each field was divided into four NUE zones using k-means clustering (Low, Low-mid, Mid-high, and High-efficiency zones) that could be used for site-specific N-management decisions. Corn yield and gross margin (revenue – input cost) from the zones were compared across fields and zones. The ECa and topography explained up to 57% of variations in NUE. The maps showed that the fields were highly variable in NUE. For example, almost all areas of the 6-12 field and >60% of the SW-16 field had Low NUE whereas, >75% area of the Y-10 had Mid-High to High NUE. We will test the usefulness of remote sensing data as predictors of NUE in the future. Results from this study will help farmers optimize N-applications for economic and environmental benefits.

Keywords: precision agriculture, nitrogen fertilization, grain quality, random forest

ID ABS WEB: 137802

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

DELINEATION OF PEATLAND AREAS BASED ON DRONE-BORNE RADIOMETRIC SURVEYS AND UNSUPERVISED LEARNING

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Peatlands are carbon-rich landscapes that contain one-third of the global soil carbon (C) pool. Their capability to either sequester or release C into the atmosphere depending on the management practice, renders them important for climate action. Climate change mitigation efforts such as the rewetting of drained peatland areas are among key strategies to reduce CO2 emissions globally. In Denmark, there is a national goal to reduce the Danish CO2 emissions by 70% in 2030; this includes rewetting 100,000 ha of the peatlands drained earlier for agricultural production. However, accurate knowledge of the location and extent of peatland areas is necessary to accomplish this. Delineating peatland boundaries based on conventional mapping is not only laborious and time-consuming but may lead to inaccuracies due to lesser sample size. Optical sensors might perform well in some scenarios, but they fail especially in those peatlands which are covered by non-peat forming vegetation due to commercial crop production. Here, UAV-borne gamma-ray radiometric surveys may be useful for rapid, cost-effective, and accurate delineation of peatland areas due to the unique attenuation behavior of peat. In this study, we present preliminary results where we assessed the seasonal suitability of performing such surveys along with the influence of different survey heights and flight speeds. The radiometric data were clustered separately using the Density-based spatial clustering of applications with noise (DBSCAN) and the clustering results were validated with ground truth measurements of peat thickness. We show that accurate delineation of the peatland boundaries is possible at various flight altitudes with different line spacing and is more importantly season unspecific. The results have implication for proper C accounting and effective planning of peatland rewetting activities.

Keywords: Peatland, Unsupervised learning, Peatland boundary

ID ABS WEB: 137805

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

MAPPING OF DANISH PEATLANDS USING PROXIMAL SOIL SENSING

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Peatlands are important Carbon (C) reserves and they provide a wide range of ecosystem services. Over the years, draining their water table to meet energy and agricultural needs has led to increased release of greenhouse gases (GHGs) and dissolved C loss contaminating potable water, thus turning them into C-sources. Globally, different initiatives are put forward to safeguard, properly manage, and restore the peatlands to reduce GHG emissions and enhance C sequestration. However, a comprehensive characterization of peat inventory providing details on the spatial extent, thickness, and water table levels is required to accomplish this. The conventional methods involving handheld probes and boreholes are labor-intensive and provide only localized and discrete measurements. Proximal soil sensing methods provide an effective alternative solution. In Denmark, we are testing the suitability of electromagnetic induction (EMI), ground penetrating radar (GPR), and gamma ray radiometric on-the-go methods across a variety of peatland types, especially for estimating peat thickness. Electrical resistance tomography is being used along dedicated transects for controlled experiments. While EMI proved superior in a minerotrophic fen, GPR provided unequivocal results in an ombrotrophic bog. Gamma-ray sensing is not only suitable for delineating the peatland boundaries but can provide insights into the peat thickness gradient. Our results suggest that no single technique is a silver bullet and the sensor choice should be based on the knowledge of the peatland type. If unsure, we recommend performing EMI surveys ahead of GPR surveys for optimal cost benefit. This is because EMI can also be very useful in predicting the GPR success rate. Future work entails developing fully drone-borne sensors for improving scale and accessibility.

Keywords: Peat mapping, Climate change, Carbon, Soil sensing, Near surface geophysics

ID ABS WEB: 137827

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

MACHINE LEARNING APPROACH USING MULTIPLATFORM DATA FOR PRECISION AGRICULTURE SYSTEMS

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Within a vineyard, the intricate interplay between plant water status and soil variability shapes the vineyard's productivity and qualitative response. The soil's physical attributes, exhibiting heterogeneity both horizontally and vertically, influence the soil water balance, leading to non-uniform responses within the vineyard. Proximal sensing emerges as a valuable tool in gauging apparent soil electrical conductivity (ECa) throughout the growing season, providing insights into the nature of spatial variability. This information not only facilitates viticultural microzoning, enabling the identification of Homogeneous and functional Homogeneous Zones (HZs and fHZs), but also supports field experiments.
We propose a machine learning approach that functions as a predictive model for soil ECa. This approach utilizes discrete measurements obtained from a network of Time Domain Reflectometry (TDR) probes, capable of quantifying ECa, to spatially predict ECa values across the surveyed area. The methodology enables the efficient management of resources and enhances crop productivity by providing farmers with a comprehensive understanding of soil conditions.
This approach was tested on Greco di Tufo grapevines (white) in southern Italy, employing a combination of data sources: soil and atmosphere system records, in-vivo plant monitoring of eco-physiological parameters in 2020 and 2021, and spatial variability of plant status monitored through UAV multispectral images. Apparent EC measurements were obtained using a PROFILER EMP 400 in both dipole modes and with three different frequencies (5, 10, and 15 kHz), enabling the exploration of various soil depths.
The predictive model exhibited remarkable performance, with results aligning well with existing knowledge of the area. This highlights the potential of this approach to revolutionize vineyard management practices, leading to improved resource utilization and enhanced crop yields.

Keywords: Machine Learning, UAV, Monitoring, Precision Agriculture

ID ABS WEB: 137903

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

A COMPREHENSIVE REVIEW OF PROXIMAL ELECTROMAGNETIC SENSORS' ACCURACY AND COST CONSIDERATIONS FOR SOIL PROPERTY PREDICTION AND MAPPING

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Proximal soil sensors (PSS) are used to efficiently characterize soil properties from point to farm/field scale and reduce the need for cost- and labor-intensive soil sampling and laboratory analysis for creating high-resolution maps. They enable rapid means for soil characterization and monitoring of soil properties, providing tools to make informed decisions aiming at the improvement of productivity, soil health conservation, and mitigation of environmental impacts. A framework for selecting the most suitable PSS method for mapping a specific soil property based on expected accuracy and associated costs is lacking. Within the ProbeField project, we are reviewing the accuracy of electromagnetic PSS in estimating specific soil properties and quantifying associated costs. Moreover, we discuss cost and accuracy variation when using multiple techniques simultaneously. The lack of information on costs in the literature caused us to perform a market analysis through questionnaires directed to companies, a unique aspect of this study. Our review hopes to be a guide for professionals, academics, and other end-users in PSS.
We reviewed a total of 209 studies. The normalized root-mean-squared error (NRMSE) was used as a measure of accuracy in estimating soil properties. Among all, diffuse reflectance spectroscopy (DRS) and X-ray fluorescence (XRF) techniques exhibit higher accuracy in estimating soil carbon and nutrients, however, require soil sample contact. Gamma-ray radiometry and electromagnetic induction (EMI) are the most common on-the-go sensor combinations, especially used to accurately estimate water content and soil texture. The Cost of mapping services ranges between a few hundred to several thousand euros per working day depending on the technique and type of sensor used. About 75% of mapping cost is attributed to fieldwork personnel, and data analysis and reporting, while the other 25% is to movement efforts and sample analysis. Several companies report extra charges attributed to fieldwork conditions. Results demonstrate that portable sensors offer accurate and cheaper point estimations, although on-the-go sensors offer better spatial estimations at the expense of accuracy.

Keywords: Cost-effectiveness, Proximal Soil Sensing, Data fusion, Combined sensors, Agricultural soils

ID ABS WEB: 137921

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

A REVIEW OF IN-FIELD SOIL SPECTROSCOPY IN VIS-NIR RANGE FOR FAST AND RELIABLE SOIL SURVEYING

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In-field soil spectroscopy represents a promising opportunity for fast soil analysis, allowing to predict several soil properties from one spectral reading representing one soil sample. This facilitates data acquisition from large amounts of samples through its rapidity and the absence of required chemical processing. This is particularly interesting in agriculture, where the chance to retrieve information from soils directly in the field is very appealing. This review focused on in-field visible to near infrared (Vis-NIR) spectroscopy (350-2500 nm), aiming at analyzing soils directly in the field through proximal sensing. The main scope was to explore the available knowledge, to identify existing gaps limiting in-field measurement reliability and robustness, to foster future research and help transition towards practical application of this technology. For this purpose, a literature review was performed evaluating the information about sensor range, used carrier platforms, sensor types, distance to the soil sample, measurement methodologies, target soil properties and soil management among others. A list of used tools with their spectral and measurement properties was produced, including the potential cross-calibration with soil spectral libraries from laboratory spectroscopy of soil samples and potentially measured soil properties. Different instruments and sensors are currently used to measure at varying wavelength ranges and with different spectral qualities, with a large range of prices. The most frequently analyzed soil properties included soil carbon contents (soil organic carbon, soil organic matter, total carbon), texture (clay, silt, sand), total nitrogen, pH and cation exchange capacity. Future perspectives comprise the implementation of larger databases, including different instruments and cropping systems as well as methodologies combining existing knowledge about laboratory spectroscopy with in-field methods. A broadly accepted measurement protocol for in-field spectroscopy, fostering harmonization and standardization, is necessary for a more robust practical application.

Keywords: proximal soil sensing, in-field measurements, soil spectroscopy, Vis-NIR, soil spectral libraries

ID ABS WEB: 138186

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

REORGANIZING SOIL DATASETS FOR DIGITAL SOIL MAPPING AND PRECISION FARMING PURPOSES: A STUDY CASE ABOUT DATA FUSION OF TWO PROXIMAL SENSORS

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Precision agriculture often involves the use of publicly available data that has been collected for different purposes. The CREA Soil Archive Collection includes digital data and physical soil samples collected from multiple research projects, that allow the reuse of samples to generate added information and fulfill different objectives. Here, we present a case study about reorganizing a dataset of soil property data collected into specific research projects that were converted into quality-enough data to support DSM using data fusion obtained from proximal soil sensors (PSS).
Data were produced during four surveys between 2019 and 2022 in two farms located in Macerata, Italy. Campaigns consisted of georeferenced sampling at times t0, t2, and t3, and gamma-ray surveys (distributions for 40K, 232Th, 238U isotopes and total count) at times t1, t2 and t3 of both sites. A total of 46 points were distributed and sampled in both sites (t0=14, t2=16, and t3=16 points). Laboratory analysis consisted of soil properties determination and collection of spectral data using a spectroradiometer. Aim of this work was to obtain plausible distributions of soil properties at time t1 by using spectral and soil available data to perform statistical models, and spatialize the result using radionuclides as covariates: 1) Support Vector Machine (SVM) was applied to calibrate models for soil properties estimation; 2) principal components (PCs) of georeferenced spectral data were calculated and correlated with radionuclides point; 3) multiple linear regression analysis (MLRA) with PCs and maps of radionuclide were used to spatialize.
SVM modeling threw accurate estimates for EC, pH, clay, and sand contents, while lower relationships were found for SOC and carbonates due to variation between sites. MLRAs' relationships with PCs were poor due to the small number of samples and high data noise. However, significant correlations were obtained. This represents new perspectives for generating plausible new data based on local models that would allow setting uncertainty thresholds for mapping soil properties.

Keywords: Soil properties estimation, Statistical Modelling, Spectroscopy, Gamma-ray, Data Fusion

ID ABS WEB: 138191

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

MACHINE LEARNING BASED FOR PREDICTING IRON OXIDES IN SOIL B HORIZON FROM DIFFERENT TYPES OF SMARTPHONES

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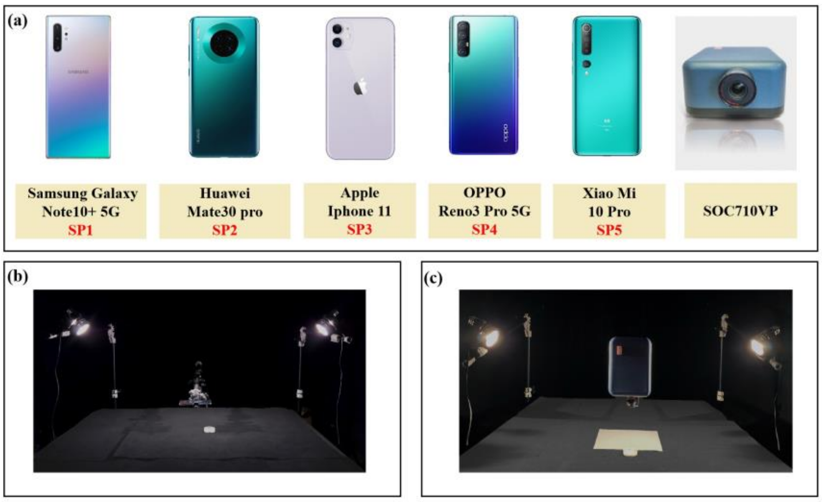
Iron oxides in the B horizon are key indicators of soil development, but traditional analysis methods like free iron oxide (Fed), total iron (Fet), and freeness of iron (Fed/Fet*100%) are too time-consuming for modern smart agriculture. In contrast, smartphones as proximal sensors for acquiring soil color parameters present a more efficient approach in precision agriculture for predicting soil properties. However, their application in predicting iron oxide content, a key soil color determinant, is less explored. Furthermore, the significant variations in imaging characteristics among different smartphone models necessitate a thorough investigation for reliable soil analysis, especially iron oxides. This study aimed to assess various effectiveness in predicting iron oxide content in soil B horizon and understand imaging variability, we imaged 150 soil samples by using five smartphones. Subsequently, these samples were scanned with a hyperspectral imager to explore the modeling capabilities. Based on the obtained soil color parameters and spectral data, Support Vector Machine (SVM) and Partial Least Squares Regression (PLSR) were utilized to build the models to predict the iron oxides (Fed, Fet, Fed/Fet*100%) content. Drawing on prior research, we analyzed spectral response curves from five smartphone cameras, uncovering that iron oxides in soil reduce brightness but increase redness, thus enhancing our understanding of smartphone imaging for soil analysis. The prediction outcomes using the five smartphones closely matched the model based on hyperspectral data, with Fet ($R2 = 0.57$~0.66, RMSE = 12.57~15.34 g/kg, RPD = 1.50~1.73) being better than Fed ($R2 = 0.51$~0.68, RMSE = 5.90~7.25 g/kg, RPD = 1.40~1.75). Comparative analysis of spectral response curves across smartphones revealed that models for iron oxide estimation were more accurate with devices exhibiting stronger spectral response and pronounced peaks in the R band. This study highlighted the viability of using various smartphones as soil sensors for iron oxide prediction, offering a theoretical guide for selecting the optimal device for accurate model development.



Keywords: Smartphone, Soil iron oxides, Soil color, Machine learning, Digital image

ID ABS WEB: 138331

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

GUIDED SOIL SAMPLING USING SOIL MANAGEMENT ZONES AND PROXIMAL SOIL SENSORS TO IMPROVE COST-BENEFIT RATIO OF FERTILIZER RECOMMENDATIONS

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Substantial improvements of field robotics could provide large coverages in a more uniform matter. However, this mechanized standard cannot be considered optimized as mostly disregarding within-in field soil variations. Large cropping areas require detailed sampling approaches to consider and reconcile soil property differences for field interventions. To identify soil heterogeneous zones demands an optimized sampling approach. The objective was to integrate soil data from two proximal soil sensors to improve the delineation of homogeneous soil regions using a k-means clustering algorithm defining three distinct management zones in an irrigation pivot with 72 ha in Itaí, São Paulo, Brazil. A regular sampling grid of one hectare was sampled for the attributes of CEC, V%, texture, organic carbon, and pH, as well as a second optimized sampling grid was guided by proximal soli sensor datasets. Maps of apparent electrical conductivity, apparent magnetic susceptibility, equivalent thorium, and equivalent uranium provided by two sensors were considered to guide this optimized sampling schema. These maps served as preliminary information using the spsann sampling algorithm in R. Six locations were defined for soil sampling in each of the three previously defined management zones. A dataset of 18 points collected at depths of 0–10 and 10–20 cm were subjected to analysis of variance, checking whether each zone could distinguish soil heterogeneities. Only clay, organic carbon, and calcium attributes showed significant differences between grids with 72 and 18 points at depths of 0–10 and 10–20 cm. The optimized approach shown that sensors information could improve management zone delineations, as identifying soil heterogeneities concerning clay texture and organic carbon content. The approach using sensor data and the spsann algorithm could promote a reduction of four time less sampling points, yet providing a more precise delineation of soil heterogeneities. It was observed that a very homogeneous spatial distribution of nutrient concentrations could not significantly contribute to delineate management zones.

Keywords: Management Zones, Proximal Soil Sensors, Soil Sampling, Precision Agriculture, Irrigated Crops

ID ABS WEB: 140108

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

A MODELLING APPROACH TO INFER COMPACTION INDUCED CHANGE IN NITROUS OXIDE EMISSIONS FROM ELECTROMAGNETIC INDUCTION DATA

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Geophysical methods can be used to map soil properties and deduce understanding soil processes at spatial scales beyond what is possible with traditional monitoring techniques such as soil sampling. In managed grasslands, geophysical methods can be crucial to bridge the scale gap from point to field scale, and to allow for field-scale characterization of animal-induced soil compaction patterns affecting soil water dynamics and controlling nitrogen cycling. In this study, we explore how integrated modelling of grazing patterns, soil structure dynamics, soil processes and electromagnetic induction (EMI) data could provide insights of nitrous oxide (N2O) emissions in managed grasslands. This was achieved by using EMI data to calibrate soil structure properties (e.g., bulk density, macroporosity and hydraulic conductivity) in an agroecosystem modelling framework. This allows to associate patterns in EMI data with soil structure variations due to compaction and ultimately allows to make predictions of soil water and nitrogen dynamics that are consistent with such observations. This approach was tested using EMI data and management information from a dairy farm in central Ireland. The EMI-calibrated model predicts that N2O emissions from compacted zones (occupying about 20% of the total area) are 2.5 higher than those from non-compacted zones. This is consistent with profile-scale studies reported in the literature for compacted grasslands. Linking agricultural management and geophysical data through agroecosystem modelling offers new means for large-scale and long-term testing and monitoring of the environmental impacts of management for different agricultural systems. This modelling framework could be used in combination with EMI data to test different management systems to help minimizing N2O emissions in compacted grasslands.

Keywords: agrogeophysics, soil compaction, nitrous oxide, EMI

ID ABS WEB: 136566

6. Soil in the digital era
6.02 129252 - Quantifying and mapping soil functions

DYNAMIC SOIL WATER MOVEMENT AT HILLSLOPE SCALE AND SOIL PROPERTY PREDICTIONS

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Digital Soil Mapping (DSM) uses topographic characteristics and remote sensing data to map soil properties. Soil property maps are useful for soil fertility and health planning and management. Soil properties reflect soil water dynamics and are used as diagnostic tools to describe past and current soil water status. However, in most cases the water dynamic characteristics used for soil classification are aggregated monthly and/or annually. Finer spatial and temporal characterization of soil water movement is needed to better understand the spatial distribution of soil properties and support management decisions at multiple scales from hillslope to watershed and regional. In this study we used a distributed soil vegetation hydrological model (DHSVM) to characterize soil water movement (soil moisture-SM and depth to saturation-WTD) at two hillslopes under pasture and forest vegetation. Modeled soil moisture was compared with sensor measured values at key slope positions (summit, sideslope and toeslope) and three depths. Temporal patterns of measured data matched those estimated by DHSVM. The positions of peaks and valleys between simulated and measured SM for both pasture and forest vegetation matched at depths 0-20 and 20-45 cm, as shown by the significant correlation coefficients that varied between 0.6 and 0.8, with values for the summit and toeslope being higher compared to sideslope. Fragipans observed in sampled transects in both pasture and forest hillslopes were found to be correlated with SM during summer and WTD during spring. The depth to C horizons showed the highest correlation for pasture (r = - 0.3*) for the forested hillslope (r = 0.1*). The validated soil moisture maps and depth to saturation (WTD) can be used to predict soil properties spatially and temporally for research on soil pedogenesis and support precision agriculture applications.

Keywords: Digital Soil Mapping, Soil Properties, Hydrological Models, Soil Moisture

ID ABS WEB: 137807

6. Soil in the digital era
6.02 129252 - Quantifying and mapping soil functions

MONITORING WATER STORAGE CAPACITIES UNDER TWO CLIMATE STRESSORS FOR SEVEN EUROPEAN PRODUCTIVE LANDS

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Reliable measurements of soil moisture can contribute to sustainable management of water resources and to safeguarding crop yields and soil health under climate change. Within the framework of the EU H2020 project SOILGUARD, we examined the effects of simulated droughts and heatwaves on water storage in different biomes across 7 NUTS-2 regions, and under different management regimes, i.e., conventional vs. organic management in croplands, monoculture vs. species mixtures in grasslands, and clear-cut vs. continuous cover forests. TOMST® soil moisture sensors were installed in the plots of five croplands (Spain, Belgium, Denmark, Hungary, and Latvia), one grassland (Ireland), and one forest (Finland) site. Drought periods of 3 months were induced using on-field rainout shelters and heatwaves were simulated using infra-red heating panels run for 5 days. The data of all countries was aggregated by averaging reads every 12 h, and it was analyzed by linear mixed effects models. The simulated climate stressors had a clear effect on soil water content. Whereas forestry practices such as shelterwood cutting significantly improved soil water retention, the rest of the studied practices on croplands and grasslands didn't show clear differences in their capacity to resist climate stressors. Rainfall exclusion and the use of heaters were useful to simulate drought and heatwaves for soil moisture monitoring; furthermore, considering longer establishment times for organic practices may help differentiate more clearly between the type of management.

SOILGUARD

Keywords: Soil health, Sustainable management, Climate Change simulations, Soil moisture, Critical Zone

ID ABS WEB: 137880

6. Soil in the digital era
6.02 129252 - Quantifying and mapping soil functions

ASSESSING DANISH PEATLANDS OVER THE LAST DECADE: MAPPING AND INTERPRETING THE SPATIOTEMPORAL VARIATIONS OF SOIL ORGANIC CARBON STOCKS AT NATIONAL SCALE

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In Denmark, drained agricultural peatlands contribute at least 10% to greenhouse gas emissions, and rewetting part of these areas will enable reducing the emissions. Optimal rewetting requires knowledge of hot spot emission areas for which rewetting may lead to the greatest reduction. Mapping soil organic carbon (SOC) stocks within Danish peatlands represents a first step towards the estimation of emission from these areas. A peatland soil database was generated from a national field survey carried out in 2009 and 2010. About 10,000 sites were visited and more than 20,000 soil samples were collected following a systematic sampling scheme with up to four subsamples taken at 30-cm depth increments at each sampling location. Recently, we revisited 1,000 sampling sites, which provided the unique opportunity to assess the variation in SOC stocks at different depths over a decade. The present study aimed at mapping and interpreting the variations in space and time of this key peat soil function at a national scale. A Cubist bootstrap modelling approach was employed using soil, geology, landscape, topography, climate, laboratory visible-near infrared spectra, Sentinel-1 and -2 data as predictors at a 10-m spatial resolution. The modelling method yielded both a mean prediction maps for SOC stocks at different depths and the associated uncertainty maps. The best-performing models were also analysed with a model-agnostic interpretation technique yielding crucial information for further use of the predictive map and enabling a better understanding of Danish peat soils.

Keywords: Peatlands, Soil Functions, Digital Soil Mapping, Digital Soil Assessment

ID ABS WEB: 138145

6. Soil in the digital era
6.02 129252 - Quantifying and mapping soil functions

MAPPING SYNERGIES AND TRADE-OFFS BETWEEN SOIL BIODIVERSITY AND ECOSYSTEM FUNCTIONS IN DANISH FORESTS

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Forests play a pivotal role in preserving biodiversity, mitigating climate change, and providing essential goods and services. In alignment with the European Biodiversity Strategy advocating for the strict protection of 10% of land area, the challenge lies in balancing these ecosystem services with societal demands for available land. This study focuses on optimizing land use planning to reconcile the multifunctionality of forests, emphasizing the critical role of forest soil in supporting biodiversity and ecological functions.
A comprehensive survey was conducted, sampling soils in approximately 320 plots from the National Forest Inventory of Denmark. This involved quantifying physicochemical properties, extracting environmental DNA (metabarcoding), and employing Ecoplates® for functional assays to construct profiles of soil communities. Additionally, soil incubation was performed to measure greenhouse gas fluxes.
The study integrates microbiome data to provide insights into the relationships between soil microbiomes and ecosystem functions. Leveraging the National Forest Inventory's comprehensive information on forest structure, dynamics, history, and composition, the research aims to map soil biodiversity including fungi, bacteria, and soil fauna.
Spatial prioritization analysis will be employed to generate spatially explicit maps of forest and soil functions, along with microbiome diversity. These maps will highlight areas of synergies and trade-offs, offering valuable insights for prioritizing regions to enhance forest multifunctionality. By bridging the gap between ecological research and practical landscape planning, this study contributes to the ongoing dialogue on sustainable forest management and biodiversity conservation.

Keywords: soil functions, priotization, forest soil, metabarcoding, community profile

ID ABS WEB: 135474

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales Where to go next?

DIGITAL SOIL MAPPING FROM SCIENCE TO PRACTICE OVER THE PAST FIVE YEARS: LESSONS FROM NORTH-WESTERN IRAN

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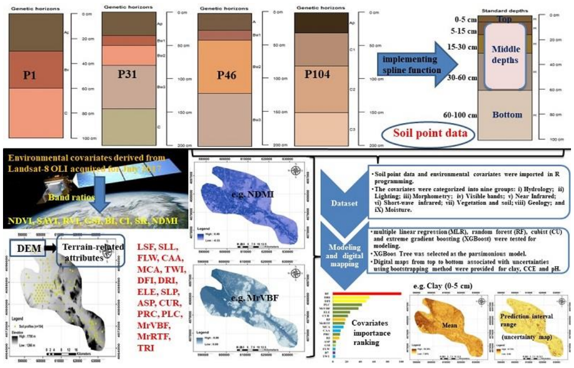
Digital soil maps are a starting point for formulating soil science hypotheses. They area a complement to conventional soil maps. Digital soil mapping (DSM) is not simply exercises in themselves, but also facilitate understanding the distribution of soil properties. Most frequently studies beyond DSM belong to Australia and China, Brazil, the United States, France, Germany and Iran. There was an opportunity to apply DSM in Urmia Lake (north-western Iran). A location which was faced desiccation. Some important issues addressed as follows: I) Spatial variability of crystalline iron (doi:10.1016/j.geoderma.2018.11.024); II) Different iron forms and futures (doi:10.1016/j.geodrs.2020.e00275); III) Potentially toxic elements enrichment due to water-level decline (doi:10.1016/j.scitotenv.2021.152086); IV) Soil salt composition and ionic strength (doi:10.1016/j.rsase.2021.100498); and V) Soil chemical ripening process (doi:10.1016/j.catena.2023.107440). The aforementioned projects were performed using solely spectral data. The map uncertainty was successfully quantified by a bootstrapping method. Obviously, terrain-related attributes play an important role in DSM (doi:10.3390/agronomy12071653). Understanding the vertical distribution of agriculturally important nutrients (doi:10.1016/j.catena.2018.10.005) and some key soil properties at multiple standardized depths following the GlobalSoilMap project specifications is indispensable (doi:10.1111/sum.12900). In summary: I) Cubist, random forest (RF) and extreme gradient boosting (XGboost) tree models show high efficiency; II) The ripened soils have been established far from the water body of Urmia Lake; III) Crystalline iron is more sensitive to the visible bands compared to other iron forms and features; IV) The soils were enriched with As and Cu with more than 60% considered polluted across the east shore of Urmia Lake; V) The valence of ions played significant role in predictive mapping; VI) The geochemical indices demonstrated the transition from geogenesis to pedogenesis using DSM; VII) Regardless of soil subgroups, there was a decreasing trend of soil organic carbon storage (SOCS) with increasing depth; and VIII) Overall, the SOCS for an agricultural area of interest, normalized by area within soil order boundaries, was generally higher in Inceptisols (9.99 Tg) than in Aridisols (8.00 Tg).



Keywords: digital soil mapping, iron forms, soil chemical ripening, salt composition, soil organic carbon storage

ID ABS WEB: 135925

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales Where to go next?

ACID SULFATE SOIL MAPPING IN WESTERN FINLAND: HOW TO WORK WITH IMBALANCED DATASETS AND MACHINE LEARNING

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One of the main challenges in digital soil mapping is the imbalanced datasets for soils classification. For these datasets, machine learning techniques use to overestimate the majority classes and underestimate the minority ones. This generates maps with poor precision and unrealistic results. Considering these maps for land use decision-making can have dire consequences. This is the case of acid sulfate (AS) soils, a harmful soil that can generate serious environmental damage when drained in agricultural or forestry activities. In the study area, the probability of finding AS soils is very high. Furthermore, some of the most hazardous AS soils in Finland are located there. Therefore, it is necessary to create high-precision maps to avoid environmental damage. Since the dataset for this region is highly imbalanced, the first step in creating accurate maps is to balance the dataset. Although most soil class datasets are imbalanced, this problem has been hardly studied. In this work, we analyze different techniques to address the problem of imbalanced datasets. The methods considered to balance the dataset are under- and oversampling techniques and the combination of both. For the oversampling of the minority class, we create a kind of artificial samples from the quaternary geological map. The method used for the modeling is Random Forest. Balancing the dataset improves the performance of the model in all the studied cases, where the values of the metrics for both classes are above 80%. Furthermore, we create AS soil probability maps for the four balanced datasets and the imbalanced dataset. A detailed comparison between the maps is made. Additionally, the extent of the AS soils obtained in all the cases is compared with the extent of the AS soils in the conventionally produced occurrence map. The modeled probability maps created from the balanced datasets have a high precision. The results of this study confirm the importance of balancing the dataset to improve the prediction and classification of AS soils.

Keywords: Digital soil mapping, Acid sulfate soils, Imbalanced dataset, Soil Classification, Machine learning

ID ABS WEB: 136019

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales Where to go next?

CONSTRAINTID: VALIDATING WITHIN-FIELD SPATIAL VARIABILITY OF SOIL CONSTRAINTS FOR INFORMED CROP MANAGEMENT

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The spatial variation of crop yields within a field can arise from various reasons, but the primary driver is often the soil. Persistent spatial variation of crop growth is likely attributed to soil constraints. These factors contribute to yield losses for grain growers globally. The initial step in mitigating this yield gap involves identifying the soil constraint. A better understanding of historical spatial and temporal variation in crop yields can empower growers to make informed management decisions. To address this, we have developed a web-based tool, ConstraintID, designed to enable grain growers in the northeastern regions of Australia to identify consistent spatial patterns within their fields. The tool utilizes historical remote-sensing data from 1999 to the present, searching for consistent spatial patterns of the Crop Yield Index derived from Enhanced Vegetation Index (EVI) Landsat data around the peak EVI. To assess the tool's effectiveness, we sampled 121 fields across the region. Each field was divided into three zones (consistently poor, consistently good and inconsistent) using ConstraintID. A representative sample was taken for each zone (three cores split into five depths/zone), and analysed for a suite of soil properties. The data analysis presented here focuses on two key questions: (i) has remote-sensing analysis proven useful in identifying areas of constrained soil, and (ii) what soil constraints correlate with within-field variation in crop growth?
The results indicate that the impacts of sodicity and salinity are evident through negative relationships between the growth zone and sodicity in surface soil, and salinity, and chloride in subsoil ($p < 0.001$). This demonstrates the tool's effectiveness in identifying areas within fields with relatively poorer growth associated with variations in soil constraints. Additionally, strong associations were found between nutrients and growth zones. Soil carbon and potassium showed strong evidence of a positive association with growth zones ($p < 0.001$). For soil nitrate N, there was strong evidence ($p < 0.001$) of a negative association in subsoil.

Keywords: Soil constraints, Remote sensing, Enhance vegetation index, ConstraintID, Northeastern Australia

ID ABS WEB: 136261

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales Where to go next?

MULTI-STAGE SOIL SURVEYING COMPLEMENTING STATISTICAL SAMPLING DESIGNS TO PROVIDE HIGH-RESOLUTION SOIL MAPS FOR POLICY AND AGRICULTURE

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In Switzerland, authorities must soon delineate areas for the high-quality arable land inventory based on high-resolution surveys that require sampling of large numbers of new locations. Consequently, efficient surveying strategies are required which fulfil high quality demands for legally binding decisions. These decisions require soil attributes which cannot only be derived by laboratory measurement but are based on pedological field description by experts.

In our study area of 1’000 hectares, we established first a feature space coverage sampling design to sample 1’500 locations based on elevation and land use data, geological information, and expert knowledge of soil scientists. 170 locations were determined by a stratified random sampling design and used for independent validation.

A first prediction of a large range of soil attributes in multiple depth using the first 1’200 samples, random forest, and a wide range of environmental covariates showed medium accuracy. Therefore, we increased the total number of sampling locations to 2’200 by two in-fill sampling design strategies in two zones:

1. Experienced surveyors directly added additional sampling locations based on their expert knowledge. Those covered landscape features which not contained in the primary sampling design such as local extrema or transition zones.
2. A complementary further covering feature space as spanned before and with a higher sampling density within zones of high model uncertainties.

Subsequently generated maps showed increased accuracy with increasing sampling density for most attributes, e.g., an increase of 0.1 for the clay content in the topsoil at a sampling density of 1.7 observations per ha compared to a density of 1.1. Our results further displayed increasing accuracy of 0.05 with higher-weighted data collected by experts and simultaneous lowering the sampling density to 1.5 per ha by ignoring data with the lowest quality, collected before the calibration of the field survey.

Additionally, we proposed applications derived from these maps for specific agricultural use to local farmers, like options for precision farming or planning bases for irrigation systems.

Keywords: Digital Soil Mapping, Survey Strategy, Sustainable Soil Use

ID ABS WEB: 136448

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales Where to go next?

HIGH RESOLUTION SOIL QUALITY INDICATORS MAPS FOR EUROPE

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High-resolution reliable and quality-controlled soil information products are fundamental for a range of applications related to climate change and sustainable management. Integration of remote sensing information is a key strategy to obtain more accurate and relevant products.

Digital soil mapping (DSM) uses a statistical model to integrate products derived from Copernicus satellites Sentinel-1 and 2, environmental covariates such as digital elevation models, ERA-5 products and soil ground truth information from the LUCAS survey and other available sources. Several data products are derived from the Sentinel-2 time series using the Soil Composite Mapping Processor (SCMaP). It comprises mean reflectance composites as well as specific soil reflectance composites that contain undisturbed and bare soils. Additionally, the bare soil frequency is a measure for the visibility of the bare soil within the whole observed time period in percent. EO based soil products were generated for primary soil properties (SOC, pH, texture), derived soil properties and some basic soil health indicators. These properties were selected as a short list by scanning the current policy framework, existing projects and initiatives. In the second phase, users are approached by a survey and webinar to prioritise and specify the user needs for the shortlist, and to check for additional user needs and specifications. In total, 150 potential users have been reached so far. The soil observations were split in 10 equally sized folds for cross-validation. Random Forest models were obtained with the ranger package, with the option to build Quantile Random Forests (QRF) to obtain pixel-based uncertainty.

This contribution will discuss where to go from the generation of high resolution products with a sparse point data sampling such as LUCAS, to their evaluation (including landscape patterns), to their relevance of use for stakeholders. The results of a user requirement survey dedicated to future soil products within the Copernicus Land Monitoring Service will be taken into account into the discussion of the products and their fitness for use.

Keywords: digital soil mapping, remote sensing, copernicus, soil quality

ID ABS WEB: 136495

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales
Where to go next?

MULTITEMPORAL SENTINEL-2 IMAGES OF BARE GROUND FOR DIGITAL SOIL MAPPING IN CROPLANDS

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High-detail soil mapping is fundamental to apply precision agriculture approaches. Although soil maps are available in many countries at a regional scale for land planning purposes, there is a need to increase the detail in the most important agricultural areas for application of site-specific agriculture practices and soil monitoring. New data from proximal and remote sensors, as well as quantitative digital methods provide the right tools to obtain these maps with sustainable costs. The limitation of using satellite images in soil mapping is the masking effects of the vegetation and the crop residues on the surface. To address these issues, multitemporal composite images of bare soil can be elaborated. The Synthetic Soil Image (SYSI) performed by the algorithm Geospatial Soil Sensing System - GEOS3, developed in Google Earth Engine, is an example of such a product. For this work, SYSI was created by applying GEOS3 on 394 Sentinel-2 satellite multispectral images (from 2017- February 2023).
This study aims at producing maps of topsoil characteristics, namely soil organic carbon (SOC), clay, sand, total nitrogen (TN), cation exchange capacity (CEC), and total carbonates (TCa) at local level (the Rieti agricultural plain, about 4,000 ha), using digital soil mapping methods combining punctual soil observations (94), Digital Elevation Model (DEM) and derivatives, and the four bands of SYSI (RGB and NIR).
A statistical correlation between soil variables and covariates shows that all the four bands of SYSI are highly and negatively correlated with clay, SOC, TN, and CEC, whereas are moderately and positively correlated to sand and TCa.
Two geostatistical methods were tested to spatialize soil parameters: i) universal kriging (UK) using all the covariates as trends; ii) regression kriging with stepwise regression (RK). An independent dataset of 11 soil samples was used to validate the spatialization. SYSI bands were found to be the most explanatory covariates for interpolating SOC, clay and sand with high accuracy.

Keywords: DIGITAL SOIL MAPPING, PEDOLOGY, PRECISION AGRICULTURE, MULTITEMPORAL IMAGES

ID ABS WEB: 136505

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales
Where to go next?

HIGH-RESOLUTION THEMATIC SOIL MAPPING AT EU LEVEL BASED ON THE COMBINED USE OF LUCAS AND NATIONAL SOIL MONITORING DATA IN THE FRAMEWORK OF THE EJP SOIL PROJECT

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The EJP SOIL project aims to provide the research and policy-making community with detailed and harmonised EU-wide thematic maps of agricultural soils, based on a common methodology, to improve the effectiveness of European agricultural and environmental policies, to contribute to European international reporting. Currently the national and the EU reporting are performed independently, which results in contrasting figures on soil status. Since national soil data sharing constraints are in place, a bottom-up approach is preferred to include as much relevant data as possible. However, this can in return, generate transboundary issues.
The specific objective of the EJP SOIL mapping exercise is to set-up a digital soil mapping procedure to: i) support participants in a bottom-up approach allowing countries to produce high-resolution thematic soil maps, ii) develop soil property maps based on the national databases (SIMS) and the LUCAS Topsoil database, iii) solve the problems of transboundary issues, iv) provide spatially explicit uncertainty estimates.
To achieve this, both top-down and bottom-up mapping have been compared using the same mapping algorithm (quantile random forest) but with different input data: i) EU-level mapping, using the most predictive EU-level auxiliary variables (EU covariates and LUCAS point data) and applying a common EU inference model ii) country-driven mapping, using a) the best national covariates and point data (SIMS) b) the EU-level input data c) EU covariates and national point data and the other way around.
The spatial resolution chosen for the mapping exercise was a 100 m grid, which implied the production of an EU-wide covariate set at 100 m in INSPIRE-compatible projection by ISRIC. Soil properties commonly observed in both LUCAS and SIMS were selected for the maps, of which the methodologically most consistent pH was mapped first. Before the mapping exercise, comparative statistical parameters of the LUCAS and SIMS databases were examined. To develop appropriate methodological comparisons and transfer functions, analyses of both LUCAS and national methods on the same samples are ongoing.

Keywords: Digital Soil Mapping, EU-wide covariates, combined monitoring datasets

ID ABS WEB: 136561

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales Where to go next?

CHARACTERIZING SOIL WATER MOVEMENT AT HILLSLOPE SCALE USING A DISTRIBUTED HYDROLOGICAL MODEL. IMPLICATIONS FOR SOILS

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Traditional and Digital Soil Mapping (DSM) use topographic characteristics to map soils. Soil maps provide inferences about soil water dynamics. However, in most cases the water dynamic characteristics used for soil classification are aggregated monthly and/or annually. Finer spatial and temporal characterization of soil water movement is needed to better understand soils and their functions which in turn would support management decisions at multiple scales from hillslope to watershed and regional. In this study we used a distributed soil vegetation hydrological model (DHSVM) to characterize soil water movement (soil moisture-SM and depth to saturation-WTD) at a hillslope scale under pasture. Modeled soil moisture was compared with sensor measured values at key slope positions (summit, sideslope and toeslope) and three depths. Temporal patterns of measured data matched those estimated by DHSVM. The positions of peaks and valleys between simulated and measured SM matched at depths 0-20 and 20-45 cm, as shown by the significant correlation coefficients that varied between 0.71 and 0.84. Simulated absolute values of SM were only accurate for the summit's surface and at depth 20-45 cm at the sideslope and toeslope, although correlations were strong and significant for all SM estimations at the first two depths. For other positions and depths, estimations were not accurate. The least accurate estimations were those for SM at depth 45-60 cm and WTD, which presented overall the weakest correlation coefficients. The validated soil moisture maps can be used to better characterize spatial-temporal soil dynamics for understanding soil development and precision agriculture applications.

Keywords: Digital Soil Mapping, Hydrological Model, Soil Science

ID ABS WEB: 137019

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales Where to go next?

HOW CAN WE QUANTIFY, EXPLAIN, AND APPLY THE UNCERTAINTY OF COMPLEX SOIL MAPS PREDICTED WITH NEURAL NETWORKS?

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Artificial neural networks (ANNs) have proven to be a useful tool for complex questions that involve large amounts of data, for example predicting soil classes on various scales. Our use case of predicting soil maps with ANNs is in high demand by government agencies, construction companies, or farmers, given cost and time intensive field work.
However, there are two main challenges when applying ANNs. In their most common form, deep learning algorithms do not provide interpretable predictive uncertainty. This means that properties of an ANN such as the certainty and plausibility of the predicted variables, rely on the interpretation by experts rather than being quantified by evaluation metrics validating the ANNs. This leads to the second challenge: these algorithms have shown a high confidence in their predictions in areas geographically distant from the training area or areas only sparsely covered by training data.
To tackle these challenges, we use the Bayesian deep learning approach “last-layer Laplace approximation”, which is specifically designed to quantify uncertainty into deep networks. It corrects the overconfident areas without reducing the accuracy of the predictions, giving us a more realistic uncertainty expression of the model's prediction. In our study area in southern Germany we divide the soils into typical soils of valleys, the Swabian Jura and the Black Forest. As a test case, we then explicitly exclude the soil types of Swabian Jura and Black Forest in the training area but include these regions in the prediction.
Our findings emphasize the need to address the issue of overconfidence in ANNs, particularly for distant regions from the training area. Moreover, the insights gained from this research are not only limited to addressing overconfidence in ANNs, but also offer valuable information on the predictability of soil types and identifying knowledge gaps. By analysing regions where the model has limited data support and, consequently, high uncertainty, stakeholders can recognize the areas that require more data collection efforts.

Keywords: uncertainty quantification, artificial neural networks, digital soil mapping, soil classification

ID ABS WEB: 137128

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales
Where to go next?

MODELLING THE DIVERSITY OF SOIL FUNCTIONS ACROSS EUROPE

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Soils sustain a number of functions playing a key role in ecosystem functioning and providing a multitude of services to human society. While it is acknowledged that all soils are multifunctional, there is, to date, limited knowledge on how the supply of soil functions and their combination differ spatially with land use type, soil characteristics, climate and land use intensity at large geographical scales. We address this gap by quantifying five functions of major importance to European soils: 1) primary productivity, 2) water regulation, 3) climate regulation, 4) nutrient cycling and 5) provision of habitat for biodiversity. We built a multi-attribute semi-quantitative model with a hierarchical structure. The model is structured for the large-scale evaluation of soil functions and takes as input a set of indicators related to dynamic and stable soil properties, as well as to climate, topography and management practices, and returns qualitative aggregated attributes representing the soil functions fulfillment. Thresholds for the soil functions fulfillment are obtained by statistical analysis coupled with expert knowledge and vary across European environmental zones. The model is tested on a large European topsoil dataset in cropland and grassland. Statistical distributions of soil fulfillment are obtained as well alpha- and beta-multifunctionality representing the diversity of soil functions represented at a sampling location and the unique contribution of the sampled site to the regional (i.e. NUTS3 level) soil functions supply, respectively. We found that soil function fulfillment varied greatly across landscapes in Europe and between environmental zones. Spatial patterns of the alpha- and beta-multifunctionality revealed hotspot sites of multifunctionality (alpha diversity) but also sites providing a set of soil function fulfillment unique within the region (beta diversity). Few sites are both unique and highly diverse. Our study set a baseline estimate of soil functions in Europe as a prerequisite to consider soil functions in environmental planning.

Keywords: Ecosystem services, Mapping, Soil functions, Multifunctionality, Soil health

ID ABS WEB: 137675

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales Where to go next?

THE BENEFITS OF A MASSIVE HARVESTING OF LEGACY MEASURED PROFILES FOR MAPPING PRIMARY AND FUNCTIONAL SOIL PROPERTIES IN THE COASTAL PLAIN OF OCCITANIE (SOUTHERN FRANCE).

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The coastal plain of Occitanie is facing up to important issues related with the dramatic decrease of the water and soil resources caused respectively by the global climate change and the progresses of urbanization boosted by a large demographic growth. Mitigating such issues requires relevant decision making based on an accurate knowledge of the spatial distribution of soil properties over the region. For the last fifteen years, such a knowledge has been provided to end-users by the successive implementations of new digital soil mapping approaches: Developing GlobalSoilMap products (10.1016/j.geodrs.2014.11.003), Regional mapping of Soil Available Water Capacities (10.1016/j.geoderma.2021.114968) and of a Potential Soil multifunctionality index (10.1111/ejss.13345). However, the low spatial density of the sets of legacy measured profiles severely limited the accuracy of these mapping products, which in turn significantly hampered the consideration of soils in the land planners' decision making.
To face this problem, a massive harvesting of legacy soil profiles was conducted in the region, involving semi-automatic entry procedures based on automatic reading. This allowed to considerably increase the spatial density of legacy measured soil profiles that were used as input of DSM models (from 1 profile/ 9.9 km2 to 1 profile/ 1.3 km2).
The new DSM models that were calibrated from this new soil dataset produced more accurate soil mapping products with lower predicted uncertainty. A subsequent effort was also conducted to communicate the remaining uncertainty under an adequate formalism (spatial aggregation, adapted semiology) that enabled a good appropriation of the soil maps by decision-makers.
The results obtained in this pilot region illustrated the feasibility of operational DSM approaches to support land planners' decision making at regional and territorial scales.

Keywords: Soil quality index, machine learning, text recognition, uncertainty, decision-making

ID ABS WEB: 137980

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales
Where to go next?

PEDODIVERSITY MAPPING IN AN ALPINE ENVIRONMENT

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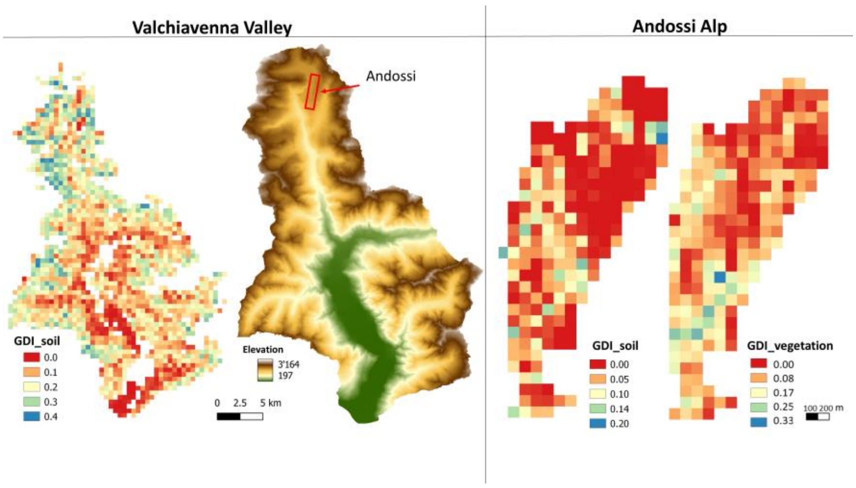
Diversity is the key to the ecosystem stability, as it provides resistance and resilience to environmental changes.
We mapped pedodiversity, defined both in terms of soil types and map fragmentation, operating at two scales: Valchiavenna valley (VCH; 450 km2), in the central Alps, and within it the Andossi Alp (AA; 3.5 km2).
Pedodiversity was assessed in the following steps: 1) 232 and 126 soil profiles, for VCH and AA respectively, were classified (WRB, 2022); 2) geomorphometric variables (extracted from a 20 and 4 m resolution DTM for VCH and AA respectively) and vegetation indices (extracted from Sentinel 2 imagery) for AA only were used as covariates to model soil types; 3) Discriminant Analysis (for VCH) and Random Forest model (for AA) were used to produce soil maps (75% of data for train by cross-validation and 25% for test); 4) pedodiversity maps were obtained by calculating the Simpson's Diversity Index (SDI), the Relative Edge Density (RED) and the proposed Global Diversity Index (GDI, product of the former), on 25 ha (VCH) or 1 ha (AA) pixels; 5) pedodiversity was compared with diversity of land use and elevation for VCH, and with geomorphometry and vegetation diversity for AA.
The main soil types were Leptosols, Regosols, Cambisols, Umbrisols, Podzols, Fluvisols (only in VCH), Gleysols and Histosols.
The results showed that for VCH the GDI was on average 0.16±0.09 (maximum 0.43); the SDI was 0.47±0.16 (maximum 0.8) and the RED was 0.30±0.10 (maximum 0.55). The GDI was not related to land use but increased with elevation.
Regarding the AA pasture, the GDI was low (0.04±0.04), due to a limited fragmentation (RED: 0.09±0.07); the typological diversity predominated (SIDI: 0.24±0.21); soil diversity was positively related to geomorphometric diversity, but more strongly to vegetation diversity. In general, pedodiversity was greater in the southern part of the AA, where lithology and morphology were more diversified than in the northern part.



Keywords: alpine environment, pedodiversity, diversity indices, digital soil mapping, geomorphometric variables

ID ABS WEB: 136113

6. Soil in the digital era
6.04 129630 - Soil and viticulture

ISOLATING THE EFFECTS OF SOIL PHYSICAL PROPERTIES ON FRUIT COMPOSITION: A CASE STUDY IN MARYLAND, USA

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Soil is often credited with affecting various qualities in grapes and wine, but the specific effects of soil properties on grape chemistry lack an empirical basis. Most previous studies have either compared vineyards across geographic areas with climatic differences or taken soil out of its natural location and changed its properties. In this project, we attempted to isolate the influence of soil properties on grapevines and fruit composition by monitoring vines and fruit in an Alberino vineyard block in Maryland on the East Coast of the USA. Other variables were constant in the vineyard, including variety, climate, and vineyard management. We assessed within-block soil differences by completing soil descriptions and sampling across transects. The main soil difference we observed across site transects was topsoil depth (A-horizons), which ranged from 0-28 cm. We then monitored vine parameters including crop load, vine size, fruit exposure, cluster density, and primary fruit chemistry throughout the 2019, 2020, and 2021 growing seasons. To determine any effects of topsoil depth on vine parameters, we completed multiple linear regression analyses. The fruit showed variability in cluster density as well as chemistry, some of which was explained by differences in topsoil depth. The most consistent results were positive relationships between topsoil and fruit titratable acidity (TA), and between topsoil and cluster density. In 2019 and 2020, fruit titratable acidity was significantly lower in vines growing in thinner topsoil, indicating that the fruit was ripening earlier. In 2021, crop load was significantly correlated with TA, suggesting that out of balance vines superseded any potential soil effects. During all three years, there was a significant relationship between cluster density and topsoil depth, where vines in thinner topsoil had looser clusters (which is a positive attribute in the Eastern U.S.'s high disease pressure). The results increase our understanding of terroir, and the specifics of how topsoil affects vine size, fruit titratable acidity, and cluster density.

Keywords: Terroir, Topsoil, Titratable acidity, Ripening

ID ABS WEB: 136355

6. Soil in the digital era
6.04 129630 - Soil and viticulture

GRAPE YIELD PREDICTION MODELS: APPROACHING DIFFERENT DATA INPUT

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Information on the expected yield of vineyards is necessary for making decisions about the fertilization and nutritional management of grapevines. The study aimed to develop grape yield prediction models and evaluate the effect of inputting different data on model calibration. A database (n = 423) derived from vineyards was used. The database comprises data from six harvests of Pinot Noir, Chardonnay, Merlot, Moscato and Isabel cultivars. Climate data (precipitation and average temperature) and soil type from the production field were retrieved. Nutrient contents in soil and leaves was used. The Random Forest machine learning method was used to calibrate prediction models considering five data input approaches: 1) soil+region, 2) climate, 3) soil+region+climate, 4) nutrient levels in soil and plant, and 5) all data. This resulted in five different models, which were evaluated by the coefficient of determination (R^2), used as a measure of variance explained by the predictors and the Root Mean Squared Error (RMSE) and Maximum Absolute Error (MAE) used as a measure of dispersion in the predictions. To develop the models, the database (n = 423) was randomly partitioned into calibration (n = 297; 70%) and validation (n = 126; 30%) data. Model 5 (all data) achieved the lowest average error rates in validation (R^2 = 0.89, RMSE = 4.18 t ha-1, MAE = 2.12 t ha-1), but very close to the performance of model 4 (nutrient levels) (R^2 = 0.85, RMSE = 4.60 t ha-1, MAE = 2.80 t ha-1), while the 1-2-3 models produced the worst results (R^2 = 0.65; 0.59; 0.66, RMSE = 6.93; 7.52; 6.86 t ha-1, MAE = 4.51; 5.18; 4.46 t ha-1, respectively). The five most important predictor variables in the prediction were the Mg and N content in the leaf, soil type, producing region and precipitation. This study offers insights for future research on predictive modeling of grape yield.

Keywords: Vineyards, Grape nutrition, Climate, Nutrient levels, Fertilization

ID ABS WEB: 136459

6. Soil in the digital era
6.04 129630 - Soil and viticulture

INTER-ROW SOIL MANAGEMENT AFFECTING SOIL MOISTURE AND PLANT DEVELOPMENT IN A SLOPING VINEYARD

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This three-year study aimed to explore the effects of inter-row soil cover and management on soil water content (SWC) and plant health in a sloping vineyard. We used two vineyard treatments: GR, which had a permanent grass cover between the rows, and CC, which had tillage in the first year, cover crops sowed in the second year, and a perennial cover crop grown in the third year. We used sensor sets to measure SWC, soil temperature, and vineyard plant growth indicators such as Normalized Difference Vegetation Index (NDVI), Photochemical Reflectance Index (PRI), and fraction of Absorbed Photosynthetically Active Radiation (fAPAR) at different slope locations.
Our study revealed clear variations between the studied inter-row managed sites and within slope positions. CC site had significantly ($p<0.05$) higher overall SWC at 15 and 40 cm depths compared to the GR site. Slope positions showed a significant influence on NDVI and PRI ($p<0.001$), but not on fAPAR. The LAI at the CC grapevine was higher by 18% compared to GR, however, it was not significant ($p=0.16$). Plant parameters showed moderate relationships with specific soil parameters, such as soil organic carbon, total N, pH, or SWC. Continuous cover crop inter-row management significantly reduced the SWC for the upper soil layers (i.e. third year), however, for plant development (fAPAR) it can be beneficial. Based on the PRI values, our results indicated better light use during photosynthesis and better grapevine productivity for the GR site compared to the CC, especially during the first year (i.e. tillage). Overall, we found that the soil and plant characteristics in vineyards were strongly affected by the type of inter-row soil management with cover-crop inter-row might be a good option when drought conditions are rare.
Acknowledgments: This material is based upon work supported by the Hungarian National Research Fund (OTKA/NKFI) project OTKA FK-131792.

Keywords: Soil water content, Inter-row soil management, Cover crop, Vineyard, SWAP

ID ABS WEB: 136474

6. Soil in the digital era
6.04 129630 - Soil and viticulture

CARBON SEQUESTRATION POTENTIAL IN ENGLISH VINEYARDS

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Agroecosystems are crucial for maintaining global carbon balance due to their capacity for carbon sequestration (CS). Amongst the cultivated lands through which the CS can be increased, vineyards are identified as high-potential sites. For instance, the physiological features and function of grapevines, cover crops, and associated soil management practices can increase vineyards' soil organic carbon (SOC) levels. With global warming, vineyards' hectarage is expanding in colder countries located above 50° N. In England, vineyard areas expanded by 3,100 ha between 2004 and 2021. However, the impact of this expansion on the CS of soil and the existing carbon stores has not yet been explored.
This study aimed to assess the CS potential of vineyards by analysing the soil organic carbon (SOC) content in 48 grapevine plots across England, in terms of age, depth and physiochemical soil properties. Secondary data was obtained from the LUCAS database. The results showed that the top 10 cm contained more SOC than the 20 cm for all soils. However, the change of SOC percentage with age varied in different vineyards: the majority of the vineyards investigated showed a positive increase in SOC percentage in both 10 and 20 cm. Most importantly, the clay content of soil played a key role in SOC accumulation ($R = 0.606$) compared to the other physiochemical properties. The SOC in the studied plots was compared to grasslands and croplands in the same pedoclimatic zone from the LUCAS database. The mean SOC percentage of vineyards (2.41 ± 1.05 %) was lower than the grasslands' (3.67 ± 2.08%) but higher than the croplands' (2.03 ± 0.86 %). Hence, it could be suggested that the grapevine and grass combination in vineyards may increase the SOC level in the soil.

Keywords: English Vineyards, Land Use, Soil Organic Carbon, Carbon Sequestration

ID ABS WEB: 137622

6. Soil in the digital era
6.04 129630 - Soil and viticulture

MANAGING IRRIGATION IN VITICULTURE TO FACE CLIMATE CHANGE AND PRESERVE TERROIR CONCEPT: THE CASE STUDY OF AGLIANICO GRAPEVINE

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The viticultural sector is one of the most challenged agricultural sectors by Climate change (CC), needing specific adaptation and mitigation actions to make local farming communities resilient and preserve the expression of terroir.
The latter is dependent on soil-plant-atmosphere (SPA) system interactions and in particular on the vine water status, affecting berries characteristics such as sugar, anthocyanins, flavonoid concentration, and acidity.
Under climate change, irrigation represents a complex issue. In fact, it is not only important to guarantee water to the plants, but to maintain a specific water stress during the ripening phase of the grapes.
The aim of this contribution is to show the first results of a task of Spoke 3 of the National Research Center for 'Agriculture Technologies - Agritech' (NextGenerationEU European program) on the identification of procedures for the optimized management of the water resource in vineyards.
We used a multidisciplinary approach to support irrigation optimization in vineyard. It is based on two main steps: 1) the identification of the functional homogeneous zones (fHZs) in the vineyard through an environmental analysis based on the soil spatial variability, the micro-morphology of the vineyard (LIDAR) and the spatial variability of the crop response at different resolutions (UAV); 2) monitoring plant and soil water status in the fHZs to optimize the irrigation achieving the field oenological goals while preserving the water resource.
We ran a test on an Aglianico vineyard (2 ha) of Tenuta Donna Elvira winery (Montemiletto, AV). Two weather stations and seven monitoring nodes were distributed within the irrigated and non-irrigated long plots.
The irrigation supply was realized through an automated irrigation system (MySOLEM) and defined according to the leaf water potential (LWP) measured, keeping its value between 1.2 and 1.4 bar during the ripening period.
At the end of the first year, we analyze collected data to develop a vineyard water management model able to support achieving oenological goals and facing climate change.

Keywords: irrigation, climate change, Aglianico, viticulture, soil management

ID ABS WEB: 137896

6. Soil in the digital era
6.04 129630 - Soil and viticulture

MULTI-SCALE AND MULTI-DISCIPLINARY APPROACH TO STUDY GRECO GRAPEVINE ADAPTATION TO CLIMATE CHANGE AND IMPROVE PRODUCTIVITY AND RESILIENCE UNDER SUSTAINABLE MANAGEMENT OF VINEYARDS

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The increasing warming and drought caused by climate change in the Mediterranean area affects grapevine yield and berry quality, particularly in some of the autochthonous grape varieties in the Campania Region of southern Italy. The productivity and quality of vineyards depend on pedo-climatic conditions, and adopting appropriate cultivation techniques such as soil and canopy management can help mitigate the effects of climate change, maintaining or improving grape yield and berry quality.
The aim of this study was to evaluate the combined effect of two types of canopy management (double guyot and double guyot flipped) and three treatments of soil management (cover crops, natural coverage, and soil tillage) on the Greco grapevine responses to study the relations of soil-plant-atmosphere system (SPA) and support the identification of specific adaptation and mitigation actions to climate change for this cultivar. The study was conducted over three years (2020-2022) in a Greco experimental vineyard of Feudi di San Gregorio winery in southern Italy (Avellino), on a Calcaric Cambisol within the Rural Development Programme 2014-2020 of Campania Region.
The status of vines was monitored using a multidisciplinary approach that allowed the analysis of vine behavior at the single plant to vineyard levels. Biometrical parameters, leaf water potentials, and functional anatomical parameters linked to the efficiency of gas-exchanges and water flow were measured to monitor growth and eco-physiological traits of vines. Yield components and berry characteristics were determined at harvest, meteorological data and soil water content monitored.
Finally, in each experimental plot SWAP model was calibrated and validated to understand the relation between plant water stress and grape characteristics. The validated model was successfully applied to simulate climate change's effect (RCP 8.5 scenario) on the SPA system studied.
The multidisciplinary approach proved to be fundamental in going in-depth into the cause-effect relations and mechanisms for vines acclimation, finding a sustainable solution to face climate change in the vineyards of southern Italy.

Keywords: Climate change, Greco grapevine, SWAP model, grape characteristics, soil management

ID ABS WEB: 137927

6. Soil in the digital era
6.04 129630 - Soil and viticulture

THE EFFECTS OF SOIL AERATION IN COMBINATION WITH A BIO-STIMULANT IN A VINEYARD IN THE TOKAJ WINE REGION

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Many challenges have arisen in vineyard soil management, such as soil compaction, soil cover, and disease control. One of the most important diseases that can be transmitted through the soil is grapevine trunk disease (GTD), which is caused by fungi. GTD is a complex disease and the infection (symptoms) can be latent. Numerous studies have focused on Trichoderma spp. biostimulants, hyperparasitic fungal material as disease control agents against GTD.
In this study, the Trichoderma spp. application method was combined with soil aeration (KX016-4 mini excavator with compressor and 60-litre tank with a hydraulic hammer). The vineyard is located in Tokaj and was planted on Cambisol loess soil, using a combination of Furmint T85 scions and Teleki 5C rootstocks. Six parcels were involved in the experiment by two parallel rows (50-50 vine). Treatments were carried out by aeration with Trichoderma spp. suspension (TR04, TR05 strains 10 million cells/mL) and by irrigation directly in the soil. A total of 300 vines (aeration, irrigation, and control blocks) were observed between 2020 and 2022, and records of external GTD symptoms were carried out yearly. The incidence of Trichoderma spp. strains were determined each year on randomly selected vines. GTD disease monitoring has been completed with leaf area index (LAI) calculation with VitiCanopy® software and cane weight measurement has been used for biomass analysis.
The results showed that the use of the biostimulant is effective as a biocontrol agent against GTD. Fungal strains (TR04, TR05) were isolated from all samples of treated vines irrespective of the application method. They were colonized through the soil by Trichoderma spp. The visual appearance of GTD decreased during the study period as a result of the treatment. An increase in the LAI was also observed for each of the methods. However, the soil aeration proved effective in increasing cane weight. There is a need for further studies to improve the method and to assess the effectiveness of the treatment.

Keywords: AERATION, SOIL, BIOSTIMULANT, VINEYARD, TOKAJ

ID ABS WEB: 138263

6. Soil in the digital era
6.04 129630 - Soil and viticulture

ASSESSING THE IMPACT OF LANDSCAPE, CLIMATIC VARIABLES AND SOIL MANAGEMENT ON ORGANIC CARBON CONTENT IN VINEYARD SOILS

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Vi industry is one of the most important in agriculture in Chile, covering a total area close to 130,000 hectares, located mainly in the central region. Understanding the drivers and developing efficient modeling techniques to assess potential increases in Soil Organic Carbon (SOC) storage is vital to mitigate management impacts. This understanding, coupled with accurate calibration of vineyard management process models, can help assess their role in soil carbon dynamics.

This study aims to model variables explaining soil organic carbon content based on farm, management and landscape variables. A total of 205 points were sampled across six vineyards at depths of 15 and 30 cm. These variables include soil properties (pH, texture, electrical conductivity), climate (average temperatures and rainfall), relief (height, exposure, slope), vegetation, lithology of the parent material, and agricultural management practices (manure application, tillage intensity). The latter category considered variables such as planting age, type and frequency of plowing, irrigation, presence of spontaneous vegetation between planting rows, and fertilization.

A combination of modeling techniques including Machine learning methods, specifically a random forest-based variable dimensionality reduction algorithm and generalized linear models (GLM), were employed to analyze the effect of edaphic and topoclimatic variables on the organic carbon content of soils in vineyards under conventional and organic management in Central Chile. Preliminary results indicate that GLM can explain up to 52% of the variability of the organic carbon content of the studied soils. Precipitation and altitude emerged as the most influential predictive variables, with soil texture and salinity being the most important soil management practices. In conclusion, our findings suggest that landscape and climatic data have a greater influence in explaining organic carbon content compared to management variables, highlighting the importance of these factors in viticulture carbon dynamics

Keywords: organic carbon, irrigated vineyards, random forest, soil management

ID ABS WEB: 137129

6. Soil in the digital era
6.05 131572 - Advancing Quantitative Soil Classification: From Soil Profiles to a Dynamic and Comprehensive Classification System

A GLOBAL NUMERICAL CLASSIFICATION OF THE SOIL SURFACE LAYER

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The quest for a global soil classification system has been a long-standing challenge in soil science. There currently exists two, seemingly disjoint, global soil classification systems, the USDA Soil Taxonomy and the World Reference Base for Soil Resources, and many regional and national systems. While both systems are acknowledged as international, there remain various examples of their shortcoming for accounting of topsoil features, local applications and communication with established regional classification systems. This calls for a numerical soil classification that addresses these discrepancies and achieves harmonization with existing national systems. In this paper, we report on the development of a layer classification system -as opposed to the classification of soil profile entities, as a first step towards achieving a comprehensive global numerical soil classification not based on a priori defined classes. We implemented a modelling approach with a set of predicted key soil properties available globally for the soil surface layer with the same depth range of 0-5 cm. The set of properties were partitioned into a number of homogeneous and disjoint classes using the k-means clustering algorithm. Next, we investigated the pattern of variation of the clusters in association with the soil property map with principal component analysis. A three-component nomenclature system is derived in a transformed space of the class-specific centroids to account for the uneven distribution of the centroids in the principal component space. We show that it is possible to build a data-based objective numerical taxonomic classification of soil layers, and that existing sets of key soil properties, predicted separately, coalesce into identifiable clusters or classes and manifest discernible spatial and/or pedological patterns. This grouping of key soil properties to logical categories is a possible step to better define diagnostic horizon features and suggest new ones. The general-purpose map of soil surface layer classes of the world also has potential applications in assessing soil change and designing monitoring surveys.

Keywords: Clustering, Horizon classification, Identification, Allocation, Classes pattern

ID ABS WEB: 138134

6. Soil in the digital era
6.05 131572 - Advancing Quantitative Soil Classification:
From Soil Profiles to a Dynamic and Comprehensive Classification System

AN ITERATIVE ALGORITHMIC APPROACH FOR OPTIMIZING A DIAGNOSTIC SOIL CLASSIFICATION SYSTEM

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Recent advancements in national and global soil classification systems have primarily relied on expert knowledge, neglecting the vast potential offered by digital soil information archives at both national and global levels for statistical analysis. The validation of soil classes, diagnostic units of classification systems, using legacy soil information and statistical methods remains largely underexplored. In our ongoing efforts to optimize and validate the Hungarian Diagnostic Soil Classification System (HDSCS), we have employed an iterative approach involving algorithmization, numerical, and statistical methods. These methodologies contribute to the substantiation of classification units, allowing for the optimization of criteria, thresholds, and the order of the classification key. The outcomes of this process have led to an enhanced version of the classification system, providing a more accurate characterization of the country's soil conditions and improving the overall user experience. This presentation showcases the supporting legacy database, algorithmization results, and numerical and statistical characterizations, highlighting the evolutionary steps that culminate in the final optimized version.

Keywords: Soil Classification, Numerical methods, Diagnostic classification, Algorithmic, Hungarian soil clasification

ID ABS WEB: 136446

6. Soil in the digital era
6.06 133437 - Novel approaches to process-based modelling in agricultural soils

CONSERVATION AGRICULTURE INCREASES TOPSOIL ORGANIC CARBON STOCKS IN BRAZIL – A MULTI-MODELING APPROACH

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In Brazil, conservation agriculture (CA), which includes no-tillage along with crop residue maintenance, cover cropping and/ or mixed crop rotations has been widely adopted to reduce soil erosion, with consolidated benefits for sustainability and land degradation control. The potential of CA to increase soil organic carbon (SOC) stocks in Brazil has not been studied yet in the context of the “4 per 1000” initiative, which proposes an aspirational 4‰ annual target for SOC stock increase.
The objective of this study was to estimate the capability of CA systems in tropical and sub-tropical sites to increase SOC stocks, relative to tilled systems without cover cropping.
For that, we collected data from three agricultural experiments in Brazil with different edaphoclimatical conditions, where several principles of CA were implemented. Then, we studied the effect of CA on topsoil OC stocks and compared it to different land management scenarios. That is, a scenario with conventional tillage, one without cover crops, and one with conventional tillage and no cover crops. We developed several methods to take into account the effects of tillage on SOC decomposition. We implemented them in an ensemble of SOC models (e.g., Century, ICBM, and Roth-C) and calibrated the models with a Bayesian approach, in order to account for both parameter and structural uncertainties.
Considering different possible representations of SOC processes allowed us to reliably assess the impact of conventional tillage on topsoil OC stocks and to uncover the structural lacks of the models. Preliminary results show that the land management with the highest SOC stock increase was CA, independently of the type of cover crop used. We found that under conventional tillage and no cover cropping, an annual 4‰ increase of SOC stocks at the studied site is unlikely, whereas the other scenarios generally showed an annual increase higher than 4‰.

Keywords: soil carbon models, conservation agriculture, multi-model ensembles, soil carbon sequestration, tropical soils

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6. Soil in the digital era
6.06 133437 - Novel approaches to process-based modelling in agricultural soils

CROP MODELLING TO SUPPORT SPATIAL N MANAGEMENT IN UK WHEAT

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Heterogeneous soil properties within fields can vary as much as they do across regions, causing spatial and temporal variation in crop growth and nutrient demand. For wheat economic optimal nitrogen (N) has been demonstrated to vary by >150 kg N ha-1 with N fertilizer recovery ranging between 30%-100% within fields. Spatially accurate N fertiliser application can, therefore, improve nutrient use efficiency as a whole field/system and forms the foundation of precision agriculture. Current spatial management technologies focus on economic return, with little consideration to environmental consequences. The challenge is balancing these often conflicting, demands. Crop models describe changes in systems in response to weather or management, quantifying how these impact interacting components including crop, soil, and system losses. Crop simulation models could identify spatially specific management strategies considering both economic and environmental impacts. To develop the technology in the context of UK wheat; firstly, a systematic review of the literature using crop simulation modeling for PA globally was performed identifying key themes for methodology development. Secondly, using the high spatial-temporal data resolution from a long term experiment the Sirius crop model was calibrated and validated across observed spatial-temporal variation in soil properties and crop growth. Thirdly, a methodology for whole farm yield map geo-spatial analysis was developed to reduce the spatial data demands for crop model parametrisation on farm. Targeted sampling based on homogenous management zones was used to spatially parametrise, validate, and apply crop simulation models to manage spatial variation across the homogenous yield zones identified. This research has demonstrated the applicability of crop simulation modeling for making spatially relevant on farm N management decisions. Future work aims to develop rotational modeling approaches and further experimental modeling to explore how models can be used to make more informed soil management decisions.

Keywords: Crop simulation models, Precision Agriculture, Nitrogen, Spatial variability, Applied modeling

ID ABS WEB: 137098

6. Soil in the digital era
6.06 133437 - Novel approaches to process-based modelling in agricultural soils

NOVEL APPROACHES TO REPRESENT REGENERATIVE AGRICULTURE MANAGMENT IN THE MEMS MODEL

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Soil carbon sequestration stands as a critical strategy for mitigating climate change by reducing atmospheric CO_2 levels. Regenerative agriculture has emerged as a promising way for enhancing carbon sequestration in soil. While traditional soil carbon models have been utilized to estimate sequestration potential, the latest generation of models use measurable soil carbon pools and incorporate an updated understanding of decomposition processes, but they are yet to be widely adopted to simulate the impact of regenerative agriculture. The MEMS ecosystem model, initially designed for grassland systems, has recently been developed to simulate annual crop and forage growth, as well as cropland and grazing land regenerative management practices. Through calibration and validation across diverse systems and environments, this model's results will be presented and discussed. The novel approaches built in the model enhance our comprehension of carbon sequestration in regenerative agriculture, offering valuable insights to develop effective strategies in the fight against climate change.

Keywords: MEMS model, soil organic carbon, regenerative management, cropland, grassland

ID ABS WEB: 138004

6. Soil in the digital era
6.06 133437 - Novel approaches to process-based modelling in agricultural soils

DEVELPOMENT OF A DECISION SUPPORT SYSTEM TO SUPPORT THE ADOPTION OF REGENERATIVE AGRICULTURE

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Over 60% of European soils exhibit signs of degradation, and compelling scientific evidence indicates that this phenomenon persists due to unsustainable land management practices, soil sealing, contamination, and overexploitation. The repercussions of degraded soils extend significantly, adversely impacting essential ecosystem services such as food production, carbon sequestration, and water regulation, among others. Despite the annual challenges faced by many farmers due to climate change and soil degradation, the adoption of conservation or regenerative agriculture remains surprisingly low. This can be attributed to various factors,lack of trust in new agricultural technologies stemming from limited accessible information and scientific evidence.

The lack of experimental studies that suit local conditions contribute to a steep learning curve in the adoption of regenerative agriculture technologies in different geographical regions. Despite large number of global studies on regenerative in various combinations over the past decades, their widespread adoption faces obstacles. In our research, we sought to amalgamate pertinent archival information from scientific literature with on-farm research findings. Additionally, for benchmarking purposes, we incorporated a national soil monitoring database containing soil physical, chemical, and biological information.

Our objective was to developa machine learning-based Decision Support System (DSS) that facilitates the intensification of conservation and regenerative technologies among farmers. The DSS relies on a farm-specific database encompassing soil properties, landscape characteristics, climate, crop rotation, mechanization, input usage, and yield information. This data enables the identification of key weaknesses in agricultural practices. Subsequently, the DSS matches relevant technologies from analogous environmental conditions and models their effects on key environmental indicators and farm profitability. The DSS then ranks these pathways based on low-cost, and high-impact considerations.

Keywords: Machine Learning, Remote Sensing, Regenerative Agriculture

ID ABS WEB: 138238

6. Soil in the digital era
6.06 133437 - Novel approaches to process-based modelling in agricultural soils

MODELLING THE DYNAMICS OF AGRICULTURAL SOILS AND THEIR IMPACTS OF WATER QUALITY

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The ASSIST/Agzero modelling framework is an integration of two terrestrial process-based models (The Rothamsted Landscape model and NCP14) and a hydrological model (LTLS-freshwater model or LTLS-FM). The Rothamsted Landscape Model simulates processes in agricultural soil, including dynamics of organic matter, nutrients and water. It also simulates livestock production, crop growth and yield, including interactions with arable weeds. The UKCEH N14CP model simulates soil and vegetation processes in semi-natural areas. The new coupled model framework has been used to predict soil-nutrient delivery to rivers across Great Britain at a 5km x 5km scale. Here we describe the development of an erosion module that is integrated into RLM. We apply various near-future scenarios for land use and management change and use the modelling framework to predict the impacts on outcomes including soil-nutrient loss to water.

Keywords: Agricultural systems modelling, Erosion, Fresh water, Nutrient loss

ID ABS WEB: 138289

6. Soil in the digital era
6.06 133437 - Novel approaches to process-based modelling in agricultural soils

SOIL GHG MITIGATION POTENTIAL AND ECOSYSTEM MODEL UNCERTAINTY QUANTIFICATION

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The DayCent plant-soil system model is used to calculate GHG emissions from most cropped and grazed soils in the USA reported in the National GHG Inventory and submitted to the UNFCCC. The model can also be applied to estimate the impacts of different management practices on soil N losses and C changes. We present results comparing the N and C consequences of management interventions such as use of enhanced efficiency fertilizers, reduction in tillage intensity, and growing cover crops. It is important to rigorously quantify uncertainty in both baseline emissions and mitigation potentials. Simplifications imbedded in model structure, imprecise values for model parameters, and uncertainty in input data contribute to overall model prediction uncertainty. We compared two methods for quantifying uncertainty, a Bayesian approach and an empirical-based method. Both are integrated into the DayCent architecture developed for the national GHG inventory. We calibrated DayCent with a Bayesian model analysis framework using different long-term cropland and grassland experimental sites, and then simulated C stock changes with random-draws from the posterior distributions. With the empirical-based method, we simulated experimental sites with DayCent and then developed a statistical model to estimate the accuracy of the predictions. We compared the estimates and uncertainties from both methods for predicting soil C changes from a region in the US corn belt. We also partitioned the total uncertainty among various sources to inform management of uncertainty.

Keywords: soil GHG flux, biogeochemistry, ecosystem model, DayCent

ID ABS WEB: 136061

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

EFFECTS OF EPHEMERAL GULLIES ON TILLAGE TRANSLOCATION AND TOTAL SOIL EROSION—MEASUREMENT, MODELING AND VALIDATION

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Ephemeral gullies are channel features created by water erosion on sloping landscapes. They are often flattened by tillage operations to prevent them from developing into classic gullies. Locations of the ephemeral gullies are mostly determined by topography thus they reoccur at the same locations year after year. This repeated cycle of creation and filling of ephemeral gullies can significantly affect the overall soil erosion in the field. In this study, we carried out a plot experiment to measure the effects of existing channels (ephemeral gullies) on tillage translocation. Tillage translocation were measured under three tillage treatments: downslope (DT), upslope (UT), and contour tillage (CT) with three channel treatments: no channel (C0), 10 cm by 10 cm channel (C10), and 20 cm by 20 cm channel (C20). The results indicate that for DT, the presence of a channel reduced total translocation, whereas for UT, it increased total translocation. For CT, the presence of a channel increased both forward and lateral soil translocation, and therefore total translocation. The results were used to develop a modified version of the Directional Tillage Erosion (ModDirTillEM) to simulate tillage erosion. This model was combined with the Raster-RUSLE2 (RUSLER) for sheet/rill erosion and the Ephemeral Gully Erosion Estimator (EphGEE) for gully erosion to simulate both tillage and water erosion in two sites in Atlantic Canada. The model estimated erosion rates were validated against field measurements using the Cs-137 technique. It was found that the models provided reasonable estimations for individual erosion processes. The integrated model was able to provide accurate estimations of total soil erosion for most parts of the fields. However, around the ephemeral gully areas, errors and uncertainties were high. This highlights the dynamic nature of soil redistribution in the ephemeral gully areas, which calls for higher density in both temporal and spatial scales for soil sampling or modeling in these areas for soil erosion assessment.

Keywords: Channel, Interactive erosion processes, Cs-137

ID ABS WEB: 136289

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

CHARACTERISTICS OF SOIL ERODIBILITY IN HUBEI PROVINCE OF CHINA

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Large-scale evaluation of the soil erodibility factor (K) for the topsoil layer plays a crucial role in formulating soil and water conservation strategies. A notable challenge in Hubei province of China has been the dearth of spatial soil data necessary for calculating the K-value across various soil and water conservation zones. The objective of this study was to investigate the distinctive characteristics of K values across the eight diverse soil and water conservation zones in Hubei Province. To achieve this, we collected 556 soil datasets encompassing metrics such as soil particle composition, soil organic carbon (SOC), land use, and parent materials through the National Soil Survey. These datasets covered different zones (DJK, NY, DB, MF, TB, JH, DT, and EY) and were employed in computing the K-values using the EPIC model. The results showed that soil erodibility K value ranged from 0.0157 to 0.0545 t•hm2•h (hm2•MJ•mm)-1 with a mean value of 0.0382 in Hebei. Notably, K exhibited its highest value in the DT zone and its lowest in the TB zone. The spatial variability of the K value across the eight zones was related with the land uses and the underlying parent materials. The K values followed an order of badland (0.0403 t•hm2•h (hm2•MJ•mm)-1) >upland>paddy field>forest>mud flat>shrubland>garden>grassland (0.0353 t•hm2•h (hm2•MJ•mm)-1), with this pattern being attributed to the influence of SOC. The red soils derived from quaternary sediments, calcareous soils originating from carbonate rocks, and purple soils derived from purple sandstones and shales exhibited the highest K values on average, followed by the soils originating from fluvial & lacustrine deposits, quartz rocks, mudstones, red sandstones and shales, basic crystalline rocks, acidic crystalline rocks, and neutral crystalline rocks. The results can provide reference for predicting soil erosion and facilitating the development of zone-specific soil management plans within the soil and water conservation zones in Hubei province in the future.

Keywords: Soil erodibility, EPIC, Land use, Soil texture, Hubei

ID ABS WEB: 136321

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

REGIONAL SOIL EROSION MAPPING - A REVIEW AND PROPECT

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This study reviews the researches of soil erosion mapping over the past 90 years, summarizes the achievements, identifies knowledge gaps that need further investigation, to provide theoretical references for global soil erosion mapping efforts.
'Reconnaissance Erosion Survey of the United States' of 1:5,000,000 published in 1935, which marking the beginning of large-scale regional soil erosion mapping. In the 1940s to 1960s, China and the former Soviet Union conducted national soil erosion mapping. In the late 1980s, remote sensing and GIS technology were applied to soil erosion survey and mapping. With the accumulation of scientific data and the improvement of computing capabilities, large-scale soil erosion mapping entered the fully digital mapping stage in the 21th century.
The scientific achievements of soil erosion mapping so far can be summarized as follows. A large amount of data has been generated and accumulated, a scientific and visual ontology for large regional (national to global) soil erosion research has been created, historical background and baseline for the study of dynamic soil erosion at large regional scales have been provided, the classic paradigm of regional soil erosion mapping has been developed.
However, researchers of regional soil erosion mapping has to face several challenges that need to be overcome.
Researches on regional soil erosion mapping should be conducted in the following areas: develop innovative paradigms for digital soil erosion mapping, improve the theory of regional soil erosion influencing factors and algorithms for generating data products of soil erosion factors, legacy data rescue, systematic analysis and application of soil erosion maps.

Keywords: Soil erosion modelling, Global Soil Erosion mapping, Regional soil erosion mapping, Soil and water conservation, Soil erosion of the world

ID ABS WEB: 136334

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

CALCULATION AND ANALYSIS OF SOIL ERODIBILITY FACTOR (K) ON A GLOBAL SCALE

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The soil erodibility factor (K) is the main parameters for large-scale soil erosion mapping using USLE/CSLE, is usually estimated uses soil physicochemical attributes and models, such as USLE-K, RUSLE2-K, EPIC-K, Dg-K. However, it remains to be studied which algorithm is more suitable to calculate K in the global scale. While, K is mostly calculated based on soil physicochemical attributes, which does not including the content of rock fragments which actually impact the K. In this study, USLE-K, RUSLE2-K, EPIC-K and Dg-K and SoilGrids v2 were used to estimate the global K and generate a K maps with 1km resolution, and analyze the spatial pattern and main controlling factors of the estimation results. The 106 point measured data of K were collected, and a database was established. The applicability of the calculation results of the above four algorithms was analyzed, and the estimated values of the four algorithms were modified. Then the USLE-K algorithm was taken as an example to calculate the effect of rock fragments in the soil profile and rock fragments on the soil surface. The results showed that (1) The spatial pattern of global K factors estimated by the USLE-K, RUSLE2-K, EPIC-K and Dg-K models is similar, with some extent different in statistical distribution. (2) The mean value of the result estimated by RUSLE2-K is the closest to the measured K factor, followed by the USLE-K algorithm and the EPIC-K algorithm, while the estimated K by Dg-K algorithm is quite different from the measured K factor. (3) The presence of rock fragment in the soil profile increases the global K by 2.84%. The rock fragment on the soil surface reduces K by 6.98%. The most affected soil types are Arenosols, Cambisols, Leptosols, etc. This study is of great significance for the global soil erosion mapping. An earlier version of this research data was made available to the FAO Global Soil Erosion Mapping Group in 2019.

Keywords: Soil erodibility factor, Soil erosion, Rock fragment, Rock cover, Soil and water conservation

ID ABS WEB: 136367

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

A MULTISCALE STUDY ON THE SPATIAL DISTRIBUTION AND DEVELOPMENT PATTERNS OF EPHEMERAL AND PERMANENT GULLIES

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Gullies have become significant issues in the Mollisol region of Northeast China, threatening national food security. Ephemeral and permanent gullies are the primary types of gullies. Many permanent gullies originate from ephemeral gullies, and once ephemeral gullies transform into permanent gullies, it signifies the destruction of soil resources, making remediation extremely challenging. This study extensively utilized high-resolution remote sensing and GIS spatial analysis at the regional, watershed, and hillslope scales to investigate gullies spatial distribution and development patterns in the Songnen Mollisol region of China (214,000 km2). The main findings are as follows:
(1) A stratified systematic sampling approach was employed at the regional scale to establish about 1000 small watershed units. Ephemeral gullies and permanent gullies were investigated based on sub-meter resolution imagery. Furthermore, field surveys of gullies and centimeter-level unmanned aerial vehicle (UAV) remote sensing surveys were conducted in 50 randomly selected small watersheds. By considering influential factors such as climate, soil, topography, and management practices associated with gully development, the spatial distribution patterns of ephemeral and permanent gullies in the Songnen Mollisol region were elucidated.
(2) At the watershed scale, we studied the dynamic development of gullies over the past decade. This research clarified the development rates, distribution patterns, and topographic threshold of ephemeral gullies transitioning into permanent gullies within ten years. This quantification of the impact of ephemeral gully development on the black soil region of Northeast China provides essential insights.
(3) At the hillslope scale, based on GNSS RTK measurements of morphological parameters of gullies during multiple runoff events in nine typical slopes over a two-year period. Developmental patterns of ephemeral and permanent gullies along hillslopes from top to bottom were analyzed. The key areas where ephemeral gullies transition into permanent gullies at the slope scale were accurately simulated.
This study can serve the national gully control efforts and provide scientific evidence and technical support for preventing and controlling black soil degradation.

Keywords: soil erosion, gully, spatial distribution, high-resolution remote sensing, field survey

ID ABS WEB: 136370

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

VALIDATIONS OF RAINFALL EROSIVITY ESTIMATED WITH HIGH SPATIOTEMPORAL RESOLUTION GRID PRECIPITATION DATASETS IN CHINA

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Rainfall erosivity is the key driving force of water erosion, which is the product of the total kinetic energy of a rainfall and the maximum 30-minute rainfall intensity, reflecting the ability of rainfall to detach soil, form runoff and transport sediment. Accurate values of rainfall erosivity depends on high temporal resolution rainfall data, and regional water erosion assessment needs high spatial resolution rainfall erosivity data. Current available grid precipitation datasets with both high temporal and spatial resolution make this possible. This study selected four datasets from year 2001 to 2020, GPM (The Final Run V06B Integrated Multi-satellite Retrievals from Global Precipitation Measurement) 30min and daily rainfall with 0.1° grids, ERA5 (an enhanced global dataset for the land component of the fifth generation of European ReAnalysis) 60min and daily rainfall with 0.1° grids, to calculate and then to evaluate the accuracy of average annual erosivity estimation by comparing the calculations with 60min rainfall data from 2399 weather stations over mainland of China. When grid datasets were used directly in erosivity equations, the calculated results of the four data sets were obviously low with the GPM data better than the ERA5 for both daily and 30min data, but there were regional differences. The 30 or 60min results were significantly lower than the daily results, which means the grid data might reduce local rainfall heterogeneity under high temporal resolution conditions, and could not be directly used. After developing a conversion coefficient by regressing annual erosivity calculated with four datasets to that with 60min rainfall data from weather stations. The annual erosivity values of four datasets were improved with 0.862 and 0.667 of Nash coefficients for GPM and ERA5 daily data respectively and 0.893 and 0.746 for 30min or 60min data respectively. This study proved the potential abilities of four grid precipitation datasets in estimation of average annual erosivity with high spatiotemporal resolution, and provided a calibration method by using local measured precipitation data.

Keywords: Rainfall erosivity, Regional soil erosion assessme, High spatiotemporal resolution, grid rainfall data

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6. Soil in the digital era
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THE USE OF RUSLE MODEL AND BATHYMETRIC SURVEY TO UNDERSTAND SOIL EROSION AND RESERVOIR SEDIMENTATION

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The aim of the paper was to compare the sediment transferred by a river catchment to the sediment volume accumulated at the river mouth. First, the sediment transferred was estimated in GIS based on the soil loss according to the RUSLE model further integrated into the sediment production equation. Then, the sediment volume accumulated at the river mouth was estimated by the diachronic overlap of topographic and bathymetric data. This methodology was validated for a case study in South-Western Romania, in the temperate climate with Mediterranean influences. Following the Iron Gate I Reservoir construction on the Danube River, the water level increased upstream and flooded river mouths. Small “gulfs” formed as in the case of the Eselnita River. Despite the extended forest cover, the Eselnita catchment is prone to erosion due to the high slope, sandy soils, and intense rain events. For the Eselnita catchment case study, the sediment production obtained by the RUSLE model corresponds to about 70% of the sediment volume accumulated at the river mouth during 53 years. The distribution of sediments indicates the prevalence of the sediments transported by the Eselnita River and a lesser input of alluvium washed from the slopes directly into the lake. The difference in sedimentation may be due to human activities on the river mouth banks to extend the built-up area and enjoy the waterscape. The RUSLE model enabled the identification of locations with a high potential for erosion, influenced by land use, soil properties, rainfall and runoff impacts, relief morphometry and anthropogenic activities. The highest erosion potential indicated by this equation corresponds to the strongest anthropogenic pressures introduced into the land by overlapping many activities. Sediment production depends on the transfer function, which is strongly influenced by the distance to the channel of each cell in the subbasins and is greatest for close cells with near-instantaneous discharge.

Keywords: Soil erosion, RUSLE, Bathymetry, Sedimentation, Reservoir

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6. Soil in the digital era
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ASSESSMENT OF SOIL WIND EROSION IN THE PAN-THIRD POLE REGION

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The Pan-Third Pole region (PTP) (covering an area of approximately 5.14×107 km2) is ecologically fragile, with intense soil water and wind erosion making greater threats to the socio-economic development of the region. An accurate assessment of wind erosion is the basis for soil conservation. Soil wind erosion in the PTP from 1982 to 2020 was calculated using the RWEQ, based on meteorological, soil, topographic, and vegetation indices data. The results showed that: (1) Soil wind erosion in the PTP mainly occurs in cropland and grassland in semi-arid areas, and aeolian landform as natural landscapes primarily occurring in extremely arid and arid areas, the average wind erosion rate is 633.65 t•km-2•a-1, of which the mean soil wind erosion rate in the area where wind erosion rate is greater than 50 t•km-2•a-1 is 4,316.94 t•km-2•a-1, for cropland, grassland, and scrubland were 1,981.14 t•km-2•a-1, 3,815.05 t•km-2•a-1, and 4,010.95 t•km-2•a-1, respectively. (2) From 1982 to 2020, the soil wind erosion rate in the PTP decreased by 10.61 t•km-2•a-1. The proportions of area with decreasing and increasing trends were 19.53% and 28.35%, respectively. (3) Soil wind and water combined erosion mainly occur in the northern of Syria, the Indus River Plain, the northern border of Iran and Afghanistan, the southwestern of the Qinghai-Tibet Plateau, central Mongolia, the central of the Loess Plateau, Inner Mongolia, and the bordering areas of the three eastern provinces, the average soil erosion rate is 4,534.77 t•km-2•a-1, for grassland and cropland being 4,752.41 t•km-2•a-1 and 1,495.68 t•km-2•a-1, respectively. This study provides a more comprehensive knowledge of soil wind erosion in the PTP, and will support the soil conservation planning, and global soil erosion mapping. However, further study is needed to evaluate the reasonableness and uncertainty analysis of the mapping, and the interaction between water and wind erosion.

Keywords: Pan-Third Pole region, Soil wind erosion, RWEQ

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6. Soil in the digital era
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CONTENTS, METHODOLOGIES AND APPLICATIONS OF REGIONAL SOIL EROSION ASSESSMENT AND MAPPING —FROM THE PERSPECTIVE OF SOIL CONSERVATION NEEDS

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Soil erosion mapping serves various purposes, the most significant one is to support soil conservation. Small-scale mapping aims to choose soil conservation practices, while at large scale, is to determine soil conservation needs. This study targets soil erosion assessment and regional scale mapping from the soil conservation perspective. By analyzing existing soil erosion maps across different scales, we clarified that the main content of regional-scale erosion mapping focused on the proportion of soil loss area, which referred to the percentage of the area with soil erosion rate exceeding the soil loss tolerance. Two methods employed at the regional scale for the above issue include sampling and grid-based methods. The former provides high accuracy at the sampling units while having uncertainties in spatial distribution. The grid-based method ensures full coverage of the entire region, thus benefitting spatial distribution. However, due to the challenges of obtaining high-resolution input factors for large areas, the accuracy of the results is insufficient to meet the requirements. To address the above issues, this study employed a stratified unequal probability systematic spatial sampling method to conduct regional erosion assessment, with detailed erosion factors investigated within each sample unit. Over 50,000 units were explored in China and 64 neighboring countries. The Chinese Soil Loss Equation (CSLE) was used to calculate the proportion of soil loss area and averaged erosion modulus for each sampling unit. The results were validated through field surveys, 137CS measurements, and runoff plots. An upscaling method was explored to upscale the soil erosion assessment results from the sampling units to regional scales. As a result, spatial distribution maps of the proportion of soil loss area and erosion modulus were generated for the whole region, providing a clear understanding of the areas and spatial distribution that require soil conservation practices. This study may provide a methodological and data reference for global soil erosion mapping.

Keywords: soil and water conservation, soil erosion mapping, regional scale, sampling method

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6. Soil in the digital era
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AERIAL PHOTOGRAPHS AS A TOOL FOR DETERMINING THE SOIL ORGANIC CARBON STOCKS VARIABILITY RESULTING FROM EROSION PROCESSES. PRELIMINARY STUDIES IN MORAINIC AREAS OF NORTHERN POLAND

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Soil erosion is one of the main factors leading to the redistribution of soil organic carbon (SOC) pools in the humus horizons. Truncation of soils located on the tops of hills and in the upper parts of slopes and the accumulation of humus material in footslope/toeslope position leads to changes in the properties of surface soil horizons like texture, colour or humus content. The aim of study is to assess the SOC stocks in humus horizons of agricultural soils in the context of their diversity resulting from erosional transformations visible on aerial photographs. SOC pools were calculated for 139 soil profiles located within arable moraine plateaus of Northern Poland. The most heavily truncated Regosols (summits of hills - light brown in the aerial photos) had resources of SOC at 2.5 $kg \cdot m^{-2}$. The clay-illuvial soils with argic horizons (mostly Luvisols) are most common in the research area. The average carbon stocks in these soils were 3.28 $kg \cdot m^{-2}$. In the group of eroded clay-illuvial soils located in upper, convex parts of slopes and with brown colours of surface horizons (due to the exposure of argic horizons on the surface) this amount decreased to 1.40 $kg \cdot m^{-2}$. Non-eroded or slightly truncated pedons of clay-illuvial soils characterized by a light brown color and location in the middle and lower part of the slopes had 4.11 $kg \cdot m^{-2}$ of SOC stocks. In areas with poor drainage Gleyic Chernozems and Gleysols with well developed and very dark on aerial photos humus horizons dominated. In non-eroded pedons with such dark A horizons SOC resources were about 10.6 $kg \cdot m^{-2}$. There were also spots of a lighter color on aerial photos, where soils with SOC stocks at 6.8 $kg \cdot m^{-2}$ were slightly shallowed by erosion. The accumulation of slope materials in the depressions led to an increase of SOC stocks to the 15.2 $kg \cdot m^{-2}$. The conducted research indicates considerable possibilities of aerial photos application in creating detailed maps of the SOC stocks.

Keywords: arable soils, soil organic carbon stocks, erosion, Luvisols, Chernozems

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

TRACING TEMPORAL SOIL REDISTRIBUTION RATES FOLLOWING DEFORESTATION USING 239+240PU AND RE-SAMPLING APPROACH

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Accelerated soil erosion and deposition processes pose major threats to soil health and ecosystem services in forested landscapes, particularly following intensive practices such as whole-tree harvest. These disturbances drastically alter soil dynamics, leading to increased soil erosion and deposition rates, which subsequently affect soil properties and carbon storage. At the Hubbard Brook Experimental Forest (HBEF) in NH, USA, a whole-tree harvest experiment was conducted from 1983-1985 in a small watershed to evaluate the long-term impacts of deforestation on the carbon budget, soil properties, cycling of nutrients, and vegetation regrowth. Our prior study at HBEF assessed the impact of whole-tree harvesting on soil redistribution rates using 239+240Pu and found concerning erosion rates and deposition rates. Those findings represent an average of approximately 60 years of redistribution processes, However, information on how soil redistribution rates have evolved after whole-tree harvesting in northern hardwood forests is still missing. In this study, we aim to examine the long-term effects of whole-tree harvest on soil redistribution rates by using 239+240Pu and re-sampling approach. We expect to understand how soil erosion and deposition rates have changed since the deforestation. We hypothesize that soil redistribution rates were initially higher and decreased rapidly, influenced by the swift regrowth of bushes and trees in the years following deforestation. To assess soil redistribution rates, we employed a re-sampling approach combined with the use of 239+240Pu isotopes as soil erosion tracers. Samples were initially collected in the years 1983 (pre-deforestation), 1986, 1991, 1998, and 2022.The soil subsampling from the HBEF archive occurred in November 2023. The samples have been analyzed for 239+240Pu isotopes, and our next steps include calculating Pu inventories and determining the rates of soil erosion and deposition. By elucidating the temporal patterns of these redistribution processes, we will be able to better predict the recovery timeline of the hillslopes. This knowledge is crucial for developing forest management practices aimed at preserving soil health and enhancing carbon storage.

Keywords: 239+240Pu, Soil erosion rates, Soil redistribution rates, Deforestation, Re-sampling approach

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

CALCULATION OF THE VEGETATION COVER AND BIOLOGICAL PRACTICE FACTOR IN THE REGIONAL SOIL EROSION SURVEYS AND MAPPING

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Vegetation cover is a crucial factor affecting soil erosion, and its high-precision mapping plays a considerable role in assessing regional soil erosion. In the Chinese Soil Loss Equation (CSLE), the Vegetation and Biological Practice Factor (B factor) reflects the impact of forest and grass canopy cover and ground cover on soil erosion. Canopy cover is calculated using NDVI to determine the Fractional Vegetation Cover (FVC), while ground cover is calculated either through field surveys or using Non-Photosynthetic Vegetation (NPV) cover, obtained through the Pixel Tripartite Model inversion. This study employed slightly different methods to obtain ground cover of arbor forest for different growth seasons in three projects: the Qinghai-Tibet Plateau, China, and the Pan-Third Pole region. (1) In the Qinghai-Tibet Plateau and Pan-Third Pole region, arbor forests were divided into evergreen and deciduous categories. Evergreen forests were assigned values based on the relationship between canopy cover and ground cover, while deciduous forests used NPV cover in winter. (2) In the project of China, ground cover from sampling points was combined with observed annual variations in ground cover for calculation. Both methods yielded satisfactory results. Based on the calculated canopy and ground cover, B factor was finally computed at both the survey unit scale and regional scale, which can be directly used in the soil erosion model to calculate the soil erosion rate. The successful implementation of these methods not only provide practical solutions for regional B factor mapping but also offer important data support for the mapping of global soil erosion.

Keywords: Soil erosion, vegetation cover, Biological practice factor, CSLE/USLE, soil erosion model

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

EFFECT OF UNDERSOWN CROPS AND STRIP TILLAGE AT REDUCING SEDIMENT AND PESTICIDE SURFACE LOSSES IN MAIZE CROPS

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Soils of the European loess belt are susceptible to runoff and erosion when intensively cultivated. Besides the loss in soil resources, the transfer of runoff, sediment and pollutants from cropland threatens the quality of surface water bodies, and causes muddy floods damaging rural infrastructure. To alleviate such externalities, we assessed the effectiveness of two cropping practices at mitigating water, sediment, and pesticide surface flows in maize crop by means of erosion plots under natural rainfall during the 2021, 2022 and 2023 cropping seasons. Conventionally tilled sole maize crop (control) was compared to 1) maize with red fescue or white clover sown in the inter-row at the same time as maize and 2) maize sown under strip-tillage, which consists in tine-tilling the maize row only, leaving inter-row undisturbed. All treatments were implemented in triplicate, on two trial sites each year. Results from the undersown plots showed no significant difference in seasonal runoff, soil and pesticide (sulcotrione) losses compared to the control practice, on any of the trials. This is because most soil and pesticide losses occurred in the spring, when both the undersown crops and maize were still poorly developed. When strip tillage was performed after a well-developed winter cover crop, and excluding trials with very low magnitude in surface flows, a statistically significant difference ($p<0.1$) between strip-tillage and the conventional practice was observed regarding seasonal runoff (mean mitigation effect of -69%), soil (-85%) and sulcotrione (-66%) losses. In contrast, when strip-tillage was performed on bare soil or after a poorly-developed winter cover crop, no significant differences were observed. Given that the success of strip-tillage in terms of surface flow mitigation appears closely related to the development of the previous winter cover crop and its effect on soil structure, a future albeit challenging avenue could lie in the use of a process-based model to identify the environmental and cover crop management conditions that would ensure a high mitigation effectiveness of strip-tillage.

Keywords: crop management, plot, maize, runoff, soil conservation

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

PROPOSAL AND PURPOSE OF A DATABASE FRAMEWORK OF CLIMATE CHANGE MORPHO-SEDIMENTARY MARKERS FROM TEST SITES OF SOUTHERN ITALY

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Climate changes in the Mediterranean area over the last 200 years followed the end of the Little Ice Age. In the last decades, global change effects are also affecting large parts of internal and rural areas of southern Italy. For example, climate seems to be a major driving factor, as well as human factors, in the recent fluvial dynamic evolution in several Italian regions. Very fast climate and environmental changes are impacting river systems inducing assessable morphological variations. Further, the intensity of extreme rainfall events represents trigger and driving factor for fluvial erosion and mass-wasting processes, in terms of efficiency and rates, which affect the slope stability in badland areas.
Erosion rates of landforms characterized by complex hydro-geomorphological dynamics, intense erosion processes, and sediment yield, are valuable for the understanding of soil erosion processes and geomorphic changes due to extreme events. Similarly, river systems provide a potential record of landscape evolution in a particular climatic framework. So, measuring geomorphic parameters means monitoring and understanding river evolution over time.
The analysis of some categories of markers, such as the geomorphological and sedimentary ones, in key areas where climate changes may cause environmental hazard seems a best practice for the territory safeguard. Geomorphological and sedimentary markers of climate change in rural areas of Basilicata, referred to both streams and slopes, are here listed:

- channel bed modifications;
- accelerated erosion landforms/soil erosion processes;
- drainage density variations;
- erosion rates;
- sedimentation rates;
- sediment connectivity evolution;
- rainfall/temperature multi-temporal values; dry/wet periods distribution; flood events frequency.

These parameters can be measured by applying different techniques (direct or indirect – field surveys, Internet-of-Things, DoD, remote sensing techniques, historical data), using appropriate spatial (from channel to catchment) and temporal scales (long-, medium- and short-term monitoring). Such a multi-scale approach will provide different inputs for the understanding of evolutionary trends, aiming to provide an operational protocol for the climate change impact assessment approach.

Keywords: Soil erosion, Global change, Environmental modelling, Soil conservation, Shallow landslides

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

INTEGRATED GIS-BASED METHODOLOGY TO ASSESS HOTSPOTS OF SEDIMENT SOURCES IN MEDITERRANEAN WATERSHEDS: A VALUABLE TOOL SUPPORTING DECISION-MAKERS TOWARDS A SUSTAINABLE WATERSHED MANAGEMENT

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Soil erosion and land degradation are among the main threats to agricultural landscapes such as Mediterranean agroecosystems. Assessing the variety of geomorphic processes at the different spatio-temporal scales must be considered for identifying hotspots of sediment dynamics, as to support decision-makers in a sustainable watershed management. However, there is a lack of integrated methods that combine geomorphic spatial data with a comprehensive approach to sediment dynamic modelling.
Therefore, we introduce a novel methodology that integrates geomorphic data derived from a detailed digital mapping with structural and functional components of sediment connectivity. In particular, a new GIS-based model named HOTSED was developed, designed to assess potential hotspots of sediment sources and related dynamics at the watershed scale.
We tested our approach in an agricultural-forested watershed in the Northern Apennines (Italy), starting with the elaboration of an Inventory Map of sediment sources. Then, we estimated the geomorphic potential of sediment sources with a relative scoring system. Moreover, we simulated the structural sediment connectivity and the sediment transport potential by combining terrain/hydrological parameters, land use data, and rainfall erosivity. Finally, the integration of these components was achieved through a raster-based calculation method.
HOTSED provides a holistic assessment of sediment sources and related dynamics allowing to detect emergent properties of the landscape through a unique and intuitive output. The results show that the model successfully identified hotspots associated with complex and polygenetic geomorphic systems. They are located in areas close to the main channels, which mostly include processes like rill-interrill and badland erosion and/or landslides associated with bank erosion. Moreover, it identified areas prone to store sediments in depositional landforms with low geomorphic potential and low connectivity.
HOTSED offers a valuable tool supporting decision-makers towards a sustainable watershed management. Moreover, the identification of hotspots of sediment sources allows for a preliminary evaluation of the contribution of different processes to sediment dynamics using sediment fingerprinting (e.g., unravelling lithological and land use features as controlling factors).

Keywords: Sediment connectivity, Sediment dynamics, Sediment sources, Watershed management, Integrated model

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

SEDIMENT CONNECTIVITY AND FRACTALS: AN APPROACH TO EXPLORE WATER EROSION DYNAMICS

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Water erosion sets a significant contemporary challenge, particularly in hilly areas, where surface runoff can mobilize large amounts of sediment to rivers. Assessing potential soil erosion involves studying relationships between sediment sources and sinks within a watershed (i.e. sediment connectivity). Sediment connectivity involves both structural and functional aspects and can be evaluated using specific indexes such as the Index of Connectivity (IC). Conversely, suspended sediment transport processes are intermittent and fluctuate across various temporal and spatial scales, making it difficult to create predictive models without a site-specific calibration. To overcome this problem, in this study, a data-driven approach for two years monitoring of streamflow (Q) and suspended sediment (SS) was applied for automating the classification of event-based sediment dynamics through machine learning. For each storm event, sediment connectivity was calculated, and the link between sediment transport and deposition was defined by treating SS as a fractal system to describe and predict patterns in SS dynamics across different temporal scales. Analyses of Q, SS and associated grain size distribution were conducted at the event base resolution, considering their probability distribution functions, Fourier power spectra, and machine-learning classification of hysteresis index. The study area was a 1 Km2 agricultural watershed located near Florence (Italy), characterized by different land cover and first-order mixed bedrock alluvial stream channels. High-resolution mapping with a Drone LIDAR scanner and a submersible particle size analyser (LISST) allowed long-term measurement of suspended particle size and volume concentration. Preliminary results highlighted a robust correlation between sediment connectivity, land cover and sediment transport. Q-SS information flows exhibited seasonally varying behaviour aligned with dominant runoff generation mechanisms from wet to dry seasons. However, runoff timing and magnitude reflected significant catchment heterogeneity attributable to baseflow contributions from different lithologies and variations in preferential flow paths (land cover). In conclusion, this study analyzed a small catchment area in terms of sediment connectivity and related sediment transport relations, identifying potential (dis)connectivity areas in the basin.

Keywords: Water erosion, Sediment connectivity, Suspended sediment transport, Fractal system

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

A NEW HIGH SPATIO-TEMPORAL RESOLUTION SOIL EROSION MAP FOR FIELD-SCALE ASSESSMENT IN LAZIO REGION, CENTRAL ITALY

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The EU Soil Strategy for 2030 states that it is essential to step up efforts to protect soil fertility, reduce soil erosion and increase soil organic matter by adopting sustainable land management practices. The recently proposed Directive on Soil Monitoring and Resilience Law would enforce the soil erosion monitoring on a regular basis. Italy, due to its climate and geo-morphology, is one of the European countries most affected by soil erosion, therefore it is critical to implement locally tailored land management actions that mitigate/revert soil losses by erosion.

Modeling can provide a quantitative and consistent approach for estimating soil erosion and sediment yield under current and alternative scenarios. However, due to the geo-morphological and land use heterogeneity of the Italian territory, the granularity of the erosion data must be adequately fine to model field-scale mitigation scenarios.

In the current study, the RUSLE equation was applied to the Lazio region by leveraging locally produced, high spatio-temporal resolution datasets. The study region, due to its high annual rainfall intensity and presence of rolling landscapes, is an excellent pilot area to assess the potential of erosion mitigation strategies. The modeling framework that we built-up can count on:

- a novel, high-resolution (5m) Digital Terrain Model was developed;
- the erosivity factor was estimated from an effectively distributed network of rainfall sensor acquiring at high frequency for 88 stations (covering the period 2012-2023);
- a very high-resolution (0.2m) map of land use-land cover, generated by photointerpretation, was used and complemented with information on arable land from farm documentation;
- a locally produced soil map was used to estimate the influence of the soil properties on the erosional process.

This bottom-up approach supported the development of a novel, 10m resolution RUSLE-based map that allowed the assessment of the soil erosion at the farm level. This can provide support to the CAP Strategic Plan 2023-2027 and the proper application of GAEC to mitigate the erosion severity.

Keywords: soil erosion, land use land cover changes, rainfall erosivity, RUSLE model

ID ABS WEB: 137742

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

SOIL EROSION IN FORESTS: EFFECTS OF PLANT DIVERSITY, TREE TRAITS AND BIOLOGICAL SOIL CRUSTS

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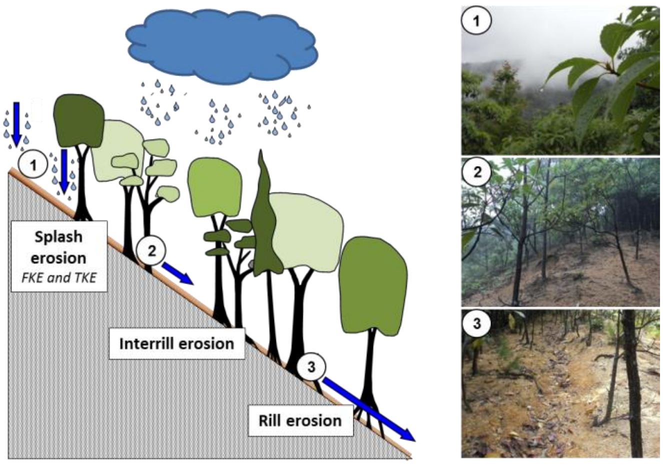
Soil erosion remains a major environmental problem globally, and it is widely accepted that forest cover is a key factor to mitigate degradation. However, severe soil losses can be observed in woodlands, particularly after disturbances. Trees provide a multi-layered canopy which largely affects precipitation patterns. Forest floor cover by plants or plant litter further influences raindrop impacts. The way in which these plant communities and characteristics interact and can mitigate, but also intensify, erosion has been little studied. Here, we summarize results on effects of species diversity, identity, functional traits and the soil covering layer including soil fauna on throughfall and interrill erosion in subtropical, temperate and mediterranean forest ecosystems.

Results show that plant covers do not necessarily have a protective effect against soil erosion and that high rates of sediment and nutrient discharge can occur under forest. Species identity affects initial erosion processes and erosion-promoting and -mitigating species can be clearly identified. That also applies to the leaf litter cover, where single species show varying influences on discharge and are further affected by soil mesofauna. Therefore, the appropriate choice of tree species during the establishment of reforestations plays a major role for erosion control. Moreover, functional tree traits affect soil erosion rates. High crown cover and leaf area index reduce erosion, whereas it is enhanced by increasing tree height. Throughfall kinetic energy is minimized by low leaf area index, low tree height, simple pinnate leaves, a high number of branches and a low crown base height. Higher tree species richness can reduce sediment discharge, although this effect is less pronounced in early successional forest stages. Moreover, biological soil crusts importantly mitigate sediment discharge and runoff generation in forest environments and this effect varies tremendously with specific traits. It can be concluded that the ability of biological soil crusts to quickly colonise soil surfaces after disturbance are of particular importance for soil erosion control under forest.



Keywords: ecohydrology, soil degradation, forest ecosystemes, biodiversity, biocrusts

ID ABS WEB: 137743

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

SANDY SOIL EROSION IN URBAN AREAS: THE COMPLEX CASE OF THE CITY OF NACALA, MOZAMBIQUE

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The coastal city of Nacala, Mozambique has been suffering from extreme soil erosion for decades. In the context of a complex socio-economic conditions, the urban area has been growing uncontrolled and without a proper drainage system. Informal settlements have been constructed on the steep sandy erodible soil of the Nacala's Peninsula. When a relatively extreme rainfall event occurs, even a moderate flood can develop gullies of several meters of depth along the unpaved streets or other paths, posing serious risk to people, buildings and infrastructures (see example in the picture below, taken in December 2022). There is an urgent need to make explicit the potential impact of urbanisation on soil erosion, either by creating awareness about the main drivers and by finding effective solutions with the cooperation of the local inhabitants. In the context of the project "Participa no Desenvolvimento!", a CSO-LA project funded by the European Commission, we explored sustainable measures to prevent erosion. Using a geographic information system (GIS) approach, including the calculation of a spatially-distributed urban-corrected stream power index (SPI), we demonstrated that the rapid urbanisation of the city during the past decades is the main reason for the increased erosion. Moreover, we showed that the high shear stress over the loose soils would require extensive and expensive structural interventions to stabilize the slopes and the formed gullies. Therefore, we selected and pre-designed nature-based and sustainable solutions to prevent erosion. The implementation of the measures should involve the local population and consisted in a combination of:
- reforestation of the remaining bare lands to prevent further soil erosion;
- stabilization of channels with suitable endemic plants;
- proposing a plan of extensive rooftop rainfall collection .

An open-source PCRaster processing tool to calculate the urban-corrected SPI has been developed and made available in QGIS. Particularly, the rooftop rainfall collection measure has been tested with the urban-corrected SPI showing a considerable reduction in erosion potential of the flow.

Keywords: Sandy soil, Erosion, Urban area, Gully, Stream power index

ID ABS WEB: 137808

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

MULTI-TEMPORAL ASSESSMENT OF LAND AND SOIL DEGRADATION DUE TO CHESTNUT MANAGEMENT FROM HYPERSPECTRAL AND MULTISPECTRAL SATELLITE DATA

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Italy is among the main European producer of chestnut, where Campania region provides about 50% of the global production nationwide. Chestnut management vary among countries, although coppicing stands for the most intriguing technique. Assessing how forests react to this technique is key to develop sustainable practices. Coppicing management in chestnut present evidence of soil erosion and land degradation, due to the type of management which include dragging the trunks over soils truncating fertile topsoils.
PRISMA satellite, symbolizes an evolution in earth observation knowledge and opens new prospects to advance hyperspectral data development in forestry applications. The objective of this study is to assess based on hyperspectral and multispectral sensors the: (i) bare soil presence, indicating where and when a pixel was detected as bare surface in a representative forest area, (ii) a clearcut map separating areas caused by coppice treatments from other bare soil occurrence causes, and (iii) impacts of chestnut management on land and soil degradation.
A multi-temporal approach was developed to select bare soil pixels along a satellite time series of five years for both PRISMA and Sentinel-2 data in the regional forests of Campania (Italy). The approach consists of a filtering process for each image, based on selective indices and thresholds, to detect and exclude green and dry vegetation, so keeping only bare soil pixels. The temporal trends of the Normalized Difference Vegetation Index and Leaf Area Index were assessed in bare soil areas caused by coppice treatment, after recognition and delineation. Afterwards, we analyze the spectral signal from forest clearcut areas, comparing it to the spectral signature of uncut forest area, and erosion-effected sites caused by chestnut managements. The notable change in the increment differences between yearly maximum NDVI and LAI defined the spatio-temporal changes of the coppice treatment over the years. We conclude the usefulness of PRISMA sensor to monitor and map bare soil occurrence under coppice managed areas from multi-year imagery in Italian forests.

Keywords: PRISMA, Hyperspectral, Coppice, Bare soil, Soil erosion

ID ABS WEB: 137841

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

QUANTIFYING AND UNRAVELING CAUSES OF SOIL EROSION TRENDS IN CHILE; A STUDY FROM 2001-2020

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Soil degradation is a process primarily triggered by hydric erosion, coupled with overexploitation and inadequate land and soil management, expected to increase in the following 25 years. By 2050, it is projected that 90% of the world's soils will be severely degraded, emphasizing the urgent need to identify vulnerable areas and implement soil recovery practices. Using spatially explicit methodologies is a helpful, cost-effective tool for monitoring soil hydric erosion (SHE), allowing large-scale estimations over multiple years. In this study, we used the Revised Universal Soil Loss Equation (RUSLE) to quantify SHE related to landcover change (LCC) in Chile between 2001 and 2020 across arid, mediterranean, temperate, and cold climates. Using Generalized Additive Models (GAMs), we identified key factors influencing the calculated annual SHE rates. Our model determined a national average erosion rate of 222.289 (Standard Dev = 189.921) tonha-1 yr-1 and net 93,834,163 ton yr-1. We also identified a cyclical trend in SHE, which considers further evaluation. Topography was the primary factor influencing national SHE. The R factor (erosivity) emerged in the Mediterranean climates, and the C factor (vegetation resistance) in Temperate and cold climates. Significantly, landcover types such as croplands and exotic forestry contribute to SHE irrespective of latitudinal variation. Based on our findings, we propose management strategies aiming to mitigate the impacts of landcover and SHE, seeking to alleviate the negative effects of landcover influence. Finally, our study contributes to SHE monitoring because it provides a unique historical perspective on soil degradation, applicable to Chile and worldwide.

Keywords: Soil hydric erosion, Soil degradation, RUSLE, Landcover change, Global change

ID ABS WEB: 137985

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

MODELLING SOIL EROSION BASED ON RAINFALL-CELL-PATTERNS USING WEATHER-RADAR AT REGIONAL SCALE

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Water erosion is one of the most widespread forms of soil degradation and it is expected to increase as an effect of global change, especially due to the amplified frequency of extreme and localised rainfall events. Focusing on the Mediterranean region, where these phenomena produce the most catastrophic erosion, this research aims to model soil erosion focusing on rainfall spatial distribution using precipitations as detected by weather ground-radar upon an analysis of rainfall-cell patterns at regional scale (Tuscany, Italy)
Precipitations were elaborated by adopting a kriging method processing CAPPI (Constant Altitude Plan Position Indicator) reflectivity and rain gauges rainfall with an External Drift Kriging (KED) over a 30' time-step frames and 5' conditional merging images based on elaborations made available by DPCN (Italian National Civil Protection Department). Soil erosion was modelled using the platform based on the soil erosion/landscape evolution model LandSoil under Python coding simulating runoff combining a cinematic wave using St.Venant equations with a conceptual "bucket" model for infiltration, and a two-level sediment redistribution process for rill and inter-rill erosion on a sediment concentration protocol.
Soil erosion was simulated over a selection of rainfall events from the last ten years. Results are illustrated through a combined representation of factors that considers: 1) The land surface affected by the storm (i.e., rainfall-cell subjected to runoff), 2) The involved rainfall energy and erosion rate of the processes, 3) The sediment yield delivered over the erosive event. Such approach, applied to seasonal analysis, opens-up to a methodology for analysing the spatial extent of the rainfall and the erosive effects at ground. Drifts in erosion could be also detected by the use of long-terms rainfall series and return-time of the erosive events, useful to inspect the evolution of the processes due to climate change.

Keywords: Soi Erosion Modelling, Hydrological Modelling, Climate Change, Weather Radar Rainfall

ID ABS WEB: 138047

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

MODELING MULTIPLE SOIL EROSION PROCESSES AT PAN-EUROPEAN AND GLOBAL SCALE

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Healthy soil is essential for agriculture and ecosystem functioning. Changes in soil quality have an impact on the delivery of critical ecosystem services such as food production, water supply, and regulation. Soil erosion is notoriously ephemeral because it is dependent on the nexus of vulnerable soil, weather, and antecedent moisture levels; particularly the occurrence of climate extremes, such as big strong rainfall episodes or droughts with wind. When the right mix of events occurs, positive feedbacks can lead to erosion striking with disastrous environmental and socio-economic consequences. A situation that makes it important to better identify locations where multiple concurrent soil erosion processes may occur.

In this presentation we discuss (i) the geography of soil loss by water, wind, tillage, and crop harvesting erosion; (ii) their possible co-occurrence at EU (Borrelli et al., 2023a) and globally scale (Borrelli et al., 2023b); and (iii) how to better integrate research on soil erosion to improve modeling performances and to support decision-makers in both ex-ante and ex-post policy evaluation.

Acknowledgement. This presentation is part of the project “Accelerating collection and use of soil health information using AI technology to support the Soil Deal for Europe and EU Soil Observatory” (AI4SoilHealth) that received funding from the European Union’s Horizon Europe research and innovation programme under grant agreement No. 101086179.

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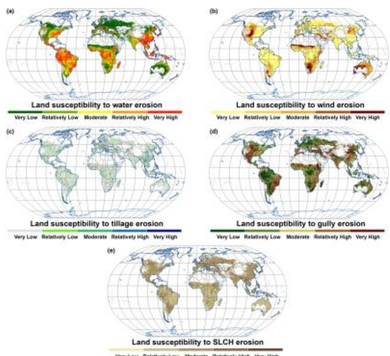

Keywords: Mitigation, European Union, CAP 2023-27, Green deal, Erosion

ID ABS WEB: 138138

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

ESTABLISHING THE CONCEPT OF TOLERABLE SOIL LOSS CONSIDERING EPISODIC EVENTS

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The established soil erosion protection in the Czech Republic is based on the long-term average values and only aims to protect the sustainability of agricultural production. Beyond that, however, real damage occurs episodically with on-site and off-site impacts, the consequences of which must be remediated. It is therefore important to ask whether the definition of the concept of tolerable soil loss is correct and where the limit should lie. To answer this question, the measured volumes of soil loss and the damage they cause need to be compared with the system of limits currently in use. For this purpose, an analysis of the available measured data on soil loss in the Czech Republic was carried out. The results show that soil loss varies depending on the form of erosion and that for higher forms of erosion the tolerable soil loss is significantly exceeded even for a single erosion event. These results are important for understanding the erosion process in the affected areas and for establishing a comprehensive system of soil loss limits.

This research was funded by Technology Agency of the Czech Republic, grant number SS05010180 and European Union's Horizon 2020 research and innovation program grant agreement No 101000224.

Keywords: soil loss, soil protection, tolerable soil loss, USLE, erosion models

ID ABS WEB: 138292

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

ARABLE SOIL RESISTANCE AGAINST EROSION SHIFTS IN RESPONSE TO EXTREME WINTER RAINFALL

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The health and resilience of aquatic environments are declining due to excessive sediment flux associated with land use. Land use and rainfall interactions drive temporal shifts in suspended sediment sources, but the magnitude of such changes remains poorly understood due to the lack of land-use specific source tracers. In this study, we applied α,ω-dicarboxylic fatty acids (diFAs)-root-specific biomarkers, as diagnostic tracers for apportioning sources of time-integrated suspended sediment samples collected from a grassland-dominated agricultural catchment in the southwest of England during the wet winter period. Applying diFA-specific stable carbon isotope analysis and a Bayesian isotope mixing model, we show stream banks contributed most of the sediment in the early winter, i.e., October–December, (90% credible interval (CI) ranging from 44% to 79%) while winter cereal-dominated arable land contributed more than half (90% CI: 35% to 85%) of the sediment during the late winter, i.e., January–March. The dominant sediment source shifted in conjunction with a period of prolonged consecutive rainfall days in the later period, suggesting that arable land loses its resistance against erosion once the soil gets saturated. Our novel findings demonstrate that diFAs isotopic signatures are promising tracers for understanding the resistance of agricultural soils to water erosion and quantifying the interactive effects of extreme rainfall and land use on catchment sediment source dynamics.

Keywords: Sediment Fingerprinting, Biomarker, Suberin, Extreme rainfall, Tracers

ID ABS WEB: 138325

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

ASSESSING SEDIMENT DYNAMICS DUE TO SOIL EROSION AND SLOPE INSTABILITIES IN ABANDONED TERRACED LANDSCAPES IN VERNAZZA CATCHMENT, LIGURIA, ITALY.

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A devastating flash flood occurred in the Vernazza catchment, Cinque Terre, Liguria, Italy, on October 25, 2011, resulting in numerous landslides and severe soil erosion, causing both fatalities and economic losses in the millions of Euros. The region, known for its terraced landscape and steep slopes, features mostly abandoned terraces that were historically used for vine and olive production. Interconnected processes exacerbate each other, leading to slope degradation, particularly affecting the abandoned terraced areas.

In our study, we employed the Limburg Soil Erosion Model (LISEM) to investigate the dynamics and potentially impacted areas concerning the source, transport, and deposition of sediments. LISEM utilizes detailed information on soil, topography, and land use. The model was applied at a 1m scale, incorporating climatic data from two nearby weather stations and field-collected soil geotechnical properties. LISEM evaluated hydrological dynamics and processes related to surface runoff, including soil erosion and landslides associated with soil water content. The results delineate the spatial distribution of soil erosion processes and landslides. Additionally, we delineate sediment transport pathways and depositional zones. These findings aid in identifying critical areas requiring interventions, especially recognizing abandoned terraces susceptible to collapse. Therefore, our LISEM approach provides crucial information for basin managers, farmers, and environmental protection agencies.

Keywords: Soil Erosion, Sediments Deposition, Sediments Transpot, Landslides, Slope stability

ID ABS WEB: 136534

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

DEVELOPMENT OF A HIGH SPATIAL RESOLUTION SOIL DATABASE IN HUNGARY BASED ON LEGACY SOIL DATA AT SOIL PROFILE LEVEL

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Based on more than 110 years of expertise in soil profile exploration, description and soil mapping, Hungary is a major power in the field of soil data in Europe and even in the world. The development of commercial agriculture in the 1950s and 1960s and the spread of modern nutrient management and agriculture required increasingly detailed and information-specific soil maps. In our country, soil mapping work developed in the 1980s, leading to the preparation of genetic soil maps at a scale of 1:10,000 for two-thirds of the country. The digitisation and program-level processing of national map data recorded on paper has not been done until today.
A high spatial resolution soil database is under development in Hungary consisting of legacy soil observation data originating from different soil surveys. In the course of our work, soil information is collected for selected sample areas in Hungary (Lake Balaton, Lake Fertö and Lake Velence catchment, Csongrád-Csanád County). The vectorisation of the soil data has resulted in the Profile-level Database of Hungarian Large-Scale Soil Mapping (Hungarian acronym: NATASA), which contains currently data on 148,000 soil layers from about 37,000 soil profiles. These data include field survey descriptions and laboratory measurements.
The geospatial processing of soil profile data and their transformation into target maps, featuring soil physical and hydrological properties using pedotransfer functions can support various applications. This includes the development of the planned Operational Drought and Water Scarcity Management System, the foundation of irrigation development investments, the implementation of natural water retention measures, groundwater resource modelling, agricultural water management policy programmes.
Acknowledgement: The work was carried out within the framework of the Széchenyi Plan Plus program with the support of the RRF 2.3.1 21 2022 00008 project and the Sustainable Development and Technologies National Programme of the Hungarian Academy of Sciences (FFT NP FTA).

Keywords: soil database, legacy soil data, soil profiles, geospatial processing, DSM

ID ABS WEB: 136654

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

TEMPORAL ANALYSIS OF SOIL SALINITY IN AGRICULTURAL LANDS OF NORTHERN TUNISIA: INSIGHTS FROM THE GEE PLATFORM AND FIELD SAMPLING

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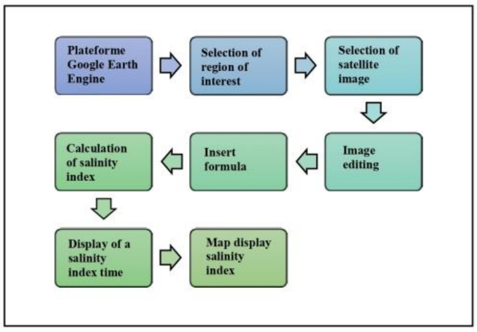
Recent droughts have had a significant impact on soils around the world. Tunisia, in particular, has experienced drought and human-induced soil salinisation.
The Harmonized World Soil Databases were the only global source of soil data specifically for soil salinity assessment. Recently, advances in Remote sensing have been made in measuring different soil salinity indices on agricultural land using machine learning approaches.
In this study, we aimed to investigate the spatio-temporal variability of soil salinity of an agricultural area in northern Tunisia, which is composed of Quaternary sediments, utilized for the cultivation of artichokes, cereals, and pears by using of the Google Earth Engine (GEE) platform.
Landsat series 5, 7 and 8 images from 2000 to 2023 were used, (i) soil salinity indices,
(ii) ground points (GPs), (iii) laboratory analysis was used to prepare the training data that served as input for the construction and execution of the code.
Surveys were conducted in irrigate soils, formed on alluvium of the Medjerda river. Resulting in the collection of twenty samples, specifically from the soil surface (0–20 cm).
Results revealed a range of electrical conductivity of saturated paste, varying from 1.17 dS/m to 5.90 dS/m, pH levels ranging from 7.12 to 7.45.
Utilising the GEE platform, the salinity indices initially registered a value of 0.2 for the area in 2005, increased to 0.30 in 2010 and in 2023 this value surpasses 0.29.
The use of the GEE platform made it possible to process large amounts of data to generate specific products, the results of which show an increase in areas with a very high probability of saline soils occurring between 2005 and 2023.
Soil salinity is known to increase primarily due to intensive irrigation practices, affecting both pH and soil salinity. Additionally, improper drain management disturb soil chemical properties, structures, and water quality.
Based on the study's findings, it is suggested that salinization frequency is likely to increase in the near future.



Keywords: Soil, Salinisation, Semi-arid area, Remote sensing, GEE plateform

ID ABS WEB: 137079

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

PHOSPHORUS TRANSPORT BY SOIL EROSION IN THE ELBE BASIN

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Soil erosion is a natural process that is associated with the occurrence of intense rainfall-runoff events. As a result of climate change, the frequency of these intense rainfall-runoff and erosion events is increasing in the conditions of the Czech Republic. The consequences are manifested in many areas (soil quality, municipal infrastructure, etc.). One of the most significant areas is quality of surface water sources, which are burdened by sediment input from agricultural land, which is often enriched by large amount of bound nutrients. In conditions of the Czech Republic, the phosphorus is the limiting element that most often determines the development of water eutrophication due to an increased concentration of nutrients.
Despite the fact the most important source of phosphorus in water is usually point sources, the soil erosion is also an important source of surface water pollution (sediment and erosion-related phosphorus). In order to be able to effectively design measures to reduce the phosphorus input into surface waters in the Elbe basin, a comprehensive analysis of the entire basin was carried out. Presented analysis was focused on defining the main sources of phosphorus in individual parts of the hydrographic network.
The article presents an erosion analysis in the Elbe basin carried out using the WaTEM/SEDEM erosion model. For the analysis, mostly generally available data were used, which, due to their detail, make it possible to define the main sources of erosion material and erosion-related phosphorus for surface water bodies in the Elbe basin.
The article presents the main data sources and the methodology of processing a large area. Furthermore, the main results of the study are presented, which is the division of the area under consideration into sub-basins, for which produced amount of eroded material and erosional phosphorus is defined in the form of specific values and the degree of significance of these localities in relation to the watercourse network.

Keywords: Phosphorus, Pollution source, Erosion, Simulation modelling, Water bodies

ID ABS WEB: 137257

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

SAMPLING DESIGN FOR MACHINE LEARNING PREDICTIONS OPTIMIZED FOR OBSERVATION TYPES WITH DIFFERENT MEASUREMENT ERRORS UNDER A GIVEN BUDGET

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High-resolution space-time soil information has recently gained large importance for policy makers and many other stakeholders. To provide the needed level of detail new sampling campaigns are needed, but are often under very restricted budget. Optimal selection of locations and sample tools becomes therefore crucial.

Traditionally, the positioning of new samples has been extensively explored within classical geostatistics and optimization strategies are available for kriging methods. However, contemporary mapping mostly relies on machine learning (ML) model prediction. In addition, proxy-technologies evolved fast over the past years providing sensors for quicker property measurement at lower cost, but with larger measurement errors or providing indirect measurements only. Consequently, observations vary, ranging from expensive wet-chemistry or laboratory spectroscopy measurements over less accurate field spectroscopy or field expert estimations and may even include observations from citizen science initiatives.

In a simulation study, we explored the impact of various budget allocation scenarios on the predictive accuracy of machine learning-generated soil property maps. Scenarios spanned from utilizing a small number of costly samples with minimal measurement error to a large number of low-cost samples. Measurement errors were introduced through random disturbance and model performance was assessed across multiple soil properties. Our findings underscore the significance of thoughtfully balancing diverse sampling tools within budget constraints.

Keywords: sampling design, machine learning, sensor measurements, field survey

ID ABS WEB: 137616

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

DEVELOPING DECISION SUPPORT SYSTEM FOR SITE-SPECIFIC MANAGEMENT OF SOIL & LAND TOWARDS SUSTAINABLE ENHANCEMENT OF PRODUCTIVITY- A CASE STUDY

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Declining productive capabilities of land and their rapid transformation into a degraded state is emerging as a major concern of scientists and farmers across the globe. Several researches have identified lacunae in management of soil, land, water and crop plants at micro level as the core reasons. Deterioration of resource capabilities starts at the farm level due to nonavailability of site specific management strategies farmed as per potentials and limitations of soil and land. To mitigate this fundamental issue a decision support system (DSS) was evolved on the bases of site specific characters of soil and land through land resources inventory (LRI) on a map of 1:7920 for 229 micro watersheds (1.5 lakh ha) in Bidar district, Karnataka state, India. Soil properties such as texture, depth, pH, EC, status of major secondary and micro nutrients along with the physical features of land comprising of slope, erosion status were characterized. Site specific recommendations for crop suitability,nutrient management, soil and water conservation measures were developed. To build a DSS in the form of LRI cards at farm level and atlas at micro watershed level (MWS), field and laboratory attributes were processed through GIS to generation of thematic maps. Further for planning, implementing and monitoring purposes a digital portal was developed. Ballur-2 MWS (622 ha), one among 229 was chosen as a case study to illustrate deployment of DSS at farm and MWS level. Out of total area, land parcels suffering from limitations such as very shallow soil depth (7.5%), moderate to severe erosion (44.16%), deficiency of available N (69.05%), P (100%), Zn (100%) were identified. Appropriate crops along with suitable interventions to address identified problems for respective site were recommended through LRI card and atlas at MWS level. Similar DSS can be developed for effective management of resources to ensure sustainable productivity by restoring and conserving capabilities of soil, water, land and crops in different geographies of the world.

Keywords: Soil and land management, Land Resource Inventory (LRI), Decision support system (DSS), Digital Soil Mapping, GIS

ID ABS WEB: 137882

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

PREDICTING AND MAPPING SOIL ORGANIC CARBON (SOC) STOCKS IN AGRICULTURAL TOP SOIL IN POLAND USING QRF ALGORITHM AND LARGE DATABASE

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Soil organic carbon (SOC) is a key indicator influencing soil quality and fertility. Predictive maps of the SOC-linked indicators are crucial to meet the assumptions of the Proposal for a Directive on Soil Monitoring and Resilience and to prepare national policies and soil protection plans. In Poland, more than half of the soils' area under agricultural use has a relatively low clay fraction share and low pH. Therefore, the substantial increase of SOC stocks for the next decades appears as a challenge for Polish agriculture. The study aims to estimate the spatial distribution of the SOC stocks for agricultural top soils in Poland. To achieve this goal, we combine spatial estimates of the soil parameters to compute SOC stocks. The SOC content and bulk density estimates were based on DSM approach based on an extended national databases. For mineral soils, we used a dataset from 2018 (n>40000) measured for 0-20 cm, for organic soils the dataset from 2022 (n>5000) measured for 0-30 cm. To create prediction maps we used Digital Soil Mapping (DSM) approach and Quantile Regression Forests (QRF) algorithm. We run four independent models: for SOC content and bulk density, each divided into mineral and organic soils. The cross-validation results show relatively good modelling performance for SOC content, where R2=0.32, RMSE=1.71 for mineral soils and R2=0.35, RMSE=20.09 for organic soils. For bulk density, the cross-validation results were R2=0.18, RMSE=0.53 for mineral soils and R2=0.33, RMSE=0.22 for organic soils. Our findings show that mean SOC stocks were 521 t·ha-1 for organic soils and 50 t·ha-1 for mineral soils. However, it should be noticed that the decrease in bulk density and at the same time lower values of this parameter underestimates SOC stocks. Based on these findings, further research needs to implement the correction equation for better and more accurate SOC stocks calculations. It is crucial to provide high-quality maps supporting further national policies, carbon farming, and soil protection goals.

Keywords: Digital Soil Mapping, Quantile Regression Forests, agroecosystems, SOC content, bulk density

ID ABS WEB: 137977

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

CHALLENGES, STRENGTHS AND WEAKNESSES OF DIFFERENT BASELINE OPTIONS FOR MONITORING SOIL CARBON REMOVALS – INSIGHTS FROM THE MARVIC PROJECT

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For reaching the EU ambition of climate neutrality by 2050, drastic greenhouse gas emission reductions are needed as well as carbon removals. Carbon farming captures CO2 from the atmosphere and stores carbon in soils and standing vegetation. Land managers get more and more interested as most carbon farming practices deliver also soil based co-benefits such as resilience against weather extremes and positive impacts on biodiversity. Through carbon farming schemes, land managers can get rewarded for their positive contribution to societal challenges by issuing carbon certificates. In recent years, carbon farming schemes are rapidly expanding. Through the Carbon Removal Certification Framework (CRCF), the European Commission wants to set out criteria for high-quality carbon removal certificates (QU.A.L.ITY criteria) and rules for monitoring, reporting and verification (MRV). MARVIC is a Soil Mission project that supports the CRCF and aims to develop a framework for the design of harmonized, context-specific MRV systems for carbon farming in arable land, grasslands, agroforestry/woody crops and managed peatlands. It is investigated how different building blocks of benchmark sites, sampling schemes, data layers, farm data, remote sensing and modeling can be smartly assembled to develop robust scalable monitoring systems. In addition, different options for the QU.A.L.ITY criteria are investigated. Here, we focus on different options to calculate baselines. Two broad categories are standardized (regional) baselines or project-specific baselines. In MARVIC we have identified more than 15 different options, depending e.g., if based on soil organic stock measuring/remeasuring or modeling and ex-ante or ex-post calculations of baselines. For baseline calculations based on modeling, hybrid approaches could exist in which some input parameters are determined ex-ante and others would better be re-determined ex-post, e.g. for also capturing weather extremes in the baseline. The pros and cons of baseline options are assessed against a set of criteria such as cost (allocations), data requirements, scalability and risks and opportunities for farmers, in order to facilitate choices to be made at the policy level.

Keywords: Carbon removals, Baseline, Soil monitoring, Carbon farming

ID ABS WEB: 138021

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

MACHINE LEARNING MODELS FOR PEDOTRANSFER FUNCTIONS AND AN INSIGHT INTO TRANSFERABILITY: USE OF OPEN ACCESS LUCAS 2015 DATA IN THE MEDITERRANEAN BIOGEOGRAPHIC REGION FOR PH AND CACO3

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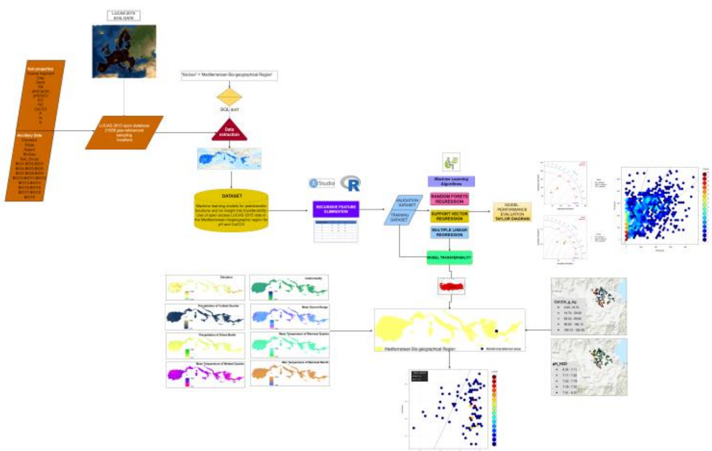
Mediterranean biogeography is primarily characterized by alkaline pH level and larger presence of CaCO3 equivalent. These features are greatly influenced by climate, which is one of the key elements in soil formation. Machine learning (ML) algorithms are extensively employed for predicting soil properties by utilizing digital covariates of soil formation factors. Moreover, ML algorithms can be employed to forecast and enlighten soil processes related to pH-H2O and CaCO3 in Mediterranean biogeography, hence enhancing scientific understanding of soil in similar regions. The open-access LUCAS 2015 data was used to get the pH-H2O and CaCO3 analysis values of 5,755 coordinated points, as well as the values of 19 bioclimatic and 3 topographic variables of these points. Machine learning models for pH-H2O and CaCO3 prediction were built using Random forest (RF), Support vector regression (SVR), and Stepwise multiple linear regression (SMLR). While building the models, 70% of the data set was utilized for training, while 30% was kept aside for testing. The deployed models were transferred to southwestern Türkiye, where typical Mediterranean biogeography, and were assessed using 91 observations. When 30% of the LUCAS data set was used for validation, the RF model had the highest performance Lin's concordance correlation coefficient (LCCC) values of 0.59 for CaCO3 and 0.78 for pH-H2O. As a result of the evaluation of the transferred models with 91 observations, the SVR model had the highest performance Root mean square error (RMSE) values of 87.91 g kg-1 for CaCO3 and 0.52 for pH-H2O. Mediterranean region which can be attributed to the typical characteristic, the most relevant environmental predictor for CaCO3 and pH prediction was the BIO-19-Precipitation of Coldest Quarter variable. Comparative results are required for the modeling and transfer processes of various mathematically based algorithms in Mediterranean biogeography, as demonstrated by the results.



Keywords: Mediterrenean biogeography, Pedotransfer functions, LUCAS, Transferability, Data availability

ID ABS WEB: 138105

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

SOIL ELECTRICAL CONDUCTIVITY (ECE) MAPPING IN THE EU BASED ON LUCAS 2018 SOIL PROPERTIES

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Abstract
Soil Electrical conductivity (EC) is a proxy of soil salinity and other soil characteristics, whose monitoring is much needed in the context of climate change, increasing irrigation in agricultural areas and sea level rise. The LUCAS soil monitoring network, established in 2009, provided EC1:5 in the topsoil (0-20 cm) in the surveys of 2015 and 2018. In this work, we provide a new pedotransfer function to convert EC1:5 to ECe using the LUCAS soil texture and soil organic carbon, and a framework for ECe mapping with a machine-learning algorithm named Quantile Regression Forest. The results are presented as predicted ECe in the topsoil. Among these issues, secondary salinity, limited drainage, and high load of animals stand out. Hotspot analysis per country (NUT0) revealed high topsoil ECe levels occurred in Spain 0.187% and 0.001% in Italy of their territories respectively. Increasing ECe can led to constrained crop productivity. With this assessment, we try to determine the hotspots for future monitoring and understanding the main drivers for sustainable soil management in light of the new European proposal for a soil monitoring directive. The ECe map and dataset will be made available after the peer-review publication through the European Soil Data Centre (ESDAC) and the European Soil Observatory (EUSO) dashboard.

Keywords: Soil Electrical Conductivity, Digital soil mapping, Pedotransfer functions, Europe

ID ABS WEB: 138204

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

AN EXPERIMENTAL CASE STUDY IN ITALY TO MONITOR SOIL QUALITY USING SATELLITE AND HYPERSPECTRAL AND THERMAL AERIAL REMOTE SENSING AND GROUND DATA ON KIWI (ACTINIDIA) DEATH SYNDROME

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Recent advances in remote sensing and geographic information led the way for the development of aerial hyperspectral and satellite multispectral sensors. The kiwi is a recent crop in Italy, but it has reached an agronomically important share of the market, which has been put at risk by the outbreak of the disease. The factors triggering the kiwi death are unknown. This is a syndrome difficult to resolve, whose causes are not yet been identified, although it is associated with different factors: fungi and bacteria in the roots, inappropriate irrigation practices, soil, with temperature anomalies and soil composition that seem to be a constant. Italy is one of the top producers in the word. The death in twelve years has affected ab. 8,000 hectares of plants, with a graduate reduction of the cultivated surface throughout Northern and Central Italy, with an estimated loss of ab. € 750 million gross saleable production. Aim of this experimental study is to analyse and compare the results achieved using aerial hyperspectral images, acquired within the Horizon Europe USAGE project (Urban Data Space for Green Deal), and multispectral images from Sentinel 2 and Landsat 8/9 satellites. All this, for monitoring of the kiwi's leaf system, one of the first signs of the plant's death. Further analyses are being carried out on the field, with chemical, physical and biological data to be correlated in a multidisciplinary work to highlight possible factors.

Keywords: Kiwi Death Syndrome, Hyperspectral Images, Multispectral Images, Soil Monitoring, Italy

ID ABS WEB: 138219

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

EVALUATING THE PERFORMANCE OF PREDICTIVE MODEL WITH DIFFERENT SAMPLING ALGORITHMS AND CALIBRATION/VALIDATION SIZES FOR MAPPING SOIL ORGANIC CARBON

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Using digital soil mapping techniques to predict real-spatial variability of soil properties depends on the strategy to capture soil samples and the size of calibration and validation data sets for training and validation of the model. For this purpose, we applied three sampling algorithms with four balance thresholds including 50:50%, 60:40%, 70:30%, and 80:20% for splitting of calibration and validation sets, respectively. In addition, each sampling design and size combination was tested for 50 iterations. The sampling algorithms were simple random sampling (SRS), feature space coverage sampling (FSCS), and conditioned Latin hypercube sampling (CLHS). The random forest model was used to create a statistical relationship between soil sample (dependent variable) and environmental covariates including terrain attributes and remote sensing data (independent variables). After determining the best calibration and validation size for each sampling algorithm, the best repetition number was selected for mapping soil organic carbon with uncertainty using the bootstrap technique.

Keywords: Digital soil mapping, Random forest, environmental covariates, bootstrap technique

ID ABS WEB: 136422

6. Soil in the digital era
6.09 133601 - Soil information standards and systems – current initiatives and advances

A GEOSPATIAL PLATFORM FOR HARMONIZING AGRICULTURAL LONG-TERM EXPERIMENTS DATA ACROSS EUROPE

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Agricultural Long-Term Field Experiments (LTEs) are agricultural infrastructures for studying the long-term effects of different management practices, soil and crop properties in changing climate conditions. With durations ranging from 20 to over 100 years, these experiments offer a rich scientific legacy. Despite their significance, accessing LTE-related information has been challenging due to its dispersed nature since they are run by different universities and research institutions. To close this gap, we developed a geospatial data infrastructure, including an LTE overview map (lthttps://lte.bonares.de) to compile and analyze the meta-information of the LTEs across Europe. This map consolidates and analyzes metadata from LTEs across Europe, contributing to the broader objectives of (inter)national soil-based information systems and harmonizing complex data. In collaboration with the BonaRes (www.bonares.de) and EJP Soil projects, the spatial representation of LTE locations and details derived from literature reviews and personal communication with LTE holders aligns with the aim of exposing and exchanging standardized soil information (Donmez et al., 2022; Donmez et al. 2023; Blanchy et al., 2023). By applying a threshold filter with a minimum duration of 20 years, we identified and included over 570 LTEs, offering a wealth of data pertinent to soil research, policy formulation, and decision-making. Our presentation of dispersed LTE information through the LTE overview map aims to contribute to the collaborative development of (inter)national soil information systems. This effort underscores the significance of LTEs and supports the growing interest in standardized soil information as a foundation for informed soil research, policy development, and decision-making processes.

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Donmez C., et.al, (2022): Provision of the metadata of European Agricultural Long-Term Experiments through BonaRes and EJP SOIL Collaboration. Data in Brief. https://doi.org/10.1016/j.dib.2022.108226.

Keywords: Long-Term Field Experiments, LTE Overview Map, FAIR, Agricultural Management

ID ABS WEB: 136500

6. Soil in the digital era
6.09 133601 - Soil information standards and systems – current initiatives and advances

ENABLING ENVIRONMENTS FOR SOIL INFORMATION SYSTEM (SIS) SUCCESS: NEW EVIDENCE FOR IMPROVING SIS INTERVENTION DESIGN

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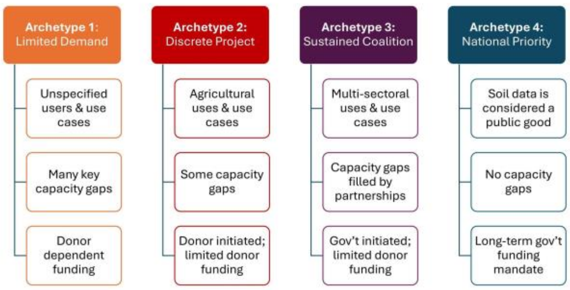
Many soil information systems (SISs) have been developed across Africa and globally to produce, organize, and serve soil information. These systems have created benefits for soil data stakeholders, yet many countries struggle to develop SISs to their full potential and to meet the needs of their intended users. What factors contribute to these challenges? How can they be addressed to fully leverage the investments in SISs in Africa?

This work, part of A Process Toward Strengthening National Soil Information Services led by CABI, supported by ISRIC and funded by the Bill & Melinda Gates Foundation, analyzed SISs across nine countries. Interviews with SIS stakeholders uncovered social, financial, institutional, and political components of in-country enabling environments that are influential for SIS outcomes, both success factors and boundary conditions. Enabling environment components were then linked with the suite of technical methods, standards and tools available for every step of the soil information workflow.

Four SIS archetypes--sets of enabling components leading to specific SIS outcomes--emerged (Figure). Three components were particularly informative: articulation of users / use cases for the SIS, severity of gaps in technical expertise, and mix of funding commitments from in-country and external investors.

A SIS is a tangible output, but it is also a process in which people and institutions must collaborate, refine, and implement plans, while balancing diverse needs, resources, and agendas. Our analysis uncovered further insights on how to define SIS success, how to approach the business case for soil data development, the key role for a soil data “champion” to ensure SIS sustainability, and on matching the ambitions of the initial SIS with the realities of users. This synthesis of socio-institutional and technological factors for SIS success is informing further work on developing and testing an improved framework for SIS intervention design.

In this session we will present the findings from our integrated analysis of existing SIS and preliminary outcomes from our developing SIS intervention framework.



Keywords: soil information system, enabling environment

ID ABS WEB: 137181

6. Soil in the digital era
6.09 133601 - Soil information standards and systems – current initiatives and advances

TOWARDS THE DEVELOPMENT OF A HARMONIZED SOIL INFORMATION SYSTEM FOR THE MEDITERRANEAN REGIONS

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In the Mediterranean Regions (MR) and in particularly in the Near East and North Africa Mediterranean (NENA) countries, soils and landscapes are extensively degraded and the average level of soil resources health is low and already inadequate to support economic development and food security. A primary obstacle to achieving policy targets related to the Sustainable Development Goals for 2030 is the limited availability and quality of soil data and information (SDI), coupled with their underutilization in the region. Soil data are frequently old, in non-digital format, relatively poor as quantity and quality, poorly accessible, due to limitations established by data owners, and lack effective archiving, homogeneity and consistency.
Therefore, as recognized by the Global Soil Partnership action plan for the NENA region, there is a compelling need to enhance the availability and accessibility of SDI and establish harmonized methodologies to create standardized soil information systems (SIS). Steps toward this objective are being taken within the PRIMA-funded SOILS4MED project, which focuses on monitoring soil health and developing SIS to promote sustainable soil management in the MR.
A key goal of the project is to design and implement country-owned standardized SIS, facilitating the effective protection, management, update, visualization, use, and controlled sharing/publication of SDI. The project starts with a comprehensive review of legacy soil data, maps, and related methods, as well as soil classification systems in partner countries. The aim is to digitize, harmonize, and make available through a SIS all legacy data provided by partner countries, including Italy, Lebanon, Spain, France, Tunisia, Greece, Egypt, Jordan, Turkey, and Morocco.
Harmonization efforts involve addressing differences in lab methods, data specifications, and soil classification systems by developing guidelines for harmonization. The ultimate goal is to make the data understandable and usable for data owners initially, with the potential for sharing among partners and the public. This collaborative effort represents a crucial preparatory step for the future realization of the Soil Atlas of the MR.

Keywords: Soil Information System, Legacy soil data, Data harmonization, Mediterranean Region, SOILS4MED project

ID ABS WEB: 138019

6. Soil in the digital era
6.09 133601 - Soil information standards and systems – current initiatives and advances

NATIONAL SOIL DATA IN EU COUNTRIES, WHERE DO WE STAND?

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Soil characteristics are needed to evaluate soil quality, soil health and soil-based ecosystem services. While some soil databases exist at the European scale, a much larger wealth of data is present in individual European countries, allowing a more detailed soil assessment. There is thus an urgent and crucial need to combine these data at the European scale. In the frame of EJP SOIL, a survey was conducted to assess the existing soil data sources, focusing on agricultural soils. The survey will become a contribution to the European Soil Observatory which aims to collect metadata of soil databases related to all kind of land uses, including forest and urban soils. Based upon a comprehensive questionnaire, 170 soil databases were identified at local, regional and national scales. Soil parameters were divided into five groups: (1) main soil parameters according to the Global Soil Map specifications; (2) other soil chemical parameters; (3) other physical parameters; (4) other pedological parameters; and (5) soil biological features. This survey shows that while most of the main pedological and chemical parameters are included in more than 70% of the country soil databases, water content, contamination with organic pollutants, and biological parameters are the least frequently reported parameters. Such differences will have consequences when developing an EU policy on soil health as proposed under the EU soil strategy for 2023 and using the data to derive soil health indicators. Many differences in the methods used in collecting, preparing, and analysing the soils were found, thus requiring harmonization procedures and more cooperation among countries and with the EU. In addition, choosing harmonized and useful interpretation and threshold values for EU soil indicators may be challenging due to the different methods used and the wide variety of soil land-use and climate combinations influencing possible thresholds. The temporal scale of the soil databases reported is also extremely wide, starting from the '20s of the 20th century.

Percentage of countries participating to EJP SOIL in the different geographical zones ((a) Central Europe; (b) Northern Europe; (c) Western Europe; and (d) Southern Europe including Türkiye) that includes the different soil parameters in the soil databases they reported in this study. Note that some countries reported only national homogenized soil databases, while other reported local soil databases as long-term experiments.

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Keywords: Soil data, Agricultural soil databases, Soil parameters, Europe, Harmonization

ID ABS WEB: 138054

6. Soil in the digital era
6.09 133601 - Soil information standards and systems – current initiatives and advances

DQ-KIT WEB APP: DATA QUALITY CHECKS FOR SOIL AND AGRICULTURAL DATA IN THE BONARES REPOSITORY AND BEYOND

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Well-curated data repositories facilitate the discovery, access, integration, and analysis of scientific data, maximizing research impacts, and ensuring the accuracy and reliability of data-driven technologies. The BonaRes Repository serves as a FAIR and open infrastructure for soil and agricultural research data publication. Next to the repository, we are currently developing DQ-Kit, an independent web application that automates comprehensive data quality assurance.
DQ-Kit addresses data authors, data reusers, and anyone who wants to evaluate and enhance the quality of their research data. It offers automated guidance on data elements that require review and confirmation. DQ-Kit checks encompass four main categories. First, it addresses formal criteria such as atomization of data, structural consistency, and other formatting issues. Second, DQ-Kit provides a summary of variables, their properties (e.g., skewness), and summary statistics (e.g., quantiles). Third, DQ-Kit allows for the exploration of relationships among variables and patterns of missingness. Lastly, we are planning to implement data plausibility checks flagging variables that contain theoretically 'impossible' values and values that seem empirically implausible based on existing knowledge. Initially, this functionality may be limited to soil data (e.g., only pH >4 plausible in German agricultural soil), where our team possesses the necessary expertise.
Importantly, the ultimate responsibility for handling the results and alerts provided by DQ-Kit lies with the data author, who has the final authority in determining their validity. Data reusers too may have different criteria when selecting datasets for specific purposes. Therefore, the concept of 'data fitness for use' is adopted, focusing on the suitability of data for specific purposes while appreciating the efforts of data authors and amplifying their impact.
Ultimately, we plan enhancing the metadata at the BonaRes Repository with DQ-Kit results. This will enable seamless quality control and facilitate the comparison of different datasets. In summary, DQ-Kit aims to ensure the integrity and reliability of scientific data available at the BonaRes Repository and beyond, supporting a wide range of research endeavours.

Keywords: Data Quality, FAIR Soil Data, Research Data Management, Open Source Web Application, Metadata

ID ABS WEB: 138142

6. Soil in the digital era
6.09 133601 - Soil information standards and systems – current initiatives and advances

PARTICIPATORY SOIL, LAND, CROP DATA CATALOG TO FACILITATE INFORMED DECISION-MAKING BASED ON OPEN STANDARDS AND OPEN-SOURCE SOFTWARE

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Using up-to-date and relevant soil and other environmental information is crucial for sustainable decision-making at multiple scales and actors in agriculture, land management, policy, business, and other domains. The first challenge is often finding data and assessing whether that data is applicable, of sufficient quality, usable and relevant. Although several large repositories exist (ISRIC, ESDAC, FAO, GEOSS, ZENODO, others), it is often desirable to have a targeted repository in each geography and domain that fits specific user needs. Recent examples are a metadata catalogue for soil data in Europe (EJP SOIL), a land, soil and crop data catalogue and viewer in East Africa (LSC-IS), and a repository for the results of a pan-African soil monitoring campaign including soil spectral data (Soils4Africa).
Although these repositories are tuned to local user needs, large parts of the functional requirements are similar, so the same commonly available software components can be used. This saves costs, facilitates interoperability and enables subsequent development with every additional project. Prerequisites for these benefits are the use of open-source software and open standards for metadata, data exchange, data models and ontologies.
In the scope of the three abovementioned projects, we have developed a participatory metadata workflow and data catalogue with mapviewer based on pygeometa, pycsw, mapserver and TerriaJS. This development has followed an iterative process in which feedback from end users in different stages provided improvements to the components. The development principles are easy maintenance and preventing redundancy by importing metadata elements directly from the data sources. Open standards used are the ISO19115 metadata model, and Open Geospatial Consortium (meta)data exchange standards such as WMS, WCS, WFS, CSW, and OGCAPI:Records. Interoperability with academia is facilitated by an OAI-PMH interface and DOI/Datacite. The storage backend is a versioned GIT system. This enables users to participate in the administration of the platform. This system's advantages are reproducibility, interoperability and stakeholder participation.

Keywords: Data discovery, Catalogue, Metadata, Participatory, FAIR

ID ABS WEB: 136294

7. Soil sciences impact on basic knowledge
7.01 125430 - Advances in soil science: past, present and the future

A PROTOCOL FOR REPORTING CARBON DIOXIDE EFFLUX UNDER EXPERIMENTAL WARMING USING CHAMBER TECHNIQUES

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The global mean air temperature has increased by 1.1-degree Celsius since the industrial revolution and is projected to rise by 1.5 °C over the next two decades. Temperature significantly influences carbon dioxide (CO2) exchange between the biosphere and the atmosphere, impacting the global carbon cycle, potentially creating positive or negative feedback on future climate. Soil respiration, the largest source of CO2 efflux from the terrestrial ecosystem, is sensitive to temperature variations. Despite the recent prioritization of studying climate warming effects on soil respiration for enhanced climate projections, there is limited documentation of reporting protocols. Addressing this gap, we propose a reporting protocol for the implications of climate warming on CO2 efflux. We call this the OeXMAR (Overview, Experimental warming, Methodological approach, Assessment, Results and Outcomes) protocol. The OeXMAR protocol serves dual purpose: (a) a checklist for authors monitoring soil CO2 efflux, (b) introducing a standardized format for documenting and reporting findings, ensuring transparency, reproducibility and facilitating meta-analysis review. The OeXMAR protocol, comprised of five main sections and twenty-two detailed subsections, offers both mandatory and optional elements. This inclusive structure provides authors with flexibility while maintaining a robust reporting framework. To demonstrate the protocol's efficacy, we analyze its application in ten previously published research studies, showcasing its adaptability and contribution to advancing the understanding of soil science in the context of climate warming.

Keywords: Carbon dioxide efflux, Experimental warming, Soil respiration, Soil science, Reporting protocol

ID ABS WEB: 136452

7. Soil sciences impact on basic knowledge
7.01 125430 - Advances in soil science: past, present and the future

HOW THE DISTANT PAST SHOULD GUIDE THE FUTURE OF SOIL STRUCTURE RESEARCH

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A long-forgotten paper by Cameron and Gallagher (1908) developed some of the earliest tools to explore soil structure formation. Their paper included possibly the first laboratory penetrometer and compression devices, and ingenious methods to measure soil shrinkage. One shrinkage device's electronic micrometer alerted users of soil contact by a 'sharp acrid taste' from electrodes placed on the tongue. Refining this work, Haines (1923) measured soil volume changes with moisture content extremely accurately in arguably the first controlled study exploring biological polymer (gelatine) impacts to soil. He concluded that 'By means of the method the effect of alternate wetting and drying of soil in producing good tilth is illustrated.' Haines (1925) went on to derive the initial theories of capillary cohesion in soils.

This early work explored fundamental processes driving soil structure formation and stabilisation, but more recent research on soil structure has become hung up on measuring soil aggregate stability, or visualising 3D soil structure with non-invasive imaging like X-Ray CT (Fig.1). Looking back at the pioneering soil aggregate stability research by Yoder and Hénin in the 1930s, however, it went beyond collecting aggregates on sieves to measure their properties, to trying to unravel underpinning mechanisms. Researchers like Monnier (1965) built on this research to demonstrate how contact angle and particle cohesion drove the stability of soil aggregates under different management practices. Indeed, Le Bissonais's comprehensive aggregate stability test simulates different hydrological and mechanical stresses that can disrupt soil structure.

It is time for soil structure researchers to get back to basics, following the ingenuity and inquisitiveness of overlooked papers of their predecessors. With more effort placed on HOW soil structure forms, and less effort on correlating WHAT we see with the properties of soil aggregates, progress would be less incremental. We have an array of exciting new tools at our disposal, but these need to be used beyond visualisation and correlation.

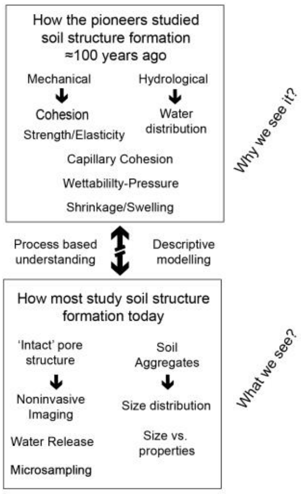

Fig. 1 - A century ago the pioneers sought WHY soil structure forms. Today we emphasise WHAT comprises soil structure. We need both.

Keywords: soil structure, basic mechanisms, aggregate stability, imaging, modelling

ID ABS WEB: 137104

7. Soil sciences impact on basic knowledge
7.01 125430 - Advances in soil science: past, present and the future

DEVELOPING SYNCHROTRON TECHNIQUES TO SUPPORT AGRICULTURAL INNOVATION

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Introduction
Synchrotron techniques were initially addressing environmental issues related to pollution. However, recent years have seen increasing interest in using synchrotron approaches for agricultural research. This presentation will focus on new methodologies using synchrotron X-ray Fluorescence Microscopy (XFM) and micro computed tomography (μCT). These have been developed to address some major challenges related to (i) food production, with a particular focus on fertiliser efficiency (ii) soil constraints.

Materials & Method
Fertiliser efficiency: the fertiliser use efficiency of conventional fertilisers is limited with most applied nutrients either remaining in the soil or being dispersed in the environment. However, understanding the reactions of nutrients in the fertosphere is challenging. We have developed techniques enabling us to assess distribution of nutrient availability in the fertosphere using a combination of novel large scale and robust diffusive gradients in thin-films devices (DGT) and tandem X-ray Fluorescence Microscopy (XFM).
Soil constraints: Crop production worldwide is often limited by one or more soil constraints such as high pH, deficiencies in macro and micronutrients, soil acidity, salinity and sodicity that limit root growth and function and crop utilisation of subsoil water. The ability of roots to grow through soil unhindered by physical or chemical constraints is key to making full use of the available water and nutrient resources. However, understanding how roots develop and respond to soil amendments is challenging. Here, we will report on the development of tomographic techniques that have enabled visualisation of roots in large soil cores from glasshouse and field trials.

Results
The methods developed have provided invaluable information regarding the distribution and gradients in macro and micronutrient distribution around fertiliser granules. A strong effect on availability was observed as a function of soil type and fertilisers combination. This was also related to root distribution and proliferation as a response to (phosphate fertilisers). This combination of techniques allow a thorough understanding of plant-soil relationships that can be used to enhance agronomic practices.

Keywords: Soil, Synchrotron techniques, Nutrient availability, Root architecture

ID ABS WEB: 137107

7. Soil sciences impact on basic knowledge
7.01 125430 - Advances in soil science: past, present and the future

THE ANTONIO BERLESE SUMMER SCHOOL OF SOIL FAUNA TAXONOMY AND ECOLOGY

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Soil fauna is the last frontier of soil ecology, and its complete knowledge could help determining a correct and sustainable soil management and assessment.
Recently, IUSS determined to establish a Soil Fauna Division.
Antonio Berlese (1863 - 1927) was the first soil scientist to extract edaphic fauna with a dynamic system. He was an entomologist, involved in the first successful experiments of biological pest control, who reached fame and honours studying soil fauna, producing an impressive bulk of literature.

One century after, we are proposing on his behalf a new Summer School on soil fauna, including its taxonomy, ecology and biogeography. This could be a first step to establish before his death Centennial a permanent institution on environmental high formation.
To update and increase capacity building in the field of soil ecology, we are trying to gather scientists, operational equips from soil monitoring institutions, and graduated, Master or PhD students, in order to keep on working on this innovative and resolutive field for the future decades. The aim is to continue and improve the Antonio Berlese training school, suddenly interrupted by his premature death, finally focusing on a correct identification, classification and ecological study of soil fauna.
A series of workshops, summer schools, events and biological monitoring campaigns will be promoted to increase soil zoology acknowledgment and to assess the real conditions of soils, both to promptly and effectively tackle soil degradation and to assess human impact on soils, as well as to accomplish a real-time monitoring of soil health and to support soil biological monitoring. Historical notes, practical examples and future application proposals will be discussed for a worthwhile establishment of a long period training institution, 'bringing to light the undiscovered secrets of life in soil, and to keep soil alive'.
Photo: gentle concession of Dr. Lorenzo D'Avino, CREA-AA (Florence, Italy)

Keywords: Soil Fauna, Taxonomy, Ecology, Summer School, Antonio Berlese

ID ABS WEB: 137158

7. Soil sciences impact on basic knowledge
7.01 125430 - Advances in soil science: past, present and the future

FROM GLEY TO FOUGERITE VIA GREEN RUSTS, PAST, PRESENT AND FUTURE OF LAYERED DOUBLE HYDROXIDES IN SOILS

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Gley was described in 1905 by Vyssotskii as « always with a rather distinct greenish blue chroma », noting « some iron was undoubtedly present as protoxides [...] the fresh samples first were grayish green and later on became yellowish, » This colour criterion is incorporated in all soil classifications and in the WRB as either properties or features. The term « green rusts » was coined by Bernal in 1954 for intermediate compounds between Fe(0) and Fe(III) oxides. The structure of green rusts is derived from brucite by partial oxidation of Fe(II), the excess charge being compensated by interlayered anions. Green rusts belong to the larger group of layered double hydroxides (LDH), with both divalent and trivalent cation in octahedra. Green rusts were found in 1996 by Trolard et al. The natural green rust was homologated by the International Mineralogical Association in 2007, as fougerite. « Green rusts » should be now simply replaced by fougerite in soil classifications.
In fougerite, the divalent and trivalent cation are identical, with a possible electron transfer between them and thus an ordering of cations. Mg and other cations can substitute for Fe in the layer. Fougerite shows a definite crystallographic structure with two variants, depending on the nature of the interlayered anion, GR1 and GR2. Exchange of anions with the solution is possible, exactly as fpr cations in montmorillonite. The name fougerite thus characterizes the composition of the octahedral layer. In the fougerite from Fougères, the most likely anion is the hydroxyl OH-, but other anions, such as carbonate, chloride or sulphate could be present in reduced alkaline or saline conditions.
Fougerite can react with a large variety of metals, metalloids and organic pollutants (Trolard et al., 2022). It may have been much more abundant in reducing conditions in the past, including in sediments that oxidized after their deposition, such as red sandstones, and could have played a major role in the emergence of life in the Hadean ocean.

Keywords: Gley, Fougerite, Hydromorphy,Iron, Mineralogy

ID ABS WEB: 137187

7. Soil sciences impact on basic knowledge
7.01 125430 - Advances in soil science: past, present and the future

REAL-TIME MONITORING OF THE ION EXCHANGE PROCESS

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Ion exchange is one of the most essential processes in soil science and has been studied for decades. Most studies look at the process through batch experiments, which yield adsorption isotherms. Those, in turn, can be used in flow and transport models. Very little is known about the transition phase of the exchange process.
In recent studies, we used geo-electrical methods (spectral-induced polarization, SIP) to track breakthrough ion exchange experiments. In SIP, a low-voltage electrical field (in a wide range of low frequencies) induces ionic movement, which can be related to ionic adsorption. Such experiments allow precise monitoring of the transport process, including the ion exchange, in a non-destructive, non-invasive fashion. Further, it enables monitoring processes where organic matter and non-soil porous media (e.g., activated carbon) are involved.
One of the unexpected results of our experiment is the observation of an electrical transition state during the exchange process. We hypothesize that this state indicates when none of the involved ions are fully adsorbed. That is, the time that the desorbed ion already left the stern layer, while the adsorbed ion still did not reach it. While SIP is probably too coarse (spatially) to calibrate molecular dynamics for specific models, it opens a new perspective on adsorption processes.

Keywords: Adsorption, Geo-electrical methods

ID ABS WEB: 137825

7. Soil sciences impact on basic knowledge
7.01 125430 - Advances in soil science: past, present and the future

SOIL GEOCHEMICAL FINGERPRINTING FOR AGRI-FOOD AUTHENTICITY AND TRACEABILITY

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Nowadays consumers are more aware of the issues surrounding food safety due to numerous food scandals over the last two decades. Soil is for plants the main source of mineral elements which can be transferred to agricultural products according to their bioavailability and pedoclimatic conditions. Therefore, differences in element distribution between geographic regions are reflected in agriproducts. This is why multielement fingerprinting is one of the most widely used technique to discriminate the geographical origin of food. In this work we tried to find a relation between mineral element content in cultivation soil and in a PDO tomato grown on the slopes of Somma-Vesuvius volcanic complex. The peculiar cultivation environment strongly influences quality and organoleptic properties of this tomato which due to its typicity it is a product susceptible to origin fraud.
For this study, cultivation soils and tomato fruits were collected from representative farms inside and outside the PDO cultivation area in 2021-2022 years. Soils were characterized for physical chemical properties and extracted for potentially and readily bioavailable elements (0.05 M EDTA, pH 7 and 1 M NH4NO3). A total of 22 elements (Ca, Cu, Fe, Mg, Mn, Mo, Na, Ni, P, K, Zn, Ba, Cd, Co, Cr, Cs, Rb, Sr, Dy, Gd, Nd, Sm) were determined in soils and tomatoes.
The PCA and LDA were used for geographical classification of soil and tomato samples. The results indicated a tendency to natural grouping of soil and tomato according to provenance farms. The mineral fingerprinting of soils and related tomato fruits from the farms inside the PDO area were correlated and compared to the cultivation areas outside PDO. LDA evidenced not-essential elements as predominant mineral elements of PDO soils discriminating the geographical origin of tomato fruits.
Work carried out in framework of METROFOOD-IT (NextGenerationEU, PNRR - M4C2, Investment 3.1 - IR0000033 - D.M. Prot. n.120 of 21/06/2022).

Keywords: soil geochemistry, element bioavailability, agrifood traceability,EU Research Infrastructures,chemometrics

ID ABS WEB: 138295

7. Soil sciences impact on basic knowledge
7.01 125430 - Advances in soil science: past, present and the future

DESORPTION-BASED SOIL ENZYME EXTRACTION: FROM BREAKTHROUGH IN KNOWLEDGE TO HIGH-THROUGHPUT ENZYME ASSAY FOR SOIL FUNCTIONALITY

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Soil enzyme activity has long been studied both to understand biochemical properties of soil and as a simple, effective, and sensitive biosensor to evaluate both soil health, soil fertility, and soil disturbance using sieved soil in suitable buffer.
Soil enzymes were not extractable in high quantity up to nineties; moreover, the extracts were brown in color because solubilization of soil organic matter was the only way to increase extraction yield. These results lead to theory that enzymes were tightly bound to soil particles. Some twenty years ago we discovered that soil enzymes could be easily extracted and in high yield, by heteromolecular exchange by using a protein in excess. Very important, extracts were colorless, so no soil organic matter was extracted, meaning interactions of enzymes with soil components were different to what was thought at that time.
Such high-yield extraction procedure has enabled us to develop a high-throughput, very sensitive, microplate-based assay by using fluorogenic substrates. Currently, more than 30 enzyme activities, including both hydrolases and oxidases, can be quantified starting from a single soil extract obtained using just 300 mg of soil. Because one person can perform all those enzyme activities in 180 samples (once weighed) in just one day, this capability corresponds to a throughput of more than 100 times when compared to traditional assay procedures in flasks or tubes. Although ANOVA and other parametric tests allow to detect significant differences among samples whatever the number of enzyme assays being performed, multivariate statistics applied to this high-throughput enzyme assay enables also to evaluate the different importance of each biogeochemical cycle (C, N, P, S) in each specific investigation.
This assay has been used in more than 70 investigations published on peer reviewed journals. Investigations have included: laboratory experiments, large sets of environmental soil samples originating from Europe, Africa, Australia and Antarctica, marine sediments, and archaeology samples.
Selected results will be shown.

Keywords: enzyme extraction, high-throughput assay, soil health,soil fertility,soil monitoring

ID ABS WEB: 135424

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

MICRODIALYSIS AS A TOOL TO STUDY RHIZOSPHERE DYNAMICS

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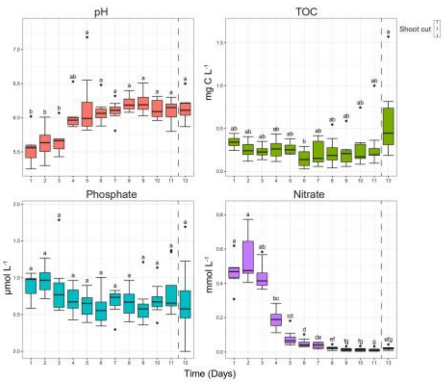
Microdialysis is a non-destructive technique exploiting semipermeable membranes to measure solute flux in soil, especially at root-relevant scales. It has been employed to explore soil carbon fractions, nitrogen and phosphorus availability, and to simulate root-related processes. However, its potential to monitor root exudation and root-driven processes in the rhizosphere in unknown. We hypothesised that microdialysis could be used to monitor pH shifts, nutrient uptake and root exudation in the rhizosphere.
Barley seeds were germinated in falcon tubes containing approx. 50g of agricultural soil. The soil was kept at 60% water field capacity for the whole experiment. Four infusion pumps were equipped with 8 micro-syringes (3mL), connected to a microdialysis probe (CMA 20; 20kDa, 30×0.5mm membrane) further connected to a 1.5mL collection tube. Each day for 13 days, probes were perfused with MilliQ water at a flow rate of 1µL min-1 for 23h. On day 12 the shoots were removed/cut. Microplate spectrophotometric assays were used to measure NO3-, NO2-, Fe2+, Fe3+, PO43-, pH, Total Organic Carbon (TOC) in the dialysate.
An increase in pH was observed between day 1 and 5, which correlated with the decrease in NO3- content. Indeed, NO3- root uptake is mediated by proton-nitrate symporters. These results show how rhizosphere nitrogen is almost completely utilized by barley after 5-6 days, considering the small soil volume. On the contrary, nitrite, iron, and phosphate levels did not vary significantly over time. Similarly, TOC did not vary over time until day 13 when, after removing the shoot, a significant increase in TOC was observed. However, the overall TOC concentration was too low to consider performing compound-specific analysis, such as gas or liquid chromatography-mass spectrometry.
The present study demonstrates that microdialysis can be used to monitor rhizosphere processes, i.e. nutrient uptake and pH, and more in general to answer multiple research questions in the area of rhizosphere research. However, the experimental setup need to be further optimized for monitoring root exudates.



Keywords: Microdialysis, Root exudates, Rhizosphere, Nutrient mobilization, Soil dynamics

ID ABS WEB: 135954

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

"HOW DO ROOTS MATTER?" – UNRAVELLING THE IMPORTANCE OF PLANT ROOTS IN SOM DYNAMICS.

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Soil organic matter (SOM) decomposition is directly linked to soil CO2 emissions and is one of the key processes in defining the overall magnitude of the carbon (C) fluxes between terrestrial ecosystems and the atmosphere. The addition of fresh C substrates, generally considered as the most straightforward way to increase SOM stocks, can result either in the acceleration or retardation of SOM decomposition. This change in SOM decomposition caused by fresh C inputs is referred to as the priming effect (PE). A special form of PE is the rhizosphere priming effect (RPE), which involves the activity of plant roots and associated rhizosphere microorganisms in interaction with the surrounding physical and chemical environment. While mechanistically these two phenomena greatly differ, there is a tendency in the literature to explain them by the same mechanisms and drivers, which ultimately may hamper accurate predictions of the ecosystem C balance. As suggested by previous studies, PE and RPE can be related to soil nutrient availability, and especially nitrogen (N), due to the stochiometric coupling of C and N cycles. In this review, we highlight the drivers and mechanisms that distinguish RPE from PE and how they change with N addition. First, we discuss underlying mechanisms that govern the temporal dynamics, and overall direction and magnitude of PE and RPE and their responses to N addition. Second, we develop different scenarios for PE and RPE separately, based on whether microbes are C or N limited. We then assess how different scenarios are supported by the literature using meta-analysis. Ultimately, these findings will provide a better understanding of plant root effects on SOM dynamics and further insights into the role of N in relation to C sequestration via suppressing or enhancing PE and RPE differently.

Keywords: Plant-soil-microbe interaction,rhizosphere, roots, carbon, C sequestration

ID ABS WEB: 136109

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

SOIL ZYMOGRAPHY: A DECADE OF ENZYMATIC IMAGING IN PLANT-SOIL-MICROBE INTERACTIONS AND FUTURE PROSPECTIVE

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Enzymes are the main drivers of biogeochemical transformations of soil organic matter, that greatly contribute to nutrients availability in agroecosystems. Soil is a very heterogeneous and “dark” environment, that hides microbial and root life. The rapid development of soil zymography – a non-invasive technique enabling in situ imaging of potential enzyme activities in soil – allows to visualize and localize the hidden microbial and root life in soil.
We aim presenting the latest methodological advancements occurred within the decade following the pioneering use of fluorogenic substrates for visualizing enzyme activities in soil. The focus extents to the spectrum of enzyme activity imaging, zymography resolution, standardization and hotspot identification. Particularly, we emphasize the integration of zymography with other visualization methods to relate spatial distribution of enzyme activities with soil acidification, root exudation, pore distribution, nutrient and water fluxes. These combined methods elucidate plant-soil-microbial interactions not only within crop rhizospheres but also in critical agroecosystem hotspots like detritusphere and biopores.
We show the current possibilities, challenges, and the potential directions for soil enzyme imaging. Soil zymography has already applied in studying natural and agricultural ecosystems under both laboratory and field conditions, offering to scale from the entire root system down to microbial communities.
In the next decade, the spectrum of enzymes in zymography imaging will be broaden to deepen the scope of hotspot localization in agroecosystems. Furthermore, coupling of zymography with physico-chemical and microbial cell imaging, and isotope applications can facilitate unraveling the complexity of soil processes, and thus improve farming practices based on these findings. Besides, we expect that soil zymography as a simple and reliable method will be further widely used by more groups from Germany, Italy, USA, China, Sweden and other countries.

Keywords: enzyme activity,imaging techniques,rhizosphere,rhizosphere interactions,spatio-temporal patterns

ID ABS WEB: 136348

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

DO ROOT TRAITS MEDIATE THE EFFECTS OF BACTERIVOROUS AND HERBIVOROUS NEMATODES ON RHIZOSPHERE BACTERIAL COMMUNITIES?

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The rhizosphere bacterial community is mainly dependent on plant species and soil types. Soil nematodes may also impact rhizosphere bacteria either via top-down (bacterivores) or bottom-up (herbivores and bacterivores) regulation. However, the complex trophic control of herbivorous and bacterivorous nematodes on the rhizosphere bacterial community remains largely unexplored. In this study, we investigated the separate and combined influence of bacterivorous and herbivorous nematodes (Poikilolaimus oxycercus and Pratylenchus zeae) on the abundance, diversity and activity of the rhizosphere bacterial community of Italian ryegrass (Lolium multiflorum), and whether root traits mediated these effects. Our results show that both bacterivorous and herbivorous nematodes altered root traits, particularly root mass density and root C:N ratio, which in turn mediated their effects on rhizosphere chemistry (e.g., pH and dissolved organic carbon), thus affecting bacterial abundance, alpha diversity, and activity. Bacterivorous nematodes had both a direct effect, which reduced bacterial abundance, and an indirect effect, which increased bacterial abundance via an increase in root mass density and root C:N ratio, resulting in a net negative overall effect. The presence of bacterivorous nematodes, either alone or in combination with herbivorous nematodes, led to different compositions of the rhizosphere bacterial community. Both root traits and rhizosphere chemistry contributed to explaining variations in community composition, with rhizosphere chemistry accounting for a larger portion of the variation, though the majority remained unexplained. We conclude that root system density and C:N ratio are key factors mediating the trophic control of bacterivorous and herbivorous nematodes on the rhizosphere bacterial community. Given the high variation in bacterial community composition and the heterogeneous nature of root systems, our results suggest the need for more detailed investigations at a finer scale to understand the effects of root traits on the rhizosphere bacterial community and the trophic interactions mediated by root traits.

Keywords: Soil nematodes,Root traits,Rhizosphere chemistry,Bacterial community,Multitrophic interactions

ID ABS WEB: 136351

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

THE INTERPLAY BETWEEN ROOT TRAITS AND THE DYNAMICS OF FE PLAQUE FORMATION AND DISSOLUTION DRIVES P AVAILABILITY FROM PLAQUE TO RICE

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Iron (Fe) plaque which normally coats rice roots has a strong affinity for phosphorus (P), with a debated effect on plant P uptake. Furthermore, plant responses to P availability shape the rhizospheric environment, possibly affecting the rates of Fe plaque formation and dissolution. The role of Fe plaque to serve as a sink or source of available P may depend on root traits, themselves influenced by P availability. However, the underlying mechanisms regulating these interactions remains unclear. In this study, we hypothesized that 1) the modification of root anatomy induced by P deficiency enhances Fe plaque deposition, and 2) this, in turn, could function as a sink or source of plant-available P, depending on the activation of plant strategies to overcome P limitation. To test these hypotheses, rice plants were hydroponically grown for 60 days under P-deficient or P-sufficient conditions, with or without Fe plaque. Root traits, rhizosphere acidification, and the rates of Fe plaque formation and dissolution were investigated and linked to differences in rice P content and growth. The increased root development promoted by P-deficient conditions led to faster and greater Fe plaque precipitation on root surfaces compared to P-sufficient conditions. However, plaque formed on P limited rice roots was promptly dissolved during plant development. This effect coincided with increased rhizosphere acidification, possibly explaining plaque dissolution. After 60 days of hydroponic cultivation, P-deficient plants showed higher P uptake in the presence of Fe plaque, whereas the opposite was observed in P-sufficient plants, where Fe plaque limited plant P uptake. We therefore concluded that the role of Fe plaque in regulating P uptake highly depends on the dynamic nature of this Fe pool that is strictly linked to P availability and regulated by plant responses to P deficiency.

Keywords: Rice,Fe plaque,Phosphorus,Root traits

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7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

MICROBIAL EXTRACELLULAR ELECTRON TRANSFER IN WETLAND SOIL: DRIVING COMMUNITIES TO DECREASE ARSENIC CONTAMINATION

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Microbial Extracellular Electron Transfer (MEET) is supposed to be a widespread phenomenon in the environment, although the identity and metabolic pathways of electroactive microorganisms, their distribution, their relationship with plants, and the extent to which MEET affects element cycling, remain largely unexplored. Rice farming is affected by arsenic contamination due to the low redox potential in flooded bulk soil, which promotes the microbial solubilization of arsenic from soil minerals. Since arsenic is a redox-active element, MEET is supposed to play a role in its transformation. The present work aims at filling the gap between natural MEET and engineered bioelectrochemical systems, studying in depth MEET-driven arsenic cycling in rice paddies and addressing many of the open questions concerning 1) the identity of electroactive microorganisms naturally inhabiting rice paddies, 2) the metabolic pathways involved in MEET, 3) the role of MEET in arsenic cycling in rice paddies, and 4) how we can employ these functions for applicative purposes in agriculture and in the related industry.
To pursue this aim, a microcosm experiment is being carried out where the soil conductivity of a flooded rice paddy soil affected by arsenic contamination is modulated by electroactive biochar inclusion, anodic polarization, and the presence of rice plants. The microbial activities expressed at the buried anode will be characterized by metatranscriptomic profiling and related to the circulating current and arsenic transformation in the different conditions. At the end of the experiment, anodic electroactive soil microorganisms will be enriched in order to elucidate their capacity to combine extracellular electron transfer to arsenic transformation. Combining biological, chemical and electrochemical measurements will provide a model of MEET-driven arsenic cycling in rice paddies.
This project represents an innovative approach where bioelectrochemical systems are employed to study microbial ecology aspects of MEET while addressing agronomic issues, such as arsenic contamination in rice.
This project is financed by the University of Milano (Piano di Sostegno alla Ricerca PSR 2021 Linea 2–Azione A).

Keywords: rice rhizosphere microbiome,arsenic cycling microorganisms,electroactive microorganisms,rice paddies,arsenic

ID ABS WEB: 136678

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

THE UNIQUE RHIZOSPHERE OF AERIAL ROOTS AND ITS ROLE IN PLANT-MICROBE INTERACTIONS

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This study challenges the century-old definition of the rhizosphere, proposing the existence of an aerial rhizosphere that extends beyond underground roots. This new paradigm introduces the mucilage microenvironment surrounding aerial roots as a distinct ecological niche, functioning independently of soil. This study reveals the dynamic parallels between the aerial root mucilage microenvironment and the conventional rhizosphere through a rigorous comparative analysis encompassing radial extents, components, physico-chemical properties, microbiota, and functions. The spatial similarity in radial extents (1 – 3.5 mm for the rhizosphere and 0.7 – 3 mm estimated for the aerial root mucilage microenvironment) suggests a consistent reach of plant-microbe interactions. Despite divergences in components and physico-chemical properties, both ecosystems serve as spatial niches for microbial colonization and activity. The rhizosphere and aerial root mucilage microenvironment are dynamic interfaces orchestrating complicated interactions between plants and microbial communities. Commonalities in components, including water, air, mucilage, root border cells, microorganisms, and enzymes, contribute to the establishment of microbial niches, fostering dynamic ecosystems. While the rhizosphere embodies a solid organo-mineral habitat, supporting microbial attachment and nutrient cycling, the semi-solid and biofilm-like nature of the aerial root mucilage microenvironment, with its higher saturation water content, offers a specialized niche. Diversity in bacterial communities is evident, with the rhizosphere exhibiting higher diversity and enrichment in bacteria associated with plant defense and soil organic matter mobilization. In contrast, the aerial root mucilage microenvironment is characterized by nitrogen-fixing bacteria, indicating a specialized niche with properties conducive to such microbial associations. I propose a model illustrating plant-microbe interactions within the aerial root mucilage microenvironment, elucidating processes such as microbiota formation and protection, microbial utilization of mucilage sugars, and plant uptake of biologically fixed nitrogen. By challenging conventional boundaries and providing insights into microbial dynamics, this study offers a transformative lens for understanding aboveground roots, paving the way for sustainable agricultural practices and ecosystem management.

Keywords: Microbial niches,Mucilage microenvironment,Nitrogen-fixing bacteria,Rhizosphere,Symbiosis

ID ABS WEB: 136837

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

MONOCULTURE VS. INTERCROPPING UNDER DROUGHT: THE FATE OF 13C-LABELED RHIZODEPOSITION AND THEIR EFFECT ON THE FUNCTIONING OF SOIL MICROORGANISMS

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The plant community regulates the composition and quantity of rhizodeposition; however, due to the impact of drought on plants' functioning, allocation and fate of assimilated carbon (C) in the plant-soil-microorganisms system is changed. The present study aimed i) to trace the fate of rhizodeposits in the maize-soybean intercropping and compare it with that in monoculture under drought vs. optimal moisture conditions, ii) to reveal the differences in the rhizodeposits-C utilization by microorganisms under pulse water regime.
The greenhouse experiment was conducted from June to August 2021 using 10-year-old abandoned agricultural soil. Maize (Zea mays) and soybean (Glycine max) were grown in monoculture (4 plants per pot) or intercropping (2+2 plants) until the vegetative stage (6-8 leaves), soil moisture was kept at 60% of water holding capacity (WHC). Further, plants were divided into four treatments (each had four replicates) and labeled with K15NO3 and 13C-CO2. The treatments were: i) constant wet (60% of WHC), ii) constant drought (30% of WHC), iii) wet to drought (labeling was done under 60% of WHC and soil dried till 30% of WHC and further kept for 14d), and iv) drought to wet (labeling was done under 30% of WHC and soil was slowly rewetted to 60% of WHC and further kept for 14d). Under drought, higher biomass of soybean roots was found in intercropping, whereas no effect was found in the case of maize. Drought increased NO3-concentration in soil solution and nitrification rates, and a positive impact of intercropping was seen under wet-drought. The presence of intercropping increased microbial biomass C and the contribution of both maize and soybean into 13C-dissolved organic C under drought. Activities of b-glucosidase and chitinase increased under drought in intercropping, whereas acid phosphatase was suppressed. Thus, intercropping can promote the transfer of available C into the soil by altering belowground plant biomass and can help mitigate drought for the plant-soil system by improving C and N cycling.

Keywords: Intercropping,Drought,13C-labilling,Activity of enzymes,Rhizodeposits

ID ABS WEB: 136946

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

UP IN THE AIR: AN AEROPONIC APPROACH TO DECIPHERING THE ROOT EXUDATE COMPOSITION DURING DROUGHT

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The composition of root exudates is known to influence nutrient availability and stimulate interactions with microorganisms. However, collection of root exudates is difficult due to potential breakage of fine root hairs causing roots to leak, sorption to soil components, and rapid decomposition by microorganisms. In addition, exudate profiles are known to vary with time and changing environmental conditions. An aeroponic method was developed to non-destructively collect root exudates from the same plants over time under various stressors (e.g., drought, nutrient deficiency, and other environmental stresses). Root exudates from mature cotton were collected throughout ideal, water-stressed, and water stress recovery. Exudates were collected every 2-3 days and characterized using a variety of techniques (e.g., FT-ICR-MS, ICP, combustion, HPLC) to evaluate root exudate composition qualitatively and quantitatively. This project is a first step in subsequent experiments to evaluate the effect of root exudates on microbiome and carbon interactions in the soil. Results indicate that water stress increased total metabolites, particularly those with nitrogen and phosphorus. Although amino acids were a small portion of exudates, drought greatly increased amino acid release. A better understanding of exudates has potential to advance science in carbon sequestration, plant breeding, and understanding plant-microbe relationships.

Keywords: exudates,metabolome,rhizosphere,drought,metabolites

ID ABS WEB: 137374

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

LET'S INVESTIGATE THE RICE RHIZOSPHERE! LOOKING INTO THE INTERACTIONS BETWEEN BELOWGROUND C AND IRON CYCLING AND THEIR IMPLICATIONS FOR CH4 EMISSIONS

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Rice paddies are important sources of methane (CH4), but they also serve as important carbon (C) sinks. Although the effects of post-harvest residue C inputs on CH4 emissions and SOC stabilization have been widely studied, the role of belowground C allocation during the rice cropping season has received less attention. Here we aim to elucidate the rhizosphere processes that link rhizodeposited C to microbial C use and interactions with Fe cycling and CH4 production under anaerobic conditions. We hypothesized that an increase in rhizodeposition would (1) stimulate the reductive dissolution of Fe(III) oxides by anaerobic Fe-reducing bacteria, releasing more Fe(II) and soil-derived dissolved organic carbon (DOC) to the soil solution, particularly in soils with higher pedogenetic Fe contents; (2) enhance CH4 production from both root and soil-derived C sources, the partitioning of which depends on soil properties. To test these hypotheses, a planted rice pot experiment was set up with two soils having different pedogenetic Fe contents. Rhizodeposition was modulated by applying different doses of N fertilization. Pulse-chase 13CO2 labelling was used to trace plant C allocation, net C rhizodeposition, its contribution to soil and microbial C pools, and CH4 emissions. From our preliminary results, the effects of root C exudation on Fe and C cycling in the rhizosphere were strongly dependent on intrinsic soil properties. Indeed, a lower reductive dissolution of Fe phases and release of Fe(II) in solution and less CH4 emissions were observed in the soil with lower amounts of pedogenetic Fe. On the other hand, the different fertilization treatments, which modulated root development and possibly also gross rhizodeposition, did not show any significant effects on the dissolution of Fe(II) and CH4 emissions. These results suggest that differences in soil pedogenic characteristics may play an important role in driving the effects of belowground C allocation on C cycling in rice paddies.

Keywords: Rice rhizosphere,C cycling,Fe cycling,Climate change

ID ABS WEB: 137642

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

LONG-TERM CHANGES IN SOIL-PLANT CARBON POOLS FOLLOWING INCREASED TEMPERATURES AND SNOW COVER IN WEST GREENLAND

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Increasing air temperatures and precipitation can influence the carbon (C) exchange rates in arctic ecosystems. The following effect on the soil-plant carbon pools can be both positive and negative, but net effects are unclear. Here we report responses on soil-plant carbon pools after nine years (2012-2021) of increased snow depth (snow fences), summer warming (open top chambers) and the combination in a tundra ecosystem in West Greenland. Data includes characteristics of depth-specific soil samples, including the rhizosphere soil fraction, as well as vegetation responses analysed based on NDVI-derived traits, LAI and aboveground-, litter- and root biomass. Furthermore, natural vegetation growth through the study period was quantified based on time-integrated NDVI Landsat 8 satellite imagery. We concluded that warming resulted in a significant and positive vegetation response driven by Betula nana, while snow addition alone resulted in a significant negative response for Betula. Treatments had significant effects on belowground traits. The rhizosphere soil characteristics differed from those of the bulk soil regardless of treatment. For rhizosphere a significant treatment effect on soil C was noted as an increase in near-surface and top 20 cm with respect to warming, which was not observed for the bulk soil fraction. The study highlights the plant-specific response to treatment and impacts on belowground C pools likely driven mainly by dead fine roots, via Betula nana. We conclude that long-term warming treatment resulted in a significant and species-specific, positive plant response, and a corresponding significant increase in both above- and belowground C pools. We also conclude that changes in soil C is more clearly observed in the rhizosphere soil fraction, which should receive more attention in future assessments of SOC changes.

Keywords: Climate change,Tundra ecosystem,Carbon pools,Rhizosphere SOC,NDVI

ID ABS WEB: 137881

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

DOES ROOT PRESENCE IMPACT PESTICIDE DEGRADATION OUTCOMES?

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Roots exert a significant amount of influence on the soils they inhabit. They have the potential to increase microbial biomass and cause shifts in the composition of the microbial community, due to changes in nutrient content alongside the pro- and anti-biotic nature of root exudates.
However, the influence of plant roots on pesticide biodegradation via root-mediated impacts on microbial communities is rarely considered in pesticide degradation trials. This omission is especially relevant for post-emergence pesticides where application will not occur without root presence in the soil. Roots have the potential to impact pesticide degradation through changing the prevalence of degrading bacteria and fungi, and the abundance and activity of these. Further understanding the influence of roots on biological properties and processes is needed for the development of future innovative chemicals and crop protection products.
We quantified the effect of root presence on pesticide degradation, and the response of soil microorganisms in 1.2 m2 lysimeters over a period of 3 months. The lysimeters were filled with a sandy loam soil at two bulk densities (1.13 and 1.34 g/cm3), and either left unplanted or planted with spring wheat. These lysimeters were then sprayed with a fungicide and herbicide to monitor degradation rates. Soil samples were taken 0, 7, 14, 30, 60, and 90 days after spraying to quantify pesticide breakdown, and microbial response (microbial biomass, fungal biomass, community response using phospholipid fatty acid analysis, and soil surface activity and light influence using chlorophyll content).
Slower decay was observed in the planted treatment, with the herbicide half-life being 50% longer in planted treatments. Community response, fungal biomass and surface activity were found to be significantly different between the planted and unplanted treatments.

Keywords: Rhizosphere,Pesticide,Degradation,Microbiology,Roots

ID ABS WEB: 138074

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

RELATIONSHIPS BETWEEN SOIL PROPERTIES AND MICROBIOME ASSOCIATED WITH MYCELIUM OF THREE SPECIES OF BASIOMICETEAE: FAIRY RINGS IN THE GARDEN OF THE ROYAL PALACE OF CASERTA (ITALY)

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In stable meadows, the biological phenomenon of fairy rings (FR) are generated by the mycelium growth of basidiomycete fungi. The mycelium expands underground colonizing new spaces outwards and, consequently, the soil becomes crumbly, whitish, and with a characteristic odour. The presence of FRs also causes a change in the vegetation on mycelium development fronts and the presence of fungal sporophores. FR are classified according to their effect on vegetation:

- Type I, they first cause suppression of vegetation at the fungal front and then a stimulation after the passage;
- Type II, they induce a stimulation of the vegetation;
- Type III, they cause no effect.

In November 2021, three FRs formed by three diffrent basidiomycetes were observed in the gardens of the Royal Palace of Caserta. Thus, a study of their effects on the soil microbial population and chemical and biochemical properties started. Different species formed the three FRs: Marasmius oreades (Type I), Amanita vittadini (Type II), and Clitocybe collina (Type III). The presence of different fungal species in the same biological forms allowed comparing the effect of macro fungi on soil. For each FR the soil was sampled at three different positions in the ring and five replicates per position. Soil samples were taken in an area where no fungal passage occurred (OUT), at the fungal front (ON), and where mycelium passage occurred one meter from the fungal front (IN). The presence of the fungi led to soil acidification and an increase in electrical conductivity, linked to an increase in nutrients, as demonstrated by an increasing bioavailability for each nutrient. An increase in organic carbon, microbial biomass, and soil respiration was also observed in the presence of fungal mycelium. Based on the enzymatic activity of the laccase and Mn peroxidase, a different lignin degradation strategy arose according to the present fungal species.

Keywords: Fungal fronts,Fungal saprotrophs,Basidiomycota,Soil enzymes,Nutrient availability

ID ABS WEB: 138229

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

IMPROVING NUTRIENT USE EFFICIENCY IN SOYBEAN THROUGH ROOT GROWTH PROMOTION WITH TRICHODERMA VIRIDE PRIMING

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A significant part of soybean performance is dependent upon imbalanced soil macronutrient status besides several uncertain stresses at different growth stages. Though biological nitrogen fixation (BNF) seemed a cost-effective and environment-friendly solution for nitrogen (N) management, several reports ascertained that a considerable amount of N-fertilizer is top-dressed indicating the ineffectiveness of BNF. Besides, soybean is very sensitive to phosphorus (P) and potassium (K) nutrition. Their combined effect is even more important under field conditions. To optimize production at the field scale, a different type of cost-effective management is in dire need. Trichoderma viride, an opportunistic endosymbiont, is renowned for alleviating plant stress and improving plants' physiological parameters. The primary objective of this study was to facilitate root proliferation of soybeans via seed-priming with T. viride (strain no. BHU-2953) to improve NPK uptake under graded soil fertilization. Root lengths, plant physiological parameters, and NPK contents were determined at three different time intervals. Lignification study was carried out to visualize the effect of T. viride inoculation. Indole acetic acid (IAA) and 1-aminocyclopropane-1-carboxylate deaminase (ACCD) activities were determined to evaluate root growth promotion through bio-priming. Results revealed that T. viride enhanced IAA production and ACCD activity within treated roots. A very thick lignification pattern was observed in treated soybeans; while untreated roots showed thin vascular lignification. Higher root proliferation in bio-primed treatments was able to uptake more ($P < 0.05$) N, P, and K through foraging higher soil volumes. Bio-primed plants up to 80% recommended dose were able to recover similar seed P as did by untreated soybeans with 100% recommended dose; while all bio-primed soybeans with graded doses of fertilizations showed statistically similar or even higher ($P < 0.05$) seed N and K recoveries as compared to untreated plants receiving full dose of commercial fertilization. Hence, cutting synthetic fertilizer doses can save the cost of cultivation. The study can serve the purpose of low-input sustainable agriculture.

Keywords: Bio-priming,Indole acetic acid,Lignification,Nutrient recovery,Trichoderma viride

ID ABS WEB: 138307

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

STUDY OF THE ARBUSCULAR MYCORRHIZAL STATUS OF ARABLE CROPS ACROSS DIVERSE AGRICULTURAL TREATMENTS IN HUNGARY

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The impact of conventional agricultural practices on soil degradation is widely acknowledged and has now led to a very serious decline in the quality of croplands, as well as the depth, carbon content, and biological potential of topsoils. Quality of soil life constitutes a fundamental aspect of soil health, encompassing the size and diversity of the soil microbiome. Among beneficial soil microbes, mycorrhizal fungi seem to be pivotal agents connecting plant roots with the soil. Arbuscular mycorrhiza (AM) stands out as the most important form of mycorrhizal symbiosis for arable crops, renowned for its multifaceted role in facilitating plant nutrient uptake, maintaining water balance, enhancing stress resistance, regulating growth and development, as well as orchestrating the rhizosphere microbiome and improving soil structure.

It is widely recognised that conventional practices such as tilling and the intensive use of fertilisers and chemicals markedly reduce the abundance and diversity of AM fungi. However, the extent to which organic or regenerative agricultural practices can enhance the mycorrhizal potential of soils remains a subject of debate.

In recent years, we have conducted numerous field studies in Hungarian agricultural settings, examining the mycorrhizal colonisation and molecular diversity of crop plants, primarily maize, under diverse agricultural treatments. Collaborating closely with companies engaged in active agricultural practices, we have observed compelling variations in root colonisation patterns, primarily attributable to agricultural setups and soil nutrient levels.

These findings offer valuable insights into the variability of mycorrhizal potential in lowland agricultural fields in Hungary, aiding in the selection of appropriate soil biological assessment methodologies to facilitate and monitor the impact of regenerative and ecological practices on soil health. Establishing a robust methodology tailored to agricultural contexts can also facilitate the evaluation of the short- and long-term effects of mycorrhizal inoculants under field conditions.

Keywords: arbuscular mycorrhiza,biodiversity,soil health,regenerative agriculture,mycorrhizal colonization

ID ABS WEB: 135525

7. Soil sciences impact on basic knowledge
7.03 130893 - Soil classification: past and present concepts and solutions

REGIONAL-SCALE DETERMINING SOIL MOISTURE AND TEMPERATURE REGIMES USING JAVA NEWHALL SIMULATION MODEL

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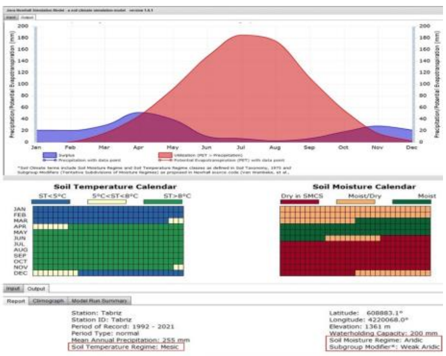
Soil moisture and temperature regimes as diagnostic soil properties play crucial role in soil classification especially in the lowest categories i.e., soil great groups. Contrary to the past era, those can be determined by a Java Newhall simulation model using present (1992-2021) atmospheric climate records derived from 52 metrological stations. The importance of such a kind of determination clears when climate change is the major challenges by the fact that it affects agricultural purposes. East Azerbaijan Province in the north-western Iran was selected as a case study since it not just is one of the most important regions for agricultural activities, but also it was faced with climate change recently. The desiccation of Urmia Lake over the past 20 years is a strong witness for this event. Furthermore, Thiessen method was also utilized in pedoclimate zoning of the entire study area using the Mann-Kendall test approach. The findings revealed that there was an increase of (Z=+3.18) and decrease of (Z=-0.56) in terms of temperature and precipitation, respectively. It was finally found that the study area comprises two soil moisture regimes (Aridic and Xeric) as well as three temperature regimes (Mesic, Thermic and Frigid). Moreover, the prepared maps showed that the north-western and western area within East Azerbaijan Province have drier and hotter pedoclimate conditions than others. The highest pedoclimate area is Weak Aridic-Mesic class, while the lowest one is Dry Xeric-Frigid. Overall, the findings of present research were: I) to identify soil moisture and temperature regimes using easy-to-hand data with less consuming in time and cost; II) to facilitate determining the aforementioned diagnostic soil properties at a regional scale; III) to introduce a pathway for pedologists in recognizing different categories of soil classification and to assist soil surveying and mapping; and IV) to enhance land capability and suitability evaluation in achieving sustainable agricultural development goals.



Keywords: JavaNewhall, pedoclimate, soil classification, soil diagnostic properties, sustainable agriculture

ID ABS WEB: 136127

7. Soil sciences impact on basic knowledge
7.03 130893 - Soil classification: past and present concepts and solutions

DO CHERNOZEMS OCCUR IN POLAND? HISTORICAL DISCUSSION AND MODERN ATTEMPTS TO CLASSIFY BLACK SOILS.

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Poland is situated in Central Europe in temperate climate, humid enough to result predomination of clay-illuvial soils. The spots of soils with thick, black humus horizon are considered relict, but their origin, age and naming/classification have been continuously debated. The topsoil humus horizon in these soils typically is thinner and poorer in humus compared to Chernozems of Eastern Europe. Depending on the dominant scientific school and profiles selected for debate, these soils were called ‘degraded Chernozems’, ‘leached Chernozems’, ‘meadow-forest Chernozems’, or were excluded from Chernozems at all. The harmonisation of criteria and terminology, initiated by FAO Legend and continued by WRB, allowed reconsideration of their status in regional or even global context. Analysis of soil profiles that have mollic/chernic horizon in five patches revealed a regional differentiation of the morphology and properties. Soils in eastern Poland (more continental area) most commonly have thick mollic/chernic horizon, have secondary carbonates in shallow subsoil, and do not have an argic horizon. Soils in SE Poland (close to the moist mountain zone) have thin mollic, but not always chernic, have thick argic, and do not have carbonates. Soils in south-central Poland have secondary carbonates, but topsoil horizons are seriously eroded (and mixed by ploughing with subsoil), and thus often do not have chernic. In SW Poland, soils do not contain carbonates, have mollic, rarely chernic, and have poorly developed argic. And finally, soils in W Poland have thick mollic/chernic horizons, often contain carbonates, but commonly have prominent gleyic/stagnic properties. The review confirmed a large variety of ‘mollic soils’ in south Poland and the presence of a general climate-driven E-W gradient of ‘mollic soils’ in south Poland (Haplic/Calcic Chernozems – Gleyic Chernozems/Mollic Gleysols), overlapping with an N-S gradient related to landscape and land use history (Haplic Chernozems – Argic Chernozems – Argic Phaeozems). Under the long-term week erosion, Chernozems were transformed into Kastanozems, while in case of strong erosion - into Calcisols or Regosols.

Keywords: soil classification, soil origin, soil degradation, Chernozems, Phaeozems

ID ABS WEB: 136347

7. Soil sciences impact on basic knowledge
7.03 130893 - Soil classification: past and present concepts and solutions

REPLACING THE TWO ISRAELI SOIL CLASSIFICATION SYSTEMS WITH USDA SOIL TAXONOMY

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Seldom do countries change their soil classification system. Since the late 1950s, two different soil classification systems have been applied in Israel: one at the academy, which is more physiographically oriented, and one at the governmental ministries, which is based on ‘soil associations’. The reason for having two different soil classification systems in one country stems from a historical debate between two parties with different views on soil classification and mapping. Despite decades of soil surveying and many references that explain the characteristics and spatial distribution of Israel soils, there is still no systematic protocol describing the guidelines for classifying soil taxa.
These two classification schemes are outdated, unwieldy, contradictory, nearly impossible to use for international communication, and lack reference to the anthropogenic factor of soil formation (which is intense in the eastern Mediterranean). To solve these problems, the Israeli soil classification committee has embraced the USDA Soil Taxonomy as Israel's official and sole classification system. The main reasons for choosing Soil Taxonomy were 1) improving national and international communication, 2) improving soil education, 3) relying on a broadly accepted soil classification system that is routinely reviewed and updated, 4) having a systematic protocol for soil classification, 5) considering the varied soil moisture regimes (xeric, ustic, aridic) of Israel, and 6) improving academic and public awareness of soils.
The updating of Israel's soil classification is being carried out in stages: 1) examining the two existing methods of classification and soil mapping to choose which of them is more suitable as a basis for the new classification, 2) correlating GIS polygons of the old mapping to Soil Taxonomy, 3) creating a new GIS layer consisting of approximately 800 documented soil profiles, 4) forming a new model-based soil moisture and temperature raster layer (due to lack of direct data), and 5) verifying data in the field and the lab.

Keywords: Pedology, Soil classification, Soil Taxonomy

ID ABS WEB: 137306

7. Soil sciences impact on basic knowledge
7.03 130893 - Soil classification: past and present concepts and solutions

ORIGIN AND EVOLUTION OF SOILS FORMED FROM NOT ORGANIC LIMNIC MATERIALS AND THEIR TAXONOMIC CLASSIFICATION

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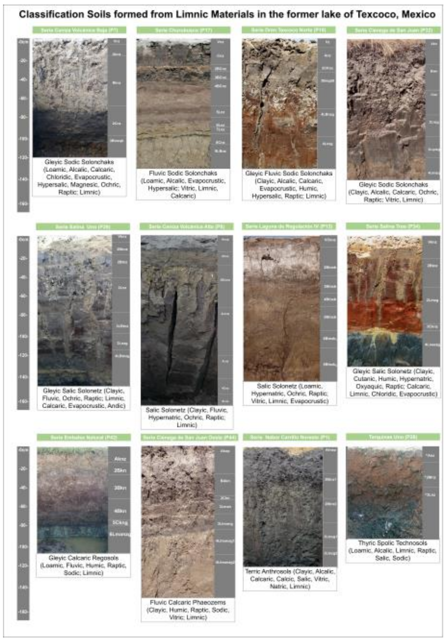
The Limnic Materials ML of organic origin are associated like qualifier (Limnic) to four Reference Soils Groups RSGs: Histosols, Technosols, Cryosols, and Fluvisols; however, they also have, not organic limnic materials that form soils whose origin and evolution are little studied. In the Former Lake of Texcoco, there are Clayic-Loam Limnic Materials with the presence of oolites in a volcanic origin site, where the soil formation was accelerated for influence of anthropogenic activities. To understand the origin and evolution of soils former lake, we classified 44 Soil Series with the international system soil classification 'World Reference Base for Soil Resources WRB 2022'. We found that in the former lake Texcoco the Limnic Materials occur in conditions with high salt concentration, cracks of drying, presence of volcanic ash, groundwater influence, and pastization activities and dredging which give rise to: Solonetz, Solonchaks, Fluvisols, Regosols, Phaeozems, Anthrosols and Technosols, with more of 10 qualifiers, of those who stand out: Gleyic, Sodic, Limnic, Calcaric, Vitric y Raptic; and a genetic designation from up to eight letters for each horizon, for example, 3Btqcnz>beta>γ y 4Ctnzgβγ<lamda>. We concluded that the former lake of Texcoco soils formed from no organic limnic materials has heterogenous morphology properties and characteristics (influenced directly by human activities), that result in a complex and diverse taxonomic classification, like so different stages of evolution in these soils.



Keywords: SALINITY, DRYING,SOIL SERIES, SOIL FORMATION, ANTHROPIC IMPACT

ID ABS WEB: 137640

7. Soil sciences impact on basic knowledge
7.03 130893 - Soil classification: past and present concepts and solutions

COMING TO GRIPS WITH COMPLEXITY OF WORLD SOILSCAPES IN WRB SOIL CLASSIFICATION

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This paper draws from a review made of some 1000 soils from soil monolith collections at ISRIC and at KU Leuven in order to update the classification of each soil monolith to the latest version of WRB and Soil Taxonomy. This update served a.o. to identify gaps in the collections and to reveal inconsistencies in WRB2022 .
Here we focus on the aspect of systematically illustrating the Reference Soil Groups (RSG) and their qualifiers in the World Reference Base for Soil Resources (IUSS Working Group WRB, 2022), with the RSG of Ferralsols as example. We review the classification of Ferralsols and their principal qualifiers, based on an analysis of typifying soil monoliths gathered from all over the world and exhibited in ISRIC's soil museum and at the KU Leuven. Examples of fully documented monoliths, illustrating the findings are given.
Based on the analysis above an alternative list of principal qualifiers can be proposed (Table). The sequence would give first emphasis to characteristics that are not indicating an intergrade with another Soil Reference Group and end with Haplic. Differences with the present WRB 2022 sequence are illustrated in the second column.
It is concluded that the WRB system could benefit from a core set of documented occurrences of Ferralsols as illustrated here, that could then be expanded if and when new additional mappable characteristics are found and documented.
The paper concludes with a call for a web-based 'WRB Documentation Centre' for the purpose of illustrating those qualifiers that have a match in soil monoliths versus those that are missing. A call is launched to the wide soil science community for providing examples of fully-documented soil profiles. Eventually, this exercise will lead to a rationalization of the qualifier lists of WRB 2022. Keywords: Soilscapes, WRB 2022, documentation Centre, soil profile data

Principal Qualifiers WRB2022	Proposed Principal Qualifier
Ferritic	Ferritic
Gibbsic	Gibbsic
Rhodic/ Xanthic	Rhodic / Xanthic
Geric	Geric / Hypergeric / Posic
Nitic	highly improbable
Pretic	Pretic
Gleyic	very rare occurrence
Stagnic	rare occurrence
Profondihumic	Profondihumic
Mollic / Umbric	Mollic / Umbric
Acric / Lixic	Acric / Lixic
Skeletic	rare occurrence
Haplic	Haplic

Table: Present and Proposed sequence of Principal qualifiers in WRB for Ferralsols

Keywords: WRB_2022, Soil data, Soil monoliths, Soil landscapes, WRB Documentation Centre

ID ABS WEB: 137961

7. Soil sciences impact on basic knowledge
7.03 130893 - Soil classification: past and present concepts and solutions

NAMING SOILS IN THE CONTINUUM - THE BASIC IDEA BEHIND GERMAN SOIL SYSTEMATICS

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Soil classification was emerging already when the ISSS was founded in 1924, and kept to be an issue of discussion ever since. One of the key problems is that soils are no discrete entities and elude sharp limitations between classes (or types). The revised German Soil Systematics, to be published in 2024, still – and even more than its earlier versions – bases on the idea that each soil type marks a center in the morphogenetic feature space. Both, transitions to theoretically each other type and deviations, are possible, without abandoning the idea of clearly assigning any soil to a single systematic unit in a hierarchy suitable also for soil mapping. The hierarchy of systematic levels allows to summarize the character of a soil as a whole in a well-graded manner that is newly based on diagnostic criteria which make use of horizon designations and depth and thickness criteria. These apply an easy-to-memorize depth threshold system. Criteria directly base on the standard profile description, without asking for an additional diagnostic horizon identification. Names for systematic units – be it typical expressions, deviations or transitions – are formed like compound nouns in German, or in the lowermost hierarchical levels by adding name elements like adjectives, so that they are intuitively understood by any speaker in their graded meaning.

Keywords: soil classification, horizon designation, transitional types

ID ABS WEB: 137991

7. Soil sciences impact on basic knowledge
7.03 130893 - Soil classification: past and present concepts and solutions

SOIL CLASSIFICATION AND THE PHILOSOPHY OF JOHN STUART MILL

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Which attribute should be used to create soil classification taxa—color, texture, mineralogy, organic matter, base saturation, depth to bedrock, moisture regime, shrink-swell? This question is fundamental to all soil classification systems. In the 1950s the developers of Soil Taxonomy adopted John Stuart Mill's philosophy in his 1843 book "A System of Logic." In this book, the English philosopher advocated two main classification precepts:

(1) Scientific classifications are best when objects are formed into groups that produce the greater number of important statements about the group. What is meant by important? Consequential. Especially, consequential in reference to a particular goal such that the classification provides the greatest good for the greatest number.

(2) Which attribute of objects should be grouped? Those attributes that cause many other attributes. For example, "differentiating attributes" used to define a class, such as the mollic horizon, have "accessary attributes" such as natural fertility and good structure that gives rise to good infiltration and aeration.

In Soil Taxonomy, soil moisture regimes are considered to be a major attribute that causes many other attributes and, consequently, were placed high in the classification hierarchy, not only because they are important for vegetation and agriculture, but also because they have significant genesis connotations. When knowing soil moisture regimes, inferences can be made, for example, about whether a soil will have redox features, carbonates, soluble salts, mollic horizons, or O-horizons under natural conditions. Soil moisture regimes built into classification systems increases to our ability to predict how soils will be changed by climate change.

Keywords: Classification purpose, Classification philosophy, Soil Taxonomy, Soil Moisture Regimes, Climate Change

ID ABS WEB: 138347

7. Soil sciences impact on basic knowledge
7.03 130893 - Soil classification: past and present concepts and solutions

PRONASOLOS – THE BRAZILIAN NATIONAL SOIL PROGRAM

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PronaSolos is the largest Brazilian technical-scientific program in the area of soils, whose objective is to carry out the largest pedological survey ever carried out in Brazil, as well as to perform the soil governance in Brazil. This is a Program to be performed over the next 30 years, with the following goals: i) define priority areas and the work agenda for carrying out soil surveys on geographic scales equal to 1:100,000 or more detailed; ii) carry out soil surveys and their interpretations; iii) structure and operationalise the national soil information system, with public access; iv) organise the existing soil data obtained from soil surveys; v) implement innovations in soil surveys methods and related topics. Currently, less than 5% has soil survey in a 1:1000,000 scale or bigger, as recommended in PronaSolos. The biggest part of Brazil (84%) is mapped at a scale of 1:250,000. The lack of information about soils in Brazil was already highlighted by soil experts as a crucial problem. Embrapa Soils is the leader of the Executive Committee. The first results were delivered in 2019 – the selection of the priority areas to be mapped in each State - followed by the web-technological platform of soils from Brazil launched in 2020 (https://pronasolos.sgb.gov.br/dashboards/), containing several maps and soil data from produced over the last 60 years. The main benefit of this platform is the availability of the collection of Brazilian soil studies and soil profiles, in a single location, from centralized and easily accessible way. In 2022 this platform was updated and a collection of Carbon Stocks Maps that gave support to FAO´s Carbon Maps of the World. PronaSolos will provide soil information to the society and the results will benefit more than a dozen sectors such as agricultural insurance and credit, agroecological zoning and agricultural suitability of states and municipalities, land vulnerability to extreme events in urban and rural areas, among others.

Keywords: pedological survey, geographic scales, soil data

ID ABS WEB: 135933

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

GLOBAL ANDISOL DATABASE: DETERMINANTS OF CARBON CONCENTRATIONS

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While soil organic carbon (SOC) is predominantly associated with soil minerals, recent regional and global studies provide increasing evidence that reactive metals, such as organically complexed aluminum (Al) and iron (Fe) and short-range-ordered (SRO) minerals, exert stronger controls on SOC than clay content, the commonly-used parameter constraining SOC turnover in models. However, the dominant types of metal or the generality of the metal-SOC relationship remain unclear as the abundance and dominant phases of Al and Fe in soil change with soil type. Andisols, relatively young soils developed on volcanic parent materials, are found under the mean annual temperature (MAT) and precipitation (MAP) spanning approximately -2–30 °C and 60–6000 mm/y, consist largely of metastable minerals that are susceptible to the exposed environmental conditions, and thus can be viewed as an ideal soil type to examine metal-SOC relationships and direct environmental controls on them. Here, we synthesize a global Andisol database from over 2850 soil samples of 574 pedons across 34 countries. We show that organically complexed Al (pyrophosphate-extractable Al, Alp), rather than Fep or SRO minerals such as allophane (acid oxalate-extractable Al and Fe), was the most important geochemical predictor of SOC concentrations regardless of the development stage of Andisols. The variation of Alp itself was explained by pH, MAT, and wetness index (MAP minus potential evapotranspiration). Clay content had little explanatory power on SOC concentrations, while exchangeable calcium showed its importance at near-neutral pH. The Alp/Fep molar ratio increased with pH decline, indicating that organo-Al complexes prevail over organo-Fe complexes at moderately acidic pH. We further found that the SOC/Alp ratio significantly decreased with MAT, suggesting that Al-bound SOC in this form is not fully stabilized but its persistence is temperature sensitive. Overall, we show that Al phases, rather than Fe, are a better substitute for clay content as a predictor of SOC concentrations at the global scale.

Keywords: mineral interaction, persistence, reactive minerals, soil organic matter, volcanic ash soil

ID ABS WEB: 135995

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

REPEATED MANURE APPLICATION ON MAIZE YIELD, N REPLACEMENT VALUE AND CARBON FOOTPRINT IN A LONG-TERM ROTATION STUDY

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Systematic assessment of manure applications on maize productivity as well as their ecological services and environment benefits is critical for developing sustainable agricultural systems. A field trial has been running since 1992 testing a maize-based cereal and legume crop rotation. The experiment consists of three cropping systems: maize-soybean (MS), maize-forage legume (MF), and continuous maize monoculture (MM). Maize plots were fertilized with varying levels of nitrogen fertilizer and dairy manure during the maize phase of crop rotation. The main points of the results can be summarized as follows: The continuous maize monoculture produced the lowest grain yield, while maize in rotation with forage-legume yielded the highest. On an equivalent amount of manure organic N basis, FNRVs were, on average, 0.38 (±0.02) for SM and 0.27 (±0.02) for RM, with a wide range of 0.12 (±0.02), 0.28 (±0.02), and 0.37 (±0.04) for RM, and 0.16 (±0.04), 0.39 (±0.03), and 0.48 (±0.04) for SM under the low, intermediate, and high N response conditions, respectively. N replacement values of legume crops ranged from 40 to 120 kg ha-1 for maize-soybean, and from 130 to 180 kg ha-1 for maize-forage legume rotation systems. The magnitude of C footprint reduction varied with N fertilizer application rates, and maize treated with 100 kg N ha-1 in MS rotation produced the greatest economic yield with relatively low GHG emissions and C footprint. Our findings suggest that increased maize yields and reduced C footprints can be achieved through appropriate N application and crop rotation with forage legumes or soybeans, and that planting canola after soybeans or wheat following canola is a viable and sustainable strategy in eastern Canada.

Keywords: Manure, Nitrogen replacement value, Maize or corn, Carbon footprints, Fertilizer

ID ABS WEB: 136038

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

SPECIATION AND POSSIBLE ORIGINS OF ORGANOSULFUR COMPOUNDS IN RICE PADDY SOILS AFFECTED BY ACID MINE DRAINAGE

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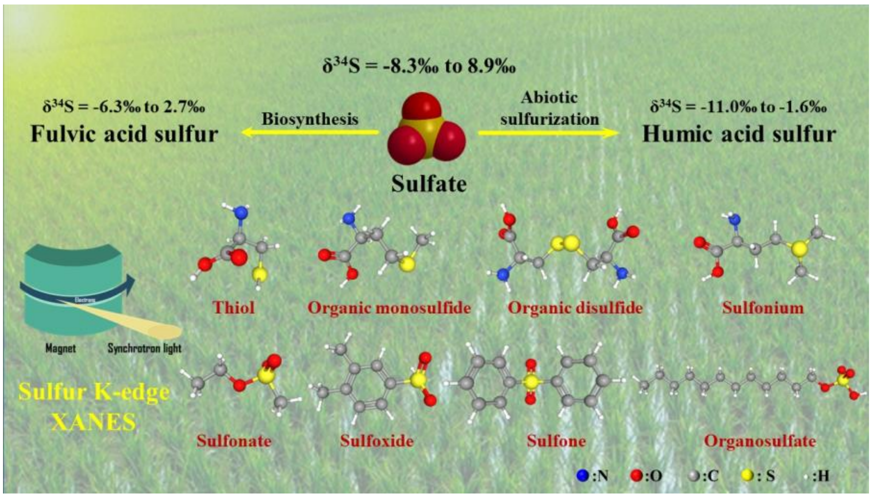
Although sulfur cycling in acid mine drainage (AMD)-contaminated rice paddy soils has received much attention, the potential transformations of organosulfur compounds in such soils remain unclear. We used sulfur K-edge X-ray absorption near edge structure (XANES) spectroscopy to quantify organosulfur compounds in paddy soils from five AMD-contaminated sites and one AMD-uncontaminated reference site near the Dabaoshan sulfide mining area, South China. We also determined the sulfur stable isotope compositions of water-soluble sulfate (d34SWS), adsorbed sulfate (d34SAS), fulvic acid sulfur (d34SFAS) and humic acid sulfur (d34SHAS) in these samples. Organosulfate was the dominant functional group in humic acid sulfur (HAS) in both AMD-contaminated (46%) and AMD-uncontaminated paddy soils (42%). Thiol/organic monosulfide contributed a significantly lower proportion of HAS in AMD-contaminated paddy soils (8%) compared to AMD-uncontaminated paddy soils (21%). Within contaminated soils, the concentration of thiol/organic monosulfide was positively correlated with cation exchange capacity (CEC), moisture content (MC) and total Fe (TFe). d34SFAS ranged from -6.3‰ to 2.7‰, similar to d34SWS (-6.9‰ to 8.9‰), indicating that fulvic acid sulfur (FAS) was mainly derived from biogenic S-bearing organic compounds produced by microorganisms in the soils. d34SHAS (-11.0‰ to -1.6‰) were more negative compared to d34SWS, indicating abiotic sulfurization of organic matter was the main process in the formation of HAS. Overall, our results show that AMD irrigation influences the concentrations of soil organic sulfur species in paddy soils, potentially altering key biogeochemical processes including soil carbon sequestration and heavy metal immobilization.



Keywords: Paddy soils, Acid mine drainage, Organosulfur compounds, XANES spectroscopy ,Sulfur isotopes

ID ABS WEB: 136399

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

A CONTINENTAL-SCALE STUDY OF SPODOSOL PROPERTIES ACROSS NORTH AMERICA AND THEIR IMPLICATIONS FOR ORGANIC CARBON ACCUMULATION

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[2] Forest Service - U.S. Department of Agriculture - Pacific Northwest Research Station, Olympia, USA
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Spodosols are predominantly found in cool, moist climates within temperate regions. These soils develop from Si-rich and sandy parent materials, resulting in nutrient-poor and acidic conditions. However, in the Coastal Temperate Rainforest of Southeast Alaska (CTR), Spodosols can form from diverse parent materials, including volcanic rocks, which is not typically observed in other regions. The CTR is characterized by a perhumid climate and dense coniferous forests, contributing to enhanced podzolization. Despite existing research highlighting the distinct properties of CTR Spodosols, including elevated soil organic carbon (SOC) and Fe oxyhydroxides, there are no quantitative comparisons across North America. This study aims to bridge this gap by comparing the properties of Spodosols from the CTR with those across North America. We hypothesize that CTR Spodosols display higher Fe-Al concentrations and clay content than their North American counterparts, fostering the formation of SOC-rich mineral horizons. This would mean that pedogenesis under the bioclimatic conditions of the CTR yields optimal mineralogical and geochemical properties for carbon sequestration. We used the Soil Characterization Database and the Pedon National Database for US and Canadian Spodosols, respectively. Analyzed soil properties including Fe and Al extractions, SOC, and clay. We selected only B horizons from well-drained Spodosols, amounting to 18k data entries. Our results show that CTR Spodosols have significantly higher mean concentrations of SOC and Fe species (Fig. 1). Pedogenic Al was higher than most other regions. Clay content was higher than in some regions but lower than in others. The SOC concentration observed for the CTR surpasses the threshold of 6% for the Humods suborder, emphasizing the SOC-rich character of these soils. Since Fe and Al oxyhydroxides are often proxies for SOC accrual and stabilization, our results demonstrate that enhanced weathering under CTR bioclimatic conditions is conducive to subsurface SOC accumulation. The next step in this study is to identify the role that climate and parent material geochemistry play in the investigated soil properties.

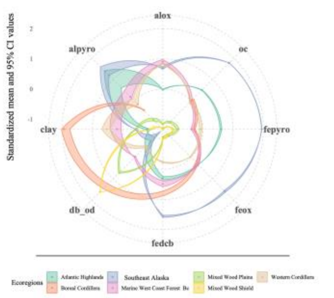

Figure 1. A radar chart depicting the variation of selected soil properties across different North American Ecoregions Level II

Keywords: Spodosols, Subsurface soil organic carbon, Iron oxyhydroxides, Forest soils

ID ABS WEB: 136498

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

SOIL ORGANIC CARBON IN SWISS ALPINE SOILS: THE ROLE OF MICROBIAL COMMUNITY DYNAMICS

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Understanding the intricate relationship between microbial communities and Soil Organic Carbon (SOC) in Alpine soils is critical as we face the challenges of climate change. Alpine ecosystems are highly sensitive to environmental change, and within them, the interaction between microbes and SOC is key to understanding present and future carbon dynamics. Microbes play a pivotal role, directly affecting SOC's stability, decomposition, and storage. This is especially central in Alpine soils, where the total carbon storage and its dynamics are largely determined by microbial processes.

Using novel tools in biogeochemistry and microbiology, we examine the diversity and functional potential of microbes across different soil depths and landscape positions in two Alpine watersheds. By correlating these findings with key environmental factors like SOC content, moisture, pH, and soil redox state, we can uncover the main mechanisms behind SOC stabilisation. Soil redox state exerts a key control on microbial metabolic pathways and thus on organic carbon transformation processes. We are particularly interested in energetic and enzymatic limitations on microbial respiration as a function of soil redox state. This interplay between microbial communities and SOC dynamics, especially in varying soil redox conditions is thus of particular interest. Alpine watersheds offer a unique setting to study the interactions between varying water tables and soil processes, essential for understanding redox effects in high-altitude ecosystems.

This research aims to illuminate how the soil environment and its microbial inhabitants influence carbon storage in Alpine ecosystems. Ultimately, our findings highlight the crucial role that Alpine soil microbial communities play in shaping SOC dynamics and ecosystem changes in the face of ongoing climate shifts.

Keywords: Soil organic carbon (SOC), Alpine watersheds, Microbial communities, Soil redox state, Carbon cycle

ID ABS WEB: 136547

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

FROM SOM TO SOC: A REVISIT OF THE VAN BEMMELEN CONVERSION FACTOR

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It is common to estimate soil organic carbon (SOC) content from easily measured soil organic matter (SOM) data by using the van Bemmelen conversion factor (CF) of 0.58. There is strong evidence that instead of a constant, CF changes with soil properties, soil conditions, and agronomy practices. In this study, we investigate how CF varies with soil texture, land use type, and intensity of soil disturbance. Soil samples were collected from different layers of the 0- to 100-cm profile with wide ranges of texture, vegetation type, and tillage methods from North and Northeast China. SOC content was determined with automated dry combustion method, SOM content and thermal stability was measured with thermogravimetric (TG) analysis, and the weight loss of soil minerals during TG measurement was measured with X-ray diffraction (XRD) analysis. Preliminary results showed that the CF varied considerably across the soil textures, land use types, tillage practices, and soil depths. Quantitative relationships were developed to represent the changes of CF as functions of soil particle size and SOM stability, which could be applied for obtaining accurate SOC results from SOM measurements.

Keywords: SOC,SOM, Conversion factor, Thermogravimetric analysis, X-ray diffraction analysis

ID ABS WEB: 137143

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

CO-AGGREGATION OF SOIL MINERAL AND ORGANIC COLLOIDS UNDER DIFFERENT PH CONDITIONS

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The complex interaction between soil minerals and organic matter is a key process determining organic matter stability. The soil particles interaction forces at mesoscale (1-1000 nm) are the important factors driving the quantity and stability of soil mineral- organic matter binding. However, it is not clear how mesoscopic forces regulate the chemical retention of organic matter in different media environments. In this research, the common minerals (montmorillonite, illite, kaolinite) and humic acid in black soil are divided into materials, and the mesoscopic scale co-aggregation mechanism in different electrolyte solutions and humus retention under different pH conditions were studied by modern spectroscopy and dynamic light scattering methods. The results showed that (a) there was only one critical coagulation concentration (CCC) for mixture colloids with different colloidal components in a certain kind electrolyte solution. (b) The CCCs of the mixture components aggregation were always between the CCC values of each single component in the mixture. (c) Humic acid will decrease soil particle aggregation by increasing the DLVO repulsive forces. The CCCs increase with the increasing of pH in potassium solutions and decrease in calcium solutions. Based on those results we concluded that, all the components would participate in the aggregation with equal probability, and the aggregation should be driven by the average DLVO forces of the mixture components. The pH conditions, electrolyte and mineral types together determine the soil mineral- organic matter binding mechanism. The results provide a basis for further revealing the mechanism of soil organic matter stability and the improvement of soil carbon pool function.

Keywords: Aggregation ,Soil mineral, Soil organic colloids, pH

ID ABS WEB: 137168

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

DIVERGENT MINERAL PROTECTION MECHANISMS OF PARTICULATE AND MINERAL-ASSOCIATED ORGANIC CARBON IN A TEMPERATE FOREST: A SOIL TRANSLOCATION EXPERIMENT

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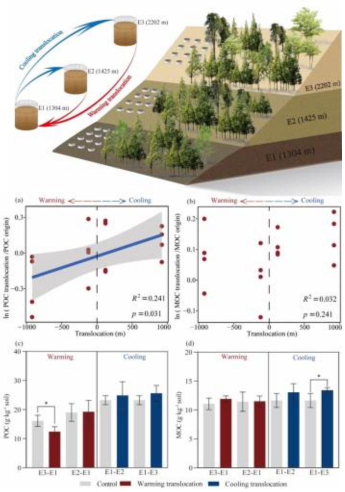
Mineral protection mechanisms are important in determining the response of particulate organic carbon (POC) and mineral-associated organic carbon (MAOC) to future climate change. However, the underlying mechanisms for how POC and MAOC respond to climate change is remain unclear. Here, based on a soil translocation experiment designed to simulate warming and cooling, we isolate POC and MAOC to determine their responses to temperature changes and mineral protection mechanisms. Results showed that warming translocation significantly decreased POC by an average of 10.84%, but increased MAOC by an average of 4.25%. Conversely, cooling translocation led to an average increase of 8.64% in POC and 13.48% in MAOC. Exchangeable calcium (Caexe) had a significant positive correlation with POC and MAOC during temperature changes, and Fe/Al-(hydr)oxides had no significant correlation or a significant negative correlation with POC and MAOC. Our results showed that POC was more sensitive than MAOC to temperature changes. Caexe mediated the stability of POC and MAOC under temperature changes, and Fe/Al-(hydr)oxides had no obvious protective effect on POC and MAOC. Our results support the role of mineral protection in the stabilization mechanism of POC and MAOC in response to climate change and are critical for understanding the consequences of global change on soil organic carbon (SOC) formation, persistence, and stabilization mechanisms.



Keywords: Temperate forests, particular organic carbon, mineral-associated organic car, mineral protection, soil translocation

ID ABS WEB: 137175

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

SOURCES OF MINERAL-ASSOCIATED ORGANIC MATTER IN TEMPERATE FOREST SOILS MEDIATED BY MYCORRHIZAL TYPE

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Temperate forests dominated by arbuscular mycorrhizal (AM) or ectomycorrhizal (ECM) tree species are characterized by divergent soil organic matter (SOM) formation and decomposition mechanisms. However, the main sources of particulate organic matter (POM) and mineral-associated organic matter (MAOM) in these systems remain undefined – particularly the relative contributions of plants and soil microbes. We informed a Bayesian mixing model with natural abundance data of stable carbon and nitrogen (N) isotopes of SOM sources, bulk SOM, POM and MAOM, in order to estimate the relative source contribution to SOM in AM- and ECM-dominated plots in a North American temperate forest. We investigated sources of SOM in N fertilized and unfertilized forest plots and at two soil depths (0-15 cm and 15-30 cm).
In both plot types, plant material was the main source of POM (>56%), whereas MAOM was mostly derived from mycorrhizal fungi (>64%). Mycorrhizal contributions to SOM increased with depth across all treatments. Under higher N availability, direct plant contributions to SOM decreased in all soil fractions within the AM system (-4.7% on average), with a corresponding increase in mycorrhizal inputs. However, direct plant contributions increased in the POM fraction of the fertilized ECM plots compared to the unfertilized ones (+6.4% and +7.4% in top- and subsoil, respectively). Overall, the contribution of plant material to SOM was consistently higher in ECM plots, compared to AM plots, especially under increased N availability.
Our results highlight divergent trends between AM and ECM forests, especially under simulated atmospheric N deposition, and underscore a heightened contribution of mycorrhizal fungi to SOM deeper in the soil. Given the shifts in tree-mycorrhizal dominance that are occurring in many forests worldwide, our results indicate that changes in SOM dynamics can be anticipated.

Keywords: soil organic matter sources, C sequestration, mycorrhizal fungi, stable isotope tracing

ID ABS WEB: 137774

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

LEAVING NATURAL VEGETATION COVER IN OLIVE ORCHARDS INCREASES SOIL ORGANIC MATTER DIVERSITY

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The increase in extreme weather events during the last years has motivated the implantation of agricultural techniques that minimize soil disturbance. The maintenance of an undisturbed soil structure reduces soil loss due to erosion. It helps in achieving a gradual enhancement of organic matter contents and therefore increases the carbon sequestration potential of soils. In order to elucidate the real impact of management on the quality and quantity of soil organic matter (SOM), long-term field experiments are essential. In this work, SOM derived from plots maintained under a conventional tillage (CT) and plots left with natural cover vegetation (NC) since 1995 from an olive orchard located in southern Spain (Benacazón, Seville) were characterized and compared to SOM of soils derived from the tree line, treated with herbicide (TL-Herb.). The analysis was performed applying 13C CP/MAS solid-state NMR spectroscopy and analytical pyrolysis (Py-GC/MS). Pyrolysis-GC/MS indicated a higher diversity of biomarkers in NC soils than in CT, whereas TL-Herb showed the lowest. NMR analysis allowed the estimation of the degree of soil humification by an indicator derived from the Alkyl C / O-alkyl C ratio. This ratio was lowest for NC as these plots were receiving constantly input of fresh litter organic matter. Our study confirms that conventional tillage and use of herbicides in olive yards is not only reducing SOM contents but also SOM diversity. These results were also supported by phospholipid fatty acid analysis, which also indicated differences among the studied plots in soil microbiome composition.

Acknowledgements: This work is financed by the project EJP Soil/Energylink, which received funding through the European Union's Horizon 2020 research and innovation programme under grant agreement N° 862695 and Tudi, GA 101000224, also of the H2020 program.

Keywords: Soil Organic Matter, NMR spectroscopy, Humification ratio, Microbiome composition

ID ABS WEB: 137834

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

TIME AND CLIMATE INFLUENCE ON THE FORMATION AND STABILITY OF SOIL ORGANIC MATTER POOLS

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This study aims at investigating the effect of climate and time on particulate organic matter (POM) and mineral-associated organic matter (MAOM) dynamics. Two chronosequences located along a climate gradient were investigated. The driest chronosequence (ADI) consisted of four fluvial terraces, whereas the wettest one (LED) included three fluvio-glacial terraces. The age of the ADI sites (Q2, Q3, Q4 and Q5) ranged from about 125,000 to 2,000 years BP, whereas that of the LED sites (Q1, Q2, and Q3) from about 16,000 to 10,000 years BP. All sites were grasslands. Soil samples (1 profile and 2 cores per site) were collected by horizon, and each horizon sub-sampled by depth (each 5 cm). From each sample, POM and MAOM were isolated and characterized by elemental and thermal analyses.
The contribution of POM and MAOM to carbon (C) storage differs among the climo-chronosequences. In the topsoil (0-15 cm), POM represents the main pool, especially in the wettest chronosequence. The average MAOM/POM ratio is almost twice in the driest chronosequence (ca. 2.6). The concentration of organic C in MAOM and POM along the whole profile is about 2x and 3x, respectively, in LED soils compared to ADI. In both chronosequences, the MAOM/POM ratio increases with depth with an unsaturated level of MAOM.
Thermal indices show that the stability of the MAOM pool increases with soil age and depth in the driest chronosequence (ADI), whereas no significant differences were observed in the wettest (LED). For the POM fraction, no significant differences in stability were observed in both chronosequences.
In conclusion, our results show that soil age plays an essential role in forming stable MAOM, in particular in drier climatic conditions. In contrast, a wetter climate determines a higher accumulation of C in both pools, although such higher C contents are negatively correlated with their thermal stability.

Keywords: MAOM, POM,climo-chronosequence, C accrual, thermal analysis

ID ABS WEB: 137839

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

INCREASING TEMPERATURE INFLUENCE ON SOIL ORGANIC CARBON POOLS AND ON SUGAR BEET AND SOYBEAN YIELDS: PRELIMINARY RESULTS

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Soil organic carbon (SOC) plays a fundamental role in the global carbon (C) cycle and represents a key element of soil ecosystem services. Thus, the response of agricultural soils to global warming is important when assessing C accrual potential and soil fertility in a climate change scenario.
In this research we investigate the influence of global warming on SOC pools, and on the yields of two crops, namely sugar beet (SB) and soybean (SOY). A temperature increase of ~2°C was simulated using Open Top Chambers (OTCs) in a randomized complete block design field experiment. Topsoil samples (0-15 cm) were collected from all plots before and after the experiment and characterized from the physical and chemical point of view. Particulate Organic Matter (POM) and Mineral Associated Organic Matter (MAOM) were also isolated.
Data collected from sensors confirmed that soil and air temperatures inside the OTCs were higher than those outside the OTCs, both in the control and in the cultivated plots. In general, SOC in the MAOM fraction was 3-4× higher than in POM (76.4±2.4 vs. 20.2±4.5%) and showed a lower C/N value (8 vs. 12) suggesting a great contribution of microbial derived SOM. Following the experiment, the MAOM/POM ratio was quite different, suggesting an influence of increasing temperature on SOC distribution between pools (work in progress).
Beside affecting SOC distribution between SOM pools, the 2°C temperature increase had also a strong impact on crop yields, with average values 3× (SB) and 5× (SOY) lower within the OTCs than those obtained outside the OTCs, corresponding to a loss of income of 1,000-3,000 €/ha.

Keywords: POM, MAOM, SOC, Warming, crop yield

ID ABS WEB: 137885

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

SOIL TYPE MATTERS: INVESTIGATING THE IMPACT OF ENVIRONMENTAL DISTURBANCES ON SOIL ORGANIC CARBON STORAGE – A CASE STUDY OF WINDTHROWS IN THE TATRA MOUNTAINS (S POLAND)

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Storage of soil organic carbon (SOC) is crucial for ecosystems' overall health and functionality. SOC influences nutrient cycling, supports biodiversity, mitigates climate change, and enhances soil stability and structure. Environmental disturbances, often induced by human activity, directly and indirectly affect SOC storage. Windthrows, which are an example of such disturbances, impact both the external conditions for the formation of SOC pools, including biomass production and decomposition, and intrinsic soil transformations. However, the direction and outcomes of such disturbance on SOC storage may depend largely on soil type. Mountains, characterized by high local geodiversity and susceptibility to global changes, serve as field laboratories for analyzing the effects of environmental disturbances on SOC storage. The study aimed to assess the impact of windthrows on the storage of SOC in the context of the local diversity of soil types. The impact of tree uprooting events on SOC concentration was assessed based on 340 soil profiles of the forest zone of the Tatra Mountains classified as Podzols and Cambisols (the latter developed both from calcareous or acid rocks). More than 50% of the analyzed soils were affected by the windthrows and on average showed a slightly lower SOC content recorded in O, A, and B horizons compared to undisturbed soil profiles. However, the effects of windthrows on SOC content varied significantly depending on soil type. Podzols, which generally stored more SOC in the study area than Cambisols, also showed significantly greater SOC losses due to the impact of windthrows. The most pronounced differences in SOC content in windthrow-affected and undisturbed soils were observed in the B horizons, which indicates the loss of the most stable SOC pool (deep SOC) from Podzols.
The research was supported by funds from Polish State Forests transferred to the Tatra National Park and grants from the Priority Research Area Anthropocene and the Faculty of Geography and Geology under the Strategic Programme Excellence Initiative at Jagiellonian University.

Keywords: SOC storage, soil-forming processes, environmental disurbance, windthrows, mountains

ID ABS WEB: 137917

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

SOIL ORGANIC MATTER TURNOVER: GLOBAL IMPLICATIONS FROM D13C AND D15N SIGNATURES

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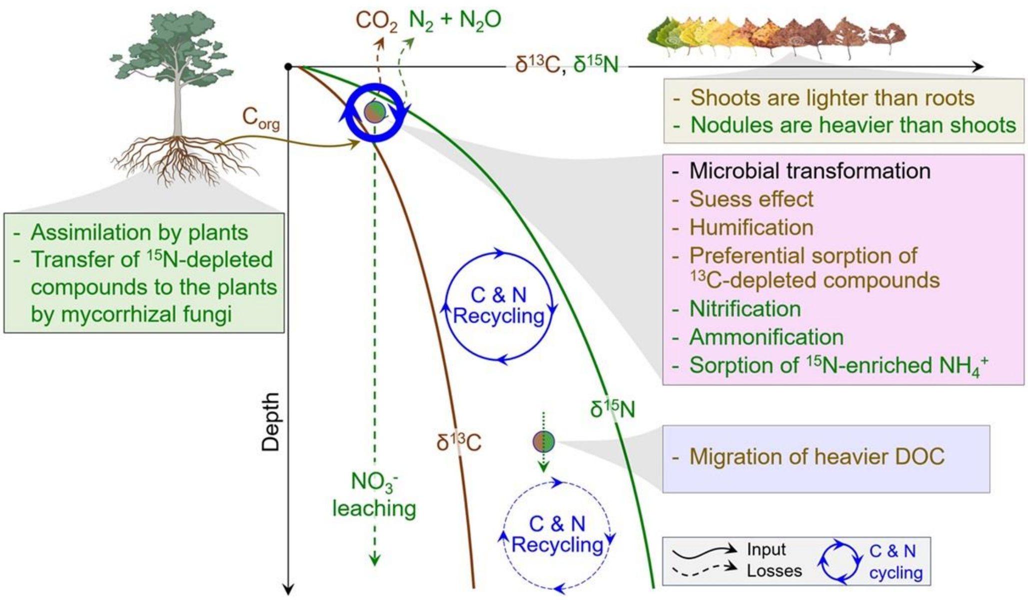
The residence time of carbon (C) and nitrogen (N) in soil is a fundamental parameter reflecting the rates of soil organic matter (SOM) transformation. Based on the global database of the stable isotopes of C (d13C) and N (d15N) depending on soil depth (171 profiles), we assessed SOM turnover and related them to climate, biome types and soil properties. The 13C and 15N discrimination by microbial utilization of litter and SOM, as well as d13C and d15N increase with depth, enabled to assess C and N turnover within SOM.
N turnover was 2 times faster than that of C because i) repeated N recycling by microorganisms, ii) C loss as CO2 and input of new C atoms, which reduces the C turnover, and iii) slower turnover of N free persistent organic compounds (e.g. lignin, suberin, cellulose) compared to N containing compounds (e.g. proteins, DNA). An increase in temperature and precipitation accelerated C and N turnover because: i) higher microbial activity and SOM decomposition rate, ii) larger soil moisture and fast diffusion, iii) downward transport of 13C-enriched organic matter (e.g. sugars, amino acids), and iii) leaching of 15N-depleted nitrates from the topsoil and losses from the whole soil profile. The temperature increase by 10 °C accelerates the C and N turnover for 40%. SOM turnover is boosted by decreasing C/N ratio because: i) SOM with a high C/N ratio originated from litter is converted to microbially-derived SOM in mineral soil characterized by a low C/N ratio; ii) litter with a low C/N ratio is decomposed faster than litter with a high C/N; iii) microbial carbon-use efficiency increases with N availability. The fastest C turnover is common under evergreen forests and the lowest under mixed and coniferous ones. Concluding, the assessment of SOM turnover by d13C and d15N approach showed two times faster N turnover compared to C, and specifics of SOM turnover depending on the biomes as well as climate conditions.



Keywords: Soil organic matter, Isotopic approaches, Turnover and recycling, Carbon sequestration, Natural abundance

ID ABS WEB: 137952

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

SUBSOILS ROLE IN THE EVALUATION OF BEECH COPPICE MANAGEMENT SUSTANAIBILITY: A CASE STUDY IN APENNINE MOUNTAIN (EMILIA ROMAGNA REGION, ITALY)

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Soil carbon accumulation and turnover dynamics affect forest management sustainability. Because of the different mechanisms (or of their relative importance) regulating C turnover in topsoils and subsoils, a different effect of forest management is expected with time. To verify it, a chronosequence of cut beech coppice (5, 11 and 16-yrs-old compared to a 70-yrs-old site) in Apennine mountains in Emilia-Romagna region (Italy) on well-drained Dystrudepts was investigated. Soil organic C stocks and organic matter decomposition estimated by C isotopes were compared in topsoils (O and A horizons) and subsoils (Bw, AC and BC horizons).
In the 26 soil pits investigated, C stock in O horizons varied from 1.89 to 4.54 Mg ha-1, and significantly differed in the oldest and youngest sites, respectively. C stock in the first 30 cm did not differ among sites (79.4±18.3 Mg ha-1), but its value was correlated with the C stock density of subsoils ($r=0.68$, $p<0.001$), stressing the relevance of subsoil in C accumulation. The regressed gradient (b) and constant (k) of d13C and the logarithm of SOC with depth were indicative of the rate and the maximum value of isotopic fractionation occurring during C turnover in the deepest horizons, respectively. b and k ranged from -2.73 to -1.76 and from -25.69 to -24.63‰, suggesting different C turnover among sites possibly regulated by: priming effect in 5-yrs-old site trigged by the accumulation of organic residues in O horizon (thick O horizon and pronounced negative b and k values); root growth promoting C input and mixing processes in-situ in 11-yrs-old site (less negative values of both b and k); accumulation of more transformed and potentially more stabilized organic compounds in 16-yrs-old site (b and k values returned to be more negative). Evidence of decreasing accumulation of few transformed organic matter, potentially leading to higher CO2 soil emissions, was instead found in the 70-yrs-old coppice, questioning the sustainability of this management practice in terms of C accumulation.

Keywords: subsoils, C accumulation, C isotopes, forest management, sustainability

ID ABS WEB: 137968

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

TREE COMPONENT INFLUENCES SOIL CARBON STORAGE AND LITTER DECOMPOSITION IN AGROSILVOPASTORAL SYSTEMS

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Integrated farming systems are recognized as agricultural production models that enhance soil carbon storage. This study aimed to evaluate the influence of the tree component on the litter dynamics and soil C and N stocks in an agrosilvopastoral system in the Brazilian Cerrado. We compared nine-years-old agrosilvopastoral system (ASP) with an arrangement of 3x2+14m, with a 24-years-old nominal pasture (NP) and a native vegetation (NV). Five treatments including three sampling points in ASP [between the eucalyptus trees (P1), in the canopy projection area (P2) and in the middle of the alley (P3)], and two areas (PN and VN) were evaluated. Litterfall production from eucalyptus were evaluated in suspended collectors while the decomposition rate was evaluated in litterbags. The assessments were carried out monthly over one year, as well as CO2 fluxes. Soil samples were taken at six soil layers until 0.5m depth to evaluate bulk density, soil fertility and soil C and N stocks. The litterfall production higher in P1, with decrease during the dry season. P1 and P3 showed higher decomposition rates, with final remaining mass of 28.71 and 32.33%. CO2 efflux was higher in the rainy season and showed similar pattern between P1 e NV. Regarding the soil fertility, NV showed higher values of macronutrients and base saturation, and these results can be associated to the nutrient exportation and the deficit of fertilization management in ASP and NP. Soil C and N stocks at 0-50 cm depth were higher in NV (115.4 and 11.3 Mg ha^{-1}), followed by NP (92.4 and 8 .8 Mg ha^{-1}) and ASP (89.9 and 9.0 Mg ha^{-1}). In the sampled points within ASP, soil C and N stocks were higher in P1, showing the influence of tree component. Our results showed that the arrangement as well as the management of eucalyptus trees in the integrated farming system influenced the dynamics of litter decomposition and soil C and N storage over time.

Keywords: Eucalyptus, CO2 emissions, Soil fertility, Soil carbon stocks, Integrated farming systems

ID ABS WEB: 138018

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

STABILIZING SOIL ORGANIC CARBON DURING WATER EROSION ON LOESS SOIL : INTERPLAY OF AGGREGATES, MICROBES AND PLANTS

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Soil organic carbon (SOC) forms a crucial reservoir in the global carbon cycle, but its stability can be significantly affected by water erosion. However, how soil microbes and plants interact with the known physicochemical processes on stabilizing SOC during water erosion is still unknown. We hypothesize that microbes (including mycorrhiza) with extracellular polymeric substances and plants will enhance soil aggregate stability during water erosion. This enhancement involves forming physical-protected particulate organic matter (POM) and mineral associated organic matter (MAOM).

We set up plant-soil systems with Trifolium pratense and Lolium perenne in loess soil of a low and high SOC content. Bare soils were set as control. Additionally, in the low SOC soil, we grew plants with and without mycorrhizal inoculum. In all treatments, plants were grown for eight weeks on a slope followed by simulated rainfall. Runoff, root and soil samples were collected; microbial factors, aggregate stability and SOC fractions were measured.

Our preliminary results show that both plant presence and higher original SOC content positively contributed to aggregate stability. Opposite to our expectation, the root colonization rate by mycorrhizal fungi hyphae correlated negatively with aggregate stability. Our results show, so far, that plants and mycorrhizal fungi might have contrasting roles in soil aggregate stability, and hence requires further investigation into these factors.

Keywords: SOC stabilization, soil aggregation, plants and microbes, SOM fractions, water erosion

ID ABS WEB: 138043

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

SOIL ORGANIC MATTER STABILIZATION IS ASSOCIATED WITH FUNCTIONAL DIVERSITY OF ORGANIC MOLECULES IN A TEMPERATE CONIFEROUS FOREST

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The effects of the inherent properties of soil organic matter (SOM) on its persistence are not fully understood. A new-emerging paradigm suggested that molecular diversity is an important factor in regulating the decomposition and stabilization of SOM. However, it is still not clear how molecular diversity is associated with SOM stabilization, especially the underlying mechanisms. We collected plant and soil samples collected from a spruce forest in the Czech Republic, and performed 210-day incubations of soil samples, followed by separating soil fractions using density fractionation. A pyrolysis-gas chromatography/mass spectrometry was performed for soil fractions and plant samples to investigate the effects of molecular diversity on SOM stabilization. Relative abundances of detected monomers were used to estimate molecular diversity according to richness, Shannon index, evenness, and functional diversity (Rao's Q entropy estimated using functional groups such as hydroxyl groups and branch chains).

We detected 179 individual compounds, which were classified into 8 groups. Results showed that free and occluded particulate organic matter (fPOM and oPOM) had higher richness than mineral-associated organic matter (MAOM), but no significant difference was found for Shannon index or evenness. For functional diversity, root and MAOM exhibited a higher functional diversity of branch-chain fatty acids, suggesting a larger proportion of microbial-derived fatty acids. Needles and MAOM had a greater diversity of compounds with hydroxyl groups, suggesting that hydroxyl fatty acids derived from needles are preferentially stabilized by associations with mineral surfaces. During the 210-day incubation, the relative abundances of compounds having similar functional groups were positively correlated for oPOM and MAOM, but not for fPOM. This suggests that functional group composition of molecules is associated with the changes in SOM during the incubation. Our findings suggest that the SOM decomposition and stabilization during the incubation are regulated by the functional diversity of SOM, especially for the diversity of compounds with the same functional groups such as hydroxyl groups.

Keywords: Molecular diversity, Pyrolysis-GC/MS, Functional group, Incubation, Density fracionation

ID ABS WEB: 138123

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

SUSTAINABLE GRASSLAND MANAGEMENT FOR HEALTHY SOILS AND VICE VERSA

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Soils perform a variety of functions that are vital for the proper performance of terrestrial ecosystems. For instance, they play a crucial role in regulating water flow and storage, as well as nutrient release, serving as the primary terrestrial carbon storage, while their rich biodiversity, encompassing 59% of the planet's species, facilitates these functions. However, intensive agriculture and livestock management can impact on soil ecosystem services. Among regenerative farming practices, rotational grazing regime involves dividing pastures into smaller sections, regularly moving livestock, and maintaining high stocking rates for brief periods. This approach extends resting periods in grazing areas, allowing defoliated grasses to recover and regenerate. It enhances productivity, optimizing land and resource homogeneity.
Conducted in four extensive and commercial livestock farms in the Basque Country (northern Spain), this study aimed to assess the impact of land use disturbance on various descriptors of soil health and associated functions. The land use gradient studied included woodland, rotational grazing, overgrazing and non-permanent cropping. On at least three sites for each land use and farm, up to 46 physico-chemical and biological descriptors were measured, which were then grouped into four ecological functions. While the primary focus was to compare rotational grazing with overgrazing, forests and non-permanent crops were included as references for low and high disturbance, respectively.
Overall, forest soils showed significantly higher provision of organic matter decomposition, carbon storage and water cycle regulation functions than other land uses, especially compared to non-permanent crops. Overall, the soils under rotational grazing and those we considered to be overgrazed showed no significant differences between them. Each soil studied on the four farms has different characteristics and historical management, which makes it difficult to compare the effect of rotational grazing versus overgrazing on soil health. To do this, it would be necessary to resample the same points over time to study how each of the soils evolves over the medium to long term.

Keywords: Soil Organic Matter, Biodiversity, Regenerative farming, Rotational grazing

ID ABS WEB: 138188

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

SHORT-RANGE-ORDERED MINERALS AS ECOZONE-SPECIFIC PROXIES TO BETTER UNDERSTAND GLOBAL SOIL ORGANIC CARBON PERSISTENCE?

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Soil organic carbon (SOC) is protected from being completely decomposed by short-range-ordered (SRO) minerals. These SRO minerals are commonly measured as oxalate-extractable aluminum (Alox) and iron (Feox) and many studies revealed positive correlations with SOC. Uncertainties remain, however, as to whether this organo-mineral relationship is a general global one, or whether regional differences will prove too relevant to ignore at the global scale. Here, we present a synthesis of globally gathered data on Alox and Feox to test whether they can be used as proxies for SOC abundance across regions. We used the Holdrige Life Zones, which are characterized by biotemperature, precipitation, potential evapotranspiration, and elevation, to define distinct pedo-climatic regions. In total, we compiled more than 31,000 individual measurements covering all major Holdridge Life Zones. The global synthesis revealed a positive relationship between Alox, Feox and SOC across regions. However, Alox and Feox are more accurate proxies for mineral-induced SOC protection at the global scale when disaggregated into regional relationships. Apparently, the wetter the region the tighter the relationship showing both higher Alox, Feox and higher SOC values. The latter is almost independent from temperature which generally showed less influence on the organo-mineral relationship. Before incorporating this organo-mineral relationship as a proxy for SOC abundance into soil models, it needs to be diversified into regions since the importance of SRO minerals for SOC persistence varies across pedo-climatic conditions.

Keywords: short range minerals, soil organic matter, global, regional aspects

ID ABS WEB: 138210

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

CAN ENHANCED ROCK WEATHERING CONTRIBUTE TO ORGANIC CARBON ACCRETION VIA ORGANO-METAL INTERACTION?

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Enhanced rock weathering is proposed as one of the climate change mitigation methods. The alkali-earth metals (esp. Ca & Mg) released by the chemical weathering of crushed rock powder can contribute to CO2 removal through carbonate precipitation or leaching. The weathering also releases other metals and metalloids (Fe, Al, Si) that have strong affinities with organic matter thereby protecting organic C (OC) via complexation, co-precipitation, and aggregation. The reactive metal release is strongly driven by the surface area of rock powder. We thus hypothesized that basalt with a smaller particle size is more efficient in OC protection in addition to CO2 removal compared to larger-sized basalt. To test the hypothesis, we conducted leaching experiments of basalt-POM (potato leaves)-quartz mixtures using two sizes of basalt powders (20-38 & 106-150 micrometers). Pure basalt and the mixtures were incubated at 28 degrees Celsius and leached weekly with artificial rainwater for up to 6 months. Dissolved elements in leachates (membrane filtered) were determined with ICP-AES. The mixtures after 3 and 6 months were destructively sampled for elemental analysis and pyrophosphate, oxalate, and dithionite-citrate sequential extractions. The (first 4-weeks) results showed the amounts of Si, Ca, and Mg released from small basalt alone were 2-3 folds higher, and those of Fe and Al were similar to 1.5 folds higher compared to large basalt, implying greater CO2 removal by smaller basalt. After 3 and 6 months, small basalt mixtures (SBM) tended to retain more total C than large basalt mixtures (LBM). Similarly, SBM showed higher contents of extractable Fe, Al, and Mg. These results are consistent with our hypothesis. However, it is also possible that (i) SBM accumulated more inorganic C and (ii) small and large basalt inherently had slightly different mineralogy. We are currently testing these possibilities by organic C analysis and mineralogical characterizations (XRF, quantitative XRD, TEM/EDX, XANES). We will report these outcomes and also discuss potential effects of basalt addition on organo-mineral aggregation.

Keywords: organo-mineral complex, selective dissolution, enhanced rock weathering

ID ABS WEB: 137220

7. Soil sciences impact on basic knowledge
7.06 132267 - Pedodiversity: major driving factors and influences on ecosystem features

PEDOGENIC DIVERSITY AND LAND USE SUITABILITY IN NORTHWEST TUNISIA

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Tunisia (32-38°North; 7-12°East) constitutes the uppermost of North Africa on the Mediterranean basin. This study aims to determine the approximative association between land use and soil type suitability in the Northwest of Tunisia. Indeed, It’s a narrow area with contrasting bioclimatic and geological conditions with highly diversified soils. We have acid soils with clay and sandstone alternation, non-calcareous, shallow but quite rich in organic matter; deep calcareous soils on marl slopes; shallow soils on calcareous rock. The World Reference Base (WRB) was used to classify soil profiles. The most accurate representations of the soil types in the studied area are Lithosols (318000ha), Chromic Luvisols (234000ha), Calcaric Fluvisols (204000ha), Calcaric Cambisols (36000ha), Rendzinas (3000ha). Lithosols are limited by the rockiness and stoniness of the substratum. They are suitable for olives and vines. In most cases, this soil type is not suitable for agriculture and should be left under natural vegetation. Chromic Luvisols are relatively poor in organic matter and phosphorus. They are used for winter cereals and olive groves. However, lack of water is the main obstacle. Calcaric Fluvisols are well endowed with exchangeable bases and with total P2O5. They constitute a fertile agricultural area densely occupied by food crops. Calcic Cambisols have a good mineral reserve and its suitability depends essentially on texture, which determines water retention capacity. They are used for winter cereals. Olives and figs are also grown, and, less frequently, citrus. But, hilly topography and an abundance of calcareous crusts are a barrier to development. Rendzinas are rich and have a high humus content. They are suitable only for the cultivation of olives, figs and vines. Moderate slopes can be suitable for winter cereals (wheat and barley) and winter pastures. Furthermore, Northern Tunisia faces various soil degradation. For example, Erosion removes topsoil, the most fertile and nutrient-rich layer. Irrigation with poor water quality, use of improper cultural practices or inadequate drainage lead to salinization.

Keywords: Pedodiversity, Tunisia, Soil, Mediterranean

ID ABS WEB: 137819

7. Soil sciences impact on basic knowledge
7.06 132267 - Pedodiversity: major driving factors and influences on ecosystem features

SURVEYING PEDODIVERSITY: THE POTENTIAL OF LANDSCAPE UNITS IN ANALYZING, MONITORING AND MAPPING SOIL DIVERSITY AND ECOSYSTEM SERVICES

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Both monitoring and assessment of ecosystems and their interactions play pivotal roles in the journey toward the effective management of both natural and agricultural lands. Among the crucial components of terrestrial ecosystems, soil stands out as a fundamental entity, recognized globally as one of the most intricate and diverse natural systems, where processes like the nutrients cycle and water regulation take place, and most of the terrestrial carbon is stored. Despite its paramount importance in sustaining biodiversity and providing essential ecosystem services, the ecological studies and policy-making processes for environmental protection and management often neglect the significant role of soil. Soil development is a complex process influenced by various environmental factors, including climate, organisms, parent material, morphology, and time, and the interaction with different biodiversity-bearing sectors is obvious. Intrinsic (within soil itself) and extrinsic (environmental) factors influence the pedodiversity at various scales. GIS-based analyses offer a powerful tool to process this amalgamation of factors, allowing the formulation of landscape units. These units represent distinct fractions of an area characterized by a unique combination of soil-forming factors. Consequently, landscape units can serve as a base to plan survey campaigns and for mapping the pedodiversity and ecosystems services of soils. This approach not only optimizes soil survey campaigns but also yields comprehensive cartographic documents. With this contribution, we elaborate on the workflow involved in creating the soil map (1:50000) of the Frignano Regional Park in northern Italy. In this area, the seventeen landscape units harbored eleven great groups from five soil orders: Inceptisols, Entisols, Alfisols, Spodosols, and Histosols. Furthermore, we highlight the potential of this mapping process in ecosystem assessment, monitoring, and management, and the role of pedodiversity in sustaining a biodiverse environment. The systematic integration of these methodologies enhances our ability to make informed decisions for the sustainable stewardship of natural resources within the intricate web of terrestrial ecosystems.

Keywords: Pedodiversity, GIS, Ecosystem services, Soil mapping, Mountain areas

ID ABS WEB: 137830

7. Soil sciences impact on basic knowledge
7.06 132267 - Pedodiversity: major driving factors and influences on ecosystem features

SALT-RESISTANCE CAPACITY OF HALOPHYTES DEPENDS ON THE GENETIC HORIZON PROPERTIES AND PLANT SPECIES

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Halophytes are plants that evolved mechanisms to tolerate and survive in coastal areas characterized by adverse conditions due to salt accumulation and seasonal anoxia. Most of these mechanisms are implemented in the root and rhizosphere, involving the accumulation of organic and inorganic compounds that promote soil microbial activity and enzyme secretion. The resistance capacity has been widely investigated in controlled conditions and/or on soil samples collected at standard depths, omitting the influence of soil genetic horizons properties. Therefore, this study aimed to investigate the adaptation mechanisms of two halophyte plants [Arthrocaulon macrostachyum (Moric.) Piirainen & G. Kadereit and Juncus maritimus Lam] in response to salt and hypoxia stress condition in a salt marsh located in the Po River delta regional park, central-north Italy. Specifically, bulk and rhizosphere soil were considered to detect the changes in chemical, physical, and biochemical properties of genetic horizons (Az, Bgz, and 2Bgz).
In the Az horizon, results suggested a salinity-resistance capacity depending on plant species due to different ions absorption (A. macrostachyum) and secretion of organic compounds (J. maritimus), though the negligible rhizosphere activity. Contrary, most of the investigated enzymes recorded higher potential activity in the rhizosphere than in the bulk soil of the Bgz horizon. The rise of the water table resulting in saturated conditions and root hypoxia may affect enzyme activity. Thus, halophytes develop an aerenchyma system that allows gas exchange from shoots to roots, enhancing biochemical activity in the rhizosphere soil. In the 2Bgz horizon, only 8 (TOC, HC, Ca2+, Mg2+, K+, Na+, SO43-, TN) out of 31 soil parameters showed significant differences. Therefore, plants adopt several mechanisms to tolerate stress conditions in the surface horizons interested by high root abundance. Below, soil dynamics are controlled by horizon properties that prevail on plant influence.

Keywords: rhizosphere, salt-affected soils, halophyte, genetic horizons, Salt marsh

ID ABS WEB: 138076

7. Soil sciences impact on basic knowledge
7.06 132267 - Pedodiversity: major driving factors and influences on ecosystem features

SOIL MICROBIAL FUNCTIONAL DIVERSITY VS. PEDODIVERSITY AT DIFFERENT SCALES IN MOUNTAIN ECOSYSTEMS (NORTHERN ITALY)

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A methodological approach is proposed to establish the interrelationship between soil microbial functional diversity to soil development under Udic soil moisture regime with different vegetation cover (Douglas fir, forest beech, grassland). As soil evolution proceeds through an increasing niche separation we expect a link between functional diversity and soil development. Shannon's (H') diversity index was calculated using eight enzyme activities (.β-cellobiohydrolase, N-acetyl-.β-glucosaminidase, .β-glucosidase, α-glucosidase, acid phosphatase, arylsulfatase, xylosidase and butyrate esterase) in order to assess functional diversity at different scales, from soil horizons (α-diversity) to soil profiles (.β-diversity) under different vegetation (γ-diversity) and belonging to different taxonomic subgroups. In addition, the ratio of acid phosphatase to chitinase was calculated as a potential index of soil development. Twenty-five soil profiles were selected in Italian Alps or Northern Apennines in three phytoclimatic zones (Castanetum, Fagetum, Picetum) with Udic soil moisture regimes at three different temperature regimes (Mesic, Frigid and Cryic). The soil under study were classified according to the Soil Service Staff (20214) as follow: 1 Typic Haplocryod, 1 Spodic Dystrudept, 2 Mollic Hapludalfs, 1 Mollic Haplocryept, 2 Typic Hapludalfs, 4 Lithic Dystrudepts, 2 Dystric Eutrudepts, 1 Lithic Cryorthent, 5 Humic Dystrudpets, 1 Humic Lithic Eutrudept, 1 Lithic Udorthent, 2 Lithic Humudepts, 2 Typic Dystrudepts. The lowest profile differentiation, the highest the variability of the values obtained within horizons in the soil profile suggesting a link between soil development and the patterns of enzymatic activity. The microbial functional diversity assessed using Shannon diversity index and phosphatase/chitinase ratio measured at different scales (from α-diversity to γ-diversity) may represent a methodological approach to establish the interrelationship between pedogenetic processes, soil development and soil microbial functions. In particular, under Udic moisture regime an inverse relationship was found between Shannon Index and soil development. Therefore, soil microbial functional diversity, measured using Shannon diversity index, might be considered linked to the highest entropy of young undeveloped soils.

Keywords: pedogenetic process, soil enzyme activity, soil development, microbial functions, Shannon diversity index

ID ABS WEB: 135950

7. Soil sciences impact on basic knowledge
7.07 133540 - The Bright Future of Pedology

A NOVEL VIEW IN GEOPEDOLOGY: HOW SMALL LANDFORMS FROM PAST LAND USE AFFECT THE PEDOSPHERE

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LiDAR-based high-resolution digital elevation models (DEMs) can now provide a centimetre-accurate image of the Earth's surface. Soil science is still in the early stages of realising how fundamentally this new technology will change our understanding of the formation, properties and functions of the pedosphere and in particular the uppermost part of it. By using these DEMs, it is possible to identify and classify small topographic features that were previously not considered in soil mapping. Therefore, precise landform analyses will be crucial in assessing variations in soil horizonation and soil stratigraphy and will provide the framework for a new perspective in Geopedology that truly integrates Geomorphology and Pedology from pedon to soil landscapes. In the digital domain, this geopedological approach is growing rapidly by using artificial intelligence (AI) to automatically identify small landforms and visualise the heterogeneity of diverse pedological information. We present the results of the study of different types of relict anthropogenic landforms (RALs) and highlight their characteristics compared to natural soils. The origins of these relict features can vary greatly, as can their distribution, morphology and age. The analysis of high-resolution relief models shows that morphological features can be found, particularly in forest that were created in pre-industrial times. Settlement structures (e.g. burial sites) or linear relief forms created by soil cultivation (e.g. field terraces, furrow systems) are common. Relict Charcoal Hearths (RCHs), which originate from historic charcoal burning, are usually small circular platforms but can still cover a considerable part of the area. A relatively complex geomorphology can be observed in historic mining areas, which may include different landform types such as mine shafts and spoil heaps, resulting in a very heterogeneous pedological mosaic. To summarise, all studies reveal a high variation of soil properties controlled by small relief structures. Pedology should take this more into account in the future and improve knowledge of the impact of RALs on the pedosphere and other components of ecosystems.

Keywords: Geopedology, Geomorphology, Anthropogenic Landforms, Artificial Intelligence (AI), Digital Elevation Model

ID ABS WEB: 136121

7. Soil sciences impact on basic knowledge
7.07 133540 - The Bright Future of Pedology

THE APPLICATION OF RARE EARTH ELEMENTS AS PEDOGENIC TRACERS

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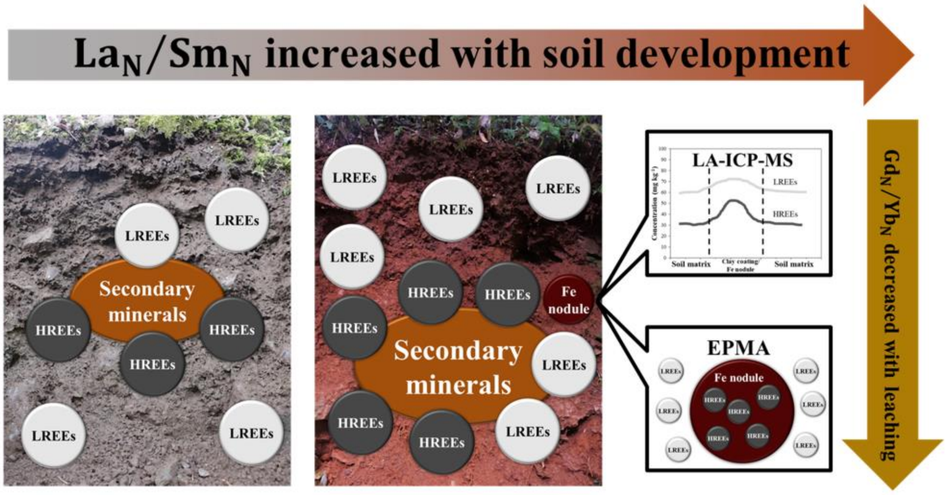
Rare earth elements (REEs) comprise 15 lanthanides and yttrium exhibiting great resemblances in physiochemical properties due to the similar trivalent chemical affinity, and hence generally occur as a group in the environment. Naturally, the concentration and constitution of REEs in soils are dominated by the parent materials. Nevertheless, the gradually decreasing ionic radius with the increased atomic weight causes the distinct affinities of REEs with organic matters, clay, and iron oxides leading to the fractionation of light REEs (LREEs, Z = 57–64) and heavy REEs (HREE, Z = 39, and 65–71) in soils. During pedogenesis, the fractionation of REEs providing possibilities of applying REEs as pedogenic tracers.
By investigating pedochemical behaviors of REEs in 50 soil pedons derived from felsic/intimidate/mafic igneous, sedimentary, and ultramafic rocks which encompassed diverse soil types attributed by intense pedogenesis processes in Taiwan, we found that the total REEs concentration in the studied soils was 119 ± 67.7 mg/kg. Additionally, the REEs abundance decreased as the following order of parent materials: granite (171 ± 92.9 mg/kg) > sandstone and shale (160 ± 34.6 mg/kg) > mafic rocks (150 ± 64.6 mg/kg) > andesite (90.4 ± 42.6 mg/kg) > ultramafic rocks (55.0 ± 43.6 mg/kg), while soils from granite, sandstone and shale, and andesite were relatively enriched in LREEs.
Regardless of the sources, HREEs co-migrated with clay particles, and iron (Fe) oxides in highly weathered pedons. Furthermore, the condensations of HREEs in clay coatings and Fe nodules compared with the soil matrix were identified by the laser ablation inductively coupled plasma mass spectrometry and the electron probe microanalyzer. The preference of secondary minerals for HREEs over LREEs caused preferential downward translocation of HREEs vs. less mobility of LREEs during pedogenesis, indicating in the increasing LaN/SmN and decreasing GdN/YbN ratios with more advanced soil development. Our results demonstrate that in humid tropical soils, LaN/SmN and GdN/YbN are capable of quantifying the degree of weathering and illuviation, respectively.



Keywords: Rare earth elements, Pedogenesis,Fractionation, Clay particles, Iron oxides

ID ABS WEB: 136556

7. Soil sciences impact on basic knowledge
7.07 133540 - The Bright Future of Pedology

AT THE DAWN OF PLANETARY PEDOLOGY IN THE CONTEXT OF MOON SPACE RESOURCES ASSESSMENT.

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The first step in the process of utilizing space resources is to identify them, localize them and assess their distribution, composition, and quantity. In the case of extra-terrestrial terrigenous material, the so-called regolith for many or real soil according to others, all this means mapping it (Certini & Scalenghe, 2010). Indeed, Moon regolith will probably play an analogous role as soil does for our civilization on Earth to provide food and building material for future extra-terrestrial human settlements. The creation of a lunar resource cartography requires to reach a consensus on the language used to communicate on the regolith or soil layers, which is a prerequisite for classification as well. On Earth, pedologists have developed an international nomenclature of soil horizons based on interpretative symbols which allow to immediately link soil description to properties and/or genesis of the described layers. Its development during the 20th century has permitted to develop pedological classification in parallel of the soil mapping process. For the Moon, we propose to use characteristics of the lunar soils such as the Is/FeO maturity index of Morris (1978) and the agglutinate content as a first attempt to differentiate soil horizons. Based on those, we propose a labelling system inspired on Earth's pedology concept but adapted to the Moon context. We expect this work to serve as a starting point for discussions between planetary scientists and soil scientists with the aim of building the foundation and concepts of extra-terrestrial soil science to avail of space resources, as already advocated by Cameron in 1963.

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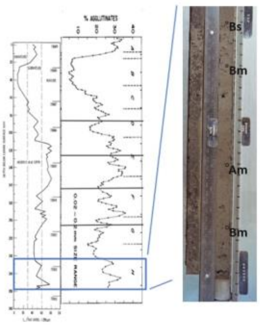

Apollo 17 Moon soil core 70002 with the labelled reference horizons according to maturity index (left) and agglutinates content (right). Image Source: Lunar Planetary Institute

Keywords: PLANETARY PEDOLOGY,REGOLITH,SOIL CLASSIFICATION, SOIL MAP, SPACE RESOURCES

ID ABS WEB: 137120

7. Soil sciences impact on basic knowledge
7.07 133540 - The Bright Future of Pedology

SOILS AND RARE PLANT HABITAT IN THE COLORADO PLATEAU

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It is common for botanists and plant ecologists to study the soil of rare plants by sampling the soil surface horizon and analyzing pH and a few other chemical properties, often looking for a “silver bullet” to explain rare plant distribution. It is rare in these studies to investigate the whole soil in a landscape context. However, multiple pedological studies of rare plants in the arid and semiarid climate of North America Colorado Plateau reveal a unique soil physical habitat where few other plants exist. These rare, endemic plants adapt and survive in soil environments and edaphic conditions that most plants are unable to survive in, effectively creating a competition-free zone. Shrubby reed-mustard (Schoenocrambe suffrutescens), Jones' waxy dogbane (Cycledenia humilis var. jonesii, Parachute beardtongue (Penstemon debilis), and Debeque phacelia (Phacelia scopulina) all occur in shallow soils in distinct sedimentary rock strata that can be mapped using remotely sensed and topographic data. Soil physical properties are typically coupled with one or more chemical properties that are challenging for most plants.

Keywords: Pedology, Plant ecology, Rare plants

ID ABS WEB: 137696

7. Soil sciences impact on basic knowledge
7.07 133540 - The Bright Future of Pedology

PEDOGENIC EVIDENCE SHEDS LIGHT ON THE POST-ROMAN PEDO-SEDIMENTOLOGICAL AND HUMAN HISTORY OF TARSUS, THE ROMAN CAPITAL OF CE 60, CILICIA

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Tarsus, the capital city of classical Cilicia dates back to the prehistoric era as one of the most important sites for the beginning of culture in the Eastern Mediterranean sphere. Located close to the coast, at an alluvial and/or lagoon environment, it provided a tryst for Mark Antony and Cleopatra. The ancient city is underlying a sediment of 350 cm where the contemporary Tarsus grew on. The diffusely stratified layers of the deposited sediment from the Kydnos (Tarsus) river overlying the Roman Road excavation site are located in the heart of the modern city. The sediment is laden with anthropogenic materials. The profile of the soil stratigraphic layers, i.e., pedosedimentary units and/or horizons (PSUs), were described and sampled for physical, chemical, mineralogical, micromorphological and thermo-luminescence analyses seeking pedogenic evidence. The overlying fluviatile and/or lagoonal (archaeologically predicted date, about 60 CE) PSUs/Technosols are calcareous and high in available and total phosphorous contents (preliminarily coined as a Phosphatic qualifier or horizon of the Technosol). They have been probably modified by human activity at a settlement area, thus, bearing some historical evidence to suggest that the site was part of the growing city after it was abandoned. Thin sections point to a vigorous biological degradation of the organic residues in the PSUs alongside occasional evidence of physical soil forming processes.
The preliminary conclusion is that sediments of the river Kydnos buried the city of Tarsus, via consecutive depositions, which were periodically settled within an alluvial-lagoonal environment. Historical evidence supported by the interdisciplinary nature of pedology, revealed that the establishment of the modern city of Tarsus at this site probably did not occur until a few hundred years ago. Thus, as soil science's interdisciplinary nature sheds light on the past, its legacy will also continue to do so in the future as the best recorder of earthly processes, as demonstrated by the example of this Roman Technosol.

Keywords: Soil genesis, Mineralogy, Micromorphology, Archaeometry, Soil classification

ID ABS WEB: 138213

7. Soil sciences impact on basic knowledge
7.07 133540 - The Bright Future of Pedology

SERIFURE (SOIL ECO-REGION INDEX ON FUNCTIONING AND RESILIENCE): A SYNTHESIS INDEX ON SOIL ECO-REGIONS THAT COULD PROVIDE USEFUL INSIGHTS ON SOIL FUNCTIONING AND RESILIENCE

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The theoretical basis underpinning the hydro-eco-region approach is a tool to macro-describe the specific characteristics of water bodies, considering their physical, chemical, environmental and biological characteristics. A similar approach could be used to identify soil macro-characteristics, driven by different environmental drivers, including edaphic fauna, fungi and microorganisms. We propose then to undertake a new holistic soil characterization, aimed at framing soils in a new identification scheme, based on multifaceted approach, having soil communities as major driver. The set of indicators should be targeted to the scale of investigation, and a simplified soil classification such as the FAO World Reference Base for Soil (2022), enriched by a layer of functional traits description of soil communities. We found advisable to choose the upper two horizons, which should grant a sufficient description of the processes that could describe the soil environment in its pedogenic evolutionary dynamics.
At the highest scale, the weighted descriptors should consider available data on fauna, flora, microbiota coupled with some abiotic descriptors. The functional traits to be considered are: food-web interactions, reproductive strategies, dimensions and mobility of the biological elements considered, and the state of soil in its basic components: texture, porosity, water-holding capacity, SOM, CEC, pH, lithological substrate and pedo-climatic factors. A qualitative analysis could take in consideration more characteristics of the soil biota, such as the presence of endemic and rare species, of stenoecious vs. euryoecious taxa, or of specialised organism vs. generalist functional groups.
A test of selected examples with a minimum data set of variables will be set up to validate and discuss the proposed methodology.
The SERIFuRe Index could grant a synthesis of the available characteristics of soil elements, both on the living communities and the abiotic environment where they live, and help identify homogeneous units that could be useful to describe, depict and correctly manage soils throughout the world.

Keywords: Soil Biodiversity, Functional Traits, Soil Monitoring, Soil Functioning, Soil Resilience

ID ABS WEB: 135994

7. Soil sciences impact on basic knowledge
7.08 133542 - Knowing topsoil to manage ecosystems

DISENTANGLING TANGEL: THE ROLE OF PLANT TRAITS FOR POST-DISTURBANCE HUMUS FORMATION

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Mountain forest soils are frequently characterized by thick organic surface layers. On pure limestone or dolomite with no or patchy mineral soil, the forest floor can reach thicknesses of decimetres up to a meter, resulting in a humus form called ‘Tangel’. Disturbance, however, can lead to rapid mineralization - in case of wildfires humus even increases fuel load and can burn down to the bedrock. A ‘burning’ question thus is how fast such humus forms recover. In our case study we investigate vegetation and humus succession in a mountain forest 70 years after a stand replacing fire. Post fire succession as interpreted from aerial images shows a rapid development of grass cover after 3 years. 60 years later, however, patchy regeneration of Erica carnea, Larix decidua, Pinus mugo and Picea abies still cover less than half of the burnt site. Soil organic carbon (SOC) stocks in these patches follow a ranking Larix < Pinus < Picea < grass < Erica (1.5, 2.4, 2.5, 2.9, 3.0 kg m^{-2}, respectively) which, in average is about 35% of SOC stocks in mature reference stands (7.1 kg m^{-2}). While under grass SOC is concentrated in mineral soil (50%), forest floor under Erica and tree patches contains 85% (Larix) to 98 % (Erica) of SOC. There is a species effect on aboveground carbon input related to litterfall (Erica~Picea >> Larix > grass), litter quality (widest C/N and C/P ratios for Erica), and soil temperature (bare soil ~ grass > Erica ~ Larix > Picea). Moreover, incubation of litter shows pronounced differences in R10 (Erica < Larix ~ Picea << grass) and microbial N per g SOC is particularly low under Erica and highest under Larix. Soil enzyme activities show distinct differences between species, indicating different mineralization and nutrient acquisition strategies. We conclude that plant traits play a key role particularly in early stages of Tangel formation.

Keywords: humus form, forest floor, plant soil feedback, carbon sequestration, mineralization

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7. Soil sciences impact on basic knowledge
7.08 133542 - Knowing topsoil to manage ecosystems

CHARACTERIZATION OF SOIL MICROALGAE AND CYANOBACTERIA IN A DIFFERENTIALLY MANAGED OLIVE ORCHARD

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Soil microalgae and cyanobacteria (SM&C) show potential benefits for sustainable agriculture. They participate to the biogeochemical processes, enriching the soil in biomass, providing nutrients (such as N) essential for plant growth, creating a hospitable microenvironment for plants through bioactive compounds production, and settling synergic interaction with other soil microorganisms. The research aim was to characterize SM&C communities in a Mediterranean olive orchard located in a semi-arid climate (Ferrandina, Basilicata, Italy), subjected to a sustainable (Smng) or conventional (Cmng) land use for 22 years. The SM&C were cultivated in two selective liquid media containing N (for all) and without N (for isolating nitrogen-fixer cyanobacteria). The Smng soils had significantly higher microalgae (2.210 · 104 g-1 soil in Smng and 0.872 · 104 g-1 soil in Cmng), and equally for cyanobacteria (0.408 · 102 g-1 soil in Smng and 0.240 · 102 g-1 soil in Cmng). Dominant species were detected by light microscopy and 16S/18S/ITS rDNA metagenomics. Trebouxia, Euglena, Chaetophora green algae genuses, and the diatom Cymbella were predominant in the Cmng soils. On the other hand, Anabaena cyanobacterial genus, Oedogonium and Scenedesmus green algae, and the diatoms Navicula and Pinnularia were more abundant in the Smng soils. Soil management type caused a different profile of the intra- and extracellular metabolites produced by SM&C, with an evident up-modulation in the Smng soils of the biosynthetic pathways of secondary metabolites, hormones, fatty acids and lipid, some of them with growth-promoting properties. We demonstrated that, besides their several essential ecological functions, SM&C can be applied for maintaining healthy soil and promoting plant growth. This study was carried out within the Agritech National Research Center and received funding from the European Union Next-GenerationEU (PIANO NAZIONALE DI RIPRESA E RESILIENZA (PNRR) – MISSIONE 4 COMPONENTE 2, INVESTIMENTO 1.4 – D.D. 1032 17/06/2022, CN00000022). This manuscript reflects only the authors' views and opinions, neither the European Union nor the European Commission can be considered responsible for them.

Keywords: autotrophic microorganisms, soil microalgae, soil cyanobacteria, soil fertility, sustainable management

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7. Soil sciences impact on basic knowledge
7.08 133542 - Knowing topsoil to manage ecosystems

SOIL BIOIVERSITY IN NATURAL AND ANTHROPIZED ECOSYSTEMS

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Land use changes (e.g. transformation of natural landscapes, forest degradation, and increase in croplands) due to human activities are considered amongst the most influential ecological disturbances affecting soil biodiversity and environmental sustainability. Restoring and managing soil biodiversity requires a better understanding of the determinants of soil biodiversity and how they function. To identify the differences in soil biodiversity of natural and anthropogenic ecosystems, we want to compare the community composition, species co-occurrence patterns, and ecological assembly processes of soil microbial communities in a paired setting featuring a natural and an anthropogenic ecosystem facing each other at identical climatic, pedological, and vegetational conditions. To achieve this goal, two pairs of relatively closed and small-island systems were chosen in Italy and China. The Italy field survey was carried out at two adjacent strips of land within the Po River delta lagoon system (Veneto, Italy), one of which is protected within a natural preserve and the other has been converted for decades into a tourist resort. The China field survey was carried out on a natural preserve island and an island heavily occupied by agriculture and industry of Guangdong–Hong Kong–Macao Greater Bay Area. This study aimed 1) to identify how the soil bacterial and fungal diversity, abundance, and community composition change under different anthropogenic disturbances(e.g. settlement, agriculture, and industrial); 2) to investigate what specific mechanisms allow certain microbes to persist under anthropogenic pressures or environmental modifications; 3) to evaluate microbial diversity changes impact the ecological function and stability in anthropogenic ecosystems.

Keywords: Soil biodiversity, Soil microorganisms, Co-occurrence pattern, Anthropogenic habitat, Environmental sustainability

ID ABS WEB: 137167

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7.08 133542 - Knowing topsoil to manage ecosystems

HUMUS FORMS AND ORGANIC MATTER DECOMPOSITION IN THE SWISS ALPS

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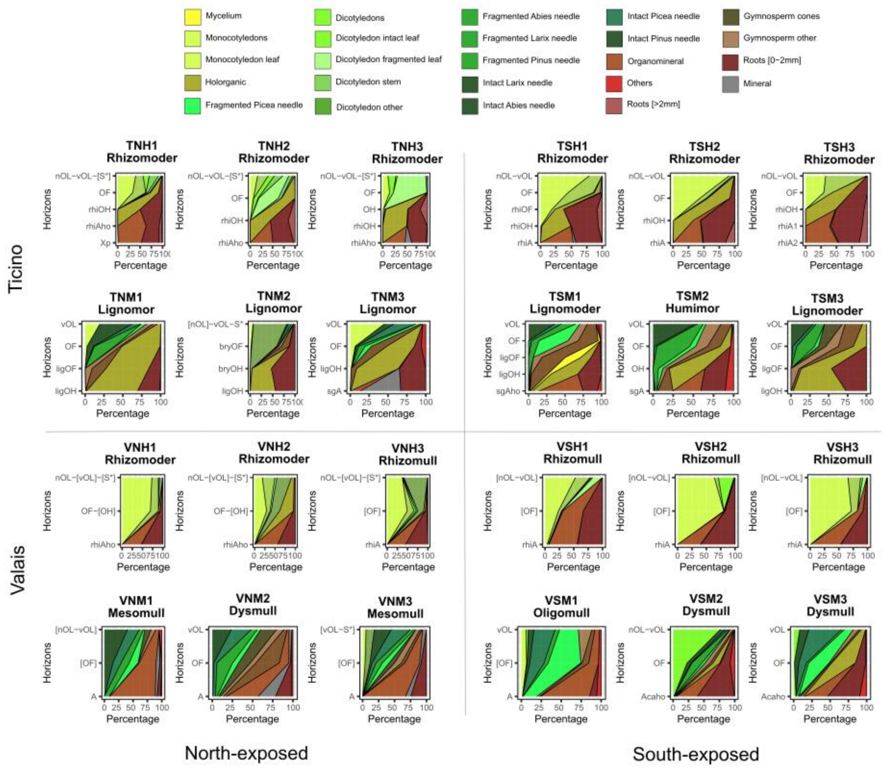
Along with the current climatic crisis, terrestrial ecosystems are undergoing significant modifications, both above and below ground. The steep elevation gradients of the European Alps might be particularly concerning because of their close connection to temperature gradients. Climate, plants, and soil decomposers influence humus forms and organic matter decomposition. Yet, whether different humus forms could be experimentally linked to litter decomposition remains to be fully assessed. To highlight the link between humus systems and organic matter decomposition, we worked in two regions of the Swiss Alps (Valais and Ticino) along elevational gradients by following a north/south exposure design. We quantified humus forms macrorests proportion types by the Ponge small-volume method and measured the decomposition of green tea and rooibos tea within the Para- and Terro-humus systems. We found that Parasystems and Terrosystems differed in tea decomposition rates, with a slower decomposition in Parasystems than in Terrosystems. We also observed that elevation, and hence, vegetation type (i.e., forest in the subalpine versus grassland in the alpine), drove humus form distribution, with Parasystems found in the alpine and subalpine in Ticino, while in Valais Parasystems were only found in the alpine and Terrosystems in the subalpine levels. Further analyses are, however, needed to identify other variables that best correlate with variation in decomposition processes within humus systems, such as soil decomposer community composition.



Keywords: Elevation gradient, Parasystems, Terrosystems, Ponge small-volume method, Teabag experiment

ID ABS WEB: 137270

7. Soil sciences impact on basic knowledge
7.08 133542 - Knowing topsoil to manage ecosystems

CARBON STORAGE IN THE FOREST FLOOR AND SOIL IN A PRIMARY BEECH-FIR FOREST

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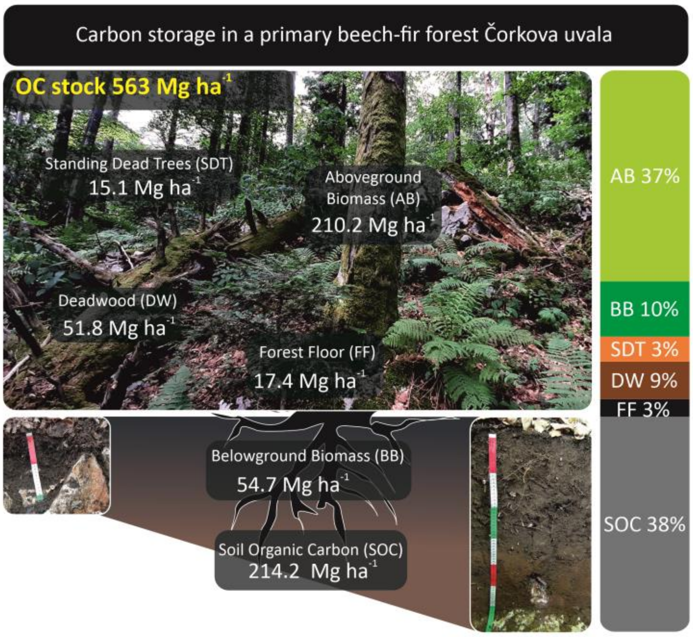
Primary and old-growth forests plays a very important role in carbon sequestration and storage and thus makes an important contribution to global efforts to mitigate climate change. These forests serve as a benchmark or reference point due to their ability to store and accumulate carbon over time and are used to compare and evaluate the effectiveness of different forest management practices, conservation strategies and restoration measures.

The aim of this study was to determine the carbon stocks in the forest floor and soil and other C pools in the primary Dinaric beech-fir forest Corkova uvala in the Plitvice Lakes National Park, which covers an area of 80.50 ha between 860 and 1028 m asl. The average annual temperature is 9.4 °C and the average annual precipitation is 1592 mm. The area is characterized by the typical karst relief. The predominant soil type is Leptic Cambisol, alternating with Mollic Leptosol, while Luvisol occasionally occurs at the bottom of the sinkholes. The trees are around 450 years old. Sampling of the forest floor (FF) was carried out by layers along the transect, while the soil was sampled in a systematic grid.

On rocky and stony areas, there is no FF at all. Where the FF was shallow, i.e. about 1 cm thick, its mass was 11.7 Mg/ha (4.9 Mg C/ha), and in some places the thickness of the FF reached almost 9 cm, i.e. the mass was 94.6 Mg/ha (48.7 Mg C/ha). The amount of C stored in the soil varied from 37.9 Mg/ha to 490.6 Mg/ha.

We have developed regression equations that relate the mass of the FF and C stock to its depth. The bulk density (BD) values obtained can also be used to convert depth measurements into mass and C stocks for each layer and the entire forest floor. The obtained data were compared with data for managed beech-fir forests and will be presented to the Congress.



Keywords: carbon storage, forest floor, soil, beech-fir primary forest

ID ABS WEB: 138035

7. Soil sciences impact on basic knowledge
7.08 133542 - Knowing topsoil to manage ecosystems

CHEMICAL AND MINERALOGICAL EVOLUTION OF KIMBERLITE MINE TAILINGS - A STUDY ON THE PEDOGENETIC PROCESSES THAT CONVERTS ULTRAMAFIC MINE WASTE TO FUNCTIONAL SOILS

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Kimberlites are plutonic igneous rocks rich in ultramafic minerals. Their formation is the product of solidified melts that intruded into the Earth's mantle because of pressured magma flowing via fractures and rising to the crust. Kimberlites are petrographically complex aggregates with a wide variety of chemical compositions, and they may contain diamonds as a rare component giving them a high economic value. The exposure of kimberlite mine waste to environmental conditions leads to geochemical reactions that change the chemical composition of the primary rock. These changes impact the morphological features of the waste, leading to the formation of new soil layers.

The study focuses on the kimberlite waste located in the North-West province of South Africa. The intended resource is extracted mechanically, meaning there are little to no added chemicals present in the mine waste. However, because kimberlites are primarily composed of silica-rich, iron oxides, magnesia, and alumina-rich minerals they are easily weathered. The investigation of elemental fluctuations using P-XRF highlighted the influence of particle size, depositional layering, and illuviation on the abundance of specific elements. The XRD analysis provided insight into the mineralogical composition of the soil samples, distinguishing between primary and secondary minerals and their distribution in the sampled profiles. The presence of minerals such as quartz, mica, amphibole, pyroxene, and olivine in the primary mineral category, and secondary minerals including; chlorite, kaolinite, vermiculite, calcite, and gypsum, illustrated the transformation and weathering processes within the waste material. Lastly, petrographic microscopy analysis revealed the ongoing processes of decomposition, disintegration of mineral fragments, and the presence of organic matter and water-soil interactions, all of which play a significant role in the formation of n new soil profile.

Keywords: Anthrosol, Kimberlite tailings, Pedogenesis

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7. Soil sciences impact on basic knowledge
7.08 133542 - Knowing topsoil to manage ecosystems

THE CIRCULATION OF CARBON IN THE TOPSOIL OF TWO BEECH FOREST ECOSYSTEMS IS GOVERNED BY THE INDIRECT EFFECTS OF TROPHIC INTERACTIONS

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Forest soils harbor a vast array of organisms that, through their trophic interactions, drive and shape the carbon flow and give rise to ecosystem functioning. The transfer of carbon throughout the soil food web depends not only on the abundance of organisms but also on the number of functional groups involved. Understanding how functional groups shape carbon flows is crucial to disentangling the role of functional diversity in soil processes. In this work, soil food webs were represented using trophic network models of two beech forests in spring and autumn, which were assembled and mass-balanced by quantifying carbon flows between their components. Employing network analysis, models were investigated aiming to identify the role of the components on carbon flow, cycling, and functional trophic relationships. Moreover, we explored how the structure of carbon exchanges between components promotes efficiency and stability.
Results indicate that the carbon requirements of each trophic group highly depend on indirect interactions and carbon cycling. Specific groups such as Collembola play the role of hubs in distributing carbon. Indirect interactions often reverse the impacts of direct trophic relationships being antagonistic to the direction of change predicted based on predator–prey interactions. The presence of generalist feeding habits causes the redundancy of energy channels and increases the resilience of food webs making them more efficient in absorbing perturbations but at the expense of transferring carbon efficiently. Although differences can be observed across sites and periods, food web structure rather than environmental variability seems to be the main factor responsible for patterns of carbon flows in the two beech forests.

Keywords: Carbon flow, Soil food webs, Microarthropods, Trophic groups, Network analysis

ID ABS WEB: 136170

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

EFFICIENT PHOSPHATE RECOVERY FROM WASTEWATER AND REUSE AS FERTILIZER USING IRON-OXIDE-CLAY COMPOSITES.

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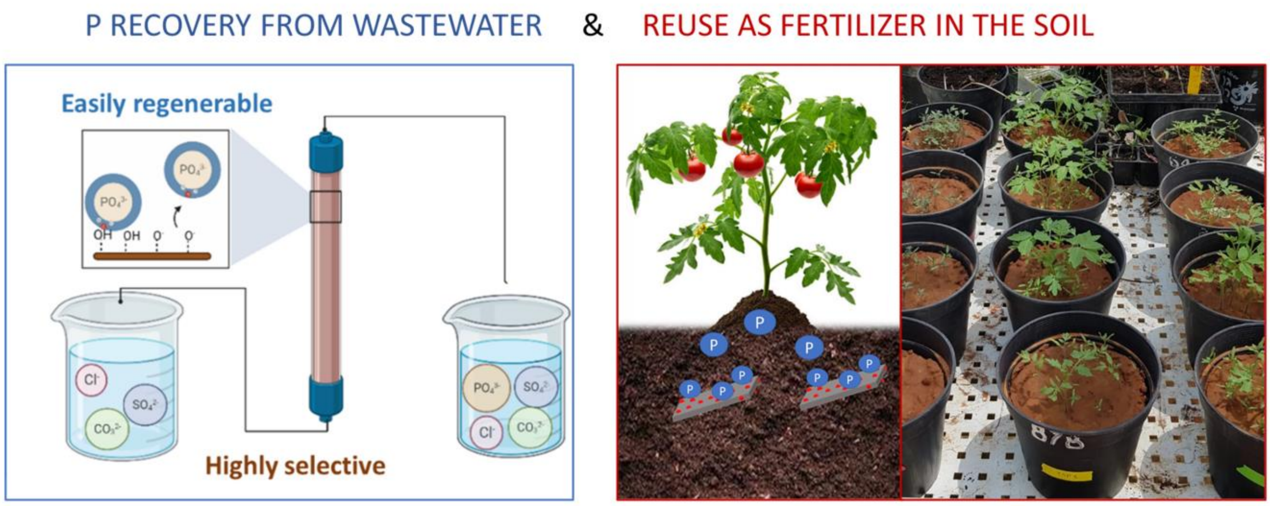
Phosphate fertilizer is in growing demand, however, the declining natural resources and the secondary environmental pollution from overuse and effluent disposal necessitate the development of sustainable phosphate (P) removal methods that allow for proper nutrient recovery with minimal energy and chemical strains. This study highlights the ability of montmorillonite (MMT) clay decorated with amorphous iron oxide nanoparticles (FeOx-MMT) to specifically recover P from wastewater and allow for easy regeneration of the surface and potential use as fertilizer when spent. The nano-sized iron-oxides deposited on the MMT show high adsorption affinity towards P due to the increase in reactivity and surface area. Batch experiments showed rapid adsorption with equilibrium reached after ~1.5 hrs. at neutral pH. Isotherms were fitted to the Langmuir model and capacity was determined to be 5.63 mg-P/gr composite or 92.3 mg-P/gr-Fe. The reaction was most efficient at acidic pH (4) and high ionic strength. Desorption experiments revealed very small hysteresis and high reversibility of the reaction even at neutral pH. Continuous column experiments were performed and compared to a commercially available product, granulated iron hydroxide. The results highlighted that the composite was able to remove higher P concentrations per g Fe and was far more regenerable than the commercial alternative over five cycles. Finally, the spent composites that were added as fertilizer to sandy soil exhibited P activity similar to the commercial fertilizer yet, almost no leaching was observed. Thus, this natural clay-based material can help alleviate P pollution in soil and water, while maintaining soil health and fertility.



Keywords: Montmorillonite clay, Nutrient recovery, Iron-oxide, nanoparticles, phosphate

ID ABS WEB: 136662

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

YEARLY EFFECTS OF SALTWATER IRRIGATION ON CROPS AND SOIL MICROORGANISMS UNDER A SALINITY GRADIENT

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Saltwater contamination is a major contributor to agricultural soil degradation. With rising sea levels and increasing dry periods due to climate change, ground water in temperate coastal areas is becoming increasingly brackish, forcing growers to use part-saline ground water to irrigate their crops in summer. In arid areas, saltwater contamination has been reported to decrease crop yields, but the short- and long-term effects of saltwater contamination in temperate areas have not yet been thoroughly investigated, especially its effects on the soil microbial communities. Here we developed a 3-year experiment to study the yearly effects of different levels of saltwater irrigation on crops and soil microorganisms. Concerning the crops after the first year, our results show that higher level of salinity (6 dS/m and 9 dS/m) have a negative impact on crop yield, while medium level of salinity (3 dS/m) has no negative impact on crop yield compared to the control. However, after 2 years of experiment, our results demonstrate a drastic decrease in crop yield between the control and saltwater irrigation, even for the medium salinity level. Concerning the microbial communities after the first year, our results demonstrate that increasing the salinity level in water has an impact on the soil microbial communities compared to the control. This experiment will be very useful to growers to help them decide how much and for how long they can safely use part-saline water to irrigate their crops, in order to reduce their costs without decreasing their yield or harming the soil microbial community.

Keywords: soil, salinity, microorganism, crop, irrigation

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7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

ANALYSIS OF EARTHWORMS AND SOIL QUALITY IN A LONG-TERM WETLAND WITHIN AN AGRICULTURAL CONTEXT

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Wetlands represent crucial ecosystems, playing a significant role in maintaining biodiversity and purifying water. This study analysed the biodiversity status of a wetland area used for 30 years for drainage and phytodepuration purposes within the Experimental Agricultural Farm 'L. Toniolo' at the University of Padua. Covering an area of one hectare and having undergone no cultivation over the years, it is characterized by dense woody shrub areas and other herbaceous parts. Semi-natural conditions and conservational features were evaluated using standardized and innovative sampling and analysis methods.
Physicochemical, microbiological, and soil fertility parameters were studied, aided by earthworm fauna analysis as a driver for soil conservation. Specifically, the earthworms collected were identified, and their distribution and abundance concerning spatial variations within the area were evaluated.
The results revealed a rich diversity of earthworms, with a significant prevalence of endogeic species, particularly abundant in woody-shrub areas. Spatial variation analysis highlighted differences in earthworm community composition among different parts of the wetland, suggesting an association between the distribution of these species and micro-environmental variations.
This work highlights the importance of the presence of semi-natural and humid areas, with drainage and phytoremediation purposes or as simple buffer areas, in agricultural contexts as they can act as sites that contribute to the resilience of agricultural territories also through the increase in biodiversity.

Keywords: Earthworms, Wetland, Biodiversity, Resiliance, Ecological Services

ID ABS WEB: 137223

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

MITIGATING SOIL COMPACTION: ASSESSING AMENDMENT IMPACT FOR SUSTAINABLE SOIL MANAGEMENT IN GRASSLANDS

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Agricultural activities involving heavy machinery often cause soil compaction, a major issue in global grassland management affecting 33 million hectares in Europe only. High axle loads and ground pressure during machinery operations, like slurry application, induce severe compaction, especially in wet soil. Soil compaction from heavy machinery operations results in reduced grass growth, nutrient uptake, and increased overland flow, impacting nutrient absorption. Ongoing efforts focus on environmentally friendly strategies to improve compacted soil physical properties. However, the impact of organic and inorganic amendments on soil physical properties under varying moisture conditions remains unclear.
Therefore, the present study assesses the remediation properties of slurry, farmyard manure and agricultural gypsum on soil physical status in a compacted Irish grassland. Prior to amendments application, 7x3 meter plots underwent compaction during a year of grassland management, involving four machinery trafficking events at three soil moisture deficit (SMD): + 10 (Dry), 0 (Moist) , and -10 (Wet) mm. Plots received slurry (33 m3 ha), farmyard manure (50 ton ha-1), or agricultural gypsum (1 ton ha-1), and were compared to non-compacted amended plots (NC) and a control (C) without compaction or amendment.
Six and twelve months post-amendments application, bulk density samples were extracted under tractor tire marks at three depths (0-10, 10-20, and 20-30 cm). Additional soil cores (10 x 5 cm) were obtained from the topsoil to measure pore size, shape, and connectivity through X-ray Computed Tomography. Dry matter yield samples were collected every four months to assess the short-term effects of the treatments.
Preliminary results at 6 months post-amendments application showed that farmyard manure was effective in ameliorating the compacted 0-10 cm, resulting in a 19% reduction in soil bulk density under Moist and Wet soil conditions. Within the 10 - 20 cm layer, gypsum had comparable efficacy to farmyard manure, yielding an 11% decrease in soil bulk density. As this study remains ongoing, further details will be provided as the results become available.

Keywords: Sustainable soil management,Soil compaction,Grassland management,Soil physical quality,Soil health

ID ABS WEB: 137250
7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

THE ROLE OF WATER USER ASSOCIATIONS IN IMPLEMENTING NATURAL WATER RETENTION MEASURES: A NATIONAL SURVEY

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Natural Water Retention Measures (NWRM) are Nature Based solutions applied to the water sector. They follow the ecosystem approach, which is outlined in the Convention on Biological Diversity [2] and recognised as the most appropriate for water management [2]. There are many links between Water Framework Directive (WFD) and the ecosystem approach. NWRM address several elements of ecosystems at the same time. They are multi-functional measures that aim to enhance and maintain the water retention capacity of aquifers, soils, and ecosystems to improve their status. NWRM can provide multiple benefits, including the reduction of risk o flood and drought risk reduction, water quality improvement, groundwater recharge and habitat improvement [3].

In Italy, Water User Associations (WUAs) can play a key role in ecosystems conservation, especially in irrigated agro-ecosystems. Until the 1990s their role was mainly to create productive areas; then it expanded towards the protection of the environment and water-related ecosystems, through the renaturation of water courses, phytodepuration, creation and management of wetlands etc. [4].

For the economic analysis of the 2021-2027 River Basin Management Plans (RBMP) under art. 5 of the WFD, and as part of the technical support to the Ministry of Agriculture for the coordination of environmental and agricultural water related policies, CREA PB carried out a survey of the measures implemented by WUAs that have a positive impact on water bodies.

The measures were analysed to identify them as NWRM or not and, if so, to code them according to the EU NWRM initiative[5]. The survey enhances measures activated in the Italian territory, which can provide several benefits of NWRM. This is relevant in the context of the mapping of ecosystem services required by the EU Biodiversity (COM(2020) 380) and Green Infrastructure (COM/2013/0249 final).

[1] https://doi.org/10.1016/j.jenvman.2011.06.023
[2] https://doi.org/10.1016/j.scitotenv.2013.09.072
[3] https://data.europa.eu/doi/10.2779/396202
[4] Manganiello V., Galeotti S., Zucaro, R. (2022). La multifunzionalità dei consorzi di bonifica nella gestione della risorsa idrica. PianetaPSR n. 117 october 2022
[5] https://data.europa.eu/doi/10.2779/761211

Keywords: NWRM, Irrigated agro-ecosystem, Water management, Ecosystem services

ID ABS WEB: 137850

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

MCDA-BASED APPROACH TO IMPROVING THE AQUACROP MODEL FOR WATER RESOURCES PROTECTION AND MANAGEMENT AS NATURE-BASED SOLUTION (NBS) OPTION.

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As described by the International Union for Conservation of Nature, NbS are nature-based solutions for the protection, sustainable management and restoration of natural and modified ecosystems that effectively and adaptively address societal challenges while providing benefits for human well-being and biodiversity. To clarify the implications of this work for the session on Nature-Based Solutions for Sustainable Soil and Water Management, it is appropriate to specify which aspects of NBS this work aims to support. As highlighted in the latest technical report published by the Joint Research Centre, the European Commission's science and knowledge service (Drought in Europe, June 2023), European countries are facing a severe drought. The significant lack of rainfall is also affecting northern Europe, making these areas increasingly vulnerable to water scarcity. A major concern in achieving sustainable food production is the impact of water scarcity on crops and vegetation. Researchers and educational institutions are working on a global and national scale to provide more interesting results related to agricultural systems modelling. In this context, AquaCrop is a useful tool for the protection and management of water resources in the field. Among these crop growth simulation models, Aquacrop focuses on water productivity and can be used to plan irrigation strategies, optimize consumption, increase farmers' profitability in situations of water scarcity. The aim of this study is to identify the aspects and functionalities of AquaCrop that need to be improved, considering users' preferences, in order to ensure successful implementation and achieve a more sustainable use of water resources. The results of questionnaires were analysed using the Analytic Hierarchy Process (AHP). The study encourages the development of the ranking of a specific set of characteristics to adapt AquaCrop use to users' needs. The improving scenario of AquaCrop tool must consider the most relevant criterion according to users C3- data is an important function because the system can be configured to communicate automatically with an external IoT platform.

Keywords: irrigation, agricultural water management, multi criteria decision analys, strategic planning, NbS

ID ABS WEB: 137871

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

NATURE-BASED SOLUTIONS FOR FLOOD MITIGATION AND SOIL CONSERVATION IN MEDITERRANEAN MOUNTAIN AREAS

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During the 20th century, farmland abandonment emerged as the predominant landscape change in Mediterranean mountains, leading to the expansion of shrubs and forests. The global consequences of this process have been widely discussed in the literature, with positive and negative effects, including landscape homogenization, increasing forest fire risk and decreasing streamflows. Post-abandonment management policies in Mediterranean mountains have encouraged the adoption of Nature-Based Solutions (NBS), being the most used natural revegetation, afforestation and shrub clearing. This study aims to assess the impacts of NBS on flood mitigation and soil conservation in Mediterranean mountains. The hydrological responses recorded in 4 experimental catchments located in the Central Pyrenees, along with an analysis of physical-chemical soil properties, form the basis of our investigation.
The hydrological results showed that: (i) land abandonment and the expansion of shrubs and forests (rewilding and afforestation) decrease hydrological connectivity, while tends to increase when shrub clearing occurs; (ii) the runoff coefficient decreases as a result of revegetation; (iii) natural revegetation and afforestation lead to a decline in the frequency and magnitude of floods, as well as peak flows; (iv) however, afforestation has only remarkable effects on small to moderate floods, with less impact in extreme rainfalls. Concerning soil conservation: (i) revegetation promotes the accumulation of soil organic carbon (SOC), but it is a slow process; afforestation can accelerate it, although a high percentage is stored in labile forms; (ii) long-term regenerated grassland, through shrub clearing, accumulates more SOC than shrublands; (iii) afforestation enhances aggregate stability. Sustainable land management based on NBS in Mediterranean mid-mountains should be applied in order to obtain benefits for soil and water conservation in a context of Global Change.

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Keywords: Mediterranean mountain areas, flood mitigation, soil organic carbon, afforestation, shrub clearing

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7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

EVALUATING THE IMPACT OF NATURE BASED SOLUTIONS ON WATER RESOURCES MANAGEMENT

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Water is an essential resource for life, supporting human activities from agriculture and industry to domestic use and ecosystem health. However, the world's freshwater reserves are threatened by a variety of factors, including climate change, population growth, and economic development. As a result, freshwater resources of sufficiently high quality are diminishing around the globe and water scarcity is pressuring sectors such as agriculture, industry, and domestic use to compete relentlessly, jeopardising socio-economic stability, growth, and environmental integrity.
One of the solutions to utilize our water resources more efficiently, and to mitigate the effects of water scarcity, is to adopt and implement Nature Based Solutions (NBSs). As NBSs offer actions to protect, sustainably manage and restore ecosystems, they can also contribute to reducing irrigation water use, thus leaving more water resources for the rest of the sectors.
The PRIMA funded project entitled "Learning and action alliances for Nexus environments (LENSES)" (Grant Agreement No: 2041) has explored the impact of applying NBSs such as low tillage, crop rotation, organic manure use, mulching, etc., and their contribution to the water budget improvement in the 6 pilot areas, which are Donana (ES), Tarquinia (IT), Pinios (GR), Koiliaris (GR), Menemen (TR), and Deir Alla (JO). According to the water accounting models developed by the Water Evaluation And Planning System (WEAP) software and supported by the hydrological models such as Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS), and Soil & Water Assessment Tool (SWAT), these explored NBSs have simulated as scenarios where the implementations of these NBSs have been applied to the entire extent of the related pilot areas.
The results of the study suggest a significant increase in water use efficiency between 10-25% depending on the NBS application, providing a considerable solution for the decision-makers and stakeholders, not just for mitigating the effects of water scarcity, but also for the sustainable management of agricultural lands and soil-water-human health.

Keywords: water scarcity, water accounting modeling, water resources management, nature based solutions, hydrology

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7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

FUZZY COGNITIVE MAPPING OF STAKEHOLDERS' PERCEPTION OF NATURE-BASED SOLUTIONS FOR SOIL AND WATER RESOURCES MANAGEMENT

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Soil and water degradation is one of the key challenges in the Mediterranean region as well as around the globe. Sectors depending on water resources, most notably rural communities are facing water scarcity mainly aggravated by natural and anthropogenic effects such as climate change, population, and pollution increase, among others. One of the solutions to mitigate the effects of water scarcity is to use water efficiently such as through the use of agro-ecological methods including Nature-based Solutions (NbSs). To ensure the wider uptake and application of NbSs, both the awareness and the capacity of rural communities have to be increased.
Thus, we investigated the current perception of NbSs among the rural communities in five hotspots of land and water degradation in, respectively, Algeria, Egypt, Greece, Lebanon, and Turkey. This was achieved through a Value-Attitude-Perception (VAP) survey which was organized in the context of the PRIMA funded project entitled "Safeguarding the Livelihood of Rural Communities and the Environment in the Mediterranean Through Nature-based Solutions (Mara-Mediterra)" (Grant Agreement No:2121).
To map and evaluate stakeholder perceptions of NbSs, a well-known mapping technique entitled Fuzzy Cognitive Mapping (FCM) is employed. Essentially, FCM is a qualitative soft computing method, introduced in the field of cognitive maps (CM). FCM is a graph-based technique that, like any conventional CM, is made up of concepts and causal connections. The distinction is that in FCM, the relationships between concepts are defined by fuzzy connections and their models are fuzzy sets.
The results of the FCM are based on an aggregate of 467 replies collected to the VAP survey that was conducted across 5 countries, capturing the viewpoint of farmers as end-users of NbSs. The findings bring a valuable means to increase awareness and build capacity towards the wider uptake of NbSs both among farmers, and local water managers, as well as policy- and decision-makers in the agricultural and water sectors.

Keywords: fuzzy cognative mapping, stakeholder engagement, nature based solutions, value attitude perception, water resources management

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7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

POSSIBILITIES FOR IMPLEMENTATION OF NBS IN RURAL LANDSCAPE FOR SUSTAINABLE MANAGING OF SOIL AND WATER RESOURCES IN VOJVODINA REGION, SERBIA

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It is generally accepted that intensive agriculture contributes to significant changes not only in land use patterns but also to the degradation of soil and water resources within the rural landscape. In recent decades more attention has been drawn to Nature-based Solutions (NbS), encompassing a variety of practices aiming to use natural solutions and processes to reach sustainability, while exploiting soil and water resources.

In the Vojvodina region, Serbia, agriculture represents one of the major economic branches, and simultaneously is a crucial factor which had influenced the reshaping landscape. While arable land occupies around 85% of the territory, only 8% of the area is under protection and the rest is under infrastructure, water bodies, etc. In such circumstances majority of the rural landscape is degraded and there is an urgent need for implementing practices that can lead to its improvement and restoration. Despite that tools and practices promoted by NbS are proven to be effective, both as economically and eco-friendly, lack of flexibility and willingness to implement necessary changes in a wider area seems to be major obstacles concerning the agricultural practice in Vojvodina region. However, there is a niche where implementation of NbS is possible and reasonable, i.e. within protected areas. Some of the successful examples are introducing grazing for suppression of invasive species, building constructed wetlands for wastewater purification for nearby villages, or establishing vegetated filter strips along arable plots and canal networks, etc.

Wider application of NbS within the rural landscape of the Vojvodina region needs to be initiated by official governmental resolutions and further promoted and supported by agriculture extension services. Cross-sectoral cooperation might play an important role, e.g. involving the Ministry of Environmental Protection of the RS, down to local managers of protected areas. Such cooperation would lead to erasing the sharp edges of protected areas and enhancing biodiversity, soil conservation, and sustainable water management in wider arable areas.

Keywords: agriculture, protected areas, sustainability, Nature-based solutions, soil & water resources

ID ABS WEB: 138218

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

NATURE-BASED SOLUTIONS: INTEGRATING SMART PRECISION IRRIGATION AND DECISION SUPPORT SYSTEMS FOR SUSTAINABLE AGRICULTURE

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Precision irrigation is an essential component of Nature-Based Solutions (NBS) for sustainable agriculture. This synergy among advanced technologies and nature-based solutions aims to optimise the use of water resources while ensuring environmental sustainability. This research as a significant contribution to the understanding of how precision irrigation, as part of Nature-Based Solutions, can promote sustainability and crop resilience in an environment increasingly affected by climate change. In the context of this perspective, we present the results of our experimentation on a field of processing tomatoes. A three-year open field experiment (2021-2023) was conducted in Italy on tomato processing (Var. Durpeel F1). Four different irrigation treatments with drip irrigation were tested: full irrigation (Fi) - (100%), deficit irrigation (Di) - (80%), regulated deficit irrigation (RDi) - (60-80-60%) and deficit irrigation (Di2) - (60%).
The impact of different irrigation treatments on crop yield and quality was evaluated. In particular, water efficiency indices including water use efficiency (WUE), water use efficiency in total and marketable yield (TYWUE and MYWUE) and water productivity index (IWP) were analysed. The results indicate a high water use efficiency in deficit irrigation treatments with no significant differences compared to full irrigation and a strong correlation between reduced irrigation and tomato quality. This study shown that the adoption of these innovative solutions can maximise water efficiency, reduce waste and mitigate environmental impacts.

Keywords: Water productivity, Drip irrigation, processing tomato, Deficit irrigation

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7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

ASSESSING AGRICULTURAL REGENERATIVE PRACTICES FOR THE PROVISION OF ECOSYSTEM SERVICES IN A RAINFED ALMOND SYSTEM IN A SEMI-ARID DEGRADED ENVIRONMENT

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Regenerative practices of diversified agriculture, offering additional income, biodiversity enhancement, and climate resilience through improved soil water holding capacity and greenhouse gas storage, faces scepticism in semiarid rainfed climates due to perceived productivity reduction from water and nutrient competition. This work used a field-level intercropping experiment in Murcia (Spain), to evaluate the performance of two regenerative systems (almond-caper; almond-thyme) and compared them to conventional management of rainfed almond crops under different scenarios. Over five years, a large collection of data was gathered to evaluate the impact of the diversified schemes on soil and plant properties. In this work a wide range of soil and plant parameters was adapted in an ecosystem services (ES) framework and a participatory multicriteria analysis (MCA) was used to evaluate the management alternatives in terms of sustainability. Supporting, regulating and provisioning ES and economic indicators were included in an integrated assessment of the three above mentioned agricultural management alternatives. Divided over these ES, there were nine subgroups and thirty-six indicators. A stakeholder consultation allowed to include the perspective of different stakeholders on ES groups and economic indicators in the evaluation.
The almond-thyme diversification offers the best results in the integrated evaluation. On the one hand, it improves the group of provisioning services, including productivity and available water, and the group of regulation services, including climate, hydrological, nutrient cycling and erosion control. Diversification with capper shows the best results in the group of support services including plant and soil biodiversity, soil structural condition and fertility. In the first two years, economic indicators were unfavorable for diversification due to initial investments in labour and installation of secondary crops. From the third year onwards, the profits from the extraction of thyme essential oil increased the direct benefits, offsetting the initial investment. In addition, the application of the new aid from the Common Agricultural Policy favours the introduction of a permanent secondary crop.

Keywords: Ecosystem services, Soil restoration, Regenerative agriculture, Multicriteria analysis, Stakeholder's participation

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7. Soil sciences impact on basic knowledge
7.10 133558 - Mechanisms of interaction of (harmful) substances with the soil phase

EFFECT OF OXYTETRACYCLINE AND IRON ON THE TRANSFORMATION OF ARSENIC IN PADDY SOIL

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In order to study the interaction of antibiotics and arsenic contamination in paddy soils, microcosmic culture experiments were carried out in paddy soils, which was sampled from a paddy field in Xiangtan City, Hunan Province. By simulating the flooding-drainage process of paddy field, the effect of oxytetracycline (OTC) on the redox transformation of iron and arsenic was explored. During the flooding stage, the presence of OTC could promote the reduction of iron minerals, and the content of Fe(II) in dissolved, exchangeable and adsorbed/weakly crystalline iron minerals were significantly increased, so more •OH radicals were generated in the drainage stage, which further promoted the oxidation of dissolved As(III). OTC had complexing and reducing effects on Fe(III), which could promote the reduction of iron-containing substances in soil. At the same time, as a broad-spectrum antimicrobial agent, the selective effect of OTC increased the relative abundance of dissimilated iron-reducing bacteria, and also promoted the reduction and dissolution of iron minerals. In addition, the relative abundance of sulfate-reducing bacteria increased in the presence of OTC during the flooding stage, which increased the amount of sulfide-bound As, and thus decreased the content of dissolved As. The results of this study indicated OTC could enhance the reduction and dissolution of iron-containing substances in soil during the flooding stage, but reduce the dissolution of As by increasing the amount of arsenic sulfide. In the draining stage, it was conducive to the generation of more •OH and the rapid oxidation of dissolved As(III). The coexisting of Fe and OTC reduces the risk of As uptake and transportation in rice.

Keywords: Paddy soil, As,Tetracycline, Redox, Electron transfer

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7. Soil sciences impact on basic knowledge
7.10 133558 - Mechanisms of interaction of (harmful) substances with the soil phase

DECREASE OF RCS TRANSFER FROM SOIL TO PLANT IS DRIVEN BY APPLICATION OF MANURE - DISTINGUISHED ROLES FOR POTASSIUM AND ORGANIC MATTER-

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Contamination by radionuclides will be one of the major concerns in initiating agricultural activity after a nuclear accident. Radiocaesium (RCs) dispersed over a large area of Japan after the FDNPP accident and several countermeasures (topsoil removal and/or potassium fertilizer application) were carried out. However, topsoil removal to reduce RCs may lead to a huge amount of discarded topsoil and also lower crop yield due to the loss of fertile topsoil. On the other hand, a huge amount of potassium fertilizer application requires a long time of soil management. This study aimed to assess the effects of cattle manure compost (CMC) application on soil properties, crop growth, and RCs transfer from soil to plant in a physically decontaminated field and pot experiment. Field trials were conducted during 2018–2022, with different CMC applications along with conventional fertilization in 2018–2019 and conventional fertilization alone in 2020–2022 (2019-2020 soybean, 2021-2022 buckwheat). A pot experiment was used to evaluate the impact of CMC application in soil on RCs transfer to Komatsuna. In the field trial during 2018–2019, CMC application exhibited higher soybean shoot dry weight than plots receiving conventional fertilization and additional K fertilizer. The transfer factor of RCs (TF-RCs: plant RCs activity concentration/soil RCs activity concentration) was negatively correlated with soil exchangeable K (Ex-K) as observed in previous reports. During 2020–2022, grain yields were higher in CMC plots than in other plots that received conventional fertilizers, and this indicates that the application of CMC improved the soil fertility. The pot experiment confirmed that CMC application resulted in lower TF-RCs and higher plant DW compared with conventional fertilized soil with the same Ex-K level. Additionally, the soil exchangeable RCs (Ex-RCs) level was significantly lower in CMC soil than in conventional soil. These findings demonstrate the potential of CMC application to improve crop growth and reduce RCs transfer in physically decontaminated fields by increasing the Ex-K level and decreasing the Ex-Cs level of the contaminated soil.

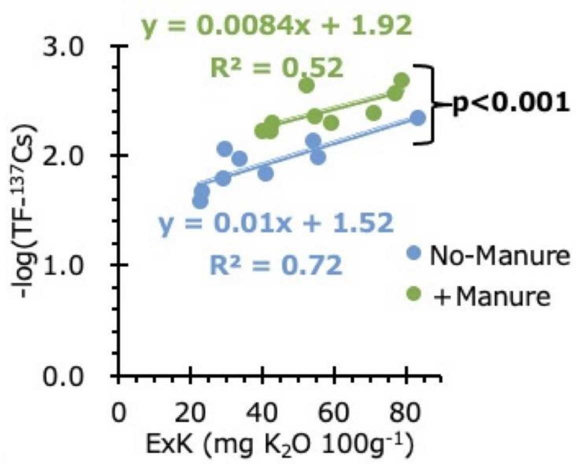

Figure Relationship between exchangeable K (ExK) and transfer factor (TF) of RCs.

Keywords: Nuclear accident, Radio active caesium, Manure, Potassium, Upland crops

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7. Soil sciences impact on basic knowledge
7.10 133558 - Mechanisms of interaction of (harmful) substances with the soil phase

GLYPHOSATE APPLICATION MODIFIES THE TRANSFER OF TRACE ELEMENTS FROM SOILS TO SOIL SOLUTIONS AND PLANTS

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The dynamics of trace elements in the soil-plant system is governed by multiple parameters, including chelating organic compounds originating from both organic matter and pesticides such as glyphosate. To evaluate the influence of glyphosate on the mobility of trace elements, we performed a greenhouse experiment considering four modalities: a control without any application, two modalities with different glyphosate doses, and one with an addition of compost in the soil to evaluate its potential influence to mitigate the glyphosate impact on trace element mobility. These modalities have been applied on four soils: one uncontaminated, two contaminated by human activities, and one naturally contaminated. We followed both trace element and glyphosate concentrations in the soil solution over time and trace element concentrations in plants at the end of the experiment. Results showed that, even though glyphosate concentrations quickly decrease in soil solutions, there was an effective influence of glyphosate on the transfer of trace elements to both soil solutions and plants. However, this influence was highly dependent on both, elements and soils considered. For example, Mn, Co, Zn, Mo, and Pb were especially more mobilized to soil solution with glyphosate in the uncontaminated soil. This influence decreased along the soil contamination gradient. The same observation was done for trace element transfer from soil to plants. The influence of compost on the transfer of trace elements to plants is unclear. Nevertheless, compost can either enhanced the transfer of trace elements to soil solutions in uncontaminated and naturally-contaminated soil or decreased the transfer in anthropogenically-contaminated soils. It thus appears that glyphosate could increase the exposure of trace elements through food consumption and their transfer to the ecosystem, particularly in uncontaminated and weakly contaminated soils. In highly contaminated soils, compost can diminish the glyphosate-induced enhancement of trace element mobility to soil solutions.

Keywords: Trace Elements, Glyphosate, Plant, Organic Matter, Transfer

ID ABS WEB: 136840

7. Soil sciences impact on basic knowledge
7.10 133558 - Mechanisms of interaction of (harmful) substances with the soil phase

SOIL PHYSICS STUDIES WITH NON-AQUEOUS PHASE LIQUIDS

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Soil physics studies with non-aqueous phase liquids (NAPLs) can have practical implications other than environmental ones. Since, unlike water, these liquids do not (or only to a limited extent) exert a dispersing, disaggregating effect during the saturation of soil samples and during measurements, they can be successfully used in soil structure studies.
The use of laser diffractometry (LDM)-based particle size distribution analysis in the study of aggregate stability (AS) in soils is a promising new methodological option, but is not yet routinely applied. LDM AS measurements offer the possibility to study the aggregate segregation processes as a function of time or input energy and can be used to investigate the role of the dispersant (e.g. water and NAPL) quality in AS.
Determination of the NAPL retention in soils based on commonly used prediction methods is rather questionable due to the different phase interactions in air/liquid/soil systems. These interactions lead to different pore size distributions in water and NAPL saturated soil systems and can cause large variations in hydrophysical parameters.
In our research, we used soil samples and test results from the Hungarian Soil Structure Database (HunSSD). LDM AS measurements were performed with the Malvern Mastersizer 3000. Water and NAPL retention measurements were performed with modified pressure plate extractors. The NAPL used for the measurements was the model fluid Dunasol 180/220.
In this presentation, we will show the experience of AS and retention measurements with the two fluids, the comparison of pore size distributions calculated from retention curves, and their relationship with other soil properties.

This research is supported by the Hungarian National Research, Development and Innovation Office Foundation (Grant No. OTKA K134563) and by a common grant from the Hungarian and Polish Academy of Sciences (Grant No. NKM 2019-17).

Keywords: soil structure, NAPL, aggregate stability, retention curves, pore size distribution

ID ABS WEB: 137998

7. Soil sciences impact on basic knowledge
7.10 133558 - Mechanisms of interaction of (harmful) substances with the soil phase

MINERAL-ASSOCIATED ORGANIC CARBON PROMOTED PHOSPHORUS ACCUMULATION IN ORGANO-MINERAL COMPLEXES UNDER LONG-TERM FERTILIZATION

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Soil phosphorus (P) pool is intimately connected to soil organic matter (SOM), especially mineral-associated organic carbon (MAOC). However, the relationship and mechanism between MAOC fractions and P fractions and their response to fertilization remain unclear. Based on a long-term (21- and 29-year) field fertilization trial in black soil, organo-mineral complexes (< 20 μm) were separated and the chemical properties, MAOC fractions, P fractions, P species and P sorption were analyzed. Compared to no-fertilizer control, chemical fertilizer resulted in soil acidification (soil pH 6.15–6.27), increasing the contents of the MAOC fraction bound to minerals by weak linkages in complexes. Straw addition maintained soil pH at 7.53–7.84, and the contents of some MAOC fractions (which were remaining water-soluble, bound by cations, encapsulated by resistant carbonate, and insoluble Humin) were significantly higher than that of chemical fertilizer alone. Fertilization increased total P contents in complexes, with chemical fertilizer mainly increasing highly labile P (Resin-Pi, NaHCO3-Pi, NaHCO3-Po, and NaOH-Pi) and straw addition mainly increasing Dil. HCl-Pi of moderately labile P. Correlation analysis showed that the increased and dominant MAOC fractions were significantly positively correlated with the increased P fractions. XANES spectroscopy further revealed that chemical fertilizer increased the proportion of AlPO4, suggesting that MAOC promotes the retention of labile P via association with Al under weakly acidic conditions. Straw addition increased the proportion of Ca3(PO4)2 and Ca5(PO4)3OH; moreover, it also increased the maximum P sorption capacity of complexes, suggesting that MAOC enhances P sorption via association with Ca under weakly alkaline conditions and that adsorbed P will transform into more stable Ca-associated P. Our findings demonstrate that MAOC promotes P accumulation via association with different P fractions, and these processes are mineral and pH-dependent. This information may be useful for managing and regulating P in agriculture.

Keywords: Phosphorus fractions, Phosphorus species, Mineral-associated organic car, Chemical fertilizer, Straw addition

ID ABS WEB: 138158

7. Soil sciences impact on basic knowledge
7.10 133558 - Mechanisms of interaction of (harmful) substances with the soil phase

SOIL REHABILITATION SHAPED DIFFERENT PATTERNS OF BACTERIAL AND ARCHAEAL COMMUNITY IN AMD-CONTAMINATED PADDY SOIL

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Long-term contamination of cultivated land with Acid Mine Drainage (AMD) has inevitably ratcheted up soil acidity and resulted in the enrichment of toxic metals and sulfate from contaminated rivers, thereby reducing the large scale of arable land and causing the appearance of environmental disaster zones. Microbial communities play a critical role in nutrient elements cycles and ecosystem functions. Microorganisms are essential for soil rehabilitation and long-term sustainability of established plants. However, the recovery process of microorganisms in AMD-contaminated paddy soil is poorly understood at present. To verify this, we sampled AMD-irrigated paddy soils before at different rehabilitation stages by characterizing bacteria and archaea community from AMD-contaminated rehabilitation to pre-disturbance levels from references sites. Next-generation sequencing is used to describe shifts in diversity and taxonomic composition of bacterial and archaeal. Co-occurrence networks are constructed to reveal potential microbial interaction patterns. The result showed bacterial community followed an observable taxonomic transition overtimes, with community structure becoming more similar to that of unmined reference sites. But the archaeal community only showed a seasonal change, which may hint that the archaeal community needs more time in rehabilitation. Both bacterial and archaeal community composition changes were apparent at high taxonomic levels, bacterial communities become dominated by Proteobacteria phylum, and archaeal community was dominated by Crenarchaeota, we proposed the possible reason is bacterial community were mainly derived by soil pH while the archaeal community was impacted by heavy metal. The bacterial co-occurrence networks increased in complexity during succession, improving the community's resistance to environmental disturbance, while the archaeal did not change monotonically with time. This study highlights the distinct recovery pattern of the bacterial and archaeal community during AMD-contaminated paddy soil rehabilitation, which provides a deep understanding of their role in paddy soil, and subsequent harnessing of their potential to pave the way in future rehabilitation strategies for mined sites.

Keywords: Acid Mine Drainage, Soil rehabilitation, Microbial diversity, Microbial network

ID ABS WEB: 135648

7. Soil sciences impact on basic knowledge
7.11 133570 - Digging deeper: Advances in subsoil science

THE IMPACT OF ARABLE SOIL MANAGEMENT ON PHYSICAL SUBSOIL FUNCTIONS- THE RATIO OF AIR CAPACITY AND AIR PERMEABILITY OR HYDRAULIC CONDUCTIVITY IN SUBSOILS AS A DOCUMENT OF HARMFUL SOIL DEGRADATION.

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The development of increasingly powerful and increasingly heavy agricultural machinery helped to enhance the soil management effectivity on even increasing field sizes and to increase crop yields manyfold, while the soils and their limited resilience and pore functionalities were mostly ignored. Zink et al. (2010) developed the Compaction Verification Tool (CVT) as a physical property, which defines the compaction status and its consequences for plant growth, ground water recharge and aeration by the linked functional indicators: air capacity AC and saturated hydraulic conductivity ks. They defined the optimal soil conditions (class I) by ks >10cm/d and AC > 5Vol %. Class II and III define conditions where either the ks or the AC are smaller than the limit. Class IV finally includes all soils or soil horizons (topsoil and especially the subsoils) where both functions are smaller than the critical ones (class I). Based on more than 500 soil profile data down to 100cm depth we could proof, that in subsoils with < 25% clay show 32% and 40% of all subsoils with > 25% clay critical site conditions. The time dependency can be derived from the pattern changes both for the top- and subsoil. While during the period 1980 – 1999 showed only a few sites already Class IV conditions in subsoils, increased the number of sites with Class IV properties intensely during the period 2000-2019. Especially Luvisols are very sensitive under conventional soil management both for top- and subsoil horizons. The dependency upon soil aggregate types for all soil profiles reveals especially for subsoil horizons with coherent and prismatic structure mostly class IV ratios, while in polyhedral and subangular blocky structured subsoil horizons are more sites in a favorable state, but Class IV conditions increase with time, too. Most prominent are the sites with a platy structure in subsoils gathered in class IV with a growing proportion in the last 2 decades.

Keywords: subsoil compaction, saturated hydraulic conductivi, compaction verification tool, soil types

ID ABS WEB: 137708

7. Soil sciences impact on basic knowledge
7.11 133570 - Digging deeper: Advances in subsoil science

EVIDENCES FOR PARENT MATERIAL'S REGULATION OF MICROBIAL COMMUNITY AND ORGANIC MATTER FORMATION IN INITIAL SOIL DEVELOPMENT

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Soil develops through interaction of biotic (plant and microbes) and abiotic components (minerals). Importance of microbial necromass to formation of soil organic matter and aggregates has been well documented, while it is still unclear whether mineral type determines microbial community composition and pathway of soil development. Mineral powder samples [granite, basalt, andesite, sandstone, kaolinite, hydrohalloysite, Akahoya volcanic ash (7300 years old), Sakurajima volcanic ash (fresh)] in nylon mesh bags were buried in Southwest Japan (Okinawa and Amami islands) and recovered 0.5, 1.5, 10, 20, 40 years after burial. We measured changes in bulk density, C and N concentrations, pH, element composition, particle size distribution, specific surface area, microbial community diversity (Shannon, prokaryote and fungi), and 32 enzyme activities (Ecoplate). The pH and acid-neutralizing capacity (ANC) decreased with time for the respective mineral species, with the higher rates in granite and Sakurajima volcanic ash. No increases in clay contents were found, but increases in short-range-order minerals contributed to C accumulation in volcanic ash and andesite. Microbial diversity increased with increasing soil C concentrations to reach saturation at the level close to the bulk soil. Enzyme activities increased with microbial diversity at the early two years, then they decreased with decreasing pH. We demonstrated that specific surface area of mineral species shape microbial composition and that pH or ANC regulates decomposition activity and soil organic matte formation.

Keywords: Soil organic matter, Artificial soil, Parent material, Mineral weathering

ID ABS WEB: 137820

7. Soil sciences impact on basic knowledge
7.11 133570 - Digging deeper: Advances in subsoil science

DEEP NITRATE ACCUMULATION IN RELATION TO SURFACE SOIL MANAGEMENT VERSUS REGOLITH INTERACTIONS IN A HIGHLY WEATHERED SUBTROPICAL CRITICAL ZONE

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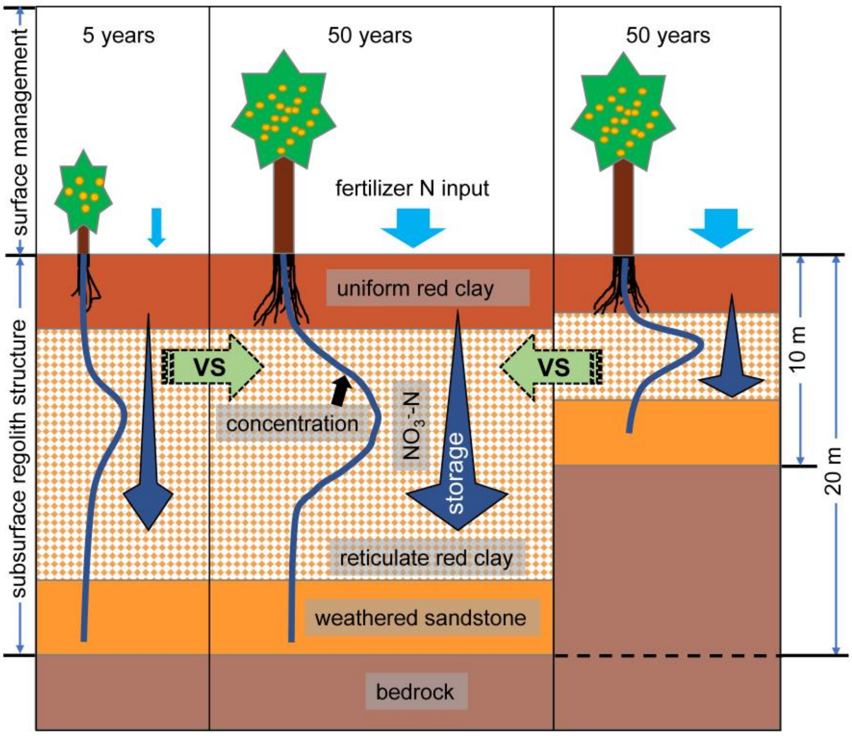
Nitrate accumulated deep (>100 cm) in the regolith threatens groundwater quality, but most studies focus only on nitrate nearer the surface (<100 cm). Surface soil management versus regolith interactions affect deep nitrate leaching, but their combined impact remains unclear. This study investigated how deep nitrate accumulation was affected by land use type, landscape position, crop planting years, regolith structure, and soil properties in highly weathered subtropical red soils. Deep nitrate storage varied from 43.6 to 1116.3 kg ha–1. Nitrate concentrations in the deep horizons of cropland and orchard regoliths were significantly larger than those in the paddy fields or woodland ($p < 0.05$). When compared to the regoliths from the upper slope of the cropland, those from the middle slope stored significantly more nitrate in the deep regolith layer ($p < 0.05$). Nitrate accumulation generally increased with the planting years. The difference in peak nitrate concentration (9.0–20.0 mg kg–1) with planting year gradient (3–58 years) varied by 2.2 times, and the difference in nitrate storage (43.6–425.7 kg ha–1) varied by 9.8 times. Regolith thickness was positively correlated with nitrate storage (R2 = 0.43, $p < 0.05$). Reticulated red clay (110–838 cm) had 81% of the accumulated nitrate and overlapped with 79% of the nitrate accumulation layer. Texture and pH explain 41.6% of the variation in nitrate concentration. As surface soil management practices interact with deeper regolith to control the spatial pattern of nitrate accumulation, vulnerable regions could be identified to avoid high accumulation. This study shows that internal hydropedological conditions determine fundamentally solute transportation and consequently environmental functions.



Keywords: deep soil, Critical Zone, nitrate accumulation, whole regolith, subtropical region

ID ABS WEB: 138209

7. Soil sciences impact on basic knowledge
7.11 133570 - Digging deeper: Advances in subsoil science

VERTICAL ANALYSIS OF ARBUSCULAR MYCORRHIZAL FUNGAL COLONISATION CAPACITY IN THE SOILS OF AN ALKALINE GRASSLAND

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Little is known about how soil depth affects the presence of arbuscular mycorrhizal fungi (AMF). AMF communities in deeper soil horizons can harbour a unique pool of biodiversity and can also contribute to carbon sequestration.
In our study, we chose an alkaline grassland site in a rural region of the Great Hungarian Plain. The grassland is in regenerative agricultural practice. A soil survey was conducted in August 2023, resulting in a precision-scale digital soil map of the area. The survey sampled soil horizons from 13 different soil profiles. The soils were classified according to the rules of the WRB system. The samples were processed and a full physical and chemical analysis of the soils in the sampling area was carried out.
Trap plants were planted in the soil samples taken during the soil survey. The percentage of root colonisation was determined. By examining the colonisation capacity of different soil horizons, we could show which soil properties have a significant effect on the presence of AMF. We can also see how AMF colonisation capacity varies within the soil profile, giving us a better understanding of how depth affects AMF communities.
By extending our research below the A horizon of soils, we can show how biodiversity varies across soil types and how biodiversity changes with depth. The results can shed light on the function and role of AMF communities in deeper soil horizons.

Keywords: digital soil mapping, arbuscular mycorrhizal fungi, vertical analysis, biodiversity, soil classification

ID ABS WEB: 135999

7. Soil sciences impact on basic knowledge
7.12 133581 - Soil mineralogy: current state and perspectives

WEATHERING AND PEDOGENESIS ON THE GALÁPAGOS ISLANDS: THE INTERPLAY OF BIOLOGICAL UPLIFT AND SECONDARY MINERAL FORMATION AFFECTS ELEMENT CYCLING AND WEATHERING RATES

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A humid soil chronosequence (1.5 to 1070 ka) was investigated on the Galápagos Islands. Indices of chemical weathering, e.g. the Chemical Index of Alteration correlated well with indicators of pedogenic development, such as solum thickness, soil pH, or the ratio of oxalate- to dithionite-extractable Fe. We found considerable loss of base cations already in the early to intermediate phases of weathering (e.g. 95% of Na and 78% of Mg lost from the topsoil after 26 ka) and almost complete loss from the entire profile in soils older than 800 ka. However, we also observed topsoil gains of Ca, K, and P in the young to intermediate-aged soils (<=26 ka), which are likely due to biological uplift, i.e. root uptake from less weathered subsoil layers, transport to above-ground plant parts and deposition onto the topsoil via litterfall. The topsoil gain of P was especially pronounced (around 200%) at the youngest sites (1.5 and 4.3 ka) and that of K was prominent at the next oldest site (26 ka). This element selectivity seems to be linked to the different capacity of the soils to retain P and K, respectively, once uplifted into the topsoil. The young (andic) soils are dominated by short-range-order secondary phases (allophane, ferrihydrite), which show very high phosphate retention capacity. After 26 ka of pedogenesis, vermiculitic phases have become predominant. These have much less P retention capacity but a high propensity to fix K in their interlayers, leading to illitization (Figure 1). Our results suggest that young volcanic surfaces experience high rates of chemical weathering and pedogenesis. However, biological uplift of nutrient elements may reverse elemental weathering losses and decelerate weathering rates at early to intermediate pedogenic stages. In this process, secondary minerals act as element-specific binding agents effectively retaining biologically uplifted nutrients in surface soils. As such, these constituents are not only products of chemical weathering reactions, but can themselves strongly alter biogeochemical element cycling and weathering rates.

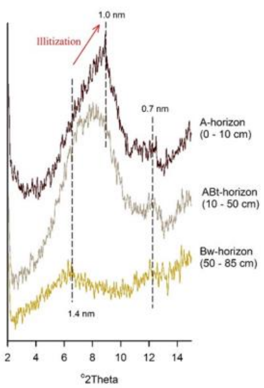

Figure 1. Stacked X-ray diffractograms of intermediate-aged profile (26 ka; clay fraction; Mg-saturated and air-dried) showing a peak shift from 1.4 nm in the subsoil to 1.0 nm in the topsoil, indicative of the illitization of vermiculitic phases.

Keywords: short-range-order minerals, allophane, illitization, biological uplift, chemical weathering

ID ABS WEB: 136392

7. Soil sciences impact on basic knowledge
7.12 133581 - Soil mineralogy: current state and perspectives

ANTHROPOGENIC INFLUENCE ON THE PEDOGENESIS OF VOLCANIC SOILS IN SOUTHERN CHILE

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In southern Chile, volcanic ash has undergone distinct evolution compared to other regions, influenced by high rainfall and humid conditions fostering the formation of short-range ordered (SRO) minerals like allophane, imogolite, and Al/Fe humus complexes. These unique soils, originally forested, have increasingly been repurposed for grasslands and croplands. Our study aimed to discern the human-induced impact on the colloidal composition of volcanic ash-derived soils in this region.
Characterization and sampling encompassed four soil types (Typic Hapludult, Acrodoxic Duraquand, Typic Paleudults, and Duric Hapludand) under different land uses: forest, cropland, grassland, and eucalypt plantation. Differential extractions using pyrophosphate and oxalate were employed to assess changes in the amorphous colloidal fraction and x-ray diffraction was conducted to identify crystalline clays. Under grassland and plantation use, the colloidal fraction exhibited dominance of SRO minerals, augmenting Alo + ½Feo and Alp/Alo contents, leading to altered characteristics in Acrodoxic Duraquand. The pH range of 5 to 7, coupled with limited complexing organic compounds, facilitated the formation of Al polymers interacting with silica to generate allophane/imogolite. Clay mineral compositions was less affected by land use but varied by volcanic soil type, with Typic Paleudults displaying a higher proportion of crystalline clays linked to longer pedogenic evolution.
Paleudults, derived from Pleistocene volcanic ash on metamorphic rocks, exhibited contamination from Holocene volcanic ash, containing amorphous materials. Typic Hapludult and Duric Hapludand showcased minimal development of crystalline clays, primarily secondary chlorite, alongside increased gibbsite presence at depth. Acrodoxic Duraquand, while sharing similar mineral compositions with the aforementioned soils, showed increased crystalline mineralogy in croplands, with kaolinite and illite potentially stemming from mica weathering. The increased mineral presence might originate from a geomorphological influence mixing materials from a neighboring estuary. However, an anthropogenic effect cannot be discounted, considering the soils' history under plantations for five decades before cropland, contributing to chemical and physical alterations.

Keywords: volcanic ash soils, Al/Fe humus complexes, short-range ordered minerals, crystalline clays, land use change

ID ABS WEB: 137151

7. Soil sciences impact on basic knowledge
7.12 133581 - Soil mineralogy: current state and perspectives

WEATHERABLE PRIMARY MINERALS IN JAPANESE AGRICULTURAL SOILS DETERMINE MULTIPLE SOIL PROPERTIES

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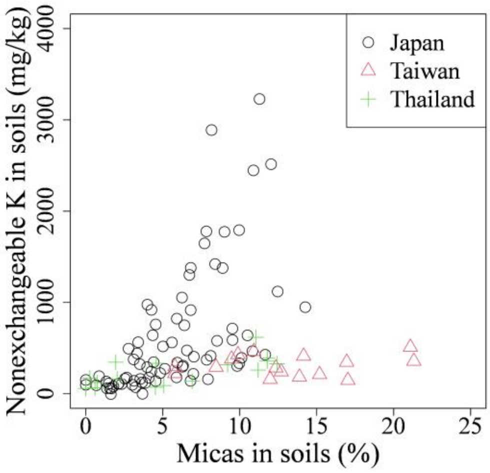
Primary minerals are major components of soil, but their spatial variations and contributions to soil properties are not clear due to insufficient quantitative information. The objective of this study was to quantify primary minerals with improved precisions and to better understand the linkage between primary mineral variations and soil properties under different climate conditions in Monsoon Asia.
Soil samples (0–15 cm depth) were collected widely from agricultural fields in Japan (n = 79), Taiwan (n = 16), and Thailand (n = 16), mostly belonging to temperate (Köppen climate classification: Cfa, Dfa, and Dfb), subtropical (Aw and Cwa), and tropical climate (Aw), respectively. The mineral composition of air-dried, 2 mm-sieved soils was obtained from the X-ray powder diffraction (XRPD) data by full-pattern summation method using self-prepared reference library of standard XRPD patterns. The nonexchangeable K content was obtained by subtracting exchangeable K content extracted with 1 M ammonium acetate from phytoavailable K content extracted with 1 M hot nitric acid.
On average, Japanese soils showed higher plagioclase content (Japan: 23.8, Taiwan: 13.8, Thailand: 4.4 wt.%) and trioctahedral mica content (Japan: 0.3, Taiwan: 0.0, Thailand: 0.0 wt.%) in contrast to lower quartz content (Japan: 28.5, Taiwan: 58.5, Thailand: 65.7 wt.%) than those of other regions. Reflecting these abundances of weatherable minerals, Japanese soils showed the highest positive correlation between sand and plagioclase content ($r = 0.48$, $p < 0.001$) and the highest nonexchangeable K content per mica content. Compared with Taiwan and Thailand where major micas were highly-resistant dioctahedral type (e.g., illite and muscovite), weatherable trioctahedral micas (e.g., biotite and phlogopite) remained in Japanese soils. Higher ability to supply K from micas is a key to reduce chemical fertilizer application rate, and especially in Japan, contribute to reduce food contamination by radiocesium. In conclusion, the improved precisions of the mineral quantification revealed that Japanese soils were abundant in several weatherable primary minerals, each of which determined different type of soil properties.



Keywords: agricultural soils, full-pattern summation, mineral quantification, soil properties, X-ray powder diffraction

ID ABS WEB: 137865

7. Soil sciences impact on basic knowledge
7.12 133581 - Soil mineralogy: current state and perspectives

A STUDY OF THE MAGNETIC PROPERTIES OF GOETHITE FROM SOILS AND SYNTHETIC ANALOGS

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Goethite (alpha-FeOOH) is, by far, the most common oxyhydroxide present in soils, occurring ubiquitously around the globe, predominantly in cold to temperate and humid climates. In nature, goethite can be formed basically in two ways (1). In the first route, Fe+2 is released from compounds such as Fe silicates, carbonates, or sulfides, then oxidized in an aerobic environment or from previously existing Fe+3 oxide phases. In such conditions, the goethite formed will mirror the primary Fe distribution of the environment. In the second pathway, the formation involves the presence of ferrihydrite that converts to goethite (1). The magnetic properties of goethite reflect its formation process and its Néel temperature can vary from 330K to 393 K, and correlates with factors like crystallinity, isomorphous substitution, the content of excess water, and cation vacancies (2, 3, 4).
Goethite present in soils was investigated by using curves magnetization temperature (50 K to 1000 K) and field dependent (hysteresis loops), and Mössbauer spectroscopy at room temperature. In addition, we investigated the impact that the substitution of varying amounts of aluminum, nickel, and chromium has on the magnetic properties of laboratory-prepared samples of goethite. The magnetic results of the synthetic samples identified the phases precipitated and the nature of their magnetic behavior, showing also an important particle size effect. Some samples showed a minor contribution of hematite. The information obtained from laboratory-prepared samples helps the investigation and understanding of goethite present in soils.

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Keywords: Goethite, Iron Oxide, Al substitution, Weathering

ID ABS WEB: 136108

7. Soil sciences impact on basic knowledge
7.13 133768 - Soils of the past for present and future

PALAEO-SOILSCAPE PROXIES FOR PAST GROUNDWATER TABLE ELEVATIONS: A CASE STUDY FROM THE KLEINE NETE VALLEY, NORTHEASTERN BELGIUM

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This investigation explores the use of podzol horizon morphology as a proxy for reconstructing groundwater table (GW) dynamics in interfluve lowland landscapes in temperate western Europe. In the absence of peatlands on such interfluves, traditional proxies for GW table reconstruction, such as palynomorphs, testate amoebae, and C/N isotopes, are often challenging to employ in these settings. To overcome these limitations, this study adopts podzol morphology as a key indicator for past groundwater table elevation. A novel approach will be presented in which past GW estimates from podzol morphology are tested against additional palaeo-soilscape features such as aeolian deflation and/or sedimentation, or rare local peat development in depressions. Previous research has employed podzols for GW table reconstruction, primarily relying on area-wide databases. The current study, however, is based on detailed field investigations on two interfluves within the Kleine Nete valley, northeastern Belgium. The research integrates fieldwork data with basic granulometric and geochemical analyses, radiocarbon dating, optically stimulated luminescence (OSL) dating, and palynology.
The results reveal the presence of dry podzol morpholoy in higher elevations, which are typically covered with aeolian sand deposited in dry conditions. Past wind deflation phenomena here align with expected deeper past GW tables at such drier sites. Wet podzol morphology is observed in lower landscape positions, and these palaeosoils tend to occupy depressions. Here, erosional phenomena are absent, and the depressions are typically filled with drift sand that was deposited in wet conditions, showing lacustrine-like features. Ultimately, the deepest depressions show the development of peat.
Chronological analysis through OSL dating of drift sand, radiocarbon dating of A-horizons, peat, and Bh-horizons places the development of these podzols between approximately 8000-1500 BP, while drift sand accumulation took place in the period between approximately 3000-200 BP. A comparison with present-day GW elevation data reveals that all past GW table estimates exceed current levels. This study underlines the importance of considering podzol morphology in GW table reconstructions.

Keywords: palaeosoils, podzol horizon morphology, drift sand facies, aeolian deflation, geochronology

ID ABS WEB: 136444

7. Soil sciences impact on basic knowledge
7.13 133768 - Soils of the past for present and future

ISOTOPY, MICROMORPHOLOGY AND COMPOSITION OF PEDOGENIC GYPSUM IN LOESS-PALAEOSOL SEQUENCES IN THE EBRO VALLEY AS A COMBINED PALEOENVIRONMENTAL PROXIE

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The loess palaeosol sequences in the Ebro valley are associated with arid and semi-arid climates where the main pedogenic process is the mobilisation of carbonate and gypsum through the soil, resulting in secondary accumulations. In this arid climatic context, the conservation of palaeoenvironmental indicators of biological origin is very limited and therefore, the development of new tools to help us to understand more about conditions of the past is essential.
This study has consisted in the micro-sampling and analysis of secondary gypsum accumulations from five Loess Primary Sequences (LPS) applying several approaches and analytical techniques, in order to understand which processes and palaeoenvironmental conditions gave place to their development and preservation. Traditional methods based on the study of gypsum morphologies supported by micro-morphological study have been applied, which has allowed us to observe a variety of crystalline shapes as well as different growths and mineral arrangements. In addition, more novel analyses in the field of pedogenic gypsum have been implemented, including the stable isotopic composition of the sulphate (δ34S, δ18O) and crystallisation water (δ2H, δ18O) of gypsum and trace element composition (137Ba, 88Sr, 23Na, 38K, and 24Mg).
From this study it has been possible to relate pedogenic gypsum with possible source areas, to identify some processes that favour its formation (precipitation in saturated or non-saturated conditions) and how this mineral varies its behaviour throughout the profile (dissolution – reprecipitation in an open environment or closed system fractionation).
The combination of different methods has confirmed that pedogenic gypsum is a potential tool for palaeoenvironmental knowledge in arid and semi-arid regions. However, due to the limitations it presents (solubility, relatively low stability under normal conditions…), it is recommended to combine additional techniques and proxies to be used as an effective palaeoenvironmental proxy.

Keywords: Pedogenic gypsum, Micromorphology, Stable isotopes, Paleoenvironmental indicator

ID ABS WEB: 137421

7. Soil sciences impact on basic knowledge
7.13 133768 - Soils of the past for present and future

THE BAIX LOESS-PALAEOSOL SEQUENCE (RHÔNE RIFT VALLEY, SE-FRANCE): A UNIQUE RECORD OF THE TRANSITION ZONE BETWEEN CENTRAL AND SOUTHERN EUROPE

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Loess-palaeosol sections (LPS) provide valuable archives of Quaternary palaeoenvironmental changes over time, and spatial palaeoenvironmental gradients during the same period.
Here we present the LPS Baix, located at the western edge of the Rhône Rift Valley in southeastern France, at 44°42'36'' N and 4°43'21'' E. Already discovered in 1934, this 14 m thick LPS has never been studied employing modern analytical methods.
It caught our attention because it is located in the transition zone between the presently temperate and the Mediterranean region of Europe. To our knowledge, no LPS has been analysed yet in such a transitional climatic position. It likely provides a missing link between the rigorously analyzed LPS in the presently temperate regions further north (e.g., in northern France, the Alsace region and Germany) and the LPS in the Mediterranean region (e.g., in southern France, Catalonia, Italy and Croatia). Therefore, we aimed at deciphering the paleoenvironmental record of the LPS Baix in this particular transitional climatic position, and analysed the LPS Baix by means of palaeopedological methods combined with OSL dating.
Reddish Btg horizons of a Stagnic Luvisol at the base of the LPS represent the remains of an Eemian to Early Würmian (MIS 5) pedocomplex formed under warm and - at least temporarily - relatively moist conditions. Two brown Bw horizons of truncated Cambisols have been preserved in the overlying early to middle Pleniglacial (MIS 5a/4 and MIS 3) deposits. The upper Bw horizon is associated with large carbonate nodules, indicating that considerable amounts of calcium carbonate were leached from the former middle Pleniglacial Cambisol and accumulated in the underlying loess unit. This truncated middle Pleniglacial Cambisol is very similar to the middle Pleniglacial palaeosol remains in the LPS Collias that we investigated 87 km further south, near Nîmes, in the present Mediterranean climate. No palaeosols were observed in the late Pleniglacial deposits of the LPS Baix.

Keywords: loess-palaeosol sequence, Late-Pleistocene, Eemian soil, MIS3 soil

ID ABS WEB: 137822

7. Soil sciences impact on basic knowledge
7.13 133768 - Soils of the past for present and future

PALEOSOLS OF THE STRATIGRAPHIC SUCCESSION OF THE VULSINI VOLCANIC DISTRICT (MIDDLE PLEISTOCENE): GEOCHEMISTRY, MICROMORPHOLOGY AND MINERALOGY OF THE SERMUGNANO SEQUENCE

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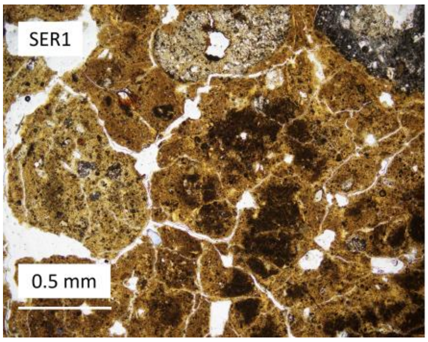
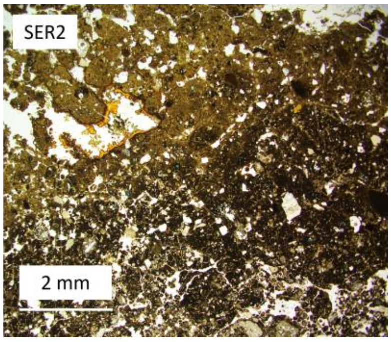
The Sermugnano sequence (Central Italy) is constrained on the top by the pyroclastic flow deposit of “Nenfro” (approx. 505 ka) and at the bottom by the pumice fall deposits of the Paleovulsini phase of activity (approx. 589 ka). In all paleosol horizons, selective extractions of Fe, Al and Si forms highlighted an andic index (oxalate extracted Alo+0.5 Feo) always below 0.4%, indicating neither andic nor vitric properties. They thus do not match the requirements for Andosols classification, as confirmed by the low (0.6-1.3%) contents of allophane and imogolite. The pyrophosphate extractable Al and Fe contents were always low, indicating the scarce presence of Al-Fe/humus complexes.

Two major paleosols have been recognised in the sequence, based on their differences in terms of geochemical composition, forms of oxi-hydroxides, mineralogical and micromorphological properties. The SER1 paleosol (first 0-100 cm), with respect to SER2 (100-210 cm), is featured by i) higher content of monovalent and divalent metal oxides (9.4% vs 6.6%), ii) lower Fed (Na-dithionite extractable)/Fet (total) ratio (0.04-0.09 vs 0.11-0.14), iii) lower Alt/Sit (around 0.4 vs 0.5-0. 7), iii) higher Fet/Alt (0.45-0.64 vs 0.21-0.36). All data are consistent with a lower development of SER1 than SER2.

This hypothesis is confirmed by the optical microscopy and SEM analyses, evidencing a prevalent massive soil structure, presence of weakly weathered lava rock fragments and minerals in SER1, while prismatic soil structure, Fe-Mn segregations in the soil matrix and in pores were visible in SER2. Moreover, the clay fraction of SER1 has a mineralogy dominated by swelling phyllosilicates (e.g. smectite), with minor amounts of illite and traces of kaolinite, while SER2 is dominated by illite, and smectites are only present as mixed layers. However, despite the long-time of pedogenesis, all these paleosols are surprisingly poorly developed.





Keywords: paleosols, volcanic soils, micromorphology, soil geochemical composition, soil selective extractions

ID ABS WEB: 137973

7. Soil sciences impact on basic knowledge
7.13 133768 - Soils of the past for present and future

PEDOSEDIMENTS IN THE KARSTIC SYSTEMS OF THE YUCATAN PENINSULA

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The geology of the Yucatan Peninsula is made up of limestone that is in constant dissolution, forming the so-called karst landscape. This system presents undulating reliefs and depressions with cave systems promoted by karstification that can develop sinkholes and closed depressions that, depending on the thickness of the rocks, can collapse. In the case of surfaces, the solution may present connection points with the caverns. Therefore, karst dynamics can promote depression sites where soils accumulate or erosion sites and subsequent accumulation within the caverns. This work presents comparative results of the jungle soils and pedosediments of the caves that are part of the karst systems within the Playa del Carmen-Tulum transect about 20 km from the coastline.
The soils on the surface that support the jungle of the Peninsula include Réndzic Leptosols, which are characterized by having a lot of organic matter and being shallow, and Chromic Luvisols filling in karst pockets, soils with high clay content.
The caverns “8 Balas” and “Garra Jaguar” have multiple entrances and occasionally small altars are located especially inside Garra Jaguar it is very common to find stoves and small coals produced by burning, so these caves present evidence of Maya occupation.
On the other hand, within these two caverns, approximately 200 meters from the entrances, there are reddish pedosediments with characteristics of Luvisol-type soils, in addition to having very thin A/B/C horizons identified. The origin of these pedosediments is a consequence of vertical type erosion (“soil piping”) that can occur in the area due to the cavities resulting from limestone dissolutions, which is why the roots can have connections from the surface and reach the pedosediments and water of the caves.
With this evidence, it can be determined that soil erosion and movement can occur naturally within the karst system but can also be dramatically accelerated due to ancient activities, especially the Mayan people who are known to have heavily populated the area.

Keywords: pedosediment, karst, Maya, micromorphology, impact

ID ABS WEB: 137983

7. Soil sciences impact on basic knowledge
7.13 133768 - Soils of the past for present and future

CLIMATIC CONTROLS ON LONG-TERM GYPSUM ACCUMULATION IN HYPERARID SOILS (GYPSIDS)

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Hyperarid soils in deserts are characterized by secondary accumulations of soluble salts (gypsum and halite) in diagnostic horizons due to limited water availability. These soils are termed Reg and classified as Aridisols (Gypsids/Salids). The sources of the pedogenic salts are atmospheric dust and rainwater. In such extreme environments, the interplay between climatic properties, dust flux, and soil properties governs the depth and content of these salt horizons. However, the controls of these climatic properties on the accumulation of pedogenic salts are poorly constrained. To better understand these relationships, we constructed a compartment model that simulates pedogenic gypsum accumulation at millennia timescales at daily time steps. The model was used to quantify the range and sensitivity of climatic factors and dust flux on the accumulation of pedogenic gypsum and estimate the most likely climatic scenarios that could have led to the formation of the diagnostic gypsic horizon developed in Reg soils, Negev desert, since the Late Pleistocene (<65 ka). Input parameters are stochastically simulated rainstorms, potential evapotranspiration (PET), dust flux, and sulfate concentration in rainwater. The model was calibrated using data from early Holocene soil profiles, assuming that the climate during the Holocene was similar to today (MAR < 80 mm and annual PET 2000 – 2300 mm). Sensitivity analysis indicates that gypsum accumulation is highly sensitive to MAR and sulfate concentration in rainwater. Synthetic gypsum profiles were calculated using different climate scenarios and then compared to observed gypsum profiles in soils developed on Late Pleistocene surfaces in the same vicinity. Results indicate that simply extending current climate conditions into the Late Pleistocene cannot explain their observed gypsum accumulation; the most plausible climate scenarios for these soils must include increased rainfall to 1.5–2.0 times today's and sulfate concentration in rainwater (2.0–2.5 times than today) to successfully reconstruct the observed accumulated gypsum in mature soil profiles.

Keywords: Paleopedology, Aridisols, Gypsum, Hyper-arid climate, Desert soils

ID ABS WEB: 138020

7. Soil sciences impact on basic knowledge
7.13 133768 - Soils of the past for present and future

ENVIRONMENTAL RECONSTRUCTIONS AND STRATIGRAPHIC INSIGHTS THROUGH PALAEOSOL STUDIES IN THE DNIEPER RIVER BASIN (UKRAINE)

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Our study investigates the Pleistocene stratigraphy of the Dnieper Basin by analyzing loess and palaeosols, which reveal climate and landscape changes post-Saalian glaciation. We've distinguished between isolated northern loess patches and extensive southern covers, integrating these findings into regional and broader chronostratigraphic contexts.
The scope of our paleoenvironmental investigation extends from the Middle Pleistocene to the Holocene, with a special emphasis on the critical role of palaeosols. These buried soils, encapsulated within aeolian deposits (notably loess units L2-L1), serve as vital stratigraphic records, enabling us to reconstruct past environmental and climatic transitions with remarkable accuracy.
Through the examination of palaeosols across various stratigraphic levels, particularly S2, S1, and S0, we have unveiled local environmental dynamics that played a significant role in shaping Quaternary events post-Saalian glaciation. Our efforts to map the interplay between landscape alterations and aeolian activity have shed light on the underpinnings of Quaternary sediment formation and distribution across both temporal and spatial dimensions.
Employing methodologies such as granulometry, spectrophotometry, chemical analysis, palaeomagnetism, and luminescence dating, we have gained a holistic insight into the origin and development of palaeosols. Furthermore, the application of palynological data for reconstructing palaeoclimatic conditions has led to a more nuanced understanding of climate fluctuations.
In conclusion, our research underscores the invaluable role of palaeosols as key indicators of paleoenvironmental conditions. Their study not only facilitates the reconstruction of past environmental and climatic shifts but also enhances the precision of dating and stratigraphic correlation within Quaternary sediments. This exploration is instrumental in unraveling the complex environmental dynamics of the Pleistocene era in the Dnieper Basin, offering profound insights into paleoclimatic interpretations.
Research carried out as part of the grant of National Science Centre, Poland as the project no. 2018/31/B/ST10/01507 entitled “Global, regional and local factors determining the palaeoclimatic and palaeoenvironmental record in the Ukrainian loess-soil sequences along the Dnieper River Valley – from the proximal areas to the distal periglacial zone”.

Keywords: Loess-Palaeosol Sequence, Pleistocene, Landscape evolution, Paleodata, Climate Reconstruction

ID ABS WEB: 138351

7. Soil sciences impact on basic knowledge
7.13 133768 - Soils of the past for present and future

REVISITING THE BIOGENESIS OF OXISOL MANTLES (OXISOLS, FERRALSOLS) OF BRAZIL AND THE TROPICS: AN ALMOST FORGOTTEN CONCEPT, CRUCIAL FOR THE FUTURE OF THE TROPICS.

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Latosols, laterite soils, ferralsols or oxisols cover approximately 70% of the Brazilian landscape, representing the most extensive planetary cover of deeply weathered soils, and the largest current agricultural frontier, responsible for global food security, in modern technical management adapted to the humid tropics. In this work we revisit the biogenetic model of the origin of these homogeneous and well-structured mantles, pointing out that the success of their conversion into agricultural and pastoral ecosystems using high inputs took advantage of their greatest virtues, precisely provided by long-term biological action, mainly by termites and ants. Understanding the cumulative importance of biogenesis can provide the search for ecologically sustainable alternatives, with inclusive and participatory management by ecosystem engineers, aiming for a more lasting and rational use of these unique soils, exclusive to the tropics, without compromising the countless ecosystem services and the protection of immense biodiversity that they shelter, both above ground and underground.

Keywords: Brazilian Latosols, Tropical Soils, Termites, Pedobiology

ID ABS WEB: 136099

8. Other
8.01 124518 - Assessing soil security

HOW ARTIFICIAL INTELLIGENCE COULD CONTRIBUTE TO ASSESS SOIL SECURITY DIMENSIONS AND IMPROVE SOIL CONNECTIVITY FOR ALL STAKEHOLDERS OF A SOCIETY.

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Supply chain disruptions, geopolitical tensions and inflation increase the risk of food shortage and food production for industrialized countries. Moreover, global peace and security depends on planetary functioning and global food security which rely on the capacity and condition of soils to deliver functions and services that are sustained by soil microbiome activities. Indigenous Microorganisms (IMO) that compose soil microbiomes are organized in trophic levels and sustain most of the seven functions targeted to be protected in the European Union. Respectively: biomass production, storing nutrients and water, biodiversity and carbon pools, physical & cultural environment for human's activities, source of raw materials and archive of geological and archeological heritage. The need to assess soil security becomes systemic and interdisciplinary because the dimensions capital (related to the value of the functions delivered by soils), connectivity (related to how soil is connected with social aspect) and codification (related to legislate to protect soils) depend on the activities coming from whole stakeholders of a society. Many Artificial Intelligence models are currently developing various types of soil assessments and indicators for research purposes as well to provide services to growers. However, most of those are still financially unaffordable for growers and complex to understand when it comes to interpreting results and making changes to farmers' daily practices (e.g. DNAe test). This presentation is part of an ongoing PhD study and aims to discuss Artificial Intelligence targeting to be accessible for all the stakeholders in order to get a quick reading of soil microbiome as an additional indicator of soil health. The objectives are first to reach out for growers and then developing the connection to soil in order to value and protect it (capital & codification) with decision makers who would have direct access to soil data.

Keywords: Soil security dimensions,Food security,Artificial Intelligence,Connectivity,Stakeholders

ID ABS WEB: 136192

8. Other
8.01 124518 - Assessing soil security

SOIL SECURITY ASSESSMENT: ESTIMATING THE CAPACITY OF THE SOIL FUNCTION NUTRIENT CYCLING IN THE HUNTER VALLEY WINE GROWING DISTRICT

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A soil centric approach to evaluating soil functions, soil services and threats to soil is essential to monitor and improve soil security to address anthropogenic forces that exacerbate the global existential challenges. This case study aims to explore methods to quantitatively evaluate the biophysical dimensions (capacity and condition [health]) and investigate the spatial variations of the soil's ability to store and regulate nutrients among contemporary land uses, and reference states (genosoils and phenosoils) in the Hunter Wine Country Private Irrigation District (HWCPID), NSW, Australia. To achieve this, five predominant pedogenon classes of the area were investigated: Wandin (Red Chromosol), Stanleigh (Brown Chromosol), Tamburlaine (Red Kurosol), Sandalyn (Brown Chromosol) and Marrowbone (Calcarosol). For each pedogenon class, soil samples at 0-10cm and 40-50cm depths of the respective genosoil and phenosoil were collected and a pragmatic list of soil properties were measured for the soil nutrient cycling x capacity (i.e., the soil function x dimension in scope). The respective utility graphs for soil properties were devised based on expert knowledge and from their estimated utility indicators are identified using principal component analysis. The utility of the indicators were then aggregated into an index to assess the capacity of the soil to cycle nutrients and results mapped across the study area.

Keywords: soil security,nutrient cycle,soil capacity,pedogenon

ID ABS WEB: 137070

8. Other
8.01 124518 - Assessing soil security

CONNECTIVITY ASSESSMENT AND REFLECTION EVALUATION (CARE) TOOL FOR SOIL SECURITY

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A connection to soil enables land managers to not only recognise the intrinsic value of soil as a provider of planetary services and human wellbeing, but also identify risks to soil security. Indeed connectivity, i.e. the intricate network of interactions between individuals, societal groups, and soils, is one of the five dimensions of Soil Security. Soil connectivity is the least developed dimension in the framework, which is structured on 23 soil functions, services and threats (roles). This study developed an evaluation tool to obtain a quantified baseline of soil connectivity for Australia's agricultural land managers. The evaluation tool measures the connectivity of land managers against the characteristics of knowledge, actions, and attitudes to the five threats and three functions in the framework most aligned with production practices. This measurement tool can be integrated into the framework, while also providing users with a connectivity report based on their answers. Spatial representation and analysis are being obtained by promoting the evaluation until at least three answers are collected from each of the 107 socio-economic representative categories located across the whole of Australia. Early results show that 95% of respondents identified at least one threat to their soils, notably erosion and structural decline, and strong connectivity averaging a connectivity level of 0.84 and a median of 0.88. Level of connectivity in decreasing order was for the roles of erosion, soil water management, soil biodiversity loss, acidification, structural decline, nutrient management, decarbonization, and salinity with levels of connectivity of 0.85, 0.81, 0.79, 0.79, 0.76, 0.74, 0.67, and 0.62 respectively. Texture (loam, clay, sandy) and colour (red, brown, black) were the most frequent descriptors used for their soils, often identifying for both soil surface and subsurface characteristics. Preliminary conclusions of the study show Australian farmers have a high connectivity to their soils and mainly use texture and colour for their description. This work is supported by the Australian Research Council Laureate fellowship (FL210100054).

Keywords: Soil Security,Connectivity,Evaluation Tool

ID ABS WEB: 137084

8. Other
8.01 124518 - Assessing soil security

CONTINENTAL MONITORING SOIL PROPERTY CHANGES UNDER HUMAN PRESSURE USING PEDOGENON MAPPING

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Soil properties are susceptible to changes due to human activities, particularly agricultural management. Traditional methods of monitoring these changes often lack the level of detail needed for comprehensive understanding.

This work uses the innovative approach of pedogenon mapping (Román Dobarco et al., 2021) over Australia, which leverages high-resolution environmental covariates as proxies of soil-forming factors, including relief, parent material, and climate. This method delineates 1370 pedogenons in Australia where soils share similar forming factors. To discern soil changes, we employed the concepts of genosoil and phenosoil. Genosoils represent soils evolving under natural conditions, such as woodlands and native vegetation, while phenosoils depict soils under human-induced pressures, like cropping areas and pastures. By integrating data estimating human activity impacts using the global Human Modification map (Theobald et al., 2020) and the Habitat Condition Assessment System map (Harwood et al., 2016b), we can distinguish between these soil types (genosoil or phenosoil) within a pedogenon (Román Dobarco et al., 2023).
Zonal statistics were computed to highlight differences in soil pH and soil organic carbon from soil profiles observations between genosoils and phenosoils.

Our findings indicate discernible changes in these properties, underscoring the impact of human activities on soil evolution. Pedogenon mapping, combined with the genosoil and phenosoil concept, offers a nuanced and precise tool for monitoring soil property changes due to human pressures. This approach holds promise for future research on and policy-making in sustainable land management.

Keywords: Soil monitoring,Mapping,Soil organic carbon,Soil security,Soil condition

ID ABS WEB: 137169

8. Other
8.01 124518 - Assessing soil security

SOIL FOOTPRINT: A SIMPLE INDICATOR TO COMMUNICATE AND QUANTIFY SOIL SECURITY

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Soil erosion is one of the biggest threats to soil security, and therefore to agriculture production. Addressing this challenge requires effective strategies to protect soil resources without compromising crop yields. Currently, to fight soil erosion and to define soil sustainable strategies, there are three main players: scientists, policymakers, and land managers. However, the considerable technical knowledge required to understand the link between soil erosion on food production hinders the communication of the potential benefits of soil sustainability strategies to nontechnical stakeholders, such as farmers and food producers. Moreover, a major player in this fight is still missing, consumers. If there is no connection between soil and society then the soil itself may not be valued and it is less likely to be managed sustainably. In this study, we propose the concept of soil footprint, defined as the ratio of soil loss to crop yield, as a simple way to communicate and quantify the soil capital dimension of soil security. This concept offers the opportunity to communicate the tangible cost of annual soil loss from crop production clearly and concisely and to promote the engagement and participation of society in soil resource conservation. By integrating existing data, we have calculated and ranked the soil footprint of the ten main crops in Spain. We are developing an online soil footprint calculator to facilitate the calculation of the soil footprint from both food production and food consumption. Since the soil footprint is a versatile concept that can be applied at different temporal and spatial scales, we discuss some of its multitude of potential uses.

Keywords: Soil erosion,Crop yield,Soil footprint

ID ABS WEB: 137178

8. Other
8.01 124518 - Assessing soil security

MONITORING THE CONDITION OF FOREST SOILS IN THE BASQUE COUNTRY (SPAIN). AN APPLICATION OF PEDOGENON MAPPING FOR POLICY IMPLEMENTATION.

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The assessment of soil condition needs to consider the context of soil-forming factors for identifying indicators' reference values for specific different soil types. The European Commission proposal for a Soil Monitoring Law suggests establishing soil districts for monitoring and assessing healthy soil condition. Soil districts would be established considering administrative boundaries but also the homogeneity in soil type, climate, environmental zone and land use. Pedogenons are a possible way of delineating and characterising soil districts. In the Basque Country forests have been subjected to enormous pressure, especially since the beginning of the 20th century, hence it is important to obtain information on how intensive practices may have affected soil condition. The aims of this study are: 1) to apply pedogenon mapping for the delineation of potential soil districts in the Basque Country, 2) to assess changes in soil condition indicators in forest soils between 2001 and 2021 via the genosoil/phenosoil concept of pedogenons, and 3) to identify reference or target values of soil indicators for each soil district. Pedogenons are classes defined applying unsupervised classification to a set of quantitative state variables that represent the soil-forming factors. The hypothesis is that classes with homogeneous conditions in soil-forming factors would undergo similar pedogenesis and result in soils with similar capacity for performing soil functions and services and response to management. Within each pedogenon we might find genosoil and phenosoil subclasses. Genosoils result from natural pedogenesis (or minimal anthropogenic pressure) while phenosoils are variants from the genosoil due to land use history and management. Soil data from Basonet, the permanent network for forest monitoring in the Basque Country, was used to assess changes in soil condition by soil district. The set of soil condition indicators were bulk density, soil organic carbon to clay ratio, extractable phosphorus, total nitrogen, pH, and electric conductivity. Time series of satellite imagery and historical orthophotos were used to connect the intensity of forest management to soil condition.

Keywords: pedogenon,forest soils,forest management,soil condition,soil indicators

ID ABS WEB: 137741

8. Other
8.01 124518 - Assessing soil security

CONSTRUCTED SOILS OFFER A WAY TO OVERCOME THE LIMITATIONS OF PHYTOTECHNOLOGIES

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Phytotechnology also referred to as phytoremediation is a non-destructive technology for the remediation of soils that uses plant species to extract, contain, fix, or degrade and decompose inorganic or organic pollutants. It aims to control pollution transfer in environmental compartments and to limit associated risks while integrating site enhancement objectives.
The success of phytotechnologies can be hindered by poor soil quality, deep soil contaminants, and the difficulty of implementing a plant cover. Additionally, they require a long-term application and induce regular management costs. Constructed soils are engineered mixtures of organic and mineral materials including waste or modified soil horizons, combined with biotic selections. Constructed soils have great potential for surpassing the majority of phytotechnologies limits and improving their outcome.
The purpose of this review is to explore the efficacy of combining constructed soils and phytotechnologies while considering the type of contaminant (organic or inorganic), its concentration, speciation, and spatial distribution. The review will also explore the most appropriate biotic and abiotic conditions, and derive considerations for amendments selection, to improve the effectiveness of contaminated site management.
The use of constructed soils is a viable way to restore crucial ecosystem services, reduce costs, adapt to climate change, and enhance waste management by utilizing locally available waste materials. Constructing soils is a promising approach to facilitate the management of contamination sites while ensuring better climate mitigation.

Keywords: Phytotechnology,Constructed soils,contaminated site management,Contimination,restoration

ID ABS WEB: 137990

8. Other
8.01 124518 - Assessing soil security

COMMUNICATING SOIL HEALTH ASSESSMENT TO ON-FARM AND OFF-FARM STAKEHOLDERS

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Collecting effective, interpretable soil health measurements across soil types and management practices is an essential step toward helping land managers set and achieve soil health goals. The Soil Health Institute and its partners have endeavored to benchmark soil health potential and improvements that producers have achieved across North America. The Institute is collecting data using the minimum suite of recommended measurements, including organic carbon concentration, wet aggregate stability, and carbon mineralization potential, along with soil texture. These indicators are measured across an a priori map of soil groups identified to have similar soil health potential, and across regionally representative management categories, which include, baseline crop production systems, soil health management systems, and reference systems that express the soil health principles such as maximizing living roots and minimizing disturbance. Upon analysis and synthesis of the data, learning how to communicate the results to farmers, crop consultants, retailers, commodity groups, and buyers interested in paying premiums, is the challenge. We reflect on learnings regarding the connectivity dimension of soil security and how we are communicating the results of our soil health benchmarking work. We summarize our multipronged communication strategy for putting soil health benchmarks in the hands of producers, crop consultants, retailers, and buyers and share feedback that we have received regarding the efficacy of our approach.

Keywords: Connectivity,Soil Health,Benchmarking,Extension,Outreach

ID ABS WEB: 137631

8. Other
8.02 133440 - Tailored microbiome-based solutions for a sustainable agriculture

THE EFFECT OF BACILLUS MEGATERIUM VAR. PHOSPHATICUM INOCULUM ON SOIL ENZYMATIC ACTIVITY AND YIELD IN NO-TILLAGE MAIZE CROP

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In the current environmental context, conservation agriculture and eco-friendly alternatives to conventional practices play an important role, but these require soil and plant assessments. Enzymatic activity is essential in transforming soil organic matter and determining nutrient dynamics being a key component of the soil health. This research investigated the effect of applying Bacillus megaterium var. phosphaticum bacteria on catalase (CAT) and dehydrogenase (DHA) activity, plant biometric parameters (cob length - CL, grain weight /cob - GW and cob biomass - CB) as well as maize yield (Zea mays L.) in no-tillage system (NT). The study was conducted in 2023 in Northeastern Romania on a non-irrigated cambic chernozem soil with clay-loam texture and slightly acid reaction. For fertilization were used: NPK (20% N, 10% P2O5, 5% K2O); Ecofertil (Bacillus megaterium var. phosphaticum) and Corona N (21% N). Experimental plots were fertilized with the following formulations: T0 - NPK (control); T1 - NPK + 100% Ecofertil; T2 - NPK + 75% Ecofertil + Corona N; T3 - NPK + 100% Ecofertil + Corona N; T4 - NPK + 125% Ecofertil + Corona N. Results on catalase and dehydrogenase activity showed high values in Ecofertil treated variants. Significant differences ($p<0.05$) from the control were reported at T1, T2, T3. Cob length, grain weight /cob and cob biomass were higher in all Ecofertil treatments. Grain yield was significantly different, being 63% higher in T3 and 68% in T4 compared to the control. Data collected so far reveals a positive response of soil microorganisms, through enzymatic activity dynamics, to the recommended dose of Ecofertil associated with foliar fertilizer. The beneficial effect was also reflected in the yield parameters of the no-tillage maize crop.

Keywords: biofertilizer,catalase,dehydrogenase,no-tillage system,NE Romania

ID ABS WEB: 137666

8. Other
8.02 133440 - Tailored microbiome-based solutions for a sustainable agriculture

BELOW AND ABOVEGROUND EFFECTS OF A SOIL BIOINOCULANT

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Soil microbial communities influence plant growth and defenses, including indirect defenses affecting the attraction of natural enemies. Microbial inoculants, such as those based on arbuscular mycorrhizal fungi (AMF), could potentially boost plant defenses, but their impact in natural settings is not well understood.
Our study investigates the potential of AMF, specifically Rhizoglomus irregularis, as a soil bioinoculant to enhance plant defenses. We examined its impact on the roots microbiota and subsequent effects on tomato plants, both wild (Solanum pimpinellifolium, var. LA1589) and commercial (Solanum lycopersicum, var. Monita), when attacked by the pest Spodoptera exigua (Hübner). We also assessed its influence on the attraction of the pest's natural enemy, Chrysoperla carnea (Steph.).
In our study, we found that pest attack altered the natural volatile emissions in both commercial and wild tomato species. Notably, in the case of wild tomatoes, the effects of the pest attack and the inoculation of R. irregularis appeared to interact synergistically on volatiles profile. Furthermore, the presence of mycorrhiza increased the attractiveness of the pest predator to attacked plants in both types of tomatoes, compared to plants that were attacked but not inoculated with R. irregularis. However, it remains unclear whether this increased attractiveness is due solely to changes in volatile blends or if additional effects of mycorrhiza on the root microbiome contribute to the observed phenotype. Our results support that shifts in the metabolically active fungal communities in the roots also contribute to this phenomenon.

Grant agreement No 765290 from the European Union's Horizon 2020 Research and Innovation program

Keywords: BIOINOCULANTS,SOIL MICROBIOME,PLANT DEFENSE,PEST CONTROL

ID ABS WEB: 137840

8. Other
8.02 133440 - Tailored microbiome-based solutions for a sustainable agriculture

THE IMPACT OF SYNTHETIC MICROBIAL CONSORTIA, FERTILIZATION REGIMES AND MAIZE GROWTH STAGES ON PLANT GROWTH AND RHIZOSPHERE MICROBIOME UNDER TEMPERATE CLIMATE CONDITIONS

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Maize is one of the oldest crops in the world and has gained an important role in global agri-food systems. In addition to the use of organic fertilizers, microbiome-based solutions have been suggested as a safe and eco-friendly solution for reducing the application of chemical fertilizers to a great extent. The main objective of the present work is to assess the impact of synthetic microbial consortia developed within the SIMBA project, the fertilization regimes and maize growth stages on plant growth, and on taxonomic and functional rhizosphere microbiome under temperate climate conditions. The effect of microbial consortia inoculation on the non-target rhizosphere soil microbiome was investigated by a coupled approach based on 16S rRNA gene sequencing and shotgun metagenomic (WGS) sequencing and bioinformatic analysis. The application of MC exerted a positive effect on plant growth especially at lower fertilization levels in 2020 while significant increases in grain yield (+10%) were observed in 2021 only when MC_C_was applied in combination with Arbuscular Mycorrhizal Fungi. MC application did not significantly affect species diversity and richness of the native rhizosphere microbial communities, as well as their functional properties, suggesting the resilience of rhizosphere microbial communities in response to MC. In contrast, higher fertlization level and plant growth stages affected rhizosphere bacterial community. Finally, WGS metagenome sequencing revealed slightly significant differences in rhizosphere microbiome only between low and high fertilization levels and a significantly higher relative abundance of reads assigned to the SEED category “Nitrogen fixation” at low fertilization level (p-value of 0.03), suggesting that fertilization alter the pool of genes assigned to nitrogen fixation. Overall, our results suggest that multifunctional MC may be effectively exploited as biofertilizer in sustainable maize cultivation without altering the biodiversity or the resident microbiota, thus avoiding risks of long-term impacts on natural biodiversity. Funded from the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 818431 (SIMBA), EJP SOIL and SOIL HUB projects.

Keywords: maize,microbial inoculants,rhizosphere microbiome,whole metagenomic sequencing,sustainable agriculture

ID ABS WEB: 138118

8. Other
8.02 133440 - Tailored microbiome-based solutions for a sustainable agriculture

THE USE OF MICROBIAL BASED INOCULANTS FOR ENHANCING THE TOLERANCE OF TOMATO PLANTS TO DIFFERENT ABIOTIC STRESS CONDITIONS: PRELIMINARY RESULTS

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The microbial inoculants are gaining interest in sustainable agriculture as a promising approach to minimize the decline in crop growth and productivity under continuous biotic and abiotic stresses. However, although the results of applying microbial-based products in controlled conditions are encouraging, their efficiencies under field condition remain variable. A better understanding of the mechanisms driving the interactions between plant, soil and associated microbes in mediating stress response is a crucial point for the translation to croplands and in higher productivity systems. Several secondary metabolites, such as oxylipins, produced by plants in response to stress conditions, play a significant role in enhancing stress tolerance. Although these metabolites have been extensively investigated in relation to biotic stress, their role in plant responses to abiotic stress conditions is less studied.

Here, we report preliminary finding from a trial in which tomato plants, grown in greenhouse conditions, were exposed to three different salinity concentration for 21 days. This preliminary work aims to determine i) the threshold levels of stress conditions and the timing that affects the growth of plants through analysis of qualitative and quantitative oxylipins and ii) the rhizosphere microbiome community changes at different timepoints following initial stress applications.

The data obtained revealed a significant difference in microbiome biodiversity between control and saline stressed conditions. The diversity of plant-associated microbiome in stress condition was significantly lower at 7 and 14 days following salinization and it recovered at the end of trial. Furthermore, the response to stress resulted in shift in community structures between experimental conditions, that was relevant at 7, 14 and 21 days after stress application. At the same timepoints, a significant difference in the type and quantity of oxylipins from stressed plant was observed.

Interestingly, the role of those metabolites in salinity stress is almost unexplored, and the comparison of oxylipins and soil microbiome will allow a thorough study of the interaction of these elements in determining tolerance to environmental stresses.

Keywords: Salinity stress,Microbial consortia,Biofertilizer,Rhizosphere,Oxylipins

ID ABS WEB: 135895

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

INFLUENCE OF POLYHALITE ON SPAD VALUES AT DIFFERENT GROWTH STAGES IN TURMERIC (CURCUMA LONGA)

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Polyhalite is a mineral used directly as a source of potassic fertiliser for different crops. Polyhalite is naturally occurring mineral and supplies calcium magnesium and sulphur in addition to potassium. An experiment was conducted at farmer's land, Arachalur, Erode district, Tamil Nadu. The soils of Arachalur village were classified under the textural class sandy loam. An initial soil sample had the pH, electrical conductivity and cation exchange capacity of 6.80, 0.06 ds m-1, 10 C mol (p+) kg-1, respectively. The organic carbon content of the soil was 3 g kg-1. Available nitrogen, available phosphorus (Olsen) and available potassium of the soil were 270, 10 and 100 kg ha-1, respectively. The field experiment was laid out in randomised block design consisting of ten treatments and replicated thrice. The treatments included were T1-Control, T2- N,P, K=0, T3-N, P, K= 100%(RD) (181 kg ha-1 MOP), T4-N, P, K= 50% (90 kg ha-1 MOP), T5-N, P, K= 50% (Polyhalite 380 kg ha-1), T6-N, P, K= 100% (Polyhalite) (750 kg ha-1 Polyhalite), T7-N, P, K= 100% (50 % as MOP + 50% as Polyhalite) (90 kg ha-1 MOP + 380 kg ha-1 Polyhalite), T8-N, P, K =150% (MOP) (250 kg ha-1 MOP), T9-N, P, K = 150% (100 % MOP + 50 % polyhalite as K2O) (180 Kg ha-1 MOP +380 kg ha-1 Polyhalite), T10-N, P, K = 150% (50% MOP +100 % K2O as Polyhalite)(90 kg MOP + 750 kg ha-1 Polyhalite). The treatment (T10) recorded the maximum SPAD meter readings of 22.5, 31.3 and 44.8 at 90, 120 and 210 DAT respectively. The maximum fresh yield (33 t ha-1) and cured yield (6.67 t ha-1) were also recorded in treatment T10. Thus the study was helpful to farmers for yield maximisation of turmeric through Polyhalite as potassic fertiliser.

Keywords: POLYHALITE,TURMERIC,SPAD VALUES,POTASSIUM NUTRIENT,CHLOROPHYLL CONTENT

ID ABS WEB: 135965

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

INTERACTION OF RESIDUAL NICKEL AND ZINC APPLICATION BENEFICIAL FOR PHYSIOLOGICAL AND NUTRITIONAL QUALITY OF COWPEA AND BIOCHEMICAL PROPERTIES OF SOIL UNDER VERTISOL

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Nickel (Ni) and zinc (Zn) have been considered as an essential nutrient for plant growth and development. The importance of Ni in plant nutrition was first noticed as Ni deficiency symp- toms of “mouse ear” found in the young leaves of pecan trees (Carya illinoensis K.). Soil application of Ni has low efficiency and expected to produce enough residual effect to cater the need of the next crop in the sequence. A pot experiment was conducted on the soil of previous season pot study, where in the Ni and Zn was applied with recommended dose of fertilizers (RDF). This study with cowpea as test crop was conducted on residual level of Ni in soil along with application of recommended dose of fertilizers (RDF) and Zn. The result showed significant increase in plant height, greenness index, number of branches, number of pods plant-1, number of seed pod-1, stover yield, seed yield and weight of 100 seed of cowpea. All these attributes were highest at 10 mg Ni kg-1 applied in the previous crop along with Zn at the rate 10 mg kg-1 in the current experiment (T10). The concentration of iron (Fe), manganese (Mn) and Zn in grain and stover significantly increased up to 10 mg kg-1 residual Ni (T10) and beyond this a reduction in concentration was observed. Behaviour of these elements with respect to uptake in both grain and stover was similar as that of their concentration. The urease activity and available N content in soil significantly increased with the increase in residual Ni content. The utilization of residual Ni in soil applied in previous crop could be an effective strategy for sustainable management of Ni application in Ni-deficient soil. This may lead to better N fixation and provided higher yield of cowpea.

Keywords: Cowpea,Growth attributes,Nickel,Yield attributes,Zinc

ID ABS WEB: 135978

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

OPTIMIZING NUTRIENT USE IN AN INTEGRATED SYSTEM WITH PRECISION AGRICULTURE TOOLS

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Integrated crop-livestock-forest systems (ICLFs) are a sustainable strategy for land use intensification, integrating annual crops, trees, and livestock in the same area and season. Climate, soil, crop, and animal interactions in ICLFs are complex and synergistic or competitive, depending on the arrangements over time and space. Therefore, digital tools like precision agriculture (PA) can be decisive for collecting, processing, and analyzing temporal and spatial data, combining them with other information to support management decisions and considering the estimated variability. Furthermore, it also contributes to improving the management and use efficiency of resources and inputs, with minimum environmental damage risks. Lime and fertilizer are critical factors for agriculture intensification in the Brazilian tropical acid-low-fertility soils. Knowing the spatial variability of soil properties by technologies such as GPS, sensors, GIS, advanced software, and variable rate technology (VRT) equipment is essential for the rational use of inputs, as in integrated nutrient management (INM). This research aimed to evaluate, monitor, and manage the spatiotemporal variability of soil properties, liming, and fertilizer requirements. A field study was conducted in a 30-ha area in São Carlos, SP, Brazil. An INM strategy has been adopted based on soil tests to determine soil nutrient availability, deficiency, and soil fertility management with VRT. From 2014 until now, yearly soil samples were collected at 0-0.2 m depth, and each sample represented a 0.5-ha paddock. Spatial variability soil properties and site-specific liming and fertilizer needs were modeled by inverse distance weighting technique. Liming and fertilization were carried out yearly based on interpretations and prescription maps. Results showed that generating thematic maps was essential to define the rational use of inputs by the spatial analysis of liming and fertilization requirements. Variable rate lime and phosphate fertilizer application technology leads to soil buildup and greater homogeneity of soil chemical attributes. INM practice can be guided by soil nutrient prescription maps and provide a history of land, issue use, and soil conditions.

Keywords: Soil fertility,Variable rate technology,Lime,Fertilizer,Integrated nutrient management

ID ABS WEB: 136054

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

PHYSICAL STORAGE OF NITROGEN IN THE PORE VOLUME. A DYNAMIC FACTOR OF NUTRIENT AVAILABILITY THAT DEPENDS ON SOIL STRUCTURE

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Soil water fluxes influences inorganic nitrogen (N) because their transport, transformation, storage and potential losses from an agroecosystem are determined by the hydraulic gradients that occur in the soil, as being a result of drying and wetting cycles (D-W cycles). The objective of this research is to evaluate the temporal availability of N physically stored in the range of matric potentials corresponding to pore diameters between 0.2 and 50 µm, in five volcanic ash soils under permanent grassland during continuous D-W cycles. Undisturbed soil samples were collected at two depths: 0-10 and 10-20 cm (n = 5), using stainless steel cylinders (610 cm3, with Ø=8.8 cm and h=10 cm). Soil samples were pre-incubated for 24 hours added 5 ml solution with K15NO3 (98 atom %15N). The labeled solution was added evenly over the soil surface. All soil samples (cores) were subjected to five D-W cycles. Dry conditions were determined when the core is equilibrated to 100 kPa. Wetting conditions were performed by applying distilled water to the top of the soil cores and leaving the soil to equilibrate until the soil water content reaches - 6 kPa of matric potential. The water that was drained for ~10 days until reaching an equilibrium equivalent to ~ 100 kPa (50% of PAWC according to water retention curve) was collected in a plastic bottle from the pressure chamber and stored cold until analysis of isotopic ratios. The physical soils' capacity to store available nutrients in time and space (mineral N movement in depth is approximately 1 cm per day in volcanic soils) forms part of a new line of study that includes the dynamic nature of soil, which depends on the hydraulic properties of the soil, the functionality of the pore system, and the spatial arrangement of its particles and aggregates. Therefore, the “physical soil condition” plays a fundamental role plays a fundamental role in the sustainable management of soil fertility.

Keywords: Nitrogen availability,Soil structure,Volcanic soils,permanent grassland,Soil fertility

ID ABS WEB: 136105

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

BASICS OF BALANCED USE OF ALBIC PANTOSTAGNIC LUVISOL

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In modern conditions of agro-industrial production, fertility management involves constant correction of reclamation and technological measures in accordance with climate change and the course of soil processes.
Among the gas flows entering the atmosphere, CO2 emission from the soil surface is one of the most powerful. Even slight disturbances of soil respiration on a global scale can lead to serious changes in the concentration of this gas in the atmosphere. Spontaneous processes of transformational development of soils and the formation of their fertility should be contrasted with a scientifically based system of management of these processes. Management decisions should be aimed at preventing soil degradation, gradually cultivating and reproducing their fertility.
Research conducted under the conditions of a long-term stationary experiment on acidic Albic Pantostagnic Luvisol showed that periodic application before each of the following four-field rotations of 2.5 t ha-1 of lime, calculated according to the pH-buffering model, when using an organo-mineral fertilization system with application of 10 t ha-1 of crop rotation area of manure + N65P68K68 optimizes the carbon regime of the soil to the greatest extent. Losses of Carbon dioxide from the soil during the growing season of crops are reduced by 1.5-2.0 times compared to the identical fertilization system with the background of lime application 6.0 t ha-1 by the hydrolytic acidity and control without fertilizers. At the same time, the introduction of lime calculated according to the pH-buffering model ensures the rational use of fertilizers and meliorant. In the soil, the acidity, the content of mobile aluminum compounds decreases, and the content of nutrients increases.
Thus, the introduction of lime according to the pH-buffering model on acidic Albic Pantostagnic Luvisol soils slows down the processes of increasing the concentration of CO2 in the atmosphere, minimizes the manifestations of global warming, thereby laying the foundations for the protection of acidic soils from decreasing fertility and general degradation.

Keywords: Albic Pantostagnic Luvisol,acidity,fertilizers,liming,emission CO2

ID ABS WEB: 136526

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

MANAGING NITROGEN FOR GLOBAL SUSTAINABILITY

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Body
Nitrogen plays a pivotal role in both positively impacting global sustainability, particularly in agriculture, and negatively contributing to environmental issues. Striking a balance between maximizing its benefits and minimizing its adverse effects poses a significant global challenge, especially in the context of ongoing global changes. In this study, we undertake a comprehensive analysis of nitrogen management, focusing on achieving global sustainability. This approach aligns with the United Nations' goal of halving nitrogen waste to attain the Sustainable Development Goals (SDGs). Our findings reveal that various socioeconomic factors, including farm size, the decoupling of crop and livestock, rural aging, urbanization, and livestock species, exert substantial influence on global nitrogen utilization and loss. Moreover, global climate change threatens the sustainable utilization of nitrogen for food production and introduces significant spatial disparities in global nitrogen cycle. Consequently, proactive adaptation measures will be essential in addressing these challenges in the future.

To enhance nitrogen use efficiency while reducing nitrogen pollution, we propose the establishment of a nitrogen credit system, serving as a central platform that integrates best management practices, socioeconomic adjustments, and climate change considerations. This integrated approach has the potential to enhance overall progress toward global SDGs by up to 20%. The associated total social benefits could amount to an impressive US$1,300 billion, considering improvements in human and ecosystem health and contributions to climate change mitigation. Importantly, implementing such a cost-effective nitrogen waste reduction strategy would require an investment of only US$300 billion. Our findings offer crucial insights for policymakers, underscoring the urgency of implementing cost-effective strategies to reduce nitrogen waste and promote global sustainable development.

Keywords: Nitrogen cycle,Nitrogen credit system,Sustainable Development Goals,Cost-effective strategy,Agriculture

ID ABS WEB: 136615

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

THE ROLE OF WEATHER AND NITROGEN BEST MANAGEMENT PRACTICES FOR AGRONOMICALLY- AND ENVIRONMENTALLY-SOUND CORN PRODUCTION IN THE US-MIDWEST

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Meeting the increasing demands for agricultural products needing large N inputs while mitigating environmental impact in the context of climate change converge in a difficult conundrum to solve. While N best management practices (N-BMPs) for corn have been researched intensively for agronomic outcomes, the same emphasis on environmental outcomes is lacking. Further, studies of N-BMPs that integrate various N loss pathways with agronomic outcomes are chronically insufficient to determine whether N-BMPs to improve corn production are concomitantly sufficient to mitigate N loss. A number of studies located on a poorly-drained fine-textured soil with subsurface drainage, and in a well-drained coarse-textured soil in Minnesota, USA were started in 2014 to measure corn grain yield, total crop N uptake, residual soil N after harvest and season-long NO3 leaching and NH3 and N2O emissions. Enhanced practices combining N source, rate, time, and application method were evaluated against traditional practices. The coarse-textured site also had no cover-crop, winter rye cover-crop, and kura clover living-mulch. Generally, crop N uptake and grain yield showed a quadratic-plateau response to N rate. Though environmental N losses often increased with increasing N rate, the losses were small and grain loss large in the quadratic portion of the curve. Conversely, N rates above the economic-optimum resulted in less profitability and substantial N loss. Using polymer-coated urea (an enhanced efficiency source), often reduced N loss and maintained productivity and profitability. Splitting the N application in-season had agronomic and environmental advantages in the coarse-textured soil, but had only agronomic advantage in the fine-textured soil. Because of poor growth, the rye cover crop had no effect on agronomic or environmental outcomes, but kura clover substantially reduced NO3 leaching, slightly increased NH3 losses, but reduced grain yield substantially, diminishing potential adoption by farmers. While the dual goal of improved corn production and environmental protection are attainable, precipitation after fertilization largely influenced N loss and diminished the otherwise attainable benefits of refining N management practices.

Keywords: Corn,Nitrogen,Nitrous oxide emission,Nitrate leaching,Ammonia volatilization

ID ABS WEB: 136818

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

BIOLOGICAL AND ABIOTIC MECHANISMS OF LOW MOLECULAR WEIGHT ORGANIC ACID SALTS IN MOBILIZATION OF PHOSPHORUS IN AN ACIDIC RED SOIL AND A CALCAREOUS ALLUVIAL SOIL

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To address phosphorus (P) scarcity and reduce dependence on phosphate rock resources, particularly in soils with high P fixation capacity, it is crucial to mobilize plant-unavailable soil P and residual P for crop demand. Low molecular weight organic acids and their salts (LMWOAs) are recognized as effective methods for soil and residual P mobilization. However, previous research mainly focused on P extraction using LMWOAs solutions and traditional adsorption and desorption, with limited in situ studies on LMWOAs application to soil. Furthermore, the co-application of LMWOAs with inorganic and organic P and their sustainable ability to enhance soil P availability have been insufficiently explored. We selected acidic red soil, which has high P fixation capacity and low available P and compared with a calcareous alluvial soil (rice-growing soil) in China and examined the P availability using XANES and 31P-NMR for characterizing organic and inorganic P functional groups as well as the latest international DGT-DET-3D DIFS model coupling technology. These technologies assisted us in quantifying the degradation, diffusion, adsorption and desorption processes of the non-labile, labile and available P as well as that of LMWOAs. In addition, we analysed microbial community structure, key enzyme activities involved in P, carbon and nitrogen cycling to investigate the abiotic and biological mechanisms of LMWOAs and their synergistic effects in mobilization of soil P to increase available P. It was found that small organic acids significantly enhance available phosphorus in acidic red soil, with 50M citric acid increasing DGT-P by 17 times and soil pore water phosphorus by over 600 times, while its impact on a calcareous alluvial soil was comparatively minimal. This difference was attributed to significant non-biological and biological effects of the added LMWOAs on the former, but not significant effects on the latter. Application of these findings will save the increasingly scarce phosphate rock resources, as well as increase agricultural production from the applied phosphorus fertilizer, especially in the acidic red soil.

Keywords: Soil available phosphorus,Organic acids,31P-NMR,XANES,DGT

ID ABS WEB: 137115

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

TO THE MOON AND MARS! RECYCLING ORGANICS FROM AEROPONIC PLANT WASTES AND SOURCING MICROORGANISMS FOR OFF-WORLD FARMING

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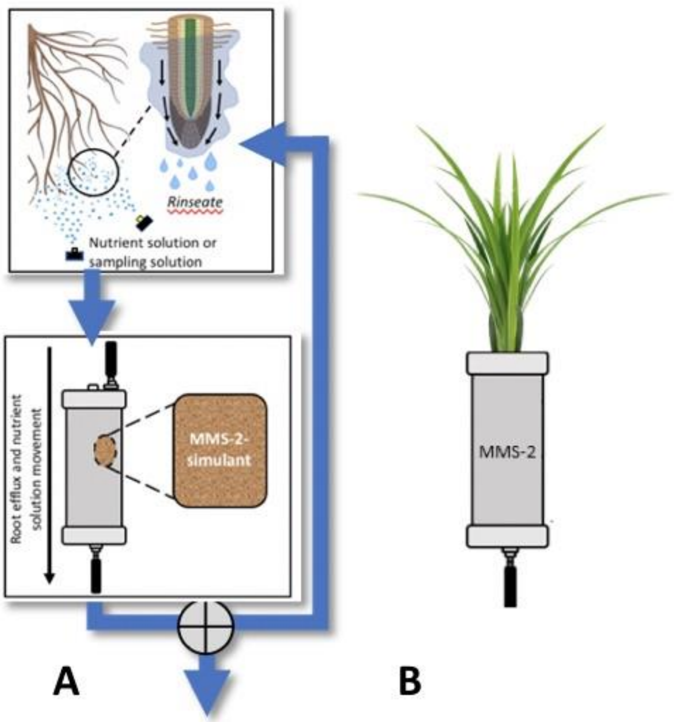
Body

On the moon and Mars, low bioavailability of several plant essential nutrients and abundant toxic oxidants and salts in unaltered surface minerals will impede crop productivity. Generating a steady food supply is essential for the success of human settlement and will require sustainable and recycled nutrient sources. A soilless cultivation practice – aeroponics – has received attention for versatility and success in low gravity and space flight environments. In aeroponics, organic compounds exuded by root systems are recirculated that could be utilized to fortify organic matter in extraterrestrial soils. An aeroponic system that enriches lunar and Martian soils is proposed. Through continual inundation of organically rich rhizodeposition products and the full suite of plant essential nutrients, it is hypothesized that fertility can be conferred to Martian regolith to support the growth of subsequent soil-based crops. Additionally, the selection and introduction of beneficial plant microorganisms will be essential for plant productivity, especially those capable of reducing harmful perchlorate salts. An experimental study of several microorganisms with perchlorate reducing activity assesses their ability to improve lunar and Martian soils. A recommended approach to terraforming lunar and Martian soils for sustainable nutrient management is provided.



Keywords: Astrobiology,Organic recycling,Root exudates,Martian/lunar soil fertility,Martian plant nutrition

ID ABS WEB: 137145

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

SUPPRESSION OF NITRIFICATION AND N2O EMISSION BY PHENOLIC ACID BNIS IS LINKED TO AMMONIA OXIDIZING BACTERIA, NITRITE-OXIDIZING NITROSPIRA AND NOSZ-N2O REDUCER POPULATIONS IN AN ACIDIC SOIL

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Plant derived biological nitrification inhibitors (BNIs) are a new strategy to reduce soil nitrogen loss and improve nitrogen utilization efficiency. Several BNIs have been found in root exudates and extracts of different plants. However, the impact of different BNIs on soil nitrification and N2O emissions is still unclear. The purpose of this study is to evaluate the effects and biological mechanisms of phenolic acid BNIs and fatty acid BNIs on nitrification and N2O emission in an acidic soil. Three typical phenolic acid BNIs have a 40% inhibitory effect on nitrification in acidic soil, while fatty acid BNIs have no significant effect. Phenolic acid BNIs significantly inhibited the amoA gene abundance of ammonia-oxidizing bacteria (AOB) and nxrB gene abundance of nitrite-oxidizing bacteria (NOB) and altered the community structure. The results of community composition showed that phenolic acid BNIs reduced the abundance of Nitrosospira cluster 3a.1 and Nitrosospira bockiana. Similarly, phenolic acid BNIs also have a significant inhibitory effect on N2O emissions through impeding both AOA and AOB, and promoting nosZ genes. Overall, our results support the potential for the use of phenolic acid BNIs in mitigating N2O emissions and enhancing N utilization in acidic soils.

Keywords: Root exudates,BNIs,nitrification,N2O emissions,acidic soils

ID ABS WEB: 137147

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

BIOSTIMULANTS DECREASED NITROGEN LEACHING AND NH3 VOLATILIZATION BUT INCREASED N2O EMISSION FROM PLASTIC-SHED GREENHOUSE VEGETABLE SOIL

J MIN

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Biostimulant application is an effective strategy to enhance soil fertility and plant growth. However, its comprehensive impacts on nitrogen (N) uptake and reactive N (Nr) losses via leaching, ammonia (NH_3) volatilization, and nitrous oxide (N_2O) emission from plastic-shed greenhouse vegetable system are still little known. Therefore, a field experiment was conducted with cauliflower tomato growth rotation receiving three biostimulants, i.e., humic acid (HA), algae extract (AE), and chitosan (CT), as well as a control without stimulant. The cumulative Nr losses over the cauliflower-tomato growth cycle via leaching, NH_3 volatilization, and N_2O emission were 104–175 kg N ha–1, 2.32–3.85 kg N ha–1, and 0.70–0.85 kg N ha–1, respectively. Biostimulant application significantly ($P < 0.05$) retarded the total N leaching by 17–44% in tomato season, while suppressed the NH_3 volatilization by 18–38% in cauliflower season. Overall, AE showed the best inhibition efficiency on Nr losses by significantly ($P < 0.05$) decreasing total N leaching and NH_3 volatilization by 36–44% and 38–52% in both vegetable seasons, compare to the control. However, all three biostimulants stimulated the N_2O emission under both vegetable cycles. Interestingly, all biostimulant-added treatments promote the cauliflower and tomato yield, particularly following the HA and AE amendments, which bring local farmers approximately 4,384–10,035 yuan RMB ha–1 more income. Enhanced yield under biostimulant treatments was due to higher N uptake capacity and enhanced root morphology. In summary, biostimulants have a contrasting influence on three major Nr lost pathways in greenhouse vegetable production. We recommend that AE is the most optimal biostimulant as it increases vegetable yield and decreases total N leaching and NH_3 volatilization while not dramatically increase the N_2O emission.

Keywords: Nitrogen loss,Vegetable soil,Biostimulant fertilizer,Integrated nutrient management,Root morphology

ID ABS WEB: 137641

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

SOIL METAGENOME INSIGHTS INTO THE PHOSPHORUS CYCLE OF A MAIZE AGROECOSYSTEM FERTILIZED WITH STRUVITE AND SLUDGE

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The recycling of residues, such as sludges and struvites, as phosphorus-rich fertilizers, emerges as a promising strategy to address the scarcity of conventional fertilizers while sustaining soil health and its microbiome. The application of bioinformatics techniques has proven indispensable for analyzing microbial communities in environments like soil. In a field experiment conducted in a maize crop in Murcia, Spain, we assessed various fertilization types (conventional, struvite, sludge, and organo-mineral) and their impact on key genes related to the phosphorus cycle in soil microbial communities across different phenological stages.

Results revealed substantial changes in the abundance of phosphorus cycle-related genes based on fertilizer type and phenological stage. The bacterial community was dominated by Actinobacteria, Proteobacteria, Acidobacteria, and Chloroflexi, with a notable increase in Conexibacter and Nocardioides during flowering in sludge and struvite treatments. The archaeal community was dominated by Thaumarchaeota, Euryarchaeota, and Crenarchaeota, with an increase in Aeropyrum and Halorubrum during flowering. At the functional level, genes such as phnG, phnJ, and phnL exhibited significant variation among treatments and stages, emphasizing the importance of nutrient-microbiota interactions.

In summary, bioinformatics and metagenomics serve as powerful tools for unraveling microbial functionality in enhancing phosphorus availability in the soil. The choice of fertilizer and phenological stage impacts microbial activity and nutrient availability, underscoring the necessity of considering these interactions to optimize soil fertilization for agricultural sustainability.

Keywords: soil,phosphorus,agricultural,bacterial community,metagenomics

ID ABS WEB: 137661

8. Other

8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

CHANGES IN PADDY SOIL FERTILITY IN TROPICAL ASIA UNDER THE GREEN REVOLUTION DURING THE LAST HALF CENTURY – IMPLICATIONS FOR THE FUTURE

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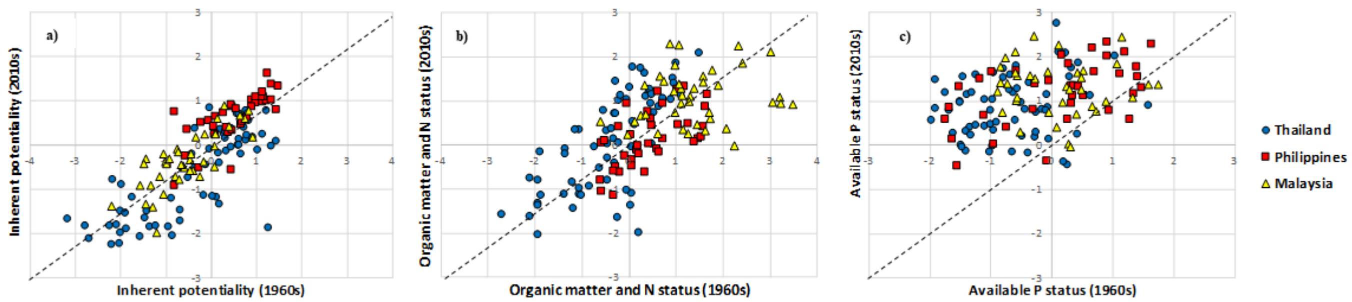
Over 50 years of the Green Revolution since the 1960s, the global population has increased by 2.5 times, cereal production by 3.3 times, and the use of N, P and K fertilizers by 9.4, 4.2, and 4.3 times, respectively. Information is still limited on the influence of these impacts on the fertility status of paddy soils. We therefore investigated the influence of the Green Revolution on 142 paddy soils in three tropical Asian countries, i.e., Thailand, the Philippines and Malaysia, by repeated soil sampling in the 1960s and 2010s at or near the same locations. We revealed that the availability indices of three macronutrients, i.e., available P, total N, and exchangeable K, showed 843% ($p<0.01$), 112%, and 101% increase on average, respectively, whereas total C showed 9% decline. Comprehensive investigation of overall fertility status by factor analysis using 11 soil parameters suggested that only the factor scores associated with "available P status" increased drastically in all the three countries ($p<0.01$) (Fig. c) whereas those associated with "organic matter and N contents" and "inherent potentiality" did not exhibit any consistent changes (Fig. a, b). In conclusion, intensive soil/fertilizer management systems under the Green Revolution have successfully improved the nutrient status, especially P status, of paddy soils with slight decrease of total C, while a large amount of N and K applied has been released to the outer environments, suggesting considerable environmental impacts due to agricultural management. In conclusion, conversion to a system with highly efficient use of external nutrient inputs combined with organic matter-conserving strategies is required to secure sustainable food production while restoring the environment during the decades to come.



Keywords: Green Revolution,organic matter,paddy,phosphorus,soil fertility

ID ABS WEB: 137678

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

AMMONIUM AND NITRATE BLUEBERRIES CV. BLUE RIBBON ABSORPTION AT THE FIRST SIXTY DAYS RESPONSE OF ESTABLISHMENT ON A SOIL: PRELIMINARY RESULTS

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Blueberry is recognized as a “natural health package” since its fresh fruits have multifunctional nutritional value with a high content of anthocyanins as antioxidants. One of the important nutrients in the plant growth is nitrogen (N), as a component of amino acids, proteins, nucleic acids, chlorophyll, and several metabolites, finally on fruit growth and reserves for next season.
Inorganic N (nitrate or ammonium) are absorbed from roots and translocated to the different parts of the plants. It seems that blueberry shows better results in the presence of NH4+, but other studies also reported a better growth in the vegetative stage when an ammonium and nitrate ratio is applied 1:1.
Split N applications can extend the time of N bioavailability for plant uptake and have been reported to promote plant yield or growth compared to a single application.
Chile has 15,601 hectares (2021-2022) planted with Highbush blueberries, with an export volume of 87,585 tons (2022-2023), an 18% less from the previous season. This reduction is an effect of several climatic and productive factors, so new varieties accomplishing export fresh requirements must be used.
In regard with forms and timing of nitrogen application, some studies show information in the blueberries production stage with limited information on the N demand for plants growth and new cultivars in early stages.
The aim of this study is to determine the effect of timing and form of nitrogen fertilizer (NH4+ or NO3-) application on physiological and growth variables and N recovery in Blueberries cv Blue Ribbon and soil after the first 60 days of establishment, using 15N isotopic techniques.
Preliminary results showed that nitrogen fertilization influences the growth of Blueberries. Applying ammonium was obtained the highest and significant growth expressed in shoots length and weight, number of leaves and weight, and roots weight. Split application resulted in a better response for some growing parameters. To determine blueberries recoveries soil and plant fractions are under 15N analysis.

Keywords: NH4,NO3,15N atom excess,Nitrogen efficiency,Blueberries

ID ABS WEB: 137736

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

PHOSPHORUS FORMS IN VERMICOMPOST AND EVALUATION OF ITS USE AS REPLACEMENT OF MINERAL PHOSPHORUS FERTILIZING UNDER DIFFERENT SOIL MANAGEMENT PRACTICES.

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The recycling of nutrients by composting organic materials from agricultural waste comes necessary in a circular economy context. Vermicomposting is a product enriched in humus and available phosphorus (P). However, P forms present in vermicompost, and the impact on biogeochemistry of P in soils is still unknown. This work aimed at studying the forms of P present in vermicompost through 31P NMR spectroscopy as well as the contribution of vermicompost on plant nutrition growth under soils with different management and depth. For this purpose, a pot experiment with wheat and vermicompost as P source (10 and 20 mg kg-1) was conducted with soil from different soil managements systems (conventional tillage (CT) and non-tillage (NT) and depths (0-5 and 20-40 cm). Results showed that 35-55% of the P applied to soil as vermicompost remains in organic forms. Vermicompost showed a higher use efficiency of P compared to mineral fertilization as similar biomass production was obtained between vermicompost and mineral fertilization with a 61 % reduction of P uptake. However, the efficiency of vermicompost, expressed as replacement value (RV), is deeply affected by soil management in superficial soils ranging values from -132% to 124 %, while a constant value of RV around 80% was found in sub superficial soil. Differences can be explained by the fact that the main differences produced by different soil management systems are observed in topsoil. Vermicompost application modified microbiological communities, increasing biodiversity expressed as Shannon Index, a 6% compared to mineral fertilization, as well as the functionality of soil boosting in P-cycle enzyme activities further enhancing the conservation tillage effect. Fe and Zn absorption was also affected by vermicompost and no-till management, leading to biofortification of wheat yield. It can be concluded that vermicompost was a suitable substitute for mineral fertilization presenting a higher efficiency of P management and further benefits can be expected when it is used over soils where conservation agriculture techniques are used.

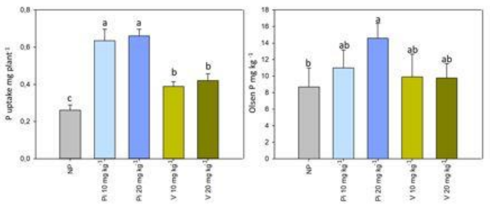

Figure 1: Effect of P source (NP, no phosphorus was applied, Pi, mineral P and V, vermicompost) on P uptake by plants, significant according to ANOVA at p-value < 0,0001 (a) and the available P extracted as Olsen P after plant harvest, significant according to ANOVA at p-value < 0,0001 (b). Means with different letter were significantly different according to the Tukey's test at p-value < 0,05.

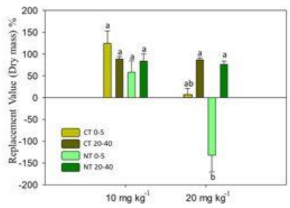

Figure 2: Replacement value of vermicompost based on the response on biomass production. CT, Conventional Tillage; NT, No Tillage; 0-5 and 20-40, indicate soil depth horizon (cm). Different letters indicate significant differences. Statistical differences were calculated for each fertilizer dose independently. From left to right: p-value were 0,1785 and 0,0108.

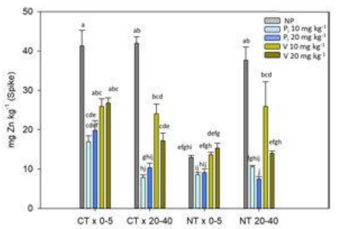

Figure 3: Zn concentration in wheat spikes (mg kg-1) expressed as the triple interaction of soil tillage (CT, Conventional Tillage, NT, no Tillage), Depth (0-5 or 20-40 cm depth horizon) and fertilizer (NP, no P fertilization, Pi, inorganic P fertilizer and V, Vermicompost) p-value = 0,036)

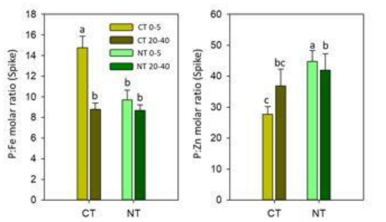

Figure 4: Interaction of soil depth and soil tillage system over P/Fe and P/Zn expressed as the molar ratio between the elements is wheat spikes (CT, Conventional Tillage, NT, no Tillage), Depth (0-5 or 20-40 cm depth horizon). p-value was 0,0028 and 0,0001 for P/Fe and P/Zn respectively.

Keywords: Phosphorous forms,Vermicompost,Plant nutrition,Wheat

ID ABS WEB: 137770

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

EVALUATION OF GHG AND AMMONIA EMISSIONS AND FERTILITY IN AGRICULTURAL SOILS TREATED WITH DIFFERENT LIVESTOCK WASTES: CASE STUDIES IN FARMS IN THE PROVINCE OF BRESCIA

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Organic fertilization by livestock wastes can be a suitable option to reduce the use of chemical fertilizers. However, the application of livestock wastes requires attention to the potential environmental impacts due to the emissions of greenhouse gasses (GHGs) and ammonia and nitrate leaching.
We have selected a set of experimental fields in farms of the province of Brescia (Lombardy, Italy) characterized by different soil type, tillage, fertilization and irrigation methods. The experiment is designed to compare the effect of the application of livestock wastes (slurry, digestate and manure) in comparison with urea-based fertilization during maize growth season (2022 and 2023) on the GHGs ($CO2$, $CH4$, and $N2O$) and ammonia ($NH3$) emissions from agricultural soils.
GHGs and ammonia fluxes were measured weekly by static chambers connected to FTIR analyser. Results showed that the highest values of $CO2$, $CH4$, and $NH3$ emissions were measured during the spreading of slurry and digestate compared to untreated soil (control). $CO2$, $CH4$, and $NH3$ emissions from soils treated with manure were comparable to those of the control. The incorporation of slurry and digestate drastically reduced $CH4$ and $NH3$ emissions. No significative differences were observed in $CO2$ emissions from different plots during the maize growth season. The peak of $N2O$ emission was observed only after the use of urea-based fertilizer in all plots.
Data collected on the nutrient fluxes in the experimental field combined with soil characterization in terms of physio-chemical and biological properties will allow the understanding of the processes involved in GHGs and ammonia formations in soils and will help determine the factors influencing these emissions and soil quality. Data wil also be used for calibrating and validating soil carbon and nitrogen biogeochemical models useful for improving farm sustainability. The use of validated modelling tools can support the develop of efficent strategies to reduce the environmental impacts of agricultural practices and evaluate the efficiency of sustainable farming practices reducing nutrient losses.

Keywords: nutrient fluxes,GHG,ammonia,livestock wastes,soil

ID ABS WEB: 137997

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

NITROGEN REMOVAL ESTIMATION AND NON-POINT SOURCE NITROGEN LOADING MANAGEMENT IN MULTI-WATER AGRICULTURAL WATERSHEDS

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Water bodies such as ditches, ponds, streams, and lakes are important for eutrophication control through sediment denitrification nitrogen removal, especially in multi-water agricultural watersheds. However, quantifying N removal in water bodies is challenging due to the high background atmosphere N2 concentration and the heavy burden of field surveys, leading to a decoupling of upland N management and water quality improvement. Here, we first conducted a one-year field study to investigate the N removal rate in small area water bodies (ditches, ponds, and streams) within a typical intensive agricultural area. We found that various N removal (from 0.22/d in streams and 0.48/d in vegetated ditches) could be well modeled by the concentrations of water dissolved organic carbon (DOC) and dissolved oxygen (DO). In addition, we developed and validated an innovative nonlinear model for big area water bodies (e.g., lake) N removal estimation by linking the N removal rates with remote sensing-derived variables (chlorophyll-a, chromophoric dissolved organic matter, and lake surface water temperature). Based on all these models, we estimated that an annual average of 32,100 t N/yr was removed in Lake Taihu from 2011 to 2020, accounting for 53% to 66% of the total lake N loading. The remaining N loading after denitrification removal in Lake Taihu would be approximately 2.37 mg N/L, and 7,900 t N/yr of lake N loading originating from the landscape still needs to be removed to meet the target of class IV water quality (1.5 mg N/L). We recommend implementing artificial management measures, such as vegetation, to enhance the N removal capacity of water bodies. However, the caution must be exercised in measures like concrete linings in ditches, as they can hinder N removal. Overall, our study highlights the importance of multidisciplinary intersections in managing soil nutrient losses to mitigate eutrophication and achieve water quality goals.

Keywords: N removal,Model,Multi-water agricultural areas,Remote sensing,Water quality improvement

ID ABS WEB: 138046

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

MILK VETCH (ASTRAGALUS SINICUS L.) AFFECTED MICROBIAL-DRIVEN RICE STRAW DECOMPOSITION IN MULTIPLE STAGES

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Although variations of microbial communities and residue components were detected during the decomposition of monospecific and mixed plant residue, little is known about the response of specific taxa to different residue types and their interactions with other microorganisms. In this study, we compared the decomposition dynamics, recruited microbial community, and lignocellulolytic genes during decomposition of leguminous milk vetch (MV), non-leguminous rice straw (S), and their mixed residue (SMV) to reveal the mechanisms of microbial-driven residue decomposition. The residue remaining weight and their main lignocellulose component contents exhibited different periodic dynamics during decomposition, while SMV maintained a relatively high decomposition rate particularly in early stages. Actinobacteria, Alphaproteobacteria, Gammaproteobacteria, and Sordariomycetes were enriched in S treatment. Eurotiomycetes and Bacilli were enriched in MV treatment, while Mucoromycetes was enriched in SMV treatment. Co-decomposition of residues increased the alpha diversity of microbial community and enriched the Mucorales by increasing its niche breadth. Redundancy analysis (RDA) revealed that Mucorales was a key functional taxon with high lignocellulolytic potential. In conclusion, our study shows that co-decomposition can widen the niche breadth of certain species facing competitive condition during decomposition, recruit more functional groups, maintain the decomposition efficiency, and finally promote residue decomposition.

Keywords: Residue co-decomposition,Lignocellulose,Microbial community,Niche breadth

ID ABS WEB: 138096

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

BIOPOLYMERIC COMPOUND (BPC) FROM OLIVE-OIL CHAIN BY-PRODUCTS USED AS ENHANCED CONTROLLED RELEASED BIOFERTILIZER

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Modern agriculture can exert a detrimental impact on natural ecosystems. Cropping systems are very demanding in terms of chemical fertilizers, plant growth promoters, water, and herbicides/pesticides. Anthropic activity can release pollutants into the environment, leading to unsustainable consumption of natural resources, affecting soil fertility and biodiversity and exacerbating climate change. More efficient forms of fertilization should be developed to reduce the use of chemical fertilizers.
In this study, lignin, bioactive compounds and nutrients were extracted from the by-products of the olive oil chain, i.e. pomace and olive mill wastewaters, and valorized by producing also biopolymeric compounds (BPCs) with enhanced controlled-release properties. The efficiency of BPC to release nutrients over time was studied in a 90-days soil incubation column leaching experiment, and the results were compared to those observed for a traditional NPK fertilizer and olive mill wastewaters. BPC was the most efficient in slowly releasing nutrients, in terms of soluble N, P and K, compared to the other treatments. Analysis of water-extractable organic C and CO₂ respiration revealed that although BPC increased the available content of C in the soil and leachates, it nevertheless resulted in the lowest emissions of CO₂ after 90 days compared to the other treatments. The microbial activity, estimated by analyzing the fluorescein diacetate hydrolysis, revealed that BPC stimulated the greatest hydrolytic activity. Such a result can be explained based on the slow degradation of BPC and its continuous release of nutrients. The study shows the possible use of BPC in agriculture, due to its efficient slow release of nutrients over time, compared to the other fertilizers investigated. Therefore, its use could reduce the need to fertilize the soil frequently and decrease CO₂ emissions, representing a high-added value biofertilizer.

Acknowledgments
This work was supported by the PRIMA, Italy, Project 4BIOLIVE: Production of biostimulants, biofertilizers, biopolymers and bioenergy from OLIVE-oil chain residues and by-products. The PRIMA program is supported by the European Union.

Keywords: olive-oil chain by-products,biopolymeric compounds,bioactive compounds,biofertilizer,sustainable practices

ID ABS WEB: 138147

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

SUSTAINABLE SOIL CROPPING MANAGEMENT STRATEGIES TO ENHANCE THE BIOACTIVE COMPOUND PRODUCTIONS OF TANACETUM BALSAMITA L.

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The use of biostimulants and/or biofertilizers has acquired considerable importance and can contribute to the sustainable management agriculture, reducing the use of chemical fertilizers, pesticides, and water. In this research, conducted in the framework of ReCROP project, financed by the European PRIMA program, the development of sustainable agroecosystem strategies for the Mediterranean area has been faced to increase the resilience of agrosystems to climate change, to reduce the chemical fertilizers, and to improve soil health. One of the Italian experimental trials aimed to evaluate the enhancement of the physical and chemical soil properties and the increase of the bioactive compound production through the combined use of bioinoculants and amendments (i.e. compost) in Tanacetum balsamita L., an aromatic plant well-known in Tuscany region (Italy). This species has remarkable medicinal properties, including hepatoprotective, spasmolytic, carminative, and antiviral effects. These qualities results from a high presence of bioactive products, such as polyphenols and essential oils . Results of the first growing season highlighted how the treatments involving bioinoculant and bioinoculant + compost contributed to increase the plant biomass (in terms of number of leaves per plant and mean plant weight) and photosynthetic apparatus (higher chlorophyll a and b content), while total phenols exhibited no significant variations between treatments. Relating to nutrient content, the major content of chlorophylls and then of higher plant biomass in these treatments could be explained because of the higher content of P and Mg in plants due to their high bioavailability of into soils.

Keywords: Cropping management,Tanacetum balsamita L.,Biostimulants,Bioactive compounds,soil health

ID ABS WEB: 138243

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

EFFECT OF DIFFERENT SOURCES OF SILICON ON PLANT AVAILABLE SI POOLS AND PHYTOLITH AND PHYTOC CONTENT IN AEROBIC RICE

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Body
Rice plants contain a large amount of silicon (Si) in the form of phytolith. Application of exogenous Si sources has been reported to be effective in enhancing Si uptake and increasing phytolith and PhytOC content (Anjum and Prakash, 2023). Various silicon (Si) sources have been reported to be effective in terms of their effectiveness on rice yield and plant-available Si. Nevertheless, comparative study of different sources of Si on phytolith and PhytOC content and soil properties is poorly known. A field experiment was carried out to investigate the effect of three different sources of exogenous Si, i.e., diatomaceous earth (DE), silicic acid (SA) and rice husk biochar (RHB) on 1) plant phytolith, C content in phytolith and PhytOC content in different rice organs; 2) relationship between plant phytolith, C content in phytolith, PhytOC content, and soil properties (soil physicochemical properties and readily soluble silicon pools. Different Si sources produced significantly higher phytolith, PhytOC content and readily soluble Si pools (CCSi, AASi and ASi) than the control (RDF), with treatment receiving 4 t RHB ha-1 outperforming the other treatments. Phytolith and PhytOC production were found to be significantly correlated to soil organic carbon (OC), available nitrogen (N) and potassium (K), 0.01 M CaCl2 extractable Si (CCSi) and amorphous Si (ASi) content in the soil. Redundancy analysis showed that treatments receiving 4 t RHB ha-1 have a stronger relationship with the CCSi and ASi which majorly contributed to the higher phytolith and PhytOC production. Through these positive effects, we conclude that practices such as Si fertilisers and especially RHB application have great potential for phytolith production and PhytOC sequestration.
Keywords: Silicon, rice, biochar, phytolith, PhytOC
Anjum M and Prakash NB (2023) Production of phytolith and PhytOC and distribution of extractable Si Pools in aerobic rice as influenced by different Si sources. Front. Plant Sci. 14:1146416.

Keywords: Biochar,Silicon,Phytolith,Rice,PhytOC

ID ABS WEB: 138322

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

BIOLOGICAL ACTIVITY AND CHEMICAL VARIATION OF PHOSPHORUS IN HUMID REGION SOILS UNDER LONG-TERM IRRIGATION WITH SECONDARY TREATED WASTEWATER

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Water scarcity is a critical global issue, particularly in regions experiencing high population growth and agricultural demands. To address this challenge, the reuse of treated wastewater (TWW) for various purposes, including, agriculture, forestry, and industry, has gained significant attention as a potential solution. While TWW irrigation offers benefits for agroforestry lands, addressing potential adverse impacts on soil properties is crucial. It is essential to emphasize that the use of TWW and its effect on soil properties can alter sorption and desorption processes of essential nutrients, particularly phosphorus (P). This situation is a concern due to potentially leading to eutrophication in freshwater, disrupting the ecological balance. Studies in arid and semiarid areas show that TWW irrigation can affect, physicochemical and biological properties. However, the findings may not be directly applicable to humid region soils due to the influence of different climatic factors, which can have varying effects on the biogeochemical cycle of P in agroforestry soils from areas with warm and rainy summers and no dry seasons. toward the development of land management strategies that reduce P losses from agroecosystems, this study aims to evaluate how long-term irrigation with secondary TWW in agroforestry soils from humid regions has affected the P speciation in soils, the sorption-desorption dynamic, and the activity of key enzymes associated with the P cycle compared to non-irrigated soils. To evaluate that, forest and agricultural soil samples were collected from The Living Filter sites in Centre County, Pennsylvania, United States, which have been irrigated with TWW over the last sixty years. In general, the results showed that soils subject to TWW irrigation altered their physicochemical properties such as, pH, organic carbon, electrical conductivity, and P concentration. Additionally, sorption-desorption experiments revealed that TWW-irrigated soils are less subjected to adsorb P, but they can desorb higher P concentrations than soils non-irrigated. Regarding the biological parameters, alkaline and acid phosphatases, pyrophosphatases, and phosphodiesterase activities increased in soils subjected to TWW irrigation.

Keywords: Treated wastewater irrigation,Sorption-desorption phosphorus,Enzyme activity,Phosphorus fractionation,phosphorus microbial biomass

ID ABS WEB: 138383

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

ROOTED IN NATURE: THE RISE, CHALLENGES, AND POTENTIAL OF ORGANIC FARMING AND FERTILIZERS IN AGROECOSYSTEMS

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Organic farming, deeply rooted in traditional agricultural practices, has witnessed a profound evolution over the last century. Transitioning from a grassroots initiative resisting the industrialization of agriculture to a global industry, organic farming now plays a pivotal role in addressing contemporary challenges related to environmental health, sustainability, and food safety. With a growing consumer demand for fresh organic products, this presentation provides a comprehensive overview of the organic farming landscape, underscoring its historical evolution, current trends, and the intrinsic benefits associated with organic practices. A key emphasis is placed on the role of organic fertilizers, detailing their types, benefits, challenges, and potential in bridging the yield gap while maintaining environmental stewardship. It also highlights the challenges faced by organic farmers, such as nutrient management, pest and disease control, and market access, offering potential strategies for mitigation. Concluding with a perspective, recommendations, and directions for future research, this presentation underscores the urgency for innovations, technological advancements, and a deeper understanding of organic practices to ensure the sustained growth and viability of organic farming in the global agricultural paradigm.

Keywords: Organic farming,Organic fertilizers,Regenerative agriculture,Soil health,Nutrient management

ID ABS WEB: 137831

8. Other
8.04 133600 - Genesis of patterned ground in permafrost affected and non affected soils.

SOIL PROPERTIES AND FREEZE-THAW CYCLES DRIVE THE PRESERVATION OF PATTERNED GROUND IN PERMAFROST NON-AFFECTED SOILS – CENTRAL APENNINES, ITALY

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Several mechanisms may be involved in the genesis of sorted patterned ground, though the sorting by different frost heave due to freeze-thaw cycles is favored by theoretical considerations. The soil freezing and thawing are generally associated with shallow permafrost presence affecting surface cryoturbation phenomena. Several studies hypothesized the occurrence of permafrost in the Majella Massif (central Apennines, Italy) because of the presence of periglacial landforms (patterned ground, kettle holes, rock glaciers), although no direct observations have been reported. Therefore, this work aimed to investigate the genesis and preservation of patterned ground in the upper part of the Majella Massif through the detection of soil and air temperatures and soil morphological, mineralogical, and physicochemical characteristics.
Mean annual ground surface temperature and winter equilibrium temperature suggested that permafrost, if present, would be at a depth >2m. A relict form, deriving from shallower permafrost present in ancient climatic phases, may have been preserved by an air circulation mechanism at such a depth that cannot affect ongoing superficial cryoturbation processes. Although the formation of patterned ground has been ascribed to permafrost-driven processes that occurred in ancient climatic phases, the preservation is related to shallower phenomena associated with freeze-thaw cycles of the upper soil layers and the water-holding capacity of the soil.

Keywords: Sporadic permafrost,Miniature patterned ground,Cryoturbation,Water-holding capacity

ID ABS WEB: 135894

8. Other
8.05 133606 - Life, agriculture, and productive systems in soils from Arctic, Antarctic and other cold regions

RELEVANCE OF THE SOIL FUNCTIONS OF A VEGA IN CHILEAN PATAGONIA AT DIFFERENT SCALES; FROM SOIL POROSITY (SMALL SCALE) TO WATERSHED LEVEL (LARGE SCALE).

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Patagonia is the world's only continental territory south of 38° S. Comprises the southern section of the Andes in the west and displays steppes to the east. In the steppe there are unique ecosystems called Vegas. These areas are special because have distinctive characteristics i.e., are within the most extreme rainfall gradient in the world and their formation is closely linked to the last glacial and post-glacial era. Therefore, there isn't a comparable situation in the Northern Hemisphere. Vegas are wetlands that provide a large number of ecosystem services, being the main source for food for livestock. Despite that Vegas are important ecosystem, not much information about their soil function exists. The aim is to highlight the relevance of the soil functions of a Vega in Chilean Patagonia at different scales; from soil porosity (small scale) to watershed level (large scale). The present study was established in the Southernmost of Chile. Undisturbed soil samples were taken at depth H1=5 cm, H2=30 cm, H3=80, to classify soil type and to evaluate the morphological and physical properties of seven pits across the Vega. In five of those pits soil water content and soil matric potential sensors were installed. A piezometric station was installed in the center of the Vega and the data of the nearest weather station were used. There is a large spatial variability of soil type and their physical properties (i.e., conduction of water and air, shrinkage capacity). Each sector of the Vega has a specific function, while the summit and footslope are areas that can provide water by runoff, the soils in the center of the Vega have the capacity to store large quantities of water, which permit to large hydric deficits in spring and summer. In addition, the soil moisture depends largely on ETo and groundwater in the center of the Vega. Also, Vegas is part of watersheds, which are recharged with water in mountain sectors.

Keywords: Sub-Antartic ecosystem,Wetlands,Soil functions,Rangelands,Magallanes

ID ABS WEB: 138221

8. Other
8.05 133606 - Life, agriculture, and productive systems in soils from Arctic, Antarctic and other cold regions

UNRAVELLING MICROBIAL DYNAMICS IN RESPONSE TO GLACIER RETREAT: A STUDY IN THE ALTAI MOUNTAINS (RUSSIA)

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Some regions are particularly sensitive to climate change and the Altai Mountains (Russia) are showing unequivocal signs. The mean annual temperature in the area has increased by 1.3–1.7 °C in the last century. According to our measurements, the glacier lost about 12 m per year during the last 50 years. Our work is focused on the analysis of the soil microbiota (archaea, bacteria, and fungi) along a chronosequence in the first 600 m of the Maliy Aktru glacier's forefront of Altai Mountains and on the microorganism (fungi and prokaryotes) associated to the pioneer plant Saxifraga oppositifolia L. Our study shows that both soil and S. oppositifolia fungal communities are differently distributed in the glacier retreating area with higher relative abundances of ascomycetes at early successional stages. The ascomycetes are gradually replaced by basidiomycetes at incremental distances from the glacier forefront. Symbiotrophs and specifically ectomycorrhizal fungi were found to increase their relative abundance both in soil and plant rhizosphere at more than 350 m from the glacier forefront. The data relating to the distance and the trophism of the fungal communities were strictly correlated to some soil parameters (i.e. cation exchange capacity and some cations such as Mg^{2+} and Ca^{2+}). Concerning prokaryotic communities (bacteria and archaea) our results showed an increase of the fraction of archaea along the transect and more in detail from 400m from the glacier forefront both in bulk and rhizospheric soil.

Keywords: Altai Mountains,,climate change,Soil microbiota,deglaciation,primary succession

ID ABS WEB: 137357

8. Other
8.06 133613 - Advances in soil health monitoring

ACCELERATED LEARNING WITH FARMERS: SOIL HEALTH MONITORING THAT HARNESSES CITIZEN SCIENCE, DIGITAL-SENSORS AND INTEGRATED DATA SHARING

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Realizing soil health monitoring with farmers shows tremendous potential in East and Southern Africa to enhance climate resilience, ameliorate natural resources and support sustainable production. However, there are many barriers to local access as digital tools, data systems and knowledge sharing often remain out of reach. This is particularly so for women and marginalized groups. In Malawi, Ethiopia and Nepal progress has been made in collaborating local communities to work with researchers, public and private partners to address these barriers and engage indigenous and science-based monitoring and problem solving for soil health. Adoption of soil health measures developed locally and shared more broadly will be discussed. These include soil organic matter technologies, zinc nutrition amelioration and nitrogen targeting practices. Audience participation is welcome, to consider lessons learned and next steps.

Keywords: Soil health,On-farm,Resilience,Local knowledge,Soil monitoring

ID ABS WEB: 137720

8. Other
8.06 133613 - Advances in soil health monitoring

USE OF MOISTURE SENSORS IN GREEN COVERS FOR SOIL RECOVERY IN FRUIT TREE ORCHARDS

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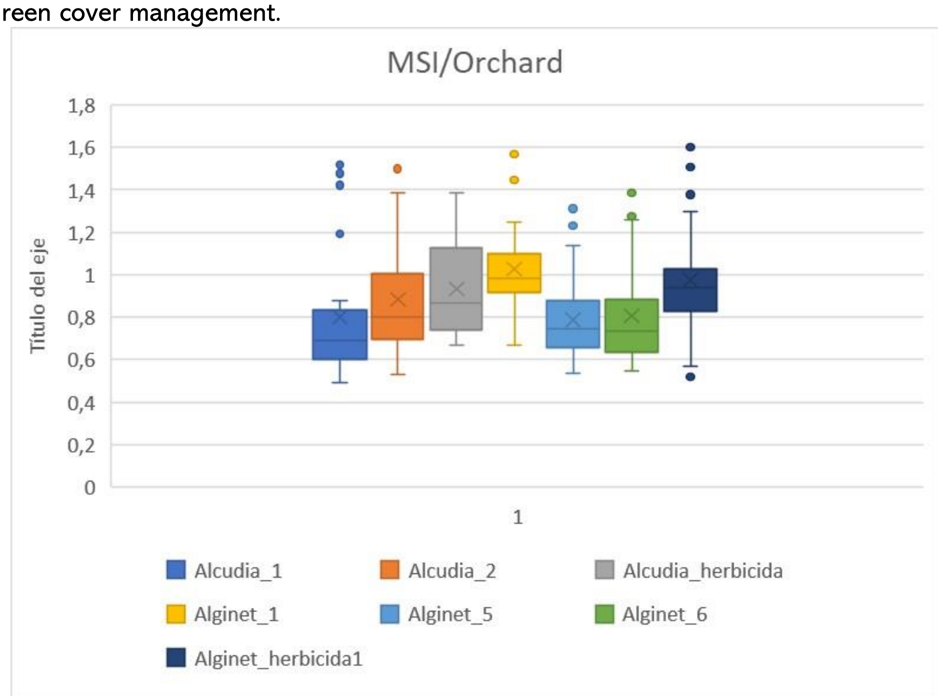
The use of green covers in Mediterranean crops has gained importance in recent decades. The goal is to enrich agricultural soil by increasing organic matter and soil nutrients, reducing erosion and biodiversity loss, creating an ecosystem in conjunction with cultivated plants. This study is conducted in Valencia region (Spain) with different green covers in persimmon orchards (Diospyros kaki, Thumb). We monitored the green covers using moisture sensors and spectral images. The trial is focused on gramine, leguminous and flowers, using species such as Festuca, Medicago, Onobrychis, Trifolium, or Vicia, among others. Ten plots were studied: two of them sown with different type of plant covers, five with spontaneous covers, and three with bare soil in which an herbicide treatment for weed control was carried out. Soil samples were obtained by systematic sampling at a total of 71 sites, within 15 cm of the surface. Comparing the different green covers with plots of bare soil, considering their contribution to soil in terms of soil moisture, temperature, electrical conductivity, organic matter, and biodiversity as well as the improvement of other properties. Results show relevant improvements in these variables, the green cover with Mix Flowers has positive balance in soil moisture, better than Leguminous and Gramineae, nevertheless all of them have a beneficial effect in soil moisture while in orchards with bare soil there is more water stress than in the orchards with green covers. This study aims to be a first step in facilitating farmers' efforts related in green cover management.



Keywords: GREEN COVERS,MOISTURE SENSORS,SOIL MOISTURE,BIODIVERSITY,ORGANIC MATTER

ID ABS WEB: 137747

8. Other
8.06 133613 - Advances in soil health monitoring

INNOVATIVE METHODS AND PRACTICAL CONSIDERATIONS FOR SCALING SOIL HEALTH MEASUREMENTS

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Over the past few decades, a wide variety of soil health indicators have been developed by researchers and commercial laboratories to track how changes in agricultural management impact soil function. While the plethora of indicators may benefit the scientific community, the variety of measurements can complicate cross-study interpretations and overwhelm the non-scientist wanting to monitor their soil health. In 2019, the North American Project to Evaluate Soil Health Measurements was conducted to identify a minimal suite of soil health indicators applicable for measuring soil health commercially -- facilitating scalability. Factors considered when selecting indicators included: responsiveness to agricultural management practices that exemplify soil health, cost, availability, and redundancy in terms of linkage to soil function. As a result of these assessments, the following minimum suite of soil health indicators is recommended for agricultural soils across North America: 1) soil organic carbon concentration, 2) carbon mineralization potential, 3) aggregate stability, and 4) predicted available water holding capacity. Furthermore, a novel modality for measuring aggregate stability will be described, specifically the Slakes phone app. Our goal is to remove the barrier of sending samples to commercial laboratories for analysis, thereby opening doors for low-cost research, connecting non-scientists with soil health and enabling agricultural stakeholders to measure and monitor improvements in soil function with improvement in management.

Keywords: Scale,Soil organic carbon,Aggregate stability,Carbon mineralization,North America

ID ABS WEB: 137948

8. Other
8.06 133613 - Advances in soil health monitoring

PROPOSITION FOR A METHODOLOGICAL FRAMEWORK AND PROTOTYPE MRV TOOL FOR CROPLAND C STOCK CHANGE ASSESSMENT AT HIGH RESOLUTION OVER LARGE REGIONS

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Increasing soil organic carbon (SOC) stocks is a well-identified climate change mitigation solution. However, accurate and extensive estimation of cropland SOC stock changes for National Inventories, for the Common Agricultural Policy or the voluntary carbon market with in-situ measurements exclusively would be too costly. Hence, soil or coupled plant/soil models are often used to quantify SOC stock changes but these models make many simplifying assumptions and lack accuracy when assessing the effect of the spatial variability in biomass production on SOC stock changes. Therefore, Paustian et al. 2019 and Smith et al. 2020 have proposed theoretical frameworks for the Monitoring, Reporting and Verification (MRV) of agricultural SOC stock changes relying on the combination of high-resolution remote sensing data, field information, and physical models.
We present here both the methodological framework and the Operational Processing Chain (OPC) AgriCarbon-EO that provides the biomass, water and carbon budget components of agricultural fields at 10m resolution and at regional scale. The OPC has been optimized to assimilate high resolution optical remote sensing data (Sentinel-2) into a radiative transfer model and a coupled crop/soil model. First, the application of a spatial Bayesian retrieval approach to the PROSAIL radiative transfer model provides Leaf Area Index (LAI) with its associated uncertainty for each date of satellite acquisition. Second, LAI is assimilated into the SAFYE-CO2 crop model using a temporal Bayesian retrieval that enables the calculation of the biomass, CO2 and water fluxes components with their associated uncertainties. Next the biomass simulated by SAFYE-CO2 is used to compute the carbon input in the AMG soil model. The outputs were validated for several cropping years with independent in-situ biomass and CO2/water fluxes data measured at several flux towers in Europe. We show the added value of assimilating high-resolution satellite data in driving the crop/soil models to account for the impact of complex processes that are embedded in the LAI signal on the biomass and carbon/water budgets components estimates.

Keywords: Soil Carbon,Remote Sensing,Modelisation,Methodological framework,Cropland

ID ABS WEB: 137217

8. Other
8.07 133620 - Soil Ambitions: Driving soil health into national and international policy

ASSESSING THE RELEVANCE AND THE FEASIBILITY OF CANDIDATE POLICY RECOMMENDATIONS FROM THE EJP SOIL PROGRAMME TO STRENGTHENING THE EU SOIL STRATEGY

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The EU Soil strategy for 2030 has the objective to restore degraded and contaminated soils, achieve carbon removals in the LULUCF sector, protect surface and groundwater, reduce nutrient losses and use of chemical pesticides. In this context, the proposals of a regulation establishing a "Union certification framework for carbon removals" and of a directive on "Soil monitoring and resilience" have been set out in the last year.
The European Joint Programme on Soil (EJP SOIL) is a vast research program about climate-smart sustainable management of agricultural soils which involves 26 partners with different expertise from 24 European countries. One of the aims of the Programme is to contribute to strengthening the abovementioned regulatory proposals.
Considering that, a mixed-methods approach was used to evaluate how the results of EJP SOIL could be incorporated into policy recommendations. The method involved a quantitative (multi-criteria assessment, MCA) and a qualitative analysis.
Specifically, EJP SOIL scientists proposed a list of recommendations for the two EU proposals and then have prioritized them. The most relevant recommendations were then submitted to national and EU policymakers for an assessment based on the following criteria:
- Feasibility: existence of the facilities that allow implementing the recommendation at the EU level;
- Effectiveness in achieving the desired objectives of the regulations;
- Internal integrity: relevance for the EU soil strategy;
- External Integrity: contribution to mitigate perverse effects of other policies (e.g. promoting the over-exploitation of agricultural soils).

Policy makers were first asked to weigh the criteria based on their importance, then to score the recommendations with respect to each criterion and finally to explain the reasons behind their choices. A subsequent focus group will allow to disentangle divergences of opinions and consolidate key messages.
Results allow identifying key strengths and weaknesses of each recommendation and their relevance in addressing the EU Soil strategy, possible conflicts with already existing EU policies and the key governance changes needed to implement the envisaged policy solutions.

Keywords: Policy recommendations,EU Soil strategy,Multi-Criteria Assessment,Carbon removals,Soil monitoring law

ID ABS WEB: 137541

8. Other
8.07 133620 - Soil Ambitions: Driving soil health into national and international policy

INVESTIGATING THE INTERPLAY OF DIFFERENT POLICY INSTRUMENTS IN ADDRESSING AGRICULTURAL SOIL HEALTH CHALLENGES IN THE EU AND TÜRKIYE

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This study focuses on the analysis of the policies addressing soil health challenges, which have been recently designed and implemented in six EU countries and in Türkiye. In this regard, the researchers involved in the study developed a common research framework consisting of five key policy areas: Incentivising the adoption of sustainable practices, with special reference to voluntary measures promoted by agricultural policies (i.e., the CAP for EU countries and IPARD for Türkiye); Enabling participatory processes, with special reference to regulations empowering collective actions (e.g. Eco-Regions, Bio-districts, Land associations, Rural districts); Regulating the protection of the environment and the landscape, which consists of both nitrate, water, and biodiversity directives as well as regulations and rules aimed at protecting landscape features; Co-creation and sharing of innovation and knowledge, with special reference to EIP-Agri Operational Groups, lighthouses and living labs and advisory services; Triggering new market opportunities, which encompasses rules on geographical indications of origin, short food chain initiatives, voluntary certification schemes.
A comparative analysis based on descriptive statistics and qualitative information is implemented to highlight convergences and divergences of policy interventions, and to assess the relevance of the policies compared to contingent soil health challenges.
The results reveal that the promoted sustainable practices are not often accompanied with robust conditionality requirements, with the risk of compromising effectiveness (at least for some types of farming systems). Moreover, the different national soil health strategies are generally still characterised by several weaknesses, partly due to the flexibility with which EU regulations and directives can be implemented, which has often led to weaken commitments, and partly due to deliberate infringements, with direct consequences on the governments' capacity to monitor and control compliance. Conclusions provide a summary of the main findings, discuss the limitations of the examined national policies, and provide some policy recommendations to address the existing shortcomings in the current plans due to the lack and poor design of relevant policy instruments.

Keywords: EU Soil Strategy,Political Economy,Desk research,Land use policies

ID ABS WEB: 137676

8. Other
8.07 133620 - Soil Ambitions: Driving soil health into national and international policy

TOWARDS A RESILIENT AGRICULTURE: UNIFYING EFFORTS IN EU SOIL POLICY FRAMEWORKS

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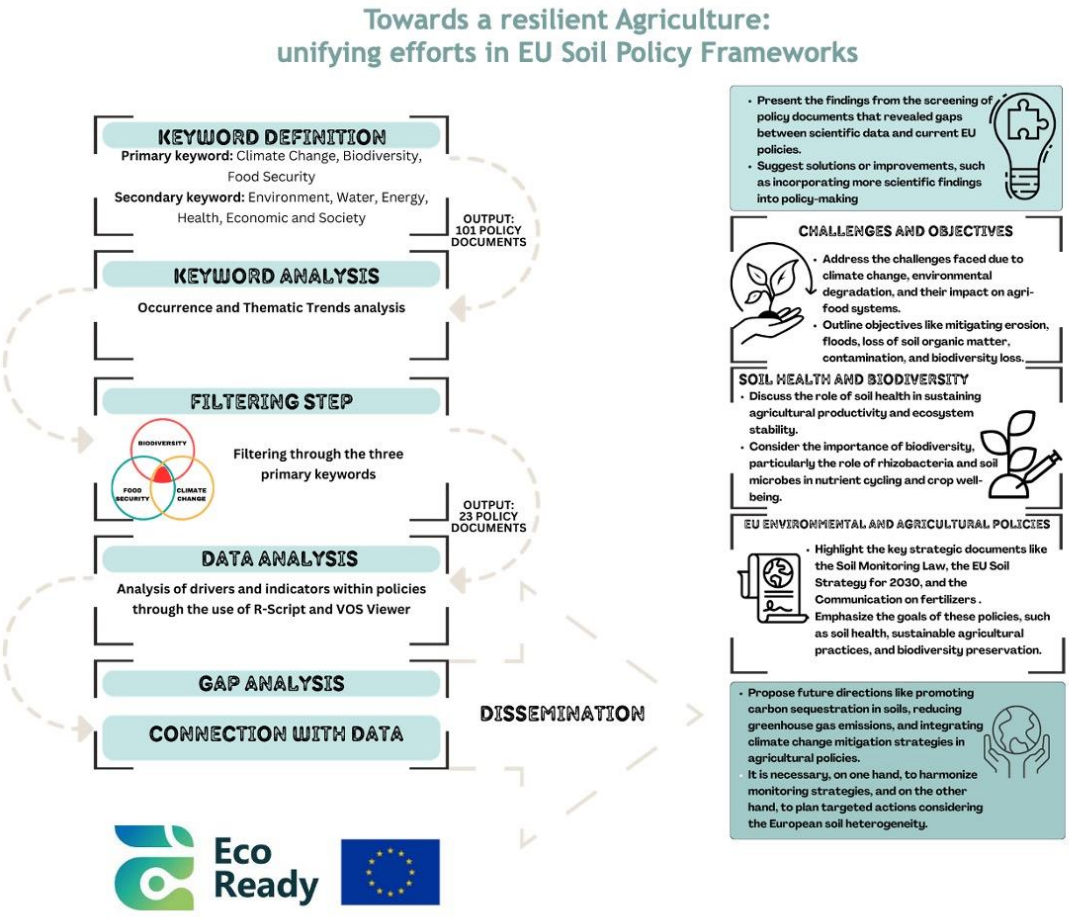
In recent years, the escalating impacts of climate change and environmental degradation have intensified the challenges faced by agri-food systems globally. Within the European ECO-READY Project, a critical examination was conducted to assess the alignment of existing policies with resilience measures for Climate Change (CC), Biodiversity (BD), and Food Security (FS). Using Eklipse synthesis methods, Expert Consultation and Systematic Map, scientific data were linked to EU policies, including Common Agricultural Policy (CAP) and the Green Deal. Screening 150 documents revealed gaps between data and policy. Evaluation of EU policies and identification of gaps were performed using keywords related to CC, BD, and FS drivers and indicators. The proposal for Directive "Soil Monitoring Law", introduced in July 2023, outlines strategies for monitoring threats like erosion, floods, and biodiversity loss. This directive, in conjunction with the EU Soil Strategy for 2030, underscores the importance of sustainable soil management, restoration, and desertification prevention. The Communication on fertilizers (COM(2022)590) complements these initiatives by addressing issues of affordability, nutrient losses, and soil fertility. Nevertheless, identified policy gaps reveal opportunities for further inclusion. The study highlights the intricate relationship among above-ground vegetation, microbial communities, and soil characteristics, urging a deeper exploration of soil health aspects. The LUCAS initiative and the European Soil Data Centre (ESDAC) play key roles in providing essential data on land use, cover, and standardized soil information. Despite these advancements, certain aspects related to soil health need thorough examination. Recognizing their significance, focused goals and investments could enhance sustainable agricultural productivity. The Soil Monitoring Law advocates a comprehensive framework, promoting regeneration and standardizing sustainable soil management. An integrated approach, considering microbial communities, water management, climate change, and soil health, is crucial for promoting soil health, environmental resilience, and sustainable agriculture within FS, BD and CC pillars. Funded by the European Union's HORIZON-CL6-2022 research and Innovation programme under grant agreement N. 101084201. https://www.eco-ready.eu



Keywords: Soil,Climate change,Biodiversity,Food security,EU policies

ID ABS WEB: 138025

8. Other
8.07 133620 - Soil Ambitions: Driving soil health into national and international policy

A SMART SOIL POLICY LAW: A PROPOSAL FROM SOIL SCIENTISTS IN ITALY

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The degradation of soils due to unsustainable management practices poses significant challenges to global agriculture and environmental protection efforts. Despite numerous soil-related policies and scientific advancements, soil degradation continues unabated. This is due to the vagueness of the proposals and the lack of effective operational instruments. In response to the need for an effective legal protection, Italian scientists under the umbrella of AISSA (association gathering all Italian association active in agricultural and forest sciences), and led by pedologists (SIPe), proposed a soil framework law adopted by the Italian Senate. This proposal, initially presented in 2013 and updated in 2022, aims to address the complex challenges of the sustainable soil use, emphasizing the preservation of soil health and ecosystem services. While the proposal has yet to be enacted into law, its integration of national and European environmental legislations and utilization of Spatial Decision Support Systems (S-DSS) represent innovative approaches to soil management. By fostering collaboration among stakeholders and overcoming institutional fragmentation, the proposed law offers a comprehensive framework for sustainable soil management. The demonstration of scientists engaging in the legislative process underscores the importance of addressing soil degradation in tackling climate change, protecting biodiversity, ensuring food security, and promoting human health. We hope that our effort will serve as a model for inspiring similar initiatives globally, emphasizing the critical role of update and smart legal mechanisms in protecting and managing the soil resources for today's challenges and for future generations.

Keywords: soil health,soil policy

ID ABS WEB: 136051

8. Other
8.08 133822 - Peatlands in a changing world

PEATLAND REWETTING IN OIL PALM PLANTATION OFFERS CLIMATE CHANGE MITIGATION BENEFIT THROUGH REDUCED CO2 FLUX WITH NO EFFECT ON CH4 FLUX

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For decades, tropical peatlands in Indonesia have been deforested and converted to other land uses, mainly oil palm and forest plantations. Given their global importance as carbon sinks, there is a growing interest in rewetting and restoring degraded peatlands. Peatland rewetting may contribute up to 13% of Indonesia's total mitigation potential from natural climate solutions. However, to our knowledge, no comprehensive assessment has been performed to understand the overall dynamics from simultaneous measurements of annual CO2 and CH4 fluxes from rewetted Indonesian peatlands, particularly from oil palm plantations. In this study, our primary objective was to investigate the impacts of peatland rewetting on CO2 and CH4 fluxes along with associated soil physicochemical properties and relevant environmental variables. We conducted biweekly monitoring of CO2 and CH4 fluxes for one year period from secondary forests and oil palm plantations located in Mempawah and Kubu Raya regencies, West Kalimantan, Indonesia. We found that peatland rewetting significantly lowered peat CO2 emissions with no clear shifts in CH4 emissions. Rewetting drained oil palm plantations can significantly reduce heterotrophic respiration by 34% and total respiration by 20%. Extrapolating our results to the areas of degraded oil palm plantations in West Kalimantan and Indonesia suggests the reduction of emissions from successful peatland rewetting would be 3.9 MtCO2 yr-1 and 15.0 MtCO2 yr-1, respectively. Nevertheless, our results indicate that rewetting drained oil palm plantations will not reach the reference emission in the secondary forest. Even though the water table in secondary forests was similar to that in rewetted oil palm plantations, total peat respiration was still higher in oil palm plantations. These highlight that peat conservation as well as peat rewetting are important to climate change mitigation actions in these critical forests of Southeast Asia.

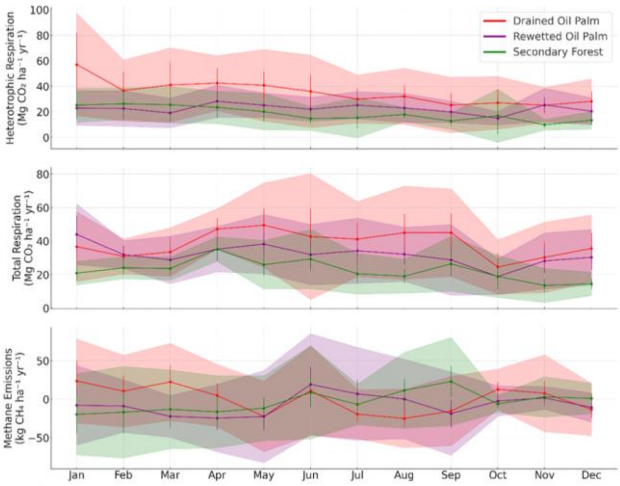

Figure. Summary of monthly measurement of GHG fluxes: (a) heterotrophic respiration; (b) total respiration; and (c) methane fluxes. The shaded area represents the standard deviation, while the vertical line represents the Standard Error Mean (SEM)

Keywords: tropical peatlands,rewetting,oil palm plantation

ID ABS WEB: 136179

8. Other
8.08 133822 - Peatlands in a changing world

ASSESSMENT OF PALUDICULTURE APPLICATION ON FEN PEATLAND – A CASE STUDY FROM CENTRAL POLAND

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Paludiculture enables farmers to utilize wet or rewetted peatlands formally drained sustainably, reducing greenhouse gas emissions from these areas. The aim of the study was to assess the paludiculture application potential on fen peatland, located in the Chludowo village, ca. 20 km from Poznan (Central Poland). The studied peatland was drained at the turn of 19th and 20th centuries, for agricultural management (grassland). Soil samples were collected from genetic horizons from four soil profile in September 2023. In the field the soil morphology was described according to guidelines for soil description (IUSS Working Group WRB, 2022). In the laboratory after sample preparation (air drying, crushing in a mortar) the following properties were determined: the stage of secondary soil transformation, total carbon, total nitrogen, pH, calcium carbonate equivalent. Studied soil profiles were classified as Murshic/Drainic Histosol (profiles 1-3) and Gleysol (profile 4). We found out that soil profiles 1 and 2 exhibit a medium secondary transformation (W1 index: 0.68 to 0.707). In contrast, profiles 3 and 4, strongly transformed (W1: 0.77 to 1.33) due to higher drainage impact. This results were correlated with C/N quotient, which indicated higher soil organic matter mineralization in the uppermost soil layers. Obtained results on physico-chemical analysis indicated that paludiculture can be done to provide biodiversity value and preserve remained peat body in the area of the soil profiles 1-3. Due to it having high plant diversity dominated with reed vegetation and a drainage channel, showed a great potential for paludiculture. While it is highly recommended to apply conservation tillage method reducing the further depletion of soil organic matter content soil in the area of profile 4. Our findings pointed out that the minimum scenario for the study area should be to avoid further conventional agriculture management, as studied soils are the most vulnerable to secondary transformation. It is crucial to apply sustainable peatlands agriculture method, addressing biodiversity and climate change mitigation concerns.

Keywords: DRAINAGE, SOIL TRANSFORMATION

ID ABS WEB: 136389

8. Other
8.08 133822 - Peatlands in a changing world

THE SPRUCE EXPERIMENT: EFFECTS OF CLIMATE CHANGE ON NORTHERN FORESTED PEATLANDS

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The Spruce and Peatlands Responses Under Changing Environments (SPRUCE) experiment is an ambitious ecosystem-level experiment that is testing the response of high-carbon northern peatland ecosystems to increased temperatures and elevated carbon dioxide. The experiment is being conducted in a black spruce peatland in northern Minnesota at the USDA Forest Service's Marcell Experimental Forest (MEF). SPRUCE is supported by the US Department of Energy and is a collaboration between Oak Ridge National Lab, the USDA Forest Service and 100's of other scientists from across the globe. Northern peatlands are an ecosystem considered especially vulnerable to climate change and responses to warming and interactions with increased atmospheric CO_2 concentration are anticipated to have important feedbacks on global climate. SPRUCE is evaluating the response of the existing plant and soil communities to a range of warming levels from ambient to +9°C, with and without elevated CO_2, provided via large, open-top chambers. Belowground heating began in 2014, aboveground heating in 2015, and elevated CO_2 treatments commenced in June 2016 with our final field season in 2025. I will present results of SPRUCE, including treatment effects on greenhouse gas production, soil processes, and plant communities.

Keywords: Climate Change,Warming,Carbon,Plants,SPRUCE Experiment

ID ABS WEB: 137166

8. Other
8.08 133822 - Peatlands in a changing world

IMPACT OF LIMING ON PEAT DECOMPOSITION AND CO2 EMISSIONS IN OIL PALM PLANTATIONS ON TROPICAL PEATLAND IN SARAWAK, MALAYSIA

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Peat soil, typically problematic for agriculture due to its acidic nature and low fertility, presents unique challenges. In tropical peatlands, liming is a prevalent method employed to ameliorate peat soil acidity and enhance nutrient availability. This study investigates the effects of liming on peat soil decomposition and subsequent CO_2 emissions. Liming accelerates mineralization in peat soil, thus influencing the decomposition rate. This decomposition contributes to mass loss and releases carbon dioxide (CO_2) into the atmosphere. However, the interaction between liming practices, the rate of peat soil decomposition, and their impact on CO_2 emission dynamics is still not well understood. To address this gap, a field experiment was conducted in an oil palm plantation, applying four different liming rates (0, 2, 4, 8 tons/ha). The liming material used was Calcium Carbonate ($CaCO_3$), applied annually over three consecutive years (2021-2023), and distributed evenly within a 2-meter radius around each oil palm. Soil CO_2 flux measurements were taken weekly for two years, from January 2022 to December 2023. Additionally, soil samples were collected quarterly at two depths (0-25cm and 25-50cm) to assess decomposition rates. Significant findings from this experiment include a direct correlation between liming rates and peat soil decomposition. Higher liming rates were observed to increase the decomposition rate of peat soil. The study also noted variations in CO_2 emissions due to liming. Based on the observed relationships among liming rates, decomposition, and CO_2 flux, it is recommended to optimize the use of liming materials. Continuous, long-term monitoring is suggested to track the decomposition trends, potential fluctuations, and gather more comprehensive data for informed decision-making. This would help in optimising both the operation cost and environmental sustainability of the ecosystem.

Keywords: Liming,Peat soil,Decomposition,Carbon Dioxide Emission

ID ABS WEB: 137721

8. Other
8.08 133822 - Peatlands in a changing world

EVALUATION OF SOIL MICROBIAL COMMUNITIES, FUNCTIONING AND GREEN-HOUSE GAS EMISSIONS IN UNMANAGED AND DRAINED PEATLANDS IN SOUTH-WEST ICELAND

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The drainage of peatlands followed by land use conversion have significant impact on the fluxes of green-house gases (GHGs, i.e. CO2, CH4 and N2O) to and from the atmosphere, driven by changes in soil properties and microbial communities.
In this study, we compared unmanaged peatlands with drained ones used as pasture or cultivated soils, common in South-West Iceland, in the frame of INTERACT program. These areas exhibit different degrees of soil water saturation and nitrogen content, following the gradient of anthropic pressure.
We assessed fluxes GHGs fluxes of the different study sites, and the impact of land conversion there on. Moreover, we investigated soil microbial community structural and functional diversity, and its connection with processes contributing to GHGs emission.
GHGs emissions resulted different between unmanaged and drained peatlands, with increased soil respiration rates (CO2 emissions) and N mineralization (N2O), coherent with the trend of anthropic pressure. Drainage drastically reduced CH4 emissions, but increased CO2, resulting in a higher global warming potential. Cultivation, involving occasional tillage and fertilization, further increased N2O emissions, mediated by higher N availability and conditions favorable to nitrification. Functional genes mirrored the overall trend, showing a shift from prevalent methanogenic Archaea (mcrA) in unmanaged, to nitrifiers (amoA) in drained-cultivated peatlands. Contrastingly, in unmanaged peatlands complete denitrification was prevalent, causing N2O consumption.
The soil water and nutrient content were critical factors affecting community composition in both environments, which overall affected the GHGs emissions and the relative contribution of the three gases.

Keywords: peatlands management,methanogenesis,nitrification,climate change,functional genes

ID ABS WEB: 138006

8. Other
8.08 133822 - Peatlands in a changing world

SUSTAINABLE AGRICULTURAL PRACTICES USING NUTRIENT CYCLING TECHNOLOGY IN COCONUT PLANTATIONS ON TROPICAL PEATLANDS

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The utilization of peatlands for agriculture is pivotal for socio-economic growth but poses environmental sustainability challenges due to the ecosystem's fragility. This research evaluates the process and effectiveness of nutrient cycling management as a sustainable agricultural solution in tropical peatland coconut plantations. The study was conducted in coconut plantations in Indragiri Hilir Regency, Riau Province, Indonesia. The plantation has implemented an integrated water management system known as 'Trio Tata Air' since 1986, along with soil fertility management through nutrient cycle, primarily to support organic product market certification. The research findings indicate that the application of integrated water management and nutrient cycle systems contributes to the sustainability of peatland ecosystem. The Trio Tata Air system maintains optimal groundwater levels for plant growth and soil moisture, preventing dryness during droughts and flooding in the rainy season. The nutrient cycle in the coconut plantation, which resembles system in natural forests, eliminates the need for external synthetic fertilizer inputs. This cycle involves the natural decomposition of understory plants, predominantly the fern Nephrolepis, which are manually weeded every four months and left to decompose naturally. The decomposition of Nephrolepis provides essential nutrients for the coconut plants, equivalent to per hectare fertilizer application per four-month manual weeding cycle: P = 23.8 kg, K = 353.7 kg, Ca = 128.8 kg, Mg = 173.6 kg, and Na = 17.0 kg. This application is succesfully maintaining coconut production,, particularly as additional synthetic fertilizers are less effective in peat soils due to chelation and leaching. Moreover, the natural decomposition process develops organic layer about 5 cm thick above the peat soil surface, offering potential for carbon capture and storage in peatlands. By maintaining the water level and adapting nutrient cycle on the field, coconut production is higher compared to unsustainable conventional practices such as excessive synthetic fertilization, herbicide use, and burning. Thus, nutrient cycling management emerges as an effective solution for sustainable agriculture in tropical peatlands.

Keywords: Nutrient cycle,Tropical peatland,Sustainable agriculture

ID ABS WEB: 138058

8. Other
8.08 133822 - Peatlands in a changing world

AN ATTEMPT TO RECONSTRUCT THE HISTORY OF THE MOST ANCIENT EUROPEAN FARMING COMMUNITY USING PEAT CORES FROM THE FIAVÈ MIRE

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The Fiavè Nature Reserve is a Natura 2000 site consisting mainly of an alkaline fen (most occurring species, Caricion davallianae), and includes the UNESCO World Heritage Site of the Bronze-Age pile dwellings of Fiavè (Trentino-Alto Adige, North of Italy).
Here, a complete, 200-cm deep core (160 cm of peat plus 40 cm of underlying lake sediment) and a shallower, 50-cm core were collected in order to reconstruct the history of the most ancient European farming community, as well as the influence of past and modern agriculture on peat development.
The peat core was cut while frozen into 3-cm samples, and each of them characterized from the physical (e.g., ash, gravimetric water content) and chemical (e.g., pH, elemental analysis – CHNS -, organic matter thermal stability) point of view. Moreover, few macrofossils were identified at different depths and 14C age dated, while selected subsamples were used to determine diatoms, filamentous fungi and yeasts occurrence and diversity throughout the profile.
Obtained results will be extremely useful to both support existing archaeological findings and promote the implementation of best management practices of the whole area.

Keywords: C stock,organic matter decomposition,drainage,agriculture,bioindicator

ID ABS WEB: 138269

8. Other
8.08 133822 - Peatlands in a changing world

HUMMOCK FORMATION IN ALPINE WETLANDS OF LESOTHO AND ITS IMPLICATIONS FOR SOIL CARBON BUDGET

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Mountains are among regions that are mostly affected by climate change because of the changing temperature and precipitation effects on soils and plant communities. Snow-cover is one of the contributing factors into the development of mountain soils because it affects soil temperature, soil moisture and length of the growing season. The depth and duration of snow-cover regulates soil temperature to ensure thermal insulation. Hence, less snow-cover may increase in the frequency and intensity of freeze-thaw cycles. These cycles do not only affect soil productivity, soil stability and erodibility, but also the soil carbon dynamics. Differences in the depth and duration of snow along the topo-sequence result in large changes in soil properties and plant communities over short distances. The freeze and thaw cycles are some of the factors that lead to the formation of microtopographic features commonly referred to as hummocks, which, are prominent features visible in many alpine wetlands' watersheds in Lesotho. These watersheds have highly productive carbon-rich soils, and the C budget illustrates that atmospheric C is sequestered through autotrophic primary production. However, changes in snow cover dynamics may directly and indirectly affect soil C dynamics and biodiversity. Data collected from Letšeng la Letsie Wetland, the only Ramsar Site in Lesotho, indicates the soil C content ranges from 3 to 9%, and hummocks have lower C concentrations than the inter hummock sites. The potential increase in average annual temperatures in the mountain regions may not only have implications for water resources but also on frequency of freeze and thaw cycles and the C budget. Long-term data are fundamental for detecting and evaluating the impact of climate change on mountain soils and for achieving a number of SDGs, in particular through SDG 15 (Life on Land) and SDG 2 (Zero Hunger), as lives of people in mountain regions depend on agriculture, which in turn depends on soil.

Keywords: Hummock,wetlands,Carbon

BEST POSTERS

ID ABS WEB: 137258

1. Equity, diversity, and inclusivity in soil sciences
1.04 133511 - Moving toward Diversity, Equity, and Inclusivity in Soil Science Societies

ANALYSIS OF RACIAL AND ETHNIC DIVERSITY WITHIN THE SOIL SCIENCE SOCIETY OF AMERICA

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The Soil Science Society of America (SSSA) Inclusivity Assessment Committee analyzed racial and ethnic members' diversity based on optional self-reported data. Despite comprising less than 67% of total SSSA members, self-reporting varied significantly across membership levels. Senior members exhibited the highest self-reporting at 98%, while students, constituting approximately 30% of the membership, reported only 22%. The limited self-reporting by students hinders a comprehensive analysis of trends over time, but insights from an earlier gender report suggest students represent the most diverse cohort. Emeriti members displayed the least racial and ethnic diversity, with 93% identifying as Caucasian White and less than 6% as BIPOC (black, indigenous, and people of color). Among active members, around 60% identified as Caucasian White, with BIPOC representation ranging from 12% (2015-2019) to 14% (2020). Graduate student retention data indicated that only 10% transitioned to full professional membership after 7 years, with a consistent 50% attrition rate in the second year for new graduate students, despite active participation in the annual meetings. Scholarships predominantly benefit younger members (students and early career), influencing their perceptions of the commitment to ethnic diversity and their decision to stay active. To address these findings, SSSA aims to actively increase engagement of students and early career members in including mentoring programs and society governance for example serving on committees. . This proactive involvement is crucial for retaining these young members, who represent the foundation of future demographic trends within the SSSA, ensuring continued vitality and diversity.

Keywords: inclusivity assessment,ethnic diversity,indigenous members,society governance,member demography

ID ABS WEB: 137222

2. Soil and humanity
2.03 129617 - Soil Health from Multiple Perspectives

HARMONY BENEATH OUR STRUCTURES: BRIDGING SUSTAINABLE ARCHITECTURE AND SOIL SCIENCE IN A CHANGING WORLD

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This presentation aims to explore the integration of sustainable architecture with soil science from an architectural perspective, placing a spotlight on the critical significance of soil health in shaping the future of architectural practices. Delving into the intersection of these disciplines, the proposal emphasizes the role of soil as a foundation for natural construction materials, promoting an eco-centric approach to building design.

Environmental art takes center stage as a catalyst for inspiration and innovation in this presentation. By combining the aesthetic aspects of environmental art with the precision of science, the proposal envisions architecture as a harmonious synthesis of creativity and technical expertise. The focus extends to the transformative potential of soil as a sustainable resource for construction materials such as brick and cement, challenging conventional paradigms and advocating for a shift towards eco-friendly building practices.

The presentation sheds light on the intrinsic relationship between soil health and architectural sustainability. It highlights the interconnectedness between the built environment and the natural world, underscoring the pivotal role of soil microorganisms in fostering a healthy and resilient foundation. The proposal advocates for a holistic approach that not only minimizes environmental impact but also elevates the overall well-being of ecosystems through sustainable architectural principles and advancements in soil science.

By exploring soil as a foundation for natural construction materials and setting Middle Eastern practices as an example, this presentation aims to inspire innovative design strategies that prioritize ecological balance. It envisions a symbiotic relationship between human-made structures and the earth, emphasizing the potential for sustainable architecture to be a transformative force. As we navigate an era where environmental consciousness is paramount, this proposal invites a reimagining of architecture as a dynamic discipline deeply rooted in the principles of integrating arts and sciences within the application of soil considerations.

Keywords: Sustainable Architecture,Soil Health,Environmental arts,Integrating arts and sciences,Soil as foundation material

ID ABS WEB: 137745

2. Soil and humanity
2.03 129617 - Soil Health from Multiple Perspectives

ROOTED – SOIL HEALTH AND MEMORY OF PLACE.

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When you extract a plant from the soil, the network of roots reveals a cartography of growth and entangled complexity within the soil. As an artist, this cartography is a rich visual field to draw upon and interpret. Collaborating with soil scientists, additional layers of unseen information – revealed through DNA mapping of soil bacteria, archaea, and fungi – have provided opportunities for fruitful artist/scientist cross-disciplinary interaction. One example of this is the “Rooted” project, which compares the embedded information of the unseen soil microbes to the idea of memory – specifically to connotations of homeland and the uprootedness of the immigrant experience.

Just as the DNA mapping of soil microbes can reveal unseen characteristics of soil, the immigrant experience is one where the memories of one’s homeland become an invisible layer beneath new lived experiences. This correlation is linguistically notable in Spanish, whereby the word soil translates to tierra, with rich connotations such as “mi Tierra,” meaning “my homeland,” or more literally, “my soil.” Carrying this linguistic connection forward in my own art practice, the “Rooted” project ties together research on soil health with narratives of immigration, assimilation, and identity.

To determine the microbial profile of two specific locations, the Sonoran Desert and the Desert Upland in Arizona (USA), I buried cotton cloths at these sites for one to two months. Soil samples from these two sites were also sent to a lab for analysis. The unearthed cloth along with the lab analysis serve as a visual device to interpret the differing microbial profiles, and inform “Rooted.” The cloth, embroidered and shaped into a pair of slip-on shoes, interpret the idea of “second skin” to explore memory of place and the soil.

Keywords: Rooted,Soil microbiology,Memory of place,Second skin of soil,Buried cloth

ID ABS WEB: 136263

2. Soil and humanity
2.05 132213 - Soil and literature

THE POPULARIZATION OF SOIL SCIENCE IN BRAZILIAN CHILDREN'S AND YOUNG ADULT LITERATURE BOOKS

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The popularization of Soil Science is committed to communicating, disseminating, and recontextualizing scientific knowledge related to soil to society at large. In this context,This summary aims to present Brazilian children's and young adult literature books used for the popularization of Soil Science. In Brazil, soil professionals or researchers have published children's and young adult literature books with soil as their main theme. The “Solo na Escola UENP” (Soil in Schools), an extension project from Statual University of Paraná (UENP), in the State of Paraná, South region of Brazil, has excelled in producing and publishing children’s and Young adult books that focus on soil, such as: “Soil Biodiversity: A World Beneath Our Feet” the book presents the biodiversity found in the soil, listing the soil's megafauna, macrofauna, mesofauna, and microfauna along with their functionalities within the system. Additionally, it showcases activities that lead to degradation of life in the soil and actions that can aid in soil recovery and conservation. The books “What is Soil For?”, “Little Red's Birthday”, and “A Special Picnic on World Soil Day” address the functions of soil in the environment, specifically portraying the soil's function as a producer of food, fibers, and fuels. The books “Little Clod is Feeling Sick”, “Where Did the Water Go?” and “A New Soil for Ant Betty” depict soil degradation and present some alternatives for soil recovery. The books are used in Soil Science popularization efforts in both formal and informal educational contexts, combined with playful activities such as storytelling, theater and animations. It is believed that children's and young adult literature books can be a powerful tool to increase awareness of the value of soil in society, particularly in popularizing Soil Science. These materials are characterized by simple, didactic, and illustrative language; they inform society about various soil-related topics; enhance human perception of soil, and ultimately, recontextualize scientific discourse with texts aimed at layreaders.

Keywords: POPULARIZATION OF SCIENCE,SOIL SCIENCE,soil and literature,Brazilian books,extension project

ID ABS WEB: 138379

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

SOIL IS NOT A LAYER: URBAN PLANNING AND SOIL KNOWLEDGE

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Soil often plays a key role in landscape planning. However, there are some key limitations to conventional approaches for incorporating soil data into planning models. The separation of soil and land-use layers in conventional planning maps has led to a systemic misunderstanding of the complex socio-ecological relationships that drive processes like land degradation and climate change induced migration. Failed conceptual models for how to imagine the relationship between soils and human environments should lead us to reconsider the way soils are made an object of planning in the 21st century.

Keywords: city planning,soil mapping,epistemology,socio-ecological systems

ID ABS WEB: 137095

2. Soil and humanity

2.08 133512 - Children and young people say present at the IUSS Centenary Celebration

GET TO KNOW THE SOIL WITH DASY: EXPERIENCES OF USING A COLORING BOOK TO EDUCATE CHILDREN ABOUT SOIL.

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Soil is an essential resource for life on Earth. It sustains plants, which in turn provide food and oxygen for animals and humans. Soil also plays an important role in the water cycle and air quality. It is therefore important to educate children about the importance of soil and the main degradation processes. In this way, children can learn to appreciate soil and take action to protect it. This is why we joined the efforts of the IUSS International Decade of Soils 2015-2024 (IDS) by developing an interactive coloring book for school-age children and young adults.

The coloring book Get to know the soil with Dasy is an effective tool for educating children about soil. The book is written in simple Spanish and addresses key soil education topics such as the importance of soil, soil biodiversity, the connection between soil and human health, threats to soil, and soil conservation. The book is illustrated with graphics that attract children's attention and help children understand complex soil concepts. In its final page, it invites the children to either paint, or write about the soil and its importance in their immediate surroundings, and to send the outcome to the outreach program Terramóvil of the Institute of Geology. In the conference we will provide examples of how the coloring book has been used in some schools from primary to secondary level. The experience has been very positive. Children who have used the book have shown a greater interest and understanding of the importance of soil. They have also been more likely to participate in soil conservation activities such as planting trees, composting and reducing waste.

The book can be complemented by school teachers with a set of hands-on activities provided by the outreach program Terramóvil. These can be downloaded from the web site or implemented at the school yard by trained bachelor students from the Earth Sciences School of the National University of Mexico.

Keywords: children,education,soil,coloring book,soil protection

ID ABS WEB: 137198

2. Soil and humanity
2.08 133512 - Children and young people say present at the IUSS Centenary Celebration

THE FUN SOIL PROFILES: DIDACTIC MATERIAL TO PROMOTE SOIL EDUCATION

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The Soil Education for All Project at the State University of Goiás, Palmeiras de Goiás campus, in Brazil, involves many activities to facilitate the understanding of complex topics for Basic Education, including the use of characters illustrating soil profiles, their main characteristics and pedogenesis (https://aaribon.wixsite.com/educacao-em-solos/perfis-de-solos-divertos). The project, called Fun Soil Profiles, started with 13 orders of soils, according to the Brazilian Soil Classification System (SiBCS), as a teaching material to support education related to the soil sciences, aiming at building the concept of soil taxonomy. In the material developed according to SiBCS, the characters were publicized on the social networks of the Soil Education Project for All and on the Extension Project website and at various events, since 2020, in workshops, festivals, lectures and other activities with different audiences, in virtual and in-person format. In this present work, the profiles were adapted to illustrate the 12 soil orders according to Soil Taxonomy: Alfisols, Andisols, Aridisols, Entisols, Gelisols, Histosols, Inceptisols, Mollisols, Oxisols, Spodosols, Ultisols and Vertisols. This system was chosen because it is one of the international soil classification systems and because it has a smaller number of classes at its highest taxonomic level, simplifying its representation. The result will be published as an illustrated book for children, translated into several languages, which will be presented at the event. The book addresses each character in a simple and playful way, according to their most defining characteristic and choosing aspects related to their genesis and the environment where these soil classes predominate, which makes the understanding of this concept easier and more enjoyable for children.

Keywords: Extension Project,soil classification systems,Pedology,Soil Education,Basic Education

ID ABS WEB: 137628

2. Soil and humanity
2.09 133548 - Microbiome as a common thread from soil to human health: Interaction, Impact and Role of Soil-Plant-Human Microbiome as a new challenge of innovative agriculture and quality food

INTERPLAY BETWEEN FUNCTIONAL DIVERSITY AND SOIL FERTILITY: UNRAVELING THE MICROBIOTA COMPOSITION OF SOIL THROUGH ARTIFICIAL INTELLIGENCE APPLICATIONS

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Understanding the importance of microbiota in the agronomic field has led to an increasing number of studies aimed at exploring ways to modulate and support a healthy microbial community for overall plant health and disease prevention. In agriculture, researchers are focusing on the soil microbiota's role in promoting plant growth, soil fertility and maintaining the health of agricultural ecosystems. Our work aims to find a correlation between the microbiota composition of the soil and its functional diversity under different farming systems, determining the optimal composition to ensure biological soil fertility. The treatments considered for the present study are three: i) organic cultivation with the use of biofertilizers; ii) cultivation under integrated pest management; and iii) cultivation under a conventional farm regime (control). Soil samples collected from different treatments were analyzed to study the composition of the microbiota community by sequencing 16S and ITS amplicons for bacteria and fungi, respectively. At the same time, soil samples were analyzed with Biolog® EcoPlates to evaluate the functional diversity of microbiological communities by measuring their ability to use different carbon sources. All the collected data will be used to train machine learning algorithms to develop a model able to produce indices of soil fertility and forecast the state of health of soils. It is important to implement a continuous monitoring system to gather fresh data to re-train and improve existing ML models and to ensure the model's accuracy . Once the model has proven to be accurate, it can be implemented to predict soil fertility. Here we represent preliminary results and the ML algorithm we intend to employ. However, it is important to note that the results will depend on the quality of the data used during the training and the accurate understanding of the relationships between soil microbial composition and soil fertility. The application of Artificial Intelligence could help farmers in optimizing resource use, improving soil management and sustainably, and increasing agricultural productivity.

Keywords: microbiota composition,soil health,soil fertility,Artificial Intelligence,machine learning algorithms

ID ABS WEB: 137974

2. Soil and humanity
2.09 133548 - Microbiome as a common thread from soil to human health: Interaction, Impact and Role of Soil-Plant-Human Microbiome as a new challenge of innovative agriculture and quality food

BIOACTIVE BASALT FLOUR COMBINED WITH LAB AFFECTS THE TROPHIC NICHE OF SOIL MICROBIOME IN BASALTIC-CARBONATE DISMISSED QUARRIES

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Lactic Acid Bacteria (LAB) have GRAS (Generally Recognized as Safe) status by the Food and Drug Administration. They are safe for human and animal consumption and now have become ideal for commercial development in food and environmental application. To date LAB are a promising candidate for sustainable agriculture and there are some recent evidences that LAB-based composting materials are well suitable also for alkaline soils. Moreover LAB are halotolerant and survive at high salinity conditions in the dry environments.
Considering that the combined application of powdered rocks and microbial inoculants has been proved to be a good strategy to restore microbial diversity and activity in disturbed soils, the aim of this research was to evaluate the effectiveness of “LAB coformulation” in oligotrophic Technosols bacterization in presence and/or absence of cover crop. Specifically “bioactive basalt flour” combined with LAB, yeast and microbial consortia, from compost, was applied as “spray treatment” to basaltic-carbonate dismissed quarries in order to assess taxonomic shifts in soil microbiome.
At Cornale experimental field (near Terni, Italy) the “LAB coformulation” was applied four times during the year 2020 (in the winter and in the spring). At July (2020) soil sampling was performed and taxonomic composition were analyzed by rRNA 16 S amplicon sequencing with NGS (Next Generation Sequencing – Illumina). In addition, the microbiological evolution of r-K-strategist spectrum was assessed. The r-K spectrum confirmed the oligotrophic traits of microbial consortia well adapted to environmental condition of quarries. NGS data for July track LAB establishment in both soils inoculated (with and without cover crop) even if the sequences assigned to LAB occurred as “rare”. Amplicon Sequence Variants (ASV) highlight the evolution of microbial resilience for plots inoculated and the results showed that trophic index (Protebacteria: Acidobacteria ratio) was positively affected. Moreover in the inoculated plots the Actinobacteria, as copiotrophs, increase with decreasing the abundance of some oligotrophs such as many member of Acidobacteria.

Keywords: Lactic Acid Bacteria,LAB,NGS,technosols,Resilience

ID ABS WEB: 137777

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

EFFECT OF SOIL WATER EROSION CONTROL AGRO-TECHNOLOGIES ON SOIL WATER SAVING UNDER WINTER WHEAT-MAIZE ROTATION ON EPICALCIC CHERNOZEM

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Contour tillage, minimum tillage, cover crops and green manure are widely accepted as agro-technologies for soil water erosion control. The aim of the current study was to compare the efficiency of water erosion control technologies for water saving under maize and winter wheat rotation on moderately eroded Epicalcic Chernozem in the region of Ruse, North Bulgaria. The field experiment was performed on sloped terrain from 2021 till 2023 year under wheat and maize in rotation at up-and-down slope tillage (T0), traditional contour tillage (T1) and crop specific erosion control contour tillage (T2). The T2 variant includes minimum tillage, direct sowing and use of cover crop after wheat harvest which is incorporated in the soil as green manure before maize sowing. The seasonal variations of reference evapotranspiration (ETo), precipitation and heavy precipitation events during the studied years were determined and statistically evaluated based on long term (1961-2023) meteorological records. Based on calculated drought indices (SPI, PDSI) it was found that severe drought occurred in 2022 and 2023. The obtained experimental data for soil moisture and run-off were used for assessing the effective precipitation and water saving effect of the studied variants. The water run-off (April-September) under winter wheat and maize was reduced by 25 and 28% in T1 and by 35 and 39% in T2, correspondingly. Cover crops decreased soil water storage in spring more pronouncedly when a single cover crop was grown in the drier and warmer 2022 (-7%) and 2023 (-13%) than when a mixture of crops was grown in wetter 2021. In the mid-season of maize the difference in soil water storage under the studied variants increased in moderately dry conditions while there was no difference in very dry years. The temporal and spatial scales of soil water balance estimates under studied variants were extended by applying simulations with Wofost, WinIsareg and SWAT models.
Acknowledgements: The authors acknowledge funding from the BNSF (K-06-H76/2 2023)

Keywords: soil erosion,tillage,cover crop,drought,winter wheat-maize rotation

ID ABS WEB: 138272

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

MULTIPLE STRESSORS (PESTICIDE, COPPER, WASTEWATER) MIGHT CHANGE AT LOW DOSES ABUNDANCE AD FUNCTION OF SOIL MICROORGANISMS IN CITRUS ORCHARDS

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Soil microbial community directly affect nutrient cycling through organic matter turnover. However, such a role of soil microorganisms is highly dependent on their resilience to environmental stress. Understanding the link between environmental factors and the activity of microbial community is essential for sustainable land management practices. Soil microbial community is considered highly sensitive to soil environmental changes, and the exposure to multiple stressors, even at low doses, could induce harmful effects on soil microorganisms. Citrus wastewaters (CWWs) have been proposed to be used for crop irrigation thus promoting the circular economy approach. However, due to their high content of organic compounds, such as organic acids, and low pH, it is necessary to understand their interaction with other environmental stressors such as copper and pesticides. Copper and abamectin are commonly used as a fungicide and as insecticide, respectively, in citrus orchards.
This study focuses on the impacts of copper and abamectin on microbial community structure and activity of soil moistened with CWWs. To investigate the effect of such factors on soil microbial community and activity, a lab-scale experiment was set up. The experiment lasted 56-days.
The soil was pre-incubated for 14-days and moistened with distilled water at 35% of maximum water-holding capacity (WHC). Eight different treatments were set up to investigate the effects of three stressing factors (2.2 mg kg-1of copper, 0.012 mg kg-1 of abamectin and CWWs), individually and in combination at a maximum WHC of 40%. Soil moistened only with distilled water was used as a control.
During the experiment, microbial biomass C and N (MBC, MBN), microbial community structure (qPCR) and activity (soil respiration and enzymes activities) were assessed. Preliminary findings suggest that treatments involving CWWs led to an increase in soil respiration, probably due to the introduction of organic matter and soil inorganic carbon solubilization.

Keywords: citrus wastewaters,pesticide,copper,microbial community,circular economy

ID ABS WEB: 136430

2. Soil and humanity
2.14 133604 - Histories of internationalization of soil science

SOIL CLASSIFICATION IN THE EAST AFRICAN SOIL MAP (1936) AND ZAMBIA'S ECOLOGICAL SURVEY: CONVERGENCES AND CONTRASTS

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The production of continental-scale soil maps was an early ambition of the IUSS. This required classifications which could be used internationally. An early soil classifications for Africa was presented by Shantz and Marbut, based on Dokuchayevian principles, but this was found wanting by those scientists tasked with producing a map for what was then British East Africa.

In developing the soil classification used in the East African Soil Map, Milne et al. (1936) can be seen wrestling with the outlines of an emerging theory of factors of soil formation, which Jenny would later formalize. In particular they recognized how topographic and geological factors are expressed in soil variation, which is not just a factor of climate. We can also see them distinguishing between the problem of how to classify soil in genetic terms, and how to predict which soils might be found at unsampled sites. Trapnell, from Zambia, then Northern Rhodesia, was involved in the margins of this process, corresponding with Milne and contributing to the proceedings of the Second Meeting of East African Soil Scientists which took place in Zanzibar in 1934 (although penny-pinching by the Government in Livingstone prevented his participation in person).

We argue that Trapnell influenced the final legend of the East African Map more than has been generally recognized (particularly in the adoption of the Plateau Soil class), and that the environmental variation of Zambia at different scales required him to develop a conceptual model of soil variation which was, in some ways more sophisticated than the one embedded in the East African map. We suggest that this early experience highlights the importance of local soil classifications, and of preserving information based on local classification from early 20th-century surveys.

Keywords: Soil Classification,Soil Survey,East Africa,Zambia,Internationalization

ID ABS WEB: 138294

2. Soil and humanity
2.16 133780 - Soil as a cultural heritage: the soil knowledge as a heritage for the future generations

THE NATIONAL SOIL MUSEUM OF MEXICO

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Within the framework of the celebration of Soil Day in the year 2020, in Mexico, we inaugurated the first and unique National Soils Museum. It has 60 examplers monoliths which were recollected by students and professors of Postgraduate of Edaphology, in the Postgraduate Colege with other institutions of several places of the country. The objective is to make known different activities, for example, diffusion and capacitation of soil properties, laboratory analysis, monolith making, and soil classification, among others. Courses and talks are aimed at undergraduate and graduate students, farmers, and the general public. We visit scientific fairs at Universities and Congresses. Also, in the year 2022, we making the first Monolith Collections with agricultural and economic importance to scale statal and regional. The first one is a collection of Mexico State, it has 14 examplers for a surface of 22 500 km which is localized in the Museum; while the second one, is from the municipality of Temascalcingo, Mexico State, which it has 7 monolith examplers for a surface of 362.39 km and it localized in the facilities of the culture house of the same municipality, that it can be consulted by farmers. With the several activities of the Museum, we aim to raise public awareness about the importance of soil conservation, their diversity, and the wide range of ecosystem services that they provide us.

Keywords: MONOLITHS,COLLECCTIONS,CAPACITATION,SOIL DIVERSITY,DIFFUSION

ID ABS WEB: 136582

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

SOIL HEALTH PARAMETERS IN VARIOUSLY POLLUTED SITES IN HISTORICAL SZCZYTNICKI PARK IN WROCLAW

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Soils of urban green areas, including parks, forests, lawns and other spaces covered by vegetation, constitute a valuable pool of natural resources in cities, providing various ecosystem services. Therefore, it is important to maintain such soils in good health. Creating urban green areas was usually preceded by land leveling that used various materials, including construction wastes, rubble, sediments from dredging lakes and rivers, industrial ashes, etc., which become soil parent rocks. Waste organic materials are often applied to such soils, for instance composts and sewage sludge, often rich in heavy metals and other pollutants.
The aim of the study was to assess soil health, visual characteristics of vegetation and its chemical composition in variously polluted parts of Szczytnicki park, the largest park in Wroclaw. Previous screening indicated some areas in this park with soils enriched with heavy metals. Present research was carried out in two parts of the park: 1) with high concentrations of heavy metals (up to 800 mg/kg Cu, 1400 mg/kg Zn, 290 mg/kg Pb and 10.5 mg/kg Cd), exceeding the levels legally considered safe, and 2) in unpolluted part of the park. In each part, two lawns were chosen where analyses were performed in four replicates. Field work involved characteristics of habitats, composition of vegetation and its visual assessment, measurements of soil respiration (several times a season). Soil features analyzed in the laboratory included pH, heavy metal concentrations, fertility, microbiome composition and enzymatic activity. Additionally, plant samples were subject to chemical analysis.
The research showed that most of soil health indices did not differ significantly between two parts of the park. Their variance within the parts was greater than the differences between them. Plant uptake of toxic elements turned out not to be a serious problem. This confirms that maintaining soil conditions appropriate for phytostabilization, including pH, allows for the safe use of urban green areas despite the presence of high concentrations of potentially toxic metals.

Keywords: soil,urban park,heavy metals,respiration,phytostabilization

ID ABS WEB: 136983

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

EX-SITU VITRIFICATION AS REMEDIATION ALTERNATIVE FOR URBAN CONTAMINATED SOILS OF BARCELONA (CATALONIA, SPAIN)

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The vitrification technology is one of the most promising alternative methods for the immobilization of heavy metals contained into polluted soils. Soils contaminated with heavy metals may have application in industry to produce glasses and glass-ceramics. Therefore, the objective of this study was to assess the viability of ex-situ vitrification as remediation strategies for contaminated urban soils of Clot neighbourhood (Barcelona, Spain). The studied polluted urban soil shows a basic pH and low organic carbon contents. Sandy-loam and clay loam texture classes are observed in the topsoil and subsoil, respectively. The most contaminated horizon of the studied soil has quartz 30%, illite 40%, clinochlore 4%, potassium feldspar 5% and plagioclase 18%. The calcite content is relatively low (4%). The main pollutants in this soil are Cd, Pb and Zn with 4.36, 154.42 and 256.77 mg·kg-1, respectively. Glass was formulated using 85 wt% of soil and 15 wt% of Na2CO3. The density of the glass is 2.50 g/cm3, similar to silica and soda-lime glass. The expansion coefficient of the glass is 10.6·10-6 ºC-1 due to the Al2O3 content of the clay horizon. The chromatic coordinates are L 43.46, a 0.37, b 1.12, C 1.18, and H 71.72. Two thermal treatments have been carried out on and analysed by XRD, in order to know which mineral phases would be generated. The evolution of the glass reflects the presence of a single very wide exothermic event at 825 ºC and an endothermic one at 1125 ºC. At 790 ºC there is still no crystalline phase. The glass treated at 950 ºC has two crystalline phases, diopside and wollastonite. The start temperature formation was 825 ºC according to the ATD. Viscosity-temperature curve was used to calculate the relevant temperatures for the process. The contents of the elements leached from the glass are well below the limits established by European legislation. Thus, the vitrification is an effective remediation technique for these contaminated soils.

Keywords: Vitrification,Heavy metals contamination,Urban soils,Remediation techniques

ID ABS WEB: 138228

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

LABORATORY EXPERIMENT ON UNDISTURBED MESOCOSMS: THE LEACHING OF HEAVY METALS FROM CONTAMINATED SOIL

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One of the most important ecosystem services provided by soil is its ability to slow down and mitigate the percolation of pollutants, of natural or anthropogenic origin, into aquifers, a function of great importance for maintaining good groundwater quality.
This study is part of the PNRR project (Biodiversity Future Center, Spoke 5: Urban Biodiversity) and aims to assess the leaching of heavy metals (Cr, Cu, Ni, Pb, and Zn) under controlled laboratory conditions.
The experiment used undisturbed soil columns (mesocosms) of Ap and Bw horizons of a Dystric Cambisol, with bulk densities of 1.07 and 1.68 g/cm³ respectively, constructed manually by assembling PVC tubes (diameter 14 cm) to create 40 cm long cylinders with a 5 cm drainage layer. Both horizons are characterized by a strong acidic reaction (pH 4.7 and 5.3 respectively), a good content of organic C (Ap: 2.34%; Bw: 1.07%), and a silt loam texture. They also have a high content of heavy metals (topsoil - Cu: 161 ppm; Pb: 214 ppm; subsoil - Cu: 64 ppm; Pb: 45 ppm).
In order to evaluate the leaching of metals under controlled conditions, an extreme meteorological event for the Milan Region (150 mm of precipitation in one day) was simulated, stressing the system while maintaining a constant head of 10 mm and collecting the percolated water every hour.
Preliminary data show that water infiltrates relatively easily into the topsoil (9.8 mm/h), leaching a small fraction of the exchangeable and soluble fraction of metals present in the Ap horizon (Cr: 1.17%; Cu: 1.10%; Ni: 1.55%; Pb: 0.09%; Zn: 0.18%). In the subsoil, however, water tends to infiltrate much more slowly (0.4 mm/h).
The results were used as a basis for a long-term monitoring period (6 months), during which the leaching of heavy metals was assessed in both the topsoil and subsoil, replicating a spring-summer precipitation cycle.

Keywords: Pollutants,Percolation,Soil columns,Undisturbed soil,Water

ID ABS WEB: 138286

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

DETERMINATION AND ASSESSMENT OF POLYCYCLIC AROMATIC HYDROCARBONS IN SOILS OF A MEDITERRANEAN AREA

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Soil pollution represents a global problem, which is increased by various human activities, such as, industrial activity, inappropriate agricultural practices, tourism, as well as urbanisation. Organic soil pollutants resulting from anthropogenic activities include the polycyclic aromatic hydrocarbons (PAHs), that stand out for their persistence, toxicity, and mobility in the environment. PAHs are a group of organic compounds with two or more aromatic rings, originating from both natural and anthropogenic sources. The latter include industrial activities, waste and biomass incineration, as well as emissions from vehicles. Therefore, soil analysis is an essential environmental and public health challenge, where preserving the health of soils is crucial to promote the sustainable development goals and meet the 2030 agenda. The objective of this work was to determine and assess the presence of 13 PAHs in urban, industrial and agricultural soils. Several field campaigns were carried out, where soil samples were collected in 59 sites from 17 municipalities in l'Horta and La Ribera de Valencia (Spain). An extraction was carried out using the QuEChERS multiresidue method and quantification of the compounds by GC-MS/MS. The results obtained showed that the total PAHs content ranged between 506.3 and 5.1 microg/kg. The high molecular weight PAHs (HMWPAHs, PAHs with 4-6 aromatic rings), predominated over low molecular weight PAHs (LMWPAHs, PAHs with 2-3 rings). LMWPAHs/HMWPAHs ratio in the studied soils indicated that the main source of contamination is of pyrogenic origin. The results also showed a correlation among total PAHs content with population density and vehicles number.

Keywords: PAHs,URBAN SOILS,QuEChERS,VALENCIA (SPAIN),DENSITY POPULATION

ID ABS WEB: 137939

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

ON SOIL DATA SHARING: LEGAL FRAMEWORK AND GENERAL SHARING POLICIES RESULTING FROM THE INVESTIGATION DONE IN EJP SOIL H2020 PROGRAMME.

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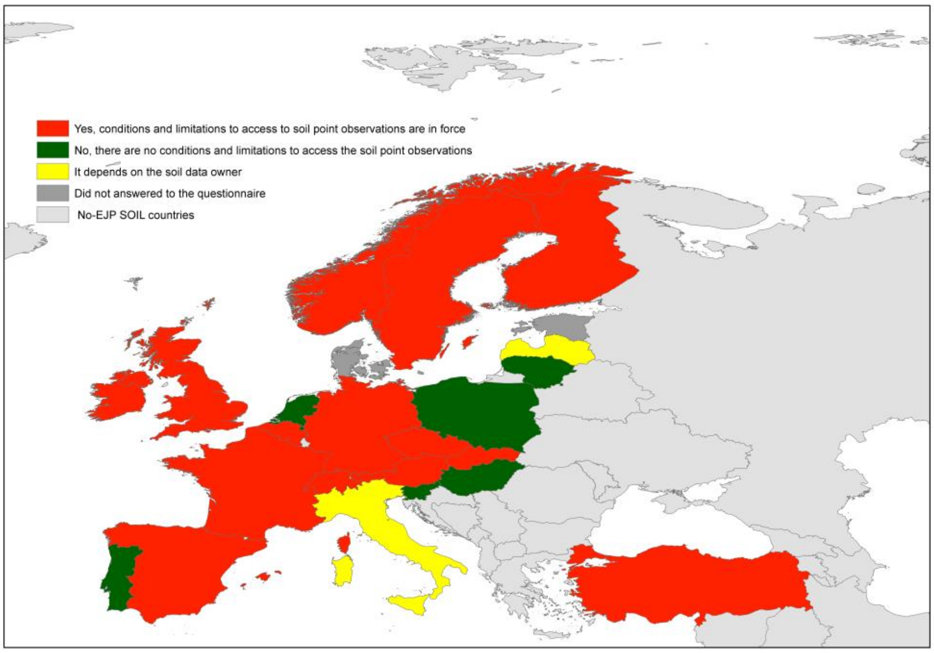
The objective of the work package 6 of the EJP SOIL programme (https://ejpsoil.eu/) is to support soil data sharing in Europe, which implies overcoming legal constrains. An analysis of the EU legal framework on soil data sharing was performed, and a questionnaire on soil data ownership and sharing was elaborated and distributed among EJP SOIL partners, and, through them, to relevant stakeholders, external to the consortium. A deliverable (D6.2), in the form of a public report (https://doi.org/10.5281/zenodo.10014912), was elaborated, which consists of an introduction to EU legal framework, an analysis of questionnaire results, and a general agreement for soil data sharing. The response to the questionnaire and the elaboration of the soil data sharing agreement involved the contribution from 62 authors, 32 institutions, of 22 European countries. The questionnaire showed the lack of specific national transpositional laws in relation to the sharing of soil information, the lack of officially appointed soil officers and, the lack of networking between the soil data owners/holders and the public institutions officially appointed for the INSPIRE (Soil) implementation. A conflict of interests between public and private rights was evidenced, and the D6.2 final agreement suggests 6 general best practices to overcome these constraints in order to get the consent from landowners for the open disclosure of point georeferenced soil data, with the only exception given by the data on emissions of pollutants into the environment, to respect the intellectual property rights of authors, and/or an economic payment in case of soil maps.



Keywords: EJPSOIL,GDPR,INSPIRE,open data,soil data sharing

ID ABS WEB: 138012

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

SHAPING FUTURE SOIL GOVERNANCE - THE NEED FOR WIDESPREAD PARTICIPATION

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Soil governance is a cross-cutting issue that needs to be addressed at the highest level. Soils serve as the basis for several uses, from agriculture and forestry to urban development, industry, and mining. Regulating the protection and the sustainable use of soil is therefore a complex operation, as it must address all possible land uses, ensure the preservation of the multitude of ecosystem services soil provides, and involve the plethora of stakeholders dealing with its management. The simultaneous presence of multiple points of view requires the participation of the maximum number of stakeholders at early stages. Since its creation in 2012, the Global Soil Partnership has become a global forum where global soil issues are discussed and addressed by multiple stakeholders. To support FAO Members in strengthening or developing their normative frameworks on soils, the GSP is developing a legal guide on sustainable soil management that includes the main principles to be included in any law on sustainable soil management and protection, including the participatory principle. This principle of participation responds to different needs: from social justice according to which it is necessary that everyone, especially those who have to do with the object to be regulated, can make their voice heard leaving no one behind. Being able to synthesize the numerous and conflicting demands of individuals to avoid regulatory vacuums and antinomies must be seen as a great opportunity. This principle of participation when applied to civil society would first and foremost succeed in increasing the existing awareness around soil and its protection. Involving citizens in policymaking helps them feel ownership and follow its dictates, as they have contributed to its definition and such imposition will be viewed more favourably. This contribution aims to present the work of the GSP on soil governance and to engage participants in reviewing and agreeing on the principles to be included in FAO's legal guide for sustainable soil management.

Keywords: Governance,Participation,Sustainable Soil Mangament,Law,Policy

ID ABS WEB: 138268

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

THE FRENCH NETWORK OF SCIENTIFIC AND TECHNICAL EXPERTISE ON SOIL: FEEDBACK FROM A HUB TO STIMULATE INTERACTIONS BETWEEN EXPERTS, DECISION MAKERS AND LOCAL AUTHORITIES

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In response to the observation of a dispersion of the scientific and technical expertise and initiatives on French soils, the French Ministry in charge of Agriculture launched the French network of scientific and technical expertise on soils (RNEST) in December 2016.
The network aims to federate French research, development, and innovation (RDI) stakeholders, working on soils (forest, agricultural, urban, industrial fallow land, contaminated sites, natural areas, etc.).
Its main mission is to strengthen the scientific and technical expertise and initiatives on soils to guide public policies, and to answer to the needs of stakeholders concerned by soil management.
The network is supported by organisations representing national soil RDI key players: the French ministries in charge of agriculture, environment, and higher education and research, which co-lead the network, three national agencies, a research institute, a research alliance, a learned society, and two agricultural organisations.
The RNEST also relies on a scientific, technical and innovation committee, composed of 32 experts with varied and complementary expertise profiles (pedology, economics, biogeochemistry, etc.), and diverse sectors of activity (academic research, consultancy firm, local authority, association, etc.). This committee carries out actions related to the field of public policy, RDI, and diffusion of information on soils.
Since its launch, the network has enabled its members to carry out actions to provide and facilitate access to expertise for decision makers, and to foster interactions between soil RDI stakeholders.
We intend to present this organisation, share feedback and perspective on how such a multi-stakeholder hub can operate, and illustrate this with two examples. The first one will show how the hub could mobilise to provide input on recent EU and French law proposals on soils. The second one will highlight an original work of the hub that draw up an approach to compare different types of soil degradation, as a first step to allow stakeholders to develop a global and shared vision of the concept of soil degradation.

Keywords: Multi-stakeholder Hub,National Hub,Feedback,Fostering interactions

ID ABS WEB: 137710

4. Soil health in achieving the Sustainable Development Goals
4.02 124990 - Towards harmonized soil health monitoring. Novel methods and perspectives and scientific, institutional, and societal challenges

RELATIONSHIP BETWEEN CS-137 AND SOIL ORGANIC CARBON (SOC) IN AN ARABLE HILLSLOPE AREA WITH TILLAGE-INDUCED SOIL REDISTRIBUTION AND EROSION PROCESSES

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Carbon storage in soil exceeds two/three fold the amount of C hold by plants and atmosphere. Recently, the effect of soil erosion on the carbon pool is increasingly drawing more attention. It is known in fact that SOC improves chemical, physical, and biological properties of soils, improving soil stability and structure while reducing erosion risk. Several studies have examined the relationship between soil redistribution processes (due to tillage) and SOC, to evaluate soil loss rates through the artificial radioisotope Cesium-137. As such isotope is non-exchangeable, bounds to topsoil colloids and decreases exponentially with depth, it has been used as a tracer in agricultural soils, thus establishing a significant relation between Cs-137 and SOC. In this work, the link between Cs-137, the redistribution process (soil erosion, deposition, movement and storage) and the loss of SOC was studied at CREA-IT on a hillslope area of arable land with elevated erosion risk. An adjacent area with limited erosion and sedimentation processes was chosen as background for Cs-137 fallout and decay. In January 2020, soil samples were taken at six sampling points for three depths (0-10; 10-20; 20-30) on a transect, and one sediment sample at valley bottom, to examine the link between the redistribution of soil particles and SOC at point level and slope. In the CREA-AA Laboratories, the nineteen soil samples were analyzed by gamma ray spectrometric for the concentration of Cs-137 and K-40 (GeHP - Ortec detector, efficiency 30%, Intercomparison INMRI-ENEA). Bulk density, moisture, porosity, grain size, and organic carbon were determined as well. The outcomes of this study address a significant, statistical relationship between Cs-137 and SOC that moves with the same paths and physical mechanisms sharing common dynamics, confirming the results of previous studies that used the technique of Cs-137 radioisotope as a tracer for predicting and mapping the spatial distribution of SOC in cultivated areas.

Keywords: soil erosion,Cs-137,SOC

ID ABS WEB: 138061

4. Soil health in achieving the Sustainable Development Goals
4.02 124990 - Towards harmonized soil health monitoring. Novel methods and perspectives and scientific, institutional, and societal challenges

EVALUATION OF REPEATABILITY, REPRODUCIBILITY AND RECOVERY AS ANALYTICAL CHARACTERIZATION OF THE MICRORESPTM SYSTEM, A RAPID METHOD TO ASSESS SOIL MICROBIAL RESPIRATION

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Scientific evidence indicates that more than 60% of European soils are unhealthy, and this is worsening due to the unsustainable use of natural resources, particularly the degradation and pollution of soils. As part of the European Union soil strategy, the European Commission has proposed in 2023 a new Directive on Soil Monitoring and Resilience. The proposed law, which is critical for ensuring a high level of environmental and health protection through soil monitoring, establishes that biodiversity loss should be determined by measuring soil basal respiration. The reference methodology proposed is the measurement of the CO2 evolution produced by soil microbiota using a respirometer. To keep monitoring costs reasonable, it is desirable to develop alternative methods for this measurement, as not all analysis laboratories have the necessary equipment. However, it is crucial to ensure that any alternative methodology provides accurate and precise results.
The objective of this study was to describe the analytical characteristics of the MicroRespTM test system, developed by Campbell et al. in 2003, which measures CO2 production during short-term incubation from a whole soil microbial community, in microtitre plates. The evaluation of the accuracy of intra-day and inter-day results was determined by analyzing soils with six levels of CO2 production, ranging from 1.5 to 135 mg C-CO2/kg dry soil/day, each level being measured for 3-4 soils for 3-4 days. The results are satisfactory at concentration levels between 8 and 20 mg C-CO2/kg dry soil/day and 60-140 mg C-CO2/kg dry soil/day, with coefficients of variation of 35 and 20%, respectively. A recovery study was also carried out, adding peat to the soil in different proportions until reaching a CO2 concentration level between 25 and 80 mg C-CO2/kg dry soil/day; the recovery obtained at all concentration levels ranges from 62 to 149%. In conclusion, the results suggest that the miniaturized MicroRespTM method is a cost-effective and accessible alternative to most laboratories for measuring basal and induced soil microbial respiration reliably.

Keywords: indicators,soil health,miniaturizated methods,microbial respiration,analytical performance

ID ABS WEB: 136513

4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

OVERSEEDING WITH LEGUMES AND P FERTILIZATION EFFECTS ON SOIL P DYNAMICS IN NATIVE PASTURES OF URUGUAY

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In Uruguay overseeding native pastures (NP) with legumes and fertilizer P application (NP+LP) is a popular management practice aimed to increase forage production and quality for grazing cattle. Soils in the northwestern (NWZ) and central-eastern (CEZ) zones of the country, where most of the land is under extensive grazing, are generally P deficient. Given the increasing prices of P fertilizers, efforts are required to improve P fertilizer recommendations. In this study the changes produced by NP+LP on soil characteristics, specially related to P dynamics were assessed. Additionally, we explored the possibility to complement the traditional recommendation system, based in available P levels, with other soil measurements. We evaluated pairs of NP/NP+LP sown with Lotus subbiflorus (10 sites in NWZ and 13 in CEZ,) in commercial farms that had been receiving P fertilizer for at least 5 years. The long-term effect of P addition reflected not only in available P level (Bray1) but also in the inorganic extractable P, and the organic P content of the soils. However, while in CEZ all these parameters showed significant effects of NP+LP, in the NWZ only the change in inorganic extractable P and the P content of organic matter reached significance. Soils in NWZ have finer textures and higher organic carbon (OC) contents than those in CEZ (average OC in the 0-5 cm layer was 59 and 26 mg kg-1, for NWZ and CEZ respectively) and these characteristics can be associated to a lower effect of fertilization in NWZ. Interestingly the P retention capacity, which showed rather high values in both zones (average 516 and 412 mg kg-1) was not affected by the change in soil management. Given the high P retention capacity of the soils the P fertilizer legacy is likely to be rather limited, therefore the annual fertilizer application with low to moderate P rates is probably adequate to maintain P availability for plants avoiding environmental hazards due to excessive P applications.

Keywords: SOIL ORGANIC PHOSPHORUS,P RETENTION CAPACITY INDEX,PHOSPHORUS LEGACY,LOTUS

ID ABS WEB: 136608

4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

USE OF BLENDED AMENDMENTS: AN INNOVATIVE APPROACH TO REDUCE SOLUBLE PHOSPHORUS IN SOILS

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Phosphorus (P) loss from agricultural soils can contribute significantly towards P enrichment in downstream water bodies and impairing water quality. Application of soil amendments is a strategy to decrease soluble P in surface soils, but to be effective, the amendment should match the soil type. Blended soil amendments could be a better approach to reduce soluble P across soils; however, very little research has been done with blended amendments in reducing P loss. We hypothesized that the application of blended amendments would be more efficient in reducing the potential P loss from soils than single amendment applications. This research compared the effectiveness of gypsum, Epsom salt and alum applied singly or blended in different ratios in reducing potential P loss from two soils in the laboratory. Two soils (0-15 cm depth) with contrasting water-soluble P (<1.5 mg/L in low P soil, and >8 mg/L in high-P soil) were collected from the Red River Valley region in Manitoba, Canada. Ten treatments used for the incubation study were; unamended soil, gypsum or Epsom salt at 2.5 or 5 Mg/ha, alum at 2.5 Mg/ha, and four blended treatments of gypsum: alum or Epsom salt: alum of 1:1 or 2:1. Amended soils were incubated under saturated soil moisture in triplicates for 2 weeks at 22 ± 1 C and analyzed for water extractable P and Mehlich 3-P concentrations. Water extractable P concentrations, which is an indicator of potential risk of P loss, was significantly reduced by all amendments compared to control. In the high P soils, the blended amendments (gypsum-alum or Epsom salt-alum at both lower and higher rate of gypsum or Epsom salt) performed better than a single amendment. Mehlich 3 -P, which is considered as plant available P, was not influenced by any of the amended treatments. Our results suggest that blended amendments can be more effective than single amendments in reducing potential P loss from high legacy P soils.

Keywords: Phosphorus runoff,Soil amendments,Soluble phosphorus in soils,Blended amendments

ID ABS WEB: 137196

4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

PHOSPHORUS AS A KEY FACTOR IN SOIL NUTRIENT ECOSYSTEMS – A CASE STUDY BASED ON LONG-TERM FIELD TRIAL DATA

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The importance of nutrient balance in agriculture lies in promoting optimal plant growth and productivity, and it also contributes to soil fertility, sustainability, and environmental issues. Of the essential nutrients, phosphorus is a key component of the nutrient cycle. As the dynamics of phosphorus in soils involve many complex physiological processes, maintaining a balanced phosphorus cycle is crucial for sustainable agriculture.
A complex macronutrient-based fertilisation experiment taking place at the Látókép Crop Production Experimental Site of the University of Debrecen can provide valuable information about nutrient cycling in plant – soil interactions. The field experiment was established in 1983 and it has been constantly active for over 40 years, providing the reliable basis to examine and analyse the interaction of soil nutrients. The experiment includes unfertilised control plots (T0) with five treatments with increasing phosphorus levels (T1: 23 kg*ha-1 P2O5; T2: 46 kg*ha-1 P2O5; T3: 69 kg*ha-1 P2O5; T4: 92 kg*ha-1 P2O5; T5: 115 kg*ha-1 P2O5;). The complex mineral profile of the upper soil layer was analysed in accredited laboratory, making it possible to evaluate the interactions between essential nutrients.
The findings obtained from the analysis demonstrated that increasing phosphorus fertilisation resulted in increased availability in the soil (T0: 56,39 mg*kg-1 P2O5; T5: 184,38 mg*kg-1 P2O5); which confirms the accumulation of phosphorus in the soil layer important for the plants. In contrast, the increasing phosphorus accumulation had adverse effects on the accumulation processes of the essential micronutrients. The zinc and the copper concentrations decreased significantly due to the increased phosphorus concentration (Zn: T0: 2,14 mg*kg-1; T5: 0,51 mg*kg-1; Cu: T0: 3,43 mg*kg-1; T5: 1,98 mg*kg-1).
Based on the obtained results concerning the interaction among essential nutrients, managing phosphorus inputs and promoting efficient fertiliser use are essential for maintaining a healthy phosphorus cycle in agricultural systems and achieving high grain yields and quality.

Keywords: fertilisation,long-term experiment,maize,nutrient balance,phosphorus

ID ABS WEB: 136427

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

MODELLING LONG-TERM IMPACT OF NOVEL BIOBASED FERTILIZERS ON SOIL ORGANIC MATTER STORAGE FROM LABORATORY SHORT-TERM C MINERALIZATION

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The growing emphasis on circular food economies and sustainable agriculture is driving the recycling of exogenous organic matter (EOM) through the production of biobased fertilizers (BBF). While this provides an opportunity to reduce reliance on mineral and synthetic fertilizers, uncertainty exists regarding the long-term impact of BBF application on soil organic matter dynamics.
This study aims to model the impact of novel BBF - such as microbial biomass, insect biomass, insect frass, biochar, and derived blends, produced in the framework of Horizon 2020 project RUSTICA - on long term soil C storage.
For this purpose, we used a modified version of the RothC model encompassing additional EOM pools. We calibrated EOM pools parameters, specifically pool size and decay rates, through inverse modelling of EOM C mineralization rates from amended soil. We performed one-month laboratory incubation experiments of soil amended with BBF and derived blends under controlled aerobic conditions (40% of water holding capacity and 20°C). Maximum likelihood estimates for EOM pools size and decay rates were inferred by a Bayesian inversion with Differential Adaptive Metropolis (DREAM) algorithm of EOM C mineralization rate. The modified RothC model with parameterized EOM pools was then used to predict the long-term effects (100 years) of BBF and derived blends on soil C stocks.
Results indicate the remarkable stability of biochar, supporting its efficacy in promoting soil C sequestration, even when blended with other BBF. Conversely, insect biomass, even in small amounts in the blend (16.7%), enhanced CO_2 flux, leading to lower EOM C retention. This emphasizes the need for careful consideration when incorporating specific BBF into soil management practices.
In conclusion, our study provides insights into the complex dynamics of EOM pools decomposition of novel BBF, offering a comprehensive understanding of both short-term impacts and long-term implications. These findings contribute useful information to advise sustainable soil management practices aimed to recover and enhance soil organic matter storage.

Keywords: biobased fertilisers,soil C modelling,soil C sequestration,biochar,inverse modelling

BEST POSTERS

ID ABS WEB: 137752

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

RESPONSE OF ORGANIC MATTER POOLS IN PADDY SOILS TO DIGESTATE APPLICATION, CHANGES IN FLOODING LEVEL AND INCREASED TEMPERATURES

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Changing climatic conditions represent a threat to the agricultural sustainability of paddy soils, not only because rice (Oryza sativa) is the main irrigated crop worldwide, but also because they represent the largest anthropogenic wetlands. Their multiple key wetland ecosystem functions also include carbon (C) sequestration. The application of anaerobic digestate represents a great potential to increase soil C sequestration. However, there is still a lack of knowledge on the fate of applied digestate and its incorporation into SOM under increasing temperatures, and about SOM stabilization processes promoted by iron (Fe) (hydr)oxides. Our research aims at gaining a deeper insight into these processes. Specific objectives are: a) to investigate the effects of increased temperature (~2°C) and reduced water levels on the amount and quality of SOM pools; b) to determine how digestate application affects SOC stability and distribution into SOM fractions; c) to assess if changes in wetting and drying cycles dictated by climate changes may alter Fe mineral dissolution and linked implications on colloidal stability and isotopic composition. The experimental design consists of 3 factors - amendment application (unamended control and digestate), climate manipulation (ambient temperature, and warming) and water management (normal supply and reduced by 30%). To capture SOM protection mechanisms, soil samples were fractionated by size following aggregate dispersion, thus resulting in a particulate organic matter (POM) and a mineral-associated organic matter (MAOM) fraction.
Preliminary results revealed that MAOM fraction was significantly affected by the flooding level and digestate application, but flooding level and warming did not significantly affect C content in the POM fraction. Our investigations of the Fe water-dispersible colloids and isotopic compositions will help to elucidate the differential mechanisms involved in paddy soil Fe cycling under variable land management and increasing temperatures.
This research has also the potential to generate the policy-relevant soil management recommendations required to underpin international programs needed to address global-change challenges and recycle organic wastes while preserving SOC.

Keywords: amendment,climate change,iron oxides,mineral associated OM,rice

ID ABS WEB: 137895

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

INDIVIDUAL AND COMBINED EFFECTS OF EARTHWORMS AND SPHINGOBACTERIUM SP. ON SOIL ORGANIC C, N FORMS AND ENZYME ACTIVITIES IN CLEAN AND METAL CONTAMINATED SOIL

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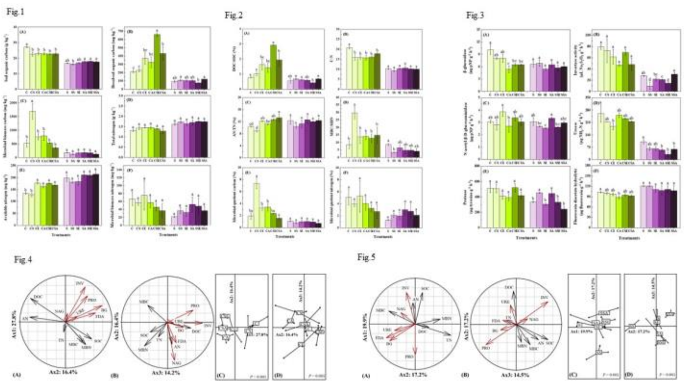
Body

Earthworm and Sphingobacterium sp. are both characterized by their strong decomposition ability of organic compound and broad distribution in soil. Little is known about their interaction on soil organic matter decomposition and whether Sphingobacterium sp. could assist earthworms with carbon and nitrogen cycles. Earthworms and Sphingobacterium sp. were inoculated in clean and contaminated soils under laboratory condition for 20 days. We investigated their single or combined effects on C and N forms and C and N related enzyme activities, evaluating their interaction on soil C and N cycles. E. fetida and A. gracilis inoculation alone increased dissolved organic carbon (DOC) contents significantly by 75.8% and 53.6% comparing with no earthworm control in clean soil; while they increased alkalihydrolyzable nitrogen (AN) contents significantly by 32.9% and 20.9% as well, respectively. Inoculation of Sphingobacterium sp. alone promoted microbial biomass carbon reaching 1685±292 mg·kg-1 in clean soil tripled of control. Moreover, the combination of earthworms and Sphingobacterium sp. increased DOC contents by 212% and 134%, and AN contents by 31.3% and 25.4% in treatments of E. fetida+Sphingobacterium sp. and A. gracilis+Sphingobacterium sp. in clean soil, respectively. In these two soils, most of enzyme activities were inhibited in treatments with earthworm alone and earthworm+Sphingobacterium sp.. However, N related enzyme activities were increased in treatments with E. fetida in clean soil and treatments with A. gracilis in contaminated soil (N-acetyl-D-glucosaminidase activities), protease activities in treatments with Sphingobacterium sp. and treatments with A. gracilis in contaminated soil (protease activities). Our results concluded that earthworm inoculation alone significantly promoted mineralization of carbon and nitrogen in clean soil rather than contaminated soil; Sphingobacterium sp. was able to assist earthworms with improving carbon and nitrogen mineralization in clean soil. In contaminated soil, earthworm alone and earthworm combined with Sphingobacterium sp. both facilitated carbon storage. These findings provided insights into the combined effects of earthworms and microbes on C and N cycling during soil remediation.



Keywords: Earthworm,Sphingobacterium sp.,metal contaminated soil,C and N forms,Enzyme activities

ID ABS WEB: 137945

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

BEHAVIORAL CHARACTERISTICS OF BIOCHAR IN FACILITY SOIL AND ITS INFLUENCING MECHANISM

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The excessive application of chemical fertilizer in facility cultivation generally leads to continuous cropping obstacles such as secondary salinization and nutrient imbalance, and increases the negative impact on the environment. Biochar can not only directly provide crop nutrients, but also improve soil physical and chemical properties, which has great potential in replacing chemical fertilizers. However, the effect of biochar aging on its function in the facility soil environment is not clear. Therefore, through a field experiment, this study discussed the effects of different amounts of biochar (B1: 22.5 t/ha-1, B2: 67.5 t/ha-1) and organic fertilizer (m: 90.0 t/ha-1) under different amounts of chemical fertilizer (F1: 30% fertilizer reduction, F2: 15% fertilizer reduction, F3: actual production fertilization) on the structure and fertility of the facility soil. The results showed that the humification degree of biochar decreased gradually after application, and microorganisms colonized in the pores of biochar, which promoted microbial activity and then decomposed soil organic matter and plant residues. After the application of biochar and organic fertilizer, the yield of tomato increased by 4.93-62.14% and 28.62-31.46%, respectively, and the incidence of umbilical rot decreased by 0.71-68.14% and 12.08-60.25%. Both biochar and organic fertilizer treatment increased water content, total porosity, macroporosity, NO3--N, NH4+-N, DOC/DON and CEC of 0-20cm facility soil. Among them, the treatment of high amount of biochar (B2) and organic fertilizer increased the contents of NO3--N, NH4+-N, DOC and DON in the 20-60 cm facility soil, which caused harm to the environment. Therefore, the combination of 30% reduction fertilizer and low amount of biochar (B1) is one of the environmentally friendly agricultural strategies to improve the physical and chemical properties of soil, reduce tomato umbilical deterioration and increase tomato yield.

Keywords: Biochar aging,Organic fertilizer,Facility soil,Soil structure,Soil fertility

ID ABS WEB: 137950

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

CITRUS SEWAGE SLUDGE AS NITROGEN SOURCE: EFFECT ON SOIL FERTILITY AND WHEAT PERFORMANCE

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Sludge is a byproduct generated through the physicochemical and biological processes applied in wastewater treatment facilities. It possesses the potential to serve as a sustainable source of energy and/or resources. The utilization of sludge as a raw material in various industries emerges as a promising way for waste management within the framework of the circular economy. The citrus industry is estimated to yield a sludge production ranging from 0.10 to 0.30 kg of sludge per kg of chemical oxygen demand (COD). Considering that the average COD content in wastewater is between 5 and 27 kg COD m-3, the specific productivity of sludge may range between 0.5 and 9.0 kg sewage sludge m-3 of treated wastewater. The citrus sewage sludge (CSS) had a subalkaline pH and high electrical conductivity, although it is lower than 4 dS m-1. CSS has usually a high content of total N, so the C/N ratio is about 6. Among macronutrient cations, Ca is the most abundant, followed in order by Mg, P, K, and Na. Based on the above considerations, a pot experiment was conducted to explore the ability of CSS to act as a nitrogen fertilizer for wheat growth. The experiment was carried out in a growth chamber using pots with a capacity of 1 L and filled with 950 g of soil previously sieved to 4 mm and homogenised. Two distinct soil types, one with a reduced carbonate content and the other one rich in carbonates, were employed. Soils were mixed with 25% of perlite, in volume, and amended with CSS or fertilised with ammonium nitrate to supply 30 mg of N per plant. Four wheat seeds were transplanted into each pot.
The plants were irrigated daily with a nutrient solution having the following composition: K2SO4, KCl, KH2PO4 and micronutrients. At the end of the experiment, lasted 80 days, soil and plants were analysed. In the poster, results will be described and discussed.

Keywords: Biochar,Climate change mitigation,Best management practices,Organic carbon

ID ABS WEB: 138002

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

CHANGES IN CO2 EMISSIONS DUE TO INCORPORATION OF FERMENTED AND COMPOSTED RESIDUES IN UNSTABLE SOIL

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Soils with unstable structure present losses due to wind erosion and nutrient deficiencies. Amending soils with organic residues has already been applied for long time in agricultural systems. Composting such organic residues by aereating and regularly turning promotes microbial activity. The microorganisms use this organic content as their energy source, emitting CO_2 into the environment. Studies on mineralization of organic residues do no consider the effect of unestable agreggates on CO_2 emissions and may contribute to estimate CO_2 release from amended soils. The objective of this work was to quantify CO_2 emissions in response to the incorporation of organic fertilizers in unstable soil under olive production. Soils classified as cambisols, from Chimalhuacán, State of Mexico were used. Soil sample was sieved to a diameter of 250 μm and 200g was added in 0.5 L plastic container.
Five treatments were evaluated: 1) control treatment (T0), 2) bokashi at 2.5% (Bo1), 3) bokashi at 5.0% (Bo2), 4) compost at 2.5% (Co1) and 5) compost at 5.0% (Co2). Soil moisture was maintained at 30% and CO_2 flux was quantified every 48 h for 45 days, with a static chamber IRGA Ppsystem.
Soil pH and EC were determined, in a 2:1 ratio (water:soil) and the active carbon (POxC) was measured..The pH of the soils ranged from 7.7 to 8.2, being classified as slightly alkaline. The EC showed values between 0.2 and 1.3 dSm-1, however do not represent a limiting factor for the growth and development of olive crop. The cumulative CO_2 fluxes were 11 486, 11 494, 15 221 mg kg1 (T0, Bo1 and Bo2), 14 582 and 16 288 mg kg1 (Co1 and Co2). The highest contents of (POxC) were under treatment (Bo1) 368.57 mg kg-1.
The results of this study show (i) fermented and compost residues promotes the emission of CO_2 to the environment and, (ii) organic amendments improves physical and chemical condition allowing improvment unstability of soils.

Keywords: organic residues,bokashi,compost,carbon mineralization

ID ABS WEB: 138192

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

FOSTERING SOIL ORGANIC MATTER DYNAMICS AND PLANT GROWTH: A COMPREHENSIVE STUDY ON THE SOIL ORGANIC AMENDMENT POTENTIAL OF PÁLINKA SPENT WASH THROUGH COMPOSTING

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The Pálinka distillery industry in Hungary generates significant organic waste, particularly 'spent wash' also called ‘mash’. This post-distillation residue poses environmental challenges due to its high organic load, low pH, and recalcitrant compounds. This research addresses the need for a sustainable solution by focusing on composting to transform Pálinka spent wash into stable organic matter and neutralize phytotoxic substances. The study targets initial challenges—acidic pH, high moisture content, and elevated copper levels—through aerobic composting. In a lab-scale experiment, the spent wash was composted with wood chips and additives like diatomaceous earth, wood ash, vinasse, coconut fiber, andesite, calcium sulfate, ready-manure compost, and carbon. Two breathable drum composters were used, one with mash mixed solely with wood chips and the other combining wood chips with finished cow manure compost as an inoculum. Comprehensive analyses, including germination and enzyme activity tests, confirmed the unsuitability of the Pálinka mash for plant growth without being composted. Evaluating the ready-mash compost using various plants demonstrated its potential to enhance soil organic matter (SOM) levels, promote nutrient cycling, and improve soil structure. The study also addressed environmental risk factors, emphasizing composting's role in food safety. High copper levels in Pálinka spent wash were effectively reduced through composting, especially with ready-manure compost and diatomaceous earth. Wood ash, diatomaceous earth, and ready-manure compost emerged as effective treatments, showcasing nutrient supply and water retention. Stable organic matter formation, crucial for soil fertility, increased significantly, especially with ready-manure compost. Pálinka spent wash compost plays a pivotal role in nutrient cycling, converting organic nutrients into plant-available forms. Enhanced SOM positively impacts soil health, promoting efficient nutrient uptake and sustainable soil management. This research underscores the urgent need to address environmental and health risks associated with Pálinka spent wash, highlighting its untapped potential as a soil amendment for sustainable agriculture. Composting offers an innovative waste management approach for traditional industries, contributing to environmental protection and supporting sustainable agricultural practices.

Keywords: Pálinka spent wash,Composting,Soil organic matter (SOM),Environmental risk factors,Sustainable agriculture

ID ABS WEB: 138247

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

ADDITION OF FERMENTED AND COMPOSTED TOMATO (SOLANUM LYCOPERSICUM L.) RESIDUES AND CHANGES IN CO2 EMISSIONS IN SOIL UNDER CONTROLED INCUBATION.

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Tomato (Solanum lycopersicum L.) is one of the most consumed vegetables. This crop generates on average 3,070 t ha-1 of residual dry matter per cycle. Such residues generally are accumulated or incinerated, causing negative environmental effects. The treatment and recycling of organic waste can be efficient through biological processes such as aerobic composting and anaerobic fermentation (Bokashi) where microbial activity is developed. Few studies evaluate the effect of amendment process on soil properties. The objective of this study was to evaluate the effects of aerobic compost and anaerobic fermentation (bokashi) of tomato residues on dynamics of a conventionally managed loam soil. Treatments evaluated were compost and bokashi at 2.5, 5% and a control treatment. The experimental unit consisted of 200g of soil sieved at 2mm in 0.5 L plastic containers, with four replicates per treatment; moisture was kept constant at 25% w/w. Treatment assignment was performed by randomization. Dissolved organic and inorganic carbon (DOC), CO2 emission, labil soil carbon fraction (COxP), organic matter (OM), total nitrogen, pH and electrical conductivity were determined. The results showed under 5% aerobicl compost had highest CO2 emissions with daily average of 1120.87 mg kg-1, followed by 5% fermented bokashi with 1026.84 mg kg-1. With 2.5% dose had 917.13 and 844.83 mg kg-1 for compost and bokashi, respectively. Bokashi increased dissolved organic carbon by 14.61 mg kg-1, followed by compost with 12.21 mg kg-1, while in untreated soils, a decrease of -7.98 mg kg-1 was obtained. For N, there was an increase of 0.44 and 0.040% for compost and bokashi, respectively. It is concluded that (i) the use of organic amendments enhances the chemical properties of agricultural soils, (ii) the addition of compost increases CO2 emissions to a greater extent compared to fermented bokashi and (iii) fermented bokashi represents a fast and efficient alternative in treatment of tomato residues.

Keywords: CO2 EMISSION,BOKASHI,COMPOST,TOMATO RESIDUES

ID ABS WEB: 138317

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

VERMICOMPOST BASED AMENDMENT AS SUSTAINABLE PRACTICE IN THE MANAGEMENT OF SOILS UNDER INTENSIVE FARMING

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Intensive farming systems, characterized by the absence of rotations, the preference of milling to plowing, mineral fertilization and the removal of crop residues, lead to negative consequences on soil quality. The loss of organic matter is one of the negative effects of intensive farming that could be counteracted by organic amendments by using different agricultural wastes to obtain positive impacts on physical, chemical, and biological fertility of soils. Soil organic matter (SOM) is a fundamental source of macro- and micronutrients for crops but also for soil microorganisms as SOM represents a substrate stimulating microbial biomass and consequently microbial activity and functionality in terms of enzymatic activities.
The aim of this research was to assess the effect of vermicompost (VC) as organic soil conditioner under greenhouse in a conventional farm and an organic farm in the Plain of Sele river in southern Italy. VC is the final product of a vermicomposting process involving synergistic action of earthworms and microbes in the bioconversion of organic matter into humus-like substances. VC derived from solid digestate from anaerobic digestion plant using livestock sewage and whey from dairy industry.
Three doses of VC corresponding to 37.5, 75 and 150 kg N ha-1 year-1 (VC1, VC2, VC3) were applied to solarized soil. Soil solarization was carried out during the summer time to control weeds, nematodes and soil-borne pathogens. Chemical and biochemical properties of soils sampled after 7 and 150 days from organic amendments were investigated to understand the correlation between the use of organic soil conditioners and organic C stock, nutrient availability, microbial biomass, enzymatic activity, and crop yields and quality.
VC provided more stable organic matter in soil with long term positive effects on soil quality. In addition, a greater available phosphorus was detected in the vermicompost amended soil. A significant enhancement of all biochemical properties of soil amended soils occurred in accordance with the VC dose spread in soil.

Keywords: organic amendment,soil organic carbon,microbial activity,microbial functionality,soil enzymes

ID ABS WEB: 136519

4. Soil health in achieving the Sustainable Development Goals
4.08 132261 - Ecosystem services provided by nematodes and other soil invertebrates and specific protection goals

IMPACT OF INVASIVE PLANT ORGANIC MATTER ON SOIL PROPERTIES, NEMATODE COMMUNITIES, AND IMPLICATIONS FOR ECOSYSTEM MANAGEMENT.

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Invasive plant species pose a threat to biodiversity and can lead to ecosystem degradation, impacting soil invertebrate communities to varying extents. Despite this, there is limited understanding of how the organic matter of plant invaders influences soil properties and nematode communities. In this study, we conducted a pot experiment using non-invaded grassland soil and organic matter from two invasive plants, Fallopia japonica and Solidago gigantea, to assess and compare nematode community composition and soil properties. The treatments with organic matter from invasive plants showed a decrease in soil pH and moisture content, and an increase in organic carbon and total nitrogen. A decrease in productivity and a slowdown in nutrient cycling, as indicated by the decrease in the abundance of bacterivores and fungivorous nematodes, may be common when adding organic matter from invasive plants to the soil. Interestingly, adding organic matter from F. japonica decreased herbivores' nematode abundance, suggesting a potential ecologically friendly strategy against plant parasitic nematodes. The study highlights the effects of invasive plant organic matter on soil communities, emphasizing the importance of understanding these interactions for effective ecosystem management. These findings contribute valuable insights into potential strategies for mitigating the impact of invasive plants on soil biodiversity and functioning.

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Keywords: invasive plants,organic matter,Nematoda,soil health

ID ABS WEB: 138048

4. Soil health in achieving the Sustainable Development Goals
4.08 132261 - Ecosystem services provided by nematodes and other soil invertebrates and specific protection goals

EFFECT OF LONG-TERM SET-ASIDE MANAGEMENT SYSTEM ON SOIL HEALTH BY BIODIVERSITY INDICATORS

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Organic matter depletion and biodiversity decline are among the major threats to soil health and agriculture sustainability. Managing set-aside land by mowing still represents an easy way to prevent land abandonment and to preserve soil biodiversity and functions, which are essential for soil fertility. Most of the studies focused on the impact of set-aside on soil biodiversity and organic C in the short-medium period, but information on the long-term effects of such practices is lacking. The present study aims to assess the potential effectiveness of set-aside for a long-time (14 years) to prevent soil health degradation.
The experimental field used in this study was in Vicarello (Pisa, Italy), where set-aside (SA) management was compared to abandoned land (AB) and conventional crops rotation (CR), and soil samples were collected in spring (before mowing) and autumn (after mowing) for two years. Different indicators were used to evaluate the soil fertility conservation and the changes in biodiversity at different scales. Soil biodiversity was assessed on microbial, nematode, and microarthropod indicators. Soil chemical analysis was also performed.
TOC was consistently higher in AB fields and, to a lesser extent, in SA than in CR. In accordance with the TOC values, AB and SA showed higher microbial biomass values than CR. The lowest soil basal respiration values found in AB indicated a reduced mineralization rate of soil organic matter, confirming how natural soils are more stable but less productive and biologically active than soils agronomically managed. MDS analysis on nematode and microarthropod taxa abundance showed that SA and AB were partially separated by CR due to the increase in bacterial and fungal feeder nematodes involved in organic carbon mineralization and the enhancement of microarthropod abundance and taxa richness.
These results evidenced that SA is an intermediate step of a transition from conventional agricultural to naturalized grassland and confirmed the potential benefits on soil biological diversity and functions.

Keywords: Microorganisms,Nematodes,Microarthropods,Soil chemical properties

ID ABS WEB: 136589

4. Soil health in achieving the Sustainable Development Goals
4.13 133539 - Development of efficient soil education scheme for tomorrow

THE USE OF THE INTERNET AND INFORMATION AND COMMUNICATION TECHNOLOGIES FOR THE TEACHINGS AND SELF-LEARNING OF SOIL SCIENCE

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The teaching of soil sciences fails to achieve its learning objectives due, among other things, to the difficulty of accessing the information generated without images, uncompleted data, very specialized taxonomic language, nonapplications of use, and ancient and inadequate forms of teaching. In recent years, many soil information technologies have been generated. However, all this information from new technologies has yet to be put at the service of soil science teaching.
The objective was to generate a virtual museum of soil geography in Mexico as a technological tool that is very useful in teaching soils and for the general population's self-learning.
The strategy consisted of developing a website called Virtual Museum of Soil Geography of Mexico, in which a menu has been placed with options to access two video channels and two blogs. Apps have been generated with maps and soil information from Tabasco, Yucatán, Campeche y Michoacán states. The museum has five types of software to analyze data on soil, climate, agricultural water quality, and heavy metals. We have generated geopedological maps of the states of Tabasco, Campeche, Michoacán, and Yucatán, as well as digital maps of heavy metals in 14 Mexican cities.
The website of the Virtual Museum of Soil Geography of Mexico is https://museosuelos.ciga.unam.mx/. The following sections are in operation: The Museum, Work team, Maps, Databases, Videos, Blogs, To Read, Links of Interest, Image of the Month, and Technology.
The videos section has 250 links to YouTube; the notes section has 150 links to blogs. The virtual soil Museum is used in various university soil science courses. The web page is then a clear example of the socialization of science. The Virtual Museum of Soil Geography of Mexico is a world reference in disseminating soil sciences, with more than 37,000 visits worldwide in its first year of operation.

Keywords: Web page,Museum,Videos,ICT,Education

ID ABS WEB: 136026

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

SOIL QUALITY ASSESSMENT OF CULTIVATING FLOODED RICE ON HISTOSOL UNDER VARYING FLOOD DEPTHS

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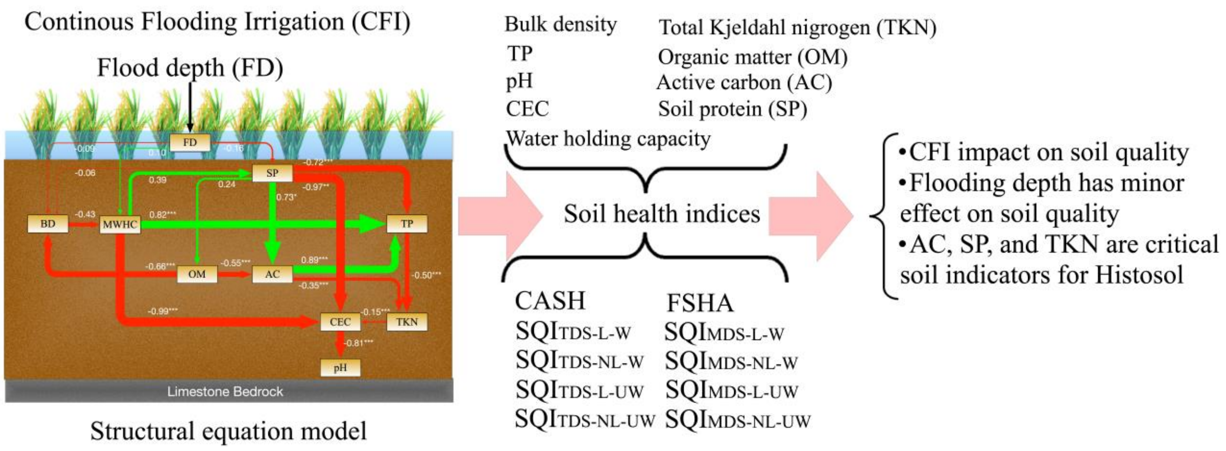
Rice (Oryza sativa L.) is a widely grown crop globally, with continuous flooding irrigation (CFI) being a common practice. However, the optimal flood depth for soil quality is poorly understood. To evaluate soil quality across flooded rice fields on Histosols using CFI, a two-year field experiment was conducted with four different flood depths - 5 cm, 10 cm, 15 cm, and 20 cm. Nine soil quality indicators (SQIs) were used to evaluate soil quality, including bulk density (BD), water holding capacity (WHC), pH, cation exchange capacity (CEC), total phosphorus (TP), total Kjeldahl nitrogen (TKN), organic matter (OM), active carbon (AC), and soil protein (SP). Various scoring methods were used to calculate each of the SQIs, including total data set (TDS), minimum data set (MDS), linear (SQIL), nonlinear (SQINL), weighted (SQIW), and unweighted (SQIUW) scoring methods. A range of soil quality indices (SQI) was applied, including Cornell Comprehensive Assessment of Soil Health (CASH), Florida Soil Health Assessment (FSHA), SQITDS-L-W, SQITDS-L-UW, SQITDS-NL-W, SQITDS-NL-UW, SQIMDS-L-W, SQIMDS-L-UW, SQIMDS-UL-W, and SQIMDS-UL-UW. The results of the study showed that flood depth primarily affected BD ($p < 0.001$), MWHC ($p < 0.05$), and SP ($p < 0.001$), but were not related to soil quality. Also, the principal component analysis indicated that SP, AC, and TKN were the critical soil quality indicators for evaluating soil quality on Histosol soil. Additionally, the importance of selecting soil score functions from high to low is: SQITDS/SQIMDS, SQIL/SQINL, and SQIW/SQIUW. Overall, this study provides important insights into water management in rice cultivation.



Keywords: Soil quality,Flooding rice,Flood depths,Histosol soil,Everglades Agricultural Area

BEST POSTERS

ID ABS WEB: 136360

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

SOIL HEALTH AS INFLUENCED BY AGRICULTURAL LAND USE CHANGES IN A HUMID SUBTROPICAL CLIMATIC REGION OF THE UNITED STATES

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Land application of poultry litter is a common practice that is used as organic fertilizer to provide nutrients. It Is considered to turn agricultural soils into a carbon sink, thus protecting against climate change. However, further research is needed on the impact of land use change from native vegetation land to agricultural lands with poultry litter application on soil health indicators. Soil samples were collected at depth of 0-15cm from a farmland with three different crop types (corn, cotton, soybean) under long-term poultry litter application and adjacent native vegetation land in Mississippi. Land use change from vegetation land to farmland significantly decreased major soil health indicators such as soil organic carbon, total soil nitrogen, extractable phosphorus, potassium, calcium, magnesium, aggregate stability, available water content and bulk density. we also assessed the correlation among soil indicators. The soil health assessment results showed that the conversion of vegetation land to farmland could decrease soil carbon content and soil health.

Keywords: land use change,soil health,native vegetation land,agricultural land,poultry litter

ID ABS WEB: 136767

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

IMPACTS OF REGENERATIVE AGRICULTURE ON GRASSLAND PRODUCTION: A NEW FARMLET-SCALE EXPERIMENT AT LINCOLN UNIVERSITY, NEW ZEALAND

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Regenerative agriculture (RA) is topical worldwide for its principles around sustainable food production. The practice has been adopted in New Zealand (NZ) without any formal assessment of its total on-farm impact. We examined the effects of RA on yield and weed invasion in grassland production and whether these effects depend on soil P.

At Lincoln University, NZ, an RA system comprising species-rich pastures and 'long grass' rotational grazing (R) was created alongside a conventional system comprising current best practices (C) in soils of low (L) and high (H) fertility (10 and 20 mg P/kg). Treatments were laid out in five 4 x 4 Latin squares of 0.1 ha plots. Plots of the same treatment were rotationally grazed by a flock of sheep at 10-14 ewes/ha.

We analysed dry matter (DM) yield and weed content for two Latin squares, from sowing (10-13/12/2021) to 30/6/2022 (establishment) and 28/6/2023 (year 1). Seed sown was R: a 12-species mix of six grasses, two herbs and four legumes and C: a monoculture of Medicago sativa. Fertiliser input was 4 t lime/ha, L: 4 P and 10 S kg/ha and H: 64 P and 116 S kg/ha.

At 18 months, we found no differences in yield (mean 14,290 kg DM/ha) and weeds comprised 7% of yield for L compared to 14% for H (p=0.022). For the first 6 months, there were no yield differences (mean 4,770 kg DM/ha) and weed was 15% for L and 29% for H (p=0.004). Over the next 12 months, yield was lower for R than C at 8,660 and 10,380 kg DM/ha (p=0.048) and there were no differences in weed content (mean 5%).

RA did not enhance yield and weed suppression. The 1.7 t DM/ha of lost yield across fertility levels for year 1 suggests a reduced utilisation of water, nutrients and light. This initial result requires further examination across the full design and duration (6 years) of the experiment.

Keywords: Regenerative agriculture,Yield,Phosphorus,Grazing,Multi-species

ID ABS WEB: 137748

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

SOIL HEALTH INDICATORS AND CROP PRODUCTION IN RESPONSE TO LAND USE AND MANAGEMENT CHANGE

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Changes in land use could have a substantial impact on soil health, as a result, could significantly affect crop yields. The objective of this study was to explore the effects of converting native vegetation lands to cultivated lands and the subsequent long-term intensive management on soil health indicators in the southeast USA. We compared soil health of land use change and investigated soil health indicators of cultivated lands as affected by different land management practices [including broiler litter (BL), BL in combination with flue gas desulfurization gypsum plus lignite (BL + FGD + Lignite)]. The soil health indicators we measured included soil bulk density, soil water-stable aggregates, pH, total nitrogen, phosphorus, potassium, soil organic carbon content and storage, as well as C/N ratio in the soils of native vegetation lands and cultivated lands. The results revealed a noteworthy increase in soil organic carbon content and storage, pH, total nitrogen, phosphorus, potassium, C/N ratio, and water-stable aggregates following the conversion of native vegetation lands to cultivated lands. Meanwhile, soil bulk density experienced a significant decrease. These findings suggest that the land-use conversion and subsequent long-term intensive management have significantly contributed to sustaining soil fertility and quality, thereby benefiting soil health. Moreover, we also observed that after native vegetation lands were converted to cultivated lands, the corn grain yield significantly increased, which may be attributed to changes in soil nutrient supply. In conclusion, our study suggests that the conversion of native vegetation lands to cultivated lands, coupled with subsequent intensive management practices, is beneficial for enhancing soil health and fostering increased corn grain yield. Therefore, for the development of sustainable cultivated lands, future management practices, such as the application of BL or BL + FGD + Lignite, which effectively increases nutrient input into soils, should be explored and implemented.

Keywords: Cultivated lands,Native vegetation lands,Intensive management,Soil health indicators

ID ABS WEB: 137933

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

CHANGES IN LAND USE ALTER SOIL HEALTH AND ORGANIC CARBON, NUTRIENTS, HYDRAULIC PROPERTIES OF SILT LOAM SOILS IN SOUTHEASTERN USA

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Land use change alters soil properties and soil health and thus affects the ability of resilience to climate change. High tunnel cultivation is an economical and high-return agricultural land use management. This study investigated the effects of changes in land use on soil health indicators. Soil samples were taken from high tunnel vegetable farms, and soil from a nearby vegetation land was used as a reference. Land use change from vegetation land to high tunnel cultivation significantly increased soil organic carbon, pH, nitrogen, phosphorus, potassium, calcium, and magnesium, with varying degrees in the 0-15cm soil layer, but decreased soil field water capacity, wilting coefficient and available water content. Cluster analysis results showed that soil properties in high tunnel cultivation were quite different from that in vegetation land. The soil health assessment showed that high tunnel cultivation increased overall soil health compared to vegetation land. The study highlights that the conversion of vegetation land to high tunnel cultivation in increase of soil health. However, organically managed high tunnel soils are at risk of alkalization also at risk of alkalization.

Keywords: land use change,soil health,soil properties,soil organic carbon,soil nutrients

ID ABS WEB: 137667

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

ABOUT THE USEFULNESS OF MICROARTHROPODS FOR ASSESSING SOIL HEALTH ALONG SEASONAL AND CLIMATE VARIATIONS IN EUROPEAN PERENNIAL CROPS

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The Soil Biological index (QBS-ar) combines the biodiversity of soil mesofauna community with the degree of soil animals' vulnerability and provides information on the soil biological quality, which is an indicator of degradation. The QBS-ar index is a metric index applied mostly in Mediterranean environment, in different land uses and managements always proving to be an excellent tool to quickly and inexpensively determine soil health. On the last few years thanks to the internal and scientific network activities of EJPsoil projects (MINOTAUR, Energylink) the index has been also proposed as a parameter for the evaluation of soil biodiversity related to mesofauna and also used in conjunction with other biological indicators or functional indicators. Although widely used in the Mediterranean climate (especially in Italy), it is necessary to standardize its application in different climatic contexts. Within the activity of Energylink project, we collected mesofauna in three long term agroecological experiment (LTE): an Olive orchard with mixed cover from Spain, biochar and mixed cover soil from Italy and Vineyards with bare interrow space and with permanent grassland from Slovenia. Sampling was done in late autumn 2022 (November) and late spring 2023 (June), air temperatures were considered with other soil characterization parameters. To calculate the QBS-ar and other related indexes we used the toolbox proposed to standardize the procedure.
The results showed that seasonality is the key factor influencing the mesofauna-based indexes in Mediterranean environment, while in temperate climates the seasonality on results is less pronounced. Data from Spain show a significant decrease in mesofauna in late spring, likely attributed to the extremely high temperatures. However, the results from Spain exhibited a more refined discrimination of the effect of agronomic practices on soil health than those from Slovenia and Italy. This result may be useful for giving correct technical and methodological information on the application of the mesofauna-based indices in order to standardize them across different climatic contexts.

Keywords: microarthropods,perennial crops,agro-ecology

ID ABS WEB: 137801

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

ASSESSMENT OF THE IMPACTS OF CARPOBROTUS SPP. AND OPUNTIA STRICTA ON MICROARTHROPOD COMMUNITIES IN THE TUSCAN ARCHIPELAGO ISLANDS

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Biological invasions represent one of the most dramatic threats to biodiversity. The effects of biological invasions are more evident on the islands for their fragility and the presence of several endemisms. Carpobrotus spp. and Opuntia spp., the most widespread invasive alien plants in the Mediterranean islands, already exert ecological impacts on natural vegetation and soil physical-chemical properties, while the effect on microarthropod communities is still unknown. For this reason, in 2023 their potential impact on microarthropod communities was assessed in Giglio e and Capraia islands of the Tuscan Archipelago.
In Giglio island, 18 randomly placed 4 m2 quadrat plots in the Mediterranean garigues were surveyed: six invaded by Carpobrotus spp. to assess its ongoing impacts, six where the species was eradicated one year before to evaluate the recovery of the community, and six naturally uninvaded by the species as control. In Capraia island, 12 (4 m2 quadrat) plots, six invaded by Opuntia stricta and six uninvaded as control, were randomly selected. In each plot, soil samples (10 cm cube) were collected using a special corer for the mesofauna sampling. Microarthropods were extracted from the samples using modified Berlese-Tullgren funnels following a standard methodology, were observed at the stereomicroscope, and classified at level order. Moreover, several indicators were calculated to evaluate soil health.
Carpobrotus spp. and Opuntia spp. showed a different effect on microarthropod communities. In Giglio island, the presence of Carpobrotus, due to the relevant changes in vegetation and soil, the abundance and biodiversity of microarthropods increased as evidenced by Dominance, Simpson, Shannon-Weiner, Brillouin, Equitability, and Berger-Parker indicators. On the contrary, the invasion of O. stricta seems not to significantly change the microarthropod communities and only QBS-ar value resulted lower in invaded plots.
Further analyses are necessary to evaluate the impact of these two invasive alien plants considering a multi-taxa approach and the complex interaction in the soil environment.

Keywords: Invasive alien plants,Capraia island,Giglio island,soil biodiversity indicators

ID ABS WEB: 137845

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

SOIL BIOLOGICAL QUALITY INDEX BASED ON EARTHWORMS (QBS-E) IN STRIP CROPPING VERSUS PURE STANDS: PRELIMINARY RESULTS OF THE ORTOBIOSTRIP PROJECT

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Climate change and intensive use of fertilizers and pesticides have reduced soil biodiversity and its long-term provisioning of ecosystem services. Several EU and worldwide initiatives recognize and address these challenges by promoting sustainable agricultural practices, such as use of cover crops, minimum tillage, and crop diversification. These include strip cropping, an agroecological technique consisting in planting different crops in alternating strips in a rotational system. This increases diversification not only in time but also in space. The main aim of this study, which is part of the OrtoBioStrip (OBS) project, is to assess the soil health status in strip cropping compared to pure stands using chemical-physical parameters and the soil biological quality index based on earthworms (QBS-e) over a period of 2 years. Earthworms have long been known to be important contributors to organic matter decomposition, water drainage and food production, and are therefore commonly used as bioindicators. QBS-e is a recently developed index and our further aim is to consolidate its use as a reliable proxy of soil health. Here we present data from the first year of monitoring carried out on 2 farms in Marche region. In spring 2023 strips and pure stands were cultivated with wheat, faba bean and clover, and earthworms were extracted from 30x30x20cm soil monoliths by hand sorting. They were counted and classified into ecological categories and species using morphological keys. Overall, 117 individuals, belonging to 3 ecological categories and 6 species were identified. Preliminary data showed that compared to pure stands, strip cropping did not significantly affect earthworm communities. Earthworms seem to be rather influenced by either fertilization or soil moisture. For the next sampling season, it is planned to use allyl iso-thiocyanate to chemically expel earthworms (including anecic ones) and to increase the number of replicates to improve the sample representativeness. At the end of the project, soil quality and agronomic data will be integrated to better understand overall strip cropping performance.

Keywords: earthworms,QBS-e,agroecology,strip cropping,soil health

ID ABS WEB: 137969

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

SETTING-UP OF MEDITERRANEAN CAMBISOL MESOCOSMS FOR ASSESSING CHEMICAL AND MICROBIAL FEATURES RELATED TO MESOFAUNA COMMUNITY HEALTH

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Mesocosms constitute simplified models of natural ecosystems and represent useful tools for developing hypotheses on the soil-plant relationship that can realistically represent certain complex interactions of natural systems and provide information that is more immediately referable to field dynamics. Moreover, in interdisciplinary research on soil systems, mesocosms help find correlations between chemical indices and ecological ones. In the present research mesocosms have been used for assessing the environmental fate of biodegradable mulch films (either commercial such as Mater-Bi© and polyethylene, or innovative prepared from biopolymers of plant and algal cell wall) as linked to the activity of prokaryotic communities and soil-dwelling fauna. The experimental set-up, located at the University of Reggio Calabria (Italy), consists of confined mesocosm-type units made up of polyethylene conic washtubs (41 cm height, 50 cm major diameter; 50 dm3 inner volume), provided with an internal draining gravel-type layer and bottom openings, which were placed in the open field by burying them in appropriately dug trenches, to allow the colonization of resident soil-dwelling organisms. Before burying, each mesocosm was filled with a soil/perlite mixture (80/20, v/v) and then added with 1 kg dry matter mature compost. The soil (Calcari-Fluvic Cambisol) was taken from the Ap horizon of a sandy loam citrus grove soil evolving over Holocene fluvial deposits. Initial microcosms soil characterization involved a number of physical (moisture), chemical (TOC, total N, pH, CE) and biochemical (Rbas, MBC, MBN, qCO2, qMin) properties related to mesofaunal biological forms indices (Acari/collembola, richness, Shannon, total abundance, QBS-ar, QBS-ar_BF). The results highlighted that in soils removed from their original environment and potentially subjected to a divergent evolution, chemical, biochemical and mesofaunal properties were evenly and equally represented in all mesocosms at the initial stage, thus confirming their high representative value as simplified ecological models to fully investigate soil health and responses to external factors.

Keywords: soil biodiversity,microarthropods,QBS-ar,soil respiration,phisico-chemical parameters

ID ABS WEB: 138157

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

EARTHWORM COMMUNITIES IN AGROECOSYSTEMS ACROSS EUROPE – AN ANALYSIS OF THEIR DRIVING FACTORS

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Earthworms are a commonly used indicator for soil health, as they play a crucial role in many soil processes and constitute a major part of soil organism biomass. One of the most important drivers of earthworm biodiversity is agricultural land use, since tillage, fertilization or the use of agrochemicals are known to affect earthworm communities. However, it is rarely investigated to what extent soil properties and climatic factors interact with this influence of agricultural activities. To study this, we analyzed datasets of earthworm surveys in 35 European countries covering different land uses, soil types, and climatic regions. Investigations were performed within the project MINOTAUR of the European Joint Programme Soil. Data on earthworm abundance and biodiversity in agroecosystems was collated by extracting it from literature, as well as from open access data bases such as GBIF, Edaphobase, datadryad, and zenodo. To prevent a publication bias, historical and non-English studies were also included. In addition, long-term ecological research sites were sampled for earthworms as part of the project. The greatest challenges in the data collation process were the heterogenous character of the data concerning e.g. species nomenclature, and the sometimes lacking meta-data regarding sampling methodology, and agricultural activities, soil properties, and climate at the study sites. Thus, preliminary outcomes of our analysis are (i) the need for data harmonization in biodiversity research to increase reusability of data in the future, (ii) the inclusion of a minimal set of meta-data in order to be able to examine the drivers of earthworm communities in agricultural systems. After a tedious data harmonization process, we will analyze our data using structural equation models, to determine which factors had the biggest impacts on earthworm abundance and biodiversity. This information then allows a better understanding of earthworm communities within agroecosystems, and to promote strategies to foster soil protection and earthworm biodiversity on a European scale.

Keywords: earthworms,soil biodiversity,agroecosytems

ID ABS WEB: 138346

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

IMPACT OF TILLAGE PRACTICES ON SOIL MESOFAUNA COMMUNITY: A COMPARATIVE STUDY IN SLOVENIA

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This study presents a detailed evaluation of the impacts of various tillage practices on soil mesofauna community, within the context of Slovenian agriculture. Conducted at the Centre for Research and Trials Jablje in central Slovenia, our study compared the effects of conventional, minimum, and no-tillage practices on soil biodiversity using a modified Quality of Biological Soil (QBS) index coupled with other diversity indices. The QBS classifies soil microarthropods into EMI forms according to their level of adaptation to the soil environment.
The two most abundant groups in our samples were Acarina (mites) and Collembola (springtails), accounting for 67.23% and 29.41% of all microarthropods, respectively. These groups showed notable variation in population densities with minimum-till supporting higher abundances of Collembola compared to conventional tillage. Both minimum and no-till supported higher abundances of hemiedaphic EMI forms compared to conventional tillage. Statistical analyses revealed a significant correlation between plant-available potassium with higher abundance of microarthropods at sites with higher potassium content.
According to the traditional QBS-ar index, which does not consider abundance and is based on the number of highly edaphic EMI groups, no-tillage obtained the highest value of 105.7. Whereas minimum tillage practices exhibited the lowest QBS-ar index value of 94.7. The Shannon and Simpson diversity indices showed analogous results. Adapted QBS-a index (taking abundances into account) showed contrasting results, classifying minimum tillage soil as of highest quality, followed by no-till and lastly conventional tillage.
Minimum tillage and no-till were shown to exhibit higher diversity and abundance of soil mesofauna, likely due to reduced soil disruption providing a favorable habitat. The positive correlation of soil mesofauna abundance with potassium content suggests that potassium creates more favorable conditions for higher soil fauna abundance either directly or indirectly by improving plant health and soil structure.
This study underscores the ecological benefits of reduced tillage practices, with minimum tillage farming particularly conducive to a diverse and abundant soil biota, thus promoting soil health and sustainability.

Keywords: soil biodiversity,QBS index,minimum and no-tillage,sustainable agriculture,soil health

ID ABS WEB: 140124

4. Soil health in achieving the Sustainable Development Goals
4.17 133569 - Revitalization of mining residue deposits

FIELD STUDY OF MERCURY AND OTHER HEAVY METAL CONTAMINATION IN ABANDONED SILVER AND GOLD TAILINGS IN COPIAPO VALLEY, CHILE

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The use of mercury to extract gold has been documented for centuries and is still used by small-scale gold miners in some countries. This practice is considered the world's largest emitter of this pollutant. Primary metal production alone releases 838 tons of mercury per year to air, water and soil. Several worldwide initiatives are currently underway to eradicate the use of mercury due to the serious environmental and health impacts they cause (UN, Minamata Convention on Mercury, 2013).
However, the levels of mercury and other heavy metals in the region's abandoned tailings are a latent threat, so it was proposed to study the current situation in order to propose the best mitigation strategies for mercury and other heavy metals present in abandoned gold and silver tailings near human sites and agricultural land. In the current research, the concentrations of mercury and other elements from the field analysis carried out in 9 abandoned tailings in the Copiapó Valley are presented. For this purpose, a Handheld X-ray Fluorescence Analyzer, the S1 Titan (Bruker, USA), was used to perform trace element measurements in situ. Subsequently, samples taken at these same sites were also analyzed by ICP-MS to confirm and validate the XRF technique for its use as a rapid, non-destructive measurement of heavy metals in this type of environmental matrix.
Results show high levels of mercury (>2500 ppm) and other heavy metals such as copper (>1800 ppm), arsenic (>2800 ppm), zinc (>10000 ppm), lead (>3900 ppm) and barium (>16000 ppm), confirming the danger of these sites, which in most cases are without access restrictions and very close to human settlements. The presence of high concentration of mercury was confirmed in the field (tailings and soil), as well as the other elements analyzed, all toxic to health. The best options for mitigation, adapted to local conditions, are currently being evaluated and will be presented as alternatives to decision-makers
Acknowledgments: Project FIC Atacama Code BIP40045269

Keywords: Mercury,Abandoned mine tailings,In situ XRF measurements

ID ABS WEB: 137108

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

AGROFORESTRY AS A SOIL RECOVERY STRATEGY IN DEGRADED NATIVE NOTHOFAGUS OBLIQUA FORESTS IN CHILE

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In Chile, approximately 37.8% of the national territory is affected by land degradation ranging from moderate to severe, primarily due to anthropogenic activities. About 44% of native forest in the southern part of the country has been partially replaced by livestock farming, particularly affecting the Nothofagus genus, with up to 70% loss of its original area. In response to this concerning degradation, agroforestry (AFS) stands out as a key climate solution, recommended by organizations such as the IPCC and FAO, for its ability to sequester organic carbon in the soil, in addition to reducing greenhouse gas emissions, conserving biodiversity, building resilience, and halting deforestation. Therefore, this study focused on determining the impact of agroforestry on a degraded native forest of Nothofagus obliqua in Ranchillo Alto (37°04´52´ S, 71°39´14´W), Ñuble Region. The study sites were classified according to previous canopy disturbance levels (+): open (Op)+++, semi-open (SOp)++, and semi-closed (SC)+. Physical, chemical, and biological properties of the soil were determined at depths of 0-30 cm and 30-60 cm. The results indicated that the topsoil horizon of 0-30 cm showed the most significant findings in all analyzed soil properties. Physically, the soils showed little variation among canopy disturbance levels, remaining within typical ranges for andisols. Chemical properties showed that the carbon (C) and nitrogen (N) contents varied between 7.9 and 10.1 ± 0.4%, and 0.4 to 0.6 ± 0.03% for C and N, respectively. The highest concentrations were found in the Op canopy. This condition could have been influenced by historical anthropogenic practices, such as agricultural burning, leading to the generation of pyrogenic carbon. Biological analyses showed greater microbial activity in the (SC) +, influenced by leaf litter and site conditions. The accumulation of organic soil carbon showed a sustained increase from 2015 to 2023 in all canopy conditions, demonstrating the capability of AFS in the recovery of soils in degraded native forests and their role as carbon sinks.

Keywords: carbon capture,climate change,degraded soils

ID ABS WEB: 137327

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

LAND USE CHANGE DYNAMICS IN TWO CONTRASTING MEDITERRANEAN WATERSHEDS (1977-2022) AND THEIR EFFECT ON SOC STOCKS

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Mediterranean region, according to the latest IPCC report, is particularly vulnerable to the impacts of climate change. This vulnerability is exacerbated by intense human activity and frequent changes in land use, leading to a notable increase in erosion and degradation processes. As a direct consequence, there is a decline in soil health and, within it, the capacity to retain organic carbon is reduced. In this context, this study aims to: (i) analyze changes in land use over the past decades (1977-2022); (ii) estimate which land uses have a higher soil of organic carbon (SOC) stocks through the collection and analysis of a total of 145 soil samples; (iii) assess the link between current SOC stocks and land use dynamics in recent years; (iv) evaluate the importance of climatic characteristics in SOC stock; (v) generate detailed SOC stocks mapping using Random Forest. For this purpose, two small Andalusian Mediterranean watersheds with contrasting climatic conditions have been selected: on one hand, a watershed (C1, Arroyo de la Pindolita – Valle del Río Genal) characterized by a subhumid Mediterranean climate (±700 mm of annual rainfall); on the other hand, a watershed (C2, Rambla del Serrón – Campo de Tabernas) with arid conditions (±150 mm of annual rainfall). The results show how the contrasting dynamics in land use changes and climatic conditions, especially rainfall, determine a highly differential behavior between the two watersheds. C1, mainly occupied by agricultural land and with a high dynamism in land use changes, has higher SOC stocks, a fact clearly conditioned by climatic characteristics favoring a biostasis situation. Meanwhile, C2 has seen a significant increase in built-up areas and land dedicated to irrigation crops, especially in recent years, identifying generally low SOC stocks.

Keywords: Carbon sequestration,Mediterranean,Climate change,Land Use Change,Digital soil mapping

ID ABS WEB: 137857

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

IS IT POSSIBLE TO RECARBONIZE AND RECOVER SOILS FROM CONSTRUCTION AND DEMOLITION WASTE - CDW (BOGOTÁ D.C.- COLOMBIA) USING BIOSOLIDS?

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Nobel Prize winner, Dr. Rattan Lal, states that “Recovering degraded soils is the best way to mitigate climate change”, added to the initiatives of the RECSOIL tool, (COP 23, 2017) of the UNFCCC, whose objective is to promote sustainable soil management focused on promoting the increase of SOC, which is why it was of interest to study one of the industrial activities that generate great impact: CDW and biosolids, considered in Colombia as a problem environmental, ignoring its potential.

Initiatives that allowed the development of this research in 2023 on a soil classified as Pachic Melanudands-Andic Dystrudepts- Aeric Endoaquepts- Aquic Hapludands complex,with a sandy frank texture . The methodology used was QGIS, Vicente Conessa, environmental impacts matrix, column study to develop using PVC tubes according to a model by Soriano-Disla et al. (2010), to established 3 treatments X 3 with soil: biosolids dose ratios T0 Control: 1:0, T1:1:2, T2:1:4, Pearson correlation, T Student and RStudio to comprobe the null hypothesis 'All doses of biosolids from the evaluated treatments contributed to the recarbonization and recovery of the soil at the CDW'. Experiment located in Chia - Universidad El Bosque for 4 months, with periodic controls of soil humidity, pH, CE and soil temperature.

After the time of the experimental phase, for the soil health and quality indicators, the following results stand out: an increase in SOC of 246% (T1) and 301% (T2), C.E of 226% (T1) and 291% (T2),C.I.C of 156% (T1) and 179% (T2), C/N of 101% (T1) and 102% (T2), gravimetric moisture of 228% (T1) and 379% (T2), and the soil aggregate stability transitioned from highly unstable to very stable. The best Pearson correlation coefficients were 0.95 between SOC and NT, 0.89 between SOC and C.E, and SOC with C.I.C, 0.87 SOC and gravimetric moisture, and 0.84 between SOC and aggregate stability. This research is considered as input to achieve specific goals of SDGs 12, 13 and 15.

Keywords: Recarbonizing,Soil Health,Environmental Engineer,Sewage Sludge,Construction-demolition wastes

ID ABS WEB: 137872

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

COUNTRYWIDE SOIL ORGANIC MATTER COMPOSITION VARIATIONS – IDENTIFICATION OF THE DRIVERS BEYOND LAND USE

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Soil organic matter (SOM) content and composition are among the most effective soil health and fertility drivers. SOM determines the most physical and chemical soil functions, and it has an essential role in food security and climate change related challenges. However, the dynamics of SOM decomposition and stabilization ways in various environments on a country scale are not entirely understood. The present study, therefore, was devoted to identifying the role of environmental properties in SOM concentration and composition variations on a country scale in Hungary. Soil samples from the uppermost, potentially tilled horizon (2–20 cm) were fractionated to determine the sequestered organic matter directly bound to the fine mineral fraction (< 20 μm) (MAOC). Altogether, 87 soil samples were fractionated from various land uses, parent materials, soil types, and environmental conditions. Consequently, the recalcitrant organic carbon concentration in the fine fraction scattered widely (0.5-14.1%) and was independent of that of the bulk soil. Instead, it was a function of the aromaticity of the bulk SOM and slope steepness. This finding suggests potential changes in the MAOC both in terms of concentration and composition due to microbial decomposition, indicating that recalcitrance by the mineral phase does not necessarily mean absolute protection. Land use seemed to affect SOM C/N ratios probably via plant residue composition, whereas aromaticity was a function of climate and soil properties, indicating the highlighted role of microbial activity.
The study was supported by the Eötvös Loránd Research Network (SA41/2021).

Keywords: Soil carbon,Soil organic matter,Land use,Carbon pools,Recalcitrance

ID ABS WEB: 135391

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

EFFECTS OF LONG-TERM ENHANCED GAME POPULATION DENSITY ON SOIL PHYSICAL, CHEMICAL, AND MICROBIOLOGICAL PROPERTIES

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Information of the impact of a high game density, which leads to high nutrient and carbon inputs via excrement and, in the case of feeding, via fodder inputs, on forest soils is almost lacking. We aimed to investigate the effect of long-term enhanced game population density on soil properties. The study site is located in Lower Austria, and consists of a fenced area (enclosure) with high game population density and a directly adjacent control area, an open forest with lower game density. Both areas contain monoculture stands (Robinia pseudoacacia (RP), Pinus nigra (PN), Quercus robur (QR), Pinus sylvestris (PS)). Soils were sampled in three depths down to 50 cm in each of the stands. Soil samples were analysed for contents of total OC and N, non-purgeable organic C (NPOC), total dissolved N (TDN), and microbial biomass C and N. We found significant differences of all parameters between the enclosure and the control area. Overall, the total OC and N as well as microbial C and N was higher in the control area, likely due to a denser understory vegetation, which was almost missing in the enclosure due to browsing. NPOC and TDN contents were higher in the enclosure indicating a higher turn-over rate of plant-available nutrients attributable to the high game animal density. Further, tree species and soil depth had a strong influence on soil parameters (especially total N, NPOC, TDN, microbial N) between inside and outside the enclosure. In detail, RP exhibited the highest total N, TDN and microbial N contents reflecting its N-fixing capacity. Furthermore, the largest interaction between tree species and enclosure vs. control area was also found for RP. These results show a clear influence of game animal density in combination with tree species on important soil properties. Future studies should include a broader variety of soil physical, chemical and biological properties, as well as stand productivity thus linking game density and forest ecosystem dynamics.

Keywords: soil organic carbon,forest soils,wild game density,tree species,nitrogen

BEST POSTERS

ID ABS WEB: 135997

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

TWO DYNAMIC PROCESS-BASED TOOLS FOR THE QUANTITATIVE ASSESSMENT OF NITRATE AND PESTICIDE LEACHING

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The estimation of Soil-based Ecosystem Services (SESs) is crucial for land management. This work presents a quantitative approach to evaluate the water regulation SESs: two web-based dynamic tools to assess and map the soil filtering capacity to both pesticides and nitrate (the LandSupport Geospatial Decision Support system).
The pesticide fate tool simulates the transport of reactive solutes, i.e. pesticides, and maps the percentage of pollutant mass that reaches the groundwater depth within a user-defined time interval. The tool integrates the extended transfer function model (TFM-ext); inputs are the soil and the vadose zone physical and hydrological properties, the climate, the groundwater table depth, and the crop-specific management (sowing and harvesting dates, pesticides doses and time of application).
The nitrate fate tool simulates the crop growth dynamics and assesses nitrate transport through the unsaturated zone until the groundwater table depth. The output maps represent the number of years for the arrival to the groundwater of 50% of the mass of nitrate leachate from the root zone. The tool is based on the coupling of the dynamical crop-growth ARMOSA model and of the TFM-ext model and its main inputs are the type of crop and/or crop rotation and related management (tillage, irrigation, fertilization, and residues), the soil physical and hydrological properties, the climate and the groundwater table depth.
This work presents the implementations and applications of both tools in three European case studies (Campania Region-IT, Marchfeld Region-AT, Zala County-HU), with two climatic datasets (baseline, future projection with RCP 4.5 and 8.5).

Keywords: Soil Ecosystem Services,Water regulation,ARMOSA model,TFM-ext,LandSupport S-DSS

ID ABS WEB: 136433

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

INTERACTIONS BETWEEN SCAVENGERS, DECOMPOSERS, AND ITS EFFECTS ON SOIL IN A PROTECTED AREA OF SOUTHERN SPAIN

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Scavenging is an important ecological process that facilitates the removal of carrion from the landscape, thereby contributing to the recycling of nutrients and ultimately stabilizing food-webs). In addition, by decreasing the time that carrion persists in the field, scavengers are regarded as pest and disease regulators, leading to tangible benefits to humans. Among all scavenger species, terrestrial vertebrates are especially relevant because they can consume large amounts of carrion over short periods of time. Therefore, insights into the organization of vertebrate scavenging assemblages around carrion resources are critical to understanding their broader contribution to ecosystem processes linked to decomposition.
On the other hand, soils represent the most biologically diverse and important ecosystem on the planet. Most of the biodiversity of ecosystems is found in the soil, about one gram of soil may typically contain one billion bacterial cells, that corresponds to about ten thousand different bacterial genomes, up to one million individual fungi, about one million cells of protists, and several hundred of nematodes.
In this sense soil microbiota and its function are extremely sensible to any change on the soil. The presence of carrion on the soil and the dynamic of scavengers can significantly modify the balance of nutrients in the soil that will affect to the structure and biodiversity of soil microorganisms. This important interaction has not been researched and there is not enough information about the effects of scavengers on soil properties.
In this study it has been evaluated the consumption process of ungulate carcasses (aoudad Ammotragus lervia) in the Sierra Espuña Regional Park (Murcia, SE Spain), in relation to the chemical and biochemical soil properties (organic carbon, N, P and K. Microbial biomass, soil respiration and enzymatic activities
The results show that most of the soil properties studied have been improved.

Keywords: Scavenging,Soil Biodiversity,Soil Quality

ID ABS WEB: 137311

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

SOILS OF VOLCANIC ORIGIN AFFECTED BY FOREST FIRES AND THE ECOSYSTEM'S RECUPERATION

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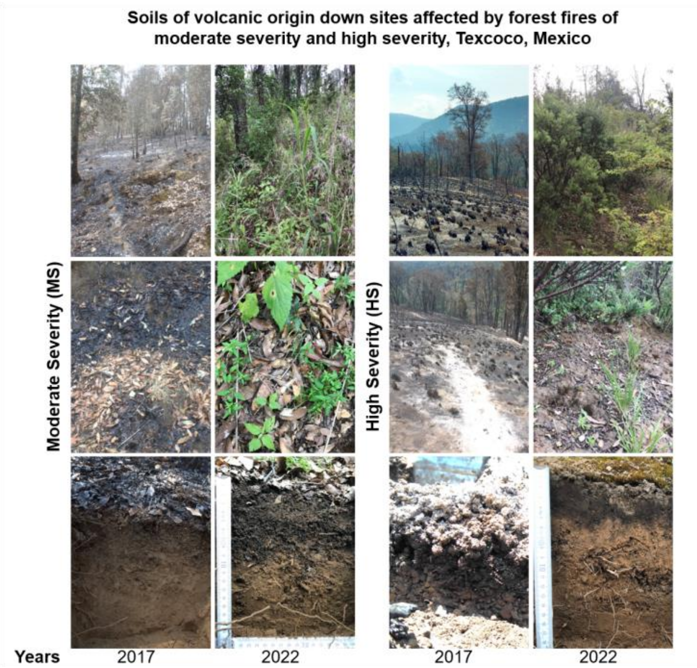
Soil is essential for the environment, and also for the ecosystem's services that benefit humans. It is a finite component exposed to threats of loss which are origin or intensified by disturbances like forest fires; nevertheless, the positive or negative effects, impact differently on each type of ecosystem. The objective was asses the changes in the properties of soils of volcanic origin down sites affected by forest fires of moderate severity and high severity, to 2 days and 5 years after the disturbance. In the Tlaloc mountain, Texcoco, Mexico there are Andosols down Mix Forest. By Procedures for Soil Analysis of Van Rewdjik (2002), we realized chemical and physical determinations on soil samples affected and not affected by forest fire, which we recollected at 0-10 cm depth. The main changes occurred on the sites with high severity, where the fire reached de top trees and, the soil reached temperatures > 250°C. Immediately after the fire forest the calcination of leaf litter, branches, and left provided Na and K to the soil, causing a percentage increased interchangeable bases; besides, the loss of organic matter caused aggregates to decrease in size and formed pseudo sands. In both severities, the changes in chemical and physical properties of soils come back to a similar condition to no affected soils after 5 years. We concluded that soils formed at volcanic ash are soils are capable of recovering, although fire severity high.



Keywords: SEVERITY,PSEUDO SANDS,TEMPERATURE,CALCINATION,DISTURBANCES

ID ABS WEB: 137730

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

VARIABILITY OF RUSLE FACTOR K IN GRASSLANDS FROM HIGH MOUNTAIN ENVIRONMENT (SIERRA DE LAS NIEVES, SOUTHERN SPAIN)

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Body

United Nations declared the majority of world's soil resources are in only fair, poor or very poor condition from soil degradation, so soil erosion is a major threat to soil. Mainly, this is the result of accelerated soil erosion processes as consequences of deforestation, overgrazing, tillage and unsuitable agricultural practices. Impacts can be severe, not only through land degradation and fertility loss, but through a conspicuous number of off-site effects leading to desertification.
In one Mediterranean high mountain environment (Sierra de las Nieves, southern Spain), this study deals with the calculation of the RUSLE Factor K in grassland soils with different degrees of degradation due to grazing and water erosion. Also, Factor K is determined for badland materials as final stage of grassland degradation. To do this, soil surface conditions is described in three different types of grassland: non-degraded, semi-degraded, and degraded, besides in badland surface material. 10-soil samples from 0-10 cm of depth are taken in all of them to analysis in laboratory: bulk density, texture, organic matter content, permeability, and aggregate stability fraction. Finally, the Factor K is calculated based on the soil data.
The results show a declining trend and significant differences between the sampled grassland and badland material: non-degraded 0.36±0.14, semi-degraded 0.56±0.13, degraded 0.68±0.12, and badland material 0.74±0.05. These significant differences are not achieved regarding mean aggregate stability fraction: non-degraded 28.7±10.5%, semi-degraded 35.8±7.9%, degraded 30.3±8.6%, and badland material 26.6±9.0%. Although the non-degraded grassland shows one Factor K indicating very low soil erodibility compared to the others and badland material, the aggregate stability data highlights a very fragile environment. Thus, when grassland is impacted by an increment in grazing activity and/or water erosion, it may become easily degraded. These results are key to improve the land management as the study are within a remarkable national park of outstanding ecosystems.

Keywords: Soil degradation,RUSLE Factor K,Grassland,Badland,High Mountain

ID ABS WEB: 138296

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

MULTI-KINGDOM DYNAMICS OF SOIL COMMUNITIES ASSOCIATED WITH THE RHIZOSPHERE OF RUBUS NIVEUS: A KEY INVASIVE SPECIES IN THE GALÁPAGOS ISLANDS

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Multiple abiotic and biotic factors (e.g. inter- and intra-species interactions) influence the communities associated with the rhizosphere. Research often only evaluates the impact of drivers on a single taxonomic kingdom, omitting possible inter-kingdom interactions in the rhizosphere. Here, we investigate the communities (i.e., bacteria, fungi, protozoan and metazoan) associated with the rhizosphere of the invasive plant species Rubus niveus in three different areas of Santa Cruz Island (Galapagos Islands, Ecuador). At each site, we collected 15 replicates of the rhizosphere of R. niveus. The taxonomical diversity was investigated via DNA metabarcoding of the bacterial 16S rRNA gene, fungal ITS2 region and metazoan and protozoa CO1 gene. Conjointly, the soil chemical parameters (e.g. pH, concentration of heavy metals, carbon, nitrogen) were evaluated. Soil biotic and abiotic parameters were integrated through ecological network analyses to reveal the interactions between kingdoms and the influenced abiotic soil parameters.
Our results indicate that bacteria were dominating networks (62-70% of nodes), fungi were the second most abundant kingdom (16-21%), followed by metazoa and protozoa (5-12% and 4-7% respectively). The three networks shared only 46 OTUs (out of 229, 293 and 227 nodes), and no common inter-kingdom interactions nor shared keystone species were found among the three sampling areas. Certain species acted as keystone species within some networks but not in others, while another subset was identified as “unique” to each respective network. The chemical parameters significantly differed among the sites, and their impact on the networks highly varied depending on the sampled site. The soil communities that are associated with the rhizosphere of R. niveus were made up of both site-specific and cosmopolitan taxa. Also, the factors that influenced these communities vary across different environments, which highlights the need to study diverse belowground communities to gain a deeper understanding of how biotic and abiotic factors are shaping them.

Keywords: Soil biodiversity,Rhizosphere,Invasive plant,Biochemistry,Ecological networks

ID ABS WEB: 137681

5. Soil in the circular economy
5.01 133614 - Soil needs in industrial agriculture and highly populated areas

DEVELOPMENT OF FERTILISER FROM BREWERY WASTE: HINTS FROM THE ALGAEBREW PROJECT

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The use of mineral fertilizers for crop production is an unsustainable approach, negatively impacting the environment, soil health, and fertility. The AlgaeBrew project addresses these linear economy-based practices by managing brewery waste, which otherwise is fated to become a catalyst for soil, water, and environmental deterioration. AlgaeBrew aims to use brewery wastewater and brewer's spent grains to cultivate Nannochloropsis spp. to produce eicosapentaenoic acid (EPA) for aquaculture feed and agricultural fertilizer using the defatted microalgae. For fertilizer production, defatted microalgae were blended with spent coffee grounds (SCG) using 0.5% xanthan gum as a binding agent to produce nine formulations through the wet granulation method. The C/N ratio was estimated for each formulation, and the formulation with 50% defatted microalgae and 50% SCG was finalized (C/N: 11). Phytotoxicity tests were conducted to examine the toxicity of fertilizer by using Lepidium sativum, Sorghum saccharatum, and Sinapis alba. Compared to control OECD soil, in S. alba, a higher germination index (GI) was observed for 1.2%, 2.5% and 5% of fertilizer applications. Whereas a higher GI in L. sativum was observed for control,1.25%, 2.5% and 5% of fertilizer application, and in S. saccharatum, for 2.5%, 10% and 15% of fertilizer application. These results depict the positive effect of novel fertilizer on GI. Moreover, upon root length analysis, no significant differences were noted in the root length of all tested plant species grown in control soil and lower concentrations of fertilizer. Furthermore, this formulation was also able to increase the water-holding capacity of the soil. As this is an ongoing EU ERA-NETs - SUSFOOD2 project, new fertilizer formulations are being developed using other brewery waste. In the future, ecotoxicological tests involving soil fauna organisms and plant pot experiments will be carried out to assess the fertilizer's effect on plant health and soil rhizosphere microbiome (i.e. bacteria and protists). In conclusion, the AlgaeBrew strives to emphasize on zero-waste generation, circular bio-economy and agricultural sustainability.

Keywords: Waste management,Microalgae fertilizer,Soil health,Nutrient circularity,Sustainability

ID ABS WEB: 138261

5. Soil in the circular economy
5.01 133614 - Soil needs in industrial agriculture and highly populated areas

EFFECT OF THE USE OF PASTEURISED SEWAGE SLUDGE ON THE ENZYMATIC ACTIVITY AND QUALITY OF AGRICULTURAL SOILS

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Population growth has led to an increase in urban and industrial waste, which has agronomic potential as a source of fertiliser, organic matter, nitrogen and other plant nutrients.
However, its use is regulated in the European Union by Council Directive 86/278/EEC, partly because of pathogens and their impact on human and soil health. The Council Directive sets a safety period of 10 months from sludge application to crop harvest, which is an obstacle for most horticultural crops and relegates them to rain-fed crops. Pasteurization processes can eliminate pathogenic micro-organisms and can therefore achieve two results: reduction of the safety period and reuse of a residue.
According to that idea, this research aims to use pasteurised sewage sludge in different formats to improve soil quality, increase soil enzymatic activity and demonstrate the elimination of pathogenic microorganisms in a laboratory control experience. A greenhouse experience was carried out with Capsicum annuum combined with fresh sludge and pasteurised sludge (paste, granule and pellet formats), 3 doses (40, 80 and 120 tonnes per hectare), 2 soil incorporation positions (buried and surface) and 3 replicates for each combination. After the harvest, chemical, biological and microbiological analyses were carried out on the soils.
The main outcomes revealed that the pasteurisation process eliminated Salmonella and Escherichia coli. In addition, an increase of 1.43% was registered in the organic matter between control and fresh sludge, 1.83% in the case of pasteurised paste, 1,65% with granulate and 1.88% with pellet. An increase between 0.06 and 0.07% was registered in nitrogen content, enzymatic activity also increased with sludge dose, especially for dehydrogenase from 0.52 ml H g-1soil in control to 4.73, 5.22, 4.31 and 4.82-ml H g-1soil in fresh, paste, granule and pellet sludge respectively, urease activity was also increased in all sludge formats.
The addition of sewage sludge to soil improved chemical and biological properties, and pasteurisation eliminates all pathogenic microorganisms contained in sludge.

Keywords: Sewage sludge,soil quality,pasteurization,soil pathogens,organic carbon

ID ABS WEB: 140115

6. Soil in the digital era
6.06 133437 - Novel approaches to process-based modelling in agricultural soils

SOIL HETEROTROPHIC RESPIRATION AND N2O EMISSIONS MODELING: A MULTI-YEAR MODEL EVALUATION WITH CONTINUOUS FIELD MEASURES

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Soil and weather conditions, alongside to cropping system management practices, influence soil heterotrophic respiration and nitrous oxide emissions in agricultural soils. This network of complex interactions can be evaluated using process-based dynamic simulations models, that represent useful tools to identify trade-off practices to reduce CO_2 and N_2O soil fluxes.
Continuous field measures of CO_2 and N_2O soil fluxes were obtained through an automated greenhouse gases (GHG) monitoring station controlling eight flow-through non-steady-state automatic chambers in two cropping systems (4 chambers for each cropping system) in two pilot farm, located in northern and southern Italy. The two cropping systems (a conventional system and an efficient system, employing a decision support system for fertilization and irrigation, that involves legume and cover crops insertion into the crop rotation) were compared through 3-year crop rotations. Additional data (crop biomass, soil mineral nitrogen, soil water content and temperature) from field monitoring have been collected in order to provide a reliable daily prediction of CO_2 and N_2O emissions from topsoil layers. ARMOSA model (Perego et al., 2013), employed in this study, simulates crop growth, water, C and N dynamics under different pedoclimatic conditions and management practices. It already demonstrated its reliability in reproducing crop yield and in evaluating crop production environmental effects (especially NO_3 leaching) under contrasting pedoclimatic conditions. After parameters calibration, the model was able to satisfactorily capture crop and soil related variables, as well as CO_2 and N_2O cumulative emissions obtained on the base of soil use. Overall, ARMOSA model adequately simulated emissions trends over time, taking into account weather conditions, tillage events, mineral N application (type and depth), crop residue type and management (removal, soil incorporation or mulching).

Bibliography
Perego, A. et al., 2013. The ARMOSA simulation crop model: overall features, calibration and validation results. Italian Journal of Agrometeorology 3, 23–38

Keywords: GHG monitoring,GHG soil fluxes modeling,soil and cropping system model

ID ABS WEB: 136349

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

TEMPORAL EVOLUTION OF PHOSPHORUS AVAILABILITY FROM ROOT IRON PLAQUE FOR RICE GROWN UNDER DIFFERENT WATER MANAGEMENT

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The redox cycling of iron (Fe) in paddy soils affects phosphorus (P) cycling, consequently water-saving practices could modify P availability for rice. The changes of Fe plaque dynamics at rhizosphere level may consequently affect P retention, release and plant uptake. Considering the variability in soil P speciation, limited information is available regarding the forms of P retained by Fe plaque and their relationship with P availability for rice. We hypothesized that dry periods during rice cropping will affect porewater chemistry, thus influencing the quantity and mineral composition of plaque. These variations will result in changes in the forms and mechanisms of P retention by the plaque, potentially impacting its role as a sink or source of available P. Rice was cultivated in mesocosms under continuous soil flooding (CF) or alternating wetting and drying (AWD) irrigation. Roots sampled during rice growth were chemically extracted to investigate the temporal evolution of Fe plaque crystallization, while the forms of P retained in the plaque were evaluated by spectroscopic techniques. The results indicated that dry periods led to a decrease of FeII in the solution, in turn increasing its P:Fe molar ratio. AWD resulted in the lower plaque deposition mainly composed of poorly crystalline Fe phases. The FT-IR spectra showed that under AWD the formation of amorphous Fe-P co-precipitates were favored compared to CF systems where surface P sorption on crystalline Fe phases was mainly observed. P-XANES revealed an increase in the retention of organic P forms under AWD, likely due to the higher P:Fe molar ratio favoring co-precipitation over inorganic P forms. Plant-P under AWD better correlated with plaque-P compared to CF, because of the different P retention mechanism. Our findings support the hypothesis that water management influences P availability for plant uptake, because AWD promote the formation of Fe-phosphate precipitates with a faster dissolution rate compared P sorbed on Fe (hydr)oxides, enhancing P availability for rice.

Keywords: Rice,Fe plaque,Phosphorus,Water saving tecniques

ID ABS WEB: 136386

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

GENETIC AND FUNCTIONAL DIVERSITY OF BACTERIAL COMMUNITIES STRICTLY ASSOCIATED WITH THE SPORES OF ARBUSCULAR MYCORRHIZAL FUNGI ISOLATED FROM THE RHIZOSPHERE OF AMMOPHILA ARENARIA

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The rhizosphere is a dynamic environment colonized by a wide variety of microorganisms, including arbuscular mycorrhizal fungi (AMF) and bacteria that are strictly associated with their spores and mycelium. They promote plant growth and nutrition, and increase plant tolerance to abiotic stresses by improving plant water and nutrient-use efficiency and plant antioxidant defence systems. The aim of this study was the molecular and functional characterization of bacterial communities strictly associated with AMF spores occurring in the rhizosphere of Ammophila arenaria growing in a maritime sand dune system, a drought-stressed and low-fertility environment. Illumina MiSeq analyses of bacteria strictly associated with two Racocetra species allowed the identification of 14 Phyla, including Bacillota (66.1%) and Actinomycetota (8.2%). 253 Amplicon Sequence Variants out of 281 included culturable bacteria, most of which known for their plant-growth promoting properties. The bacterial community found in Racocetra persica was richer than that of Racocetra fulgida and 16 indicator species were found, including some rhizobia and actinobacteria species. Interestingly, two endosymbiotic bacteria of AMF were found. Culture-dependent analyses allowed the isolation in pure culture of 203 and 81 strains from R. persica and R. fulgida spores, respectively. Interestingly, diverse bacterial communities were associated with the spores of the two AMF, although originated from the same host plants and environmental conditions, showing that each AMF isolate recruits on its spores a different microbiota. Functional analyses showed the ability of many bacterial strains to produce high levels of exopolysaccharides, key compounds for plant drought tolerance, favouring water retention and protecting roots against desiccation. Moreover, different bacterial strains were able to produce a number of plant growth promoting compounds. This work selected the best performing bacterial isolates to be further tested in the formulation of effective microbial consortia and applied as innovative inocula promoting plant growth and resilience under climate change.

Keywords: arbuscular mycorrhizal symbion,Ammophila arenaria,microbiome,drought stress,exopolysaccharides

ID ABS WEB: 136731

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

ADVANCING RHIZOSPHERE BIOENGINEERING FOR ENHANCED NODULE FORMATION IN LEGUMES AND SOIL DYNAMICS

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The symbiotic relationship between Rhizobium and legumes plays a significant role in biological nitrogen fixation (BNF), offering an economical way to improve soil quality and increase the yields of subsequent crops. These crops are rich in nutrients, including fiber, carbohydrates, B vitamins, and essential minerals like iron, copper, magnesium, zinc, and phosphorus. In this process, nodules form on the roots of legumes, where rhizobia bacteria convert atmospheric nitrogen into usable forms. However, the success of nodulation and nitrogen fixation relies on the mutual compatibility and effectiveness of the Rhizobium-legume partnership, which can vary with different soil and environmental conditions. In our research study for enhancing products yields, we are working on isolation and characterization of PGPR associated on the nodule surfaces and crushed into legume seed effectively improve the nodulation of legume plants under real-world field conditions. Legume plant samples collected from the research field of Ayub Agricultural Research Institute, Faisalabad. The nodules were cut from samples and subjected to PGPR isolation through serial dilution method purified on nutrient agar media followed by the morphological characterization including colony size, colour, texture and Gram's reaction. The isolated strains were analyzed for their ability to promote plant growth, focusing on key characteristics like their capacity to solubilize phosphate, produce indole-3-acetic acid, and to exhibit ACC deaminase activity. In the next phase of our research, a pot experiment will be conducted through complete randomized design to check the effect of inoculation influence of screened bacterial isolates on nodule formation of legume plants. We are expecting the identification of potential PGPR strains with enhancing possible role in legume crops nodule formation, examining the current effectiveness of microbial interventions in soil ecosystems and exploring the potential of advanced bioengineering aiming to enhance soil health and crop production.

Keywords: Legume crop,Nitrogen fixation,PGPR isolation,Rhizosphere bioengineering,Soil fertility

ID ABS WEB: 137847

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

GEODIVERSITY AS A DRIVER OF THE SOIL MICROBIAL COMMUNITIES IN MEDITERRANEAN CENTURIES-OLD OLIVE ORCHARD

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This study shows how geodiversity is a key factor of the microbial community diversity in the soils of ancient olive groves. Extreme climate events determine important variations in olive tree activities, but their impact on soil microbial biodiversity is still poorly documented. Eighty soil samples were collected from six different geochemical provinces of Tuscany, Italy. We investigated by metabarcoding sequencing, the phylogenetic and functional profile of soil bacteria in ancient Tuscany olive groves cultivated in areas named as Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI). Lithological geodiversity factors of soils were assessed by using the rare earth elements (REEs), the latter considered as fingerprints of the sediments origin and monitors of environmental variations (e.g. soil erosion processes, plant uptake and related soil nutrient depletion, nutrient biolifting). Soil bacterial diversity, shaped by soil-forming factors such as bedrock degradation, weather changes and microclimate, was assessed by 16S rDNA NG Sequencing.
To date, little is known about the biogeochemical processes related to the absorption and translocation of REEs especially in the olive tree and their relationship with microbial activities.
We showed that REEs fractionation patterns in soil were major drivers for bacterial communities, with a significant influence also by soil hydrologic characteristics. In fact, evidence from phylogenetic and environmental data support the existence of an evolutionary group that appears to possess important adaptations such as resistance to environmental hazards. Our study, for the first time, explored the relationship between REEs and soil microbiome under natural olive tree growing conditions in a large variety of geochemical environments. Moreover, it provides new environmental implications for the definition of soil quality.

Funding information
Financial support provided by Rural Development 2014-2020 program of Tuscany Region, through the Projects GeOEVO WEB GIS “A geospatial framework to support integrated biogeochemical modelling of the Tuscany olive grove and olive oil traceability context” and MONITOIL “Monitoring olive ripening for oil production: rapid methods compared”.

Keywords: Bio-geochemical signature,Lanthanides,Soil bacterial community,Global change,Olive grove

ID ABS WEB: 140040

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

MICROBIAL GROWTH AND FUNCTIONAL TRAITS ADAPTATION IN A 5 YEARS MAIZE MONOCULTURE

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Plant roots modulate functional traits of the rhizosphere microbial community, which process and transform organic matter in soil. How root morphology and soil texture affect functional traits through altered microbial activity remains uncertain. To address this question, two maize genotypes with contrasting root morphology - a mutant deficient in root-hairs, rth3, and its wild-type sibling, WT, were grown 5 consecutive years in excavated plots filled with two homogenized soil substrates - loam and sand. Soil sampling was performed annually at the plant growth stage of BBCH19, corresponding to vegetative growth. Soil was excavated from the first 20 cm depth and roots, separated from bulk soil, brushed for rhizosphere collection. We hypothesized (H1) larger increase in carbon content in loam than sand bulk soil due to greater CO_2 losses in sand related to better aeration and lower water retention in soil pores; and (H2) increased enzyme affinities to substrates in the rhizosphere over the years due to microbial adaptation producing specific enzyme systems. Despite the positive trend in general, a significant 19 % increase in bulk soil C content was detected solely under rth3 in loam. In contrast to C supply, remarkable increase in N content of 7 and 41 % in loam, and 62 and 82 % in sand, for WT and rth3, respectively, was observed. This resulted in lower C:N ratio in sand than loam soils, accompanied by slower microbial specific growth rate (μ_{max}), smaller microbial C pool, and lower maximum enzymatic rates for ß-glucosidase, N-acetylglucosaminidase, leucine aminopeptidase, and acid phosphatase, in the former. Enzyme affinities in the rhizosphere increased in all treatments over the years for ß-glucosidase, N-acetylglucosaminidase, and acid phosphatase, which confirmed our hypothesis. Respiration-to-biomass ratio was essentially higher in sand than loam bulk soil, resulting in larger CO_2-C losses per unit of microbial C in the former. Concluding, changes over the years occurred differently for sand and loam, marginally affected by the presence of root hairs.

Keywords: microbial functional traits,enzyme kinetics,microbial growth kinetics,soil organic matter,root morphology

ID ABS WEB: 140107

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

CLIMATE CHANGE-INDUCED HEAVY METAL ACCUMULATION IN SPINACH.

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Body
Climate change poses challenges to global agriculture, affecting both crop production and food security. While models predict climate effects on crop yields the impact of climate change on the fate of nutrients and contaminants within the soil-plant system and the potential consequences for crop quality remain understudied.
Here, we investigate the impact of climate change on heavy metal accumulation by spinach (Spinacia oleracaea), chosen as a model plant for leafy crops. Spinach is recognized as a significant source of essential micronutrients like iron (Fe), zinc (Zn), manganese (Mn) and magnesium (Mg) yet it also accumulates the non-essential element cadmium (Cd), even up to toxic levels in edible parts. Four spinach varieties were cultivated in soils with diverse geochemistry and heavy metal contents under ambient climatic conditions (20°C daytime temperature, ambient atmospheric CO2 and 50% water holding capacity) and anticipated future climatic conditions (+2.25°C, +290 ppmv CO2, and 7% less gravimetric water content).
Three out of four spinach varieties yielded significantly more edible biomass under future compared to present climatic conditions. Alongside the increase in biomass, significant higher Cd concentrations were found in the edible parts of all spinach varieties under future climatic conditions. Factors such as element partitioning from soil particle to soil solution, soil-to-root transfer and root-to-shoot translocation suggest that the increase in shoot Cd was not caused by changes in the physiological plant traits, but by increased Cd bioavailability in the soil, allowing more Cd to pass the soil-root boundary. Comparative analysis with micronutrients (Fe, Zn, Mn, Mg) showed a similar pattern of increase in metal concentrations in the edible parts of spinach under climate change, but these patterns were overall less consistent and showed lower statistical significance than for Cd.
Our findings provide insights into future spinach production and quality, possibly transferable to other leafy vegetables, and emphasize the importance of considering soil contaminants when investigating climate change impacts on human food security.

Keywords: Climate change,Spinach,Heavy metal,Soil contamination,Crop quality

ID ABS WEB: 140128

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

INFLUENCE OF CLIMATE AND MANAGEMENT ON THE PARTITIONING OF GRASSLAND SOIL RESPIRATION

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Grasslands play a crucial role in providing food, fuel, and fibre, while also serving as significant carbon reservoirs globally. However, they face pressures from intensive management practices and the ongoing impact of climate change. The interplay between these factors and their effects on carbon and nitrogen cycling in grassland soil, along with resulting CO2 emissions, remains uncertain. The presence of roots and/or mycelia in grassland soil is essential for regulating ecosystem functions and likely plays a significant role in determining how CO2 responds to global changes. This study aimed to examine how climate warming and grassland management practices interact to influence soil respiration originating from roots, rhizosphere, mycelia, and free-living microbes. We utilised an in-growth core method to partition below-ground respiration. The experiment, designed in a fully-randomised way, assessed the combined effects of warming, nitrogen addition, above-ground biomass removal, and below-ground biotic compartments on CO2 emissions, as well as carbon and nitrogen pools in grassland ecosystems. Our findings revealed that basal respiration was the highest, followed by respiration from mycelia and roots across all treatments. Interactive treatments demonstrated an antagonistic interaction between warming and nitrogen, which reduced root respiration. These results underscore the importance of understanding the mechanistic processes driving differences in carbon and nitrogen cycling among below-ground components. Moreover, they highlight how interactions between climate change and grassland management practices may either exacerbate or mitigate the effects on soil below-ground respiration.

Keywords: grassland ecosystem,autotrophic and heterotrophic,CO2 emissions,interactive effects,warming

ID ABS WEB: 140133

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

STRONGER EFFECTS OF MAIZE RHIZOSPHERE THAN PHOSPHORUS FERTILIZATION ON PHOSPHATASE ACTIVITY AND PHOSPHORUS-MINERALIZING-RELATED BACTERIA IN ACIDIC SOILS

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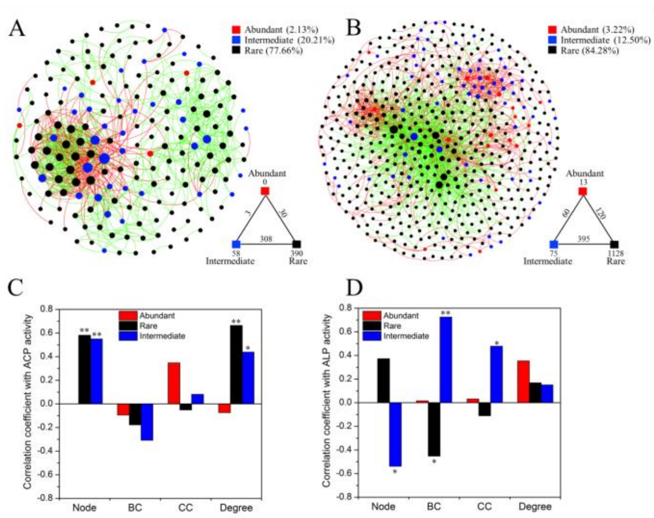
Phosphorus (P) is a major limiting nutrient for crop growth in many agroecosystems. Phosphorus-solubilizing microorganisms (PSM) mineralize soil Po mainly through secreting P-mineralizing-related enzymes such as acid phosphatase (ACP) and alkaline phosphatase (ALP). However, the different responses of phoC and phoD-harboring bacterial community to fertilization strategies need to be clear. In addition, the similar research has not been conducted in phoC-harboring bacteria, and the contribution of rare phoC-harboring bacteria to the ACP activity is still unclear. Therefore, we performed a long-term experiment that included organic manure and mineral fertilizer treatments at the same nutrient input level in the North China Plain and determined soil phosphatase activity and phoC- and phoD-harboring bacterial subcommunities.The results showed that relative to bulk soils, rhizosphere showed higher ACP and ALP activities and phoC and phoD gene abundance, but this effect strength was reduced under HP treatment, except for phoC gene abundance. The rhizosphere effect increased diversity of phoC-harboring bacteria under P fertilization but reduced phoD-harboring bacterial -diversity under P0 and LP treatments. The rhizosphere signiffcantly inffuenced phoC- and phoD-harboring bacterial community compositions, with stronger effect on phoD-harboring bacteria; while P fertilization only affected phoD-harboring bacteria. Immigrated and extinct species play important roles in reshaping phoC- and phoD-harboring bacterial communities, respectively, in response to the rhizosphere effect. Overall, compared with P fertilization, the maize rhizosphere more strongly inffuenced soil phosphatase activities, phoC- and phoDharboring bacterial communities in acidic soils, with phoD-harboring bacteria responding more strongly to the rhizosphere effect and P fertilization. Notably, the strength of the rhizosphere effect heavily relied on P fertilization level.



Keywords: Acidic soil,Organic manure,Phosphatase,Bacterial community,Rhizosphere

ID ABS WEB: 136374

7. Soil sciences impact on basic knowledge
7.03 130893 - Soil classification: past and present concepts and solutions

CLASSIFICATION OF HUMUS-ILLUVIAL SOILS OF GEORGIA USING WRB

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Georgia is distinguished by a very interesting soil cover dominated by mountain-meadow soils with the landscape-geographical nominations listed in the national classification system. During the last decades, the works toward implementation of WRB classification system were intensified in Georgia, which revealed certain characteristics of some soil types not being properly documented and interpreted before due to a lack of analytical techniques and/or field description methodology. The current study describes one of the characteristics found in mountain-meadow soils with humus-illuvial horizons found in the highlands of Georgia. The mountain-meadow humus-illuvial soils occupy a relatively small area in subalpine and alpine zones on the Great Caucasian chain, therefore only four soil profiles with similar properties were identified. Those profiles are distinguished by the participation of humus-illuvial horizon - Bh in their construction. Humus-illuvial horizons start at a 35 cm depth from the surface and are characterized by dark reddish or dark brown colour (5 YR 2.5/2 and 7.5 YR 2.5/2). Humus-illuvial soils have acidic and weakly acidic reactions, horizons are rich in humus and its content is maintained through a depth of a profile. These soils are unsaturated with bases and have a heavy loamy texture. Those properties closely correlate with Sombric horizon properties given in FAO/WRB guideline for soil description. Due to limited data, there is a need for further studies to confirm the existence of Sombric properties in similar soil types spread in mountainous areas of Georgia, which will support advancement in soil classification both at the national and international levels.

Keywords: Humus illuviation,Sombric horizon,soil classification,WRB

ID ABS WEB: 140119

7. Soil sciences impact on basic knowledge
7.03 130893 - Soil classification: past and present concepts and solutions

CHARACTERIZATION OF SOILS ON TOP OF MORAINE HILLS IN THE SOUTH-EAST PART OF LATVIA.

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Three soil profiles were created in the Dagda hill area, subjectively in the highest relief areas, where the feasibility study revealed three different soil texture classes, respectively N 56°05´170´´E 27°19´124´´; 187 m above sea level, N 56°05´218´´ E 27°17´097´´; 175 m above sea level and N 56°05´240´´ E 27°16´137´´; 180 m above sea level. In the first soil profile, sandy texture dominates, in the second, sandy loam is found, and in the third, respectively, clay. Although geologic Quaternary sediment maps show moraine sediments throughout this area, they are found only in the second profile. The first soil profile shows the influence of the stream and shows sorted material. The third profile shows glaciolimnic sediments. Although all the studied soils are located on relief elevations and have been cultivated, no erosion has been observed in any case. During the study, in addition to the analyzes required for WRB classification, analyzes of soil infiltration and moisture capacity have been performed. This was done with the aim of finding out the reason why plants sown at the same time have different germination abilities.

Keywords: Morainic hill,Texture,Classification,Upper slope,Bulk density

ID ABS WEB: 136541

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

MANGANESE CYCLING IN EUROPEAN FORESTS TO CONTROL SOIL ORGANIC MATTER

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Manganese (Mn) plays a key role in soil organic matter dynamics, through stabilization or destabilization reactions. Yet, it has been shown that Mn is one of the most intensively recycled elements by vegetation in forest ecosystems through litterfall (dead leaves falling to the soil) and throughfall (rain water that percolates through the canopy), much more than iron or aluminum. An accurate quantification of Mn fluxes inside the ecosystem is therefore required to better assess the soil organic matter dynamics. In this context, we propose to quantify the influence of environmental variables on Mn fluxes in forest ecosystems. For this purpose, we used the European ICP Forests database that consists in a large environmental data set in forest ecosystems, including periodic measurements on atmospheric deposition, litterfall, and soil solution. We considered 500 sampling plots in Europe from early 1990's to 2018. Annual Mn fluxes were calculated for each main tree species. In parallel, additional environmental variables were included in the analysis, such as climate and soil, using international databases (Copernicus and LUCAS, respectively). The data were processed using a generalized linear model (GLM). Interestingly, litterfall and throughfall fluxes were correlated together for each tree species. Results showed that the GLM predicted 50% of the variance of the actual Mn fluxes. Alongside climate and soil parameters, tree species was an important factor in controlling the Mn throughfall fluxes. The expected modifications in tree species distribution with forest management and climate change will thus likely influence soil organic matter dynamics in forest ecosystems.

Keywords: Manganese,Litter decomposition,Soil organic matter,Modelling,Biogeochemical cycle

ID ABS WEB: 137173

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

ARGAN TREE AS A POTENTIAL MODEL SPECIES FOR REFORESTATION: IMPACTS ON SOM AND MICROBIAL COMMUNITIES.

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Argan tree (Argania spinose L.) is common in arid and semi-arid zones of the Moroccan sub-Saharan region and is adapted to resist periods of drought (less than 250 mm per year) and extreme temperatures. In the context of climate change, these characteristics could make argan tree a candidate model for afforestation on marginal, degraded lands in other semiarid areas where this plant species is not yet present. The suitability of this tree for reforestation strategies will depend on its impact on SOM composition and soil microbial communities, among others. In this study, we evaluated physicochemical characteristics, nutrient contents, molecular composition of SOM (analytical pyrolysis and thermogravimetry) and activity and abundance of microbial communities in soil under Spanish ecotypes of argan trees in comparison with that under pine trees and bare soil in a semi-arid region of southeast Spain. Our preliminary results indicate increased SOM and nutrient (carbon, nitrogen, phosphorous, etc.) contents detected in soils under influence of argan where not different from those influenced by pine. Thermal analysis showed that the two types of vegetal cover enriched soil with SOM of intermediate recalcitrance in the same proportions respect to the bare soil. The pyrolytic behavior of SOM under argan and pine showed to be of a wider functional variety. Increased bacterial and fungal abundances and enzyme activities (β-glucosidase, alkaline phosphatase, urease) were found in soil from argan respect to the bare soil, but differences respect to the soil under pine trees where not detected. Instead, the fatty acid-based structure of microbial communities did change between soils influenced by argan and pine. Further insights into these differences will be obtained by functionally and taxonomically characterizing microbial communities through metagenomics. Our preliminary results seem to indicate that the impact of reforestation with argan on SOM characteristics and microbial communities is similar to that of pine.

Keywords: SOM composition,microbial communities,reforestation,argan,enzymes activities

ID ABS WEB: 137359

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

TREE SPECIES LITTER QUALITY EFFECTS ON C SEQUESTRATION AND STABILITY IN SANDY FORESTS SOILS IN THE NETHERLANDS AND BELGIUM

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Elevated atmospheric CO2 levels contribute to climate change, posing a threat to ecosystems. Forest soils, rich in carbon (C), offer potential as C sinks to mitigate climate change. However, there is limited understanding regarding the influence of tree species composition on C stability. Therefore, the objective of this study is to identify the effect of tree species composition on C sequestration and stability in sandy soils within the Netherlands and Belgium.
We hypothesize that the input of organic matter (OM) plays a key role in influencing soil OM decomposition rates, thereby impacting soil pH and in the long term (decadal) stabilisation of C. Litter quality can be categorized as high (rich) or low (poor), which influences dominating decomposers and nutrient cycling. Twin-plots within a forest conversion trial in The Netherlands and Belgium with poor and rich litter quality forest stands were identified. Composite samples of the topsoil (0-10cm) and subsoil (10-20cm) have been analysed for soil physicochemical parameters, C and nitrogen content and C stocks. Additionally, soil fractionation into the particulate OM fraction and the mineral associated OM fraction provides insight in C stabilisation mechanisms. Together with molecular characterisation of the OM using Pyrolysis-GC/MS and data on soil biodiversity, a wide set of parameters is obtained to provide a comprehensive overview of soil C dynamics. Preliminary findings indicate distinct differences in molecular compositions between the rich and poor litter quality stands in the topsoil, highlighting differences in degradable and aromatic components. Poor litter stands show higher abundances of aliphatics and lignins, while rich litter stands show relative enrichment of polysaccharides and nitrogen-containing components, suggesting diverse OM inputs and distinct degradation pathways and C stabilisation mechanisms. This ongoing experiment enhances our understanding of the interplay among tree species composition, litter quality, and soil C dynamics, providing valuable insights for sustainable forest management practices aimed at climate change mitigation.

Keywords: Soil organic C,C stability,Pyrolysis-GC/MS,SOM fractions,Forest soils

ID ABS WEB: 137404

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

STOCKS OF ORGANIC CARBON (SOC) IN SLOVENIAN FOREST SOILS – FIRST RESULTS OF THE FOREST SOIL SURVEY 2022-2023

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In the years 2022 and 2023, we sampled forest soils on 200 plots throughout Slovenia. The basis for the selection of sampling sites was subsample of a grid of 2 x 2 km. The plots were selected according to the most important forest soil types in Slovenia. The main task was to determine the amount of SOC content in the organic and mineral layers of the forest soils.
To determine the carbon storage, sampling was performed to a depth of 40 cm. The organic horizons were sampled using a wooden frame (25 x 25 cm). The samples of the mineral part of the soil were taken with a metal soil sampling probe with an inner diameter of 6.7 cm. Mineral part of the soil were sampled individually in steps of 10 cm till the depth of 40 cm. Due to the heterogeneity of the forest soil, all samples were taken from five locations in each plot. After, the composite sample was made, presenting each sub-horizon or soil depth, prepared for the physical and chemical analysis.
Forest soils are characterized by high variability of soil properties and consequently carbon storage. Therefore, the estimation of the skeleton content in the soil has an important impact on the calculation of mineral carbon stocks in the soil, especially on sites with calcareous substrates.
Based on 1022 soil samples, we obtained results for the SOC content in the soil expressed in t/ha. Differences in the average SOC stock between the individual soil types are considerable (Table 1). The individual minimum (2.11 t/ha) and maximum values (167.15 t/ha) also indicate even greater differences within the individual plots.
After additional analysis and verification, part of the data will be used for the assessment of carbon storage in mineral forest soils and litter in the reporting process for the LULUCF sector.

Table 1: Basic statistical parameters that provide values for the SOC content in different forest soil types (organic horizons and mineral part up to 40 cm depth together).

SOIL TYPE	N plots	AVG (t/ha)	Min (t/ha)	Max (t/ha)	Med (t/ha)	SD	CV
Dystric brown soils / Dystric Cambisols	46	86.7	35.6	151.01	86.92	31.24	36.03
Eutric brown soils / Eutric Cambisols	18	76.83	11.52	127.45	80.97	27.28	35.51
Hypogley / Gleysols	1	131.43	131.43	131.43	131.43	NA	NA
Leached soils / Luvisols	5	81.84	46.76	123.16	86.37	28.73	35.1
Alluvial soils / Fluvisols	6	78.71	3.33	143.99	88.37	48.55	61.69
Pseudogley / Planosols	6	95.99	65.88	167.15	81.84	38.81	40.43
Ranker / Dystric Leptosols	7	61.2	31.23	98.47	68.25	26.73	43.68
Rendzinas / Rendzic Leptosols	82	50.14	2.11	149.14	46.27	32.2	64.22
Brown soils / Chromic Cambisols	29	51.52	15.8	111.47	40.94	29.01	56.61

Keywords: CARBON STORAGE,FOREST SOILS,SOIL SAMPLING,LULUCF REPORTING,SOIL TYPES IN SLOVENIA

ID ABS WEB: 137716

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

COMPOSITION OF DOM ALONG DEPTH GRADIENTS IN PADDY FIELDS TREATED WITH CROP STRAW FOR 10 YEARS

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Crop straw return is a widely used agricultural management practice. The addition of crop straw significantly alters the pool of dissolved organic matter (DOM) in agricultural soils and plays a pivotal role in the global carbon (C) cycle, which is sensitive to climate change. The DOM concentration and composition at different soil depths could regulate the turnover and further storage of organic C in terrestrial systems. However, it is still unclear how crop straw return could influence the change in DOM composition in rice paddy soils. Therefore, a field experiment was conducted in which paddy soil was amended with crop straw for 10 years. Two crop straw-addition treatments [NPK with 50% crop straw (NPK+1/2S) and NPK with 100% crop straw (NPK+S)], a conventional mineral fertilization control (NPK) and a non-fertilized control were included. Topsoil (0–20 cm) and subsoil (20–40 cm) samples were collected to investigate the soil DOM concentration and compositional structure of the profile. Soil nutrients, iron (Fe) fraction, microbial biomass carbon (MBC), and concentration and optical properties (UV–Vis and fluorescence spectra) of soil DOM were determined. Here, we found that the DOM in the topsoil was more humified than that in the subsoil. The addition of crop straw further decreased the humidification degree of DOM in the subsoil. In crop straw-amended topsoil, microbial decomposition controlled the composition of DOM and induced the formation of aromatic DOM. In the straw-treated subsoil, selective adsorption by poorly crystalline Fe(oxyhydr)oxides and microbial decomposition controlled the composition of DOM. In particular, the formation of protein-like compounds could have played a significant role in the microbial degradation of DOM in the subsoil. Overall, this work conducted a case study within long-term agricultural management to understand the changes in DOM composition along the soil profile, which would be further helpful for evaluating C cycling in agricultural ecosystems

Keywords: Paddy soil,Soil dissolved organic matter,Soil depth,Straw return

ID ABS WEB: 137915

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

EFFECT OF SHEEP WOOL PELLET ON NITROGEN UPTAKE BY PLANTS DEPENDING ON THE ORGANIC MATTER CONTENT AND BIOLOGICAL ACTIVITY OF SOIL

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The adaptation of recycling and advanced techniques is crucial for the establishment of a sustainable agriculture that is not reliant on artificial fertilizers. Pellets made from waste sheep wool have emerged in recent years as a prospective substitute for nutrient replenishment in horticultural production. However, little information is available on the impact of wool pellets on soil biological activity and plant nutrition. Hence, it can be assumed that wool pellets can influence the microbiological activity in the soil depending on soil organic matter content. In this study, we investigated the effect of wool pellets on permanganate-oxidizable carbon content, fluorescein diacetate activity and β-glucosidase activity in two sandy soils with different organic matter contents in a pot experiment. We also examined the influence of wool pellets on the nitrogen content of both soil and pepper plants, as well as on the photosynthetic pigments, gas exchange intensity, and growth parameters of the plants. Results show that treatments with wool pellets increased soil biological activity in both soil types. Wool pellets significantly increased soil and plant nitrogen content and improved plant physiological parameters compared to untreated control. Moreover, wool pellets significantly increased plant biomass in both soil types, but was higher in the low soil organic matter content soil type due to faster mineralization rate and higher air capacity. In the case of higher soil organic matter content, higher yields were observed with the wool pellet treatment, due to slower and more progressive decomposition and nitrogen supply of the wool pellets. These results suggest that wool pellets are an important source of nitrogen for plants and that their biological effect plays a key role in enhancing soil biological activity, but this effect is highly dependent on the intensity of mineralization and decomposition in the soil.

Keywords: wool pellet,nitrogen utilisation,microbiological activity,FDA,POXC

ID ABS WEB: 138172

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

THE BIOLOGICAL ACTIVITY AND CARBON STORAGE CAPACITY OF THE SOIL IS SIGNIFICANTLY DETERMINED BY THE QUALITY AND QUANTITY OF ORGANIC MATTER

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SOM is found in soil in different forms, qualities, with different properties, functions and decomposition rate. During our experiments, we analyzed the soils of organic matter (OM) manipulation plots set up under open field conditions on the Luvisols soil of a deciduous forest in Hungary. In “Detritus Input and Removal Treatments” experiment we used Double Litter, Double Wood, Control, No Litter, No Roots, and No Input manipulations. The aim of our research was to compare the effects of long-term removal and addition of OM on different soil properties. We investigated the changes in glomalin related soil protein content, Active carbon (POXC), SOC and biological activity with the help of DHA GLU enzymes. 24 years after the beginning of the treatments, the SOC content of the soil in the DL treatment showed a significantly higher value (21%) than in the litter removal treatments. POXC content is the portion of SOM that is easily accessible to microbes. Therefore, it is reliable indicator of microbial degradation processes and soil health. In the long term, we measured a significantly higher value of this carbon fraction in the DL treatment than in any treatment without litter. We showed similarly higher values for the Co and DW plots than for the treatments without surface litter. In terms of biological activity, the Co and DL showed significantly higher activity than withdrawal treatments. In case of the glomalin content, we can show a similar trend as the POXC content; treatments without surface litter were significantly different from the other treatments. Overall, it can be determined whether the decrease in OM entering the soil had a greater impact on the decomposition and transformation processes taking place in the soil, SOM dynamics, than the increase in the amount of OM. In the future, it is important to explore the relationship between glomalin and the soil to find the connections between glomalin formation and the carbon storage capacity of the soil.

Keywords: glomalin,active carbon,orgnaic matter,enzyme activity,soil biology

ID ABS WEB: 138355

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

EVALUATION OF AGRICULTURAL PRACTICES FOR MITIGATING CLIMATE CHANGE ON RAIN-FED SOILS IN THE MEDITERRANEAN REGION

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In the face of climate change, management strategies should focus on techniques that can mitigate negative effects and meet society's demands for environmental protection, food security for a growing population and rural-urban migration.
In Mediterranean soils, increased soil fertilisation is necessary due to the generally already low levels of organic matter. Increasing restrictions on inorganic fertilisation mean that organic fertilisers must be used to achieve the required increase. However, this can lead to higher operating costs and uncertainty about the economic viability of farms. Implementing mitigation and adaptation measures in rainfed agriculture can result in increased soil fertility, CO2 sequestration, improved water infiltration and reduced soil erosion.
Implementing mitigation measures based on the 4 per thousand initiative can improve and conserve soil resources, promote organic farming through the use of local waste, and encourage a circular economy, which can help reduce rural exodus and increase fertility, leading to greater prosperity.
A baseline has been established to define the initial state of the monitored areas, which has allowed the calculation of different indicators and the real costs of improving soil ecosystem services. It can be concluded that measures to add organic matter to the soil increase soil fertility and do not cause phytotoxicity problems. These measures meet the objectives proposed in the Green Pact, moving towards soil neutrality and increasing the ecosystem services it provides.
As part of the LIFE AMDRYC4 project, the use of green manure, the provision of locally sourced composted plant material, the use of plant waste, compost management and crop rotation were identified and monitored on four plots as measures to improve soil fertility in the Region of Murcia. Implementing good agricultural practices, including adding organic matter to the soil and restoring natural vegetation, can improve biodiversity and soil quality, thereby slowing desertification and contributing to Initiative 4‰. The effectiveness of these proposals has been assessed using indicators such as the DESERTNET fertility, salinity and phytotoxicity indicators.

Keywords: Agricultural Practices,Mitigation,Rain-Fed Soils,4 per thousand initiative,carbon farming

ID ABS WEB: 140087

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

SOIL NITROGEN AND CARBON POOLS UNDER ALDER, BIRCH AND SPRUCE CANOPIES IN SPRUCE-DOMINATED MIXED STANDS

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Tree species is one of the key determinants of the quality and quantity of soil organic matter in forests. Spruce produces recalcitrant litter, thus lowering nutrient availability and increasing forest floor carbon (C) stock, whereas broadleaved trees may have potential to enhance soil organic carbon (SOC) accumulation to mineral soil. We studied how grey alder, having symbiosis with N2-fixing Frankia, and birch affect soil nitrogen (N) and carbon pools and organic matter characteristics in spruce stands.

Our study sites, located in Southern Finland, were three 40-60-year-old Norway spruce -dominated stands with grey alder and birch (silver birch and downy birch) as admixture and a 20-year-old spruce-dominated stand with only alder as an admixture. Applying the Finnish forest type classification, the two 60-year-old stands represented a relatively fertile Oxalis–myrtillus type (OMT), and the two younger sites represented less fertile Myrtillus type (MT). We took the soil samples from forest floor and 0-10 cm mineral soil at 50-100 cm distance from 3-8 trees of each tree species and analysed SOC and total N stocks. Induced diffusive fluxes of plant-available N forms were determined using microdialysis technique in situ.

We found significantly higher N stock of forest floor under the canopy of alder, as compared to birch or spruce. C:N-ratio of both forest floor and mineral soil was lower under alder versus spruce. In the 60 yr. OMT sites, tendencies for differences between the tree species were observed in microbial biomass N content (alder < birch), microbial biomass C:N-ratio (birch < spruce), C mineralisation rate (alder < spruce), and dissolved organic C content (alder, birch < spruce).

Alder affected soil properties of the spruce stands more strongly than birch, but against our hypothesis, SOC stocks or N fluxes were not significantly affected. In conclusion, the situation in mixed forest is complex, as the spatial distribution of litter and roots reduces the differences between the tree species.

Keywords: mixed forests,Norway spruce,organic matter,soil nitrogen,soil organic carbon

BEST POSTERS

ID ABS WEB: 136125

7. Soil sciences impact on basic knowledge
7.06 132267 - Pedodiversity: major driving factors and influences on ecosystem features

SUBAQUEOUS SOIL RESEARCH AT THE LOW SLOVENIAN COAST OF THE ADRIATIC SEA

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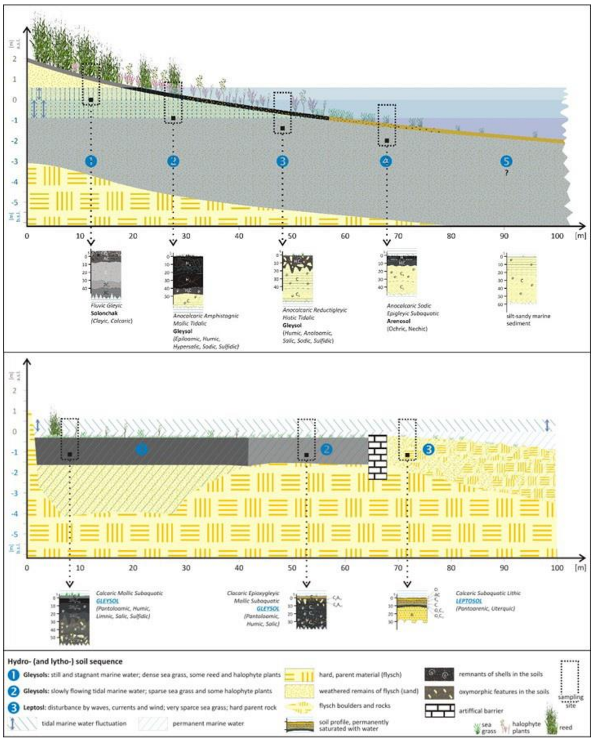
In Slovenia and generally around the world, the topic of subaqueous soils is still poorly investigated. In the case of subaqueous soils in Slovenia, there are only two studies. Both study areas are located exactly at the intersection of two provincial plains in Slovenia. The sea part is represented by the Slovenian part of the Adriatic Sea, the land part by Submediterranean Slovenia. We took a look at the soil forming factors and processes that are important for the development of subaqueous soils. The Slovenian Sea is characterised by low transparency, the shallow water depth and the high nutrient and plankton load. All this fine material accumulates on the bottom and forms the basis for the formation of the seabed. The waves with its force are generated by strong local winds (e.g. the Bora wind) and can seriously disturb the accumulated underwater bottom material. The investigated part of the coastline consists entirely of flysch. The Slovenian coast belongs to the Rias coastal type, where rivers and streams carry material into the bays and form coastal plains. The parent material, water depth and movement, existing vegetation and time play the most important role in the formation of subaqueous soils in this area. The main focus of subaqueous soils research has been to determine the relationship between soil properties (i.e. soil types) and the degree of seawater influence (length of tidal water duration and type of water movement). One sampling site is located on land but is strongly influenced by marine groundwater, two sites are under the influence of tidal water (partially exposed to atmospheric air) and four sites are completely submerged throughout the day and year. All soils were found to be very young and poorly developed. The soil samples were classified according to the WRB classification. Directly above and below the shoreline, different soil types were discovered, namely a Solonchak, Histosol, Gleysol, Arenosol and Leptosol, which form a soil hydrosequence.



Keywords: soil geography,subaqueous soils,soil forming factors,soil forming processes,soil sequence

ID ABS WEB: 140126

7. Soil sciences impact on basic knowledge
7.06 132267 - Pedodiversity: major driving factors and influences on ecosystem features

INFLUENCE OF PEDOGENESIS ON SUCCESSION IN PINE FORESTS

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Four soil profiles were created with the aim of clarifying the peculiarities of pedogenesis in Clodinoso-callunosa and Vacciniosa forests. In each forest type, two profiles were created at the highest and two at the lowest points of the local terrain. These soil profiles lie on sand sediments of glaciolimnic origin, which formed inner dunes after the retreat of glacial water. Soil profiles were created respectively at N 57°38´521´´ E 25°51´563´´; 70 m above sea level, N 57°38´500´´ E 25°51´586´´; 65 m above sea level, N 57°38´515´´ E 25°51´545´´; 66 m above sea level and N 57°38´451´´ E 25°52´010´´; 63 m above sea level. In all soil profiles, podzolization can be observed, as well as an increasing amount of organic matter and a decrease in soil pH as the succession from Clodinoso-callunosa to Vacciniosa intensifies. The following soils were found in the soil profiles: Dystric Arenosol (Claric, Cordic, Humic, Nechic, Aeoli-novic, Pyric); Albic Rustic Ortsteinic Podzol (Arenic, Epic, Oxyaquic, Placic); Dystric Arenosol (Claric, Humic, Nechic, Oxyaquic); Hemic Folic Histosol (Dystric).

Keywords: podzolization,Cladinoso-callunosa,Vacciniosa,inner dunes,classification

ID ABS WEB: 136602

7. Soil sciences impact on basic knowledge
7.07 133540 - The Bright Future of Pedology

MICROPHOTOMOSAICS OF THE AP HORIZON AT 11 YEARS OF CONSERVATION VERSUS MECHANIZED TILLAGE

E V GUTIÉRREZ CASTORENA [1], V V ENCINIA URIBE [1], M D C GUTIÉRREZ CASTORENA [2], C A ORTIZ SOLORIO [2], E OLIVARES SAENZ [1], R E VAZQUEZ ALVARADO [1]

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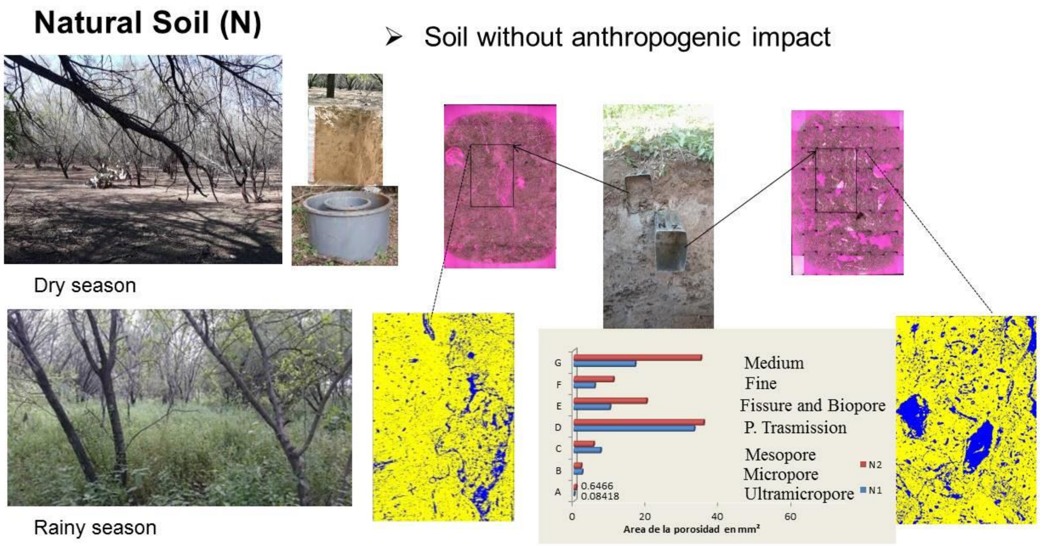
Although conservation tillage (CT) versus mechanized tillage (MT) has been extensively studied in soil science, some aspects are still not understood. In particular, a microscale soil aggregation and porosity and their correlation with penetration and infiltration, essential for soil management (Stoops, 2010). The objectives were to evaluate in situ changes in soil structure with different tillage systems, porosity data, infiltration rate (Ir) and penetration resistance (Pr) regarding time. Six treatments were selected: four corresponding to CT, established on Opuntia sp. for 5, 7, 8 and 11 years, with irrigation and organic fertilization; one with MT for corn, and one on natural soil (N). At each site, undisturbed soil samples were taken at various depths (0-10 and 10-20 cm), producing mosaics (91 images, 2. 5 µm pixel size, in 3147 mm2 on average) by thin section (Ts), quantifying ultramicropore, micropore and mesopore (Gutiérrez-Castorena et al., 2018), in addition to infiltration rates (Bouwer, 1961) and (Pr). Transmission and storage pores predominate, in soil N, and decrease from 16% to 7% and from 50% to 26%, respectively, while structural pores increase from 34% to 67%. In the LM system, there is an inverse relationship from 15 to 35% and from 7 to 19%, respectively, with a decrease in structural pores from 78% to 55%. While in LC, the values varied during the seven years, with values averaging 35%, 15% and 50%, respectively. The Ir value for N was 6.7 cm/hr (11 years), in LC it was 8.5 cm/hr, and finally in LM it was 3.5 cm/hr of water infiltration rate. The column was 245 mm, 273 mm and 137 mm, respectively, in a time of 170 min. When correlating Ir with Pr during the dry period, they reported resistance between 225 and 300 psi, and in the wet period between 125 and 210 psi. In conclusion, soils with LC will reach hydrophysical properties similar to Natural between 5 and 7 years after disturbance.



Keywords: Microcartography,Penetrometer and Infiltration,Meso and microporosity,Agricultural sustainability

ID ABS WEB: 137632

7. Soil sciences impact on basic knowledge
7.07 133540 - The Bright Future of Pedology

STUDY THRESHOLD BETWEEN MACROMETRY AND MICROMETRY IN IN SITU DIGITAL MICROPHOTOMOSAIC.

V V ENCINIA URIBE [1], E V GUTIÉRREZ CASTORENA [1], M D C GUTIÉRREZ CASTORENA [2], V E AGUIRRE ARZOLA [1], R E VÁZQUEZ ALVARADO [1], J M MÁRQUEZ REYES [1], T GONZÁLEZ VARGAS [2]

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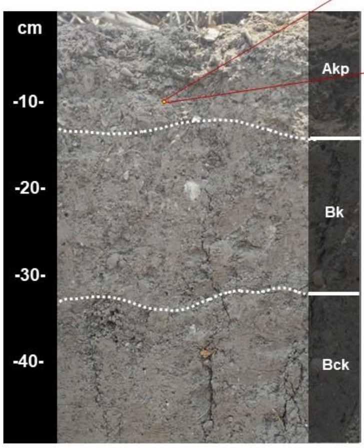
Over a century, different methodologies have been formulated to study soil genesis, morphology, and micromorphology. Despite the efforts achieved by researchers, the absence of In situ, non-destructive, and multiscale techniques is addressed in limited research, considering the implementation of study strategies at the threshold of the macrometric and micrometric scale (Baveye et al. 2018). For this purpose, a methodological proposal is proposed that includes studies of pedons (macroscale) with direct interaction with the digital micromorphometry (Hartemink & Minasny, 2014; Gutiérrez et al. 2018) of the soil In situ. The tests were carried out in a pedological profile of the Ap horizon, located in a moringa (moringa oleifera) production system. Images were captured in situ with a DSLR digital camera adapted to observation amplitudes of 4×, 10×, 40× and 100×; however, so far, it has only been possible to process real visible fields of 5 sequential images at 4× objective, thus creating an In situ microphotomosaic with an area of 111.65 mm². A thematic map of micro and macroporosity was generated, identifying medium vesicular macropores, medium and fine irregular mesopores, and coarse and medium irregular micropores, covering an area of 35% of the total mosaic; others such as aggregates in subangular blocks of medium and coarse size, moderately developed, and partially accommodated, in an area of 64.7%; or mesofauna (mites), with only 0.3% of the total classified area. The description of the In situ micromosaic uses morphological and micromorphological scale terminologies quantified with micromorphometric image analysis techniques. Creating the In situ microphotomosaic establishes the first interactive advances between both scales of observation to study soils.

***In situ* microphotomosaic in soil profile**



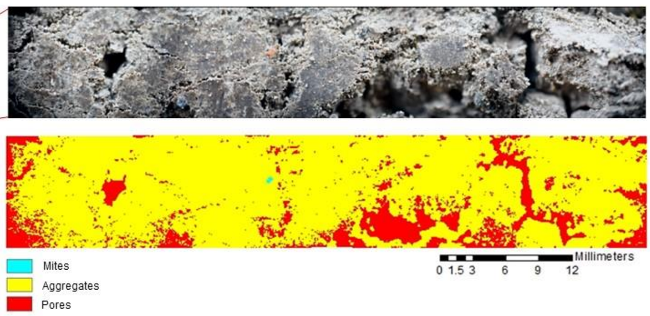


Table 1. Microphotomosaic (Metadata)

Objective	4X
Columns, Rows	17301, 3223
Cell size	0.003 x 0.003 μm
Image size	638.37 MB
Pixel Depth	32 bit

Keywords: Micromorphometry,Micromorphology,Microcartography,Real visible field,Image processing

ID ABS WEB: 135985

7. Soil sciences impact on basic knowledge
7.08 133542 - Knowing topsoil to manage ecosystems

MORPHO-FUNCTIONAL CLASSIFICATION OF HUMUS FORMS USING THE TERRHUM-APP: CORRELATION OF MORPHOLOGICAL INDICATORS AND STANDARDIZED LABORATORY ANALYSIS PARAMETERS

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The humus form classification system TerrHum assigns morphological features to ecological soil functioning. We tested if soil organic matter (SOM) turnover diagnosed by this ecological indicator tool corresponds to standardized laboratory analysis parameters. By sampling 30 survey plots of a forest site classification project in Styria, Austria, we cover calcareous and felsic parent material, a steep elevation gradient and different vegetation communities. Humus profiles were classified and sampled (horizon-wise) in a nested design. Organic carbon (OC) and nitrogen (N) concentration, pH value, microbial biomass carbon (MBC) and nitrogen (MBN), basal respiration (R10), temperature response (Q10) and eco-physiological quotients differ significantly between diagnostic horizons. There was evidence for SOM turnover patterns following the ranking supposed in the classification system. Rapid SOM turnover in Mull systems is confirmed by large microbial biomass (MBC), no constraints regarding organic matter quality (C/N ratio and microbial quotient), and high respiration levels (R10, and predicted Rh). Mor systems with retarded decomposition show low MBC, high acidity, and low litter quality. In Amphi and Moder SOM turnover is constrained. Moder horizons show higher acidity, slightly lower litter quality, lower respiration, and higher fungal abundance than corresponding Amphi horizons. In Amphi, and even more pronounced in Tangel systems (very slow SOM turnover), climatic factors are the main constraints for turnover. Heterotrophic respiration (Rh) for individual humus systems can be predicted with multiple regression models with moisture, temperature and diagnosed horizon as independent predictors. A multinomial logistic regression model confirmed that environmental factors have a significant influence on the distribution of humus systems along catenas. We conclude that the morpho-functional classification is a useful tool in characterizing the main SOM turnover types.

Keywords: humus forms,SOM turnover,mircrobial biomass,chemical properties,respiration

ID ABS WEB: 136655

7. Soil sciences impact on basic knowledge
7.08 133542 - Knowing topsoil to manage ecosystems

ASSESSMENT OF TOPSOIL EVOLUTION ASSOCIATED WITH LAND USE CHANGE IN VAL CAMONICA SUBALPINE GRASSLANDS

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Alpine pastures and meadows are agroecosystems with biological and landscape importance, protected by the European Union. Grassland areas had a rapid decline in the last decades due to changes in management and/or abandonment of traditional mountain farming in the Alps.
The aim of our study is the characterization of the relationship between historical and present-day subalpine grassland management, their plant diversity, soil properties and humus forms. Humus forms are important indicators of biological functioning of soils and of organic matter degradation pathways, easily affected by land use change.
We chose an area in Alta Valle Camonica (Rhaetian Alps, Lombardy), between 1800-2000 m a.s.l., on sialic glacial till, characterized by strong land use changes, as visible in historical aerial photographs. Since the 70s, large herbaceous surfaces are being colonized by subalpine heath and forests, because of a decreased and more localized grazing pressure. We selected 21 sites across six dynamic phases from grazed grassland to forest, in which we performed phytosociological surveys (10x10 m) according to the Braun-Blanquet method, a soil profile and a characterization of topsoil and organic horizons to detect humus types and properties. Standard physico/chemical soil properties were analyzed in the lab.
The widespread decrease in grazing intensity led to an expansion of less palatable grasses (e.g., Nardus stricta L.), shrubs and trees, and changes in plant diversity and vegetation structure. Soils are mostly Entic/Umbric Podzols, Histosols in bogs. Humus forms are more varied: we observed Para humus forms of Rhizo humus systems where grass roots were a main source of organic matter in soils. Mull and Amphi are the main forms in grazed areas, Dysmoders and Hemimoders in abandoned soils colonized by trees; no Mors have been detected.
Thus, humus forms and biological activity/organic matter degradation pathways can describe the gradients in land use change. Some more differences might be observed in the next experimental phases, with microbial analysis and topsoil thin section observations.

Keywords: Land use,Subalpine grasslands,Humus,Podzol,Soil ecology

ID ABS WEB: 137672

7. Soil sciences impact on basic knowledge
7.08 133542 - Knowing topsoil to manage ecosystems

WEED MONITORING AS KEY SOIL BIO-INDICATORS IN MANGROVE RICE PRODUCTION AGRO-ECOLOGIES IN GUINEA-BISSAU.

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Mangrove rice production (MRP) is crucial for guaranteeing food supply and environmental sustainability in Guinea-Bissau. Within this production system, different agro geological conditions exist, primarily attributed to variations in precipitation and temperature across the country, thus contributing to specific soil and water availability conditions.
Farmers local knowledge is key in recognizing and building co-innovative processes that will enhance soil fertility, rice production, thus, local communities well- being.
Utilizing on-site identification and leveraging the farmers' expertise for various plant species and their cultivation practices, recognizing their role in soil nutrient enrichment, the primary objective aimed at identifying predominant plant species, mapping their spatial distribution, and comprehending their distinct characteristics and nutritional impact. This initiative seeks to enhance agricultural productivity by boosting soil fertility while concurrently promote agro-ecological conservation within these communities.
This research was concentrated in two main coastal regions of the country, where we applied:
a) Agro-ecologies general characterization
b) Weed spatial distribution and image processing
c) Transects for main weed identification
d) Soil and isotopic analyses
Results from image classification show a high capability to distinguish green biomass into main classes such as: weed predominant species, water, soil, and others (secondary species with very low abundance).
Agro-ecological characterization showed TM (Tidal Mangrove) to have a better fertility status even with few present salinization limitations. In contrast, the AM (Associated Mangrove), despite their weaker fertility status, have higher organic carbon and nitrogen content.
There is a clear top-down weeds distribution, indicating three predominant weed species as Blutaparon Vermiculare, Sesovium portulacastrum (TM) and Enchinochloa (AM).
Weeds exhibit a wide dispersion of 15N values ranging from -1.5‰ to +9.5‰ (AIR). These values are consistent with various nitrogen sources and, notably, with the nitrogen dynamics in the soil. The 13C values of organic matter in soils indicate the percentage contribution of C3 and C4 biomass. Spatial patterns and specific in-situ conditions have been identified as influential factors on the isotopic signals of 15N and 13C in weeds.

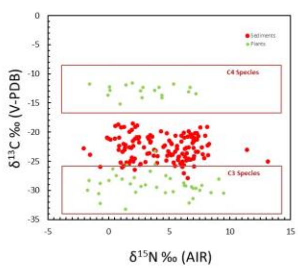

Figura 1: Isotopic C δ13 and N δ15 for 136 soil samples soil and 45 vegetation species taken during field campaign 2022.

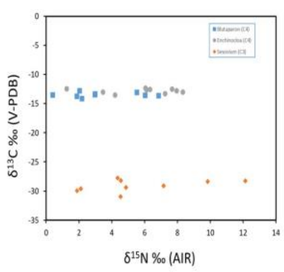

Figura : Isotopic C δ13 and N δ15 for three principal identified species (n=28) from transect campaign july 2023.

Keywords: soil nutrient,mangrove rice production,weeds,Isotopic N and C

ID ABS WEB: 138098

Topic: **7. Soil sciences impact on basic knowledge**
Sub Topic: **7.08 133542 - Knowing topsoil to manage ecosystems**

HUMIPEDON DYNAMICS IN ALPINE SOILS AFTER A SEVERE WINDSTORM

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In October 2018, "Vaia" storm hit the Italian Alps, causing major damage to forests. The resulting changes in microclimate and soil structure are expected to shape the structure of soil communities and the dynamics of humus formation and of soil organic matter (SOM) accumulation.
In Val Di Fassa (Trentino-Alto Adige, Italy), 12 sites were identified, uniform in altitude and plant composition, half of which was hit by the storm. Soil samples of 3 conditions were taken: intact forest (IF); under grass in windthrow areas (G); under decaying wood in windthrow areas (W). For each sample, Humus system was identified, soil arthropod community were analysed, and SOM stored in organic (O) and organo-mineral (A) soil horizon was quantified.
Regarding Humus, the majority of IF samples express Amphi system (86%). This percentage drops to 50% in windthrow areas, with small differences between G and W, where the other 50% is represented majorly by Mull system. SOM quantification shows a similar pattern, with IF containing a greater quantity of SOM compared with G and W. Considering also soil microarthropods communities' parameters (abundances, number of taxa, Shannon index, QBS-ar index), FAMD Analysis shows that the IF category is the only cluster that deviates from the others and that there's no clear differentiation between G and W. Only the structure of the community in W was different from the other categories.
In conclusion, in studied forest sites, the passage of Vaia storm produced a shift in the functionality of the humipedon, from a system characterized by a medium speed of SOM turnover (Amphi) to one with a faster turnover of SOM (Mull). The differences are clear between intact forest soils and windthrow soils, but not between conditions in windthrow soils. The small differences observed between G and W suggest that different management of windthrow areas cannot influence humipedon dynamics in these few years after the disturbance. Longer monitoring is needed to help address this question

Keywords: Alpine Humus,Soil microarthropods,Windthrow,SOM dynamics

ID ABS WEB: 136518

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

THE NBSOIL PROJECT - NATURE BASED SOLUTIONS FOR SOIL MANAGEMENT

E PADOAN, A GIORDANO, E BORGOGNO MONDINO, M SCHIAVON

Università degli Studi di Torino - Dipartimento di Scienze Agrarie, Forestali e Alimentari, Torino, ITALY

NBSOIL (Nature Based Solutions for Soil Management) is a four-year project coordinated by the Institute of Soil Science and Plant Cultivation (PL). Its overall objective is to design an attractive blended learning programme to enable soil advisors to implement a holistic vision of soil health through Nature Based Solutions (NBS) and collaborate effectively across different temporal and spatial scales.
NBSOIL will focus on 6 multifunctional NBS categories to develop a holistic approach to land management and soil health fully in line with the IUCN Global Standard for NBS (IUCN, 2020): organic fertilisers from locally available biowastes, cover crops, paludiculture, forest diversification, bioremediation, and blue - green infrastructure in urban and periurban areas. NBSOIL builds on previous research results and available Open Source technology to deliver the following NBSOIL thematic packs: Knowledge base, Academy, Soil Health assessment, monitoring and mapping resources, Policy Navigator, and Marketplace.
Approximately 300 participants from 8 countries (PL, AT, CH, UK, FR, NL, IT, ES) are expected to complete the full 2 years training offered in 6 languages (English, Polish, German, Dutch, French, Italian, Spanish). The 2 years training programme will provide an immersive, interactive, flexible learning experience, through an introductory MOOC and four advanced modules on 1. Soil and NBS, 2. Living Labs facilitation, 3. Digital tools for Soil Health monitoring and 4.Improving soil related decision making in business and policy, and a Final Project.
The NBSOIL consortium will deliver Impact and contribute decisively to achieve the Soil Health Mission by mainstreaming NBS knowledge and advice for soil management, providing Soil Health Living Labs facilitators, making soil monitoring and mapping tech user friendly and inclusive and embedding soil care across all land management and land related decision making processes.

Keywords: Nature Based Solutions,Digital tools,Open innovation,GIS platform,Advisory service

ID ABS WEB: 137209

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

THE IMPACT OF CONVENTIONAL AND PRECISION CULTIVATION TECHNOLOGY ON THE MOISTURE CONTENT OF THE CHERNOZEM SOIL

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Efficient water management is crucial for optimising crop yields and developing sustainable cropping systems. The measurement of moisture content in the soil of the long-term field experiment provides insights into the interaction between cultivation methods and water conservation.
The studies were carried out in a long-term field experiment at the Látókép Crop Production Experimental Station of the Institutes for Agricultural Research and Educational Farm of the University of Debrecen, Hungary (N 47° 33' E 21°26'). Soil moisture measurements were conducted in the soil of the long-term field experiment set up on calcareous soil. The probe measures soil moisture content using an FDR sensor and records it as percentage of field capacity (FWC). The measured values were converted to volumetric water content (VWC). Measurements were taken every two weeks during the growing season of maize. The measurements were used to monitor the movement and distribution of soil moisture within the 0-80 cm soil profile.
The treatments included in the experiment significantly affected soil moisture. Under non-irrigated conditions, a significant difference was observed between conventional and strip tillage treatments at all measurement times. Soil moisture content measured in the rippering treatment did not differ significantly from the conventional winter ploughed and strip tillage treatments. There was an average difference of 3-4 vol% moisture between the tillage treatments at the top 80 cm soil depth, which was stabilised at nearly the same level at all measurement times during the growing season. The additional water applied by means of irrigation eliminated the differences in moisture content between the tillage treatments. Significant soil moisture differences were measured between the control and fertilised treatments. In most of the performed measurements, there was no significant difference in soil moisture between the 80 kg N/ha and 160 kg N/ha treatments. Significantly higher soil moisture was measured in the control plots in both irrigated and non-irrigated treatments, and 5-7 vol% lower in the 160 kg N/ha treatment.

Keywords: long-term experiment,soil moisture,conventional tillage,precision strip tillage,fertilisation

ID ABS WEB: 137875

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

NATURE BASED SOLUTIONS FRAMEWORK FOR AGRO-ECOLOGICAL TRANSITION IN SERBIA

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[3] CREA - Council for Agricultural Research and Economics, Roma, ITALY
[4] Institute of food technology, Novi Sad, SERBIA

Nature-based solutions (NbS) approach in agriculture aims at establishing some new agri-food systems relationships to bring health co-benefits and achieve global food security similar to agroecology. These similarities are most pronounced in methods (conservation agriculture, agroforestry, nutrient management, C-farming reforestation etc.) that can be used to reach the goals of sustainability in food production and addressing societal challenges. The differences between these two concepts are how they access the problem - while NbS has a top-down approach, agroecology uses using bottom-up direction. The territory is argued to be a decisive point for both NbS and agroecology as a place where these two concepts overlap. Conversely, this could be an advantage for reaching the inclusiveness and synergies necessary for scaling out sustainable systems that lead to multiple benefits in agriculture. This could help the current system of agricultural production encompassing the farm vs. food system approach and foster the integration of methods and mechanisms of transition to establish the new food systems. Identifying where the territorial domain of NbS and agroecology overlap is important and may represent the eatery point where the transition of agriculture can be initiated. Given the agroecological background and socio-economical conditions, we can propose using such an approach to agri-food transformation in Serbia. Developing a coherent policy framework based on a holistic performance covering sustainable intensification and traditional food production based on innovation could be a way forward in agri-food improvement.

Keywords: Sustainable agriculture,Nature based solutions,Food system,Agroecology,Food territory

ID ABS WEB: 138070

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

ECONOMIC VIABILITY OF CARBON FARMING THROUGH COMBINED INCENTIVE MECHANISMS.

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The study evaluates the economic viability of carbon sequestration practices in agricultural soils (carbon farming, CF). It is based on a simulation analysis built upon available literature referring to temperate regions and considers existing and potential incentive schemes. Currently, The European Common Agricultural Policy (CAP) offers incentives to encourage CF and voluntary carbon markets (VCMs) are expected to be formalised through the European regulation on carbon removals. CF practices analysed in this study refer to soil management, crop management, crop rotation, and land use change. Each practice represents a different cost to land managers; incentives might provide an opportunity to cover such costs. An overview of the carbon sequestration potentials and costs of these practices enabled the estimation of a marginal abatement cost curve, considering a baseline scenario of conventional monoculture on arable land with maize (irrigated) and wheat (non-irrigated).
This information was then used to feed an economic interpretative model that allows identifying which financial mechanism is more appropriate in promoting CF practices, and the minimum size for CF projects, that is the operational scale below which a CF project may not be economically viable. The minimum size is essential to balance economic, environmental and practical aspects in CF projects, ensuring their long-term effectiveness and sustainability. The analysis reveals that the minimum size is significantly lower for land use change strategies than for other practices and much lower under CAP payments than under VCMs. However, CAP and VCMs currently only partially offset the costs of climate mitigation actions, making further financing mechanisms necessary. In conclusion, the analysis draws recommendations for both VCM and CAP, highlighting the need for comprehensive strategies to improve the effectiveness of incentives in addressing climate challenges. It is suggested that existing Information, Administration and Control Systems (IACS) are used both for the management of CAP payments and the issuing of carbon credits, to reduce transaction costs, preventing the risk of double financing and facilitating monitoring.

Keywords: Carbon Farming,Economic viability,CAP,voluntary carbon markets,carbon sequestration potential

ID ABS WEB: 139473

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

SUSTAINABLE FORESTRY: THE IMPERATIVE OF SOIL MAPPING IN FOREST RESOURCE INVENTORY, MODELLING AND MANAGEMENT IN SCOTLAND, UK

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Site specific knowledge of soil resources is essential to understanding their potential contribution to silvicultural management.
This is particularly important in Scotland, UK, where there is great diversity of climate, geology, landscapes and soils within a relatively small area.
An approach based on soil classification and mapping has been devised to incorporate detailed soils information into decision support for silvicultural management.
Detailed soil surveys are a vital component in the decision-making process whether to grow trees and if so, what species and how best to manage stands.
Scotland's landscape has been radically changed by human influence, with forest cover reduced to 4% by the early 1900s.
Re-establishing woodland cover was identified as a national priority and during the 20th Century, extensive planting took place to create a largely state-owned forest estate.
Forest cover is now approximately 18% with a vision of around 25% for mid-late 21st Century.
Expansion of native woodland is also underway to meet nature conservation and Habitat Action Plan targets.
Detailed soil mapping is now deemed as an essential aspect of forest inventory planning.
The James Hutton Institute has worked on this project for the last 14 years, mapping around 850 km2 at a detailed scale of 1:10,000.

Keywords: Sustainable Forestry,Soil Mapping,Scotland,Forest management,Soil Classification

ID ABS WEB: 135991

7. Soil sciences impact on basic knowledge
7.10 133558 - Mechanisms of interaction of (harmful) substances with the soil phase

CONTRIBUTION OF COMPONENTS IN NATURAL SOIL TO CD AND PB COMPETITIVE ADSORPTION: SEMI-QUANTITATIVE TO QUANTITATIVE ANALYSIS

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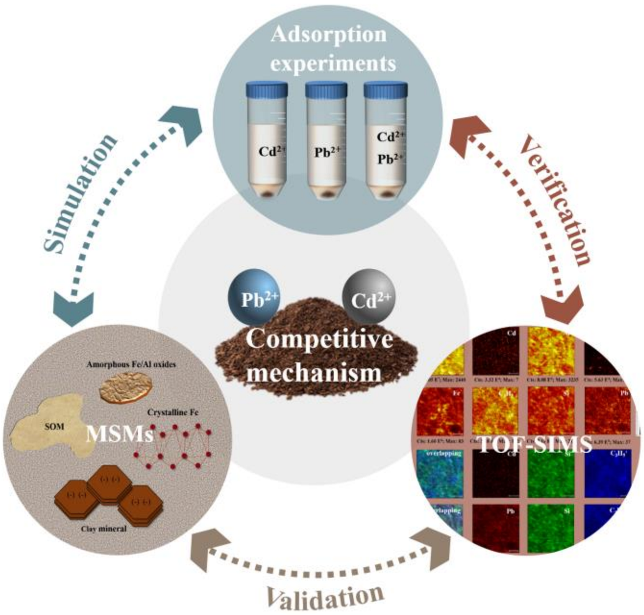
Cadmium (Cd) and lead (Pb) are two of the most common elements found in contaminated terrestrial sites. Multiple heavy metals can compete for the same sorption sites in the soil, affecting and increasing the availability and types of heavy metals released to the environment. In this study, adsorption experiments, multi-surface models, and advanced spectroscopy technology were employed to explain the adsorption mechanism of Cd and Pb and to quantify the contribution of soil components in this system. The results show that pH is the main factor determining the contribution of soil components to metal adsorption while soil organic matter (SOM) is the dominant adsorbent for both Cd and Pb. Clay minerals play an adsorption role at low pH, whereas Fe/Al oxides adsorb metals primarily in the high pH range. Furthermore, the competitive effect of Pb on Cd was largely observed on SOM rather than on clay minerals. When the Pb concentration increased from 0 to 500 mg/L, the adsorption of Cd on SOM decreased by 132 mg/kg, whereas it decreased only by 1.9 mg/kg on clay minerals. Thus, the competitive effect of Pb on Cd is especially prominent in soils with high organic matter content. Pb may lead to the occupation of adsorption sites on SOM, thereby enhancing the mobility of Cd. Therefore, prediction based on a single metal may underestimate the risk of Cd in the environment.



Keywords: Competitive adsorption,Heavy metal,Soil organic matter,Multi-surface model,Soil phase

ID ABS WEB: 138253

7. Soil sciences impact on basic knowledge
7.10 133558 - Mechanisms of interaction of (harmful) substances with the soil phase

EFFECT OF MICROENCAPSULATION ON THE PERSISTENCE AND LEACHING OF DELTAMETHRIN IN AGRICULTURAL SOILS

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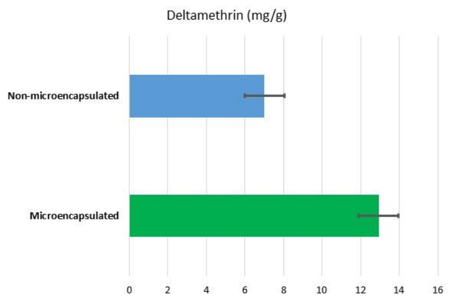
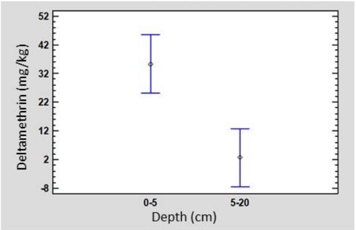
The European Commission established halving the use of chemical pesticides by 2030. This aims to reduce greenhouse gas emissions and reverse soil degradation, improving its quality. This fact has caused companies producing phytosanitary products to begin to develop more sustainable products or improve the effectiveness in the application of active substances. However, there are pests that for the moment must be controlled with the application of active substances. This is the case of cotonet (Delottococcus aberiae) in the citrus and persimmon production sector in the Valencian Community (Spain), which is causing million-dollar losses. Therefore, in NECOTDIM project an experience to analyse the effect of microencapsulation of Deltamethrin in soils and leachates has been carried out. In some plots, the microencapsulated product was applied in different doses and the effect of deltamethrin degradation was observed, as well as its concentration in installed lysimeters. The main outcomes revealed that microencapsulation allowed deltamethrin to remain at higher concentrations in the plot, since the active substance is slowly released and therefore the effect on pest is higher in time. The main results revealed that microencapsulation favored higher concentrations in the soil as the active ingredient was slowly released, being better in the fight against the pest. 5.92 mg/g of Deltamethrin concentration was the difference between the microencapsulated and the non-encapsulated, registering a deltamethrin reduction rate between 82-88% in 100 days. Deltamethrin was positively correlated with Organic carbon and total nitrogen, and negatively with soil pH. Microencapsulation also presented effects on leachates, since for flood irrigation, the application of non-microencapsulated deltamethrin presented higher values (0.026 mg/L) than the microencapsulated one (0.014 mg/L), being in the case of irrigation by similar drip (0.0064 and 0.0066 mg/l, respectively). Therefore, it can be concluded that microencapsulation favors the retention of the active substance in the soil, with the concentration of deltamethrin being higher in the leachates of those applications without microencapsulation in the case of flood irrigation.





Keywords: microencapsulation,soil quality,deltamethrin,lixiviate

ID ABS WEB: 137928

7. Soil sciences impact on basic knowledge
7.12 133581 - Soil mineralogy: current state and perspectives

MINERAL NANOPARTICLES SYNTHESISED FROM COAL MINING WASTE FOR AGRICULTURAL PURPOSES

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This study reports the synthesis of iron-based oxide nanoparticles (IONP) using acid mine drainage (AMD) water and their bioavailability to plants as an agricultural fertilizer and as a biocontrol agent. The size of the synthesized particles was below 100 nm for 95.9% of them, which predominantly presented hematite and positive charges on their surface. Sulfur, magnesium, silica, potassium, and phosphorus were among the nutrients found in IONPs composition. The synthesized particles were also able to release and trapped by cation and anion resin membranes significant amounts of available iron, calcium, magnesium, and phosphorus ions into water, which allows the IONP to be characterized as a nano-fertilizer for agriculture. In addition, IONP, due to its specific properties, represents a tool to mitigate the limitations of biological agents and has also shown potential in the management of plant diseases. The application of IONP (at the dose of 75 mg kg-1) in association with a biological agent reduced M. javanica females in the roots of soybean.
This study allows us to infer that the nano iron may be made by a friendly strategy using mining waste. In addition, this systemized IONP has the potential to be used in agriculture as a source of some nutrients and as an efficient agent in the management of plant-parasitic nematodes.

Keywords: Acid Mining drainage,Nanotecchnology,Metal oxide nanoparticles,Soil fertilizer,Mineral-biologic interaction

ID ABS WEB: 137795

8. Other
8.02 133440 - Tailored microbiome-based solutions for a sustainable agriculture

SELECTION OF BOTH CYANOBACTERIA AND HETEROTROPHIC BACTERIA FROM DRYLAND BIOCRUSTS WITH PLANT GROWTH PROMOTING (PGP) PROPERTIES

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Agricultural soil degradation primarily stems from the combined effects of climate change and the intensification of agricultural practices. Inoculating plant growth-promoting microorganisms (PGPM) emerged as a promising solution to enhance agricultural practices sustainably, offering simultaneously an alternative to chemical fertilizers, pesticides, and supplements. In recent years, scientists have extensively studied PGP properties, especially in bacteria and, to a lesser extent, in cyanobacteria. However, the most recent research has mainly focused on finding these beneficial microorganisms in agricultural soils, especially in the root zones of crop plants, while other niches such as biocrusts are unexplored. The main goals of this work were (i) to isolate heterotrophic bacteria strains in biocrusts collected from semi-arid study sites and (ii) to characterize the functional traits associated with plant growth promotion and enzymatic activities of both newly isolated heterotrophic bacteria and previously identified biocrust-forming cyanobacteria. The cyanobacteria strains used in this study were isolated from biocrusts of semi-arid ecosystems from Spain and Italy where they are ubiquitous and belong to the species Nostoc commune, Tolypothrix distorta, Trichocoleus desertorum, Stenomitus frigidus, and Scytonema hyalinum. Moreover, twenty-six heterotrophic bacterial strains were isolated from one of these ecosystems. Quantitative and qualitative tests were conducted to assess their PGP properties, including the production of indole-3-acetic acid (IAA), siderophores, phosphate solubilization, nitrogen fixation, biofilm formation, and the presence of enzymatic activities such as ACC deaminase, DNAse, amylase, catalase, oxidase, lipase, and protease. The test results reveal that among the cyanobacteria, the strain N. commune CANT2 exhibited the highest number of PGP properties, followed by N. commune NR64 and N. commune AB55. Bacterial strains with a greater number of PGP traits were identified by sequencing the 16S rRNA gene. The strain Peribacillus frigoritolerans AMO has emerged as the most promising candidate for future application as a biofertilizer. Developing microbial inoculants from these strains has the potential to innovate plant cultivation, fostering increased environmental sustainability and reduced reliance on chemical inputs.

Keywords: biocrust,cyanobacteria,heterotrophic bacteria,Plant Growth Promoting,dryland

ID ABS WEB: 136288

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

CO-APPLICATION OF ZINC AND PHOSPHORUS FERTILISERS TO AGRICULTURAL SOILS: EFFICACIOUS FOR PLANT NUTRITION, OR AN INEFFECTIVE MICRONUTRIENT PRACTICE?

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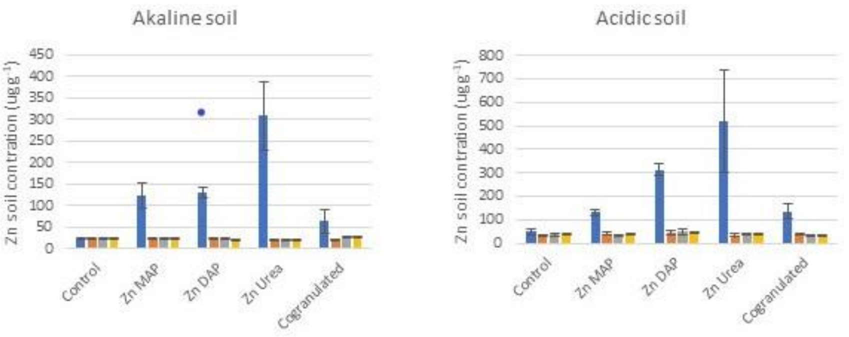
Introduction
Macronutrient fertilisers coated with Zn offer economic and agronomic benefits for crop production. Ammonium phosphates are the most commonly used P-fertilisers coated with Zn. However, the dissolution and subsequent bioavailability of Zn in these fertilisers is complex. In fertiliser granules, Zn concentrations typically range from 10,000 to 50,000 mg Zn/kg (1-5% Zn w/w) compared to 10-300 mg Zn/kg1 in soils. The behaviour of Zn dissolution in the sphere of soil surrounding the fertiliser granule (the fertosphere) is unlikely to follow Zn behaviour observed in the bulk soil. The objective of this study was to investigate the behaviour of Zn coated P fertilisers in the fertosphere of acidic and alkaline soils.

Materials & Method
Two soils with contrasting physiochemical parameters were placed in a petri dish and incubated for 7 days at 80% WHC after which one Zn coated fertiliser granule was placed in the middle of the petri dish at a depth of 5-mm. The Zn coated fertiliser granule was left in place for 28 days after which the soil adjacent to the granule was collected. The fertiliser treatments were Zn-coated urea, Zn-MAP, Zn-DAP, and co-granulated Zn-DAP. Dried soils of various distances were analysed for pH, EC, total Zn and P concentration, Zn availability (DGT and E-value) and distribution and speciation (XFM and XAS).

Results
Analysis of the collected soils found higher Zn concentrations in the soil collected adjacent to the fertiliser granule. The total Zn concentration was dependent on both the fertiliser and the soil type (Figure 1). Zn coated urea contained the highest total Zn concentration compared to all the other treatments. In the Zn coated urea treatment, no intact fertiliser granule was recovered but fertiliser granules were recovered from all other treatments indicating fertosphere chemical limited Zn dissolution in this study.

Figure 1. Zn distribution and total concentration in soils (0-8-mm blue, 8-15 mm orange, 15-25-mm grey, >25-mm yellow).

References
[1]Mertens, J & Smolders, E. (2013).



Keywords: coated fertiliser,zinc,DGT,phosphate,synchrotron

ID ABS WEB: 137131

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

RICE GROWTH AND YIELD, AND SOIL NUTRIENTS IN NATURE FARMING PADDY FIELDS WITHOUT FERTILIZATION AND PESTICIDES IN MOUNTAINOUS AREA IN SOUTHWEST JAPAN

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The main raw materials for chemical fertilizers are fossil fuels and mineral resources. These resources have a limited shelf life, making sustainable food production impossible under the current cultivation system. Therefore, it is necessary to develop cultivation methods that reduce fertilizer use. In this study, we focused on long-term rice paddies cultivated without fertilizers or pesticides and investigated the growth and yield of rice paddies and their soil nutrient supply characteristics. In 2023, we tested nature farming (NF) paddy fields in which rice has been cultivated without fertilizer or pesticides for more than 10 years in the mountainous area of Ehime Prefecture, Japan. Conventional farming (CF) rice paddies in the neighborhood were used as control plots. The yield of brown rice in NF was 2920 kg ha-1, which was 32% lower than that in CF. However, the number of rice grains per ear was significantly higher in NF, suggesting that sufficient nutrients were supplied during juvenile ear formation. Regarding the appearance quality of brown rice, the grain quality ratio was significantly ($P = 0.05$) higher in NF than in CF, and the number of immature grains was lower in NF. The small sink size per unit area in NF is considered to have resulted in sufficient accumulation of carbonate assimilation products. Furthermore, the protein content in nature farming was lower than that in CF, and the eating quality was significantly higher in NF. The ammonia nitrogen content in the soil of NF remained higher than that of CF throughout the growing period, indicating that the soil fertility of NF was relatively high despite no fertilization (Fig. 1). The amount of nitrogen absorbed by rice per hectare in NF was 50% of that in CF, but the grain yield was 70% of that in CF, suggesting that increasing nutrient absorption efficiency by suppressing weeds is a factor in increasing yield in NF (Fig. 2).

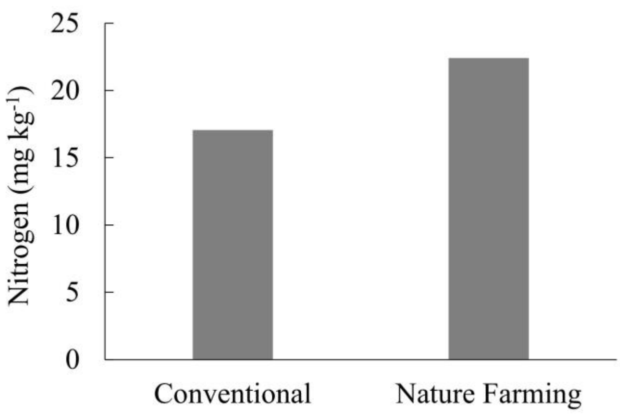

Fig. 1. Average concentrations of ammonia-N in the soils under conventional and Nature Farming.

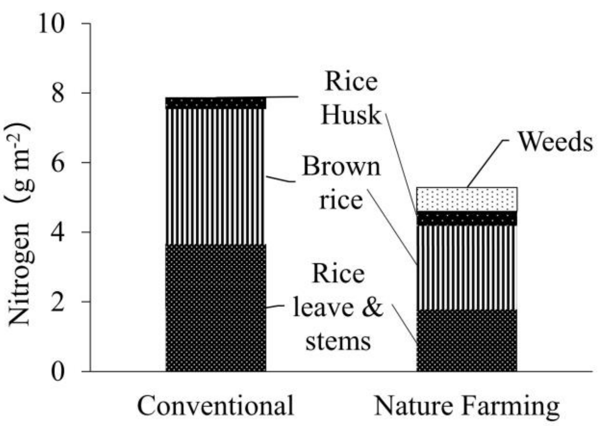

Fig. 2. N uptake by rice and weeds in conventional

Keywords: rice,nature farming,organic farming,nutrition,soil chemistry

ID ABS WEB: 137239

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

THE IMPACT OF CONVENTIONAL AND PRECISION FARMING TECHNOLOGY ON MAIZE YIELDS

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Strip tillage is a conservation tillage practice employed in maize production, involving the cultivation of narrow strips where seeds are planted while leaving the intervening space undisturbed. The undisturbed residue cover in between the tilled strips acts as a protective layer, preventing soil erosion and promoting overall soil health, making strip tillage an advantageous approach in sustainable maize farming.
The studies were carried out in a long-term field experiment (crop rotation x tillage x fertilization x irrigation x plant density x genotype) at the Látókép Crop Production Experimental Station of the Institutes for Agricultural Research and Educational Farm of the University of Debrecen (N 47° 33' E 21°26') on calcareous chernozem soil. The tillage in the experiment were winter ploughing, precision strip tillage and primary tillage with a ripper. The fertilizer levels were control, 80 kg N/ha + 60 kg P2O5 /ha + 90 kg K2O/ha; and 160 kg N/ha + 60 kg P2O5 /ha + 90 kg K2O/ha.
The yields of the 9 years of the trial (2015-2023) were evaluated with repeated measures ANOVA with Least Significant Difference test.
In the scope of the study, the highest yields were recorded in the case of ripped tillage with 160 kg N/ha +PK fertilizer treatment (14.46 t/ha in 2016), and this was not significantly different from winter ploughing with the identical fertilizer treatment in the same year.
The lowest maize yield (1.66 t/ha) was in the severe drought year of 2022, in the case of the winter ploughing 160 kg N/ha + PK treatment. The highest maize yield in strip tillage treatment was in 2016 in the 160 kg N/ha +PK fertilizer treatment which was only 1.2 t/ha less than the highest yield of the period. In the final year (2023), strip tillage provided significantly lower yields than winter ploughing. However, this difference was only 0.56 t/ha, which is compensated with the reduced amount of fuel consumption.

Keywords: long-term experiment,conventional tillage,precision strip tillages,fertilization,maize yield

ID ABS WEB: 140063

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

EXPERIENCES FROM H2020 SMARTWATER PROJECT: SMART AND SUSTAINABLE SOIL AND WATER MANAGEMENT IN AGRICULTURE IN BIH

M. MARKOVIC [1], D. HAJDER [1], M. SIPKA [1], M. TODOROVIC [2], N. ZAPATA [3], T.A. PACO [4], E.E. RIEZZO [5], S. CADRO [6]

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[7] SYSMAN PROGETTI & SERVIZI SRL, Roma, ITALY
[8] University of Sarajevo, Faculty of Agriculture and Food Science, Sarajevo, BOSNIA AND HERZEGOVINA

Implementation of Horizon 2020 project “Promoting SMART agricultural WATER management in Bosnia and Herzegovina” (SMARTWATER) started on 1.1.2021. The Coordinator of SMARTWATER is the University of Banja Luka Faculty of Agriculture (UNI-BL). Project consortium consists of partners from BiH, Spain, Portugal and Italy. The main objective of SMARTWATER is to reinforce networking, research and S&T cooperation capacities of the University of Banja Luka (UNI-BL), the University of Sarajevo (UNSA) and other connected national institutions, in the field of sustainable agricultural water management and to increase their competency and fund-raising skills for a successful participation in the European Union Research Programs. The basic project scientific themes include: 1) cloud-based smart technologies, 2) new generation of satellite remote sensing data, 3) water-energy-food nexus and 4) climate change impact on agriculture. As part of WP3, a 3-year joint experimental studies on maize (Zea mays L.) at two locations in BiH and with different irrigation and fertilization regimes were also performed. With data from these experiments, several academic papers were already published open access in international Journals . Project teams promoted SMARTWATER at 20+ international conferences in BiH and abroad. In period 2021-2023 project consortium organized 3 advanced training courses, 3 summer schools, 3-year experiments, 2 stakeholders’ meetings (roundtables), 3 MSc courses, 10 mutual staff exchanges, 3 R&I hands-on workshops and many more. Posts about our activities are published at social media profiles (Facebook, Twitter/X, LinkedIn) and the SMARTWATER website . SMARTWATER project officially ends in June 2024. Twinning activities in 2024 (academic exchanges, dissemination etc.) will be aimed at promoting smart management of agricultural resources, upgrade of networking and research between partner institutions and work with project stakeholders. We ask all interested actors to visit our sites, to attend our events and to join the SMARTWATER network.

Acknowledgement

SMARTWATER: This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 952396.

Keywords: soil,irrigation,smart tools,maize,eco-efficiency

ID ABS WEB: 140089

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

ACQUISITION OR UTILIZATION, WHICH IS MORE CRITICAL FOR ENHANCING PHOSPHORUS EFFICIENCY BY MAIZE LANDRACES IN ACID SOILS OF MEXICO?

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Low phosphorus (P) availability is a principal constraint to crop production worldwide. In most soils, soil and fertilizer P are easily bound by either soil organic matter or chemicals, and thus are unavailable to plants. Therefore, the development of P-efficient crop varieties that can grow and yield better with low P supply is a key to improving crop production in the central Mexican highlands. This study evaluated the contribution of root architecture and plant growth traits associated with P acquisition efficiency (PAE) and/or P utilization efficiency (PUE) of maize landraces from the Purhepecha Plateau, Michoacan on a P-deficient Andisol with low and high P fertilization under rain-fed conditions. The results showed that both PAE and PUTE were critical factors explaining the variation in P use efficiency at both P levels. Late maturiting P efficient genotypes showed the greatest variation for P uptake per unit root weight and growth under low P. The 32P isotope dilution technique was employed to assess the ability of the genotypes tested to utilize P from different P sources. P-efficient genotypes accessed soil P not available to P-inefficient ones, whereas the P-responsive genotypes showed increased P acquisition from fertilizer. Greater P utilization efficiency was related to an improved distribution of dry matter in the plants and a lower absorbed P allocated in the grain. On a P-deficient acidic soil, early genotypes, were categorized as the most P efficient and the most responsive to increased P availability. These results indicate that maize landraces exhibit variation for several plant growth traits that may be useful for genetic improvement of P use efficiency in maize.

Keywords: P acquisition efficiency,P utilization efficiency,root architecture and morpholo,32P,Maize

ID ABS WEB: 136527

8. Other
8.08 133822 - Peatlands in a changing world

NUTRIENTS AND DISSOLVED ORGANIC CARBON DYNAMICS IN RESPONSE TO ENVIRONMENTAL DRIVERS IN A BELGIAN PEATLAND

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[1] Earth and Life Institue, Université catholique de Louvain, Louvain-la-Neuve, BELGIUM
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Peatlands are providing crucial ecological services such as significant carbon storage. These sensitive ecosystems are subjected to degradation due to land use and climate change resulting in carbon emissions. Multiple studies focused on the gaseous carbon fluxes from disturbed peatlands while dissolved carbon fluxes have often been overlooked. However, hydrologic export of carbon can represent up to 30 % of the ecosystem carbon exchanges and is highly variable.
We investigated the spatiotemporal variability in dissolved carbon in a peatland located in the Belgian High Fens. The site was previously drained for forestry and is now under passive restoration. These disturbed peatlands are understudied despite their ubiquitous presence in the Ardennes-Eifel region. It is therefore important to understand their actual state and their recovery potential. Our objectives are to: (i) characterize the spatiotemporal variability in dissolved nutrient and carbon concentrations in soil solutes; (ii) investigate the association between soil moisture, redox conditions and nutrient and carbon concentrations; (ii) identify hot-spots or hot-moments in the biogeochemical functioning of peatlands.
Soil pore water samplers were installed at five contrasting positions along a toposequence, at three different depths. Soil pore and river waters are collected and analyzed once per month during one year. These water samples are analyzed for their conductivity, pH, major element concentrations, dissolved C, dissolved N, NO3, NH4, Cl, organic carbon aromaticity and Fe(II)/Fe(III) ratio. At the same topographic positions, sensors were installed to record continuously soil temperature, moisture and electrical conductivity. This provides a finer temporal resolution to study the influence of soil moisture on the soil electrical conductivity, and thereby nutrients mobility.
Our first results revealed that meteorological events influenced concentrations of nutrients and organic carbon. They also demonstrated the importance of the ground water dynamics in controlling the soil conductivity and pH equilibriums. Finally, the soil solute chemistry varied largely as function of topographic position and sampling depth; and will be further analyzed in terms of hydrologic export.

Keywords: Peatlands,Dissolved organic carbon,Nutrients,Soil moisture,Redox conditions

ID ABS WEB: 138007

8. Other
8.08 133822 - Peatlands in a changing world

ANALYSIS OF PEAT SOIL CHARACTERISTIC AND ENVIRONMENTAL PARAMETER VARIABILITY IN CONTROLLING CO2 EMISSION ON THE TROPICAL PEATLANDS AGRICULTURE

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Peatland utilization for agriculture in Indonesia has a history dating back to the 1920s, initiated by the Banjar community in South Kalimantan, and has experienced significant growth over the years. Agricultural practices involving drainage in peatlands consistently draw attention as a significant contributor to atmospheric CO2, accelerating peat oxidation and releasing carbon stocks as CO2 gases. This research focuses on peatlands utilized for coconut plantations and oil palm, implementing water management practices following responsible peatland management since 1986 and 1994. Research findings indicate that environmental parameters such as groundwater table, soil moisture, and soil temperature do not directly control the magnitude of CO2 emissions. Changes in the physical characteristics of peat, such as the degree of decomposition, determine the availability of organic material that can be further oxidized and released as CO2 emissions. Field measurements indicate that peat soil emissions are partly influenced by root respiration rather than by the loss of organic matter on peat. CO2 emissions from peat soil (heterotrophic respiration, RH) are 7.77 t C-CO2/ha/year in coconut plantations and 11.1 t C-CO2/ha/year in oil palm plantations, while autotrophic emissions (RA) contribute 212% to 424% to soil respiration (RS) in peatlands. Bulk density was observed every 10 cm of the peat layer, revealing that 81% of subsidence in peat occurs due to compaction, with bulk density values changing from 0.072 gr/cm3 to 0.146 gr/cm3 and 0.144 gr/cm3 in oil palm and coconut plantations. Therefore, estimating CO2 emissions by converting subsidence data in peatlands may have limited applicability. A comprehensive understanding of processes in tropical peat, especially for agricultural cultivation, is crucial for evaluating CO2 emission calculations in peatlands and climate change mitigation for sustainable peatland management.

Keywords: peatland,coconut,oil palm,emissions,sustainable management

ID ABS WEB: 138222

8. Other
8.08 133822 - Peatlands in a changing world

RECOVERY OF FEN PEATLAND MOLECULAR COMPOSITIONS AFTER REWETTING

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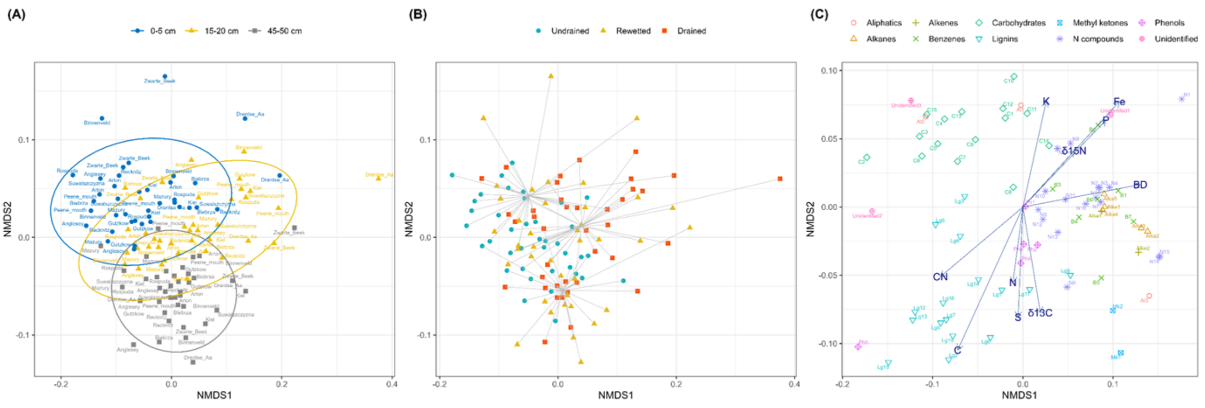
Peatlands degradation has been severely manifested due to intensification of human activities across western Europe. In order to retrieve these ecosystem to the original state that possibly serves multi-functionalities, rewetting restoration has been initiated by maintaining water table. However, it still remains elusive how rewetting restoration shifts peat organic matter (OM) chemical composition. Peat OM chemical composition not only indicates decomposability, but it also regards as footprint to the undergoing hydrological state and vegetations. This research is aimed to characterize if rewetting itself enables to recover peat OM chemical compositions to the original state. To evaluate the effect of rewetting, we compared peat OM chemical compositions across three contrasting hydrological regimes (undrained, rewetted, and drained) at three depths (0-5, 15-20, and 45-50 cm). In addition, our study implemented stoichiometric assessments encompassing elemental analysis, and stable isotope. In pairwise comparison analyses, peat OM chemical composition similarity between rewetted vs. undrained is significantly different, but not between rewetted vs. drained ($P < 0.05$; $P > 0.05$). Drainage significantly increases relative abundances in N compounds, benzene, aliphatic, and decreases relative abundances in carbohydrates, phenol compared to relatively intact one ($Ps < 0.05$). This result enables to further infer that primary shift drivers as a function of vegetation alterations and oxic-anoxic interface condition. Particularly, peat OM chemical compositions at a depth of 15-20 cm went through the most length trajectory compared to other two depths, and there is no significant difference at a depth of 45-50 cm across hydrological regimes ($P_{15\text{-}20\ cm} < 0.05$; $P_{45\text{-}50\ cm} > 0.05$). By linearly plotting rewetting period to dissimilarity distance, it is estimated that recovery time windows of peat OM chemical composition is about approximately 30 years. These findings suggests that peatlands hydrology is a key driver to alter peat OM chemical composition, and also rewetting restoration itself for several decades is not sufficient to successfully return to its original selves.



Keywords: Organic matter composition,Peatlands,Rewetting,Pyrolysis_GC/MS

ID ABS WEB: 140105

8. Other
8.08 133822 - Peatlands in a changing world

LONG-TERM EFFECT OF ASH FERTILIZATION ON SOIL MICROBIOME IN DRAINED PEATLAND FORESTS

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In Finland, fertilization of drained peatland forests with wood ash is one of the actions in the climate plan for the land use sector aiming to improve annual carbon capture. Wood ash is known to increase tree growth but its effects on overall greenhouse gas balance and soil microbial communities are not yet fully understood.

The aim of this research is to investigate how ash fertilization affects the structure, diversity, and functional gene pool of microbial communities in drained peatland forests. Additionally, we explore how the potential changes in the microbial community impact soil carbon storage and which microbial groups participate in the greenhouse gas cycle in drained peatland forests.

The experimental design consists of eight peatland forest sites in Finland representing three drained peatland forest types with varying nutrient levels. Each site has an ash fertilized plot and an adjacent unfertilized control plot. The sites have been fertilized (5 tons of wood ash per hectare) at different times; the oldest in 1937 and the most recent in 2014. Whole community DNA was extracted from a total of 192 soil samples, followed by metagenomic sequencing and analysis.

Based on our results, the ash treatment has an effect on microbial communities when examined on individual sites. However, simultaneous comparison of all sites indicates that site and peatland forest type may have a greater impact on the structure of microbial communities than ash treatment. The effects of ash fertilization on the functional gene pool of the microbial communities are currently being investigated.

Keywords: Drained peatland forest,Soil microbiome,Ash fertilization,Soil carbon storage,GHG balance

EPOSTER PRESENTATIONS

ID ABS WEB: 138190

1. Equity, diversity, and inclusivity in soil sciences
1.02 131441 - Boosting Global Soil Science Collaboration: Fostering Equity, Decolonization, and Capacity Strengthening

DOCTORAL TRAINING TO SUPPORT SUSTAINABLE SOIL GEOCHEMISTRY RESEARCH IN AFRICA

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Africa's potential for scientific research in is not yet being realised, for various reasons including a lack of researchers in many fields and insufficient funding. Strengthened research capacity through doctoral training programmes in Higher Education Institutes (HEIs) in Africa, to include collaboration with national, regional, and international research institutions, can facilitate self-reliant and sustainable research to support socio-economic development. In 2012, the Royal Society (RS) and the UK's Department for International Development (DfID) (now the Foreign, Commonwealth and Development Office, FCDO) launched the Africa Capacity Building Initiative (ACBI) Doctoral Training Network which aimed to strengthen research capacity and training across sub-Saharan Africa (SSA). The ACBI supported 30 core PhD scholarships, all registered/supervised within African HEIs with advisory support from United Kingdom (UK)-based institutes. Our "Soil Geochemistry to Inform Agriculture and Health Policies" consortium project which was part of the ACBI doctoral training program network, was implemented in Malawi, Zambia, and Zimbabwe between 2014 and 2020. The aims of our consortium were to explore linkages between soil geochemistry, agriculture and public health for increased crop productivity, nutrition and safety of food systems, and support wider training and research activities in soil science. Highlights from our consortium included: (1) the generation of new scientific evidence on linkages between soils, crops and human nutrition; (2) securing new projects to translate science into policy and practice; (3) maintaining sustainable collaborative learning across the consortium. Our consortium delivered high quality science outputs and secured new research and doctoral training funding from a variety of sources to ensure the continuation of research and training activities. For example, follow-on Global Challenges Research Funded (GCRF) Translation Award provided a strong evidence base on prevalence of deficiencies in children under five years of age and women of reproductive age in Zimbabwe. Although our project and the wider ACBI has contributed to increasing the self-reliance and sustainability of research within the region, many challenges remain, and ongoing investment is required.

Keywords: Doctoral training networks, Laboratory Investments, PhD Thinkers, Research Partnerships, Strengthened Research Capacity

ID ABS WEB: 136104

1. Equity, diversity, and inclusivity in soil sciences
1.03 133426 - Gender inequalities and soil health

DIFFERENCES IN THE SOIL HEALTH OF MALE AND FEMALE FARMERS: PRESENT STATE OF THE RESEARCH, KNOWLEDGE GAPS AND FUTURE RESEARCH OPPORTUNITIES

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Since women represent 43% of the global agricultural labour, food security research is moving towards a multi-disciplinary approach where gender has a growing importance. But assuring food security is not possible with an unhealthy soil incapable to support crop production. However, there is little research in soil health under a gender framework. In 2021 a systematic literature review was conducted using Web of Science aiming to determine the type and extent of evidence reporting soil health differences between plots farmed by men and women. 54 articles were involved, mostly based on African countries. Only 7 articles used quantitative data measuring soil health indicators between plots farmed by men and women, with no generalisable conclusions. This scarce evidence may be related to the prominence of shared farming systems and the difficult to establish a gendered division within them. The rest of the articles used mixed quantitative and qualitative data collected through questionnaires and discussed the adoption of soil enhancing technologies among women. Their findings suggest female farmers are less likely to adopt capital intensive practices because of a limited access to loans. In circumstances where households are financially secure, women then will choose the less labour-intensive practices because of a restricted labour availability due to different causes, such as a reduced number of working age members in their households or social norms about the tasks they are allowed to do. However, the survey processes used here were not clear or accurate. For instances, there is no description if women were interviewed separated by men, and if their answers were influenced by their presence.
Finally, the reviewed articles discussed soil health functions as nutrition or land degradation but did not discuss functions like soil biology and the regulation of pests and diseases. Summarising, the review unveiled many research opportunities. Future works should analyse the labour division patrons, provide detailed surveys, and explore other soil health functions, specially in countries outside Africa.

Keywords: Soil Health,Food Security,Gender,Female Farmers,Adoption of soil technologies

ID ABS WEB: 137255

1. Equity, diversity, and inclusivity in soil sciences
1.03 133426 - Gender inequalities and soil health

SOIL HEALTH IN NEPAL'S TERAI REGION: USING MENTAL MODELS TO EXPLORE PERCEPTIONS AND PRACTICES

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Soil fertility decline in Nepal's Terai region is a growing concern among agricultural stakeholders. Soil organic matter levels have fallen to critically low levels in 95 per cent of cropland, contributing to declining yields and increasing vulnerability to climate change. Management practices such as deep tillage and crop residue burning are cited as contributory factors to human-induced soil degradation. Correspondingly, rhetoric exists in policy and research organisations that soil degradation is a mismanagement problem. Farmers are blamed for poor decision-making because they purportedly lack knowledge, awareness, and support for soil management. From this perspective, one solution to soil degradation is to educate farmers on best practices. However, questions such as what constitutes "good" soil health; who defines "best" practice; and whose knowledge is considered legitimate and credible, can result in conflicting approaches to soil management. Considering these questions is critical because the responses can shape the way issues such as soil degradation are perceived, the responses deemed appropriate, and the specific land management goals that may be pursued. Intersectional issues such as gender, age, and education may also play a critical yet understudied role in peoples' environmental management decision-making. Exploring these themes, this project will apply a mental model approach to investigate the diverse ways in which soil health is conceptualised, assessed, and practised in the Terai. A mental model represents someone's thoughts about how something works in reality. Data will be collected through interviews with farmers and other stakeholders, focusing on their experience of soil degradation, as well as socio-demographic factors that may influence their approach to soil management. As data collection is ongoing, this presentation aims to stimulate the research agenda by summarising key literature, highlighting gaps, and exploring the application of mental models to understand divergent perspectives and practices. Understanding these different viewpoints holds implications for comprehending, advocating, and targeting sustainable soil management support in the future.

Keywords: Soil health,Mental models,Intersectionality,Ethnopedology,Nepal

ID ABS WEB: 137670

1. Equity, diversity, and inclusivity in soil sciences
1.03 133426 - Gender inequalities and soil health

SOIL STATUS AND ITS RELATIONSHIP WITH GENDER AND HEALTH INEQUALITIES IN GUATEMALA

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This research examines the relationship between soil inequalities, gender disparities, and health outcomes in Guatemala. The historical context of land concentration, limited access to land, internal conflict, and socioeconomic factors contribute to soil inequalities, which in turn affect household gender dynamics and health outcomes.

Using a case study approach in San Martin Jilotepeque, Guatemala, this research examines the challenges faced by male and female farmers in managing their soil. The study employs a mixed-methods approach, including field observations, surveys, and a literature review. A total of 250 surveys were conducted, gathering information on managing practices in homefield and outfield areas, as well as the gender of field managers and household heads.

Preliminary findings reveal the impact of gender inequalities in land management and access to agricultural resources affect soil quality. Women often experience limited access to agricultural resources such as fertilizers, improved seeds, and machinery, hindering their ability to improve their soil status. This gender-based resource inequality further exacerbates existing gender disparities in agricultural productivity and household well-being.

By highlighting the connection between soil and gender inequalities, this research contributes to understanding intrahousehold gender dynamics and their connection to health inequities. It aims to provide insights for addressing gender and health disparities in Guatemala. Integrated approaches that consider the multifaceted nature of these challenges are essential for sustainable development and community well-being.

Keywords: Gender,Soil status,Small scale farmers,Guatemala,Inequality

ID ABS WEB: 136850

2. Soil and humanity
2.01 124495 - Youth digging - The progress of early career global soil research

CAMELINA AND CARINATA CULTIVATION ON SANDY-TEXTURED SOILS – CASE STUDY FROM POLAND

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Camelina and Carinata are a promising biofuel crops (rich in fatty acids), suitable for cultivation on marginal (sandy textured) soils. The aim of the presented study was to assess the crop yields of mentioned plants on sandy soils (Brunic Arenosols) and present the overview of soil conditions and minimum fertilization effect on it. The study was conducted at 4 locations in Poland in the growing season of the year 2023. In the case of all fields reduced tillage and application of 30 m3 of liquid manure was applied, before plant sieve. Plant harvesting took place at the turn of July/August 2023. The soil samples were collected (from 5 points within each fields, up to 100 cm) 1-2 weeks after plant sieve. The following analysis were done in soil samples: soil texture, pH, total organic carbon and total nitrogen content, plant available forms of phosphorus, magnesium and potassium, sum of base cations, hydrolytic acidity, cation exchange capacity and base cations saturation. It is worth to mentioned that the long-term drought was observed during the experiment. The climatic water balance was definitely below 0 (-100 to -200 mm). The highest yield of Camelina seeds (1.2 t ha-1) was obtained in the field no. 2, while the highest yield of Carinata seeds (370 kg ha-1) was obtained in the field no. 1. In one location due to plant diseases the yield of Carinata was not obtained. In one location due to plant diseases the yield of Carinata was not obtained. Analysis of the tested soil properties showed that the crucial parameter that affect plant growth was soil pH, what directly impacts the nutrients availability. Our study reveals that chosen plant are promising solution for cultivation under harsh environmental conditions, and reduced fertilization.

The research was financed within the project: CARINA - CARinata and CamelINA to boost the sustainable diversification in EU farming systems, within the framework of Horizon Europe. Project no: 101081839.

Keywords: Brunic Arenosols,coarse textured soils,reduced tillage,biofuel crops,central Europe

ID ABS WEB: 137763

2. Soil and humanity
2.01 124495 - Youth digging - The progress of early career global soil research

MEXICAN SOIL JUDGING CONTESTS

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Soil judging contests serve as educational platforms wherein soils are described and classified. In Mexico, five national contests have been conducted, comprising two virtual and three face-to-face events. These contests aim to foster participation, learning, and networking among young students and early-career scientists. Distinguished national and international figures evaluate the events. Over 1,000 participants from 16 Mexican states have engaged in these competitions, facilitating interactions among students, coaches, and experts. This interaction has heightened interest in soil studies, leading to the discovery of potential colleagues and research opportunities. Furthermore, the contest has proven to be an effective didactic method for teaching and learning. In conclusion, national competitions serve as excellent forums for identifying future international representatives, with each edition attracting a growing number of young individuals interested in soil science.

Keywords: Learning soil classification,Soil profile,Students,Early career scientists

ID ABS WEB: 138215

2. Soil and humanity
2.01 124495 - Youth digging - The progress of early career global soil research

SENSITIVITY ANALYSIS OF TWO EROSION MODELS IMPLEMENTED IN AN AGRICULTURAL WATERSHED IN SOUTHWEST FRANCE

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To address the erosion of cultivated soils, various types of actions are being taken. Infrastructure improvements help slow down the transfer of sediments to watercourses. To prevent processes of soil structure degradation, changes in agricultural practices can also be used. All of these solutions represent a significant cost that must be shared by all stakeholders and planned for the long term. Aware of the challenges, stakeholders in the territories are seeking decision support tools to prioritize actions to be taken.
In order to prioritize actions in the municipalities most at risk, watershed managers of the Save river sought to obtain a map of the erosion risk in the watershed. This watershed of the southwest of France is highly agricultural and affected by soil erosion. To qualify the erosion risk, we used a modeling approach using the widely used model RUSLE and the model MESALES adapted for the south of France. The results of this modeling approach depended on the initial assumptions, particularly the model used. Therefore, we sought to understand the sensitivity of these two models.
While the RUSLE model is empirical and based on measurements made in the 1970s in the USA, MESALES is based on an expert system aimed at prioritizing risk without quantifying soil losses. In both approaches, soil erodibility is not assessed in the same way. While RUSLE considers the partitioning of precipitations between infiltration and runoff, MESALES mainly considers the structural instability of soils due to the abundance of silts. Of course, the model outputs also depend on the quality of input data such as precipitation, land cover, and soil characteristics. The coarse resolution of the available soil maps in the region required aggregating data within the polygons of the map. The final map rendering was therefore affected by the aggregation method used. Managers must be aware of these conditions of use to better convey messages to stakeholders about the required change in practices.

Keywords: Soil erosion,Modelling,Watershed,Agricultural landscape,Sensitivity analysis

ID ABS WEB: 136911

2. Soil and humanity
2.02 129339 - The development of Soil Science in the IUSS countries: 100 years of history

DEVELOPMENT OF SOIL SCIENCES IN JAPAN

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Modern soil science was introduced just after the reformation of Japan in 1867 mainly by two German teachers, M. Fesca and O. Kellner. Fesca published the first modern soil map in 1885 and Keller initiated fertilizer experiments in 1880s. Then, their students formed the Foundation of Agricultural Sciences in 1887, based on which the Society of the Science of Soil and Manure, Japan, currently called the Japanese Society of Soil Science and Plant Nutrition (JSSSPN), was established in 1927. The Japanese soil scientists have participated in the major international academic gatherings since the 2nd International Conference of Agrogeology (ICA) at Stockholm in 1910. Two joined the 4th ICA at Rome in 1924 when the ISSS was established.
The academic activities then expanded not only in Japan but to Korea, Manchuria and Inner Mongolia as well as Taiwan and Sakhalin in accordance with a military invasion to China and Southeast Asian countries during WWII. Economic growth of Japan in the 1970s accomplished self-sufficiency in rice production and extended the range of crop to grow, however, a variety of environmental issues came out. The JSSSPN became more actively involved in international activities and hosted a number of international conferences, the most significant of which was the 14th ICSS at Kyoto in 1990. The JSSSPN proposed there a regional organization to cope with the unique issues, e.g. improvement of paddy rice cultivation, for Asian countries and established East and Southeast Asian Federation of Soil Science Societies (ESAFS) in 1991. Since the early 1990s, the research topics have become more related to the global as well as regional environmental issues.
Major achievements in the history of the society may include 1) development of research particularly on paddy soils, volcanic ash soils and soil acidity, 2) consistent commitment to the education for constructing sustainable society, and 3) international cooperation in improving rice production in the developing countries in Tropical Asia, Latin America and Sub-Saharan Africa.

Keywords: Japan,History of society,Paddy soils,Volcanic ash soils,soil acidification

ID ABS WEB: 137879

2. Soil and humanity
2.02 129339 - The development of Soil Science in the IUSS countries: 100 years of history

50 YEARS OF SOIL SCIENCE SOCIETY OF SWITZERLAND: FROM TEXTURE TRIANGLE DISCUSSIONS TO THE POWER OF FREEZING A CONSTRUCTION SITE

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The Soil Science Society of Switzerland (Bodenkundliche Gesellschaft der Schweiz (BGS) / Société Suisse de Pédologie, Società Svizzera di Pedologia (SSP)) was founded in 1975 and will thus celebrate its 50-years anniversary in 2025. Originally founded and mainly supported by academic members, the society always had a practitioner's focus and increasingly has been transformed into an association for soil professionals not only from research institutions, but also from local and national governments or the private sector. The BGS/SSP currently has almost 600 members that are active in soil engineering, mapping, policy making or both fundamental and applied research. The diverse background of its members is also expressed by the multitude of working groups of the BGS/SSP that pursue different aspects of soil classification or soil protection policy, contribute to legal consultations, build a platform for soil related educational material from elementary to high school or to ensure knowledge transfer of most recent digital methods into practical application.
With this contribution we will outline the specific features of the BGS/SSP, summarise the work of prominent Swiss soil scientists and will outline the current and future challenges of soil professionals of the many domains in Switzerland.

Keywords: BGS/SSP

ID ABS WEB: 138144

2. Soil and humanity
2.02 129339 - The development of Soil Science in the IUSS countries: 100 years of history

TOPOSEQUENCE: AFTER ALL, WHAT ARE WE TALKING ABOUT?

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Toposequence was initially proposed to characterize the lateral succession of soils on slopes influenced by topography. However, its use has evolved and diverged from its original concept. Our objective was to examine the application of this concept since its inception. To achieve this, we conducted bibliometric analyses of publications in the Web of Science database from 1900 onwards. We identified three primary approaches and associated concepts, whether explicitly stated or implied: one at the regional scale and two at the local scale. Based on our investigation, we propose the following recommendations: a) When adopting a regional approach, terms such as Geomorphic Surface or landscape position should be utilized to address the spatial distribution and genetic implications of soils at this scale. b) Employ the term catena for mapping purposes or when emphasizing taxonomic classification in the series/sequences of soils with soil profiles spaced on slopes. c) When the determining factors of the soil sequence are climatic, biotic, lithological, or chronological, the corresponding terms are climosequence, biosequence, lithosequence, or chronosequence, respectively. d) If dealing with a lateral succession of horizons in a continuum on slopes, resulting from the influence of topography on soil formation and potentially reflecting the contribution of soils to the evolution of the topography, only in this scenario should the term 'toposequence' be applied, reverting to its original concept. This analysis contributes to a nuanced understanding of the evolving usage and appropriate application of toposequence terminology in soil science. <FILE IMAGE='1643_20240131154951.jpg'>

Keywords: Soil Sequence,Geomorphic Surface,Catena,Structural Analysis of Pedolog,Topography

ID ABS WEB: 138340

2. Soil and humanity
2.02 129339 - The development of Soil Science in the IUSS countries: 100 years of history

SOIL SCIENCE IN ITALY ACROSS THREE CENTURIES: PROTAGONISTS AND ACHIEVEMENTS.

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The history of science is a useful and powerful tool to make young people acquire not only the knowledge, ideas, and the most important theories that, in certain historical periods, have constituted specific scientific knowledge but, also, the scientific investigation methods as they have been formed and evolved over time.
This communication describes the history of Soil Science in Italy from the nineteen to the twenty-first century, highlighting the main research activities and results carried out by its protagonists. Soil Science in Italy has been carried out by diverse Institutions, belonging to Universities and Research Centres, also in collaboration and with the support of Ministries, mainly Agriculture and Environment, Regional authorities, and the European Union.
Analyzing the evolution of Soil Science in Italy, we can see that it follows a historical thread often made of causes and effects, sometimes simple and banal, but sometimes so complex and cumbersome to be unimaginable. In particular, the ‘80s and '90s of the twentieth century were the “golden age” of Soil Science in Italy, when soil scientists managed to make a system of fruitful collaboration between the Institutions, with many basic and practical results, among which the creation of several regional soil services. The “golden age” achievements were to many respect the outcomes of the school of Soil Science led by Prof Fiorenzo Mancini and his many fellows, who have been operating all over the country since the foundation of the Soil Science Society of Italy (SISS) in the ‘50s.
But also former years, namely the two periods that preceded the two world wars are fundamental for understanding the subsequent developments that soil science had in Italy. It was just in this period that the International Sol Science Society was founded in Rome. These factsexplain to us, perhaps better than any other historical element, that small variations in cultural systems can subsequently provoke large cultural evolutions, whose effects remain today.

Keywords: History,Soil Science,SISS,Italy

ID ABS WEB: 137764

2. Soil and humanity
2.03 129617 - Soil Health from Multiple Perspectives

BEACH DANAT (PEARLS): LET NATURE DRAW FOR US

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My role as an artist is to create a constructive cultural and artistic dialogue between myself and nature – let nature draw for us. The more you care for nature, the more it will care for you. The more you neglect and destroy it, the more you will see the power of its anger.
My current process began in 1998, when I dug a hole on the beach so that my canvas could be exposed to the seawater and the tides. Along with the canvas, I buried saffron, pomegranates, pieces of rusted iron, and iron filings. After about a week, the chemical and biological processes in nature resulted in oxidation of the iron and other materials, resulting in shapes and color gradations of iron rust. Over a period of 25 years many works of art were produced with different materials, conditions, and time periods. This art was a global addition to the world of visual arts that is credited to the Emirates. In recent works, I have added three colors: black, orange, and turquoise to some paintings.
My objectives are to produce unique contemporary works of art, which is also a form of art therapy. It is a treatment for the soul, a relief for the nerves, a release of negative charges through the steps of producing work, a source of happiness, and interacting with nature. In my presentation, I will emphasize the importance of cooperating with nature to discover, respect and preserve its beauty. It is important to perform continuous research in the field of visual arts to discover and invent new artistic and creative methods from what has come before.

Keywords: Beach Danat,Soil Art,Nature Draw for us,Abu Dhabi

ID ABS WEB: 138131

2. Soil and humanity
2.03 129617 - Soil Health from Multiple Perspectives

FUNGAL DIVERSITY AS AN INDICATOR OF SOIL HEALTH IN POST-FIRE FOREST RESTORATION

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Twenty years ago, the Cedar fire, one of the largest ever in the state of California, ravaged the city and county of San Diego. One of the hardest hit areas was Cuyamaca State Park, known for natural biodiversity, where almost all the conifers perished. Within a few years the land was covered by shrubs, primarily Ceanothus palmeri, or wild lilac. Ceanothus, in symbiosis with bacteria, fix nitrogen, an essential nutrient that is often depleted during forest fires, but their dense growth is believed to compete with tree seedlings.

Since the fire, park managers have implemented a controversial policy of clearing the ceanothus, followed by controlled burns and replanting of conifers. Some argue that ceanothus will naturally disappear over time in a process of secondary succession. Removing the shrubs only further damages an already imperiled ecosystem.

In this project, buried cloth and DNA analysis of soil microorganisms was used to compare an area that was undisturbed since the initial fire, to another site that was cleared, burned, and subsequently replanted with conifers. The fungal DNA data suggests significantly higher biodiversity (Shannon Index) in the undisturbed site. The decomposition of the buried cloth provides visual evidence of the richness of the subterranean environment. When this site is compared to others in the ecoartspace “Soil Dialogues” project, the undisturbed site had one of the highest indices of fungal diversity, and the disturbed site had one of the lowest, though the two sites are on similar soils series, altitude, and latitude.

This exploration is a continuation of an earlier project; “Walking with trees,” bearing witness to increasing loss due to urbanization, invasive species, drought, bark beetles and fire. At the intersection of art and science, this project asks the question; “given the multiplicity of challenges facing forests are conventional restoration efforts the best means to regenerate forests for future generations?”

Keywords: Forest restoration,Fungal diversity

ID ABS WEB: 138156

2. Soil and humanity
2.04 129928 - Soil sciences entering into transdisciplinary research

A SMART SYSTEM TO SUPPORT AWARENESS ON SOILS AND LAND IN ITALY

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Ecotourism and rural tourism, especially for many inland areas, are activities that can generate significant income and support the rural economy and reinforce the awareness of land and soils of specific territories. Because of their cruciality, the United Nations includes them in the 17th Sustainable Development Goal to be achieved by 2030 (SDG 8.9 and SDG 12). Recently, there has been a strong increase in digital tourism, which, however, is almost exclusively aimed at popular tourist destinations.
This paper aims to demonstrate that a geospatial decision support system (S-DSS), developed on a freely accessible, web-based geospatial cyberinfrastructure (GCI), could provide a valuable operational tool to improve both the tourism offer of inland areas and the awareness of land and soil environmental resources.
The S-DSS platform supports the acquisition, management, processing and analysis of both static (e.g. soil, geology) and dynamic (e.g. daily climatic data) data, together with data visualization and on-the-fly computer applications and is designed to support a multi-user community (farmers, tourism businesses, associations and public bodies).
The S-DSS tool known as EcoSmarTour works on the entire Italian national territory and can return a large amount of information (including soils) that will improve knowledge of the territory, manage scenario analysis, produce maps and evaluate potential trails or areas of interest for ecotourism. Furthermore, through the use of artificial intelligence EcoSmarTour can narrate the selected route in text form and does so with a degree of complexity chosen by the user. For instance, this allows to build automatic customized storytelling for children, teenagers, adults or experts. The methodology adopted is highly transferable because it is based on very general algorithms that can be easily applied wherever the necessary data are available.

Keywords: soil awareness,Ecotourism

ID ABS WEB: 139810

2. Soil and humanity
2.04 129928 - Soil sciences entering into transdisciplinary research

MULTI-ELEMENT PROFILE OF DURUM WHEAT AND PROVENANCE SOIL AS POTENTIAL GEOCHEMICAL FINGERPRINTING FOR GEOGRAPHICAL TRACEABILITY

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Ensuring the safety and authenticity of food has become an increasingly complex analytical task over the last decades, mainly due to the globalization of trade in foodstuffs. Agri-products from some geographical regions often command premium prices due to their recognized high quality. There may be an economic incentive to replace or adulterate with cheaper batches of a given product. Multi-element fingerprinting analytical technique has been used to identify the geographical origin of various foods. The aim of this study was to prove the usefulness of geochemical fingerprinting as provenance markers of wheat by evaluating their link with soil composition and their discriminatory power. For this reason, cultivation soils and wheat were collected from various Italian regions during the harvest period. It is known that plant element composition predominantly reflects plant requirements and metabolism, local environmental conditions such as geo-lithology, climate, soil properties, management and their possible interactions. This is why concentrations of mineral elements in wheat and their provenance soils were analyzed by inductively coupled plasma mass spectrometry (ICP-MS). Chemometrics have been implemented for ICP-MS data processing. The relationships of concentrations of these elements between wheat and soil were studied. The elements associated with origin soil were used to discriminate wheat provenance with principal component analysis (PCA) and linear discriminant analysis (LDA). Multivariate analysis demonstrated that origin has significant influences on the content of each element. These findings provide evidence of the validity of multielement profile as marker for the geographic traceability of wheat, and that a geochemical fingerprinting approach can be successfully applied in the development of a database of Italian wheat. In future work, correlation of the element profile of wheat with other soil parameters and climatic factors, need to be investigated to further substantiate the potentiality of multielement for food traceability. Work carried out by METROFOOD-IT (NextGenerationEU, PNRR-M4C2, Investment 3.1-IR0000033 (D.M. Prot. n.120 del 21/06/2022).

Keywords: Bioavailability,Chemometrics,Mineral elements,Wheat,ICP-MS

ID ABS WEB: 140125

2. Soil and humanity
2.04 129928 - Soil sciences entering into transdisciplinary research

THE DESERT WE EAT: HOW TO DRAW SOIL AS A WAY TO UNDERSTAND FOOD SYSTEMS.

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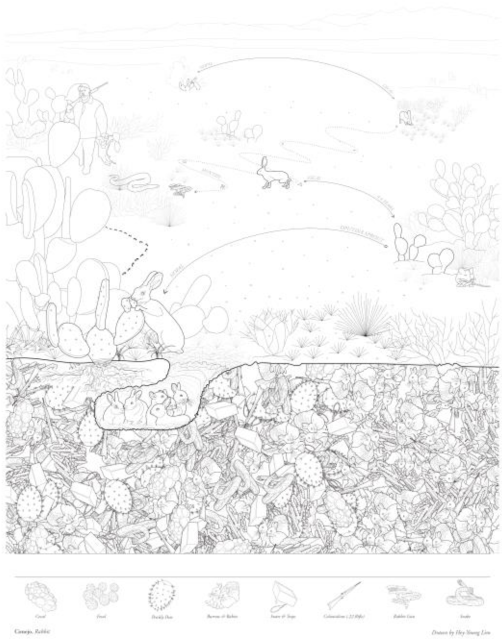
How we represent soil in design disciplines? This could seam a simple question but in fact is a profound one. Designers: landscape architects, urban designer and urban planners could really benefit to know more about. As designers we get to know things by drawing them but we commonly not know how to draw soil beyond its material presence. As we know soil is also a result of processes that have formed it and continue to transformed. So the question is how can we represent this?

This poster will explain how the importance of understanding an specific site through the act of drawing both the above and bellow of the place itself. This a part of a methodology of an ethnobotany/food systems class focused on the desert landscape of the Mezquital Valley in Central Mexico.

All drawing explorations trace an ingredient and its milieu above and bellow ground. Underground, We seek to produce descriptions of soil that acknowledge the full range of human and non-human desire that participates in the process of the soil's formation and, for ethical reasons, we want to produce this portrait of the emergence of the soil's identity. Above ground, We seek to represent all entanglements that depict the ecological relationships of the ingredient (plant or animal) with its own environment and the limits of it.

In conclusion, this poster will show the approach of how to represent holistically a place by taking apart all its relationships and put them back together, with specific emphasis on soil.



Keywords: Interdisciplinary integration,Soil representation,Soil divulgation,Soil knowledge

ID ABS WEB: 137089

2. Soil and humanity
2.05 132213 - Soil and literature

POETRY AS A TOOL FOR SOIL EDUCATION

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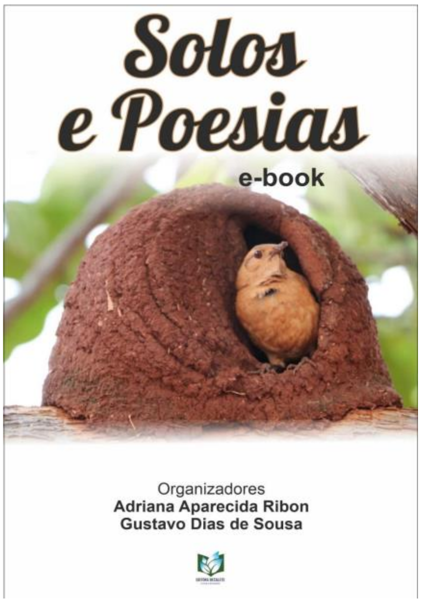
Since the production of texts, with an emphasis on poetry, contributes to the awakening of sensitivity, to the formation of the imaginary and the symbolic in people, as well as creativity, and helps in the observation of experiences lived in everyday life, especially among children, the idea arose to give new meaning to this literary genre through themes that have been little explored. In this sense, in the search for interdisciplinarity, writing poetry allows us to combine the stimulus to awaken children's habits and pleasure regarding writing and the construction of the concept of soils. Thus, the Profiles, Soils and Poetry Extension Project developed at the State University of Goiás - Palmeiras de Goiás Campus promotes activities related to the construction of the concept of soils (workshops, short courses, teaching exhibitions) to evaluate students' perception through poetry writing. The methodology of this project consists of, firstly, a work related to the dissemination of knowledge and information related to the soils, and secondly, poetry reading and writing workshops, to familiarize students with poetic writing, with an emphasis on the soil sciences. Thus, through the project, poems become tools that facilitate the teaching and learning process of basic education students, helping to understand soil concepts and allowing for a greater interaction between those involved in teaching, extension and research projects and society, in addition to strengthening the teaching-research-extension tripod within the University. As a final result, the project holds annual poetry competitions, with the soil as a main theme, and organizes books with the participants' literary productions.



Keywords: Literary production,Soil science,Soil education,Soil and literature,Extension project

ID ABS WEB: 137447

2. Soil and humanity
2.05 132213 - Soil and literature

DIGGING IN THE DIRT: SEARCHING FOR EFFECTIVE TOOLS AND LANGUAGES TO PROMOTE SOIL AWARENESS AND VALORISATION

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Although soils undergo degradation processes worldwide, it seems that the general public has not a clear perception of this important global environmental issue. There is a lack of effective communication tools that can vehicle soil instances throughout common citizens. Being a hidden resource, not particularly attractive, soils are not perceived for the functions they perform and are generally ignored. In most cases soils are considered a mere inert surface without including the three-dimensional properties that comprehend their numerous and precious functions. Furthermore, the tight relationship between humans and soils has been lost with time leading to the current unawareness. Hence, a change of perspective and language is necessary if a larger public needs to be reached with the aim to increase soil literacy. It is imperative to propose additional viewpoints and attributes aimed to enhance soil perception among the general public that could, ultimately, foster valorisation and consequently protection.
Starting from the recently proposed soil security concept, introducing additional pillars (the five Cs) for securing soil, the contribution focuses on connectivity as a social dimension dealing with communication. In particular, the aim of this contribution is an attempt to focus on the likely factors underlying the contemporary common disregard towards the soil resource, then it will encompass semantics issues, analyse new attributes, discuss ethical behaviour and, finally, propose new communication tools. A specific focus on visual arts is included as art shows a great potential for utilising global issues as content for artworks, particularly when the concept to be communicated is difficult to convey and perceived by a wider public which is definitely the case of the soil resource. Finally, different branches of human sciences can play a central role for an effective communication of scientific issues because they hit the emotional, sensitive, intimate side of humans going beyond the conventional language of science that is almost unknown to the general public.

Keywords: soil awareness,art,language,communication,ethics

ID ABS WEB: 137783

2. Soil and humanity
2.05 132213 - Soil and literature

CULTIVATING CONNECTIONS: SOIL'S PRESENCE IN LITERATURE

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The concept of soil, either considered as such or extended to land, is present in literature in all languages, as novels, essays, traveler writings, and even as poetry. Although soils are seldom acknowledged as individual objects, their meanings as indispensable resources for food production, recycling of materials, hydrological regulators, and witnesses of history and cultures, among other ecosystem services, are implicit in many literary works. This symposium welcomes contributions showing representations of soils by writers, in any language, that are hidden in their works, which may become compelling tools to increase awareness of the value of soils in our societies. The potential contributors are soil scientists reporting literature or writers with a certain awareness of the value of soil and land.

Keywords: Literature,Poetry,Soil awareness,Arts

ID ABS WEB: 136017

2. Soil and humanity
2.06 132332 - Soil science and geoethics: contributing to create a more sustainable society

PLURALISING SOIL HEALTHS – EXPERIMENTING WITH 'OPENING-UP' TYPES OF SOIL ENGAGEMENT AMONGST DUTCH FARMER-PRACTITIONER-SCIENTIST COLLABORATIONS

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This paper presents work-in-progress of PhD research on how soil might be known, treated, and experienced differently when foregrounding soil health. Could work on soil health by farmers, trainers and scientists be seen as part of an emerging alternative ethics? Can they forge new types of relations with soils and if so, how?
This paper is based on ongoing ethnographic fieldwork within farmer-practitioner-scientist collaborations on stimulating and understanding soil health of Dutch peat grasslands. The paper introduces the context of the collaboration on soil health by illustrating: scientists attempts and debates on how they can know and measure soil health, farmers seeking to experience and stimulate soil health, and regenerative agriculture advisors in their role as interlocuters between generic knowledges and situated understandings of soil health. The shared quest their work responds to is how they can support soil health. These collaborations on the surface seem to narrate a story of role inversion between human and soil, where human actions, knowledges and sensitivities are intended to support soil, rather than that these should further human's capacities of exploiting soil. But is this inversion the only interpretation of the emerging collaboration? Which other stories emerge and how do these stories speak to critical perspectives on human-soil relations and geoethics?
In seeking to answer these questions, this paper presents a research approach that not merely describes or critiques, but simultaneously aims to be generative. This means that beyond critical insights, I explore alternative trajectories that could augment the existing farmer-practitioner-scientist collaborations. Specifically, by inquiring how rather than existing 'closing down' types of knowing soil health, 'opening-up' types of engagement may be fostered. The paper concludes with reflections on how geo-ethics as a practice, an attitude and sensitivity might become situated in place like the Dutch peat grassland and as such would allow for knowledges that are sensitive to specific and plural ways of relating with soils and in turn with soils' plurality.

Keywords: plurality,experimentation,soil health,sensitivities

ID ABS WEB: 136594

2. Soil and humanity
2.06 132332 - Soil science and geoethics:
contributing to create a more sustainable society

DEVELOPING A SOIL HEALTH AND WELL-BEING INDEX

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Cost-benefit analyses of soil health management practices do not account for well-being outcomes and other intangible benefits of soil health management. Developing an easy-to-grasp number to communicate the well-being outcomes of soil health may help communicate the full range of soil health impacts to producers and policymakers. A multi-step process was used to develop a 5-question index to measure the intangible benefits of soil health management in agricultural systems. First, a soil health and well-being framework was inductively developed through interviews with producers. Over 300 potential items were then developed within each domain and sub-domain of the framework to capture intangible benefits of individual subjective and community well-being. The 300 items were then reduced to 80 by eliminating redundancy, lack of clarity, lack of ability to create a range of responses, and context-specific statements. A two-stage iterative Delphi panel of soil health professionals (n=10) provided feedback via an online survey and then a follow-up interview on the content validity of the statements. Between the two rounds of the Delphi panel, the items were clarified, new items were added to increase the dimensionality of constructs and reduce overlap between constructs. Next, pre-testing of questions with producers (n=8) via cognitive interviews was conducted to improve the face validity of the statements. Finally, the index was administered to a sample population (n=400) at two time points (3 months apart). The answers were analyzed for reliability, tests of dimensionality, and statement reduction. The resulting 5-item soil health and well-being index was developed for use with agricultural producers.

Keywords: Adoption,Well-Being,Survey,Interview,Farmer

ID ABS WEB: 136723

2. Soil and humanity
2.06 132332 - Soil science and geoethics:
contributing to create a more sustainable society

TOWARD A RELATIONAL LAND ETHIC: FROM LEOPOLD TO RELATIONAL MATERIALITY

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The global polycrisis is one of compounding wicked problems, most of which are related to the battle for finite land and resources. Clearly, we need new ways of approaching this increasingly acute plight that move beyond the usual siloes. Transdisciplinary research facilitates deep integration across not only disciplines, but social divides as well. Tackling the proverbial land question (which must include the resource question) from the vantage point of multiple and braided knowledges at the planetary scale requires a systematic ethical framework that serves not only as a guide for developing reciprocal social-ecological relations, but also as a foundation for high-level policy decisions.

This paper proposes the development of a relational land ethic that weaves relational materiality into Leopold's famous land ethic (1949). Land here is seen as community enfolding all biota embedded in their evolving common habitat and implies a continuum across space and time. Scholars working at the intersection of soil science, social science, and humanities, such as Krzywoszynska and Marchesi (2019), have called for a relational materiality approach that effectively bends the curve of economic growth and environmental degradation by generalizing nature under the sign of ecological (instead of extractive) value. This is not so different from Leopold's assertion that humans, as a part of nature rather than its master, must recognize nature's intrinsic value and limit their own freedoms where they impinge on nature's continuity. Leopold, however, offered no clear and abiding framework for his land ethic. Hence, I see it as the work of scholars working at the intersections of soil science, social science, and humanities to not only develop this framework, but also use it to inspire a planetary vision that is wide-ranging in impact, from informing policy and instituting resource security to birthing new modes of perception and imagining new ways of living together, some perhaps already foreshadowed by ancient Indigenous worldviews (e.g., Buen vivir; see Bjork-James et al. 2022).

Keywords: land ethic,relational materiality,transdisciplinary research,planetary vision,policy change

ID ABS WEB: 136522

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

THE POSITIVE EFFECT OF COMPOST AGAINST URBAN SOIL COMPACTION

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Urban waste management and recycling are important issues for the sustainability of cities. Although current uses of composted urban wastes are mostly oriented towards rural land applications, they can also be used successfully within the cities for the restoration of degraded soils. In this work, urban waste composts were assessed as amendments for the reconstruction of urban soils degraded by compaction, where plant growth is hindered. Three soil-like materials –excavated subsoil, construction sand, and crushed construction/demolition waste– were blended alternately with each of three types of composts –green waste compost, food waste compost and municipal solid waste compost– at 20% weight. Imported topsoil, currently used for the remediation of compacted areas by the University of Santiago garden service, was employed as a control. The mixtures were characterized for their main physicochemical properties, and the influence of compost on susceptibility to compaction was assessed preparing compaction curves by the Proctor standard test. The results show that the addition of each of the composts increased the fertility and water retention of all the earthy materials, and reduced their susceptibility to compaction, in some cases even improving the properties of the control soil. The mix of excavated subsoil and green waste compost presented the least susceptibility to compaction, whereas the mixtures with sand presented the poorest properties. Testing the performance of the materials with the best properties under field conditions will be the next step necessary to assess the use of compost for remediation of compacted urban soils.

Keywords: urban soil,compaction,restoration

ID ABS WEB: 136717

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

HEAVY METAL BACKGROUND IN URBAN SOILS OF BARCELONA (CATALONIA, SPAIN)

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Heavy metals are prevalent in urban environments due to rapid urbanization and industrial development. The main objective of the current study is to assess the contamination status and spatial distribution of heavy metals in urban soils from the Barcelona city in Catalonia, Spain. For this purpose, a total of 41 urban topsoil (0-15 cm) and subsoil (15-30 cm) samples were collected, and eight heavy metals were analyzed, including arsenic (As), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), nickel (Ni), lead (Pb), and zinc (Zn). Considering the need to find a simple and robust statistical test, the calculated distribution function was used. The upper limits of the background ranges were expressed in mg kg-1: As 27.9, Cd 13.1, Co 17.2, Cr 145.5, Cu 103.8, Ni 48.1, Pb 258.2 and Zn 426.6. Once the background upper limits were established, some points with anthropogenic signatures were observed. The greatest enrichment anomalies in Cu, Pb and Zn were detected in a small urban area between buildings in Sants neighbourhood that was occupied by a metal smelting industry in the last century. Another enrichment point (As, Co and Zn) was an urban park occupied by shacks made of asbestos materials during the 1960s. Moreover, in the metropolitan area of Barcelona, there are still areas with strong industrialization such as Sant Adrià del Besòs with enrichment anomalies in Co, Cr, Cu, Pb and Zn. Anova test showed significant differences between uncontaminated urban Technosols and in situ developed soils for the contents of Cd, Co and Cr. The Geoaccumulation Index indicated that 75% of contaminated soil samples are in range of slightly contaminated samples, and only 3% are extremely contaminated. The study allowed to verify the heterogeneity of metal content values in the city's soils and their dependence on urban characteristics and historical use.

Keywords: urban soils,heavy metals contamination,Background

ID ABS WEB: 136786

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

GIANCARLO DE CARLO: ENVIRONMENT IS EVERYTHING. A RETROSPECTIVE FOR THE FUTURE

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In the last two decades of Giancarlo De Carlo’s academic and professional career, the theme of the environment has taken on a significant role. It has sparked a fertile line of research aimed at a deep revision of urban planning methodologies. Multiple in-depth analyses. Three are the main ones. The first one concerns an interview from 1987, where De Carlo wonders whether “a new discipline that deals with the environment and includes urban planning as a specific case” is necessary. The second one concerns an essay from 1991 titled “It’s Time to Turn the Telescope”. The thesis is radical: “the environment is everything: territory, landscape, countryside, urban outskirts, cities, historic centers, buildings, squares, streets, etc., are specific cases within the environmental universe”. The third is retrospective and concerns the exhibition dedicated to De Carlo at the MAXXI in Rome in 2005: “Turning the telescope upside down meant freeing oneself from certain distortions, such as building in blocks rather than sequences of landscapes”.
The question posed pertains to the relevance of this research direction today. A challenging thesis to support, considering the limited attention it received during the centenary of De Carlo’s birth. However, when looking at the ability to reflect on the city, reinterpret notions of urban soil and territory, and reformulate research questions, as happened in the Urbino Urban Plan in 1994, De Carlo’s legacy represents an extraordinary asset for urban planning. This legacy follows four priority lines of action: the interdependence of all components of the territory, ecology, landscape, and transdisciplinarity. It deserves to be revisited. Not only for historical-cultural interest but also as a contribution to the greatest challenge that urban planning must face: combating climate change. De Carlo’s foresight, even today, struggles to become common awareness: “Destruction of a forest is not only an ecological crime but is simultaneously and correspondingly a geographical, geological, topographical, landscape, architectural crime”. Yesterday an intuition, today a possible new beginning.

Keywords: Environment,Territory,Urban soil,Landscape,Planning

ID ABS WEB: 137690

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

WELL-MANAGED URBANIZATION COULD HALVE NITROGEN POLLUTION IN CHINA

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Halving nitrogen pollution is crucial for achieving sustainable development goals (SDGs). However, how to reduce nitrogen pollution from multiple sources remains a grand challenge. Here we show that reactive nitrogen (Nr) pollution could be roughly halved by well-managed urbanization in China by 2050, with emissions of NH3, NOx and N2O to air declining by 44%, 30% and 33%, respectively, and Nr to water bodies by 53%. Urbanization shifts population from rural to urban areas and promotes large-scale and crop-livestock coupled farming, which reduces non-point source pollution from rural sewage and agriculture. Although rural-to-urban migration increases point-source nitrogen emissions in metropolitan areas, regional air and water quality can be improved by reducing upstream and regional total Nr losses, with increased opportunities to control of point source emissions vs. diffuse emissions. Approximate US$ 61 billion would be required for additional urban waste treatment, agricultural land consolidation and livestock relocation, as well as upgrading industrial facilities. However, the overall benefits are calculated at US$ 245 billion due to increases in agricultural productivity and improvements in environmental quality. Such a large benefit-to-cost ratio suggests the feasibility and cost-effectiveness of halving Nr pollution through urbanization, and this would make significant contributions to achieving several SDG targets.

Keywords: Urbanization,Nitrogen management,Pollution,Cost-benefit

ID ABS WEB: 137744

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

REFLECTIONS ON URBAN EXPANSION AND AGRICULTURAL SOIL

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Scientific and professional communities from different fields represent nowadays a significant challenge in proposing appropriate forms of territorial occupation. According to multiple researchers, the interactions between society and nature, manifested in diverse land uses, lack harmony when contrasted with the land's inherent potential. This is leading to unsustainable situations of ecosystem services in the environment which ultimately has a negative impact on society. The most dramatic manifestation of the above mentioned is expressed, to a large extent, by the exponential growth of the global urban population. According to the UN, the urban population currently reaches 57%, with Latin America facing a more critical scenario where 81% of the population lives in cities and urban settlements. The session titled, “Soil for Planning Sustainable Cities” reflects one of the primary concerns that soil researchers and specialists from different fields engaged in urban development and planning should address. The predominantly horizontal urban expansion phenomenon has led to the degradation of soils with significant agricultural potential and the compromise of other ecosystem services essential for human life. This work intends to underline the importance of understanding the land’s potential, aligning it with Colombian policy on rural land occupation, providing technical insights to preserve rural areas with an agricultural vocation in territorial ordinance plans, and serving as a guarantee of sustainability and life.

Keywords: Land capability,Land suitability,Land use change,Urban planning

ID ABS WEB: 138085

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

REUSING REMOVED ASPHALT IN DESEALED SOIL TO REDUCE DISMANTLING COSTS

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The practice of permanently covering soil with impervious material such asphalt and concrete (soil sealing) increased exponentially since the industrial revolution, crippling soil ecosystem services. As a result, soil sealing represents a compelling danger on sustainability, at both local and global scale. At the dawn of the new millennium, efforts to convert this trend are due and are actually being carried out, although on a still too limited surface. Desealing (or depaving) has shown enormous potential for recovering new surfaces to plant growth and other soil ecosystem services. However, soil desealing is not as simple as it may appear. In addition to technical and legal issues, high practice costs and material disposal refrain the attempters, who usually are public administrations. To individuate a cheaper alternative to landfill disposal and favouring the reuse of anthropic wastes, we studied the effects of incorporating the removed asphalt, once suitably crumbled, into the desealed soil to be used as a green area.
The experiment is underway, in situ, in a former parking lot in Prato, Italy, which has been dismantled and transformed into a public park. In a fenced part of the meadow, the performances of four different blends of urban soil, compost (5% everywhere) and asphalt in different proportions (up to 50%) to the soil, are going to be monitored for at least one year in terms of physical, chemical and biochemical properties evolution, as well as supported microbial, animal and plant biomass, activity and diversity. Here, we present some preliminary results.

Keywords: Desealing,Depeving,Sustainable cities,Soil Ecosystem Services,Soil Sealing

ID ABS WEB: 138102

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

IDENTIFYING RESEARCH PRIORITIES TO ACHIEVE NO NET SOIL SEALING IN THE EU POLICY FRAMEWORK

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This contribution presents the preliminary results to identify knowledge gaps and research priorities to achieve the EU's no-net soil sealing and land take targets. The work is undertaken within the project SOLO - Soils for Europe, funded by the EU Soil Mission. The methodological approach is based on a scoping review of the scientific and grey literature, combined with facilitated discussions with a team of experts (Think Tank), and input from a group of peer-reviewers. Based on the identified knowledge gaps, during the next four years, the project will iteratively refine a research and innovation roadmap for soil health in Europe, aimed at guiding future funding priorities at EU level.
The poster introduces the participatory approach adopted by SOLO and the opportunities for contributing to the ongoing roadmapping exercise. It then presents the identified knowledge gaps related to soil sealing, land take, and urban land recycling; and discusses the results of the first round of scoping review and consultations.
The identified knowledge gaps span from gaps related to the technical dimension, such as methods, data, and indicators to map and classify sealed and unsealed soils; to gaps related to actions and policies to counteract soil sealing, including legal and societal aspects. Among others, the Think Tank discussed the lack of suitable data and homogeneous approaches to track changes in soil sealing associated with small sealing interventions such as those in urban domestic gardens, as well as the need to overcome a binary classification of sealed vs unsealed soils towards a classification system that explicitly accounts for soil properties and functions.
Discussions around the poster will provide the opportunity to further elaborate on the list of gaps, including other perspectives not yet integrated in the participatory process, and to collect opinions about priority gaps to be addressed to support the ambitious European objective of 100% healthy soils by 2050.

Keywords: Soil sealing,SOLO - Soils for Europe,Think Tank,Knowledge Gaps,Small sealing

ID ABS WEB: 138152

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

URBAN GARDENS IN FOOD SECURITY AND SUSTAINABILITY: A STUDY IN THE PAULO FREIRE OCCUPATION, BELO HORIZONTE, BRAZIL

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Urban gardens play a vital role in the food security of communities in large urban centers, as well as providing a source of income and leisure for marginalized populations, such as in settlements. The common use of organic waste from composting by small farmers often lacks technical guidance and is guided by local knowledge. Understanding the composition of waste and soils is crucial to identifying nutrients or contaminants that affect soil health, productivity and, consequently, the health of the population. The physical and chemical characteristics of the soils in horticultural beds, extensions for agriculture, at the Paulo Freire occupation in Belo Horizonte, MG, Brazil, were evaluated. The area comprised four 10x30m beds, growing lettuce, cabbage, spring onions, mustard and medicinal plants. Soil samples were collected at two depths (0-20 cm and 20-40 cm) and analyzed for texture, fertility, soil organic matter content and compost. The soils ranged from sandy loam to sandy loam, with averages of 26.8% clay, 44.3% silt and 28.9% sand. They had an alkaline pH, at the limit of suitability for vegetables. Plant nutrients (Ca, Mg, K and P) were high, reflecting the abundance of organic material in the beds. Organic matter levels at depths of 0-20 cm reached 15% and 28% at points P1 and P2, respectively. In addition to the economic benefits, urban gardens play a therapeutic and subsistence role, contributing to the goals of the Sustainable Development Goals (SDGs) 2 (Zero hunger and sustainable agriculture), SDG 3 (Health and well-being), SDG 6 (Drinking water and sanitation), SDG 12 (Sustainable consumption and production), SDG 13 (Action against climate change) and SDG 15 (Life on land), which jointly aim for global action to end poverty, protect the environment and climate, and ensure that people can enjoy conditions of peace and prosperity.

Keywords: women agriculture,soil health,food security,solo heath,sustainable development

ID ABS WEB: 138335

2. Soil and humanity
2.07 132746 - Soils for planning sustainable cities

SOIL MAP AS A BASIS FOR MANAGEMENT DECISIONS AT UNAM CENTRAL CAMPUS

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The basis of soil management to ensure that its ecological functions are optimally fulfilled and thus contribute to the quality areas in cities, the most relevant indicator of sustainable cities, is to have cartographic information. In a city, this represents a challenge due to the modification that the forming factors have undergone due to the influence of human activities, which makes it difficult to elaborate a soil map, such as the one required to make decisions on soil management.
This work presents a proposal for the elaboration of a soil map for the central campus of the National Autonomous University of Mexico (UNAM). This map is necessary to apply the actions contained in the Integral Plan for Sustainability (PISU) prepared by the University Coordination for Sustainability at UNAM, which is the guiding document for the consolidation of UNAM as a sustainable university. One of the objectives of the PISU is to promote the adequate management and preservation of soils, green areas and natural reserves, which is why it is very necessary to have a detailed soil map.
This work also intended to lay the groundwork for other UNAM campuses to prepare their respective soil maps. It can also be part of a strategy to train professionals who can later work in the planning of sustainable cities.

Keywords: soil map,forming factors,technosols,sustainability,university

EPOSTERS

ID ABS WEB: 137099

2. Soil and humanity
2.08 133512 - Children and young people say present at the IUSS Centenary Celebration

STRATEGY OF THE MEXICAN SOCIETY OF SOIL SCIENCE FOR THE DISSEMINATION AND POPULARIZATION OF THE IMPORTANCE OF SOIL IN THE MEXICAN EDUCATIONAL SYSTEM

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In 2020, the Mexican Society of Soil Science (SMCS) included in its organizational structure the Secretariat of Education and Teaching of Soil Science, whose objective is to link the SMCS with educational institutions and society, in general, to disseminate the importance of this natural resource, generate awareness of its use and sustainable management and promote its conservation. To achieve this, a strategy with four lines of action was generated and executed collegiately, interdisciplinaryly, and simultaneously. Axis 1 addresses the issues of education and teaching, through which the National Network for Soil Science Education and Teaching has been created, with 60 researchers from different institutions of higher education who carry out continuous workshops with elementary schools, promoting the IUSS GO TO THE SCHOOL Educational Program; Axis 2 focuses on the elaboration of dissemination material, in which several infographics, agronomic cards and books on the importance of soil have been developed for different educational levels; Axis 3 is in charge of public and educational policy, where several approaches have been made with SEMARNAT and the Ministry of Education to include soil science topics in the curriculum of the educational system. Finally, axis 4 focuses on the annual organization of the Symposium on Soil Science Education and Teaching within the National Congress of the SMCS, which is currently in its XVII edition. In the last Symposium, more than 250 attendees from primary, secondary, and high school education attended, and schools from indigenous peoples participated, exchanging their knowledge on soil management with students from urban areas and science workshops given by soil scientists. The creation of the Secretariat of Soil Science Education and Teaching is significantly promoting the inclusion and dissemination of the importance of soil in the Mexican educational system.

Keywords: ESTRATEGY,EDUCATIONAL POLICY,SOIL SCIENCE,DIVULGATION,EDUCATION COMMISSION

ID ABS WEB: 138116

2. Soil and humanity
2.09 133548 - Microbiome as a common thread from soil to human health: Interaction, Impact and Role of Soil-Plant-Human Microbiome as a new challenge of innovative agriculture and quality food

EFFECTS OF TOROCHICK POULTRY MANURE AND BACTERIAL SEED DRESSING ON THE SOIL BACTERIOBIOTA

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Our study aimed to compare the rhizosphere autochthonous bacteriobiota of plants grown from dressed seeds with Priestia megaterium M1.5 and seed and soil treated with Torochick poultry manure at standard and double concentration (MIV1 and MIV2) with negative controls. Sampling was carried out at three different times during the season: in May, only the soil was sampled (NK); in June and July, both the negative control (NK1 and NK2) and the soil treated with MIV1 and MIV2 were sampled. The Torochick showed a high diversity in genera such as Fastidiosipila (51.36 %), Corynebacterium (11.92 %), Caldicoprobacter (5.85 %) and the family Bacillaceae (3.43 %). However, this abundance did not affect the subsequent composition of the indigenous soil bacterial communities. NK showed a high abundance of Nitrososphaeraceae (21.89 %), Gaiellales (9.69 %) and Rhizobiales (6.91 %), indicating a nitrogen-rich soil. In June, NK1 showed a decline in these taxa, while the biotreatments recovered or exceeded their abundance. The Nitrososphaeraceae increased from 4.12 % to 5.12 % and 6.07 %, the Gaiellales from 8.94 % to 17.31 % and 14.23 % and the Rhizobiales from 6.36 % to 8.68 % and 9.95 %. Similar patterns were observed in July. Some treated samples showed a relative abundance of Variovorax above 70 %, possibly related to drought stress. Alpha diversity analyses revealed a generally high diversity in the negative controls and the MIV samples, with slightly higher Shannon indices for MIV1 compared to its negative control. Contrary, the MIV2 samples showed a slight decrease compared to their respective negative controls. PCoA beta diversity analysis grouped all samples, indicating low differential abundance. Notably, the Torochick-only samples showed significant differences in taxa abundance compared to the controls and MIV1/MIV2. According to the statistical data, the yield of MIV1 increased to 9931 kg/ha compared to the negative control (9810 kg/ha), while the yield of MIV2 increased significantly to 9210 kg/ha compared to the negative control (8748 kg/ha).

Keywords: Soil bacteriobiota,Metabarcoding,Poultry manure,Biofertilizer

ID ABS WEB: 136062

2. Soil and humanity
2.10 133559 - Soil literacy, communication and citizen engagement

RE:PEAT - A LOOK AND LISTEN AT POST-EXTRACTION PEATLAND

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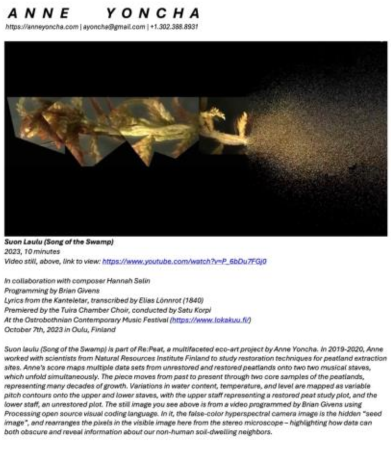
I collaborate with ecologists at the Natural Resources Institute Finland to materialize data about peatland via an art-science approach, with a goal of building affinity with new publics. Peatland is a rare type of ecosystem where Sphagnum moss slowly decomposes and creates an anaerobic, water-logged desert where only it can survive and thrive. In this way the plant is similar to us.

I explore the physiology of Sphagnum – how cells can expand to hold 20 times their weight in water, how the plants weave together to form a mat, and sometimes create an artificial water table. I combine hand-made paper from plants at our study site, digitally altered photos of the site, laser cuts from microscopic images of Sphagnum, to create not-quite-flat paintings I call “peat quilts”. I also use soil data collected via a hyperspectral camera and translated into sound to allow us to hear parts of the ecosystem we can’t see. 50 humans voice approximately 160 years of peatland soil development in 10 minutes and 30 seconds. We are able to hear some choir members voice conserved peatland soil development, and some voice changes in soil development at a peatland extraction site. The insertion of the human voice into this data translation process is meant to highlight our entanglement with non-human, and specifically soil, species.

Peatland is a valuable carbon and climate data preserver. It’s also a source of local fuel and jobs. However, peatland can’t regenerate quickly or regrow reliably– so we are left with an altered, or “novel”, ecosystem. This close look at an ecosystem we have forever changed can provide insight on how we can deal with other post-human landscapes closer to home.



Keywords: Citizen engagement,Biogeochemical cycles,Environmental journalism,Communication,Earth system science

ID ABS WEB: 136141

2. Soil and humanity
2.10 133559 - Soil literacy, communication and citizen engagement

SEARCHING FOR SOIL: ELUCIDATING PUBLIC INTEREST IN SOIL AND SOIL CONSERVATION FROM 20 YEARS OF INTERNET SEARCH TRENDS.

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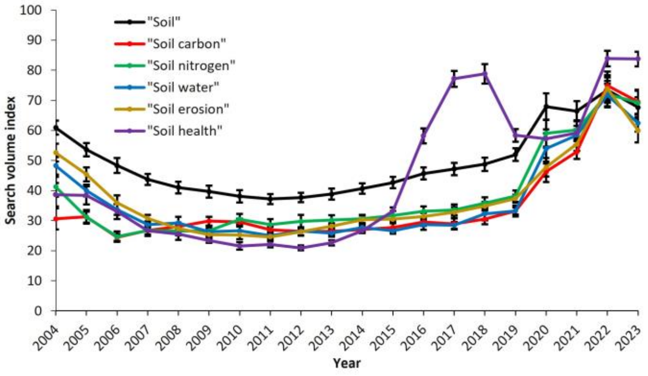
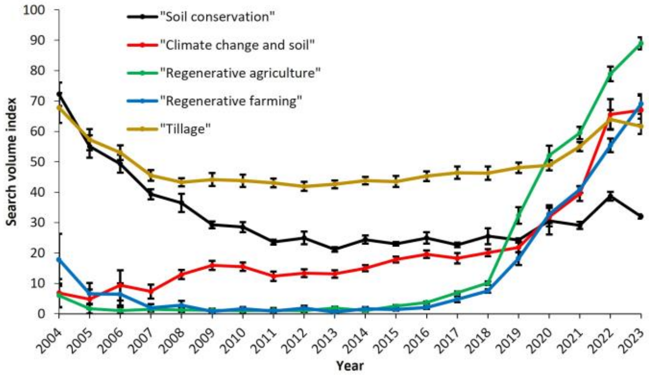
Over the past two decades, soil science has experienced rapid expansion, driven by its crucial role in addressing major challenges such as climate change and food security. Assessing public interest in soil science is pivotal for evaluating the success of dissemination efforts and situating it within broader environmental discourse. This study investigates the trajectory of public interest in soil and soil conservation over a 20-year period using Google Search Trends. Analysing data from 2004-2023, this research aims to uncover temporal patterns in online engagement with soil-related topics, while also exploring potential influences on these trends. Averaged yearly search volume index for search terms related to soil characteristics, conservation practices, and their potential co-influences were produced. Kruskal-Wallis tests with post hoc Wilcoxon rank-sum test to produce year-year pairwise comparisons were conducted. Several significant trends emerged, with searches related to specific soil characteristics displaying stability or gradual increases until 2019, with significant spikes in interest observed in 2019-2020 (carbon, nitrogen, water, erosion) and 2021-2022 (carbon, water, erosion). Searches for 'Soil Health' did not follow this pattern. Interest in soil conservation practices and their links to climate change showed significant increases 2019-2022. Influential factors such as the documentary 'Kiss the Ground' and searches related to climate change and carbon sequestration demonstrated significant increases and peaks in these periods, potentially explaining similar trends in more specific soil-related searches. Searches for “IPCC” did not trend in the same patterns, suggesting their reports are not co-influences on interest in soil and soil conservation. However, searches for “Sustainable development goals” did trend with a number of soil characteristic searches and soil conservation topics, suggesting interest in soil is well linked with the UN’s sustainable development goals. This study highlights a significant rise in interest in soil science, likely influenced by dissemination events and broader interest in climate and environmental science. Ongoing communication is key to ensure sustained progress in soil science awareness compared to other disciplines.





Keywords: Soil,Public interest,Co-influences,Search trends,Dissemination

ID ABS WEB: 136257

2. Soil and humanity
2.10 133559 - Soil literacy, communication and citizen engagement

DIRTY MATTERS – THE SOIL GAME

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Soil is an integral aspect of several vital functions, services and socio-economic activities, such as biomass production and clean water supply. Consequently, many of the UN Sustainable Development Goals (SDGs) such as SDG 2: food security, SDG 6: clean water, and SDG 13: climate change can be delivered by good soil management. Despite its necessity, there is a general lack of awareness regarding the importance surrounding soil as a resource. With our project, we wanted to make soil literacy and awareness accessible to a wide audience. Our aim was to create a fun and educational boardgame that demonstrates the ability of soils to deliver on these SDGs whilst showcasing the interlinking complexity of the soil ecosystem.
The resulting game is called Dirty Matters: the Soil Game. It focuses on how soil management practises affect soil, which in turn affect the SDGs. Dirty matters is a fully cooperative game where the players embody soil organisms (including the mole, earthworm, and rhizobia) and move around the soil implementing soil management techniques (such as cover crops, no tillage regimes, and adding manure) to counteract events that negatively impact the soil (such as soil compaction, acid rain, and erosion). This is all done with the overarching aim of keeping the soil healthy enough to meet the yield requirements of a growing population whilst trying to avoid polluting water and excessive carbon loss.
The process of making this boardgame involved brainstorming sessions to form a game design and rigorous research to make sure our concepts were backed by up-to-date science, play testing with other soil scientists and a variety of other communities to make sure both the mechanics and science worked, and lastly making it look appealing by engaging with a graphic designer. As of today, Dirty Matters is free to download and printer friendly educational tool to advance the understanding of soil and how we should take care of it and everything in it.

Keywords: Boardgames,Sustainable Development Goals,Soil health

ID ABS WEB: 140959

2. Soil and humanity
2.10 133559 - Soil literacy, communication and citizen engagement

PERCEPTION OF LOCAL PEOPLE ON LAND USE PRACTICES IN THE SOUTHERN ISSYK-KUL REGION, KYRGYZSTAN

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Agriculture is a crucial sector for the livelihood of people in Kyrgyzstan. In this context, the local people perception of agricultural practices plays a significant role in land use management. This study aimed to assess the understanding of land use practices among local residents in four districts of Southern Issyk-Kol in 2020. The research was conducted between June and October 2020 with randomly selected farmers (n=40).
The results revealed that farmers were well aware of the existing challenges and their contribution to decreased agricultural productivity and increased vulnerability to environmental changes. Addressing these challenges requires collaborative efforts from government institutions to empower farmers with the necessary information and resources to adapt to climate-smart agricultural practices. The presence of an agricultural specialist within the Local Self-Government can contribute to a significant positive change in the livelihoods of rural farmers. This recommendation strongly emerges from the findings of this research.

ID ABS WEB: 135962

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

SOIL EROSION ON THE VOLCANIC ISLAND OF MONTSERRAT

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Coral reefs to the west of the island of Montserrat, in the Caribbean, are being swamped by sediment but the source of this sediment has not been identified. The variable topography of the island results in a large number of very small catchments. Associated with these are steep, often deeply incised, ephemeral watercourses called ghauts. After high rainfall some ghauts are associated with flooding transporting sediment to the ocean. We collected 200 sediment samples from 40 ghauts extending from Little Bay in the north of Montserrat, to Plymouth in the south. Samples were transported to Lancaster University and analysed by laser diffraction to determine the particle size distribution. Across the island a majority of the sediments were sand. Whilst on the island we observed that other sources of sediment were likely to be coastal erosion and erosion of volcanic deposits. The volcano on Montserrat became active in 1995 and in the years that followed enormous amounts of volcanic debris were deposited. These deposits are eroding and lead to the transport of large amounts of sediment to the coastal waters. Identifying the relative importance of these sources is a priority for future research.

Keywords: Sediments,Erosion,Montserrat,Volcanic soil,Coral Reef

ID ABS WEB: 137109

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

IMPACT OF VEGETATION RESTORATION ON CHANGES OF RUNOFF/SEDIMENT AND UNDERLYING MECHANISM ON LOESS PLATEAU

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To improve the ecological environment, China issued a policy of GFG in 1999. Afforestation and revegetation play a prominent role in improving soil properties and controlling soil erosion. A typical catchment was selected to analyze the trends in climate, LUCC, and runoff/sediment from 1960 to 2020, and investigated the role of vegetation restoration in the changes of runoff/sediment in these land-surface processes and the underlying mechanism.

1) Annual precipitation in the area showed a slight decreasing trend over the past 60 years. Landsat-image interpretation showed that, compared to 1980, the area of farmland in 2020 decreased by 46.4%, and that of vegetated area increased by 25.6%. While the average annual streamflow decreased significantly from 35mm in the 1960s to 19mm in the 2010s. The average annual sediment yield dropped from 0.99 billion t to 0.10 billion t over the period.

2) Planting trees and grasses since 1999, significantly affected soil properties. It increased the organic matter content, decreased the soil bulk density, increased the content of >0.25mm water-stable aggregates, enhanced the stability of aggregates, increased the soil porosity, and improved the soil infiltration performance. The structural equation model indicated that soil bulk density, total porosity, and macroaggregate content are the key soil parameters affecting the saturated soil hydraulic conductivity.

3) Budyko's elasticity-coefficient method and fractal theory approach tested that, large-scale ecological restoration since 1999, contributed 66.3% and 81.7% to the change of runoff and sediment yield in the area, respectively. SWAT and the Geodetector tool were further used, and find that the explanatory power for the spatial distribution of runoff, is significantly greater for soil properties such as saturated hydraulic conductivity, organic matter, and total porosity, than for surface human activities like increased vegetation cover and climate factors like precipitation changes.

These findings reveal and corroborate that vegetation restoration affects runoff-sediment changes, in essence by improving soil quality and enhancing water storage and retention capacity.

Keywords: Vegetation restoration,Soil property,Change of runoff and sediment,Loess Plateau

ID ABS WEB: 137123

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

COMPARATIVE ANALYSIS OF LONG-TERM MINERAL FERTILIZER IMPACT ON GROUNDWATER NUTRIENTS IN AN OIL PALM PLANTATION AND A DRAINED SECONDARY FOREST ON TROPICAL PEATLAND

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Nutrients from fertilizers, when not absorbed by trees or attached to soil particles, can dissolve and be lost through surface run-off, denitrification, and leaching processes. These substances accumulate in surface water and subsequently seep into groundwater, contributing to the deterioration of groundwater quality. Particularly in peat soils, which are highly porous, there is a significant risk of leaching losses from applied fertilizers. In oil palm agroecosystems, where high fertilizer inputs are crucial for maintaining yields, there exists a potential environmental threat particularly to clean water sources and aquatic ecosystems if excess nutrients migrate to waterways. Despite this, research into the long-term effects of fertilizer use on groundwater quality, especially in oil palm plantations located on tropical peatlands, remains limited. This study, therefore, aims to examine the long-term effects of fertilizer use on groundwater nutrients in an oil palm plantation (Elaeis guineensis) situated in tropical peatland, comparing it with a nearby drained secondary forest in Sibu town, Sarawak, Malaysia. Groundwater samples were collected from installed monitoring wells across 12 blocks of the oil palm plantation (OPP) (Q1-Q12) and the drained secondary forest (DSF) between January 2011 and December 2017. Sampling resumed from October 2021 to March 2022 following the planting of second-generation oil palms. The results showed that long-term fertilizer application led to increased groundwater acidity in the OPP, particularly after the replanting of second-generation palms, compared to the DSF. Moreover, the concentrations of potassium (K^+) and chloride (Cl^-) in groundwater were consistently higher in the OPP than in the DSF throughout both wet and dry seasons, likely due to the leaching of these elements from soil into groundwater post-fertilization. This study is the first to evaluate and provide baseline data on the long-term impact of mineral fertilizer use on groundwater nutrients, aiming to contribute to the conservation of groundwater quality and sustainability of oil palm cultivation in tropical peatlands.

Keywords: SOIL AND WATER CONSERVATION,GROUNDWATER NUTRIENT,OIL PALM PLANTATION,TROPICAL PEATLAND,MINERAL FERTILIZER

ID ABS WEB: 137635

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

GULLY EROSION STUDY IN CHINA

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Gully erosion plays an important role in sediment yield and pollutant transportation within watershed. However, compared with interrill and rill studies, there are limited data available regarding quantification of gully erosion processes, which has restricted the development of process-based erosion model and implementation of conservation measures. Thus, the objective of this study was to quantify erosion processes of ephemeral gully (EG) and classical gully (CG) by using integrated monitoring methods of field observation, simulated experiments, GPS-RTK, 3D Laser Scanner (LiDAR) and geometrical measurement. Moreover, EG erosion processes were quantified and impacts of rainfall, upslope and inflow rates, topography and plough activity on EG erosion were analyzed. Meanwhile, the evolution processes of CG were quantitatively described, and a gully erosion evolution model with high estimated accuracy was developed. In addition, key research points in near future were proposed, including continuous sediment transport equation in watershed needs to be developed; seepage and soil pipe flow impacts on gully erosion processes needs to be quantified; soil erosion prediction models, which can be used to predicts gully erosion, needs to be developed. In conclusion, this study provides an important reference for controlling watershed erosion and developing process-based erosion model.

Keywords: Ephemeral gully,Classical gully,Monitoring methods,Evolution processes

ID ABS WEB: 137689

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

NITROGEN LEGACY AND ITS IMPACT ON MANAGEMENT IN THE CHANGJIANG RIVER BASIN

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NITROGEN LEGACY AND ITS IMPACT ON MANAGEMENT IN THE CHANGJIANG RIVER BASIN
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Legacy effects induced by soil nitrogen (N) biogeochemical transformation and hydrological could impact on the achievement of water quality goals. It is explicit that the N legacy effect is crucial for improving soil and water quality and enhancing ecological environmental quality. Despite the improvement in environmental protection strategies over the past 20 years, especially since Chairman Xi proposed Green mountains and clear waters are as valuable as mountains of gold and silver in 2005, Significant progress has been made in water pollution control in China, but in recent years, some basins still face pollution issues.
Here, we utilized a modified Soil Water Assessment Tool (SWAT) coupled with a groundwater travel time distribution module to capture the effects of N legacies on N export from the Changjiang River Basin. The results show that the improved model is highly applicable to the Changjiang River Basin. Through model simulations, there is an increasing trend in N output in this Basin, with N output nearly tripling over the past half-century.
We found that different N reduction scenarios lead to a decrease in N output at the estuary. However, there is a significant time lag between input reduction and subsequent reduction in basin output N among different nitrogen reduction schemes. In other words, achieving the same N export reduction requires more time for a 30% N reduction compared to a 50% nitrogen reduction. In summary, under different N management scenarios, both the reduction rate of basin N output and the time required to achieve N load reduction are affected. It can be understood that more stringent N reduction measures can achieve water quality benefits more quickly.

Keywords: Water pollution,Soil nitrogen legacy,Evaluation model,Changjiang River Basin,Nitrogen management

ID ABS WEB: 137833

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

SOIL PROTECTION IN POLAND – ADVANTAGES AND DISADVANTAGES

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Soil protection is crucial in the context of the European Green Deal, the UN Sustainable Development Goals and the EU mission 'Caring for Soil is Caring for Life'. The LOESS project is a European soil health restoration program. It focuses on increasing soil knowledge through the development of educational offerings and continuing training programs. Soil protection is an important issue. Based on a review of applicable regulations in this area, it was found that in Poland soil protection is influenced primarily by two legal acts: the Environmental Protection Law Act (Journal of Laws of 2024, item 54) and the Act on the Protection of Agricultural and Forest Land (Journal of Laws 1995, No. 16, item 78). They were modified many times, which did not contribute to optimal soil management. The acts do not have a direct connection with the formal process of education about soils, although the Environmental Protection Act takes into account aspects of broadly understood ecological education. These documents force part of the society (e.g. farmers, officials, investors) to acquire knowledge about soil, e.g. in terms of soil quality, soil types, erosion threats, protection and reclamation rules. Thus, they commit to soil protection and rational land management. Soil protection takes into account its quality. The legislation limits the use of agricultural land for non-agricultural purposes, protecting the best quality land. Nevertheless, scientific research indicates that agricultural land of good quality is also excluded from agricultural use. This is a disturbing phenomenon because the quality of Polish soil is among the lowest in Europe - 1/3 of arable land is poor and very poor. Therefore, first of all, high-quality soils should be protected. It should also be emphasized that in Poland the protection of agricultural land in cities has been abandoned, which has a particularly negative impact on the functioning and development of urban agriculture.
Research co-financed by the EU, Project LOESS 101112707 HORIZON-MISS-2022-SOIL-01

Keywords: soil,soil protection,legal soil protection,farmland conversion,Poland

ID ABS WEB: 137960

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

WATER RESOURCES HEALTH: MAGNETIC CHITOSAN-BASED NANOCOMPOSITE FOR THE UPTAKE OF ORGANIC POLLUTANTS

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The environment is contaminated with numerous substances that are hazardous to human and environment health. Particularly, water pollution is of great concern as water resources are the basis of life and all human activities. Among the contaminants detected in surface- and ground-water there are organic pollutants such as pharmaceuticals and dyes. To date, many methods such as biodegradation, membrane filtration, sedimentation and advanced oxidation processes have been widely used to remove pollutants from water. Adsorption is very attractive in view of its simplicity of implementation, cost-effectiveness and no by-product formation. Several materials have been proposed as adsorbents; among them, magnetic materials have caused high attention because they can be easily and rapidly separated from the aqueous solution; in fact, no centrifugation or filtration is required but only the application of an external magnetic field. Experiments were conducted to evaluate the capacity of two magnetic chitosan-based materials to remove the organic contaminants. In a first study, aqueous solutions containing methylene blue (MB) were treated with a magnetic chitosan-based nanocomposite, obtained by cross-linking chitosan on the surface of magnetic nanoparticles of iron oxides using glutaraldehyde as cross-linking agent. In a second study a magnetic chitosan-based nanocomposite, synthesized through a co-precipitation of chitosan, ferrous sulphate heptahydrate and ferric chloride hexahydrate, was used for the removal of sulfamethoxazole (SMX) from aqueous solutions. In both cases, the effect of pH, treatment time, adsorbent dosage and initial pollutant concentration on the absorption capacity were studied. Moreover, the ability of the above materials to be regenerated and reused was assessed by running consecutive adsorption/desorption cycles. The highest adsorption capacity of MB was 150000 mg/kg at pH 4.0, while the highest adsorption capacity of SMX was 264300 micromol/kg at pH 7.0. These results are encouraging, showing that adsorption on magnetic chitosan-based materials is an effective and low-cost method for the decontamination of waters.

Keywords: Magnetic Chitosan,Environment health,Sulfamethoxazole,Pharmaceuticals,Remove pollutants

ID ABS WEB: 138262

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

DYNAMICS OF WATER-SOLUBLE METALS IN SOIL MOISTENED WITH CITRUS WASTEWATERS DEPENDS ON SOIL REACTION AND ORGANIC ACIDS

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The demand of water for civil and industrial use is diminishing the availability of such a valuable environmental resource for agricultural purposes. Thus, for the next generation it is imperative to find alternative water source for crop irrigation. Wastewaters produced by citrus industry (CWWs) are rich of organic matter and mineral nutrients thus making them potentially usable for crop irrigation. Conversely, due to their high content of organic acids and low pH, they may increase the availability of soluble metals, both plant nutrient and contaminants.
The aim of this study was to evaluate the effect of CWWs on the dynamics of soil water-soluble metals and pH. To this end, CWWs coming from the processing of lemons, oranges, and tangerines, at three different doses, were used. CWWs were analyzed to investigate type and amount of organic acids. Soil water-soluble metals (Na, Mg, Al, K, Ca, Fe, Co, Ni, Cu, Zn, Cd) and pH were determined at day 1, 3, 7, 21 and 28 since the addition of CWWs. After the addition of CWWs, soil pH promptly decreased from 7.2 to, at least, 5.3 depending on the type and concentration of CWWs.
Concurrently, the concentration of almost all investigated metals sharply increased within 7 days after the addition of CWWs. Then, it decreased reaching values similar to that of the control.
The increase of metals availability as a consequence of pH decrease was ascribed to different causes: exchange reaction between H+ and cations adsorbed onto colloids surface, addition of organic matter by CWWs that stimulated microbial activity and quantity and type of organic acids added via CWWs.
In conclusion, obtained results suggest that the use of citrus wastewater for irrigation purposes could be a valid solution being them rich in plant nutrients and easily mobilizes macro-nutrients.
Further research is needed to enhance the understanding of the long-term impact of CWWs and to develop targeted strategies for managing industrial wastewater in agriculture.

Keywords: pH,citric acid,metals availability,sustainable agriculture,circular economy

ID ABS WEB: 139527

2. Soil and humanity
2.11 133574 - Soil and water conservation issues worldwide: from the past to the future

CAN AGROFORESTRY CONSERVE THE SOIL AND SECURE LIVELIHOODS IN HIGHLY ERODED SLOPES IN THE PHILIPPINES?

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This work presents a field study conducted in the North Cotabato region of the Philippines. The Cotabato Province, renowned for being the food basket of the Philippines, paradoxically also has one of the highest poverty and food insecurity rates. Decades of conflict afflicting the region has led to farmers deprived of know-how and resources to sustainably enhance their productivity and uplift their livelihoods. Adoption of poorly informed farming practices has led to degradation of natural resources, most importantly soil and water. The intensive monoculture of maize (corn) on deforested hilly slopes using practices similar to flat lands is a major matter of concern.
This is probably the first study evaluating and documenting the impact of different farming practices on soil and water in the region, which is of crucial value for policy institutions. This study was conducted in eight barangays (villages) of the Carmen municipality, namely, Macabenban, Liliongan, Cadiis, Aroman, Bentangan, Macabenban, Tambad, Kibudtungan. At each location two field sites close to each other with comparable soil conditions were selected respectively under corn and banana production. The field sites were spread across a range of different slope gradients and being in hilly area, most of them (except 3) had more than 30% slope. We found that, irrespective of the crop grown, the soil cover is most important factor in reducing soil erosion. An exposed field i.e. without any green cover may lose more than 75 tons of soil per hectare per year, taking along the fertility of the field. Along with the ploughing during / just before rains, the application of non-selective herbicides was a strong contributor to soil erosion.

Keywords: Soil erosion,Slopes,Monoculture,Agroforestry,Ground cover

ID ABS WEB: 136936

2. Soil and humanity
2.12 133584 - Soils in Archaeology

BRONZE AGE ANTHROSOLS, TECHNOSOL, OR 'JUST' CULTURAL LAYERS? UNDERSTANDING THE DIRT WE DIG IN NORTH ITALIAN ARCHAEOLOGICAL SITES

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In northern Italy, especially since the Middle Bronze Age (MBA, 1650-1300 cal BCE) we see the widespread colonization of the floodplain by large embanked settlements, known as Terramara. At the same time, deforestation, hydraulic systems (moats, wells, irrigation ditches), earthen structures and roads requiring enormous quantities of soil material, reveal the intensification of human impact on the soilscape. Yet, very little is known about the soils that were the core of this advanced agricultural system. Only within settlements some witnesses of such soils have so far been encountered. These are often agricultural or horticultural topsoil horizons (Anthrosols) formed on an archaeological parent material, normally referred to as 'cultural layers'. These cultural layers can also be undisturbed, i.e. when their accretion rate is very fast or when they are fast buried, and therefore lack any pedogenic trait. Conversely, when accretion is gradual and exposure prolonged, cultural layers can be affected by soil forming-processes such as leaching and bioturbation, giving rise to weakly developed Technosols. In all these three different scenarios, these soils represent a source of archaeological information on human dwelling and on agricultural practices taking place within the sites. Some of these archaeological soils were therefore studied using pedological, archaeobotanical, and geochemical methods (i.e. the GC-MS analysis of soil organic fraction). The study addressed various Terramara sites of the Veneto region of NE Italy that cover the timespan between the Middle, Late (LBA), and Final Bronze Age (FBA). These include La Muraiola di Povegliano (MBA-LBA), Fondo Paviani (MBA-early FBA), Castelar di Leppia (LBA-FBA), Frattesina, and Villamarzana (FBA-Early Iron Age).

Keywords: Bronze Age,Anthrosol,Ancient Agriculture,Cultural Layers

ID ABS WEB: 137671

2. Soil and humanity
2.12 133584 - Soils in Archaeology

PALEOENVIRONMENTAL STUDIES AT MIDDLE BRONZE AGE ERIMI IN CYPRUS

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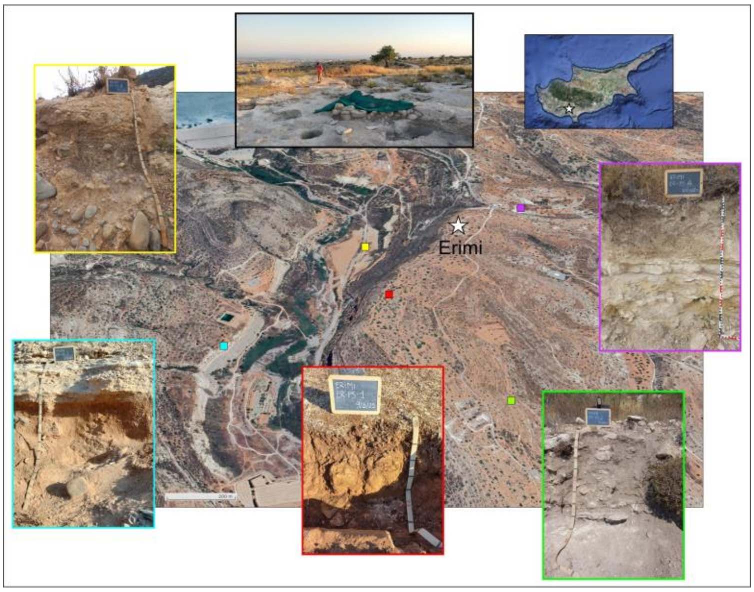
This paper focuses on the first pedo-stratigraphic research performed in the landscape of the Kouris river Valley, in the south region of Cyprus. This represents an area of intensive human occupation from the early Neolithic period. The study proposed is part of the PRIN project "EARTHERITAGE, Earthen Heritage in the Eastern Mediterranean between Archaeology and Sustainability", conducted by the joint team of the Universities of Genova, Siena and Palermo. The project has received funding from the Italian Ministry of Education, University and Research (MIUR) under grant agreement N. 2022H3K7W9.
The study presented constitutes the first stage of a two-year programme finalised at fostering the current state of the art about earthen architecture in the Mediterranean region focusing on the island of Cyprus. In particular, the research aims at reconstructing the paleoenvironmental changes of Kouris Valley from the Pleistocene to historic time and the related human-environment interactions, using GIS approach with conventional soil and geomorphological survey.
The spatial distribution and variability of the most extensive soil types were analysed and several stratigraphic sequences with buried paleosols were described in natural exposures. The age of paleosol was estimated on the base of artefacts and on a few radiocarbon analyses. Soil chronosequences and catenas provided stratigraphic control allowing the correlation among different landforms. Soil micromorphology was used in conjunction with routine laboratory analyses in order to determine their genesis and to assess their palaeoclimatic significance. The research consented to greatly expand the environmental data available for the southern region of Cyprus.
Finally, statistical analysis of the spatial relationships between archaeological record locations and landform units permitted us to determine whether there was a significant correlation between Erimi site location and specific geomorphic elements.



Keywords: Paleosol,Geoachaelogy,Pedology,Micromorphology,Cyprus

ID ABS WEB: 138015

2. Soil and humanity
2.12 133584 - Soils in Archaeology

CHARACTERIZATION OF ANTICS STREETS AND ROADS IMPROVEMENTS THROUGH GEOARCHAEOLOGY FROM THE PREVENTIVE ARCHEOLOGY DATA IN THE NORTHEAST OF FRANCE

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Over the last few decades, the development of preventive archaeology and research into traffic routes have led to significant advances in our knowledge of the road network and ancient urban structures in France.
Recently, as part of preventive operations, the use of other methods, such as micromorphology, has been envisaged in the case of streets and lanes identified during the field phase. Geoarchaeology makes it possible, on the one hand, to study the materiality of a traffic area on a large scale - through the organisation and hierarchisation of the elements making up the road networks using a detailed stratigraphic study and micromorphological analyses - and, on the other hand, to document the ways in which these areas were laid out and functioned - trampling and driving - and how they changed over time.
The results of the micromorphological analyses reveal specific soil and sedimentary characteristics and highlight significant microstratigraphic variations in the socio-spatial uses of these traffic routes. These analyses provide answers to archaeological questions about the passage, spatial organisation and function of these areas (developed and undeveloped spaces).
This recent research has broadened our perception of streets, roads and paths. They show that they should not be considered as a massive deposit or a superimposition of backfill, but should be studied using the same geoarchaeological tools as other archaeological deposits. As a result, the various micromorphological studies carried out as part of preventive archaeology operations enable us to move away from the view of a road or street as a simple paved area and shed new light on traffic roads (Charbonnier, Cammas 2018).

Keywords: Antiquity,geoarcheology,street,road,micromorphology

ID ABS WEB: 138069

2. Soil and humanity
2.12 133584 - Soils in Archaeology

SEDIMENT PROPERTIES AND INTERACTIONS WITH WATERLOGGED ARCHAEOLOGICAL WOOD: THE CASE STUDY OF GRAN CARRO WOODEN PILE DWELLINGS (BOLSENA LAKE, CENTRAL ITALY)

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Wooden pile dwellings (WPD) inform on landscape evolution and cultural activities developed around lakes. Much research has been performed on WPD submerged in Alpine areas, however, knowledge is missing from Mediterranean volcanic lakes. Furthermore, the conservation of these archaeological remnants is threatened by the ongoing climatic changes and anthropogenic pressures which are more intense in small and sensitive lake environments.
The study of WPD in Mediterranean lakes was the object of WOODPDLAKE project financed by JPI-CH19. Its main objective was to assess the impact of extreme climate events and anthropic pressure on the conservation and safeguard of pile dwellings in Mediterranean lakes. The research was interdisciplinary merging environmental analyses (water and sediment quality) with the investigation carried out on WPD through dendrochronology, wood degradation analysis based on physical, chemical and morphological analyses. Furthermore, an artificial ageing experiment, performed in acquarium using sediments and samples of waterlogged wood collected from Bolsena lake, allowed to estimate the effect of induced climatic stress (namely high temperature) on wood degradation.
The conservation of waterlogged archaeological wood (WAW) is strongly dependent on the environmental context surrounding it, in particular sediments and water. These, together with the primary intrinsic physico-chemical properties of wood, are two natural matrices affecting each other, with an impact on the intensity of deterioration/conservation rates.
The physico-chemical (texture, total organic C and N, inorganic N and P, redox potential, pH, total elements and heavy metals), biochemical (enzymatic activities belonging to C, N, P and S cycling) and microbiological (EL-FAME profiles) properties of Gran Carro archaeological site sediments were assessed during the three years of the project (2021-2023). The aims of the study were to: i) characterise the environmental context surrounding WAW, ii) demonstrate a likely “wood effect”, if any, due to the presence of WAW.

Keywords: Bolsena Lake,wooden pile dwelling,sediments,arsenic,waterlogged wood

ID ABS WEB: 137965

2. Soil and humanity
2.13 133597 - Soil, soul and society: transformative pathways in soil care practices

INSIGHTS INTO THE CONCEPT OF SOILS AS SUBJECTS OF LAW

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The survival of our society is inextricably linked to the integrity of the soil ecosystem. In fact, healthy soils are the basis of all terrestrial life and ecosystems. Regrettably, the extent of soil degradation worldwide is a matter of much concern. In the light of such degradation and its consequences for our society, more and more voices are being raised to call for the recognition of soils as subjects of law. This notion is not new, the UN General Assembly on Harmony with Nature has highlighted the inherent rights of nature, a concept supported on the recognition that humankind and nature share a vital, non-anthropocentric relationship. Nature's rights are formulated as recognized, as opposed to granted by humans, and as such, our role is to use legal mechanisms to enforce the rights of species and ecosystems to exist, flourish and be restored. The declaration of nature´s components as subjects of law is a consequence of a shift in our relationship with nature, from exploitation to protection and respect. Soils have attracted a low degree of interest from an emotional point of view and, concomitantly, conservation perspective. This circumstance is reflected in the initiatives on nature´s rights which have ignored the world´s soils. But hopeful changes are perceived, as reflected in the fact that the Center for Democratic and Environmental Rights launched a "Land That Owns Itself Program" and, in 2022, released "A Rights of Soil Model Law". Many initiatives worldwide have dealt with the maintenance and recovery of soil health. But soils are dynamic, evolving ecosystems of overwhelming complexity, whose functioning is supported, on the activity and biodiversity of a myriad of biological species whose roles, interactions and patterns of response are largely unknown. There is still debate on key aspects of soil health monitoring, which hinders the use of the soil health concept as the foundation of the proposal of soil as a subject of law.

Keywords: Soil health,World heritage,Landscape

ID ABS WEB: 138319

2. Soil and humanity
2.13 133597 - Soil, soul and society: transformative pathways in soil care practices

SOIL SONICS, FLYING ROOTS AND THE EARTHWORM AMBULANCE: CURATORIAL PRACTICES AND RELATIONAL MATERIALITY OF SOILS IN THE DANISH EXHIBITION PLATFORM RENÆSSANCEJORD.

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There is a growing scene of art and science constellations facing the global soil crisis with soil exhibitions (Toland). Curated by the Danish Jordens Hus (House of Soil), the exhibition series called Renæssancejord consists of six exhibitions in 2023-2024 taking place in a former prison outside of Copenhagen. As Renæssancejord unfolds, artists, architects, designers and scientists carry their own weight in soil, identify with soil living creatures, craft soil sound recordings into sculptures and make earthworm ambulance.
In the article “Towards a Relational Materiality of Soils”, Anna Krzywoszynska and Greta Marchesi pose the question of what modes of co-being emerge as we follow soil entities and soil processes, with the aid of art-enhanced apparatuses? Expanding this notion into the context of sensory museology (Howes) and curatorial studies (Von Bismarck), I explore what soil realities that get enacted in the exhibition platform Renæssancejord and the different artistic ways of making sense of soil matters. Visiting these diverse exhibitions, I contemplate “the curatorial” of these exhibitions attentively, focusing on the sensorial and affective encounters it stages between soils and visitors. How does the curatorial perform different materialities and scalar complexities of soils?
The exhibition series is not only legitimized through aesthetics and as reinforcement of soil connectivity (Pino et al.), but art is also a proclaimed catalyst in a collaboration project with the city development program Vridsløselille. Renæssancejord is played out to give new life in the citadel of Albertslund, create social meetings and cultural communities. As Renæssancejord unravels, the curatorial practices around artisanal soil transform the former prison into a public place, and in reverse, the prison surroundings impacts the curatorial.

Keywords: Museology,Soil art,Curatorial studies,Sensory studies,Relational materiality

ID ABS WEB: 138323

2. Soil and humanity
2.13 133597 - Soil, soul and society: transformative pathways in soil care practices

DR. CARLOS ALBERTO ORTIZ SOLORIO REGIONAL SOIL MUSEUM: A TOOL FOR ENVIRONMENTAL EDUCATION IN THE PINE-OAK FORESTS OF ZAACHILA, OAXACA, MEXICO

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The construction of the Regional Soil Museum was based on the approaches of Environmental Education, because it provides tools to generate a link between the understanding of soil processes, the environment and the social actors involved in the use and conservation of pine and oak forests. It exhibits a collection of ten soil monoliths of the Entisol Order with contrasting characteristics, described and classified in local and scientific terms. The methodology for the collection and exhibition of the specimens is based on the work of Dr. Carlos A. Ortiz Solorio, Dr. Ma. Carmen Gutiérrez Castorena and M. C. Patricio Sánchez Guzmán, from the Genesis, Morphology and Soil Classification Area, Soil Science Program, Colegio de Postgraduados en Ciencias Agrícolas, in Mexico; The installation of the resiento was made possible by the support of local authorities, community members and the general population of the municipality of San Miguel Peras, Zaachila, Oaxaca, owners of a vast territory where nature and society have evolved together throughout history as a wide biological and cultural diversity. The Museum offers the observer the attributes of the soil in unaltered conditions and exposes the role they play in the environmental dynamics of the regional forests and agroecosystems; offers biannual training courses and workshops for sustainable land management. The design and construction of the Regional Soil Museum fosters the values and practical skills to participate responsibly in the solution of environmental problems and the management of the territory.

Keywords: Ethnopedology,soil collections,environmental education

ID ABS WEB: 135949

2. Soil and humanity
2.14 133604 - Histories of internationalization of soil science

AN ASSESSMENT OF COLONIAL AND POST-INDEPENDENCE SOIL SCIENCE IN ZAMBIA

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The role soils play in optimizing food production and providing ecosystem functions necessitates a transdisciplinary appraisal of its study in Africa and the world over. We undertook a comparative assessment of the Exploratory Soil Map of Zambia (ESMZ) produced in 1991 and the Vegetation–Soil Map produced by Trapnell and colleagues in 1947. We examined differences between broad soil physiographic units of the two maps. We examined a number of exemplar transects undertaken by Trapnell from 1932 to 1942, evaluating the information provided on soil, vegetation, landscape, and farming systems. A comparison of the legend units of the ESMZ (1991) and Trapnell's 1947 map was done. A reading protocol was developed which was used to examine the records and extract information on soils, vegetation, and farming systems. For a subset of the large-scale post -independence map-sheets, we compared the texture and intricacy of the mapped boundaries with international standards based on average size delineation (ASD) and index of maximum reduction (IMR). Results showed that there was no significant variation in the soil properties with clear similarities observed between the soil physiographic units of the Trapnell's Soil–Vegetation Map of 1947 and broader physiographic units into which the legend units of the ESMZ of 1991 are grouped. It was noted that detailed information about farming practices can be used to understand how these have changed over time. Our assessment of a subset of post-independence map sheets showed that the map scale was consistent with the index of maximum reduction (IMR) and appropriate for the declared use of the survey. However, the publication scale and the texture/complexity of the surveys were not entirely consistent with international norms. This does not necessarily reflect poorly on past surveys but reflects, in part, the intricacy of the local soil landscape. We therefore, concluded that legacy soil records remain a valuable resource in understanding current land management issues and can help track changes overtime.

Keywords: Historical soil records,Zambia

ID ABS WEB: 136724

2. Soil and humanity
2.14 133604 - Histories of internationalization of soil science

FROM "NATIONAL WEALTH" TO "HUMAN HEALTH": DISCOURSES OF SOIL CONSERVATION AND SOIL HEALTH DURING THE SECOND AMERICAN AGRICULTURAL REVOLUTION

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This paper explores the emergence of the soil conservation and soil health concepts during the second American agricultural revolution. I argue that the concepts of soil health and conservation are not only related, but also complementary, and reflected deep anxieties about the stability of the nation-state in a time of massive social upheaval. While the soil conservation concept preceded the soil health concept by several decades in soil science, they emerged simultaneously in the political sphere. Despite its association with the Dust Bowl of the 1930s, soil conservation emerged much earlier, in the mid-nineteenth century, among New England farmers who recognized the impacts of their practice in the changing colour of their soils. It didn't appear in soil scientific literature until the late 1920s but made its official debut in soil conservation "crusader" H.H. Bennett's work in the 1930s. The soil health concept has a similar story. While it didn't appear in soil scientific literature until the 1950s and didn't enjoy widespread visibility until quite recently, soil health was the brainchild of farmers in the early 20th century, including Henry Wallace. This is where these stories converge. Both Bennett and Wallace, in their own ways, recognized a connection between the poverty of a soil and the poverty of a people. Bennett, for example, expresses the "evils" of soil erosion in terms like "wasteful" and "costly," and he attributed these to the "immigrants," the "colonialists." Hence, soil conservation sought to conserve what remained. Soil health, by contrast, sought to restore soils that had been depleted, returning and growing productivity. Equally importantly, they signalled a shift in discourses through the second half of the American agricultural revolution. Indeed, if soil conservation expressed anxieties about national wealth as imbued in a nation's natural resources, and the costly choice to plunder them, soil health reframed these economics in terms of the service of human health provided by healthy soils.

Keywords: soil conservation,soil health,United States,national wealth,human health

ID ABS WEB: 137647

2. Soil and humanity
2.14 133604 - Histories of internationalization of soil science

GROUNDING INTERNATIONALISM: THE HISTORY OF INTERNATIONAL SOIL SCIENCE BETWEEN THE WARS

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This paper re-considers the early 20th century history of soil science as an example of scientific internationalism, focusing on the role of the International Institute of Agriculture (IIA), established in Rome in 1905 by the American businessman and agriculturalist David Lubin. The IIA was the co-ordinating organisation in which the International Society of Soil Science (ISSS) operated from 1924 until World War Two. Drawing on the IIA's international networks and alliances, the ISSS sought to foster international scientific cooperation, improve the management of soils in different regions of the world, and secure global food production. However, the political landscape of interwar Europe - in which rival nation-states sought not just to expand cultivation of their underdeveloped territories but also challenge existing state borders - partially undermined the ISSS's internationalist ambitions. The paper examines the complex politics of the ISSS's endeavours in this period, the attempts by nationalist and internationalist agendas to influence the practice of soil science, and the organisation's reconstitution after the war as an independent agency.

Keywords: history of soil science,internationalism,science and politics,political ecology

ID ABS WEB: 137211

2. Soil and humanity
2.15 133605 - Epistemologies and Ontologies of Soil: Towards New Politics of Soil Knowledge

WHAT ROLE FOR SCIENCE IN CONSTITUTING SOIL HEALTH AS A POLICY-PROBLEM? THE EXAMPLE OF SOIL COMPACTION IN GERMANY

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While soil health has become the topic of legislative initiatives, it remains relatively unexplored in critical policy studies. We thus inspect the interface of scientific and political discourses around soil health, taking the example of soil compaction as a subtopic in Germany. Specifically, we analyse the role of scientific knowledge on soil compaction in constituting it as a policy problem.

We follow constructivist researchers by positing that soil compaction is not a strictly objective problem but rather represents social constructions. It is the product of a political process that defines and attaches it to particular political interests. We accordingly investigate the politics of knowledge, namely the "political motivations, political employment and political effects " (Hurri & Kestilä, 2019, p. 12), of scientific knowledge on soil compaction at the science-policy-interface.

The study revolves around two core analyses: of the scientific community's supply of knowledge and the policy community's demand of knowledge. For the supply dimension we dissect the degree of scientific consensus regarding soil compaction within soil science and agricultural economics. For the demand side we probe how scientific knowledge is reflected in policymaking. We examine the reproduction of scientific positions, the political preference or refusal of certain scientific positions, and the underlying reasons for their acceptance or dismissal. We show whether scientific knowledge is considered a neutral fact that answers political questions, or whether scientific knowledge provides "a source of questions that need to be politically answered" (Dominguez Rubio & Baert, 2022, p. 3).

We conducted semi-structured interviews with experts on soil compaction and key actors in German soil health policy formulation. The data was analysed with qualitative content analysis to systematically identify thematic aspects and conceptualise them.

By scrutinising the interplay between scientific narratives and political actions, our research aims to shed light on the constructed nature of soil health as a policy problem, thereby contributing to the understanding of the politics surrounding soil health issues in Germany.

Keywords: Soil compaction,Policy-problem constitution,Soil health policy,Constructivism

ID ABS WEB: 136745

2. Soil and humanity
2.16 133780 - Soil as a cultural heritage:
the soil knowledge as a heritage for the future generations.

FOOTPATHS: A HUMAN-MADE SOIL SURFACE AND ITS POSSIBLE ENVIRONMENTAL IMPACT

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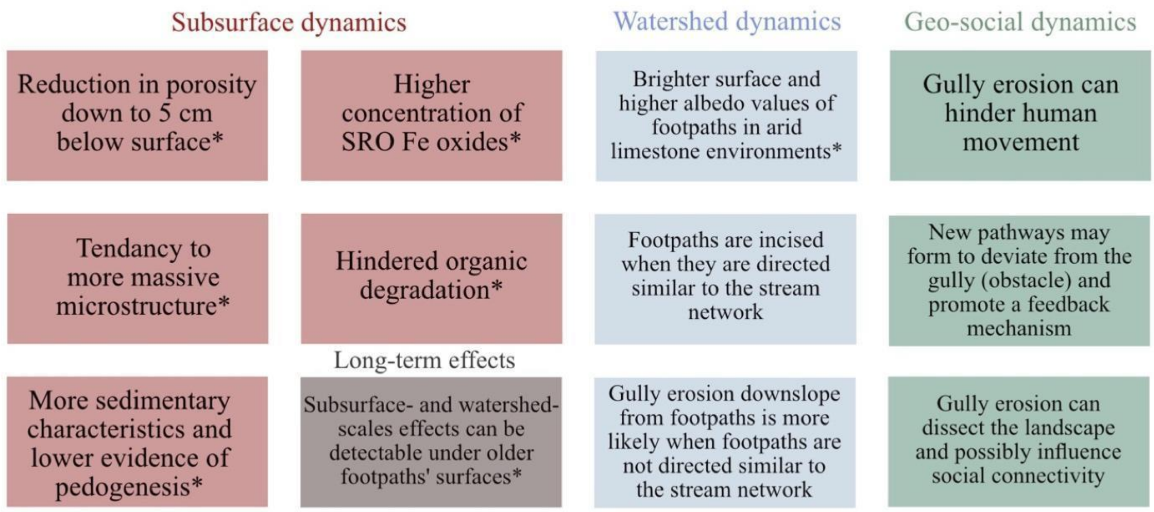
Footpaths are widely distributed socio-cultural soils and sediments. These forms of human imprint on the landscape, offer a unique window into understanding the intricate relationships between humans and soils. The elongated features are the outcome of continuous human movement over time scales ranging from days to centuries or millennia. In this overview of our recent insights, we adopt a holistic approach that integrates micromorphology (including voids analysis), chemical soil parameters (such as selective iron oxide dissolution), and remote sensing (assessing spatial distribution, orientation of footpaths, and color differences) to assess the enduring residues and environmental impacts resulting from the formation of footpaths. Our diverse case studies explore footpaths utilized for recreational and transport purposes across temperate, sub-humid, and arid climates, considering both recent and archaeological perspectives. Microscopically, the studied footpaths exhibit lower porosity and fewer biogenic activities compared to their non-path counterparts, influencing the sub-surface environment. This lower porosity restricts the supply of oxygen and/or water, fostering water stagnation on the compacted footpath surface. These processes result in elevated levels of pedogenic Fe oxides and, at times, macro-organic residues under footpaths, affecting soil formation.Through field observations and color analysis, we uncover that footpaths in arid limestone environments may lead to a brighter surface color than their non-path surroundings. This color alteration is confirmed through laboratory analysis and high-resolution remote sensing, highlighting significant differences. As an additional consequence of compaction, surface runoff is promoted, potentially triggering the initiation of gullies downslope from footpaths or leading to the incision of footpaths themselves. The likelihood of incised footpaths increases when oriented parallel to the stream network. Once formed, incised footpaths may reduce gully erosion susceptibility downslope, acting as channels that decrease a footpath's 'overbank' flow.This transdisciplinary study invites a collaborative effort for recognizing human impact and supporting sustainable soil management.



*Footpaths compared with control samples

Keywords: Footpaths,Surface Color,Pedogenic FE Oxides,Micromorphology,Soil Erosion

ID ABS WEB: 137722

2. Soil and humanity
2.16 133780 - Soil as a cultural heritage: the soil knowledge as a heritage for the future generations.

ACTIVITIES CARRIED OUT BY THE SOIL EDUCATION AND PUBLIC AWARENESS SECTION OF THE SPANISH SOCIETY OF SOIL SCIENCE FOR THE KNOWLEDGE OF SOIL BY SCHOOLCHILDREN

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The objective of the Soil Education and Public Awareness Section of the Spanish Society of Soil Science (SECS) is to make known the essential role of soils for life and to raise awareness of the need to ensure their sustainable development, especially among schoolchildren and university students. To protect the soil, it is essential to spread the knowledge of Soil Science. Among the activities carried out were workshops with primary and secondary school children. The experiments carried out were very carefully chosen so that they learn about soils and soil properties according to the age of the schoolchildren. The schoolchildren completed a questionnaire before conducting the experiments and answered a few questions at the end of the workshop. In the workshop, the students determined the texture to the touch, observed the reaction of organic matter with hydrogen peroxide, measured soil basal respiration, observed the flocculation of clays and the cation exchange, and studied the infiltration of nutrient solution in the soil. For the sixth consecutive year, the Section launched a school drawing contest to celebrate the World Soil Day (WSD). This year's contest was entitled 'Water and Soil' and more than 250 schoolchildren participated. On the edafoeduca web page (http://edafoeduca.es/) where the drawings were uploaded, schoolteachers had information related to the minimum teachings for Primary Education regarding soil (Royal Decree 157/2022). Among this information was that primary school students need to know how to identify the relationship between people's lives and their actions on environmental elements and resources such as soil and water, and consolidate healthy and sustainable lifestyles, such as those aimed at a responsible management of soil, air, water. The Section participates in the IUSS educational project 'THE IUSS GOES TO THE SCHOOL' preparing educational materials for young people, and in the book contest for children organized by the IUSS and FAO on the WSD.

Keywords: Soil science education,soil knowledge,school students,teaching

ID ABS WEB: 138350

2. Soil and humanity
2.16 133780 - Soil as a cultural heritage:
the soil knowledge as a heritage for the future generations.

SOIL INFORMATION AND REFERENCE CENTER FOR TEACHING AND CONSERVATION OF SOIL HERITAGE IN CUBA

R. MAS MARTINEZ [1], E. PINEDA RUIZ [1], Y. VIÑAS QUINTERO [2], R. CHANG RAVELO [2], I. LUGO RUIZ [1], R. VILLEGAS DELGADO [2]

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The dispersion of information and the scarce knowledge of soils constitute one of the main challenges facing agricultural sciences today. Numerous have been the studies that have been carried out in Cuba, by the different personalities and related institutions, all in their time have contributed to the development of this discipline and constitute the edaphological heritage of the country. On many occasions, the lack of knowledge of the results of these investigations and the limited reach to different users puts at risk the loss and application of such valuable documentation. The objective of the work was to reflect on the importance of the Soil Information and Reference Center of Cuba (Soil Museum) in the teaching of this subject, through the review, collection, digitization, standardization and dissemination of scientific knowledge about this resource natural. The soil monoliths that belong to the center help to better understand their formation, characterization, classification and capacity for sustainable use at the local and regional level and represent reference sites to evaluate edaphoclimatic changes in the tropics and facilitate the transfer of sustainable agronomic management technologies. The role that the center has played in the conservation of the soil heritage was shown, through the rescue of samples, maps and databases of the main surveys carried out in the country. The feasibility of the establishment and development of these entities in the region was demonstrated.

Keywords: collection of soil monoliths,edaphology,soil museum

ID ABS WEB: 139284

2. Soil and humanity
2.16 133780 - Soil as a cultural heritage: the soil knowledge as a heritage for the future generations.

SOIL INFORMATION AND REFERENCE CENTER FOR TEACHING AND CONSERVATION OF SOIL HERITAGE IN CUBA

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Keywords: collection of soil monoliths,edaphology,soil museum

ID ABS WEB: 136699

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

SOIL CHARACTERISTICS OF PREINDUSTRIAL LIME-BURNING KILN PLATFORMS IN A CENTRAL EUROPEAN FOREST LANDSCAPE

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Lime burning was traditionally an important activity in the Bükk Mountain, Northern Hungary. The most common way of constructing preindustrial lime-kilns was to use larger boulders of non-calcareous rocks in the direct vicinity of limestone outcrops to construct the kiln, where the source material for lime-burning was easy to access with simple collection from the surface without necessity of quarrying and transportation. The lime was burned at the occurrence of rock outcrops, where also wood in sufficient amount was available, preferable along roads facilitating the transport of the produced quicklime.
In this study we examined the soil environment of lime-kiln platforms compared to their surrounding's soil characteristics in low-altitude hilly forest stands. Both bulk and undisturbed soil samples were used to assess the basic soil properties, nutrient content, cation exchange capacity, enzyme activity, and soil active carbon content. Soil color, aggregates, coarse fragments, artefacts, root density, and horizon thicknesses were surveyed in the field.
The lime-burning sites show up anthropogenic characteristics as far they have 10-100 cm thick compacted calcareous technic hard material enriched in charcoal and slag. The platforms represented inhospitable technogenic environment while used, but since their abandonment turned into valuable habitats. They are frequently overlayed by organic rich, base-saturated, calcareous humus layer developed as a result of 300-400 years of post-technogenic soil development. The soils classified as Technosol with Isolatic, Spolic, Thyric, and Ekranic principal, and Ochric, Mollic, Supra-mollic Supra-calcaric, and Endodystric supplementary qualifiers.
Our study confirmed that the abandoned lime-burning kiln's platforms act as separate microhabitats in the dominantly acidic Luvisol environment, which show up eluviated soil characteristics in topsoil. In few cases, the studied Technosols overlay non-calcareous, acidic regolith of schists and shales. With their fertile, base saturated topsoil layer they increase the pedodiversity, and also function as an archive for land use history and serves as valuable parts of cultural heritage.

Keywords: post-technogenic soils,technosols,anthropization of soils,anthropogenic soil development

ID ABS WEB: 137161

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

DEVELOPING A CONTROLLED-RELEASE PERSULFATE MATERIAL TO OXIDATE CIPROFLOXACIN IN GROUNDWATER

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In order to alleviate the ecological and human health risks caused by groundwater pollution, it is necessary to take a series of measures to repair and control the pollution. In-situ chemical oxidation remediation is one of the most widely used techniques in groundwater remediation in recent year. However, in-situ chemical oxidation remediation technology also subject to some limitations, such as the tailing or rebound of pollutants.
In order to improve the stability of pollution remediation and achieve continuous and stable release of oxidants, the environment-friendly bentonite and polylactic acid were used as raw materials to prepare controlled-release persulfate material (CRPM) by granulation and coating method. The antibiotic ciprofloxacin commonly detected in water was used as the target pollutant, the degradation effect of CRPM on ciprofloxacin and the release stability of CRPM were investigated. Meanwhile, the changes in the chemical and thermal stability of the polylactic acid coating layer during the oxidation process were characterized. The main findings of this study are as follows:
The release law of the prepared CRPM conforms to the zero-order kinetics (R2>0.96), indicating that the CRPM can release sodium persulfate stably. The release rate of the CRPM can be regulated by changing the ratio of porogen NaCl, the size of CRPM and the number of coating layers, so that the release half-lives of persulfate can be adjusted between 4 and 1613 d, which can meet the needs of different remediation period. The characterization by SEM indicated that porogen NaCl and the number of coating layers could control the release rate. The ciprofloxacin was degraded by Fe2+ activated CRPM, and the removal rate of ciprofloxacin was relatively stable for 5 cycles of oxidation, which indicated that the CRPM can stably release persulfate. In addition, the chemical and thermal stability for the polylactic acid coating layer did not change significantly during the oxidation process, and had fairly good stability.

Keywords: groundwater remediation,chemical oxidiation,controlled-release persulfate,antibitics pollution

ID ABS WEB: 137637

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

STRUCTURE CHANGES IN CONSTRUCTED TECHNOSOL SYSTEM OF BIORETENTION CELL STUDIED BY X-RAY COMPUTED MICROTOMOGRAPHY

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Constructed Technosols are important in urban hydrology, especially in the functioning of stormwater bioretention cells. The study aimed to relate changes in bioretention cell performance to the structural changes of soils at the microscale by invasive and noninvasive methods. X-ray microtomography was used to investigate Constructed Technosol of the biofilter in terms of structure development, pore-clogging and pore geometry deformations.
Two identical bioretention cells were established in December 2017. The subsurface of the cells is formed by biofilter (Constructed Technosol), sand filter, and a drainage layer. The 30 cm thick biofilter soil mixture is composed of 50% sand, 30% compost, and 20% topsoil. Soil sampling program was initiated in 2018 to visualize and quantify the soil structure and internal pore geometry of samples. Over three years, five batches of undistributed samples were taken. Analyses of pore network morphology were performed on the segmented 3D images of samples.
During the first year, the macroporosity decreased in both BCs due to soil consolidation. Results of the study show that short term consolidation was followed by gradual development of macropore system in biofilter. A significant correlation was found between macroporosity and connection probability, as well as between macroporosity and critical diameter. Pore thickness analysis revealed that the most represented pore fraction during the three years was 80-310 μm in size. The biofilter exhibited optimal conditions for plant growth.

Keywords: Constructed Technosols,Bioretention cell,Soil structure,X-ray computed microtomography,Layered system

ID ABS WEB: 137668

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

URBAN SOIL COMPACTION: PRELIMINARY RESULTS FROM THE CITY OF MILAN (ITALY)

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We present some preliminary results of a research project aimed at studying soil compaction in public green areas in the city of Milan and its potential effects on soil ecological functionality. To achieve this goal, beside soil compaction assessment, the investigation involves the characterization of chemical and physical soil properties, to determine any relationship with compaction. To evaluate soil functionality, water infiltration capacity and soil biological activity will be examined. This project is part of the research activities of the PNRR – NBFC, spoke 5 ("Urban biodiversity").
Five categories of green areas were selected: lawns of urban parks inside (i) and outside (ii) the historic centre; lawns (iii) and forests (iv) of peri-urban parks; lawns of small urban green spaces (v).
A total of 60 sampling sites were identified. In each of them, a georeferenced experimental plot (4 x 4 m) was defined, to carry out soil sampling and compaction measurements (bulk density and soil resistance to penetration). Soil was sampled by layers (0–10 cm, 10–20 cm, 20–40 cm). Bulk density (BD) was measured on the first 5 cm of depth. Soil resistance to penetration was measured with a field penetrometer up to a maximum depth of 45 cm. Because soil resistance varies depending on soil moisture, soil water content was also measured.
The first data obtained on soil compaction were analysed to determine if any differences emerged among the green area categories. BD of forest was significantly lower (mean ± sd: 0.91 ± 0.05 g*cm-3) and BD in lawns of urban central parks was significantly higher (1.15 ± 0.12 g*cm-3) than BD of the other green area categories. Penetrometer data confirmed that forest soils were significantly less compacted than the others. In all the green area categories except forest, soil resistance increased with depth reaching a maximum at 10-15 cm and then remaining constant or decreasing slightly; in forest soils the increase with depth is more gradual.

Keywords: Urban soil,Soil compaction,Penetrometer measurements,Soil bulk density

ID ABS WEB: 138052

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

POTENTIALLY TOXIC ELEMENTS IN URBAN PARK SOILS OF ROME AND NOVI SAD: CONTENT AND POTENTIAL ECOLOGICAL RISK ASSESSMENT

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Urban soils are influenced by human activities resulting in a change in soil health that can strongly affect human health, plants, and soil organisms. To identify the anthropogenic influence in urban parks in Rome and Novi Sad, cities different in traffic intensity, industrial activities, population, and geomorphology, in the framework of a scientific collaborative project between Serbia and Italy, supported by MAECI a study on soils, plants, and road dust has been carried out. Determining the total concentrations of some potentially toxic elements (PTEs) (such as Pb, Cu, Zn, and Cd) of the urban soil samples confirmed great differences between the nature of the soil of these two cities, mainly related to the different geological settings. However, despite their lower total metal concentrations, samples from Novi Sad exhibit higher mobility than those measured in Rome urban soils (Montereali et al., 2017).

To get more comprehensive information about soil pollution, a wider list of PTEs and their possible ecological risk, potential indicators, the pollution index, and potential ecological risk index have been calculated. The focus of this study is on the following 20 potentially toxic elements (PTEs): Mn, Cu, Pb, Zn, As, Ba, Cd, Co, Cr, Cs, Ni, Rb, Sb, Sc, Th, U, Zr, Be, V, Sr.

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Keywords: Urban soils,PTEs,Trace elements,Ecological risk assessment

ID ABS WEB: 138163

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

MONITORING AND MODELING OF SURFACE TEMPERATURE AT BARE-SOIL AND SEDUM COVERED GREEN ROOF

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Soil surface temperature is one of the key parameters for prediction of evaporation from bare soil and evapotranspiration from vegetated surfaces in natural and urban environments. There is a wealth of literature on the experimental investigation of the surface temperature of agricultural and natural soils, but the experiments monitoring the surface temperature of urban soils are still relatively sparse. This paper analyses the thermal behaviour of an experimental extensive green roof plot, focusing on surface temperature variations and their correlation with environmental factors. The 1x1 square metre green roof plot was located on the larger green roof in a peri-urban environment. The plot was elevated above the roof and thermally insulated from below. The vegetation was established several years before the experiment with a sedum mat covering the plot. The bare patch of soil used in the green roof experiment represented a site where the vegetation had receded since its establishment. Over a period of thirteen weeks, surface temperatures were monitored using a series of thin stainless steel thermistors on both the bare soil and vegetated parts of a green roof plot. The influence of solar radiation on the surface temperature of the roof was analysed along with the temperature of the substrate below, solar radiation and other environmental factors. The study aimed to identify temperature patterns and perform statistical analysis using a simple heat transfer model. The results suggest that vegetation has a significant cooling effect, particularly in warm weather, but that this effect diminishes during periods of dry substrate. The simple thermal model used in the study fitted the actual temperature measurements reasonably well, although it showed limitations during extreme high temperature conditions. The results contribute to a better understanding of the thermal dynamics of green roofs.

Keywords: Constructed Technosol,Surface temperature,Green roof,Heat flux

ID ABS WEB: 138227

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

SOIL MONITORING AFTER A DE-SEALING INTERVENTION IN PORTO DI MARE (MILAN, ITALY)

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Artificial soil sealing is one of the main soil degradation processes in Europe. De-sealing, or depaving, is the process of removing the impermeable cover to expose the underlying soil and restore its correct functionality.
The main goals of our project are (i) to assess the effects of different treatments for restoring unsealed soil and (ii) to evaluate the impacts of using pavement demolition waste (DW) as soil parent material. Here we present the preliminary results from a 5-month soil monitoring following a de-sealing intervention carried out at Porto di Mare, an abandoned site in the south-east of Milan. After defining the plots to be used for the various soil recovery treatments, and describing the soil profiles, the following instruments were installed: i) sensors for soil temperature, water, and oxygen content; ii) lysimeters for measuring water percolation. Sensors were also placed under a layer of concrete in a still-sealed part of the site. A 20 cm thick layer of DW was then spread over the entire unsealed soil surface. Four treatments were carried out approximately four months after the de-sealing intervention. For t1 and t2, two distinct herbaceous mixtures were sown directly on top of the debris layer. For t3 and t4, compost was added to the DW before sowing the same mixtures.
In the unsealed area, the soil water content showed an initial increase and daily oscillations which disappeared after the placement of the debris layer on the soil surface. Concurrently, the daily temperature variations became less noticeable. The sealed sensors recorded a trend and temperature values similar to those observed in the unsealed soil surface covered by the debris layer. The water content, on the other hand, showed a gradual and constant decrease. As for the oxygen content, a gradual increase was observed in the unsealed soil.

Keywords: depaving,urban soil,demolition waste,soil restoration,soil sensors

ID ABS WEB: 138264

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

DETERMINATION AND ASSESSMENT OF MERCURY CONCENTRATION IN SOIL AND VEGETATION AFFECTED BY A FORMER CINNABAR MINE

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Mining activity is one of the most relevant anthropogenic sources of worldwide pollution, affecting soil, water and vegetation alike. Even after the mining activity has ceased, metal concentrations remain alarmingly high, which can affect the surrounding vegetation as well as water bodies near the mine. Cinnabar mining leaves a residue of mercury, a heavy metal that is highly toxic, accumulates in soils, and has a high capacity for bioaccumulation. The study of Hg contamination in the proximities of abandoned cinnabar mines is of great interest because it allows us to evaluate the degree of contamination of these sites and the possible environmental and human health risks. The aims of this study were to determine the Hg content in soils and plants of a former cinnabar mining area in the town of Chóvar (Castelló, E Spain), as well as to evaluate the state of contamination by means of the enrichment factor (EF) and potential ecological risk (ERI) indices. Three areas were selected according to their proximity to the cinnabar mine: Masía Mosquera (14 km from the mine), another area 700 m from the mine, and the mine itself. Soil and leaf samples of the Quercus suber tree species were taken in the three areas; the fundamental properties of the soils were analyzed and the Hg concentration in soils and plants was determined using a Milestone™ tri-cell DMA-80 Hg autoanalyzer. Hg concentration in soils and cork oaks in the mining area was significantly higher than in the other two areas, with similar characteristics, and a significant relationship was observed between some soil properties and Hg concentration, as well as between soils and trees, indicating the existence of Hg uptake. The calculation of EF and ERI indicate the existence of significant contamination and ecological risk in the mining area and adjacent areas, which requires soil contamination monitoring and control measures to avoid loss of ecosystem functions and risk to public health.

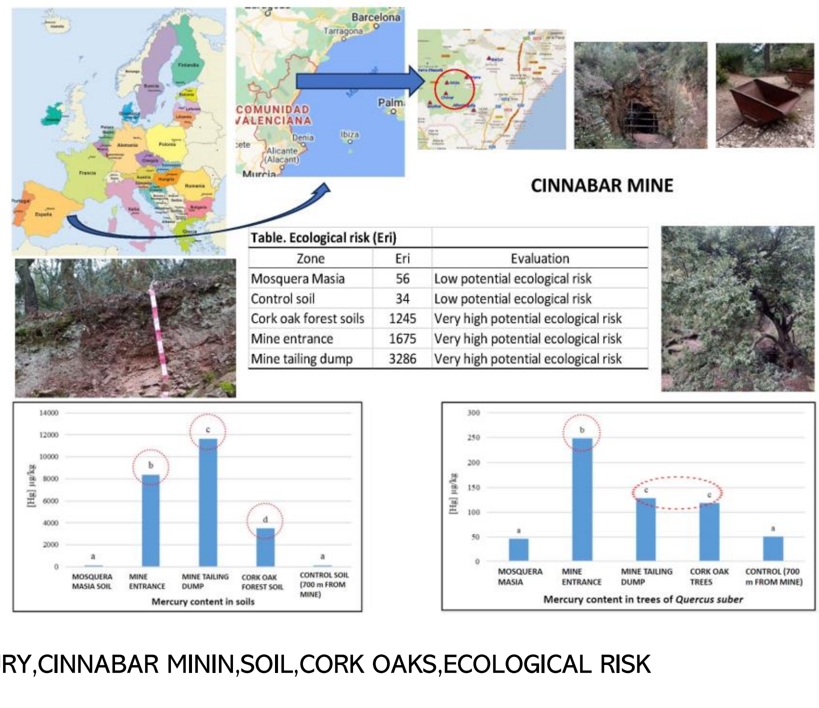

Table. Ecological risk (Eri)

Zone	Eri	Evaluation
Mosquera Masia	56	Low potential ecological risk
Control soil	34	Low potential ecological risk
Cork oak forest soils	1245	Very high potential ecological risk
Mine entrance	1675	Very high potential ecological risk
Mine tailing dump	3286	Very high potential ecological risk

Keywords: MERCURY,CINNABAR MININ,SOIL,CORK OAKS,ECOLOGICAL RISK

ID ABS WEB: 138276

2. Soil and humanity
2.17 134978 - SUITMA
(Soils of urban, Industrial, Traffic, Mining and Military Areas)

ASSESSING DISTRIBUTION OF HEAVY METALS IN SOILS FROM A FORMER BARITE MINE USING BCR SEQUENTIAL EXTRACTION PROCEDURE

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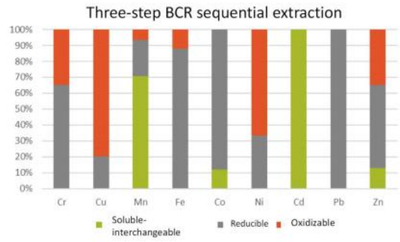
Mining is considered a significant contributor to environmental contamination. Mining activities associated with barite extraction can lead to heavy metal contamination of nearby soils. The total trace element concentration in soils does not represent the available fraction. Sequential extraction procedures allow determining the available fraction, one of the most widely used is the three-step BCR sequential extraction scheme recommended by the European Community Reference Bureau. In BCR the metals are divided into acid soluble/exchangeable, reducible and oxidizable fractions. The main objective of this study was to determine and evaluate the content of Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn in different fractions of soils near the Atrevida mine (Tarragona, Spain) using the sequential BCR extraction and EDTA extraction procedure. Soil samples were taken in seven locations around the mining area. The physicochemical properties (pH, electrical conductivity, texture, organic matter) of the topsoil samples (0-15 cm) were analyzed by standard methods, and the concentration of heavy metals (Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn) was determined in different sequential extraction fractions (H3COOH, ClH4NO, H2O2), and EDTA extraction (0.05 mol/L, pH=7) by AAS (Agilent Technologies 200 Series AA). In general, the results showed that for all elements analyzed the residual fraction is the more abundant, in the following order: soluble-exchangeable forms < reducible forms < oxidizable forms < available-EDTA << residual forms; manganese was the most abundant metal in the soluble, exchangeable and assimilable fraction, as iron was the most abundant metal in the residual and oxidizable fraction. These results indicated that the elements have low availability, which is related to the characteristics of the soils, suggesting that the environmental risks will be low. Correlations among soil parameters showed significant inverse relationships between pH and Cr, Cu, Fe and Ni content in the same fractions and EDTA, as well as significant direct relationships between EDTA-extracted elemental content and exchangeable and reducible soluble fractions were observed,

ATREVIDA MINE



Keywords: HEAVY METALS,BARITE MINE,SOIL,SEQUENTIAL EXTRACTION,BCR

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3. Soil governance
3.01 133567 - Soil and Water Conservation:
Water- drainage and irrigation strategies:
from securing production to protecting environment

INFLUENCE OF LAND USE INTENSITY ON SATURATED HYDRAULIC CONDUCTIVITY OF THE MAGELLANIC VEGAS

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The Patagonian Vegas constitute the main forage resource in the Magallanes Region, reaching a biomass production about 10 to 20 times higher than the surrounding sub-Antarctic rangelands. Therefore, they represent main economic axes of the region: sheep farming and lamb production, accounting 56% of the national lamb production. The edaphoclimatic conditions i.e., waterlogged soils till late spring and water restriction in summer force the farmers to the implementation of drainage systems which limits the plant water supply, leading to a decrease in growth rates during summer as the soils dries out. Additionally, the increasing animal stocking rates means that soil has to support higher internal and external stresses leading to deterioration of their structure, erosion and intensifying the negative effect of drainage. The aim of drainage is to increase of the air fraction in the pore system; however, this produce a significant soil settlement due to the high organic matter content of Vega Soils (VS) affecting their ability to store and conduct water and air, since the soil volume and pore continuity are reduced due to soil subsidence. Therefore, the aim of this work is to evaluate the changes in pore functions of the VS with different hydraulic history. For this purpose, VS with different management were sampled: Natural Situation (Peatland from Sphagnum sp.), Drained Natural Situation (Peatland from drained Sphagnum sp.), Vega under Conventional Management, Mineral Drained Vega, Undrained Mineral Fertile Lowland, Vega under Intensive Grazing, Vega under Continuous Grazing, Vega Tilled and Grazed, Vega not Tilled and Continuously Grazed. Undisturbed soil samples (n=5, vol=220 cm3) were taken from depths: 5 cm and the last horizon before the glaciolacustrine sediment (~80 cm). Under laboratory conditions, the saturated hydraulic conductivity was measured in water permeameter after 1, 2, 6, 12, 24, 48, 72 hours after the water flow start. Before and after this measurement, air conductivity was determinate. At the end the bulk density was determined as well. Fondecyt 1231934

Keywords: Magellanic Vegas,drainage,porous system functionality,soil management intensity,hydraulic properties

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3. Soil governance
3.01 133567 - Soil and Water Conservation: Water- drainage and irrigation strategies: from securing production to protecting environment

MONITORING OF ALLUVIAL SOILS IN THE SOUTHERN MORAVIAN REGION OF THE CZECH REPUBLIC

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The largest complex of floodplain forests in the Czech Republic is situated along the confluence of the rivers Morava and Dyje/Thaya. The studied locality is located in an area close to the Czech-Austrian-Slovakian border. Natural conditions, which affected the natural floodplain ecosystem for a long time, were markedly disturbed by man in the ´70s of the 20th century. After extensive water-management measures, both rivers including their local tributaries were channelised and diked. Formerly regularly repeating short-term floods were eliminated and as a result, the groundwater level decreased. However, its important annual dynamics have been preserved. The impaired water balance resulted in the local die-back of mature forest stands of the floodplain forest during a climatic dry spell. Monitoring takes place at the right and left banks of the Dyje river. The right bank of the Dyje river is covered by wetland meadows and the area takes approximately 231.87 ha. It is also an important protected catchment of drinking water for municipals. Stress factors like land use changes, riverbed regulations, and changes in temperature and humidity conditions directly affect the ecosystem stability. On the other hand, revitalization efforts, transboundary river management, wetland restoration, and integrated planning are undertaken to mitigate the negative effects and groundwater decline. Therefore, continuous monitoring and data set collecting are important, especially with the designation of National Nature Reserve Podyjí. This study aims to track changes in groundwater level, soil hydrophysical properties, and forest vitality during the period of 2019-2023. The results were assessed using z-scores, means, and standard deviations. Monthly evaluations of soil and climatic conditions revealed that irregular rainfall patterns and rising temperatures have a significant impact on the soil's hydrological regime and forest growth. Ongoing monitoring is important for developing projection models that can provide a better understanding of changes in both soil properties and tree growth parameters.

Keywords: floodplain forest,soil hydrophysical properties,climate change

ID ABS WEB: 136484

3. Soil governance
3.01 133567 - Soil and Water Conservation:
Water- drainage and irrigation strategies:
from securing production to protecting environment

IMPROVED DRAINAGE CAPACITY WITH ALTERNATIVE DRAINAGE METHODS FOR NORWAY

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Climate change is expected to increase precipitation amount and intensity in northern Europe, particularly during extreme events. This increases the need for drainage measures to prolong the growing season. Approximately 60% of the agricultural area in Norway is artificially drained, with the proportion in cropped land areas even higher. Much of the crop land area is located on marine clay in Eastern and Mid Norway. Here, the soil is completely dependent on systematic drainage to provide good yield. In a survey among farmers in Norway it is found that there was a difference of around 300 kg/ha cereal yield between a bad drained and optimal drained field, and up to 850 kg/ha for newly drained fields compared with the 'before-drain' period. High intensity rainfall events lead to flooding and water-logged conditions, which have negative impacts on yield and operational conditions related to tillage and transport. With the goal of an increased degree of self-sufficiency, and in a changing, wetter climate, drainage conditions must be improved.
A project on drainage efficiency is started in 2019, with the goal to increase knowledge about how drainage of cultivated soil with low water conductivity can be improved, with particular focus on new methods as an alternative to traditional drainage. At a field site, torpedo drainage, slotted drainage and traditional drainage systems were installed. We monitored soil pressure heads and water outflow at each drainage pipe. During a rainfall episode we also measured water content changes with electrical resistivity tomography (ERT) at each drainage for better understanding of the hydrogeological processes. In case of a slowly increase of soil water content, the slotted drainage is effective, but during heavier rainfall events or when the soil is already wet, the torpedo drainage is most effective. For peak events as well, the torpedo drainage system exceeds significantly the traditional system by approx. 21%.

Keywords: Drainage,Waterbalance,Agriculture

ID ABS WEB: 138136

3. Soil governance
3.01 133567 - Soil and Water Conservation:
Water- drainage and irrigation strategies:
from securing production to protecting environment

SENSITIVITY ANALYSIS OF SOIL COMPACTION AND IRRIGATION PRACTICES ON SOIL SALINIZATION IN SEMI-ARID AGRICULTURAL LANDS

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The use of saline groundwater for irrigation can lead to significant salt accumulation in agricultural soils. This in turn can lead to decrease in crop yields threatening food security. This problem is particularly encountered in arid and semi-arid environments and when shallow watertable conditions are present. This study examines the senitivty analysis of capillary rise, soil compaction and irrigation pattern on the salt dynamics in soils in the presence of a shallow saline water table. Water and solute transport in unsaturated soils was numerically modelled with the Hydrus-1D computer program. Results show that capillary action and evaporation from the soil surface can significantly contribute to the accumulation of salts in the topsoil. Sub-surface soil compaction resulted in a greater capillary rise leading to an increased risk of salt accumalation in topsoil in comparison to uncompacted deep tilled soil. It is shown that properly managed irrigation schemes and tillage practices can help alleviate the problem of soil salinization and sodification. The findings of this study underline the significance of developing effective irrigation practices for sustainable agriculture and enhanced food secutiy, and to help conserve limited fresh water resources in arid and semi-arid regions.

Keywords: Salinization,Irrigation,Soil,Compaction,Semi-arid

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3. Soil governance
3.01 133567 - Soil and Water Conservation:
Water- drainage and irrigation strategies:
from securing production to protecting environment

SPATIAL MODELLING OF HYDRAULIC CONDUCTIVITY AND INFILTRATION RATE FOR THE REASSESSMENT OF AGRICULTURAL RESTRICTIONS IN GROUNDWATER PROTECTION AREAS IN SLOVENIA

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Slovenia has one of the modest arable land area per capita in Europe. Besides that, a significant part of the best agricultural land in Slovenia is located on sandy soils. Following the Nitrates Directive, the Groundwater Protection Areas (GPAs) were defined and restrictions on agricultural production were set. Unfortunately, soil properties were not consulted at that time so the need to reassess agricultural restrictions in GPAs was identified.
Spatial modelling of hydraulic conductivity was conducted using pedotransfer function for texture soil parameters: fractions of clay and sand since those are omnipresent soil parameters in measured soil profiles. Input data was harmonised to depths of 10 cm in the range from 0 to 60 cm to cover the depth of most root mass of agricultural plants as well as positive correlation to soil retention.
The result is a separate GIS layer made by combining information from point-measured soil data and the 1:25,000 soil map. It covers agricultural land within GPAs and is classified into 6 permeability classes. Permeability rates on national GPAs range from 10.1 cm/day to 1369.7 cm/day. Mean value is 130.8 cm/day, median 108.5 cm/day and standard deviation is 113.3 cm/day. Moderately permeable soils prevail (55 %), followed by low permeable soils (30 %) and poorly permeable soils (14 %).
The result of the study suggests that permeability of the most restricted areas is higher than on areas less restricted or without restrictions. The data will be used for reviewing groundwater protection regulations and, if necessary, proposing to redefine management restrictions in GPAs to increase local food production.

Keywords: soil permeability,agricultural practices,food security

ID ABS WEB: 137093

3. Soil governance
3.02 133591 - Impact of global trade of food, feed and fiber (3Fs) on soil C and N dynamics, GHG emissions and land use changes

FOOD AND FEED TRADE HAS GREATLY IMPACTED GLOBAL LAND AND NITROGEN USE EFFICIENCIES OVER 1961–2017

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International trade of agricultural products has complicated and far-reaching impacts on land and nitrogen use efficiencies. We analysed the productivity of cropland and livestock and associated use of feed and fertilizer efficiency for over 240 countries, and estimated these countries' cumulative contributions to imports and exports of 190 agricultural products for the period 1961–2017. Crop trade has increased global land and partial fertilizer nitrogen productivities in terms of protein production, which equalled savings of 2,270 Mha cropland and 480 Tg synthetic fertilizer nitrogen over the analysed period. However, crop trade decreased global cropland productivity when productivity is expressed on an energy (per calorie) basis. Agricultural trade has generally moved towards optimality, that is, has increased global land and nitrogen use efficiencies during 1961–2017, but remains at a relatively low level. Overall, mixed impacts of trade on resource use indicate the need to rethink trade patterns and improve their optimality.

Keywords: trade,nitrogen,protein,land use,optimality

ID ABS WEB: 137354

3. Soil governance
3.02 133591 - Impact of global trade of food, feed and fiber (3Fs) on soil C and N dynamics, GHG emissions and land use changes

DECOUPLING CROP AND LIVESTOCK PRODUCTION GLOBALLY

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Decoupled crop and livestock production systems, within the context of globalized trade and characterized by the overuse of synthetic nitrogen (N) fertilizers and insufficient recycling of manure, pose threats to both environmental and human health. Our synthesis of global agricultural production and trade data highlights the escalating prevalence of decoupling, illustrated by the global decline in the ratio of manure management N to crop removal N from 0.8 in 1961 to 0.3 in 2020. The global crop trade has surged 13-fold from 2.3 Tg N in 1961 to 31.7 Tg N in 2020, with the most significant increase observed in oilseeds trade, of which 58% is allocated for livestock feed. It is crucial to emphasize that resolving the decoupling of crops and livestock appears unlikely under the no-trade hypothesis, given the diverse N requirements among countries. Enhancing N management embedded in trade, reallocation of domestic livestock production space, and dietary changes, could enable the recoupling of crop and livestock systems, potentially reducing N losses by 65% and making a significant contribution to the achievement of multiple SDGs.

Keywords: Nitrogen cycle,Decoupled system,Feed trade

ID ABS WEB: 137787

3. Soil governance
3.02 133591 - Impact of global trade of food, feed and fiber (3Fs) on soil C and N dynamics, GHG emissions and land use changes

HOW TO RECONCILE THE POLICY OBJECTIVES OF FARM SUPPORT AND GREEN AGRICULTURE?

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Body

The government fiscal and financial policies have played an important role in the productive use of land and land conservation and development. The channels through which the policies impacting on land and soil include the government subsidies on land use, agricultural input and output, and financial regulations on the entry of new types of financial institutions, the rate of interest, and loan securitization. This presentation focuses on two government policy initiatives in the Asian region: government subsidies on fertilizers and other farm inputs, and credit rationing closely associated with regulations on the rates of interest charged by formal and semi formal rural financial institutions. The presentation will also discuss how shall the policies respond to new challenges in land use, chiefly to support carbon smart sustainable agricultural development for the transformation of food and agricultural systems.

Keywords: land conversation,Sustaimable finance,fiscal subsidies

ID ABS WEB: 138045

3. Soil governance
3.02 133591 - Impact of global trade of food, feed and fiber (3Fs) on soil C and N dynamics, GHG emissions and land use changes

NITROGEN AND CARBON DYNAMICS IN ARABLE SOIL AS IMPACTED BY PRODUCTION INTENSITY OF MIXED ORGANIC DAIRY FARMING SYSTEMS

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The separation of crop production and animal husbandry in modern agriculture has led to decoupled nutrient cycles with nitrogen surpluses, declining soil organic matter stocks, increasing greenhouse gas emissions, and lower animal welfare. Organic mixed dairy systems, are considered to overcome these problems, but can differ in feeding and crop rotation, and thereby productivity. However, knowledge regarding the balancing of intensities with which mixed farming can meet the demand for organically produced food while minimizing environmental impacts, is required, but lacking.

In high-intensity farming systems, cattle are fed large amounts of protein-rich fodder leading to higher N concentrations in the manure. In low intensity systems, roughage with low N content predominates the animal diet, making room for crops for human consumption. Consequently, farm manures differ in quantity and composition, which influences the C and N dynamics in the soil. Carbon sequestration strategies face the challenge of increasing the C content in soils without increasing nitrogen fertilization or risking N immobilization. We hypothesize that C-sequestration improves under high-intensity farming systems due to the N nitrogen content of the manure.

This hypothesis is tested in the project “GreenDairy” at an organically managed experimental farm in Germany. Within the framework of the project, half of the trial area on arable land is converted to a lower farming intensity and the impact of organic milk production under low- vs. high intensity on humus and nitrate leaching is analyzed. At the beginning of the project, soils of the arable and grassland plots were sampled by core drilling. Changes in concentration and composition of the C and N fractions are measured semi-annually via soil coring for the extractable and continuously for the dissolved fractions using glass suction cups. Due to the variation in manure and crop rotation, changes in C- and N-dynamic are expected in the long term. These changes are expected to occur first in the dissolved and water-extractable C- and N-fractions.

Keywords: Soil nutrients cycling,Mixed organic dairy farming,Farming intensity,Impact of feeding change

ID ABS WEB: 138063

3. Soil governance
3.02 133591 - Impact of global trade of food, feed and fiber (3Fs) on soil C and N dynamics, GHG emissions and land use changes

TILLAGE AND HEMP RESIDUES EFFECT ON SPRING WHEAT YIELD

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Climate change and soil degradation are biggest threats to sustainable agrodevelopment there is demand for new solutions at the moment. In order to avoid catastrophic effects on global society, every effort should be made to keep the average temperature from increasing by more than 1.5°C compared to pre-industrial times. Therefore, in addition to the rapid reduction of greenhouse gas emissions, it is necessary to look for alternative methods for the accumulation of carbon and mineral substances in the soil. But not only climate change threatens the balance of planetary ecosystems. For example, soil degradation has resulted, among other things, from unsustainable farming methods and subsequent deforestation in search of new farmland, which also directly threatens global biodiversity, to soil sealing or compaction which leads to unfavourable farming conditions.
The aim of this study was qualitative and quantitatively determine how different tillage practices and hemp residues influence spring wheat yield. The experiment was conducted in Lithuania Research Centre for Agriculture and Forestry experiment fields, loamy soil. Spring wheat was sown 02/05/2022 – 08/05/2023, 210 kg/ha. Three treatments were selected, 1 – Control (without hemp residues, traditional tillage autumn) 2- Traditional tillage autumn added additional hemp residues, 3 – Traditional tillage early spring added additional hemp residues, 4 – no tillage hemp residues left on the top soil.
The results show that hemp residues and different tillage has influence on spring wheat yield. The highest spring wheat yield were determined in treatment 1 and 2 the lowest in treatment 4.

Keywords: Hemp,Residues,Soil,Tillage,Wheat

ID ABS WEB: 137818

3. Soil governance
3.03 133593 - The European soil observatory (EUSO): making soil data speak to policy stakeholders and civil society

CONCEPTS AND IMPLICATIONS OF NOVEL SOIL DATA COMMONS TO SUPPORT SOIL POLICY IMPLEMENTATION AND RESEARCH ADVANCEMENTS

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Soil supports critical ecosystem services, whose recognition is growing in the scientific community and in multiple environmental policies. Therefore, soil monitoring and assessment initiatives have been put in place from the global level to the farm scale, passing through the EU. Considering the common soil understanding implicated in the sectorial environmental policies and the interconnections between the soil processes and functions, integration of the data and monitoring methodologies in a unique soil data commons platform is critically needed. Here, we present some concepts and implications of novel soil data commons that are conceived to interoperate within an ecosystem of data commons, potentially including the EUSO infrastructure, and report on a relevant activity in Italy.
For what concerns the governance, the soil data commons would be managed by the public institutions mostly contributing with both legacy and novel data. Some data and products would be open and used for citizen engagement and awareness, while the sensitive data would be accessed by public and private stakeholders with different privileges through authentication. Data feeding would be encouraged by granting the contributors more privileges and engaging them in the activities of the soil data commons community.
The soil data commons will host georeferenced multidiscipline, multisource and multiscale soil data from monitoring campaigns, research projects, land restoration activities, environmental assessments and farm monitoring. Data heterogeneity deepens understanding and promotes research questions but requires effective data curation. A quality flagging system would assign a confidence level to the data based on the metadata. A coherence flagging system would reconcile the data co-located in homogeneous areas for pedo-climatic conditions, land use and management. Data reconciliation could be made through conceptual modeling, potentially revealing the causal relationships between soil processes and external forcing. An adaptive monitoring system, shared within the soil data commons community, could complement the traditional monitoring campaigns by focusing on the priority areas characterized by poor data quality/coherence or exposed to intensifying environmental pressure.

Keywords: Data quality,Data coherence,Conceptual modeling,Adaptive monitoring,Data integration

ID ABS WEB: 138125

3. Soil governance
3.03 133593 - The European soil observatory (EUSO): making soil data speak to policy stakeholders and civil society

URBAN SOIL THREATS IN THE EUROPEAN UNION, A SYSTEMATIC REVIEW

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There is an urgent need by the European Union to establish baseline levels for most pollutants (e.g., Potentially Toxic Elements (PTE), Polycyclic Aromatic Hydrocarbons (PAHs), microplastics and antimicrobials) and to define the sub-indicator soil pollution under the Zero pollution action plan. Hence, the main objective of the present analysis is to contribute to the general understanding of the pollution status of EU urban soils by preparing a systematic inventory. A comprehensive systematic map of the available literature on key urban soil threats such as PTEs, organic pollutants, microplastics, and antimicrobials does not exist. Through Scopus and Web of Science databases, the peer-reviewed scientific contributions that use the terms urban soil and (soil compaction, bulk density BD, soil organic carbon dynamics, microplastic, PAHs, antibiotics, PTEs, N and P, herbicides, pesticides) were included. In total, we analysed 2194 papers (after duplicate removal), of which about 1500 were irrelevant to the topics investigated (not about soil, no soil data provided). Notably, less than half of the records collected by keyword searching in the database were within the scope of the inventory compilation. The subset articles about urban soils were analysed to provide an overview of the current knowledge on urban soil threats, the geographic spread of this data, the breadth of the data, and bibliometric statistics on the dataset, and to compile an inventory that future research can build upon. The main threat identified by both the bibliometric and the systemic analysis is PTEs. This study fits in the frame of the Zero pollution action plan. It can suggest to policy stakeholders particular aspects that must be better considered in an urban context, such as increased research on soil reuse, sealing and compaction.

Keywords: European Union,Urban soils,Potential Toxic Elements,Soil mission,Soil Security

ID ABS WEB: 136409

3. Soil governance
3.04 133595 - Soil Governance to Prevent Loss of Fertile Lands: Soil Remediation and Photovoltaics

SUSTAINABLE SOIL MANAGEMENT IN HONDURAS

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An account of the most important soil studies in the history of the country is presented. Soil studies in Honduras started in 1880 with banana cultivation. Actually, soil studies are being conducted by the Honduran government, FAO, USAID, and private enterprises interested in melon, oil palm, bananas and coffee cultivation. The soil forming factors in Honduras are highlighted to assess their production potential and their sustainability. Soil degradation, process in mountainous and flood plain soils under cultivation are discussed aimed to secure their sustainability. The main processes of soil degradation identified are soil erosion, sedimentation, salinization-sodification, loss of soil structure and porosity, soil compaction, acidification, loss of biological activity, contamination, and urban expansion in agricultural soils. The soils of Honduras have a strong influence of topography, climate, and parent material. The soils with agricultural potential only comprise 12% of the country´s territory making soil sustainability crucial for the future of the country. A Soil Conservation National Plan and a Land Use Legislation and implementation are strongly recommended as major components of an effective Sustainable Soil Management Plan.

Keywords: MANAGEMENT,SOIL,SUSTAINABLE,HONDURAS

ID ABS WEB: 136839

3. Soil governance
3.04 133595 - Soil Governance to Prevent Loss of Fertile Lands: Soil Remediation and Photovoltaics

HARMONY BENEATH THE WHEELS: SOIL GOVERNANCE STRATEGIES FOR SUSTAINABLE GAME DRIVES IN WILDLIFE PROTECTED AREAS TO PROTECT SOIL HEALTH, BIODIVERSITY, AND WILDLIFE CONSERVATION

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This presentation aims to spotlight the escalating adverse effects of off-road driving (ORD) and underscore the critical role of soil governance in African wildlife protected areas within the context of ecotourism. Effective soil governance involves legal, political, and scientific management to enforce game drive and ORD protocols, ensuring sustainable land management and ecological well-being. Roads and road networks, pivotal for ecotourism, impact natural habitats and soils, both positively and negatively. Game drives, integral to the industry, bring tourists closer to wildlife, with ORD increasingly prevalent since 2000. While ORD offers unique wildlife encounters, it poses significant long-term harm to the environment, particularly the soil. Despite proven negative impacts, ongoing research seeks mitigation strategies for more sustainable game drives. This presentation focuses on highlighting these issues and emphasizes research efforts towards mitigating the negative impacts, aligning with UN Sustainable Development Goals, notably 'Responsible consumption and production' (12), 'Climate action' (13), 'Life on land' (15), and 'Partnerships for the goals' (17). Addressing soil governance in ecotourism contributes to broader sustainability objectives outlined by the United Nations.

Keywords: sustainable game drives,wildlife protected areas,ecotourism,soil conservation,soil governance

ID ABS WEB: 137318

3. Soil governance
3.05 133724 - Industry, Policy and Science: Working Together for Meaningful Scaling of Soil Assessment and Climate Mitigation

SOIL CONSERVATION WITHIN THE CAP: TWO DECADES OF PUBLIC SPENDING FOR SOIL CONSERVATION IN SPAIN.

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Measures for soil conservation were structured during two decades along the Rural Development Programs (RDPs) developed by the 17 Spanish Autonomous Communities (hereafter regions) following the European Common Agricultural Policy's (CAP) guidelines.
Besides the accuracy and detail of published regional statistics, a global picture of the spatial and temporal distribution of public spending at the regional level and the drivers for the allocation of resources is lacking. After two decades of implementation of public spending for soil conservation this work aims to analyse spatial and temporal distribution of direct and indirect measures for soil conservation applied within the Rural Development Programs in Spain, as well as the correlation with soil condition at a national level.
The methodological approach consisted in (i) a recollection (data mining) and inventory creation of agri-environmental and forestry measures aimed at soil conservation published by the Ministry of Agriculture; (ii) a spatial and temporal analysis of the measures' progress, and (iii) a preliminary exploration to the potential relations between the selected measures and soil condition, land use and socio-economic factors by using multivariate statistics. It was observed that public spending in RDPs decreased over the 3 programming periods, whilst public spending in measures for soil conservation increased. Also, distribution varied over the regions. Distribution of data revealed similarities among regions, as Principal Component Analysis showed clustering. Canonical Correlation Analysis results allowed to correlate patterns of public investment with other sets of variables. Erosive states in particular was found to be strongly correlated to public investment distribution, highlighting the importance of measures for soil conservation within RDPs, which act as a tool for regions and farmers to access finance and apply
them where it is needed. It seems that the CAP's second pillar was during two decades a very effective tool for soil conservation policies in Spain. From 2023 onwards, all new rural development actions will be incorporated into national CAP strategic plans.

Keywords: soil conservation policies,subsidies,soil erosion,CAP,Rural Development Programes

ID ABS WEB: 140112

3. Soil governance
3.05 133724 - Industry, Policy and Science: Working Together for Meaningful Scaling of Soil Assessment and Climate Mitigation

DECARBONISING THE DEFENCE: EXPLORING SOIL-BASED SOLUTIONS FOR CLIMATE MITIGATION ON MILITARY SITES

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Record-breaking temperatures occur annually globally, coinciding with rising greenhouse gas (GHG) concentrations in the Earth's atmosphere. Immediate actions for cutting emissions and potentially advancing carbon (C) capture are required from all individuals and sectors, including energy, transport, agriculture, industry, and the military. A pioneering collaboration between Newcastle University and the UK's Ministry of Defence (MoD) has initiated a groundbreaking scientific project to decarbonise the UK's Royal Air Force (RAF) on military premises. The ViTAL Living Lab project at RAF Leeming base conducts experiments, including one targeting C emission mitigation through soil C capture. In this context, there is a pressing need to assess “Frontier-technologies” such as the addition of crushed rock (Enhanced Rock Weathering-ERW) and biochar. This extends beyond C capture potential to also encompass broader benefits/impacts on soil health (chemical, physical and biological aspects), aboveground vegetation, leachates, and GHG emission. A mesocosm experiment was established combining different land uses: urban (garden and grass areas) and agriculture (conventional and organic agricultural systems), with the application of crushed rock and/or biochar to explore their individual and interactive effect on CO2 fluxes, aboveground nutrient and potential trace metal uptake, and alkalinity, cations and anions efflux. Intact soil cores were extracted from the 0-0.45 m depth in 2023. Preliminary findings reveal notable changes in alkalinity (analysed using titration) likely associated with soil monoliths treated with crushed rock, which also alters the balance of anions and cations (analysed through inductively coupled plasma-optical emission spectrometry-ICP-OES). Changes in CO2 flux (analysed by a portable gas analyser) do not appear to be influenced by crushed rock or biochar application but rather by different land uses and management systems. As one of the largest landowners in the UK, with an estate encompassing nearly equal to 2% of the country, the MoD stands to benefit from initiatives such as these, offering potential evidence of their ability to positively contribute to C removal from the atmosphere utilising military-owned lands.

Keywords: Carbon,Enhanced rock weathering,Greenhouse gas emissions,Interventions,Land uses

ID ABS WEB: 140676

3. Soil governance
3.05 133724 - Industry, Policy and Science: Working Together for Meaningful Scaling of Soil Assessment and Climate Mitigation

POLICY DEVELOPMENT FOR ORGANIC URBAN AGRICULTURE FOCUSSED ON SOIL-RELATED ECOSYSTEM SERVICES AND GREEN BUSINESS MODELS TO SUPPORT A SHARING ECONOMY

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Climate change, population growth, urbanisation and shrinking areas of arable land may increase the need for alternative and sustainable solutions to produce food in the future. Urban agriculture has many different forms, which can greatly contribute to the food security of the continuously increasing urban population. Therefore, a resilient urban planning should include the mapping and environmental assessment of unused or abandoned urban areas and green spaces to establish urban gardens, rooftop farming, vertical farming systems, community gardens and school gardens, parks, and green areas for recreation to design new and complete urban ecosystems. Furthermore, the environmental status and regional differences of soil conditions in these urban areas will determine future land use and environmental remediation strategies. This new development requires community participation and an inclusive approach to stakeholder management from the political decision makers. We must therefore strive to raise awareness of the importance of soil in urban environments, thereby promoting green, optimal urban design and management of natural resources. Soil conservation in urban and peri urban environments is a part of a resilient urban metabolism, based on total recycling, remediation of biodiversity and community participation supported by local and microregional green business models, which are both environmentally and economically viable. Therefore, urban planning practitioners need a strategic tool to transform the results of environmental and socio-economic assessments into urban actions, which must be integrated in the urban ecosystem planning process. The future is likely to include a combination of different ways for city dwellers to obtain their food. It is not to be expected that cities can grow all the food their citizens need, arable farming, wheat fields and potato fields will still be needed. But urban agriculture, as part of the sharing economy, can enhance the multifunctional use of land, combining food production with social inclusion, educational opportunities, and improved quality of life. We have therefore developed a multifunctional urban policy model focussed on organic urban agriculture with particular emphasis on regenerative soil management, development of green infrastructures, capacity building through practice-based formal and non-formal education programmes and support of local sustainable business initiatives to create new employment opportunities.

Keywords: organic urban agriculture, urban gardens, rooftop farming, food security, soil conservation, ecosystem services, participatory approach, green infrastructure, sharing economy, resilient urban planning

ID ABS WEB: 137226

3. Soil governance
3.06 133726 - Potential of Soil Archives to Answer Management Questions Today

THE CREA SOIL ARCHIVE, A NATIONAL COLLECTION FOR ITALY. EXPOSING A TOOL TO ACCESS PHYSICAL SAMPLE AND DIGITAL DATA

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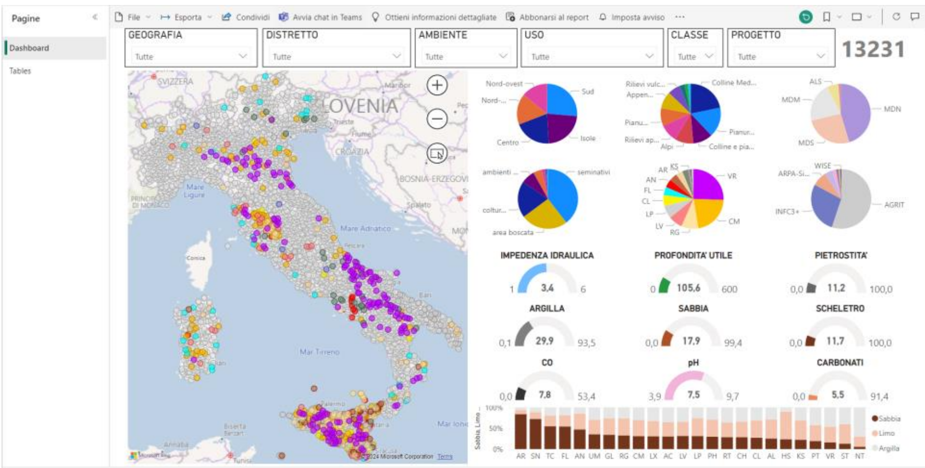
"The Archive's soil specimens are invaluable time capsules for assessing temporal changes in soil properties" Physical samples are a basic element for reference, study, and experimentation in research. There is an urgent need for better integrating these physical objects into the digital research data ecosystem, both in a global and in an interdisciplinary context to support scientific reuse.

The CREA collection, located at the Experimental Farm of Fagna, Scarperia (FI), stores specimens and associated metadata. Part of collected samples was recently received and are temporarily stored unordered. It covers all major agricultural and forestry soil landscapes in Italy for organic and mineral horizons. Parameters include water impedance, rooting depth, stoniness, Coarse fraction, particle size, pH, organic carbon, and total carbonates, World Reference Base classification.

With the present work, a tool was developed to expose both metadata, digital research data, displacement to support FAIR principles. The tool was developed by means of Ms Power BI. The original local Ms Access database was stored on the cloud and connected to the tool to allow automatic updates. Geographic and semantic queries are graphically implemented through drop-down menus and pie charts on administrative units; Soil districts; European Environments; Land use; WRB; and Project.

The tool expose data collected by 13 different projects from 1986 to 2017. Contains 13,231 analyzed observations (pedological profiles, minipits, or augerings) for a total of 33,523 samples. Soil properties resulted in ranging for Clay: 0.1-93.5 (29,9 average); Sand: 0.0-99.4 (17.9), pH (water): 3.9-9.7 (7.5); Organic carbon: 0.0-53.4 (7.8); Total carbonates: 0.0-91.4 (5.5) for the whole dataset. Textural composition of every Reference Soil Group (24 out of 32) is presented as Bar Histogram. A navigation panel allows to preview the site location and storing collocation.

Although samples access is restricted, data and storing displacement are exposed to support use of the data and specimen's reuse. The developed tool represents a first attempt to expose both metadata, soil data and filtering capabilities.



Keywords: Tools and services,Knowledge dissemination,Sample selection,Data visualization

ID ABS WEB: 136866

3. Soil governance
3.07 133729 - Nitrogen Use Efficiency as Influenced by the Microbiome

COMPOSITIONAL SHIFTS AND ASSEMBLY IN RHIZOSPHERE-ASSOCIATED FUNGAL MICROBIOTA THROUGHOUT THE LIFE CYCLE OF HIGH NITROGEN USE EFFICIENCY RICE UNDER INCREASED NITROGEN FERTILIZATION

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Soil fungal microbiomes facilitate a range of beneficial functions for their host plants, and rhizosphere fungal community composition, richness, and diversity affect plant growth and development, and crop yield. Therefore, exploring the community structure and assembly of the rhizosphere fungal microbiome and its relationship with soil biochemical properties are fundamental to elucidating how rice plants benefit from their fungal symbionts. In this study, soil samples were collected at the seedling, tillering, heading, and ripening stages of high nitrogen use efficiency rice variety, subjected to three levels of nitrogen fertilization. Plant growth demonstrates a substantial influence on fungal community composition and diversity. From the tillering to the ripening stage, the fungal communities were governed by homogenizing dispersal and dispersal limitation. The prevalence of Glomeromycota, the beneficial fungi, was considerably higher during the heading stage compared to the three other growth stages. This increase in abundance was strongly associated with increased levels of soil nutrients and enhanced activity of nitrogen acquisition enzymes. This strategy may be developed by rice grown in flooded soil to recruit beneficial fungi in the rhizosphere to meet high nitrogen demands. Our study findings contribute to elucidating the influence of plant development and nitrogen fertilization on the structure and composition of the fungal community as well as its relationship with soil key soil nutrient content and nitrogen-related enzyme activities. They also illustrate how a shift in the fungal community mediates and reflects the effects of nitrogen fertilization input in rice agroecosystems. These findings provide new insights into the effects of changes in nitrogen application in rice rhizosphere at different growth stages on fungal communities and soil biochemical characteristics.

Keywords: Soil fungal microbiome,Nitrogen fertilizer,Rice,Plant growth stage,Soil biochemical properties

ID ABS WEB: 136243

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

JOIN THE SOIL CARBON INTERNATIONAL RESEARCH CONSORTIUM !

S. REYNDERS

INRAE, Paris, FRANCE

Join the soil carbon community!
The Soil Carbon International Research Consortium (IRC) was launched during Soil Mission Week in Madrid. It is supported by ORCaSa - a three-year Horizon Europe initiative -, and its 5 regional nodes. Hand in hand with the 4p1000 Initiative, the Soil Carbon IRC covers all soils: agriculture lands, forests, pastures, wetlands, urban areas, etc. You can already join the Soil Carbon IRC! Depending on your expertise and type of involvement, you will be part of one of the three colleges (researchers, funders, and users), and included in the regional node corresponding to your location.

Targeted services delivered by the Soil Carbon IRC:

1. Harmonisation MRV framework

You can be part of an international community truly committed to raise awareness and develop scientific knowledge on how to measure, report and verify soil carbon stock changes by contributing to an internationally harmonised Monitoring, Reporting, and Verification (MRV) framework

2. Open access knowledge platform

You can access and contribute to a knowledge platform driving you to:- scientific evidence through meta-analysis and reviews- description of best practices from verified sources- interactive mapping of data (for instance, easy visualisation of carbon stock and its evolution) - initiatives, projects, and a large network of stakeholders.

3. Research alignment and calls

You can contribute to an aligned Strategic Research and Innovation Agenda (SRIA) that will consider all types of land use in each region to ensure that soils play a role in soil health and innovation for climate change mitigation and adaptation. In addition, you will access to funds designed to facilitate international collaboration between projects. The Soil Carbon IRC will propose calls dedicated to the implementation of the SRIA and negotiate them with international funders.

Soil Carbon
International Research Consortium

Keywords: Research Consortium,International,Knowledge Platform,Research Alignment and Calls,MRV harmonisation

ID ABS WEB: 137081

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

PRIME FARMLAND SOILS ARE UNIQUELY VALUABLE FOR THEIR ECOSYSTEM SERVICES, BUT ALSO UNIQUELY VULNERABLE TO UNPRECEDENTED LAND TAKE AND SOIL SEALING

L. PEAKE

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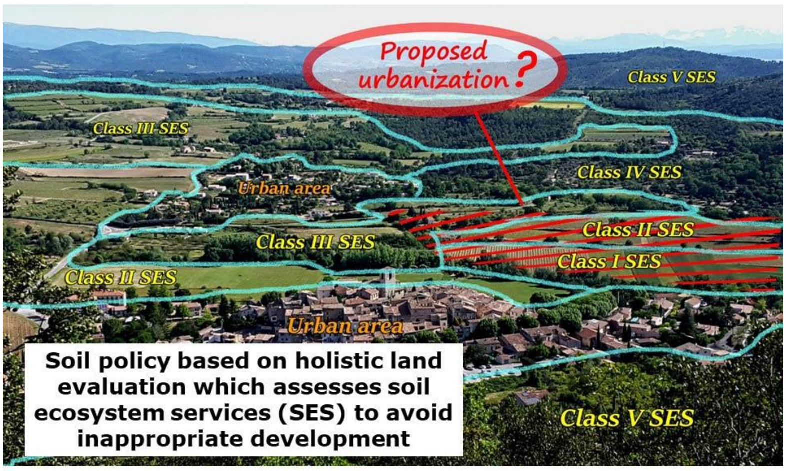
Resource-rich soil, often referred to as prime farmland, provides optimal food and fibre, and a high degree of less tangible soil ecosystem services (SES), e.g. the storage and filtration of water, a genetic reservoir, carbon sequestration and the ability to incorporate biological waste. However, spreading urbanisation and infrastructure incurs land take and irreversible soil sealing, the most extreme form of soil degradation, which largely eradicates in situ SES. The result is further ecological loss and diminution of our resilience in the face of climate change, e.g. flood and drought mitigation. Since high-grade soils typically provide more SES than any other type of land, their sealing will have the greatest environmental impact.
Yet it is precisely such land that is often at most risk of development. Its proximity to urban centres makes it accessible and close to infrastructure, and it is cheaper to develop than brownfield land. Escalating land prices encourage farmers to sell, often to pay off debts. In the 20th century, agriculture was intensified by technology, fossil fuels and government incentives to maximise production. Now that the focus has shifted to pollution, climate change and ecology, agriculture is increasingly pilloried as an enemy of Nature. Consequently, agricultural land is often seen as having less intrinsic value than natural ecosystems. Furthermore, soil does not invoke the emotive responses associated with wildlife or landscape and its loss often goes unnoticed.
There is an urgent need to prioritise prime farmland preservation (PFP), as well as conserving natural ecosystems. Development needs to be more innovative in its use of space, but also directed at brownfield sites, low-grade soils and other marginal land of low landscape or ecological value. Fewer than a third of the world's countries have policies to discourage the loss of prime farmland and, of these, just a handful have stringently enforced laws to this effect. PFP deserves to become one of the highest priority global soil governance issues.

Soil Governance: Prime Farmland Preservation (PFP)



IUSS Centennial Conference, Florence, 19-21 May 2024: Soil Governance theme

Keywords: Prime Farmland Preservation,Land take,Soil sealing,Soil policies,Soil laws

ID ABS WEB: 137210

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

STAKEHOLDERS' COLLABORATION IN DEFINING SCENARIOS RELATING TO AGRICULTURAL SOILS, ON THE BASIS OF TRENDS IN RELEVANT DRIVERS

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[6] ENEA, ITALY

The SERENA Project (EJP SOIL) aims to improve the effectiveness of European environmental policies, and in particular those on soil health, through the analysis of soil threats and soil-based ecosystem services in European agricultural landscapes. The need for good agro-management practices and techniques to contribute to the improvement of soil health and to mitigate the effects of and adapt to anticipated global change scenarios have been widely recognized. The predicted effects of global changes make it necessary to properly inform stakeholders about risks under future scenarios. To contribute to the improvement of soil health and to mitigate and adapt to the effects of global changes, it is important that people are made aware of the benefits of sustainable cropping systems and the implementation of beneficial for the soil agro-management practices and techniques. With information taken from literature and in collaboration with stakeholders, this study focuses on defining the relevant scenarios for agricultural soils. The main drivers of change considered are climate change, demographic trends, changes in land use/land cover as well as land management. Stakeholders have been asked to identify potential mitigation entry points and have been offered the possibility to share their opinions and expertise on the outcome of the scenario analysis and the resulting implications for soil health and ecosystem services. The results indicate that further consideration must be given to how best to raise awareness among stakeholders on aspects of soil health. Here especially, the importance of soil threats and soil ecosystem services in maintaining soil health should be acknowledged. The scenario co-creation process with stakeholders plays a key role in evaluating the effectiveness of soil related policies in striving to achieve national and global environmental targets, including Agenda 2030 and its Sustainable Development Goals, the provisions given in the Rio Conventions, in the European Green Deal, and the proposals contained in the new EU Soil Law.

Keywords: soil health,soil threats,soil-based ecosystem services,drivers of change,EJP SOIL

ID ABS WEB: 137648

3. Soil governance

3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

SOIL INVESTIGATION IN THE PROTECTED AREAS OF ISLAND OF MONTECRISTO (NORTHERN TYRRHENIAN SEA, ITALY)

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The small island of Montecristo, one of seven islands in the Tuscan Archipelago of Italy's Tyrrhenian Sea, is a natural reserve since 1971 and it has been awarded in 1988 by the Council of Europe with the European Diploma of Protected Areas. It is included in the National Park of Tuscan Archipelago since 1996. State Forestry Corps (CFS) administrated the Protected Area until 2016, then and to date it is managed by Carabinieri Biodiversity Office of Follonica. In the past, the CFS has successfully managed several LIFE Nature projects for the conservation of both species and habitats of EU relevance. However, limited attention has been paid in relation to soil protection and to its ecosystems services. Therefore, the aim of this research is to map soil units via conventional soil surveys, laboratory analyses and GIS approach in order to provide useful soil guidelines for local land planning strategies. The soil mapping of the island required an intensive level of field investigation and sampling based on survey fieldwork due to the challenging environmental setting. The spatial distribution and variability of the most extensive soil types were reproduced in GIS and presented in a pedo-landscape map, with a descriptive legend based on World Reference Base classification. Five RSGs have been identified: Leptosol, Regosol, Cambisol, Umbrisol, Kastanozem. Several soil types were resulted highly affected by soil erosion processes. We applied a GIS based analysis using the RUSLE model to estimate annual soil loss on pixel level (25 m2) and to assess the spatial distribution of soil erosion in the study area, following several methodological improvements of the new JRC modelling assessments. This knowledge might be very useful for stake-holders to prepare the area and to identify the hotspots for erosion and for SOC preservation that might need intervention measures. In fact, soil erosion can affect SOC content and that is of great importance because of global environmental concerns.

Keywords: Protected Area,Soil mapping,RUSLE,Soil erosion,SOC

ID ABS WEB: 137769

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

EXPERIENCING SOIL PERSPECTIVES – AN INTERDISCIPLINARY APPROACH TO SOIL

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How do soil scientists perceive and experience soils? They use a wide variety of devices and tools, such as microscopes, laboratory equipment and field campaigns, and they summarize their knowledge through publications, graphs, and tables. Approaching soils with this academic perspective is likely to cause scientists to have different relationships with soils than people without soil science training. Humans have relationships with soils, and in addition to the science-based ones, these relationships can be personal, artistic, cultural, sensorial and more. Clearly, soils matter at many levels since people and communities can feel a deep connection with the soil of their homeland, as a source of identity, sustenance and a sense of place and belonging. What we proposed during the Wageningen Soil Conference was to let soil scientists discover the diversity in ways that soils can be experienced and perceived. During these event we took participants beyond the scientific perspective in an informal and relaxed space where we engaged with soils in unexpected and creative ways. Seventeen 'stations' were dedicated to experiencing colors, smells, tastes, textures, sounds, visuals, emotions and feelings peculiar to soils. Each station was organized by either a scientist or an artist that was present to encourage discussions, conversations and sharing of stories to inspire to experience new soil perspectives. One of the goals of this exercise was to expand the, often narrow, view of soil scientists on soils and let them discover other dimensions which can allow them to better connect with society and inspire them to share their work and knowledge about soil. This event was just the beginning of our collaboration towards experiencing soil perspectives and in the future more events using the same or a similar format for different stakeholder groups (non-soil scientist, general public) are going to be organized. During the conference we will share our concept, experiences and reflection with a broader group of soil scientists.

Keywords: Perceptions,art,connecting,awareness,senses

ID ABS WEB: 138282

3. Soil governance
3.08 133775 - Soil governance: building on stake-holders interactions and involvement for a sustainable management of soils

A CHANGE IN THE APPROACH TO PROTECTING AGRICULTURAL LAND IN POLAND

K. KOLINSKI

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Apart from the obvious benefits, Poland's constant development also has negative consequences. One of them is the constant loss of agricultural land, which is being transformed into urbanized land. This situation is a consequence of the country's inappropriate spatial policy. The development of buildings in Poland is carried out in a chaotic manner. As a remedy, it was decided to introduce a new act on spatial planning. According to the author, the act will significantly inhibit the uncontrolled development of buildings. Thanks to the changes, agricultural land will be better protected and its loss should be stopped. The aim of the poster is to present the current changes in agricultural land and to present potential instruments that inhibit these processes.

Keywords: development,agricultural land,spatial chaos,loss of agricultural land

ID ABS WEB: 136649

4. Soil health in achieving the Sustainable Development Goals
4.01 123826 - Soil science lessons from 100 years or more old experiments

ONE HUNDRED TWO YEARS AT THE EXPERIMENTAL STATION OF WULS-SGGW OF ORGANIC FERTILIZATION AND THE FORMATION AND STABILIZATION OF SOIL ORGANIC MATTER

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The experiment was established in Skierniewice (central Poland) on sandy loam Luvisol, which received mineral fertilizers (CaNPK). The treatment included: control; manure; legumes; and manure with legumes. Soil samples from A horizon were collected during the 2022 mid-growing season and analyzed for total organic carbon; plant available water, the fractional composition of humic substances (HS), and spectroscopic properties of SOM and isolated humin fraction (HUM). Soil moisture, soil temperature, and CO2 emissions were measured in the field during the 2022 and 2023 growing seasons.
The greatest impact on SOM content was observed in plots where manure had been applied. The fractional composition of HS revealed that the transformation of organic matter under fertilization with manure led to significant increases in the humic acids/fulvic acids ratio compared to the control, while the application of legumes caused a decrease in HUM vs. manure alone. Changes in the spectroscopic properties of HUM, and an increase in absorbance and fluorescence emission in legume-applied soil were detected.
Thermochemolysis and gas chromatography/mass spectrometry (TC-GC/MS) showed no general order for the relative abundance of compound classes carbohydrates, lipids, and lignin building blocks. Manure enriched HUM with lipids relative to the control whereas HUM in legume treatments had more lignins than the others. Most striking was the carbohydrate enrichment in the combination of manure and legumes.
Changes in the amounts and properties of SOM influenced water holding capacity. Manure fertilization significantly increased plant available water, while legumes alone decreased.
Based on the two years of monitoring, CO2 emissions were affected by soil temperature only.
The results confirmed the beneficial effect of long-term organic fertilization on carbon dioxide sequestration. Furthermore, long-term different soil management practices not only altered the SOM contents and resulting chemical and physical properties but surprisingly also the chemical composition of HUM, which is considered as particularly stable and a long-term sink of atmospheric carbon.
The research was financed by EJP SOIL program, NCBR project EJPSOIL/I/78/SOMPACS/2022.

Keywords: soil management,carbon sequestrtion,soil organic matter,humin fraction,spectroscopic properties

ID ABS WEB: 137261

4. Soil health in achieving the Sustainable Development Goals
4.01 123826 - Soil science lessons from 100 years or more old experiments

REGENERATIVE AGRICULTURE : A MODEL TO EMULATE

R. RAMESH, D.P. SINGH

Higher Education Government of H.P, Shimla, INDIA

The regenerative agriculture is a dynamic system which webs all aspects of agriculture-which grow, enhance, exchange, distribute and consume goods and services. This system has holistic principles which restore soil and ecosystem health and addresses inequity and leaves our land, water, and climate in better shape for future generations (UN sustainable development). The customary and indigenous practices in India symbolize the bond between man and nature needs to be revived. The regenerative agriculture pattern which existed traditionally in India was based on the experiences of generations that focus on improving soil health, increasing biodiversity, and restoring ecosystems. It involves practices like minimal ploughing, crop rotation, and the use of organic fertilizers. It addresses soil degradation caused by intensive farming, enhances soil's ability to store carbon dioxide, and helps mitigate climate change by turning agricultural lands into carbon sinks. The key practices include reducing soil disturbance, rotating crops to improve biodiversity, using natural fertilizers, and managing grazing patterns to prevent soil degradation. Benefits include improved crop yields, enhanced soil health, reduced emissions, increased carbon sequestration, and greater resilience against climate change impacts. Himachal Pradesh is a small State in India 90 percent of its population live in rural area and 70 per cent are directly dependent on agriculture for their livelihood. Under the natural farming system, 3 to 12 crops are cultivated together on the same area. This study is undertaken to document the regenerative agriculture in India with its focus on Himachal Pradesh and regenerative farming practices which contribute to combat climate change in multiple ways; as agro-forestry and multi- cropping, often involve the cultivation of diverse crop species. There is a diversity of customs and traditions which results in vividness in the conservation practices.
The study intends to give a model based on success stories of the farmers and that of the State based on customary practices. This study will also incorporate the lived experiences of farmers.

Keywords: Regenerative,customary,sustainable,soil-health,diversity

ID ABS WEB: 136303

4. Soil health in achieving the Sustainable Development Goals
4.02 124990 - Towards harmonized soil health monitoring.
Novel methods and perspectives and scientific, institutional, and societal challenges

BIO-TILLAGE: A NEW PERSPECTIVE FOR SUSTAINABLE AGRICULTURE

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For sustainable agricultural production, we propose bio-tillage, which is defined as improving soil structure with plant roots to boost the growth of crops. Cover crops with thick and deep roots can be used for bio-tillage since they can effectively improve soil structure and water and air conductivity by forming biopores (root channels), which provide space with the least resistance and a high level of oxygen and nutrients to promote root growth. The effect of bio-tillage on crop yields varies with climate conditions and management practices. An effective bio-tillage cover crop should have thick and deep roots with rapid root growth rates, rapid decomposition of remnant roots, and good adaption to climate and soil constraints. Planting cover crops in a timely manner and eliminating them at a suitable stage with a roller-crimper can benefit bio-tillage.
The bio-pores, created by cover crop roots, are cylindrical, continuous, and stable and facilitate the transport of air and water. The soil around biopores also affects plant growth by its rich nutrients. The behavior of roots encountering biopores is impacted by soil strength, oxygen concentration, biopore characteristics, and crop species. For example, the effect of biopores on crop growth depends on biopore size. The smaller biopores (<2 mm) promoted plant growth, but the larger biopores did not (>2 mm), which was mainly related to the degree of contact between root and soil in biopores. The limited understanding of ideal biopore architecture for root growth, more effective bio-tillage cover crop species, and field management of bio-tillage, needs to be addressed before a wide application of bio-tillage.

Keywords: Bio-tillage,Subsoil compaction,Soil structure,Sustainable agriculture

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CAN SMARTPHONE APPLICATIONS REVOLUTIONISE HOW WE MEASURE AGGREGATE STABILITY?

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Aggregate stability describes the ability of soil aggregates to remain stable against external forces such as rapid wetting and raindrop impact. Stable aggregates can improve soil structure, water holding capacity, and protect organic matter. Aggregate stability is therefore an important physical indicator of soil health. Current methods to measure aggregate stability often involve disrupting soil aggregates in distilled water. These tests are time consuming, require specialised equipment and are usually done in laboratories.

The Soil Aggregate Stability (SLAKES) smartphone application, developed by the University of Sydney, Australia, quantifies aggregate stability by measuring how quickly soil aggregates disintegrate once submerged in water. The SLAKES application requires three soil aggregates between 2-15 mm in diameter to be placed in a petri dish. Water is added and the SLAKES app provides a measurement of aggregate stability within 10 minutes.

To determine the sensitivity of the SLAKES app, we compared its aggregate stability measurements with that of the established “Le Bissonnais” method. Soil samples of different texture were taken from fields under fallow, permanent grass, and continuous arable cropping management at two experimental sites on different soil types. The results of the SLAKES app were similar to the results achieved with the standard “Le Bissonnais” method. The SLAKES app was able to differentiate between different managements on clayey soil but it was less sensitive when tested with sandy soil. Despite this, the SLAKES app is a legitimate method to measure aggregate stability. The app offers a simple, fast, and cheap alternative to standard laboratory methods, allowing land managers and non-scientists to actively test the quality of their soils.

Keywords: Soil Health,Soil Health indicators,Aggregate STability,SLAKES Smartphone Application,Novel approaches

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NEW APPROACHES FOR FAST DETERMINATION OF WATER-EXTRACTABLE SOIL ORGANIC CARBON BASED ON HIGH TEMPERATURE COMBUSTION AND VNIR SPECTROSCOPY

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Water-extractable organic carbon (WEOC) fractions are reliable and sensitive indicators for monitoring soil organic carbon and assessing the effectiveness of soil policies. However, determining WEOC pools is a time-consuming process. The aim of this study is to validate new methodologies for the fast determination of cold (CWC) and hot (HWC) water-soluble carbon, using high-temperature combustion and visible and near-infrared (VNIR) spectroscopy.
100 topsoil samples were collected from three long-term experiments in 'L. Toniolo' farm (Legnaro) on four different types of soil. Total organic carbon (TOC), CWC and HWC were analyzed at temperatures ranging from 200 to 600°C. VNIR spectral data were collected in laboratory from bulk soil and modeled using PLSR and cubist. Fourier Transform Infrared (FTIR) analysis was used to provide molecular information on bulk soil samples, CWC and HWC residues before and after heating.
Significant correlations ($0.7 < r < 0.9$) were observed between CWC500, HWC300-400 and TOC300-400-500-600 in sandy, clay and peaty soils. PCA plot showed that CWC500 grouped with HWC pools and clay. Weak relationships ($0.4 < r < 0.55$) were found for OC pools at 200°C, and between TOC, CWC and HWC in silty-loam soil. CWC300-500 and HWC300-500 exhibited higher sensitivity to texture and applied treatments. Before heating, the signal intensity of FTIR spectra was stronger in HWC than CWC. Most of the spectra presented bands associated with carbonyls, carboxylates, aromatics and carbonates. HWC300-400 and CWC300-400 residues underwent structural changes due to decarboxylation and condensation reactions. PLSR model performed better with respect to WEOC ($r2 = 0.66$ vs 0.60 and RPD = 1.7 vs 1.38, on average). Even more promising results were obtained for TOC content ($r2= 0.93$ and RPD = 3.98, on average).
These initial findings indicate the potential for utilizing rapid techniques to quantify water-soluble carbon. Further analyses are imperative to implement proximal and remote sensing techniques.

Project funded by the European Union - NextGenerationEU, under the National Recovery and Resilience Plan (NRRP)

Keywords: Soil monitoring,TOC,Water-extractable OC,High-temperature combustion,VNIR spectroscopy

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ACCOUNTING FOR SOIL HEALTH - CORPORATE SUSTAINABILITY REPORTING PERSPECTIVES

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Recent years have seen significant growth in sustainability reporting disclosures by corporate agribusiness entities. These trends have been stimulated through growing interest in sustainable agricultural investments and facilitated by the advancement of a number of international sustainability reporting initiatives including the European Union's Corporate Sustainability Directive and the International Sustainability Standards Board's climate and sustainability-related disclosures projects. These developments, however, have largely overlooked soil health and the significance of soil-related risks.

This project sought to understand the potential usefulness of soil-related disclosures to agri-investors and identify relevant means of advancing soil reporting by corporate agribusinesses. This is an important area of development given the impact of corporate agribusiness activities on soil health and increasing agri-investor exposure to soil-related risks.

A mixed-method research approach was deployed. This included data gleaned through an archival review of current annual report and other disclosure practices by corporate agribusiness entities and in-depth interviews with agri-investors and senior corporate agribusiness managers.

Results from the analysis of archival data identified few existing examples of comprehensive soil health information by corporate agribusinesses. Interviewees acknowledged the importance of soil health in maintaining agricultural productivity. There was a strong backing for the focus on enhancing soil reporting, including the disclosure of soil-related risks, strategies, metrics, and objectives. However, in recognition of the diverse and complex nature of soils, respondents acknowledged the challenge of reaching a consensus on standardised soil metrics. Should soil reporting advance, there was a preference for presenting soil-related information in a simple, concise manner, using terms and benchmarking approaches familiar to investors. This information on soils should be linked to other environmental-related matters and the financial ramifications associated with soil-related risks and opportunities should be clear. Additionally, any information conveyed to investors should be aligned with the types of information already utilised by agribusinesses for their internal management purposes. Doing so should help to minimise the reporting burden on reporting entities.

Keywords: Soil Health Reporting,Agri-investments,Sustainability Reporting,Soil Stewardship,Corporate Farming Entities

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REFLECTIONS ON LARGE BENEFITS IN PRODUCING SOIL INFORMATION IN SOILS4MED PROJECT: THE TUNISIA CASE STUDY

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In the Mediterranean region, and in particular in the Near East and North Africa Mediterranean (NENA) countries, there is urgent need to enhance availability and use of soil data and information (SDI) and define harmonized methodologies to realize standardized soil information systems (SIS) as enabling conditions to monitor and improve soil health and support policies to achieve land degradation neutrality (LDN) and other Sustainable Development Goals. In the framework of the PRIMA-funded SOILS4MED project, all the countries involved are collaborating to create a country-owned standardized soil information systems (NSIS) to collect and manage harmonized SDI. Some NENA countries involved in the project, such as Tunisia, have various SDI collected across many decades since the mid-1900s, but often stored in non-digital format, poorly accessible, yet not standardized and harmonized. The NSIS will facilitate the management, update, visualization and use of the data. It will include existing soil point data and maps, and laboratory data, that will allow to produce soil quality, indicators, soil fertility, soil constraints, soil degradation and land capability maps. The NSIS, in Tunisia, will be first used to update the agricultural map, of primary importance for rural development plans, and secondarily to implement models and pedotransfer functions to calculate erosion rates and risk, and physical properties (e.g field capacity, erodibility, water infiltration, proneness to compaction, and salinization), fundamental for crop performance evaluation and improvement, and for mitigating of environmental degradation and restoration planning. The NSIS will also allow assessing and monitoring the efficiency and sustainability of land uses and management practices. The NSIS will implement in use cases embedded in Soil Living Labs (LL) established in Tunisia. A use case is the connected flows of actions defining the interactions between agricultural actors and NSIS, as well as other relevant data and tools, to achieve specific objectives. .

Keywords: Soil information,Soil data,Soil management,Soil Living Labs,Soil Living Labs

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ALTERNATIVE SOIL CHARACTERIZATION BASED ON PROTEIN STRUCTURE BY MALDI-TOF MS

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The available literary data suggest the general applicability and benefits of the Matrix-assisted laser desorption/ionization (MALDI) time-of-flight (TOF) mass spectrometry (MS) in the field of microbiological identification including food quality and safety, and the clinical field. Since microorganisms are present in large numbers in the soil, our study aimed to examine the protein composition of the soil in a long-term detritus manipulation experiment on luvisols. The experimental sites were previously conducted with the following treatment in an oak wood forest. Double Wood, double litter, no litter, no woods, and no input. Soil samples were collected from the 0–5 cm layer in mineral soil twenty-three years after the treatments were established in the early autumn period. Different pre-digestion treatments were used to extract the protein content of soil samples was performed. The filtrates were then analysed by a MALDI-TOF MS. 1 μL of the sample was dropped onto a slide, and after drying, 1 μL of 70% formic acid was 6 of 14 added. Finally, it was sealed with 1 μL a-HCCA (a-cyano-4-hydroxycinnamic acid in 50% acetonitrile and 2.5% trifluoroacetic acid) matrix. The measured mass spectrum of the preparations was in the range of 100–1200 Da. A peak list was created from each spectrum, and then these peak lists were averaged per treatment. During the evaluation, we calculated with normalized intensity values, that is, the intensity values belonging to each point were divided back by the intensity value of the base peak. A cluster analysis was then performed on the normalized data. It can be concluded that the NI and NL treatments were significantly different from the other litter treatments and from the Control. The spectra of the DL and DW treatments and the Co and NR treatments showed close similarity in the different extraction methods.α

Keywords: quantitative MALDI-TOF,diagnostics,organic matter,soil biology,protein pattern

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SOIL HEALTH ASSESSMENT IN THE MEDITERRANEAN REGION: CHALLENGES AND CONCEPTUAL FRAMEWORK

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Soils play a crucial role in ecosystem functioning that provides multiple ecosystem services making human livelihood possible and environmental sustainability. The soils of the Mediterranean region (MR), particularly in the Near East and North Africa, are degraded due to prolonged unsustainable management and effects of climate change. In NENA region, soils are weakly developed, naturally low in organic carbon, and vulnerable to degradation processes widespread in the region (e.g. erosion, salinization). The amount of fertile arable land is continuously decreasing and increasingly contaminated. The improvement of soil management to achieve land degradation neutrality urgently needs a regional soil health assessment framework with comprehensive, relevant indicators and measuring methods. However, soil health indicators and methodologies for soil sampling and analysis may differ across countries, requiring harmonization. The PRIMA-funded SOILS4MED project develops conceptual frameworks to define quantifiable indicators of soil ecosystem services, soil quality and soil health adapted to the environmental conditions, soil types, and stakeholder needs. The approach is inspired to that adopted in Europe by the EJP Soil project, the LUCAS programme, and by FAO/GSP, and will be mostly based on data that are available in each country. The development of health indicators using various soil properties require to establish threshold values to define the soil is healthy or not healthy and to decide upon the weight of each property in the assessment of soil health, which may vary depending on local environmental conditions, policy objectives, and stakeholder perception. This might be a challenge at the scale of the studied MR as pedoclimatic and socio-ecological conditions are highly variable and soil management systems. The project will implement Living Lab-embedded use cases that are connected flows of actions defining the interactions between agricultural actors and country-own soil information, as well as other relevant data and tools, to achieve specific objectives. The Living Lab approach with explicit use case implementation will harmonize and test the soil health assessment framework with multi-level stakeholders.

Keywords: Soil health indicator,Mediterranean region,NENA region,assessing method,regional framework

EPOSTERS

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TOWARDS ZERO POLLUTION AND IMPROVEMENT OF FERTILIZER QUALITY AND SAFETY: STANDARDIZED HEAVY METAL ANALYSIS

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Heavy metal content, particularly cadmium, copper and uranium in some of the raw materials used to manufacture phosphate fertilizers creates severe and difficult-to-reverse health problems for soils, crops, products, animals, and people. This poses a significant challenge to achieving the objectives of the One Health approach. The evaluation of fertilizer quality and safety is an essential step in moving toward a healthier and more sustainable use of mineral fertilizers, especially those containing phosphorus, because of their relevance in the productivity of agricultural systems. Given this scenario, the FAO-Global Soil Partnership is acting toward safer and sustainable use of fertilizers and eliminating soil pollution through the collaboration of the International Network on Soil Pollution (INSOP) and the International Network on Soil Fertility and Fertilizers (INSOILFER). In joint efforts, the two networks are working on evaluating and monitoring heavy metal content in phosphate fertilizers. Laboratory analyses are a primary step in assessing the quality of fertilizers that have significant impacts on soil quality. This work presents the process of harmonizing the standard operating procedure (SOP) for determining the heavy metal content in phosphate fertilizers. The SOP was developed through extensive collaboration with soil laboratories around the world, who shared their analytical procedures with the two networks of the Global Soil Partnership.

Keywords: heavy metals,fertilizers,harmonization,laboratory,methodology

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THE RECSOIL INITIATIVE CONTRIBUTION TOWARDS LAND DEGRADATION NEUTRALITY AND SOIL HEALTH

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Because soil organic carbon (SOC) is a key factor for soil health and land restoration, SOC stocks are one of the three metrics currently used to assess land degradation within Sustainable Development Goal (SDG) Indicator 15.3.1. Therefore, long and short-term development and investment decisions addressing the evaluation, prevention and restoration of degraded lands under the Land Degradation Neutrality (LDN) framework of the United Nations Convention to Combat Desertification (UNCCD) require integrated strategies to increase SOC stocks. The RECSOIL initiative for recarbonizing global soils provides a method to increase and monitor soil organic carbon stocks, making RECSOIL a valuable tool in achieving LDN targets.
While enhancing the implementation of the LDN framework, site-specific strategies to recarbonize soils are also capable of improving ecosystem services through enhanced soil health. RECSOIL promotes the adoption of sustainable soil management adapted to the local context, which ensures that soils have “the ability to sustain the productivity, diversity, and environmental services of terrestrial ecosystems” according to the definition of soil health by the Intergovernmental Technical Panel on Soils (ITPS, 2020). A healthy soil with a high SOC stock is usually more resilient and contributes to climate change mitigation and adaptation and to biodiversity objectives, as per the other Rio Conventions on climate change and on biological diversity (UNFCCC and CBD, respectively). SOC is also recognized as major topic in the Koronivia Joint Work on Agriculture (KJWA).
Here we present the RECSOIL initiative and toolkit for soil recarbonization monitoring, sustainable management, and decision support, highlighting their advantages in terms of a sound and sustainable implementation of the LDN framework. The aim is to share experiences, highlight barriers for implementation and receive feedback on the overall usefulness of the RECSOIL approach for LDN. Potential contributions to the implementation of the other Rio Conventions will be also discussed in pursuit of increased impact.

Keywords: Soil recarbonization,Land degradation neutrality,Global Soil Partnership,sustainable development goals,Soil organic carbon

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REGIONAL-SCALE ASSESSMENT OF SOIL STRUCTURAL STABILITY IN CROPPING FIELDS OF FARMS ADOPTING CONTRASTING SOIL MANAGEMENT PRACTICES: INSIGHTS FROM CASE-STUDIES IN THREE FARM NETWORKS OF WALLONIA

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Climate change, especially through the frequency of extreme climatic events like heavy rain, directly impacts soils, one of the most important components for sustaining agro-ecosystems. Intensive farming practices can also significantly affect soils, leading to a decrease in organic matter content, a loss of biodiversity, and heightened susceptibility to erosion. Recognizing these challenges, some farmers are adopting innovative soil management practices to protect or restore agricultural soil fertility in its three components: biological, physical, and chemical.

A new measurement protocol, the QuantiSlakeTest (QST), has been developed to assess soil structural stability. The QST is a low-tech method that continuously measures the disintegration of a soil sample submerged in water. Initial applications of QST in Belgian long-term experiments have confirmed the benefits of reduced tillage on soil structural stability and shown the advantages of this novel approach (Vanwindekens & Hardy, 2023).

Based on these promising findings in controlled conditions, the QST was implemented in real farms through three projects led by researchers or advisors from a support organization of the Walloon agricultural sector. The three case studies aimed to compare the impact of practices related to (i) the establishment and management of intercropping cover, (ii) the diversity of technical choices of farms engaged in conservation agriculture, and (iii) soil management in sugar beet cultivation.

Overall, the results from the three case studies confirm the relevance of the QST, even in contrasting pedoclimatic conditions at a regional scale. Specific findings highlight (i) that there is lower soil structural stability in fields that are tilled for sowing or/and destroying canopy of cover crops and (ii) the added value of temporary grassland in crop rotation. Our approach has further potential for implementing the QST in regional or national soil monitoring networks.

Keywords: quantislaketest,soil structural stability,soil management practices,farm networks

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INTRODUCING A NATION-WIDE AGRICULTURAL SOIL MONITORING IN SLOVENIA

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In 2022, several paragraphs were added to the Slovenian Agriculture Act, which oblige the Ministry of Agriculture, Forestry and Food (MAFF) to finance regular monitoring of soil condition. The law defines soil parameters, analysis methods and a hierarchical structure of institutions responsible for the annual monitoring of agricultural soils. In 2022, MAFF initiated a five-year pilot project to develop a new nationwide Agricultural Soil Monitoring Programme (ASMP). The Agricultural Institute of Slovenia (AIS), the leading national agricultural research institute, was commissioned to organise and manage eight regional agricultural advisory services. After initial seminars on the correct and uniform soil sampling technique, soil samples were taken at 250 locations to a depth of 30 cm. The resulting 560 samples were analysed for a number of soil parameters: texture, acidity, nutrient and SOM content, CEC and heavy metals as well as organic pollutants. At the same time, the harmonisation and standardisation of laboratory analyses was carried out in national laboratories. In Slovenia, the predominant land uses are arable lands and meadows. On 161 sampled arable lands, the mean soil acidity was measured at pH 6. The soil here shows a plant-available phosphorous content of 15.7 g/100 g and a potassium content of 21.2 g/100 g. Additionally, the average soil organic matter is noted to be 3.6%. In contrast, on 70 sampled meadows, while sharing the same average soil acidity of pH 6 as arable lands, exhibit significantly different nutrient levels. The phosphorous content in meadow soils is much lower at 5.9 g/100 g, and the potassium content is 15.7 g/100 g. However, meadows have higher soil organic matter content, averaging at 6.5%. The first development and testing phase of the ASMP has been completed. The ASMP will be further expanded and refined. The knowledge gained will contribute to the fine-tuning of the system. If necessary, the ASMP will be adapted to the requirements of the recently discussed EU Soil Monitoring Directive.

Keywords: soil quality,sampling,soil parameters,food security

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4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

ASSESSMENT OF P MINERALIZATION FROM POULTRY MANURE, ORGANO-MINERAL FERTILIZER AND COMPOST THROUGH AN INCUBATION EXPERIMENT

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This study was aimed to evaluate different strategies processing poultry manure, in order to offer environmental acceptable solutions to its disposal for the poultry industry of Uruguay, producing P rich soil amendments. The mineralization of organic amendments in the soil can be affected by the sources of organic materials and their physical form. We evaluated P availability after the addition of poultry manure, organo-mineral fertilizer, washed solids, compost with MEN (native efficient microorganism), compost without MEN and pelletized, to a sandy soil. The incubation experiment under controlled conditions (temperature and humidity for 13 weeks) was completely randomized, with 2 doses per material and 3 replicates. The soil was sampled four times along the incubation. In other experiment microbial respiration was measured, calculating cumulative C-CO2 release and daily respiration rate. The organo-mineral fertilizers were obtained by Quick Wash through acidification of manure with sulfuric or oxalic acid. The liquid was separated from the solid and the P was precipitated with Ca(OH)2 from the acidified liquid. Two precipitates were obtained: sulfuric acid (PPS) and oxalic acid precipitate (PPO). The by-product called washed solid was obtained from sulfuric (WSS) or oxalic acid (WSO) treatment. The composts were obtained from different treatments of poultry manure: compost (CC), compost with MEN (CMEN) and pelletized (CPE). All treatments increased CO2 production compared to control. WSS and WSO showed a greater increase, while CC, CMEN and CPE showed lower respiration rates. All of materials increased the soil available P from the 15 days sampling, maintaining the increase compared to the control (12 to 41 mg P kg-1) for at least 90 days. WSS presented the smallest increases, probably because most of the P is in organic form, while CPE presented the greatest increases. The results suggest that all the poultry manure derived amendments were effective to supply readily available P to plants. The calculated P efficiency rates were in a narrow range in all materials, excepting WSS.

Keywords: Poultry manure,Soil,Incubation,Organo-mineral fertilizer,Compost

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4. Soil health in achieving the Sustainable Development Goals
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PHOSPHORUS USE AND BALANCE IN FIELD CROPS OF ARGENTINA

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Argentina is a world leading producer of field crops ranking sixth as cereals producer and fourth as oilseed crop producer. Main field crops are soybean, maize, wheat, sunflower, sorghum, and barley. Grain production progressively increased in the last 30 years. The six main crops yearly averaged an area of 18 million ha and a production of 40 million t in the period 1993-1995 and boosted to 37 million ha and 137 million t in the period 2019-2021. The Pampas and Chaco regions encompass most of the area under field crop production. Originally, soils of these regions presented sufficient phosphorus (P) levels, and P deficient soils were circumscribed to the eastern and southeastern areas.
Fertilizer use has been low through mid 1990´s, but it increased steadily since then; it averaged 577 thousand t fertilizer product per year in the 1993-1995 period augmenting to 5.2 million t per year in the 2019-2021 period. Annual consumption of P fertilizers increased from 43.5 thousand t P in 1993-95 to 378.3 thousand t P in 2019-21. Sources other than fertilizers are scarcely use in Argentina.
Partial P balances (PPB, removal/application ratio) for field crops went from 4.9 in 1993-1995 to 1.3 in 2019-21. Analysis of P use by the three main field crops in the last twelve years (2010-2021) shows PPB close to neutral values in wheat (0.8-1.0) and maize (1.1-1.5), but still negative in soybean (1.4-2.2). Partial P productivity was of 229-283, 424-567, and 309-477 kg grain per kg applied P for wheat, maize, and soybean, respectively.
As result of negative P balances, recent soil surveys have shown sharp decreases in soil extractable P levels in most of the Pampas and Chaco regions. P balances should be improved through increased use of P fertilizers, manure, and/or other sources, especially in cropping systems dominated by soybean which is the crop that usually receives the lowest P fertilizer rates and shows the most negative P balances.

Keywords: maize,wheat,soybean,soil survey,nutrient use efficiency

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4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

EFFECTIVENESS OF TREATING MANURE WITH ALUM, GYPSUM, AND EPSOM SALT TO REDUCE PHOSPHORUS LOSSES UNDER SIMULATED SNOWMELT FLOODING.

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The recurrent use of animal manure on land has raised environmental alarms, especially with the increased concentration of animal production. Phosphorus (P) losses from lands during the snowmelt period contribute to water quality parameters. The impact of treating liquid swine manure with P-sorbing chemicals to mitigate P losses has not been thoroughly explored. This research investigated the effect of manure treatments on the release of P from soil under spring snowmelt conditions. An incubation study used intact soil columns collected from a high-P (100 mg kg-1) and a low-P (6.4 mg kg-1) soil. Liquid manure was treated with alum, gypsum, or Epsom-salt at and was added to intact soil columns. Treated- and untreated-manure-added soil columns were incubated for eight weeks at cool temperatures. Dissolved reactive P (DRP) concentrations in pore water and floodwater were measured weekly. At the end of the incubations, P fractions were measured after being sequentially separated. In low-P soil, the pore water DRP was 32 to 82% lower with the application of alum-treated manure than the untreated manure. The high-P soil had higher pore water DRP concentrations in all treatments than the low-P soils, with no significant differences among treatments. Surface water DRP concentrations were higher than pore water in all treatments in both soils. In both soils, significantly lower DRP concentrations in surface water were observed with the application of alum-treated manure (25 – 45%), compared to untreated manure. Analysis of the speciation of P in the soil after incubation revealed no significant differences among treatments in the low-P soil. However, in the high-P soil, lower levels of labile P species and higher levels of non-labile P species were observed in the alum-treated manure compared to untreated manure. Treating manure with alum before applying to agricultural soils significantly reduced DRP mobility to surface water, in both low-P and high-P soils and increased the non-labile species in high-P soil.

Keywords: phosphorus losses,snowmelt flooding,manure treated with phosphorus

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ID ABS WEB: 137133

4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

INTRICATE INFLUENCES OF LONG-TERM BIOCHAR ON THE PHOSPHORUS TRANSFORMATION ASSOCIATED WITH IRON AND SULFUR IN RHIZOSPHERE

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The effects of long-term biochar application on soil phosphorus (P) diffusion, resupply process, the flux across the root-soil interface and its availability in the rhizosphere of rice (Oryza sativa L) remain unclear. We used high-resolution dialysis (HR-Peeper), diffusive gradients in thin films (DGT), laser ablation-inductively coupled plasma mass spectrometry, and planar optode sensor techniques to characterize, in-situ, the 1D and 2D heterogeneity and dynamics of rhizosphere soil P, iron (Fe), sulfur (S), dissolved oxygen and pH in a paddy soil, after 10 years of biochar application. Both the field and greenhouse pot experiments demonstrated that biochar addition notably decreased the soluble/labile P and Fe concentrations in rice rhizosphere (vs. no biochar addition; CK) based on the results of Peeper, DGT, and two-dimensional imaging of labile P fluxes. Furthermore, DGT-induced fluxes in the soil/sediment (DIFS) model and sediment P release risk index (SPRRI) further indicated that biochar addition decreased the diffusion and resupply capacity of P from soil solid to the solution, thereby decreasing the P release risk to the environment. This decrease under biochar treatments via changed redox status of Fe and S caused by the lower dissolved oxygen in rhizosphere soil, and increased soil pH induced precipitating of soluble inorganic P into insoluble P forms, such as calcium-bound and residual P that are unavailable for crop uptake. The in-situ study on the biogeochemical reactions of P in the rice rhizosphere may provide a new and direct perspective to better evaluate the biochar addition and potential benefits to agricultural soils.

Keywords: phosphorus availability,rice rhizosphere,high-resolution visualization,biochar,in-situ

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4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

CONTRIBUTION OF FOREST PLANTATIONS TO SOIL PHOSPHORUS RESERVES

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Forest plantations represent a productive alternative in Argentinian Pampas region and little is known about how their use impacts on phosphorus (P) cycle in long-term. In this context, understand how these plantations regulate the functions of the ecosystem and in particular their impact on soil total P (TP) reserves is essential to maintain soil productive capacity, make sustainable use at scale of stand or basin and contribute to mitigate climate change. Understanding the mechanisms underlying P availability is important to predict forest productivity in a changing environment, particularly with agricultural history. The aim was to evaluate the TP reserves in poplar plantations (Populus spp) with different ages and in a continuous agriculture system with more than 40 years. The study was carried out in the Pampas region, Argentina, through a completely randomized design with 3 repetitions on an entic Hapludol soil from the Saforcada series. Treatments were: 1) Poplar stand 1: 9-year-old plantation; 2) Poplar stand 2: 19-year-old plantation and 3) an agricultural site. Soil samples were obtained, from which the concentration of TP and bulk density (DAP) were measured. Since DAP showed differences between treatments, we calculated TP values at same soil mass. The TP mean reserves at 0-100 cm were 1714 $\pm$ 89 ppm, 2370 $\pm$ 105 ppm and 2318 $\pm$ 152 ppm for agricultural site, poplar stand 1 and poplar stand 2, respectively. The forest plantation increased TP reserves by 39.6 and 42%, after 9 and 19 years of plantation, respectively, compared with agriculture site (Kruskal-Wallis test; $p<0.07$). We hypothesize that this increase was due to the absence of grain extraction and the mitigation of runoff losses. Plantation of fast-growing forest species produced significant changes in TP reserves, presenting a greater content of TP under poplar plantation in comparison with agriculture. Forest plantations represent an alternative productive which reduce nutrients exports and support the input of organic matter into the soil, contributing to the sustainability of agroecosystems.

Keywords: Poplar,Nutrients,Sustainability

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4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

ENVIRONMENTAL PHOSPHORUS RISK CLASSES FOR SILAGE CORN IN THE FRASER VALLEY, CANADA

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Phosphorus (P) loss from agricultural land through runoff is a major risk to the environment, which can result in eutrophication and water quality degradation. The objectives of our study were to: (1) identify environmental P risk classes using critical thresholds for P saturation index (PSI) and water extractable P (Pw); and (2) evaluate the identified environmental P risk classes against the agronomic performance of silage corn. We used 424 composite soil samples collected between 2018 and 2021 in corn fields with contrasting soil properties within the Fraser Valley, Canada. Environmental critical values of 10.8% for PSI and 4.1 mg/kg for Pw were established, and four environmental P risk classes namely low, moderate, high, and very high risk classes were defined. Soils in the low risk class (PSI = 0-6.6%, Pw = 0-2.2 mg/kg) showed the least risk of P loss but had the lowest corn dry matter (DM) yield = 13.7 mg/ha, far below the provincial optimum. In the high (PSI = 10.8-24.3%; Pw = 4.1-10.3 mg/kg) and very high (PSI > 24.3% and Pw > 10.3 mg/kg) risk classes, soils had excessive P concentrations, but corn DM yield did not increase. However, our results showed that soils in the moderate risk class (PSI = 6.6-10.8%, Pw = 2.2-4.1 mg/kg) have adequate soil P to optimize corn DM yield with minimal risk of P loss to the environment. Using PSI as an indicator of environmental risk, this work provides a robust and integrated criterion to monitor and assess P risk in silage corn systems in the Fraser Valley.

Keywords: critical P saturation index,optimum silage corn yield,P loss,water extractable P

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4. Soil health in achieving the Sustainable Development Goals
4.03 125012 - Matching food security and environmental goals: phosphorus, a key global element

CABINDA PHOSPHATE ROCK AS AN EFFECTIVE SOURCE OF PHOSPHORUS TO IMPROVE YIELDS IN ANGOLA AND SURROUNDING COUNTRIES IN AFRICA

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Minbos is a company developing the Cabinda Phosphate Rock (PR) from Angola and will soon start producing Prosper Primeiro (Trademarks of Minbos), a natural phosphate rock (PR) that will be the first fertilizer to be produced in the country. Since 2017 the company funded agronomic research at various levels (laboratory, greenhouse and field trials) through IFDC-USA, NPCT-Brazil and IIA-Angola. The field experiment outlines were designed to compare sources of P and the control with no P added at regular rates of P2O5 applied in Angola. The sources tested are a standard water-soluble P (WSP) source, MAP or TSP, the PR and the PR with additional low rates of WSP. On average, the results of all trials show that the PR per se substantially increased the yields of all crops by at least 80% and presented a RAE in average of 85% (65% to 100%). When applied with additional low rates of WSP the yields were the same to the WSP source by itself. The effectiveness of a PR varies with several factors, the most positive being PR high reactivity, soil pH < 5.6, crops > two months and rainfall > 500 mm/year. The Cabinda PR has medium to high reactivity and the conditions in most of Angola are suitable for its use. Also, good quality PR can with time present higher residual effect as related to WSP sources. Angola currently uses very low amounts of fertilizer (about 120.000 tons), all imported at high cost, and the crop yields are in average very low. Besides producing the Cabinda PR in Angola Minbos will import fertilizers and produce different blends. Based on the agronomic results so far the vision is that smallholder farmers (Grow to Eat) will use only the Cabinda PR as a source of P, while more technical farmers (Grow to Sell and Grow to Export) will be using this PR plus small additional rates of WSP.

Keywords: Phosphate Rock,Angola,Phosphate Fertilizers,Food Security,Fertilizer Effectiveness

ID ABS WEB: 135974

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

SYNERGISTIC EFFECT OF RICE MILL WASTE AND POULTRY DROPPING ON SOIL PROPERTIES, DEGRADATION OF HEAVY METALS AND GROWTH OF ONIONS (ALLIUM CEPA)

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A two-year greenhouse study investigated the combined effect of rice mill waste and poultry droppings on sandy loam soil properties, heavy metal content, and onion growth. Different application rates of rice mill waste (15, 25, 35, and 45 tons/ha) and a fixed rate of poultry droppings (10 tons/ha) were tested in an RCBD design with four blocks. The soil was analyzed for pH, organic carbon (SOC), nitrogen (N), available phosphorus (Av. P), and heavy metal content (Al, Fe, B, and Zn) at the start and end of the experiment. The highest application rate (45 tons/ha) increased the average soil pH from 5.13 (control) to 5.55. In both seasons, SOC content ranged from 0.75% (control) to 1.41% (45 tons/ha). Total N in the soil ranged from 0.19% (control) to 0.69% (45 tons/ha). The control plots had 4.71 Cmol/kg soil Av. P, whereas the 45 tons/ha rate had 5.78 Cmol/kg. The 45 tons/ha treatment reduced (P=0.05) soil heavy metal content compared to the control by 65% (Al), 79% (Fe), 94% (B), and 58% (Zn) in both growing seasons. The 45 tons/ha treatment resulted in the highest onion plant height (75.7 cm) and the heaviest onion bulbs (69.6 g - 98 g) compared to the control (57.1 g - 57.6 g). The study suggests that applying rice mill waste and poultry droppings can enhance soil fertility, health, and productivity, improving plant growth and yield.

Keywords: Rice mill wastes,Poultry droppings,soil properties,heavy metals,Onions

ID ABS WEB: 137141

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

THE EFFECT EVALUATION OF COMPOST SURFACE APPLICATION AS MULCH ON THE SOIL PROPERTIES

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The application of organic mulching materials is a sustainable agricultural practice with significant potential. Utilizing compost as a surface mulch can enhance soil water management, alleviate water stress in cultivated plants, suppress weed growth, reduce soil erosion, preserve soil moisture, and regulate temperature. In this study, conducted at two distinct locations (A and B) with varying growing conditions, the impact of compost applied as surface mulch on soil properties was evaluated.
Both locations featured cambium modal eubasic soil, skeletal less, with up to 25% skeleton admixture, and a depth ranging from deep to medium-deep (up to 0.30 m). Site A was a plain area, while site B had sloping terrain with a 5–7° slope, making it susceptible to erosion. Compost was applied annually at location A, post-harvest, at a rate of 30 t.ha-1. At location B, compost was applied as a surface mulch without incorporation in February, on frozen soil, at a one-time rate of 200 t.ha-1. Stable, mature compost with specified parameters was uniformly applied across the fertilized plot. Crops at location A followed prescribed sowing procedures, while only maize was cultivated at location B. The experiment compared two variants: a control variant (without compost) and variant 2 with compost application.
Results indicated positive impacts of compost surface application on soil consolidation, structure, and moisture at both locations. Location B exhibited favorable effects in terms of water erosion. However, the compost application showed a partially negative impact on soil compaction in the second year at both sites. Chemical properties showed a noticeable difference only in the HA/FA ratio, which was lower in variant 2 with compost at both locations. Overall, this study highlights the potential benefits and some challenges associated with the application of compost as a surface mulch in different agricultural settings.

Keywords: soil science,covering mulch,physical soil properties,chemical soil properties

ID ABS WEB: 137651

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

DIGESTATE AND MANURE APPLICATION IN THE KOHLRABI PRODUCTION: THE EFFECTS ON TOTAL AND MINERAL N, TOTAL AND HOT WATER-EXTRACTABLE C CONTENT IN SOIL

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Digestate is the residues of the anaerobic decomposition of organic materials from biogas plants. In Serbia, there are ~30 biogas plants, and it is necessary to find their application. The content of organic matter in soil decreases, due to insufficient application of organic fertilizers. Our previous research showed positive effect of digestates on the yield of kohlrabi, and with application equal to 100 kg N ha-1, the permitted amounts of PTEs according to Serbian regulations, was not overloaded. This research aimed to examine the effect of digestate and manure application on total and mineral N, total and hot water-extractable C (HWEC) content in the soil after kohlrabi harvest.
The experiment was conducted during three growing seasons (2019-2020) on the fields in the vicinity of Novi Sad, Serbia. The experiment was set up as randomized block design. The treatments were: Control – without fertilization (Ø); Solid digestate – 100 kg N ha-1 (SD1) and 200 kg N ha-1 (SD2); Liquid digestate – 100 kg N ha-1 (LD1) and 200 kg N ha-1 (LD2); Manure – 100 kg N ha-1 (M1) and 200 kg N ha-1 (M2); Standard fertilization (NPK) was 100 kg N ha-1, 80 kg P2O5 and 100 kg K2O.
Total N was increased with the application of M2, M1, LD2 and NPK treatment compared to control. Application of NPK, LD2, LD1, M2, and M1 treatments increased mineral N (NH4+NO3) compared to the control. The growing season was a significant factor affecting the NH4-N in the soil, while the NO3-N was affected by both fertilization and the growing season. Compared to the control, the HWEC in the soil was increased with the application of SD2, SD1 and LD2. The results indicate that the application of liquid digestate can increase total and mineral N in the soil more than solid digestate. In addition, the application of organic fertilizers increased the HWEC in the soil, suggesting that they are easily degradable.

Keywords: organic fertilizers,anaerobic digestion,soil fertility

ID ABS WEB: 137859

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

COMPARATIVE EVALUATION OF THE PROPERTIES OF SOIL ORGANIC AMENDMENTS PRODUCED FROM BIOWASTE RECYCLING

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Intensive agriculture and invasive cultivation practices contribute to the progressive decline of the organic reserve of the soil. To address this issue and the related widespread soil pollution, the use as soil amendments of C-rich products and byproducts of technological treatments of biowaste can represent a sustainable solution. In addition to improving overall soil fertility, these materials significantly enhance the efficiency of the soil in retaining pollutants, thus limiting their leaching and the contamination of the food chain. This study, as part of a PRIN 2022 PNRR Project (P20223YAYP) funded by NextGeneration-EU M4C2, is focussed on the characterization of some organic materials obtained from both processed and untreated agri-food waste, such as a solid digestate (DG) from mixed feedstock, DG-derived compost (CP) and vermicompost (VC), a wood biochar (BC) from forest trees, ground olive stones (OS) and pistachio shells (PS). Basic characterization evidenced the alkaline reaction of DG, CP, VC and, especially, BC and the acidic nature of OS and PS, while the highest EC values were measured for DG and PS. Attenuated total reflectance Fourier transform infrared (FTIR-ATR) spectroscopy together with Raman spectroscopy were used to investigate functional groups of the raw and processed materials, aiming to: i) identify the main biomolecular classes (featured lignin and lignocellulosic functional groups, hybrid inorganic clays and moieties and complex polysaccharide bulk); and ii) detect the chemical maturation state after treatments. These preliminary investigations pave the way for a pure and concrete perspective of nature-based and low-cost solutions, so all materials studied can be in principle useful tools for soil pollution control.

Keywords: organic amendment,digestate,compost,FTIR analysis,characterization

ID ABS WEB: 137979

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

PYROLYSIS OF TUNISIAN PINEWOOD INTO SUSTAINABLE BIOMATERIALS AND ITS PERFORMANCE IN CALCAREOUS SOIL

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Agroforest biomass is an abundant, renewable and ecofriendly source for chemicals and energy production. Pinewood (PW) is seen as potential forest biomass generated annually with a great quantity in the Mediterranean region and in particular in Tunisia. This study aims to evaluate the Tunisian PW potential for conversion into solid biochar through slow pyrolysis and its effect on some calcareous soil properties. The PW and their obtained biochar were characterized in terms of proximate and ultimate analyses, thermogravimetric behavior, FTIR spectroscopy, X-ray diffraction, pH, Electrical Conductivity (EC) and surface morphology. Then, the pyrolysis runs were performed in a laboratory scale fixed-bed batch pyrolyzer at 500°C as final pyrolysis temperature, 10°C/min as heating rate, 1h (PW500-1) and 2h (PW500-2) as residence time. A three months pot experiments in a greenhouse using the produced biochars (PW500-1 and PW500-2) were conducted at the rates of 0, 2 and 4g/Kg soil.
The obtained results showed that the biochar generated have a high Carbon content (~80 wt%) and surface area (323 m^2/g). The addition of carbon-rich biochars increased the total Organic Carbon (TOC), total nitrogen (TN), pH and EC values. However, there was a decrease in C/N ratios indicating the acceleration of mineralization of the treated soil. The variation in soil properties increased with increasing biochar application rates.
The findings reveal the potential of PW as biomass for biochar production with high quality through pyrolysis, as well as the performance of its application as an amendment to agricultural calcareous soil.

<FILE IMAGE='686_20240130213322.jpg'>

Keywords: Pinewood,Slow pyrolysis,Biochar,Calcareous soil,Application rate

ID ABS WEB: 138133

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

A BIOREFINERY APPROACH FOR THE VALORIZATION OF OLIVE OIL MILL BY-PRODUCTS TO OBTAIN RENEWABLE ENERGY AND BIOFERTILIZERS

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Biorefinery is defined as the sustainable transformation of biomass in bioenergy and bio-based products, such as biostimulants and biofertilizers, bio-polymers and bioactive molecules. The olive oil mill by-products represent a significant fraction of agro-industrial waste and can be valorized through a biorefinery approach, which aligns with ecological transition and circular economy.
The study addressed the anaerobic treatment of different residual biomass from the olive-oil chain: olive pomace (OP), olive mill wastewaters (OMWW), OP after the recovery of nanoscaled lignin and protein hydrolysates, and OMWW after the extraction of bioactive molecules. A digestate from the anaerobic treatment of livestock and agro-industrial by-products was used as inoculum (control). The mixtures used in the experimentation consisted of 75% of inoculum and 25% of each previously mentioned biomass. A batch experiment was carried out in 50 mL bioreactors under mesophilic conditions (37 °C) and monitored for 30 days. Biogas production was assessed volumetrically and cylindrical bottles were used as gasometers. Results indicated that treated OP and treated OMWW did not negatively affect the biogas production compared to the control and the raw olive oil mill by-products (OP and OMWW) during the batch test. These findings underscore the potential of the biorefinery system for the final disposal of olive oil mill waste materials to recover valuable substances and renewable energy generation. Ongoing studies are evaluating the agricultural quality of the residual digestates, before and after their co-composting.
In conclusion, biorefinery serves as a cutting-edge approach to repurpose these by-products, reducing their volume, meanwhile generating high-value-added products that can be reused as biofertilizers.
Acknowledgments:
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This work was supported by the PRIMA, Italy, Project 4BIOLIVE: Production of biostimulants, biofertilizers, biopolymers and bioenergy from OLIVE-oil chain residues and by-products. The PRIMA program is supported by the European Union.

Keywords: Biorefinery,Biofertilizer,Circular economy,Renewable energy,Olive oil mill by-products

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4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

IMPROVING BIOCHAR AMENDMENTS DERIVED FROM FIBER SLUDGE BY LOADING NITROGEN SOURCED FROM LIQUID ORGANIC FERTILIZERS

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Nutrient surpluses in combination with fertilizer-related emissions and maintenance of soil organic matter levels have brought enhanced efficiency fertilizers (EEFs) to the forefront of modern agriculture. Fiber sludge (pulp and paper mill sludge) has great prospects of becoming a matrix for EEFs production due to its strong sorption power, especially after pyrolysis, and considering the high content of organic carbon and lime in it.
Physisorption analysis of the biochars derived from fiber sludge showed a higher surface specific area (m2/g) of low-nutrient fiber compared to raw mixed sludge. Mass losses of mixed sludge during slow pyrolysis at 450–550 C were two times lower than the low-nutrient fiber.
N-loading experiment with liquid side streams (pig slurry, tannery wastewater, and biogas effluent) at the char:solution ratio 1:10 and original pH proved the dependence of NH4+ adsorption by chars on the particle size distribution within the applied range (0.25–1 mm). The highest NH4-N content was found in particles <0.25 mm in solutions char : tannery wastewater corresponding initial content in liquid side streams. Biochar derived from low-nutrient fiber exhibited the highest N adsorption capacity with NH4-N content of 2.62 ± 0.30 % in the dry sample.
Carbon content in N-enriched biochars produced varied from 41.3± 8.7 % in mixed sludge to 72.8± 6.5 % in low-nutrient fiber.
Clay-textured soil was incubated with N-enriched biochars at an application rate of 5 t ha-1 with the following rain simulation which represents typical rains in Finland. Amending soil with N-enriched biochars resulted in higher soil pH values. The mobilization and transport of soil particles can have negative agronomic and environmental effects. In laboratory experiment, we observed decreased turbidity in percolated water from biochar-amended soil sourced from fiber sludge compared to untreated soil. The addition of recalcitrant carbon introduced with biochar application would also be beneficial considering the carbon sequestration.

Keywords: biochar,fiber sludge,organic amendment,nitrogen loading

ID ABS WEB: 138226

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

BIOLOGICAL ACTIVITY IN SOIL UNDER COVER CROPS IN FRUIT ORCHARDS

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Soil health is a major issue for crops and human health, as it supports plant and animal productivity and maintains ecosystem quality. In recent decades, the use of green cover in fruit orchards has gained importance. The objective of the use of green covers is to maintain and improve soil quality. These covers can increase organic matter and nutrient content, reduce erosion, contribute to balance the water balance, hydrological cycle and even soil biodiversity. Therefore, this work was focused on evaluating the effect on the soil of the use of cover crops based on grasses, legumes, crucifers, and a mixture of various flowering species in soils dedicated to the cultivation of persimmon (Diospyros kaki, Thumb) in the Ribera Alta Valenciana (East Spain). In total, ten orchards were studied: two sown with the different plant covers, five with spontaneous covers and three without covers in which an herbicide treatment was carried out for weed control. Soil samples were obtained by systematic sampling at a total of 71 sites within 15 cm depth. Soil respiration was measured in the field and pH, electrical conductivity, organic carbon, organic matter (SOM), and enzyme activities (EA), as well biomass carbon (BC) were determined in the laboratory. Preliminary results showed that some of the cover crops such as legume mixture, flower mixture and spontaneous cover increased SOM, respiration, BC, and some AE values (ex. hydrolases). In the conditions of our experiment the use of cover crops is a recommended practice to improve soil quality in persimmon cultivation.

Keywords: Green cover,biological activity,enzymatic activity,biodiversity,soil health

ID ABS WEB: 138298

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

FIELD TEST FOR ESTABLISHING CROP-SPECIFIC APPLICATION RATES OF BIOCHAR

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Biochar is an efficient method for carbon neutrality and is recognized as one of the negative emissions technologies proposed by the IPCC. It is known that treating biochar on agricultural land can improve crop yields, improve soil properties, reduce salt accumulation, and reduce greenhouse gas emission. Many countries, including South Korea, are making efforts to achieve carbon neutrality through the utilization of biochar. In South Korea, the main sources of biochar are wood pellets and rice husks, and various initiatives are underway to utilize livestock manure, given the continuous increase in its production. However, there is still a lack of prior research on the types of biochar and the utilization rate of biochar by cultivated crops. In this study, pot experiments were conducted to determine the optimal application rates for cabbage and radish using three types of biochar. The application rates were set at 1 t/ha, 2 t/ha, 4 t/ha, and 8 t/ha, and two different soils with varying levels of organic matter content (25.5 g/kg, 8.5 g/kg) were used. There was no significant difference in yield changes of radish and cabbage according to biochar treatment up to the 4t/ha treatment group. However, from 8 t/ha, there was a decrease in yield due to biochar treatment, which is believed to be because a large amount of biochar inhibited the movement of nutrients in the soil. Soil properties such as pH, OM, and CEC increased with biochar treatment increased. Through this study, it has been confirmed that adhering to the appropriate biochar application rates can be a crucial consideration for enhancing crop productivity, improving soil characteristics, and promoting sustainable agriculture. Therefore, it is suggested that future research should involve long-term field experiments to monitor changes in soil properties and crop productivity.

Keywords: Biochar,Crop productivity,Amendment,Soil organic matter,Field test

ID ABS WEB: 138532

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

THE INFLUENCE OF LONG-TERM USE OF RYE AND CORN MONOCULTURES AND DIFFERENT FERTILIZATION ON THE SPECTROSCOPIC PROPERTIES OF SOIL ORGANIC MATTER

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The aim of the investigation was to determine the influence of different soil management on the properties of humin – the most stable fraction of soil organic matter.
The research deal with loam cambisol located at the long-term field experiment established in 1967 on the Norekiskes plots of the Experimental Station of the Vytautas Magnus University, Agriculture Academy, Kaunas, Lithuania. The experiment included plots with two cultivation variants: rye monoculture and corn monoculture. Three fertilization variants were used for each crop: no fertilization (control), NPK fertilization, NPK fertilization with manure and legumes (NPK_MAN_LEG). Soil samples were collected from A horizon and examined for soil texture, total organic carbon (TOC), and total nitrogen (TN). The obtained results indicate that 54-year use of manure with legumes under corn monoculture resulted in an increase in TOC by 70% and TN by 48%. In the case of rye monoculture, no significant changes in TOC content were observed, while NPK-MAN_LEG fertilization resulted in a slight increase in TN.
Humin was obtained after discarding humic and fulvic acid, and digesting the mineral fraction in an HF-HCl mixture. The obtained humin was purified by dialysis, and then freeze-dried. To analyse the optical properties absorption spectra in the UV-Vis range and fluorescence spectra (synchronously scanned SSF and three-dimensional EEM matrix spectra) were recorded.
Comparing with results of our other investigation, the studied humin indicated relatively lower complexity of the molecular structure and a more aliphatic character. Their structure also showed specific aromatic systems with a not very extensive network of conjugated bonds. The NPK in both crops resulted in an increase in absorbance in the short-wave part of the absorption spectra, while the NPK_MAN_LEG resulted in a decrease in absorbance compared to the control. In the case of fluorescence spectra, an opposite tendency of changes in its intensity was observed.

The research was financed by EJP SOIL program, NCBR project EJPSOIL/I/78/SOMPACS/2022.

Keywords: soil organic matter,humin,long-term field eperiment,fluorescence,fertilization

ID ABS WEB: 139295

4. Soil health in achieving the Sustainable Development Goals
4.04 131145 - Dynamics and functions of soil organic matter under new and traditional amendments

FOSTERING SOIL ORGANIC MATTER DYNAMICS AND PLANT GROWTH: A COMPREHENSIVE STUDY ON THE SOIL ORGANIC AMENDMENT POTENTIAL OF PÁLINKA SPENT WASH THROUGH COMPOSTING

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The Pálinka distillery industry in Hungary generates significant organic waste, particularly 'spent wash' also called ‘mash’. This post-distillation residue poses environmental challenges due to its high organic load, low pH, and recalcitrant compounds. This research addresses the need for a sustainable solution by focusing on composting to transform Pálinka spent wash into stable organic matter and neutralize phytotoxic substances. The study targets initial challenges—acidic pH, high moisture content, and elevated copper levels—through aerobic composting. In a lab-scale experiment, the spent wash was composted with wood chips and additives like diatomaceous earth, wood ash, vinasse, coconut fiber, andesite, calcium sulfate, ready-manure compost, and carbon. Two breathable drum composters were used, one with mash mixed solely with wood chips and the other combining wood chips with finished cow manure compost as an inoculum. Comprehensive analyses, including germination and enzyme activity tests, confirmed the unsuitability of the Pálinka mash for plant growth without being composted. Evaluating the ready-mash compost using various plants demonstrated its potential to enhance soil organic matter (SOM) levels, promote nutrient cycling, and improve soil structure. The study also addressed environmental risk factors, emphasizing composting's role in food safety. High copper levels in Pálinka spent wash were effectively reduced through composting, especially with ready-manure compost and diatomaceous earth. Wood ash, diatomaceous earth, and ready-manure compost emerged as effective treatments, showcasing nutrient supply and water retention. Stable organic matter formation, crucial for soil fertility, increased significantly, especially with ready-manure compost. Pálinka spent wash compost plays a pivotal role in nutrient cycling, converting organic nutrients into plant-available forms. Enhanced SOM positively impacts soil health, promoting efficient nutrient uptake and sustainable soil management. This research underscores the urgent need to address environmental and health risks associated with Pálinka spent wash, highlighting its untapped potential as a soil amendment for sustainable agriculture. Composting offers an innovative waste management approach for traditional industries, contributing to environmental protection and supporting sustainable agricultural practices.

Keywords: Pálinka spent wash,Composting,Soil organic matter (SOM),Environmental risk factors,Sustainable agriculture

ID ABS WEB: 136461

4. Soil health in achieving the Sustainable Development Goals
4.06 131649 - The centrality of organic carbon in balancing the multifunctional nature of soils for sustaining human and planetary health

ASSESSING THE IMPACT OF SUSTAINABLE LAND MANAGEMENT ON MITIGATING DESERTIFICATION AND IMPROVING SOIL PROPERTIES IN MEDITERRANEAN SEMI-ARID ECOSYSTEMS: A CASE STUDY FROM SOUTHERN PORTUGAL

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The European Mediterranean region currently faces a significant risk of desertification, mainly due to unsustainable land management practices and accelerating climate risks. This study, integral to the LIFE16 CCA/IT/000011 Desert Adapt project, seeks to assess the ability of a Sustainable Land Management (SLM) approach, employing adaptation measures and nature-based solutions to improve ecosystem services. The specific focus is on the introduction of Rotational Grazing (RG) as a sustainable approach to counteract land degradation in conventional grazing (CG) areas in southern Portugal. After five years of implementing, we conducted a follow-up comprehensive assessment of soil amelioration, comparing results with nearby conventional grazing systems. Our evaluation included physicochemical and biological properties of the soil. Notably, soil carbon (C) emerged as a pivotal variable, exhibiting significant correlations with total nitrogen (TN), cation exchange capacity (CEC), water-holding capacity (WHC), and essential biological metrics such as fungal and microbial biomass. Remarkably, RG, particularly when implemented without tillage, led to significant improvements in overall soil health. Total Organic Carbon (TOC) observed a remarkable increase of 118.9%, while TN recorded a noteworthy improvement of 119.3%. Additionally, WHC demonstrated an improvement of 27.6%, and CEC increased by 57.5%. Biological parameters also showed significant improvements, with microbial biomass increased by 44.2%, and fungal biomass by 84.7%. Beyond the soil-focused outcomes, our study unveiled broader benefits. The sustainable management practices, including RG, were found to enhance grass productivity while concurrently reducing dependence on external feed, thus promoting a more resilient and self-sustaining farming system. The findings of this study exhibit the relevance of adaptive sustainable management to enhance soil carbon and related ecosystem services and revert land degradation. Such strategies are key for the environmental, social and economic sustainability of Mediterranean areas under desertification and climatic risk.

Keywords: Desertification,Sustainable land management,Rotational grazing,Soil health,Mediterranean Ecosystem

ID ABS WEB: 137207

4. Soil health in achieving the Sustainable Development Goals
4.06 131649 - The centrality of organic carbon in balancing the multifunctional nature of soils for sustaining human and planetary health

HOW CAN WE REDIRECT N SURPLUS FROM FERTILIZATION TO INCREASE SOIL ORGANIC MATTER AND ENHANCE FOOD PRODUCTION?

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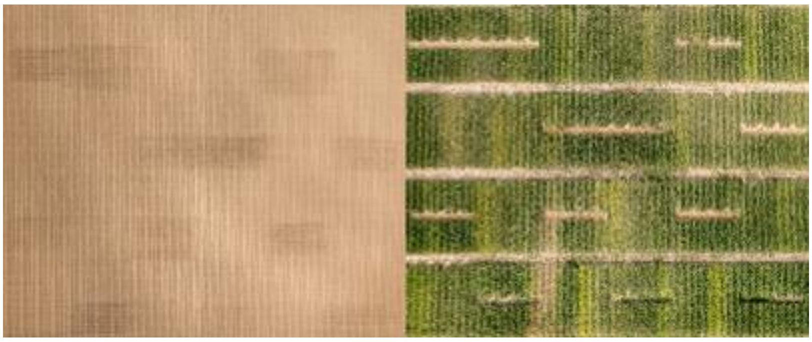
The loss of soil organic matter (SOM) from cropland soils hinders the provision of ecosystem services and contributes to climate change. In parallel, the nitrogen use efficiency (NUE) of fertilizers has barely improved in the last decades. Besides being a promising negative emission technology, increasing SOM in croplands is advocated as a solution to limit N losses to the environment because of its role in regulating the N cycle. Unfortunately, our ability to manage SOM remains limited by knowledge gaps about the impacts of soil input stoichiometry on microbial metabolism that, indeed, drives the C stabilization pathways in SOM. The system is further complicated by the feedbacks of the amount and quality of SOM on the same microbial processes that result in the stabilization of inputs into SOM.
The MaCaN project aims at identifying the optimum fertilization practices for croplands to increase SOM and NUE of organic and mineral fertilizers. We take advantage of a long-term field trial established since 1976 in Switzerland with several types of organic amendments (OA) and different levels of mineral N fertilization (minN). As OA have induced a gradient of SOM over the years, the specific effects of SOM content on C stabilization and NUE is addressed by implementing, in the original plots, subplots that did not receive OA. The impacts of treatments on the preferential stabilization pathways of organic matter inputs is assed using Py-GC/MS to determine the ratio of microbial-to-plant derived SOM. The effect of SOM and minN levels on the proportion of fresh organic matter residues that have been stabilized in SOM fractions is addressed by the differences in isotopic signatures between maize biomass and the SOM. Finally, microbial processes driving the stabilization of C and N in SOM and the distribution of N among the soil-crop system will be assessed using 15N-labeled mineral fertilizer. The project will highlight the interconnectedness of three functions, namely C storage, nutrient retention and food production.



Keywords: soil organic matter,nitrogen use efficency,food security,stoichiometry,microbial metabolism

ID ABS WEB: 137704

4. Soil health in achieving the Sustainable Development Goals
4.06 131649 - The centrality of organic carbon in balancing the multifunctional nature of soils for sustaining human and planetary health

INCREASING MICROBIAL FUNCTIONAL DIVERSITY AND ORGANIC MATTER STABILITY IN MOUNTAIN SOILS CAUSED BY TREELINE SHIFTS

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In the mountains, modern climate change is rapidly shifting the treeline on the meadows. This can affect soil microbial activity and the redistribution of soil organic matter (SOM) between its particulate (POM) and mineral-associated (MAOM) fractions. Decomposing more recalcitrant plant residues, such as forest litter, requires a wide variety of enzymes. Consequently, the treeline shifts may increase both the ability of soil microorganisms to metabolize diverse organic substrates (i.e., microbial functional diversity) and the accumulation of their degradation compounds in the MAOM fraction. To test this hypothesis, we chosen six forest-meadow ecotones on reserved and grazed slopes in the Northwest Caucasus of Russia. All slopes were of north-eastern exposure, steepness of 25-30 degrees, and had nonalkaline soil parent materials. Along each ecotone, plant material (above-ground herbaceous biomass, forest litter) and soil samples from the upper 0-10 cm layer were collected in 0.5 × 0.5 m plots in forest, treeline and meadow. Plant recalcitrance was determined by aromaticity index based on CP/MAS 13C-NMR analysis results. Microbial functional diversity was measured using the MicroResp™ technique and expressed as Shannon-Wiener index (Hclpp). MAOM was determined by wet sieving through 53 µm cells. From meadows to forests, plant residue recalcitrance increased, as evidenced by aromaticity index increasing from 0.21 to 0.25 (on average for both land uses). A similar average upward trend was found for Hclpp index (from 2.45 to 2.49) and MAOM portion (from 17% to 35%). This confirms our hypothesis that the tree expansion into meadows increases microbial functional diversity and SOM stability.

The study was supported by Russian Science Foundation 22-74-10124.

Keywords: forest-meadow ecotone,mineral-associated organic C,plant aromaticity index

ID ABS WEB: 137912

4. Soil health in achieving the Sustainable Development Goals
4.06 131649 - The centrality of organic carbon in balancing the multifunctional nature of soils for sustaining human and planetary health

ANTHROPOGENIC SOIL MANAGEMENT PRACTICES IN RESTORING AND MANAGING SOIL QUALITY AND CARBON SEQUESTRATION POTENTIAL

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Anthropogenic soil management is one of the most noticeable indicators of human activities that either contribute to soil degradation or soil improvement. These problems are further compounded by intensive agricultural usage and largely attributed to soil degradation concerning a decline in soil organic content, soil erosion, water contamination, and loss of biodiversity. The selection of sustainable agricultural practices is crucial to maintaining soil qualitative parameters and optimizing carbon sequestration potential, as well as developing an effective strategy for ensuring sustainable agriculture. This study aimed to achieve the following objectives: (1) to analyze the alterations in SOC and other parameters caused by the various anthropogenic management practices in acid soil; (2) to find out whether management-induced changes are large enough to have the potential to reduce soil degradation and improve SOC sequestration and soil quality.

The study was based on comparing different chemical indicators data from 3 long-term experiments, conducted in the Western part of Lithuania. Changes in soil properties during more than 20 years (1999-2022) were identified. The most common soil management practices applied in Lithuania such as liming, manuring, residue maintenance, and tillage have been selected for analysis. Changes in soil parameters, carbon sequestration potential, mean effect size, and resistance indices were examined and compared. Considering the soil quality determinant indices, applied agricultural practices ranked as follows: manuring > residue management > reduced tillage > liming. Manuring and residue maintenance showed a greater SOC content accumulation potential with the mean effect size of 0.02 – 0.28 and the increase varied from 1.89% to 32.89%. The lowest soil resistance indices values were obtained for low level of nutrients (N and P), organic carbon, pH, and Zn, showing that these properties, compared with the others, are more sensitive to applied agricultural practices. All these findings provide information for promoting better soil management, soil protection, land use planning, and planning remedial measures, especially in the most affected areas.

Keywords: soil retoration,liming,manuring,tillage,agricultural practices

ID ABS WEB: 138164

4. Soil health in achieving the Sustainable Development Goals
4.06 131649 - The centrality of organic carbon in balancing the multifunctional nature of soils for sustaining human and planetary health

FACTORS INFLUENCING ORGANIC CARBON STOCKS IN FOREST SOILS OF THE CZECH REPUBLIC

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Forest soils represent a very important pool of soil organic carbon (SOC) and proper management of these soils can thus mitigate climate change. In this research, we analyzed factor influencing the SOC stocks in temperate forests at national scale of the Czech Republic. We used data from the aggregated database of forest soils of the Czech Republic, containing standardized soil properties compiled from several national-scale soil surveys done in the years 2000-2020, including results from several thousands of sampling sites. The effects of principal drivers on SOC stocks were studied separately for forest floor horizons (F+H), mineral topsoil (0-30 cm), and deeper mineral layers (30-80 cm), and for the whole soil profiles.
Tree species composition, altitude and forest vegetation zones were found to be the most important drivers of forest SOC stocks. Generally, the total carbon stocks are higher under deciduous forests than under the coniferous ones. Under coniferous forests, the contribution of forest floor (F+H) to the total SOC stock to the depth of 30 cm is higher than under broadleaved and mixed forests. Nevertheless, the mineral part of the profiles is still the most important SOC pool. Bigger accumulation of SOC in soil profiles is related to lower temperatures and higher precipitation at higher altitudes, and lower pH reducing the decomposition rate. The strongest effect of pH on SOC accumulation was found in forest floor. The high SOC stock is generally connected also with lower organic matter quality indicated by higher C/N ratio. Some differences between soil classes were also shown: the highest SOC stocks were in Podzols and Histosols, the lowest in Leptosols, Stagnosols, Technosols and Cambisols Arenic.

Acknowledgement: This contribution is supported by the Technology Agency of the Czech Republic, project No. SS06010148, and by the Ministry of Agriculture of the Czech Republic, project No. QK22020217.

Keywords: soil organic carbon stocks,forest soils,drivers,forest type,altitude

ID ABS WEB: 140024

4. Soil health in achieving the Sustainable Development Goals
4.06 131649 - The centrality of organic carbon in balancing the multifunctional nature of soils for sustaining human and planetary health

REGULATING SOIL CARBON STOICHIOMETRY AND STORAGE: THE ROLE OF METAL CONTAMINATION AND CLIMATE CHANGE

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Soil carbon and nutrient stoichiometry are critical indicators for the quality and quantity of soil organic matter, reflecting the relationships between nutrient mineralization and immobilization. High metal inputs adversely affect soil health by impacting nutrient availability, microbial growth and activity. Future climatic conditions can enhance organic matter decomposition/mineralization rates and render nutrients and metals more mobile in soils. Consequently, the coupling of metal contamination and climate change may impact carbon dynamics more severely than either single factor. Although many studies have focused on a single factor, the study of combined factors remains underexplored. To investigate whether, to which degree and how the coupled effects of metal contamination and climate change affect carbon and nutrient cycling, we cross-factorially incubated an agricultural soil with either background or elevated heavy metals (+760 mg/kg Zn, +0.4 mg/kg Cd, and +1.5 mg/kg Pb) under today's or future climatic conditions (according to IPCC RCP 8.5: +4° C, lower soil moisture and +400 ppmv CO_2). Future climatic conditions significantly increased Pb and Zn availabilities in the contaminated soil. However, the impact of climate change alone or coupled with metals on carbon cycling and stoichiometry was negligible compared to metal contamination alone. Metal inputs triggered severe stress on soil microorganisms, as observed by reduced microbial biomass, lower carbon hydrolytic enzyme activity, and a doubled metabolic quotient relative to non-metal amended soils. This indicates that microorganisms allocated more energy on maintaining to cope with metal stress rather than to growth. This higher energy demand under metal stress produced shifts in carbon stoichiometry as observed in lower C:N ratios and a strong stoichiometric imbalance for carbon and nitrogen compared to the homeostatic response in the background soil. The outcomes of this study show how an environmental stressor such as heavy metals can overcome the effects of climate change, producing a decoupling of C and N cycling. This may lead to long-term decreases in C and N storage in soils.

Keywords: Soil carbon,Carbon stoichiometry,Nutrient cycling,Climate change,Metal contamination

EPOSTERS

ID ABS WEB: 135947

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes - Importance for climate resilient future, degraded lands restoration and plant health control

BIOCONTROL POTENTIAL OF RHODOTORULA YEAST STRAINS FROM POLLUTED ENVIRONMENTS AGAINST MYCOTOXIGENIC FUNGI

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Agricultural crops are frequently affected by bacterial and fungi phytopathogens with negative impact on plants, animals and humans. The current antimicrobial strategies involve excessive use of chemical pesticides with low biodegradability which causes the decrease of soil quality. The antimicrobial activity of yeasts, natural competitors of phytopathogens, represents an important basis for the development of ecological antifungal products essentials for the transition to sustainable agricultural practices.
Three Rhodotorula strains isolated from polluted environments from Romania, R. mucilaginosa CMGB-G1, R. mucilaginosa CMGB188 and R. glutinis CMGB189, were tested for their ability to inhibit mycelial growth of seven fungal strains belonging to Botrytis cinereea, Rhizoctonia solani, Aspergillus ochraceus and Aspergillus flavus. The results showed that regardless of the type of culture medium used for cultivation (Sabouraud Agar, Potato Dextrose Agar and Yeast-Sucrose Agar), all yeasts reduced by up to 30% the growth of the fungal mycelium, the most sensitive strain being A. ochraceus for which complete inhibition of growth was observed in the presence of R. mucilaginosa CMGB-G1, followed by A. flavus strains. Among the main mechanisms of antimicrobial action described for Rhodotorula strains, the production of carotenoids and rhodotorulic acid stand out, and their production being influenced by the use of alternative sources of nitrogen or carbon. In order to determine the mechanism of antifungal activity, the Rhodotorula strains were cultivated on YPG medium, (glucose as a carbon source, peptone/ yeast extract as organic nitrogen source) and on Rhd-urea medium (sucrose as carbon source, urea as organic nitrogen source). The results revealed that for R. glutinis CMGB 189, the mechanism of action is based on both the synthesis of carotenoids and rhodotorulic acid, while for R. mucilaginosa most probably riels on carotenoid synthesis.
In conclusion, the present work allowed the characterization of three Rhodotorula strains with significant antifungal abilities, as promising biocontrol agents for protecting crops with minimum impact on the quality of agricultural soil.

Keywords: Rhodotorula,polluted soil,sustainable agriculture,antifungal,biocontrol agents

ID ABS WEB: 136098

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes - Importance for climate resilient future, degraded lands restoration and plant health control

EFFECTS OF A MEGAFIRE ON THE ARBUSCULAR MYCORRHIZAL FUNGAL COMMUNITY AND PARAMETERS IN THE BRAZILIAN CERRADO ECOSYSTEM

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The biggest fire event in the history of the Cerrado, suspected as arson, occurred in the Chapada dos Veadeiros National Park in October 10, 2017, destroying about 66,000 ha. The Chapada dos Veadeiros National Park was created in 1961 and comprises an area of 240,614 ha, and in 2001 was declared a Natural World Heritage Site by UNESCO. This study aimed to evaluate the effects of a megafire on the AMF community in Cerrado soils, by measuring parameters such as spore density, easily extractable glomalin (EEG), and the rate of successful root colonization, comparing burned and unburned areas in five commonly found phytophysiognomies in the region. Study area: Chapada dos Veadeiros National Park, Goiás, Brazil. This site suffered the biggest fire in its history on October 10, 2017, with an affected area of 66,000 ha. Materials and methods: We analyzed AMF spore density, roots' mycorrhizal colonization rate, easily extractable glomalin (EEG), as well as the AMF genera present. These parameters were evaluated in burned and unburned areas of five common hytophysiognomies of the region. Main results: Fire presence immediately affected the mycorrhizal community parameters in Cerrado soils, which tended to increase afterwards. The presence of AMF genera did not differ between burned and unburned areas, with Acaulospora, Claroideglomus, Diversispora, Glomus, Funneliformis, Sclerocystis, and Gigaspora being present. The recovery of AMF community conditions in the Cerrado after fire events could also be observed in the mycorrhizal parameters evaluated, as the values of spore density, roots' mycorrhizal colonization rate, and EEG were similar in the burned and unburned areas. Research highlights: AMF diversity, and especially their community parameters, show great recovery after fire events, since they are crucial in processes like nutrient cycling and soil aggregation.

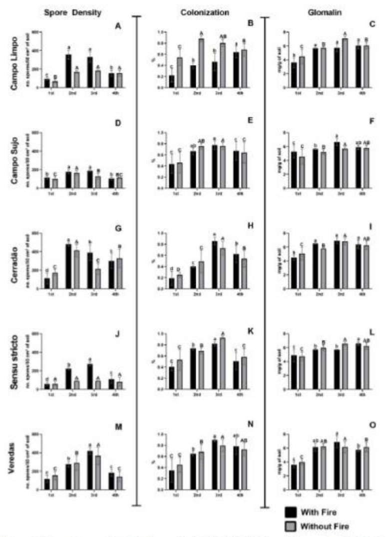

Figure 1. Arbuscular mycorrhizal fungi spore density (A, D, G, J, M), roots' mycorrhizal colonization (B, E, H, K, N), and easily extractable glomalin content (C, F, I, L, O) in Cerrado soils in burned and unburned plots during four samplings times (1, 5, 8 and 13 months after megafire). Small letters indicate significant differences for sites without fire, capital letters for sites with fire.

Keywords: Cerrado,Savannas,arbuscular mycorrhizal fungal,diversity,fire

ID ABS WEB: 136471

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes - Importance for climate resilient future, degraded lands restoration and plant health control

IMPACT OF LONG-TERM FERTILIZATION ON THE DIVERSITY AND GLOMALIN PRODUCTION OF THE ARBUSCULAR MYCORRHIZAL FUNGI

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Arbuscular mycorrhizal (AM) fungi are key indicators of soil health. Glomalin produced by the AMF hyphae helps the formation of soil aggregates, it improves soil structure, water-holding capacity and it is a significant part of soil organic matter.
The effect of soil management on glomalin (Easily Extracted Glomalin-Related Soil Protein; EE-GRSP) has been examined at sites of NPK fertilization [160 kg ha-1 N (NH4NO3), 80 kg ha-1 P (P2O5), 80 kg ha-1 K (K2O)] long-term field experiment with and without farmyard manure treatments in Haplic Chernozem soil (Martonvásár; Hungary). Soil physicochemical properties were measured, the AM fungal colonization and community composition were determined.
Highly positive correlations were detected between various physicochemical soil properties (humus and nitrogen content, dissolved organic carbon and macroaggregate stability) and the EE-GRSP. The EE-GRSP was inversely related with pH. The topsoil glomalin ranged from 0.37 mg/g soil to 0.77 mg/g soil. The highest soil glomalin contents were found in the N-fertilized plots.
The rate of AMF colonization responded mainly to plant nutrition status and plant requirements and this plant-mediated effect appears to be present in the case of AMF colonization. The AMF diversity and abundance were decreased by both mineral and organic fertilization. Nitrogen trials reduced drastically the abundance of Funneliformis mosseae, which was a dominant indigenous AMF species in control plots. Rhizophagus intraradices was also abundant species in the soils, it was significantly declined by NPK trials. Septoglomus sp. is a good indicator species, that was eliminated by long-term N fertilization.
Agricultural land use optimization contributes to yield and soil security. The synthesis of our data could result in a land use effect assessment considering the quantity of soil glomalin. Glomalin can be a universal indicator of land use change effects on soil C and soil health.
The research was funded by the Hungarian Research Network (SA-26/2021) and the Sustainable Development and Technologies National Programme of the Hungarian Academy of Sciences (FFT NP FTA).

Keywords: long-term fertilization,soil health,bioindication,AM fungi,glomalin

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lands restoration and plant health control

MICRO-MAPPING OF BACTERIA IN AN EXTREMELY ACIDIC ENVIRONMENT BY MEANS OF THIN SECTIONS, DIFFERENT LIGHT SOURCES, AND IMAGE ANALYSIS

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In environmental remediation, the application of calcium carbonate to pyrite-rich mine tailings is a common practice. However, little is known about how the process of neutralisation and soil formation occurs in situ and at the micron scale, where bacteria are thought to play a fundamental role. The aim of the present research was to map at the microscopic scale to determine the distribution and quantification of bacteria in the mine waste and in different plantations. The study was carried out in Zimapán, Hidalgo, Mexico, where the mining activity started 100 years ago, so that the tailings, with a high content of pyrite, have different degrees of alteration and extreme conditions of acidity. Some of the tailings have been under vegetation cover for 30 years with different plant species. Bulk samples (0-10 and 10-20 cm depth) for laboratory analysis and undisturbed samples for micromorphological description were collected from each plantation (rhizospheric zone) and tailings. High-resolution images (5.3, 2.6, and 0.25 μm) of the entire thin section were taken using different objectives (2×, 10×, and 20×) and four light sources. Brightness values (RGB) were obtained for each component: PPL (aggregates and organic matter), oblique incident OIL (pyrite and goethite crystals), XPL ($CaCO_3$ and gypsum) and fluorescence LF (bacteria), to generate thematic maps. Spatial operators were used for image analysis and map quality. The results indicate that under extremely acidic conditions and up to neutral conditions, bacteria are associated with pyrite to form biofilm-like structures. They also occur on calcite in fissures or dissolution features. The transition between oxidation and dissolution develops metastable minerals such as goethite and gypsum. The distributions and relationships of bacteria with other mine tailings components vary with their degree of alteration between minerals, aggregates, and organic matter. Thematic maps and the quantification of each of the components and bacterial colonies with sulfate-bearing minerals in the tailings mine were facilitated by the different types of light and brightness values.

Keywords: Pyrite,Micromorphology,Sulfate-bearing minerals,Spatial operators

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LYSIS OF SOIL MICROBIAL CELLS BY CO2 OR N2 HIGH PRESSURIZATION COMPARED WITH CHLOROFORM FUMIGATION

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The classical chloroform fumigation-incubation (CFI) and fumigation-extraction (CFE) methods are nowadays among the most used for determining soil microbial biomass, although the chloroform lysing of microbial cells is not always complete. Here, we have tested a physical method, used for sterilizing foods but never in soil, based on N2 or CO2 high pressurization (N2HP or CO2HP, respectively) to cause microbial cell lysis. The N2HP and CO2HP were tested on two soils differing for their organic matter content, one agricultural (AGR) and one forest (FOR), and firstly were compared with the CFI. The CO2 extra-flush from both soils during 10-d incubation by N2HP was lower than that by CFI method, whereas that by CO2HP was greater. Then, the lysis by CO2HP was compared with that by the CFE method by varying CO2 pressure and duration. The CO2HP, at proper conditions, was more efficient than CFE method to cause the lysis of soil microbial cells. Moreover, both CO2 pressure value and duration were important in increasing the extractable organic C compared to the CFE. The most successful combination of high CO2 pressure and duration was 4.13 MPa and 32 h. However, we cannot exclude that CO2HP might have caused the release of soil organic C not ascribable to living organic matter. Further studies using 13C and/or 15N-labeled microbial cells should assess the release of abiotic organic C.
Paliaga, S., Laudicina, V.A. & Badalucco, L. Lysis of soil microbial cells by CO2 or N2 high pressurization compared with chloroform fumigation. Biol Fertil Soils 59, 609–618 (2023). https://doi.org/10.1007/s00374-023-01725-5

Keywords: Soil microbial biomass,Cell Lysis,Chloroform fumigation,CO2 high pressurization

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ACTIVITY OF THE SOIL MICROBIOME IN A HUNDRED-YEAR FERTILIZATION EXPERIMENT UNDER SPRING BARLEY OR WINTER TRITICALE IN CROP ROTATION

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The research was carried out based on a field experiment established by the WULS-SGGW research station in Skierniewice (Poland, 51.965° N, 20.160° E) in 1921. The study included soil samples taken from a depth of 0-20 cm under wheat cultivated in crop rotation for 100 years. Various fertilization treatments were used within the experiment, including CaNPK mineral fertilization, CaNPK mineral fertilization used together with organic fertilization in the form of manure and the same treatments, but with the use of legumes every five years in crop rotation.
The research of soil microbiome activity included determination of soil enzymatic activity, biodiversity indicators and the metabolic profile of soil microbiota using Biolog Ecoplates.
As a result of the conducted research, significant differences were observed in the activities of beta-glucosidase and protease, while the activities of dehydrogenases, urease and phosphatase did not differ significantly between the treatments.
Based on the analysis of the results, it was shown that metabolic biodiversity indicators differed significantly between the treatments, which indicates various activity within the soil microbiota in individual fertilization systems. The highest substrate richness and Shannon indicess were found in both treatments with manure, and the highest overall activity, measured by the AWCD and the ENS indices were determined for treatment with manure and legumes.
In the treatment with mineral fertilization, N-Acetyl-D-Glucosamine, Tween80, D-Xylose and L-Phenylalanine stimulated the growth of microorganisms at the highest level, while in the treatment with legumes, this effect was visible for Phenylethylamine. In the treatment with manure and legumes, the highest values were observed for L-Alanine and Tween 40. However, D-Mannitol was one of the compounds that were used by microbial communities to the greatest extent in all fertilization systems, and the lowest soil microbial growth was obsreved on 2-Hydroxy Benzoic Acid.
This work was supported by The National Centre for Research and Development in Poland in frame of the project EJP SOIL, Project SOMPACS, contract number EJPSOIL/I/78/SOMPACS/2022.

Keywords: soil microbiome,microbial biodiversity,enzymatic activity,fertilization,functional diversity

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THE USE OF MICROBES TO ENHANCE THE GROWTH, PATHOGEN RESISTANCE, AND STORAGE CONDITIONS OF MICROGREENS

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The cultivation of microgreens began in the mid-90s in the USA, and the term “microgreens” has been used since 1998. However, in recent year vertical and urban farming of such plants is increasing. Cultivation of microgreens has started to become important due to their enriched nutritional composition beneficial to humans (vitamins, minerals, fibres, antioxidants, macro-, micro-elements, carotenoids, ascorbic acid, phylloquinone, and phenolic compounds).
The constant market demand for this product has highlighted problems: the yield, storage conditions, quality, safety, resistance, and shelf-life of microgreens. The choice of growth substrate can significantly influence nutritional quality, yield, and dry matter.
The aims of our research will be to improve and optimise the cultivation and storage conditions, yield, quality, safety, and resistance and try to increase the self-shelf period through the application of an adequate bio-stimulated microbes. In fact, by improving the soil microbiome we can suppress disease, improve abiotic resistance, make microgreens resistant. In our study we would like to be able to study the application of beneficial microbes, such as Bacillus subtilis, AMF or endophytic fungi on four different microgreens such as coriander (Coriandrum sativum L.), basil (O. basilicum), radish (Raphanus sativus L.), and beetroot (Beta vulgaris). The study will include of different fields of research with studying and understanding the microgreens-microbiome interaction to improve production in different cultivation media and understanding the microgreens-microbiome interaction and how it can interact and improve the safety, quality and shelf-life of microgreens.
The results we would obtain from all these different sectors will allow us to understand and explore how the colonization of microgreen plants by the microbial community occurs and how beneficial microbes can improve the organoleptic characteristics of the plants. Knowing these characteristics in depth will allow us to improve the yield, quality, resistance to pathogens, and shelf-life of microgreens.
This work was supported by The National Centre for Research and Development within the framework of the program OPUS-23, contract number 2022/45/B/NZ9/04254.

Keywords: microbiomes,microgreens,vertical farms,urban farming,soil

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4.07 132182 - Soil microbiomes - Importance for climate resilient future, degraded lands restoration and plant health control

EFFECTS OF LOWER ATMOSPHERIC PRESSURE ON ACTIVITY AND DIVERSITY OF SOIL MICROORGANISMS

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Climate change is affecting the composition and functioning of ecosystems across the globe. In alpine ecosystems, species are confronted with new conditions, requiring them to either adjust their life strategies to higher temperatures or migrate to higher elevations to match their thermal preferences. Species moving to higher elevations encounter lower atmospheric pressure alongside unaltered temperatures. The reduced air pressure influences crucial physical parameters such as vapor pressure deficit, gas diffusivity, and CO2 partial pressure. While the effects of these parameters on plants are well established, little is known about the consequences of moderate atmospheric pressure reduction on free living and plant associated soil microorganisms.
Thus, one of the main goals of the international UPSHIFT project is to assess how soil microorganisms react to lower air pressure in terms of diversity, functional traits, and biomass production. For that purpose, we set up a gradient design by incubating soil-plant mesocosms under lowered air pressures that simulate four elevational levels (260, 1500, 2500, and 4000 m a.s.l.) in hypobaric chambers (terraXcube) while temperature, humidity, gas composition and solar radiation are kept constant at conditions of 1500 m. For each simulated scenario, the reaction of common microbial test strains as well as the effect on soil microbial diversity from both the bulk and rhizosphere soil of three test plants were investigated.
Our results indicate significant effects of pressure reduction on soil microorganisms. We observed a plant-specific alteration of microbial biomass and activity within the rhizosphere fraction. A significant decrease in microbial diversity and richness occurred at lower pressures, corresponding to higher elevations. Importantly, we could confirm that the effects observed in the rhizobiomes were not a consequence of altered plant growth. Our results clearly point out that air pressure reduction, as a facet of climate change, affects soil microorganisms, thus contradicts conventional knowledge and so needs significantly more attention and additional research.

Keywords: microbiota,climate change,elevation,atmospheric pressure,rhizobiome

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NOT ONLY THE AMPLITUDE BUT ALSO THE FREQUENCY OF ABIOTIC STRESSORS AFFECTS SOIL MICROBIAL ACTIVITY AND DIVERSITY

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It is well established that climate change is leading to an increased occurrence of extreme weather events such as droughts, floods and temperature extremes. It is also acknowledged that (soil) microorganisms are impacted in activity and diversity by these extreme occurrences. Typically, a clear correlation exists between the intensity of stress and the biological response, whether linear or non-linear. However, since not only the amplitude but also the frequency of disturbances undergoes changes, our objective was to investigate whether and to what extent the frequency of a disturbance, indicating the occurrence rate of an abiotic stress factor, influences the activity and diversity of soil microorganisms.
We conducted experiments with incubated soil to observe the response of soil microorganisms to alterations in two stress factors: temperature and pH. We manipulated the intensity of the disruptive factors, represented by the stress temperature and pH magnitude and also the frequency of disturbances, described by the rate of changes over time. Subsequently, we analyzed the impacts on microbial abundance, activity and diversity by counting colony forming units, measuring enzyme activities and amplicon-sequencing the V3-V4 region of the 16S rRNA gene, respectively.
Both stressors led to significant changes in microbial abundances and activities as well as prokaryotic community compositions. The rise in temperatures led to a shift in the predominant phyla in the soil, shifting from Proteobacteria to Bacillota (formerly Firmicutes). Moderate temperature stress first caused an increase in microbial diversity before a significant reduction was observed at higher temperatures. The varying frequency of a stressor resulted in significant changes, except when the amplitude was too high. This observed pattern was true for both, temperature and pH variations. Overall, we could prove that microbial diversity was significantly affected by both the amplitude and the frequency of a stress factor. Obviously microbial diversity is a complex regulated variable with reactions that are not yet understood, emphasizing the need for further research.

Keywords: soil microbiota,stress factor,frequency,temperature,pH

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ASSESSMENT OF MICROBIOTA DIVERSITY IN SOIL ECOSYSTEMS

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DNA metabarcoding has become standard for characterizing soil microbial diversity. However, to emphasize the interconnectedness of soil, animals, and plants microbiota within the soil ecosystem, suggesting a "OneSoilMicrobiota" concept, methodological advances are needed to efficiently compare microbial communities from matrices typified by contrasting physical and biochemical properties.
Here, we quantified differences in soil ecosystem microbiota between a selection of terrestrial organisms, including above-ground vertebrates, soil invertebrates as well as bulk and rhizosphere soil. Five DNA extraction kits were used to identify a single protocol for processing all samples from the soil ecosystem. As existing pipelines and protocols lack controls for bias in DNA extraction, amplification, and sequencing, we tested the usefulness of a mock community added to a sub-set of these samples before DNA extraction to act as such a control.
From the comparison of five DNA extraction kits commonly used to study soil, feces and invertebrates, we showed that NucleoSpin Soil (Macherey-Nagel; MNS) and QIAamp Fast DNA Stool Mini (Qiagen) extraction kits were associated with the highest and lowest alpha and beta diversity estimates across the different sample types, respectively. The stable performance across sample types indicates that MNS efficiently captures both the composition and diversity of microbial communities found in the terrestrial samples considered in this study, and is in our view recommended for any large-scale ecological study on microbial communities. Our results demonstrate further that an appropriate mock community added directly to a sample before extraction can function as an effective positive control with negligible effect on alpha and beta diversity estimates. The experimental procedures presented here lower methodological variability essential for ecosystem-level microbial diversity studies.

Keywords: microbial diversity,OneSoilMicrobiota,mock community,DNA metabarcoding,method evaluation

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DYNAMICS AND FUNCTIONAL ROLE OF THE SOIL MICROBIOME TO QUANTIFY THE SOIL HEALTH OF SOME FORESTRY ECOSYSTEMS FROM THE MOLDAVIAN PLATEAU, ROMANIA

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The research on soil health is considered of crucial importance as a target objective of the Horizon Europe Program on the EU agenda for the period 2021-2027. To have a comprehensive biochemical characterization of the soil, a soil enzymatic profile is needed, according to the activities of enzymes involved in the bio-geo-chemical cycles of the main elements (C, N, P).
A soil enzymatic assay was conducted in eight benchmark soils (Chernozem, Gleysol, Luvisol and Lithosol) belonging to eight forestry ecosystems from Eastern and Northern Romania, along an elevational transect that encompasses Vaslui county (Lunca Veche; Badeana), Iasi county (Probota, Ezareni and Barnova), Neamt county (Vanatori and Manastirea Neamt) and Suceava county (Voronet).
Catalase, dehydrogenase, invertase, urease, acid and alkaline phosphatases were investigated in soil samples related to the abundance and metabolic activity of soil microbes, the biological oxidation of SOM, soil fertility and the soil health. These enzymes were assayed using titrimetric and spectrophotocolorimetric methods. The soil enzymatic activities correlated with the morpho-descriptive, physical and chemical soil properties respond to different soils during seasonal dynamic. The redoximorphic processes in the whole soil profile, the climate and the altitude, as restrictive ecological indicators highlighted the lowest dehydrogenase and urease activities in Lithosol of spruce forest Voronet, Luvisol of mixed forest Vanatori and Luvisol of fir forest Manastirea Neamt in seasonal dynamics. The lowest acid phosphatase activity was found in Gleysol of ash forest Probota and Chernozem of acacia forest Lunca Veche. Opposite to acid phosphatase and mainly produced by soil microbes, the highest alkaline phosphatase activity was found in Gleysol of ash forest Probota and Chernozem of acacia forest Lunca Veche, correlated with less humified organic matter.
These data highlight the conservative and equilibrium role of the forests on soil microbiome in terms of influence of climatic factors compared to other ecosystems, the enzymatic profile of forestry soils providing the functional indicators with an essential role for the sustainable forest management.

Keywords: forestry soils,soil enzymatic profile,soil health,Moldavian plateau,Romania

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BIOCRUSTS FAVOR SOIL AGGREGATE STABILITY IN SITES WITH IMPACT OF SUBSISTENCE HUMAN ACTIVITIES IN A TROPICAL MEXICAN DRYLAND

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Biological soil crusts or biocrusts are edaphic communities composed of cyanobacteria, lichens, and bryophytes in the uppermost few centimeters of surface soil in drylands. Biocrusts act as ecological indicators in erosive processes because they can promote the soil aggregate stability and retain soil. In Mexico, biocrusts are an important component of the temperate and tropical drylands. The study of these communities is recent and their role in preventing soil erosion has not been evaluated. Within the Tehuacán-Cuicatlán Biosphere Reserve, Puebla, in tropical dryland, the subsistence activities have modified the original vegetation. We described the type of human activities at the sites, soil characteristics, taxonomic composition, and cover of biocrusts, as well as the participation of biocrusts in the stability of aggregates. In the study area, there are four sites with different types of management: a site with an irrigation canal for agriculture, a site with trampling by livestock, a ravine with a garbage dump, and a conserved site (without evidence of management). The soils in the four sites are similar: sandy soils, with a pH of 7 to 7.8 and, apparent density between 1.4 and 1.7 g/cm3. The percent of soil aggregates was similar between sites; trampling site 38%, ravine site 30%, conserved site 29%, and irrigation site 27%. Biocrusts are composed of 32 species including cyanobacteria, lichens, and bryophytes. The biocrust cover was similar between the four conditions. However, cover in taxonomic groups differed between sites. Therefore, the impact of the activities is modifying the specific cover of the taxonomic groups. In each site, the biocrusts had a specific composition and cover of taxonomic groups. The impact is favoring a greater cover of lichens in sites with livestock, cyanobacteria in ravines, and bryophytes in irrigation and trampling sites. Thus, the impact of subsistence human activities may be modifying the biocrusts cover, and the functional role of each taxonomic group is favoring the aggregate stability.

Keywords: Biological soil crusts,Bryophyta,Cyanobacteria,Erosion,Lichens

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THE SILVA NOVA PROJECT - RESTORING SOIL BIOLOGY AND SOIL FUNCTIONS TO GAIN MULTIPLE BENEFITS IN NEW FORESTS

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Afforestation and forest restoration are seen as key factors to mitigate climate change and biodiversity loss given that forests host a major part of the species pool. In Denmark, most of the areas intended for afforestation are former cropland, and their agricultural legacies (high nutrient availability, altered soil biota structure, and function) constrain the development of forest-adapted species, tree growth and stability, ecosystem functions, and biodiversity.
The central hypothesis of Silva Nova is that inoculation of former arable land with soil (including microbiome, fauna, and seeds/rhizomes of understory vegetation) from old forests will improve productivity and more rapidly restore forest-adapted communities. The project will test this hypothesis by 1) evaluating temporal and spatial responses in biomass production, soil biota and soil functions to afforestation in existing chronosequences and sites with increasing distance to other forests; 2) quantifying the effects of inoculation methods regarding donor, amount and application mode to different soil types and tree species through mesocosm experiments; 3) expanding knowledge of inoculation methods from mesocosm to new and existing field-scale experiments; 4) incorporating the landscape context into guidelines and tools for spatially explicit prioritization of areas for promoting dispersal.
Our methodologies link results from state-of-the-art eDNA analyses for above and below-ground microbiome characterization (bacteria, fungi and insects) to vegetation analyses, forest structure (LiDAR), in-situ and laboratory measurements of soil functions (e.g. greenhouse gasses and soil metabolic activity) and soil and plant chemical properties. Silva Nova aims to resolve barriers to successful restoration and develop landscape-scale afforestation strategies that optimize productivity and biodiversity while generating knowledge on the trees, ground vegetation, soil fauna, and microbiome nexus and its effects. Silva Nova is a collaborative effort between the universities of Copenhagen (DK), Leiden (NL) and Tartu (EE), that received a six-year grant from the Novo Nordisk Foundation.

Keywords: Soil microbiome,Biodiversity,Afforestation,Inoculation,Ecosystem functions

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LAND USE AND BACTERIAL COMMUNITY: AN OVERVIEW ANALYSIS OF BACTERIAL DIVERSITY IN ANDISOLS OF SOUTHERN CHILE

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Chilean volcanic ash soils (Andisols) can be found between Linares (35 51 S-71 36 W) and Puerto Montt (41 28 S -72 56 W).These soils, which are important for the economy of southern Chile, and support the bulk of agricultural and forestry production, can be found as young Andisols (e.g.Acrudoxic Hapludand), well developed Andisols (e.g. Typic or Duric Hapludand), Ñadi Soils (e.g. Duric Histic Placaquands) and soils developed from old volcanic ashes such as Ultisols. Andisols exhibit very specific particle properties like variable charge, high phosphate retention and consequently low P availability for plants, low bulk density, large air and water holding capacity. These soil attributes, which are unique and differentiate Andisols from other soil types, are related to the high amount organic matter and the presence of allophane in these soils. Despite their importance, the interplay between soil factors, bacteria, and land use change (forest, grassland, wetland) in Andisols remains poorly understood. Our analysis of physical, chemical, and bacterial community data across these land uses revealed the complex interactions that shape microbial populations in Andisols. Genomic DNA extracted from soil samples were analyzed byPCR-DGGE and quantitative PCR and metabarcoding of the 16S rRNA gene using the Illumina MiSeq platform. Preliminary, our results have shown that pH, organic matter, bulk density and gravimetric water content have a significant influence on bacterial communities. Moreover, Proteobacteria phyla was the most abundant taxa in the selected soils followed by the phyla Firmicutes, Acidobacteria, Actinobacteria Verrumicrobia and Chloroflexi. Our data contributes to understanding the bacterial communities, which are also relevant considering the change use land and the potential consequences of climate change in southern Chile increase in soil temperature and reduction in rainfalls on water and temperature dynamics as well as bacterial activity in these soils.

Keywords: Bacterial community,Land use change,Andisol

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TAXONOMIC DIVERSITY OF PROKARYOTIC COMMUNITIES IN A MEDITERRANEAN PADDY SOIL MANAGED WITH COMPOST AMENDMENT

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Paddy soils are highly managed agricultural soils showing unique ecological features. Alternating dry and wet conditions during the growing cycle can promote changes in prokaryotic diversity, soil functioning and nutrient dynamics; particularly carbon and nitrogen cycling, which is intimately related to the soil fertility status and environmental issues. Given the importance of rice cultivation for food provision worldwide, assessing the taxonomic diversity responses to soil management practice becomes decisive for adopting proper sustainable measures. Aim of the present research was to investigate compositional shifts in soil bacterial diversity in a rice-cultivated silty clay loam slightly alkaline Mediterranean soil managed with compost amendment. The experimental design was set-up in a paddy field located in Southern Italy, where rice crop (Oryza sativa L. var Karnak) was cultivated over an area covering 250 ha. Experimental plots (~1 ha each, 3-time replicated) were randomly arranged to compare a conventionally managed soil and a soil amended (8 t/ha) with composted municipal solid waste. Surface (10-20 cm) soil samples were taken at five sampling times to investigate immediate vs short- and long-term responses: before the start of the trial (bare and wet soil), 2 days after the compost amendment (bare and dry soil), and then 6 (rice crop and flooding), 17 (rice crop and flooding) and 62 (wet soil) weeks after compost addition. Soil-extracted DNA was amplified with tagged primers targeting the V1-V4 hyper-variable region of 16S rDNA and sequenced by MinION platform (Oxford Nanopore Technologies). Prokaryiotic soil communities were largely (> 50%) dominated by oligotrophic Chloroflexi and then Firmicutes and Actinobacteria. The taxonomic assignment evidenced that the compost addition brought about a marked albeit not-persistent increase in copiotrophic Firmicutes (class Bacilli) (2 days after the treatment). Whereas no differences between treatments in major phyla were noticed at following times; thus suggesting that, besides ephemeral compositional changes due to compost-derived substrates and nutrients, soil type and properties created ecological conditions conducive to a resilient bacterial community.

Keywords: paddy soil,16S rDNA sequencing,soil metagenomics,Chloroflexi,bacterial resilience

ID ABS WEB: 138216

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes - Importance for climate resilient future, degraded lands restoration and plant health control

RELICT CHARCOAL HEARTHS REPRESENT SPOTS OF INCREASED BIODIVERSITY AND MODIFIED SOIL CONDITIONS IN PRESENT-DAY MANAGED FORESTS

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Relict charcoal hearths were studied to assess their impact on biodiversity and soil properties. Their old age reaching several hundred years represents unusual experimental conditions for prediction of charcoal-biochar influence not only on local environmental conditions but also on the stability and recycling of carbon, which has consequences for agriculture and climate change. Ten sites differing in forest type, soil conditions and estimated age of charcoal hearths were selected.
At each site, a phytocoenological relevé was performed and a soil probe was dug at both the hearth and control plot about 25-50 m away. A total of 10 pairs were sampled per site. Soil samples were dried and sieved to measure pH(H2O), Al^{3+}, Mn^{2+}, Fe^{3+}, Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}, Cox, total N, C, and S contents. Infrared spectroscopy was used to assess organic matter quality and thin sections were used to analyze soil mineralogical composition. Total soil DNA was extracted and amplified with primers for 16S rRNA gene (prokatyotes) and 18S rRNA gene (micro-eukaryotes). Amplicon sequencing was done using Illumina platform and analyzed by Usearch v11.0.667.
PCA revealed large differences between hearths and respective controls in vegetation cover. Soil analyses revealed an increase in pH, CEC and BS mainly in FH horizons, a greater effect was manifested in acidic habitats. Hearths were also enriched in Cox and organic matter had a different composition. Taxonomic composition of prokaryotic (Bacteria and Archaea) communities differed significantly in charcoal hearths compared to controls in all soil horizons. Diversity of prokaryotic communities was significantly increased by charcoal residues at hearths. In the NMDS plots prokaryotic communities at FH horizons appeared the least separated from the other communities of either hearths or controls but the difference was still significant at the $p<0.001$.
In conclusion, biodiversity of soil was significantly higher in charcoal hearths possibly reflecting changed soil conditions particularly increased soil pH and basic cations.

Keywords: biodiversity,forests,nature protection,soil horizons,biochar

ID ABS WEB: 138550

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes - Importance for climate resilient future, degraded lands restoration and plant health control

SOIL MICROBIOME INFLUENCE ON WHEAT AND MAIZE BIOMASS RESPONSES TO DROUGHT STRESS

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Drought stress is challenging food security and agriculture sustainability under climate change scenario. Soil microbiomes are critical for supporting the future of crop production, yet little is known about how changes in soil microbes can influence the capacity of crops to produce food. In this study, we conducted a greenhouse experiment to investigate the growth responses of two major cereal crops, wheat (Triticum sp.) and maize (Zea sp.), to different microbial inoculums under contrasting drought conditions. Drought reduced crop biomass in both wheat and maize. Moreover, we found that soil microbiomes can regulate the responses of crop growth to drought events.
This study contributes insights into the adaptive strategies of wheat and maize under drought stress and this knowledge is essential for sustainable agriculture, ensuring global food security in the face of climate change.

Keywords: Drought,Maize,Wheat,Microbiome,Biomass

ID ABS WEB: 138709

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes - Importance for climate resilient future, degraded lands restoration and plant health control

MICROBIAL EVIDENCES OF ABRUPT SHIFTS IN DUNES ECOSYSTEMS AFTER PASSING AN ARIDITY THRESHOLD

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Dune ecosystems are among the most vulnerable regions to climate change worldwide. However, studies on how crossing critical aridity thresholds influences the microbiome of these ecosystems remain scarce. These microbes play a pivotal role in shaping terrestrial ecosystem traits and functions.

In this study, we collected 1.4-meter sediment cores at 5-cm intervals from deserts in Xinjiang, China, in two study sites before and after crossing a previously described aridity threshold. We conducted a comprehensive analysis of community diversity and spatial structure, in light of the changes in environmental heterogeneity and autocorrelation, further exploring the community's differential sensitivity to fluctuations and evidence of state transitions under various states.

The results demonstrate that microbial communities in sand dunes before and after crossing aridity thresholds exhibit distinct vertical ecological niche differentiation patterns under spatial effects. This includes variations in their beta diversity, rarity mode, assembly process, topological properties, and the stability of their networks. This offers new insights into the possible evidence of microbial community state transitions and potential mechanisms in deserts crossing ariditythresholds.

Keywords: soil biodiversity,microbial communities,drylands,soil vertical profile,ecological thresholds

ID ABS WEB: 140055

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes - Importance for climate resilient future, degraded lands restoration and plant health control

HIGH-INTENSITY AGRICULTURAL PRACTICES INDUCE A LOSS OF SOIL MICROBIAL BIOMASS IN EUROPEAN CROPLANDS

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Soil biodiversity plays a crucial role in sustaining the ecosystem services and agricultural practices influence the biomass, activity, and diversity of soil microbes, as well as microbial-mediated functions. Here, we aim to assess how the biomass of soil microbial communities, encompassing total, bacterial and fungal components, is affected across a gradient of long-term intensity-gradient of agricultural practices under contrasting climatic conditions at a continental scale. We conducted this experiment using plots with different agricultural practices in eight diverse locations across Europe.
Our findings underscore a pronounced influence of agricultural practices on soil microbial biomass, as estimated by fatty acids. We found notable reductions in bacterial and fungal biomasses as agricultural practices intensified. Besides, bacterial biomass was more susceptible to these perturbations compared to fungal biomass. In response to varying degrees of agricultural practices intensity, soil nitrogen content and pH levels emerge as the main drivers shaping microbial biomass. Furthermore, we observed a significant correlation between soil microbial biomass and nitrogen content, which outweighed the influence of carbon content in all examined soils. This underscores the pivotal role of nitrogen availability in modulating soil microbial biomass and highlights its significance in shaping soil health and fertility.
To conclude, this study advances our understanding of the nuanced impacts of diverse agricultural practices on soil physicochemical properties and their effects on microbial biomass. In this respect, promoting sustainable agriculture practices could foster soil health and resilience to better sustain ecosystem services under a climate change scenario.

Keywords: Soil microbial communities,Sustainable agriculture,Soil biodiversity

ID ABS WEB: 140096

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes - Importance for climate resilient future, degraded lands restoration and plant health control

SOIL MICROBIAL DIVERSITY IN MEDITERRANEAN OAK FOREST ECOSYSTEMS SUBJECTED TO UNGULATE GRAZING

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This study is part of the PNRR Biodiversity research project, developed within the national network established in order to study how climate change and anthropogenic activities impact the biodiversity in the different ecosystem compartments (soil and vegetation).
The specific research aims of this research are i) understanding the ecological responses of soil microbial community (SMC) to forest environmental change due to ungulate grazing; ii) evaluating the effect of forest grazing on SMC functional and genetic diversity; iii) assessing the impact of forest fenced on C storage and N recycling.

The study was conducted at the natural reserve of Castelporziano (Rome). The experimental area named Campo di Rota is an oak forest grown in soil developed in ancient dune and consists of 12 ha fenced forest and 12 ha unfenced. For statistical relevance, both areas were divided into 9 plots using QGIS. The core sampling was conducted taking the soil in the centre of each plot, under a bushy area, and in a clearing. Then the soil was sieved (2mm) and split in 3 parts to store in different conditions: dry at room temperature for physical-chemical-biochemical analysis, 4°C for the microbiological analysis, and -20°C to preserve the DNA for the metagenomic analysis.

The preliminary analysis of soil (core sampling at 0-10 cm, 10-30 cm, and 30-50 cm) at the qualitative level -chemical-physical analysis, and qPCR assay targeting 16S/18S rRNA genes- show no substantial differences between the two areas under study i.e. fenced vs unfenced. For such reasons, the qualitative analysis -biochemicals and metagenomics analysis- can used to evaluate how different strategies of forest management have an impact on the soil microbial community and soil biogeochemical cycles in a territory highly sensitive at the effects of forest grazing.

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Keywords: biogeochemical cycles,soil microbiology,soil microbial community,metagenomics,microbial biodiversity

ID ABS WEB: 140098

4. Soil health in achieving the Sustainable Development Goals
4.07 132182 - Soil microbiomes - Importance for climate resilient future, degraded lands restoration and plant health control

BIOWASTE DERIVED THERMOCHEMICAL DIGESTATE FOR PROLIFERATION OF ROOT ENDOPHYTIC PIRIFORMOSPORA INDICA AND AS SOIL ORGANIC AMENDMENT PROMOTING NITROGEN AND PHOSPHORUS NUTRITION IN TOMATO

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As the global population surges towards 9.8 billion by 2050, the strain on Earth's finite resources intensifies, demanding nearly three times the planet's available natural resources to sustain our current lifestyles. The alarming population growth and environmental degradation have led to a global crisis, threatening our future development and survival. By 2030, one of the primary aims of the United Nations Sustainable Development Goals is to significantly reduce waste generation by prioritizing prevention strategies, implementing reduction techniques, and actively promoting recycling and reuse practices. Management of degradable biowaste and food waste becomes paramount, signalling excessive consumption and necessitating immediate attention through dedicated policies, alongside investments in technology and infrastructure. The thermochemical processing technology for rapid conversion of degradable solid waste into an organic fertilizer is an innovative degradable solid waste management strategy pioneered and patented (No 321857) by the Kerala Agricultural University, harnessing principles of green chemistry. This technology utilizes renewable feedstock and employs thermochemical degradation with specific reagents to rapidly transform waste into thermochemical digestate fertilizer (TDF). TDF, rich in labile carbon, serves as an efficient carbon and energy source for beneficial soil microbes, enhancing their population in soil and facilitating efficient nutrient acquisition by plant roots. Inclusion of the highly beneficial root endophyte, Piriformospora indica, with TDF enhanced its proliferation. In a tomato field experiment employing soil test-based fertilizer application, along with P. indica-inoculated TDF, results demonstrated a 19.09% increase in the number of fruits per plant and a 24.34% higher fruit yield per plant as compared to conventional fertilizer treatment. Application of TDF, along with such beneficial microbes, served to reduce the external input of inorganic fertilizers by enhancement in nutrient uptake and translocation as evidenced by specific nitrate and phosphate transporters in tomato plants. The reliance on the recycling of degradable solid waste and the efficient crop nutrition derived from the endophytic fungi associated soil organic amendment are an impetus to the concept of circular economy.

Keywords: Thermochemical digestate,Piriformospora indica,Endophytic Fungi,Organic Fertiliser,Tomato

ID ABS WEB: 136163

4. Soil health in achieving the Sustainable Development Goals
4.08 132261 - Ecosystem services provided by nematodes and other soil invertebrates and specific protection goals

MEDIUM-SIZED HERBIVORES' EXCRETA HAS A SIGNIFICANT IMPACT ON SOIL BIOTA IN A MEDITERRANEAN FOREST ECOSYSTEM

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Herbivores' fecal depositions are an important source of essential chemicals, such as phosphorus and nitrogen, for soil organisms. The impact of nutrient cycling through feces and urine on soil ecosystems has been well-studied for large herbivores; however, reports on the effects of smaller herbivores' excreta on the soil biota are scarce. To fill this gap, we determined the impact of feces deposition of the Indian crested porcupine (Hystrix indica) on the abundance, structure and diversity of the colony-forming units of fungi and bacteria and free-living nematode communities in Israel's Mediterranean region during the annual dry and wet seasons. Results confirmed our assumption that medium-sized herbivores can also have a significant impact on soil communities and their habitats. Fecal deposits of the Indian crested porcupine were found to exert various effects on the observed soil properties, and mainly on the abundance of soil biota. In accordance with earlier findings, we showed that soil properties and the observed external environmental factors have a seasonal effect on the abundance of soil microorganisms and free-living nematodes. Environmental indices confirmed that nutrient supply through the porcupine's urine and feces can have different (stimulatory or inhibitory) impacts on the abundance of the soil communities, affecting the abundance and structure of the colony-forming units of fungi and bacteria and free-living nematode communities during the observed months and seasons of the year.

Keywords: herbivores,feces,soil biota,soil microorganisms,free-living nematodes

ID ABS WEB: 136633

4. Soil health in achieving the Sustainable Development Goals
4.08 132261 - Ecosystem services provided by nematodes and other soil invertebrates and specific protection goals

QUALITY OF AGRICULTURAL SOIL: PHYSICAL AND BIOLOGICAL INDICATORS

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The studies on agriculture's impact on soil have become very important since they can provide new knowledge for better human and environmental health and protection and for improving agriculture quality. Nematofauna and soil structure were chosen to assess the effects of agricultural practices on soil. The research, which had been underway for almost 20 years, at the time of the research, involved 5 single succession cultivation systems: 1) annual rotation of Italian ryegrass and Zea mays; 2) 3-year rotation of Italian ryegrass + corn – (barley + corn) – (grain corn); 3) 3-year rotation of Italian ryegrass + corn and alternate grass (every six years); 4) permanent grass; and 5) grain maize monoculture. All systems were subjected to 2 levels of agronomic intensification, one optimal (input A) and one lower (input B) where the tillage was replaced by harrowing and the manure was reduced by 30%. The effects of the different cropping systems were compared on soil nematode community (trophic structure, biodiversity, maturity Index, ecological Indices) and soil physic parameters (structure or aggregate stability). Differences in nematode genera composition and distribution among the different agricultural systems were recorded. The Structural Stability Index (SSI) values indicate that the cropping systems had negative effects on the aggregate stability. Crop systems were found to be a significant source of variation, while differences between the two inputs of the same crop systems were more evident considering nematodes rather SSI. Chemical attributes did not seem able to show differences in the impact of the cropping systems with quite a high level of stress. Instead, nematode community parameters were able to underline differences even in those environmental soil conditions highly stressed, with similar management so that it is possible to consider it as an integrative bioindicator suitable for evaluating soil health and/or crop management. Data are linked to the potential ecosystem services provided by nematode communities recorded in the different systems.

Keywords: Biodiversity,Soil quality,Agricultural management,Ecological indices,Physical indices

ID ABS WEB: 137390

4. Soil health in achieving the Sustainable Development Goals
4.08 132261 - Ecosystem services provided by nematodes and other soil invertebrates and specific protection goals

EFFECT OF PLANT DIVERSITY ON OCCURRENCE OF EPIGAEIC AND ENDOGAEIC ARTHROPOD MACRO AND MESOFAUNA IN OILSEED RAPE CROP

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During three seasons (2020/21, 2021/22, 2022/23) abundance, species richness and spatio-temporal distributions of epigaeic and endogaeic arthropod macro and mesofauna were assessed in winter oilseed rape (WOSR) crops that differed in plant diversity (WOSR monocrop vs. WOSR crops enriched with two different frost-susceptible accompanying plant mixtures; each plot with acreage 0.33 ha). WOSR monocrop has been a part of conventional crop rotation and both more diversified WOSR plots a part of more diversified crop rotation (catch crops and intercrops included). Both crop rotations have been managed at the same trial field in locality Rapotín (Czechia). Sampling was carried out with usage of several types of traps (pitfall, endogaeic and emergence traps). Across the monitoring area the traps were distributed in rectangular grid and emptied 1–2 times per week. In each of the seasons the monitoring activities were divided into two periods: 1) from September to November/December and from March/April –to July/August. Special interest was aimed at carabids (Carabidae), staphylinids (Staphylinidae), spiders (Linyphiidae a Lycosidae), Opilionida and Chilopoda as important predators of larval stages of WOSR insect pests and at Diplopoda, Isopoda, Collembolla and earthworms (Annelida, Lumbricina) as indicators of good soil quality. In the last season the monitoring was supplemented with soil samples (0–10 and 10–20 cm) analysed with usage of Berlese-Tullgren funnel on occurrence of Enchytraeids and mites from suborders Oribatei, Pterostigmata, Meostigmata and Astigmata. In epigaeic Carabid fauna slightly higher abundance (insignificant) was recorded in WOSR monocrops in all three years, but species richness (42 against 34 species) and diversity were higher in more diversified WOSR. In more diversified WOSR plots epigaeic even endogaeic carabids, staphylinids and Collembola showed significantly lower tendency to aggregation than in monocrop (Spatial Analysis by Distance indices, SADIE). In more diversified WOSR plots epigaeic even endogaeic carabids and staphylinids showed stronger spatio-temporal association with distribution of Collembola, earthworms and diplopods (Quick Association Analysis).

Keywords: epigaeic arthropods,endogaeic arthropods,soil biota diversity,crop diversity,agro-ecosystem stability

ID ABS WEB: 137646

4. Soil health in achieving the Sustainable Development Goals
4.08 132261 - Ecosystem services provided by nematodes and other soil invertebrates and specific protection goals

NEMATODES: THEIR ROLE AS ECOSYSTEM SERVICE PROVIDERS AND SOIL HEALTH BIO-INDICATORS

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Nematodes constitute a very abundant and diverse group of microfaunal organisms that provide various ecosystem services. They play an important role in the soil food web, contribute to soil structure and function, are involved in nutrient cycling and decomposition, and act as biological control agents. On the other hand, they are useful in measuring changes in soil function and status because they are globally distributed and occupy a wide range of habitats, and because they are representative of multiple trophic levels in the soil food web. Moreover, their rapid response to both physical and chemical disturbances makes them valuable for reflecting changes in terrestrial ecosystems. Not only the most common biodiversity indices are applied to this taxon, but also other specific indices based on taxonomic and functional diversity of nematodes and their ecological characteristics. An analysis of the nematode community makes it possible to measure dozens of indicators which provide diverse information, including on the soil fertility (nutrient flow-pathway of degradation of organic matter), the level of disturbance and the risk linked to plant-parasitic nematodes specific to crops or plants. Furthermore, a specific framework is available for selecting a targeted subset of nematode-based indices for diagnosing soil functioning in relation to its use. This presentation introduces the ecosystem functions of nematodes and their role as bioindicators. Key examples are highlighted, and the state of the art understanding of the correlation between nematodes and soil health is elucidated through Vos Viewer analysis. We additionally demonstrate the effective utilization of valuable nematodes bio-indicator tools, particularly emphasizing their application on online platforms. Finally, we highlight educational facets within environmental nematology.

Keywords: Nematology,ecosystem service,bio-indicator,education

ID ABS WEB: 135998

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

WHEAT-CLOVER INTERCROPPING CAN INDUCE POSITIVE PLANT-SOIL FEEDBACK WITH MINIMAL IMPACT ON SOIL PHYSICAL PROPERTIES.

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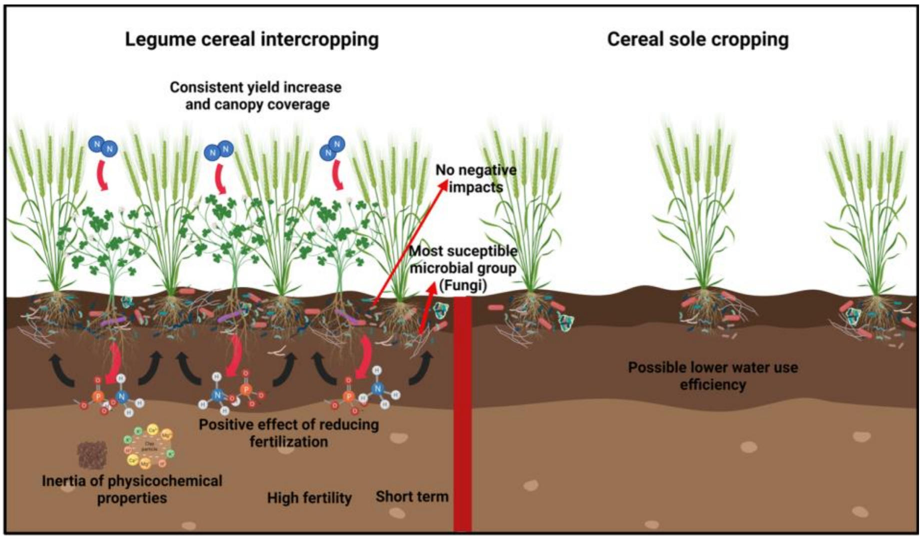
Sustainable intensification of crop production plays a pivotal role in achieving food security while reducing negative environmental impacts. Based on their physiological complementarity, legume-cereal intercropping could be used to achieve this objective. However, its effects on plant performance, soil edaphic factors and microbial communities are still not fully elucidated. In this study, clover-soft wheat intercropping with an additive design under two N fertilization levels (normal vs reduced) was tested for its effect on crop performance and soil fertility in a one-year field trial. Different plant morphological parameters and yields were evaluated at two times to determine interspecies interactions. Physical properties of soil were evaluated along the profiles. Rhizosphere and bulk soil were sampled to determine their chemical and microbiological properties. A qPCR approach, starting from the total soil DNA, was used to quantify the abundance of microbial phylogenetic markers and functional genes (N and P cycling). Intercropping had limited effects on plant morphological parameters, but system performance was strongly increased (Land Equivalent Ratio>1). A possible suppression of Cuscuta sp. infestation by wheat has also been observed. The physical properties of soil were not affected by the tested factors. Similarly, physicochemical properties were not significantly different between the two niches, except for soil humidity in one case. Fungi were the microbial group most affected by the plant species, as clover increased their abundance in the rhizosphere. The tested factors had different impacts on ammonia-oxidizing bacteria and diazotrophic prokaryotes. The limited effects of the tested factors might be due to high soil fertility. Reducing N fertilization by 30% in intercropping did not induce negative effects because of its positive Plant-Soil Feedback. Therefore, soil diazotrophs may regulate N availability for other microbial groups. Overall, the results indicate that wheat-clover intercropping can be a valid tool for the sustainable intensification of crop production in the Mediterranean climate and has great potential for ameliorating the ecological environment of soil microbial communities.



Keywords: MICROBIAL COMMUNITIES,NUTRIENT CYCLES,INTERCROPPING,PLANT-SOIL FEEDBACK

ID ABS WEB: 136460

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

AGROTECHNOLOGY BASED ON UTILIZATION OF ALGAE

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A prerequisite for the successful introduction of technologies involving the use of beneficial soil organisms (biopelletization, foliar application of algae) is knowledge of their effectiveness in agrosystems. Time-space biomonitoring of large groups of soil organisms such as N-fixing bacteria, mycorrhizal fungi and also algae can detect certain indicators of soil microbiome changes in the long term. The current assumption of consistent monitoring of changes in soil characteristics, including the soil microbiome in the rhizosphere, is influenced by several factors 1) soil characteristics; 2) composition of stands and weeding intensity; 3) frequency of use of legumes in crop rotations; 4) used agricultural technologies. The results of long-term monitoring of the surface layers of the soil horizon at several locations in northern Moravia (Šumperk region) in the Czech Republic pointed to two abundant representatives of soil algae, the genera Klebsormidium and Phormidium. Klebsormidium is a filamentous unbranched charophyte alga indicating changes in the soil environment by the occurrence and change of cell morphology. Phormidium is a filamentous unbranched cyanobacterium with the ability to fix atmospheric nitrogen through heterocysts. A diverse representation of algae was demonstrated in relation to different degrees of weeding, e.g. in carraway crops with herbicide applications. Soil cyanobacteria represent a great benefit in terms of soil properties, especially in relation to soil structure, erosion control and atmospheric nitrogen fixation, similar to their bacterial teammates. Cyanobacteria are also the source of several other elements and substances that in a complex support plant growth (e.g. phytohormones). The use of cyanobacteria for application on the leaf (Tolypothrix, Trichormus) supports controlled production and the possibility of regulating the content of some undesirable substances (toxins) that are applied to the ecosystem by cyanobacteria in natural soil conditions.

Keywords: soil algae,indicators of soil quality,seed encrustation,microbiome diversification,field pea

ID ABS WEB: 136472

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

DYNAMICS OF SELECTED SOIL PARAMETERS IN RELATION TO YIELD CHARACTERISTICS OF CROPS IN DIVERSIFIED SYSTEM CONSISTING OF LEGUMES AND CEREALS

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Agricultural practices are currently more than ever looking for alternative approaches to soil cultivation, diversification of crops, support the soil microbiome and targeted application of beneficial soil organisms. There are approaches for reducing the use of chemical fertilizers and pesticides, strengthening the tolerance of crops against (a)biotic stresses and improving soil conditions. For purposeful diversification in agroecosystems, a new seed encrustation technology is used to apply beneficial soil organisms (biopelletization) to the soil environment. The inclusion of legumes using biopellets as an accompanying component in crop rotation systems enrich the soil environment with atmospheric nitrogen due to symbiosis with rhizobia, but also with available forms of phosphorus due to the action of specific strains of arbuscular mycorrhizal fungi (Rhizophagus irregularis) with profit for the current and next crops. To effectively support the activity and encouragement of desired interactions among the applied organisms, it is necessary to know the soil parameters of the location where this new technology is being applied. The precise assessment of several basic and specific soil characteristics (physical soil parameters – retention water capacity, bulk density, humidity; chemical parameters – content of C, N, P, S, Mg, Ca, K, pH; biological parameters – soil organic matter, diversity and composition of soil microbial communities by sequencing and qPCR) enabled from a long-term perspective to specify the conditions for development of soil beneficial organisms. This is reflected in several monitored crop yield characteristics, including their resistance to dynamic climate changes. The multi-component mixture of crops that share the same location at the same time makes it possible to suppress effects such as susceptibility to fluctuations in the availability of water in the soil. Due to representation of peas in mixture, the main crop (cereals) achieves higher performance and better health. These considerations are supported by our results with the application of biopelletized peas with the aim of diversifying agroecosystems at locations within North Moravia (Šumperk region) in Czech Republic.

Keywords: soil parameters,beneficial soil organisms,seed encrustation,crop diversification,field pea

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4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

CAN INCREASED ROOT DIVERSITY RETAIN MORE SOIL AND REDUCE SEDIMENT LOSS IN COVER CROP SYSTEMS?

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Agricultural systems need to strengthen their resilience to abiotic stress to mitigate climate change effects on agricultural production and environmental degradation. Increasing plant diversity can help build this resilience by improving ecosystem function through the more efficient use of resources in time and space. While much research has focused on the direct benefits of increased plant diversity for crop productivity, there is limited evidence on how diversity and species selection affect soil stabilisation. Knowledge is lacking in cover crop rhizosheath development, the root-soil interface, that can indicate the soil binding capacity of a plant reducing soil erodibility.

A winter field trial investigated the impact of cover crop diversity on rhizosheath development and soil erodibility by conducting overland flow simulations. Species (Secale cereale, Brassica juncea, Vicia faba) were chosen for their suitability to UK environmental conditions and were sown as single species and in all possible combinations. Results established that root biomass increased with cover crop diversity and was determined by the presence of Vicia faba. Rhizosheath formation was not affected by crop diversity and was greater in treatments containing Secale cereale. Overland flow simulations showed neither rhizosheath mass nor species diversity had an impact on soil erodibility, and the field variability of soil structural and hydraulic properties had a greater influence.

This work highlights the importance of species selection over diversity, and informs land managers about cropping practices to conserve soil function and restore agroecosystems.

Keywords: COVER CROP DIVERISTY,ROOT DIVERSITY,SOIL RETENTION,RHIZOSHEATH,SOIL HEALTH

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4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

EFFECT OF CLOVER-WHEAT INTERCROPPING ON SOIL ENZYME ACTIVITIES AND ABUNDANCE OF MICROBIAL BETA-GLUCOSIDASE GENES

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Current modern agriculture practices such as monocropping, high dosage of chemicals have negative impacts on soil health, biodiversity, and vulnerability to disease. These practices should be replaced by sustainable practices such as use of organic fertilizers, crop diversification etc. Intercropping is one of them that offers a promising alternative to conventional agriculture. It is an ancient agricultural technique in which two or more plant species are grown simultaneously in the same field. In a logic of sustainable development, legume-cereal intercropping has the benefit of maximizing the productivity and efficiency of the agroecosystem, improving the use of resources, and reducing external inputs. However, the ecological processes and mechanisms that regulate this cropping system are not yet fully understood.
The present study aims to evaluate the effect of legume-based intercropping on the edaphic factors and microbial biodiversity of rhizosphere and bulk soils. One year field trial was carried out to determine the short-term effect of wheat-clover intercropping under two levels of nitrogen fertilizers (normal vs reduced) on soil physicochemical properties, enzymatic activities and the abundance of functional genes linked to the cellobiose hydrolysis.
Soil physico-chemical properties did not have any significant impact of soil depth, management practices as well as fertilization treatments, except for soil moisture, which increased significantly in the cereal monoculture in response to reduced fertilizer rates.
Soils from monocultures and intercropped plots contained similar potential for microbial activity. Nonetheless, a significant effect of reduced fertilization and intercropping was observed on alkaline phosphatase activity.
The cultivation strategy and N fertilizer dosages had significant effects on the abundance of fungal and bacterial beta-glucosidase genes. Intercropping significantly increased the abundance of bacterial GH1 family genes in bulk soil, especially under reduced N fertilization. Fungal beta-glucosidase genes were more affected by cultivation strategy and N fertilization compared to bacterial genes especially in rhizosphere soil. Intercropping significantly increase the abundance of fungal genes both GH1 and GH3, especially under reduced N fertilization.

Keywords: Sustainability,Intercropping,N fertilization,Enzymatic activities,Cellobiose hydrolysis

ID ABS WEB: 136650

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

EFFECT OF LIVING WINTER COVER CROPS ON PESTICIDE CONCENTRATIONS IN SOIL AND SOIL SOLUTION IN TEMPERATE AGRO-ECOSYSTEMS

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Throughout the growing season, fertiliser and pesticide applications take place mainly in spring and summer. However, the greatest risk of these chemicals leaching into the soil and water occurs in autumn and winter, when increased rainfall and reduced crop growth facilitate aquifer recharge. While avoiding the use of agrochemicals remains the optimal strategy to prevent soil and groundwater pollution, a number of practices can reduce the risks. As part of crop diversification strategies and in addition to their many other ecosystem services, the effectiveness of living winter cover crops (catch crops) in reducing nitrate leaching during this period is well documented in the scientific literature and has been widely advocated over the years. However, their comparable effect on pesticide leaching remains a generally under-explored area of research. This study aims to determine the potential extension of the removal capacity of catch crops to pesticides, by assessing the influence of a living winter cover crop on residual pesticide levels from the previous growing season in agricultural soils. To this end, we quantify the concentrations of 18 pesticides (9 herbicides, 6 fungicides, 1 insecticide, 2 safeners) in both soil and soil solution samples and compare their evolution over time under three conditions: (i) a winter catch crop (a multi-species cover crop); (ii) a winter cash crop (a winter cereal crop); and (iii) bare soil as a control modality. This comparison is carried out in 10-litre pots in a greenhouse. The cover crops are sown in early January 2024. Soil solution samples are collected three times between January and April 2024, using micro-rhizons (Rhizosphere®) and are analysed by LC-MS/MS for the quantification of pesticide and residue concentrations. Soil samples are collected according to the same schedule, extracted using QuEChERS and processed by LC-MS/MS. The experiment will be completed in April and aims to provide critical insights into the potential of living winter cover crops to mitigate pesticide leaching into agroecosystem soils and aquifers.

Keywords: pesticide,cover crop,catch crop,crop diversification,soil health

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4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

EFFECT OF AGRONOMIC PRACTICES OF COFFEE CROPS ON THE ENZYMATIC AND MICROBIAL ACTIVITY OF SOILS IN SOUTHERN META (COLOMBIA)

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The coffee crop is one of the most important farming systems for Colombia, allowing its economic development and recognition, as well as allowing the substitution of illicit crops, as occurred in the south of Meta department. However, due to the armed conflict in this region, research hadn't been carried out focused on estimating the effect of coffee production on soil microbial and enzymatic activity, and likewise, very little research generally considers the effect of the agronomic practices on these variables. Considering the above, 40 semi-structured surveys were conducted with coffee growers to identify their agronomic practices. Additionally, soil sampling was carried out in each of the farms, where the age and type of associated crop in each coffee crop were considered, taking at least three random samples from each of the coffee crops visited, for a total of 150 samples collected. To select the explanatory variables (agronomic practices) of greatest relevance concerning the response variables, a principal components analysis was carried out, which allowed redundant variables to be eliminated, and non-collinearity was also verified. Likewise, the farmer's perception of the identification of dry season, organic carbon, pH, soil particle size distribution, and acidity were selected as covariates. For the response variables, the enzymes related to the C, P, and S nutrient cycling (Beta-glucosidase, acid and alkali phosphatase, and arylsulfatase, respectively) and dehydrogenase were measured. We also recorded the cumulated microbial respiration and the basal respiration rate. To analyze the effect of explanatory variables and covariates, a partial redundancy analysis was used, which allowed us to identify that the covariates represented 23% of the variability in soil microbial and enzymatic activity, while the agronomic practices explained 33%. Finally, a statistically significant model ($p < 0.001$) could be identified that managed to explain 27.2% of the variability between sites. The previous results allow us to infer the need to include the identification of the farmer's agronomic practices when evaluating the microorganisms' activity.

Keywords: Soil enzymes,Basal respiration,Explanatory variables,Partial redundancy analysis

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4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

INFLUENCE OF INNOVATIVE AGRICULTURAL PRACTICES ON REDUCING PESTICIDE AND NITRATE TRANSFER IN MAIZE MONOCULTURE

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Maize represents a third of the cultivated area in Ariège, southwestern France. Controlling pests requires the use of pesticides that are dispersed in soils and natural waters. However, some agricultural practices may modify their transfer into the environment: reduced tillage, organic amendment, pesticide application management. The objective of this study was to evaluate the influence of these innovative agricultural practices on the pesticide and nitrate transfer in irrigated maize monoculture by studying the soil solution for four consecutive years. On each study site, a reference modality was compared to: (1) a reduced tillage modality; (2) a reduced tillage modality with addition of organic matter; and (3) a localized pesticide application modality (i.e., herbicide application only on the maize rows to reduce the dose applied). In total, nitrates and 32 pesticides (including 16 herbicides, 3 insecticides, and 6 fungicides) were analyzed in soil solutions at 50 cm soil depth collected by suction cups. Pesticide concentrations showed a high variability within each molecule (with an average factor of 4000) and between the molecules measured (with an average factor of 1000). The highest concentrations (median concentration >1 µg L-1 and maximum of 2331 µg L-1) was observed for S-metolachlor and its metabolites. The results did not show significant differences between the modalities in the experimental conditions tested. Using partial least square regression and decision trees, environmental variables such as organic carbon content, soil pH, and soil water stock, however, were dominant in controlling the transfer of pesticides by limiting or promoting their presence in the soil solution. The temporal factor was also a key factor, favoring the dissipation and/or degradation of molecules (in particular for S-metolachlor, glyphosate, and azoxystrobin), while the concentrations observed during the fallow period were relatively higher than those measured at the end of the previous culture. The trends observed were, however, largely dependent on the physicochemical properties of the molecules studied, controlling their dynamics in the environment.

Keywords: pesticides,transfer,soil,solution,practices

ID ABS WEB: 137152

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

REVEALING THE IMPACT OF COVER CROPS ON SOIL FUNCTIONALITY AND BIODIVERSITY IN APPLE ORCHARDS

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Cover crops are a valuable food source for microorganisms and soil fauna, shaping key biogeochemical cycles in agricultural ecosystems and carbon (C) sequestration. The study aims to evaluate the impact on soil microbial functionality and biodiversity of two distinct cover crop mixtures (Hühnerauslauf, a mixture of low-growing grasses, and Südtirolmischung, which contains predominantly Leguminosae). In close cooperation with regional farmers, the study is carried out in six different apple orchards in South Tyrol, Italy, each characterized by differing agronomic practices. Soil samples are collected at two depths (topsoil: 0-30 cm, subsoil: 30-60 cm) three times a year (spring, summer, and fall). Soil microbial functionality is examined by measuring soil respiration and specific enzyme activity linked to the C cycle. As expected, the topsoil has higher respiration rates than the subsoil. Furthermore, results indicate that the time of sampling significantly affects soil respiration, implying that climatic or meteorological factors play a key role in influencing respiratory dynamics. The selected enzymes are currently being studied. This study can help us understand how cover crops affect soil biological functions and processes, which are essential to laying the foundation of agroecological strategies that promote C sequestration.

Keywords: Cover crops,soil biodiversity,soil respiration,enzyme activity,Soil microbial functionality

ID ABS WEB: 137305

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

SHAPING THE BACTERIAL AND FUNGAL MICROBIOME IN LEGUME-CEREAL INTERCROPPING

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Modern agriculture, characterized by its reliance on chemical inputs and non-renewable energy sources for high yields, is facing scrutiny due to its adverse impacts on public health and the environment. Recent revelations underscore the need to shift towards a more sustainable model incorporating ecological principles and ecosystem services, minimizing the use of chemicals and non-renewable energy. This alternative approach, termed agroecology, emphasizes the design of cropping systems to enhance both sustainability and production efficiency.
Adhering to agroecological principles involves adopting various practices with intercropping, crop rotations, cover cropping, green manure, reduced tillage, agroforestry. Among these practices, intercropping, cultivating multiple crops simultaneously on the same land, is particularly promising, as it offers substantial optimization of cropping systems through diversification. In these systems, legumes are a key functional group and highly valued for the agroecological services they provide.
The intercropped legume-cereal systems reduce interspecific competition by enhancing complementarity/facilitation processes thereby improving the exploitation of resources, which is, in turn, reflected in the increase in plant production corresponding to the greater efficiency of the agroecosystem. Plant production, including above- and belowground biomass, is positively correlated with microbial abundance and diversity. This microbial life is assumed to play a significant role in the availability and transfer of soil nutrients to plants as well as in plant health and soil fertility.
Despite the importance of these interactions, limited research has explored the functional and genetic diversity of soil microorganisms in intercropped legume-cereal systems. The intricate nature of both the soil microbiome and plant holobiont has created considerable uncertainty regarding how different crop species influence the shaping of soil microbial communities, particularly the bacterial and fungal microbiomes in legume-cereal intercropping. Therefore, the aim of this ongoing study is to determine the functional and genetic diversity of microbial communities inhabiting the soil, rhizosphere and plant compartments in legume-cereal intercropping.
This study was supported in the frame of Horizon Europe Programme, agreement no. Project 101082289 — LEGUMINOSE

Keywords: intercropping,soil microbiome,legumes,biological activity,functional diversity

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4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

SOIL HEALTH IMPROVEMENT BY USING UROCHLOA TROPICAL GRASSES AS A COVER CROP IN A FORAGE-MAIZE ROTATIONAL SYSTEM

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The introduction of Urochloa grasses in rotation with maize is a viable option in tropical regions to mitigate nitrogen (N) losses from the soil as nitrous oxide (N2O). Urochloa grasses are known for their deep rooting ability and the improvement of soil properties as observed in permanent pastures. However, the specific impact of Urochloa grasses on soil health when introduced as a cover crop in rotation with maize is unknown. The main objective of this study was to evaluate the residual effect of Urochloa grasses on soil aggregation and soil macrofauna of the subsequent maize crop. The field trial was established in 2016 with the planting of nine Urochloa grass genotypes in 20 x 20 m plots (n=3), along with three control plots left as bare soil treatments. At the end of 2019, maize was introduced to half of each plot, resulting in a comparative analysis between permanent grasses, maize grown on previous grass plots and those on bare soil, alongside conventional maize treatments. Soil samples collected in 2023 from a 0-20 cm depth across the treatments revealed that permanent grasses significantly promote higher aggregate stability (mean weight diameter, mm), due to a higher proportion of macroaggregates (water-stable aggregates> 2mm). These results can be explained by the origin or formation pathway of soil aggregates, because in the treatments with permanent grasses a higher proportion of aggregates of root origin was obtained (about 15%). We found that soil aggregates in maize grown on previous grass treatments were more stable (42%) than those from conventional maize treatment. A total of 10 groups of soil macrofauna were identified, the most diverse groups were found in maize grown on a previous grass treatment, which were related to groups that live on the soil surface (Diplopoda, Symphila and Diplura). Results from this study indicate that Urochloa grasses grown as cover crops could provide soil health benefits linked to soil structure and soil organic carbon sequestration.

Keywords: Crop rotation,Forage grasses,Soil aggregation,Aggregate stability,Deep rooting

ID ABS WEB: 138153

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

EXPLORING THE IMPACT OF REGENERATIVE AGRICULTURAL MANAGEMENT PRACTICES ON SOIL MICROBIOME COMPOSITION AND ACTIVITY

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Increased concern over the rate of soil degradation and biodiversity loss within agroecosystems has prompted a shift from conventional to regenerative management practices. Cover cropping and shallow tilling are two practices widely associated with soil regeneration as opposed to leaving soil bare and conventional tilling. The soil microbiome is central to plant growth, soil fertility and overall agricultural sustainability. Its composition and activity are highly susceptible to shifts in management and serve as early stage indicator of soil health. However, empirical data characterizing soil microbial parameters in response to shifts in agricultural management practices remains scarce and disparate.

We assessed the taxonomic and functional composition of soil fungal and bacterial communities extracted from a sectioned homogenized plot subjected to shallow tilling and cover cropping, shallow tilling without cover cropping, conventional tilling and cover cropping, and conventional tilling without cover cropping. Extracellular enzyme activity was quantified to assess microbial activity. Soil sampling was repeated in June, August and September to assess seasonal variability. Targeted metagenomics sequencing of the V4 region of 16S-rDNA and the ITS1 region of ITS-rDNA was conducted to respectively identify soil bacterial and fungal community composition. Bacterial and fungal functions were assessed using FAPROTAX and FUNGuild respectively. Activity of ß-glucosidase (BG), acid phosphatase (AP) and N-acetylglucosaminidase (NAG) was colorimetrically determined.

Thus far, metagenomics analysis of the first time point revealed shifts in microbial community composition and activity. Fungal alpha-diversity significantly increased when shallow tilling was applied rather than conventional tilling. However, fungal alpha-diversity was unchanged with respect to cover cropping, suggesting that tilling regime has a profound impact on fungal communities that cannot be remediated by cover cropping between growing seasons. BG, AP and NAG activity significantly increased when cover cropping was implemented rather than leaving soil bare. BG, AP and NAG activity was unchanged relative to tilling regime. Thus far our soil analysis might indicate that tilling and cover cropping affect soil health via distinct, non-trivial mechanisms.

Keywords: Soil microbiome,Regenerative agriculture,Soil health,Metagenomics,Extracellular enzyme activity

ID ABS WEB: 138167

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

ENHANCING SUGARCANE HEALTH: SUSTAINABLE STRATEGIES FOR FUSARIUM CONTROL THROUGH CROP RESIDUE MANAGEMENT

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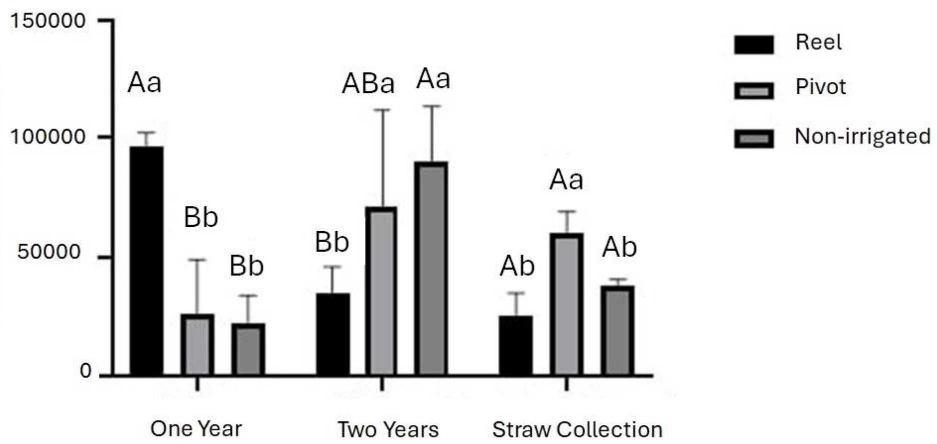
The use of crop residue in sugarcane as a measure for controlling fungal diseases has proven to be an efficient and sustainable practice in agriculture. Fusarium wilt, caused by Fusarium oxysporum, is of significant importance in various sugarcane-producing regions worldwide and can cause serious damage to plantations. One of the major issues is the persistence of the pathogen in the soil. The fungus penetrates the roots and colonizes the vascular system, disrupting the proper flow of water and nutrients to the upper parts of the plant.

For the genomic DNA extraction process from soil samples, the DNeasy® PowerSoil® Pro Kit (Qiagen) was utilized, following the manufacturer's established protocol. Specific primers for the identification of Fusarium oxysporum were used for qPCR analyses. Three cultivation types were evaluated: reel and pivot with their respective irrigations, and non-irrigated cultivation. Regarding crop residue management, collection was assessed after 1 year, 2 years, and with no residue collection.

There were differences in the years evaluated for residue collection. The reel irrigation had the highest pathogen population in the first year, while non-irrigated and pivot had the highest population in the second year of residue collection. For the no-collection treatment, there was no difference in pathogen population. In terms of irrigation, within the first year, the reel had the highest pathogen population again. In the second year, it was precisely the reel that had a lower population, indicating that with 2 years of residue collection, the reel seems to have a greater impact on reducing the population of Fusarium oxysporum for sugarcane. For the year with no residue collection, the pivot had a higher pathogen population. In conclusion, this study underscores the nuanced impact of irrigation methods and residue collection timelines on pathogen populations, providing valuable insights for optimizing agricultural practices and promoting the long-term health and productivity of sugarcane plantations worldwide.



Keywords: Sugarcane,Crop residue,Control of fungal diseases,Fusarium oxysporum,Fusarium wilt

ID ABS WEB: 138224

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

TERROIR UNVEILED: EXPLORING THE IMPACT OF UNTER-ROW SOIL COVERS ON GRAPEVINE TERROIRS IN TOKAJ

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Terroir, defined as a man-made ecosystem where the vine interacts with soil and climate, emphasizes the importance of understanding the specificities of the production environment for quality wine production. Global and local climatic variations significantly impact vine- growing areas, microclimates, and grape- and wine quality. Implemented in vineyards in Tokaj wine region with varying soil types (loamy, sandy loam, and clayey) and climatic conditions, the underrow cover experiments focus on soil biological effects and grapevine responses. Employing consistent grapevine varieties (Vitis vinifera L. convar Furmint) and rootstocks ('Richter 110' Vitis berlandieri×V. rupestris) ensures comparability for physiological measurements of vines, enabling the detection of terroir differences and effects induced by under-row covers. In our research, we examined the soil components of the wine terroir by physical, chemical, and biological measurements. The treatments used were Lucerne hay and underbelly wool as row cover. As a ground cover, mulch affects water retention, nutrient availability and microbial activity, influencing the expression of terroir. Based on our preliminary results, we determined that the enzyme tests related to the nutrient cycle in the soil (phosphatase, glucosidase) did not show any significant difference after the short time that had passed since the planting in the spring of 2023. In case of the FDA enzyme used as an indicator of biological activity, a higher activity value was observed in wool- covered treatments. In summary, studying the soil component of the wine terroir through research on soil covers like mulching offers insights into various aspects of vineyard management, ranging from water conservation and weed control to soil health and sustainable practices, ultimately influencing grape quality and wine characteristics in the unique terroir of Tokaj. Researching its effects aligns with the global trend toward sustainable agriculture and can provide evidence to support environmentally conscious viticultural practices. This multidisciplinary approach can help to preserve the current terroirs and identify new opportunities.

Keywords: grapewine,underrow cover,soil biological activity,wool mulch,terroir

ID ABS WEB: 138552

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

EXTREMOPHILE MICROORGANISMS TO DEVELOP À LA CARTE BIO-INOCULANTS FOR A SUSTAINABLE AGRICULTURE

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The rhizosphere is recognized as the environment with the highest biological activity on Earth's surface. This space is where root exudates converge with the rhizosphere microorganisms, taking advantage in the rapidly available source of carbon and energy utilized by millions of bacteria and fungi, many of which promote plant growth or enhance the nutritional characteristics of agrifood products, thereby increasing plant tolerance to various environmental stresses. This is crucial in a scenario dominated by climate change, which is negatively affecting agricultural production needed to sustain the growing global population. However, the coexistence of diverse groups of microorganisms in microbial communities generates a range of ecological relationships that can be synergistic, neutral, or even detrimental. Therefore, it is necessary to understand the compatibility between different microorganisms intended for use and their impact on native soil communities where they will be inoculated. This adds a higher degree of complexity, which must include a deep understanding about how other agricultural or environmental management alternatives can 'condition' the rhizosphere to favor plant establishment and growth, referred to as rhizosphere management or rhizosphere engineering. Here, we present the most relevant experiences and results obtained by our research group regarding the use of Plant Growth-Promoting (PGP) microorganisms, with a special focus on arbuscular mycorrhizal fungi (AMF), free-living yeasts, and bacteria, which have been isolated from a wide range of extreme environments in Chile (Atacama Desert, high mountains, contaminated soils, and Antarctica, among others). Emphasis will be placed on results demonstrating their benefits in environments dominated by toxic elements, drought, and salinity. Finally, we will discuss their projections in the current scenario of global climate crisis, including a comprehensive overview from their isolation in extreme environments, their characterization in plant growth promotion, and the feasibility of their use in consortia designed à la carte to be used as inoculants for different agricultural species.
Acknowledgements: Research supported by ANID/FONDECYT/1210964, ANID/FONDAP/15130015, INACH_RT_16_20 and R22A10003 GORE O'Higgins grants.

Keywords: Arbuscular mycorrhizal fungi,PGP bacteria,Yeast,Bioinoculants

ID ABS WEB: 139315

4. Soil health in achieving the Sustainable Development Goals
4.09 133435 - Optimization of plant-soil-microbe interaction under crop diversification

OVERCOMING BARRIERS TO THE ADOPTION OF INTERCROPPING IN THE UK

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Conventional cropping deteriorates soil quality and reduces biodiversity. There is an urgent need for more sustainable yet productive systems. Intercropping involves growing two crops together, enhancing biodiversity and productivity. However, few UK arable farmers practice intercropping. We held a workshop with farmers and stakeholders to conduct a SWOT analysis of intercropping. The key strength identified was improving biodiversity and resilience. The main weakness was “the need to separate and market the product. The major threat was lack of knowledge. The main opportunity identified was “increasing in grain protein and reducing nitrogen use.

The LEGUMINOSE project aims to reduce the barriers to intercropping by conducting applied scientific research. 20 on farm trials are being established across the UK to compare legume/cereal intercropping with their respective monocultures. The overarching objectives of the trials are to determine whether intercropping could (i) reduce the use of pesticides by suppressing weeds, pests and pathogens and improving beneficial species; (ii) improve soil fertility by increasing belowground biomass and thus C sequestration and reduce GHG emissions and (iii) increase the yield of the main crop. Field trials have been established on the University of Reading research farm. Our preliminary data indicates that the land equivalent ratio generally decreases when applying nitrogen fertiliser to cereal/legume intercrops. However, applying a higher rate of nitrogen results in a greater land equivalent ratio than applying a low amount.

Our future trials will attribute intercropping yield benefit (land equivalent ratio) to nitrogen supply or other factors by combining wheat with legumes (faba beans, lupin and soybean). These trials will provide data for farmers to decide how much less nitrogen to apply to wheat intercropped with legumes while retaining premiums for grain protein content and maintaining biological nitrogen fixation. Measurements include crop yield and quality (e.g. N content of grain) and nitrogen losses through emissions and leaching. The poster provides the rationale for our trial designs for the purpose of obtaining peer feedback.

Department of Geography and Environmental Science

University of Reading

Overcoming barriers to the adoption of intercropping in the UK

Tom Sizmur | Jerry Alford | John Hammond | Martin Thorsoe | Imelda Uwase | Shamina Imran Pathan

Introduction

Intercropping is when two crops of different species are grown together in the same field at the same time. Intercropping can enhance biodiversity, maximise land productivity, and optimise biogeochemical cycles in agroecosystems. However, intercropping is adopted by very few UK arable farmers.

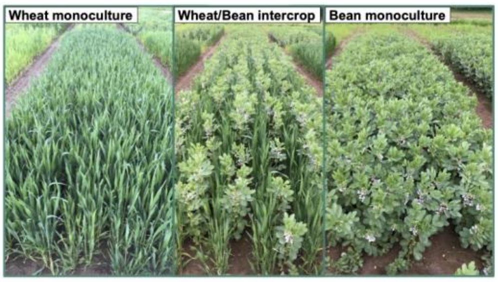
Workshop outcomes

We held a workshop with UK conventional and organic farmers and other stakeholders to conduct a SWOT (Strengths, Weaknesses, Opportunities, and Threats) assessment of intercropping in the UK.

Strength	Weakness
the opportunity to improve farm biodiversity and resilience	*the need for separation and a market for the product*
Opportunity	**Threat**
an increase in grain protein content and a reduction in nitrogen use	*the lack of knowledge to get it right*

The LEGUMINOSE project

The LEGUMINOSE project aims to reduce the barriers to intercropping by conducting applied scientific research. Twenty on-farm trials will be established across the UK to compare legume and cereal intercrop mixtures with their respective monocultures.



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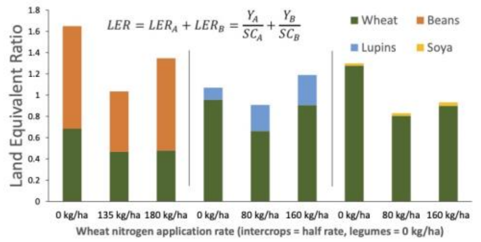
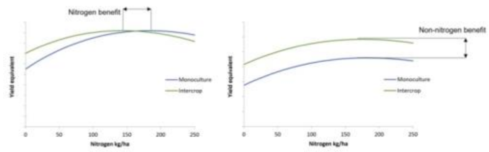
Preliminary research trials

Field trials have been established on the University of Reading research farm. Our focus is on combining wheat crops with legumes. Our preliminary trials used legumes that have previously performed well in prior field experiments (faba beans and lupins) and an emerging UK crop (soybeans). Wheat and faba beans were planted in autumn 2022. Wheat and lupins or soybeans were planted in spring 2023. We observed poor establishment of lupins and soyabeans due to cold weather in spring 2023. Our preliminary data indicates that the land equivalent ratio generally decreases when applying nitrogen fertiliser to cereal/legume intercrops. However, applying a higher rate of nitrogen results in a greater land equivalent ratio than applying a low amount.



Future research trials

Our future research trials specifically aim to attribute the yield benefit that intercropping makes to the supply of nitrogen, or to other factors. We have designed the trials to provide data that will enable farmers to decide how much less nitrogen they need to apply to a wheat crop to achieve milling quality grain when the wheat is intercropped with a legume.



Measurements will comprise crop yield and quality (e.g. N content of grain), nitrogen losses (N_2O emissions and NO_3^- leaching) and soil physical, chemical, and biological properties that underpin soil health (e.g. soil structure, nutrient availability, organic matter, and microbial activity).

Acknowledgements

- Richard Casebow, Caroline Handley, Nephele Swann, Simone Osborn, Ben Adams
- This project has received funding from the European Union's Horizon Europe Research and Innovations programme under GA No 101082289 and is supported by the United Kingdom Research and Innovation under the Horizon Europe Guarantee [Grant Numbers 10039837 and 10057156].

Keywords: Cereal-legume intercropping,Trials,Nitrogen,Yield,Soil fertility

ID ABS WEB: 135971

4. Soil health in achieving the Sustainable Development Goals
4.10 133439 - Soil health implications of adapting to the Planetary Health Diet

IMPLICATIONS OF THE PLANETARY HEALTH DIET TO THE NITROGEN ISSUE: A SOIL HEALTH AND FOOD SECURITY PERSPECTIVE

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Nitrogen (N) issue is a trade-off between the benefits of N use as fertilizers and industrial materials and the threats of various N pollution such as climate change, air pollution, and eutrophication due to the human-induced reactive N (N compounds other than inert molecular N) loss to the environment. It has been assessed repeatedly that human-altered N cycling has transgressed the planetary boundaries since its first report in 2009. One of the fundamental reasons of the N pollution is the low N use efficiency in food system, where N use efficiency (NUE) of animal production tends to be lower than that of crop production. The planetary health diet based on plant-based food is effective also to mitigate the N pollution. Even the NUE of crop production is not high, and therefore high N input crop production results in the N loss from cropland to the environment and imbalance of soil health in terms of eutrophication. On the other hand, in countries where fertilizers are difficult to obtain due to economic conditions, there are concerns about soil health degradation and food insecurity due to exploitation and overuse of cropland soil. Planetary health diet can be diverse, and each country and region should have its own model based on its soil, climate, traditions, and food culture. In this regard, consideration should also be given to the international supply chain of food and feed commodities. The presenter is working on inter- and trans-disciplinary research to address the N issue as the leader of Sustai-N-able Project (https://www.chikyu.ac.jp/Sustai-N-able/en/index.html) funded by the Research Institute for Humanity and Nature, Japan as well as the director of the East Asia Regional Centre of International Nitrogen Initiative. An important action is to promote awareness of the N issue to various stakeholders and to facilitate their engagement.

Keywords: Nitrogen issue,Nitrogen use,Nitrogen pollution,Soil health,Food security

ID ABS WEB: 137417

4. Soil health in achieving the Sustainable Development Goals
4.10 133439 - Soil health implications of adapting to the Planetary Health Diet

SEEDLING PRODUCTION AND TOP DRESSING FERTILIZATION FOR THE ESTABLISHMENT OF BARUZEIRO (DIPTERYX ALATA VOGEL) IN A RED LATOSOL IN THE CERRADO BIOME

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The baruzeiro (Dipteryx alata Vogel) has high potential for food, timber and medicinal use. It is among the species with high demand for domestication, promoting the diversification of species in cultivation, consolidation of its production chain and expanding the sources of obtaining the fruit, which currently come exclusively from extraction in areas with native vegetation. To this end, an experimental plantation was set up at Embrapa Cerrados (Planaltina, DF) with the aim of evaluating the establishment of two baruzeiro progenies subjected to three levels of top dressing under field conditions. The seedlings were produced in nurseries from the seeds of two selected matrices, progenies G1 and G2, from the Embrapa Cerrados germplasm bank. The experimental design was in randomized blocks with three replications and a factorial subdivided plot layout, with two factors being studied (fertilization and progeny) and levels of top dressing fertilization with increasing doses of nitrogen, phosphorus, potassium and boron (T1, T2 and T3) being allocated to the plots (32 plants) and the progenies to the subplots (16 plants). The spacing between plants was 7 m x 7 m, totaling 288 plants in the experiment. The development of the plants was assessed at 3, 6, 9, 12 and 18 months after planting, by verifying neck diameter, plant height and crown volume. The results showed that at 6 months the G2 progeny stood out in terms of height growth. At 9 months, the dry season contributed to a reduction in crown volume. Up to 12 months, there was no significant interaction between the levels of fertilization and the progenies for all the variables evaluated, and with the return of the rainy season, the plants resumed growth. At 18 months after planting, there was a significant interaction between the progenies and the top-dressing treatments. The response to maintenance fertilization was different between the two genotypes studied.

Keywords: Dipteryx alata,genotypes,plant nutrition,production system,Cerrado Biome

ID ABS WEB: 137856

4. Soil health in achieving the Sustainable Development Goals
4.10 133439 - Soil health implications of adapting to the Planetary Health Diet

THE TERM AGRICULTURE NEED TO DIVIDE FOOD PRODUCTION FOR ANIMALS (COWS, PIGS, CHICKENS MAINLY) AND FOOD FOR HUMAN CONSUMPTION

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In the past 4th Global Soil Security Conference (Seoul, 2023) important conceptual concepts were treated equally.

When speaking about soil security, soil depletion, soil erosion, soil risks or environmental pollution (air, soil and water) it will be very helpful to know that it is not the same to produce food to feed the cattle and the farmed animals, than to feed people.

The amount of land (deforestation), water, and pollution generated to produce food for animals is much bigger than what will be needed to feed humans with fruits, flowers, vegetables, seeds, grains, roots, or fungi. Without meat or animal products.

How are we going to secure food production for the next years to come? Depleting the soil, the land and the water, the environment and the biodiversity; or working as scientists, professors and professionals to educate the population in the consumption of much less harmful food?

The change suggested will not only improve the soil and environment. Several studies have shown that the population living in rural areas without consuming meat is in much better health condition compared to urban areas with highest consumption of meat and animal products.

In addition, this will promote a much more respectful relationship with other sentient animals avoiding killing billions each year. Industrial agriculture (the vast majority) has the animals living in deplorable conditions of overcrowding. Even in the best slaughterhouses, animals die horribly. As Paul McCartney said: if slaughterhouses had glass walls...

Cultural changes need to be guided by knowledge, not by the lobby of important companies to save their brands and interests.

More people live on the planet now compared to all other eras and 5 times more meat and animal products are available now due mainly to industrial agriculture.

We do not need anymore animal foods to get proteins. A plant based diet will feed many more people in the future and without harming the environment and the animals and additionally improving our own health.

Keywords: Animal agriculture,Food human consumption,deforestation,water,pollution

ID ABS WEB: 136156

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

SOIL QUALITY CHANGE AND SPATIAL DIFFERENTIATION CHARACTERISTICS OF GREENHOUSES LAND SOIL IN LHASA RIVER VALLEY, QINGHAI-TIBET PLATEAU

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Soil quality problems often arise in the process of greenhouse agriculture pursuing economic benefits. There are also signs of soil quality changes in the Qinghai-Tibet Plateau greenhouse land, and the regional differentiation pattern of soil quality changes in the Lhasa Valley. Taking the arable land soil samples as the references, this study collected 240 soil samples of greenhouse land and 112 soil samples of arable land. The texture, pH value, organic matter, soil heavy metals elements etc. were determined. The comprehensive soil quality index (SQI) and factor detector methods were used to study the soil quality changes and spatial differentiation characteristics, and the main factors of soil quality changes in the greenhouse land soil were identified. The results showed: 1, The comprehensive soil quality indices of the Lhasa valley greenhouse land and the arable land soil were 0.36, and 0.43, respectively. The soil quality of the greenhouse land was relatively high on the sunny slopes within 930 m from the river at an altitude of 3,700~3,750 m. 2, There were spatial differences in the degree of soil quality variation in the study area. The SQI of the greenhouse land decreased by 16.28% on average compared to that of the larger field farmland. 3, There was spatial heterogeneity in soil quality changes in the greenhouse land affected by altitude and slope direction. With the increase of elevation and the change of soil quality from sunny slope to shady slope, the change of soil quality in the agricultural land facilities showed a significant trend of increase. 4, The soil quality change in the whole region was generally affected by changes in salt content, available potassium and cadmium content and the explanatory power of all three could reach 20%. Under the changing influence of salt accumulation, available potassium and cadmium content changes, the overall soil quality of the study area's greenhouse land showing a decreasing trend and varied significantly in different regions.

Keywords: Greenhouse soil,Soil quality,Spatial differentiation,Lhasa river valley,Qinghai-Tibet Plateau

ID ABS WEB: 137723

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

ASSESSING AND MAPPING SOIL-BASED ECOSYSTEM SERVICES OF THE EMILIA-ROMAGNA APENNINES

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This work presents the results of the implementation of a methodological framework to assess and map the multiplicity of soil-based ecosystem services, based on measured soil data (N = 10309) for a reference depth of 30 cm for the hilly and mountainous area (10532 km2) of Emilia-Romagna (NE Italy). The methodology consists of: (i) definition of soil based eco-system services indicators (SES), based on available soil data and on societal demands; (ii) definition of appropriate indicators for SES potential supply and coding; and (iii) assessment and eventually mapping of soil based multiple ecosystem services at a 100 m resolution.
In this work we used spatial data to characterize and model the spatial heterogeneity of the following provisioning, supporting, and regulating SES resorting to Digital Soil Mapping (DSM) techniques: habitat for soil biodiversity, buffering capacity, carbon sequestration, food provision, biomass provision, erosion control, water regulation and water storage. In addition, an overall soil quality index based on selected SES is assessed and mapped. In order to explicitly take into account the spatial variability and the related uncertainty, and in order to exploit at best the available information, we: (i) realized a continuous coverage (on a 100 m regular grid) of basic soil properties (coarse fragments, sand, silt and clay fractions, organic carbon content, pH) via Quantile Random Forest (QRF) resorting to categorical and continuous covariates available over the entire area and (ii) derived the relevant soil properties (e.g. bulk density, porosity, retention properties, hydraulic conductivity) via locally calibrated pedotransfer functions.
Results are presented and analysed in terms of land use and pedolandscapes, to highlight how in the study area different mountain soils under different land use contribute to the potential supply of multiple ecosystem services, providing information for sustainable soil management and land planning.

Keywords: Soil ecosystem services,Soil properties and functions,Indicators,Emilia-Romagna Apennines,Digital Soil Mapping

ID ABS WEB: 137814

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

"CAMPO RUPESTRE" – AN OLD CLIMATICALLY-BUFFERED INFERTILE MOUNTAIN RUPESTRIAN GRASSLAND (OCBIL) ENDANGERED BY THE EXPANSION OF IRON MINING ACTIVITIES

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Federal University of Ouro Preto, Ouro Preto, BRAZIL

Campos Rupestres (CR) are montane ecosystems, present at altitudes above 900m, which develop on rocky outcrops or shallow/nutrient-poor soils, mainly derived from the weathering of quartzites (QCR) and banded iron formations (FCR). They are ancient ecosystems, which developed under stable and very specific edaphoclimatic characteristics, whose soils and communities co-evolved over thousands of years, in other words, an OCBILs (Old, Climatically-Buffered Infertile Landscapes). CR are especially important in regions that house large reserves of iron ore, characterized by presenting different types of vegetation, with a great richness of species (many endemic), result of their isolated geographical position, on hilltops. Recent changes in environmental legislation of Minas Gerais State (Brazil) allow mining companies to compensate (exchange) half of their degraded area with the preservation of different vegetation complexes, if there is an "ecological equivalence", an equivalence that does not include edaphic parameters. Undoubtedly, the lithotypes (quartzites and banded iron formations) and their derived soils are determinants of the vegetation spectrum, distribution, and species richness of the CR. This research aimed to assist in the scientific understanding of this issue by analyzing geochemical data from soils in the Iron Quadrangle (QF), one of the few regions in the world that has CRQ and CRF with the same geological evolution. The results show that theit soils have significantly different average concentrations and background values (FCR > iron and phosphorus; QCR > barium, copper, and potassium). Furthermore, the large standard deviation values obtained from elements concentrations analysis demonstrate the great heterogeneity of soils, even within the same ecosystem, CRQ or CRF (especially manganese). Maps of element concentrations isovalues reinforce these geochemical variations. Considering the differences observed, it becomes clear that these areas should not be automatically defined as equivalent and used for environmental compensation, running the risk of losing part of the ecosystem services they provide, considering especially that they are aquifers recharge areas and their importance to the sustainability of downstream regions.

Keywords: mining impact,OCBIL,environmental legislation

ID ABS WEB: 137978

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

FROM SOIL TO FORAGE IN ALPINE REGION: THREE-YEAR MONITORING OF NUTRIENT AND ORGANIC CARBON CIRCULARITY IN MOUNTAIN PERMANENT MEADOWS

D. BONA, D. BERTOLDI, S. SILVESTRI, G. IUSSIG

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The study has been performed in an Alpine Valley. Dairy farms are essential for several reasons, including the impact on tourism. Part of the milk produced was collected and processed to produce quality dairy products, and their production protocol requires the use of fodder from the origin area. A consortium plant to treat the manure produced from local farms (115 KWe; feed with 19,000 tons/year of manure) has been built (2019). The liquid digestate (LD), after separation, returns to the permanent grasslands as fertilizers. The solid fraction is mainly delocalized to nearby vineyards. The work aims to monitor (from 2020 until 2022) the fertilizer used (LD), soil, and forage produced in three permanent grasslands at three different mowing dates (June, July, and September).
The LD had a low dry matter (DM) (4.66%) and volatile solids content (74.52%DM), while nutrient content was high (6.45%DM of N; 4.38%DM of Ammonia; 1.77 %DM of P; 9.13 %DM of K). The forage productivity ranged from 7.5 to 11.5 (tons/ha) with annual and seasonal (mow) differences. The nutritional properties of forages show differences among mow and years. The crude protein was about 12–22 (g/100 gDM), the total fibre was from 18-34%, the nitrate content was about 1000 mg/kgDM, and the phosphorus and potassium were 0.1–0.8% and 2.5–4.5%. The soils had a high content of SOM (6-16%) and good nutrient content. The higher value of N was 4 g/kg; exchangeable K values were always greater than 1000 mg/kg, and Mg values were between 400 and 800 mg/kg. Phosphorus has the year's greatest variability: 2020 showed the lowest values (around 200 mg/kg) while 2021, had the highest (between 600 and 900 mg/kg).
The main output of this work is the monitoring of the nutrient and organic carbon circularity in mountain areas to improve farming practices for soil health maintenance, and for ensuring higher quality forage for livestock.

Keywords: Digestate,Permanent Meadows,Forage,Nutrient,Soil organic carbon

ID ABS WEB: 138078

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

MANAGING AGROPASTORAL LAND TO PRESERVE SOIL BIODIVERSITY AND PROVISION OF ECOSYSTEM SERVICES (MAIELLA MASSIF, ITALY)

E. GAGNARLI [1], M.C. ANDRENELLI [2], S. SIMONI [1], L. DI MARTINO [3], C. BECAGLI [2], F. TARCHI [1], V. DI CECCO [3], M. DI SANTO [3], T. FABBRICATORE [1], S. GUIDI [1], D. GOGGIOLI [1], B. PENNELLI [2], M. RENZAGLIA [2], C. DI BENE [2]

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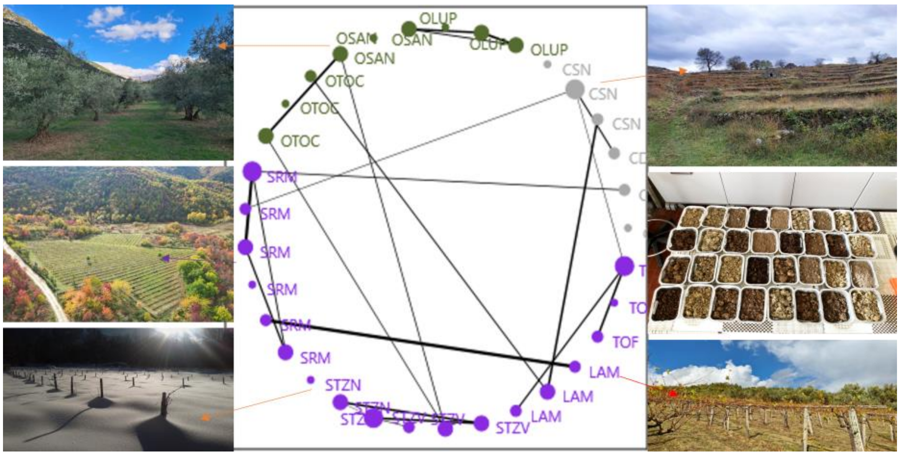
Intensive agricultural systems are facing significant challenges worldwide related to high production costs, land abandonment, and rural depopulation. In the Central Apennines of Italy, the sustainable land use policies adopted in the Maiella National Park retain biodiversity and protect soil from degradation by promoting agro-ecological practices linked with maintenance of indigenous crop varieties, self-production seeds, ecological infrastructures as dry stonewalls and huts for ancient pastoralism, and use of natural cover crops. The present study aimed to evaluate the effect of different cropping systems on biodiversity conservation and soil functionality, using a multidisciplinary approach. The study area is characterized by a compact limestone massif, rich in geosites with humid subtropical climate (Csa - Köppen classification). Nine sites are selected according to cropping systems: four heroic vineyards with different cultivars (i.e., Vedovella, Nero Antico, Pecorino, Trebbiano, Montepulciano), three olive orchards (Toccolana, Intosso, Rustica-Gentile) and two terraced high mountain meadows. To evaluate the soil functionality of the upper layer (10 cm), from 2021 to 2023, in Autumn, the soil was sampled to analyze water retention, pH, texture, electrical conductivity (EC), total organic carbon content (TOC), and edaphic microarthropods community using soil biological quality index (QBS-ar), abundances, and ecological indices. The main findings highlighted that land use affected soil characteristics (MANOVA, $p<0.001$; Tukey HSD test). Soils of meadow and old vineyards were fine-textured, with high TOC, neutral pH, and high moisture (GWC= 23%), while in olive orchards, soils were coarse-textured, with alkaline pH, and low moisture (GWC= 14%). High values of microarthropod density and richness were registered in soils of the three cropping systems. The QBS-ar index was very high in old vineyards (>200). In olive orchards, the tillage practice, although reduced, has a negative impact on the eu-edaphic arthropod community. Vineyards and olive orchards, which are integrated into their surroundings, turned out to be more resilient.



Keywords: sustainable agriculture,edaphic arthropods,soil functionality,olive orchards,indigenous grape variety

ID ABS WEB: 138101

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

SAVE THE LIFE-SUSTAINING MATTIC LAYER ON THE QINGHAI-TIBETAN PLATEAU

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A striking phenomenon in alpine meadow on the Tibetan Plateau is the prevalent occurrence of a mat-like surface soil layer, which mantles most of the land wherever environment allows. This typically fine-textured, organic-rich and fairly resilient mattic layer protect both topsoils and subsoils from erosion, which is fundamental for soils' multiple ecological functions and ecosystem services. The significance of this thin life-sustaining soil layer, however, has not been well acknowledged. From the perspective of earth surface system, we proposed that formation of the mattic layer was a long-term interaction of biological, sedimentological and pedological processes, which renders the mattic layer as a nonrenewable resource. We emphasized the ecological significance of the mattic layer by highlighting its key role in providing multiple ecosystem services such as primary productivity, soil conservation, as well as water and carbon regulation. It is no exaggeration to say that without the mattic layer, the ecosystem of the Tibetan Plateau is doomed to collapse. We appealed that more investigation and field monitoring should be conducted over a broad area to evaluate the impacts of climate changes and existing management practices on the health of the mattic layer and call on the central and local government to prioritize the protection of the mattic layer to safeguard the Tibetan ecological security barrier and to achieve sustainability of soils and other natural resources thus overall ecological and socioeconomic security in Tibetan Plateau.

Keywords: Mattic layer,Qinghai-Tibetan Plateau,Ecosystem service,Kobresia pasture,Alpine ecosystem

ID ABS WEB: 138129

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

SOIL C AND N CYCLING AND BIODIVERSITY IN ALPINE GRASSLANDS (LTER SITE ISTITUTO MOSSO, NW ITALIAN ALPS)

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Alpine grasslands are fragile ecosystems formed by plant species that have developed different adaptations to survive and reproduce in harsh environments. In alpine tundra, among the typical vegetation communities, two different types can be distinguished: the snowbed communities and the alpine Carex curvula grasslands. The first ones are characterised by a long snow cover duration (SCD), whereas the second ones have a shorter SCD. In both communities, snow plays a crucial role on soil carbon (C) and nitrogen (N) dynamics. In snowbed communities, soil moisture, snow melt-out day, and duration of soil freezing are the main drivers of soil C and N dynamics, with a potential influence on bacteria and fungi characterised by various genes coding for enzymes involved in the soil C and N cycling. Mountain regions are particularly affected by global warming, with a higher temperature and an earlier spring snowmelt. Consequently, a potential transition from snowbed communities towards alpine Carex curvula grasslands can be hypothesized, thus leading to a loss of biodiversity. For this reason, in 2016 a research activity was started in the LTER site Istituto Mosso (2650 – 2900 m a.s.l., NW Italian Alps), with the topsoil sampling in a snowbed community and in a Carex curvula grassland, during the snow-free season, to evaluate the dissolved organic carbon (DOC), nitrate and ammonium content in soil extracts. The topsoil temperature and gravimetric moisture are measured since 2016, while from the autumn 2023 also the collection of the soil solution was carried out. The results show that the soil ammonium and DOC in the alpine Carex curvula grassland are significantly higher than in the snowbed community, while there is no significant difference in the nitrate content. Under a changing climate, it is crucial to study the potential transition from snowbed communities towards alpine Carex curvula grasslands and the functioning of these ecosystems.
Research supported by NBFC – University of Turin (DISAFA) - PNRR Project CN00000033

Keywords: Climate change,Alpine grasslands,N and C cycling,Biodiversity

ID ABS WEB: 138260

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

BLACK SOILS IN THE SOUTH SIDE OF THE ALPS: LARGE C STOCKS, STRONG WEATHERING DEGREE, GENETIC ISSUES

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Umbrisols are the most common soil type in the Southern side of the Alps, between Piedmont and the Lake District in Lombardy (NW-Italy) and Switzerland, particularly on sialic substrates and glacial till but also on carbonates, if the soil is sufficiently deep. They are best developed on southward aspects, and below chestnut, beech forests or anthropogenic grasslands, at montane elevations. Many of these soils, particularly if developed on stable surfaces above the LGM trimline (i.e., the upper limit reached by glaciers), have 20-40 cm thick A horizons, with fine granular structure and abundant roots, overlying black sombric or sombric-like horizons (80-120 cm of depth) lacking biogenic aggregation, containing very few roots, and characterized by very low bulk densities, even <500 kg/m3. Carbon stocks are very high, up to 40 kg/m2. Egli et al. 2008 found the black horizons to be rich in charcoal, whereas Blaser et al., 1997 interpreted them as spodic horizons dominated by Al and organic matter (OM), and lacking Fe. However, some of their properties were not considered and their pedogenic interpretation is dubious.
To better characterize the black horizon, and particularly its OM properties (e.g., age, stability, chemical recalcitrance to decomposition, mineral stabilizing factors) five well-developed Umbrisols were sampled, in different locations in NW-Italy, between Torino metropolitan area (west) and Lake Como (east); soil micromorphological observations, and detailed analysis on mineral weathering and on OM characteristics were performed.
The results show that these soils developed during long periods of time, and podzolization is not a primary pedogenic process; strong mineral weathering, associated with temperate temperatures and high rainfall, has been able to release large quantities of Al from the parent materials, creating the conditions for Andosolization-like processes.
These soils are highly resistant to erosion and to degradation, due to the strong stabilizing effect of some ions, but their high C contents and old age make them precious and worth of protection.

Keywords: Alps,Carbon stock,Pedogenesis,Umbrisols

ID ABS WEB: 140095

4. Soil health in achieving the Sustainable Development Goals
4.11 133521 - Caring for mountain soils, the hidden key to climate change adaptation and SDGs: challenges, threats, success stories

EXPLORING THE RELATIONSHIP BETWEEN SOIL BIODIVERSITY AND FOREST STAND ATTRIBUTES IN THE AUSTRIAN ALPS

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Soil biodiversity is essential to ecosystem services such as carbon sequestration and nutrient cycling but is threatened by mismanagement and global change. Austrian mountain forests are a global hotspot for soil biodiversity and carbon storage but are experiencing climate change at double the rate of lower altitude areas. Forest soil biodiversity is influenced by management-related drivers like forest stand structure, deadwood, and understory vegetation. However, these forest-specific drivers along with environmental variables have not been assessed in a combined monitoring program before.
AlpSoil is an ongoing project aiming to address these knowledge gaps with a twinned soil biodiversity study in the Northern Calcareous Alps and the siliceous Central Alps. We wish to integrate soil biodiversity surveys into existing forest biodiversity monitoring schemes at the Austrian Research Centre for Forests to test for drivers of soil community structure. Specifically, we address the following research questions: How is soil biodiversity influenced by 1) forest stand structure and 2) understory vegetation? 3) How does deadwood relate to soil organic carbon content and soil biodiversity? 4) What influences do pedological factors have on soil biodiversity?
Therefore, 60 study sites have been established on both calcareous and siliceous parent material in and around selected Austrian National Parks, spanning gradients of management intensity and altitude. Insect, bacterial, and fungal diversity in organic horizon and mineral soil has been measured with environmental DNA techniques alongside in-depth soil profile descriptions and forest stand structure, deadwood, and understory vegetation surveys. Additionally, soil organic carbon content, its bioavailability and soil pH have been measured.
Our results will provide a baseline for the status of soil biodiversity and will deliver information on important drivers of mountain forest soil biodiversity. We will inform stakeholders and the interested public about the importance of soil biodiversity for forest health and best practices to conserve it. Thereby, AlpSoil provides a key step for implementing soil biodiversity indicators into future country-wide forest biodiversity monitoring programs.

Keywords: Austrian mountain forest soils,soil biodiversity,forest biodiversity monitoring,soil organic carbon,forest structural complexity

ID ABS WEB: 135472

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

MODIFIED SPENT COFFEE GROUNDS AND BIOCHAR REMEDIATION OF HEAVY METAL CONTAMINATED URBAN SOILS IN GLASGOW

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Heavy metals have long been a major source of soil pollution for both urban and agricultural soils. Different remediation methods have been implemented, some of which have proved successful, and others haven't. Earlier cleanup methods' efficacy was prioritised, while today's innovative methods are assessed for sustainability, cost, and multifunctionality. Due to the low cost of the biomass and its purpose as part of waste reuse, the use of spent coffee grounds for soil restoration is a great example of a sustainable remediation strategy. It has been demonstrated that using raw coffee grounds and biochar to amend and improve soil is successful. The purpose of this study is to investigate how used coffee grounds can help soils immobilise heavy metals. Used coffee grounds will be utilised in two ways: half will be converted into Biochar (by pyrolysis at 550°C), while the other half will be used raw. Both will undergo additional hydrogen peroxide modification after being pyrolyzed to produce biochar. Raw SCG, modified SCG, pristine Biochar, and modified Biochar will be the four main treatments. Each of them will be divided into application rates of 5% and 10%, with each treatment being repeated five times. 500g of contaminated soil will be combined with these treatments in a plastic column. The treatments will spend six weeks in a temperature-controlled space, receiving regular irrigations of distilled or deionized water, with the leachate being collected and tested. The top of the column will be covered, gas fluxes will be measured. After six weeks of growth, bok choy plants will be examined for the presence of heavy metals to determine the impact of the treatments on the bioavailability of heavy metals. Heavy metal concentrations in the soil/SCG/Biochar combinations will also be analysed.

P/S Final poster will have some results

Keywords: Soil Remediation,Carbon sequestration,Biochar,Waste resuse,Heavy Metals

ID ABS WEB: 135940

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

EXPLORING ORGANIC HIGH TUNNEL SOIL HEALTH UNDER WINTER COVER CROP ROTATIONS

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High tunnels are semi-permanent structures used in temperate climates to increase vegetable production by leveraging shoulder seasons when open fields may be inaccessible due to cold weather or spring flooding. They have become increasingly popular with the advent of cost-share programs through the NRCS. However, HTs are associated with soil degradation through nutrient buildup, compaction, and yield losses. Organic high tunnels differ significantly from the open field due to a lack of natural rainfall, uneven soil wetting, and temperature differentials. Planting winter legume cover crops in rotation with summer vegetables is an emerging strategy to mitigate possible adverse effects. Yet, there is limited knowledge of how the planting and termination time of winter cover crops impact soil health and cash crop yield. Productivity tradeoffs are expected, as early fall cover crop planting and late spring termination may interfere with lucrative cash crop production windows. Conversely, extending the growth period of the cover crop may increase its potential to provide soil-enhancing biomass. This research evaluates the degree to which fall planting and spring termination time of two winter cover crops, hairy vetch (Vicia villosa Roth) and Austrian winter pea (Pisum sativum L.), affects 1) cover crop biomass, 2) pepper yield, 3) active soil organic matter pools (POX-C), and 4) plant-available soil nitrogen (N) in organically managed high tunnels. Biomass samples were collected pre-termination in spring 2022 and 2023. Soil samples were collected two weeks post-cover crop termination. Early-planted peas produced the most biomass in both years, while late-planted vetch produced the least. Termination time had varying effects, suggesting that initial fall biomass production is essential to total biomass production. Soil-N, POX-C, and cash crop yield data from both years are currently under analysis. This data will help farmers make informed decisions regarding the tradeoffs of planting winter cover crops in HTs.

Keywords: Soil Health,Cover Crops,High Tunnels,Organic Agriculture,Soil Organic Matter

ID ABS WEB: 135948

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

RHODOTORULA YEASTS - POTENTIAL TOOLS FOR BIOREMEDIATION OF HYDROCARBON AND OIL CONTAMINATED SOILS

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During past decades, the industrial and household wastes became a growing threat for the environmental health and balance. Bioremediation technologies based on metabolic intrinsic abilities of microorganisms to degrade organic and inorganic contaminants, represent an ecologic alternative for decontamination of polluted areas.
The yeast genus Rhodotorula comprises species able to assimilate a hydrocarbons and vegetable oils and to convert them into eco-friendly biocompounds. Our work focuses on three yeast strains from oil-polluted soil: Rhodotorula mucilaginosa CMGB-G1, Rhodotorula glutinis CMGB189 and Rhodotorula mucilaginosa CMGB188. The cell growth was monitored over a week on yeast peptone (YP) medium with 1% n-hexadecane, petroleum and fried sunflower oil (single used, reused). The R. mucilaginosa strains preferred the sunflower oil, CMGB-G1 showing an impressive growth within the first 48 hours on reused fried oil. R. glutinis CMGB189 grew onor hydrocarbons, but fried oil was also assimilated with a slow ascending slope during the whole experiment. Microscopy observations revealed interactions between the yeast cells and the hydrophobic substrates and presence of lipid droplets.
Biosurfactant synthesis was evaluated in the presence of fried oil, by calculating the emulsification index (E24%). Best biosurfactant producers were R. glutinis CMGB189 (49% on reused, 43% on single used fried oil after three days) and R. mucilaginosa CMGB-G1 (42% on reused fried oil after three days, 45% on single used fried oil after six days).
The MATH values suggested that the R. mucilaginosa strains incorporate the n-hexadecane by direct cell-droplets interactions, the assimilation mechanism of R. glutinis CMGB189 relying mostly on biosurfactant synthesis.
The PCR-RAPD biodiversity studies using seven primers (OPA01, OPA11, OPA18, OPE18, OPH15, OPH19; M13) recommended OPE18 as molecular marker for determination of phylogenetic relatedness based on strain origin of isolation, respectively, OPA18 and OPH19 for identification of interspecific polymorphism.
In conclusion, our three Rhodotorula strains represent promising candidates for the development of strategies aimed to combat soil pollution and to reintegrate degraded soils for a sustainable agriculture.

Keywords: Rhodotorula,polluted soil,bioremediation,hydrophobic wastes,sustainable agriculture

ID ABS WEB: 136096

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

TRACKING TRACE ELEMENTS DISPERSAL IN THE LIGNITE OPENCAST MINING ZONE USING SCOTS PINE (PINUS SYLVESTRIS L.) BARK AS PASSIVE SAMPLER – A CASE STUDY OF BELCHATÓW, POLAND

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The study aimed to evaluate trace elements dispersal in the opencast lignite mining zone using Scots pine bark as a passive sampler. The study was performed near Belchatów (Poland), where lignite opencast mining began in the 1940s and continues to the present day. Lignite opencast mining, its transport, combustion in power station, heaps, and fly ash settlers should be indicated as major sources of contaminants in this area. The study covered 815 km2, where the above-mentioned objects were centrally located. Scots pine bark was collected from 100 locations. The age of the trees ranged from 28 to 131 years, and their diameter from 20 to 44 cm. Bark samples were dried at 65°C and milled into powder. The contents of As, Ad, Co, Cr, Cu, Mn, Ni, Pb, Sr, V, and Zn were determined by ICP-OES (Avio 200, Perkin Elmer) prior samples microwave digestion in a mixture of 65% HNO3 and 38% HCl, whereas S by dry combustion (Vario MacroCube, Elementar). Results of the studies clearly show the large importance of lignite opencast mining as a source of trace elements in the surrounding environment. Their concentrations in pine bark strongly varied, reaching the highest values usually in the vicinity of emission sources. However, in more detail, spatial distribution patterns differed among elements. Some of them (As, Cd, Cr, Mn, Pb, Zn) were strongly affected by predominant wind directions, thus reaching the highest contents in the E and SE locations from emission sources. Another elements (Cu, Co, Sr, V) occurred at the highest amounts directly near the power plant station. This is probably due to their association with lignite dust. Generally, our study demonstrates the large role of lignite opencast mining and processing as a source of environmental contamination with trace elements. However, dispersal of these substances is a function of elements and environmental factors. Moreover, our study confirmed the relevance of pine bark as a sensitive bio-indicator of environmental pollution.

Keywords: trace elements,opencast mining,environmental contamination,bioindicators

EPOSTERS

ID ABS WEB: 136258

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

RESISTANCE OF SOIL TO PENETRATION AS A PARAMETER INDICATOR OF SUBSOLATION IN CROP AREAS OF SUGAR CANE

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Sugarcane is a very important economic crop that relies heavily on agricultural machinery, which contributes to soil compaction and a consequent decline in productivity. Subsoiling operation reduces the problems caused by compression; however, it is necessary to know its location and intensity. Accordingly, the aim of this work is to present a compression diagnostic method based on soil resistance to penetration as the parameter that indicates need for intervention in the subsoil. Measurements of penetration resistance was carried out in areas of sugarcane, located in the municipalities of Goianésia, Barro Alto and Santa Isabel, in the Brazilian state of Goiás. The Falker penetrometer (PLG 1020) was used, adjusted to a maximum depth of 40 cm and adopted as a critical resistance value of 4.0 MPa. The data were interpolated using kriging and adjusted in AutoCAD 2013 (Autodesk). The methodology proved effective in areas of compacted soil, and the surface layer had less resistance. The reduction in soil preparation was 96.54% and when considering the topographic adjustments, the reduction was 74.07%, showing the viability and importance of the diagnosis to show the proper management.

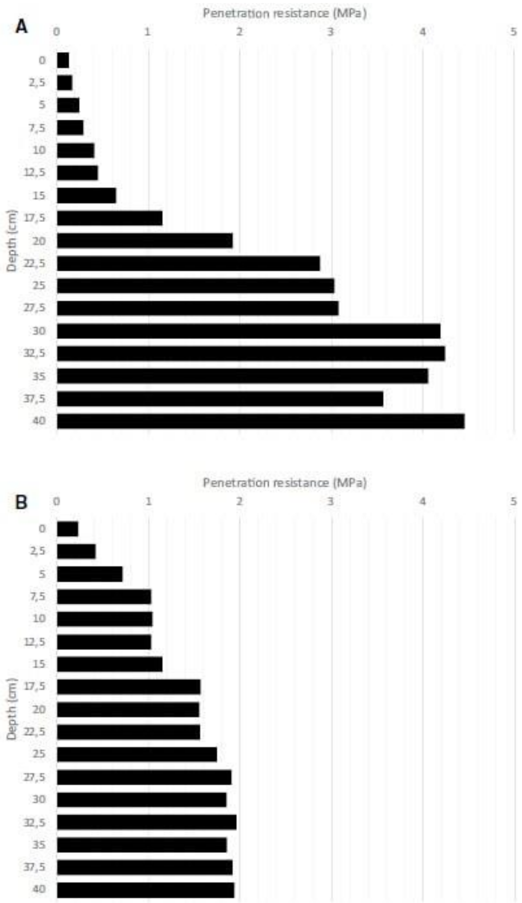

Figure 1. Resistance to root penetration (MPa) in soil cultivated with sugarcane in areas with compaction less than 4 MPa (A) and in areas with compaction greater than 4 MPa (B).

Keywords: Soil resistance,Penetration resistance,Sugarcane,Soil compaction,Agricultural machinery

ID ABS WEB: 136283

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

IMPACTS OF SIMULATED EROSION AND FERTILIZATION USE ON SOIL QUALITY AND CORN YIELD IN NORTHEASTERN BLACK SOIL REGION

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Soil erosion is a major factor causing soil thinning and crop productivity reduction in the Northeast black soil region, China, but assessing its effect quantitatively is lacking. Hence, a two-factor completely randomized block design with simulated erosion depth (8 levels of 0, 10, 20, 30, 40, 50, 60 and 70 cm) and fertilization (no fertilization and fertilization) was set up. In 2022, a series of soil physicochemical [bulk density (BD), soil water content (SWC), clay content, pH, soil organic C (SOC), alkali-hydrolyzed N (AN), Olsen-P (AP) and available K (AK)] and biological properties [microbial biomass C and N (MBC, MBN), urease, catalase, beta-glucosidase (glucosidase), cellulase activities] in 0-20 cm and corn yield were measured. The results showed that:
1) Soil clay content, SOC, AN, AP, MBC and cellulase activities decreased significantly with the increased erosion depth, while BD and AK increased significantly. Fertilization significantly decreased soil BD, pH and AK, and increased clay content, SOC, AN and AP, fertilization also significantly increased the activities of urease, glucosidase, cellulase, but decreased catalase activities.
2) Simulated erosion resulted in significant reductions in soil quality and corn yield. The decrease of soil quality and yield mainly occurred before the erosion depth of 40 cm, and fertilization mainly improved soil quality and yield within this range.
3) The main factors affecting soil quality under simulated erosion were AN, MBN, and urease activity for the no fertilization treatment, and AP, MBC, cellulase and glucosidase activities for the fertilization treatment, and the fertilizer application shifted the soil quality from N-limitation to co-limitation of C and P. The main factors affecting corn yield under simulated erosion were AN for the no fertilization treatment and AP for the fertilization treatment, and yield limitation shifted from N limitation to P limitation.
These results deepen the relationship between soil erosion-soil quality-productivity in black soil, and may be useful for evaluating the long-term evolution process of black soil quality.

Keywords: Black soil,Simulated erosion,Fertilization,Soil quality,Corn yield

ID ABS WEB: 136436

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

GEOCHEMICAL SIGNATURES OF YTTRIUM, THORIUM, NIOBIUM, RUBIDIUM AND ZIRCONIUM IN SELECTED SOILS FROM CROATIA

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In most scientific research, the geochemical characterization of soil is focused on determination the content of potentially toxic metals (Cu, Mn, Cr, Ni, Pb and Cd), and to a lesser extent on certain rare elements such as yttrium (Y), thorium (Th), niobium (Nb), rubidium (Rb) and zirconium (Zr). These elements are a key part of today's modern industry which can contribute to increased accumulation of these elements in the soil. The aim of this study was to determine the variability of total concentrations of Y, Th, Nb, Rb and Zr in selected soils from continental and costal part of Croatia regarding the different types of land use. Research was based on 33 surface composite soil samples collected at 13 locations in Croatia. The samples differed according to soil type, land use, applied mineral and organic nitrogen fertilization, and climatic condition at each specific location. The detection and quantification of Y, Th, Nb, Rb and Zr was performed in duplicate using the handheld Vanta C (Olympus) XRF analyser according to the loose powder method and “point and shoot” technique. The results reveal that Croatians soils in average contained 31.2±6.8 mg Y/kg, 7.8±4.5 mg Th/kg, 18.2±7.0 mg Nb/kg, 100.8±26.1 mg Rb/kg and 283.3±116.3 mg Zr/kg. Significantly the highest contents of rubidium (116.8±16.0 mg/kg), niobium (20.2±6.2 mg/kg) and thorium (10.3±4.8 mg/kg) were recorded in meadow soils, while the lowest amounts were quantified in soil from ski slope (42.5±0.7 mg Rb/kg, 6.5±2.1 mg Nb/kg, 4.0±0.1 Th/kg). Yttrium content in soils according to different land use declines in the following order: ski slope (33.5±0.7 mg/kg) > crop production (32.4±7.0 mg/kg) > meadow (32.3±1.4 mg/kg) > forest (32.0±9.5 mg/kg) > apple orchard (26.8±6.3 mg/kg) > city road (25.8±3.8 mg/kg). Accumulated amount of zirconium significantly varied from 158.8±21.9 mg/kg in soils near city roads to 333.0±97.8 mg/kg in arable soils.

Keywords: rare elements,meadow,arable land,ski slope,urban soil

ID ABS WEB: 136493

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

CHANGES OF THE SOIL ERODIBILITY FACTOR IN THE LONG-TERM EXPERIMENT ON CHERNOZEM

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Soil erodibility is the most widespread form of soil degradation in Europe. However, information on the intensity and susceptibility to erosion of arable soil is lacking for Serbia. Therefore, we access the K-factor erodibility nomograph values (Wischmeier and Smith, 1978) in the long-term experiment in the semi-arid region of northern Serbia. The erodibility between the initial state in 1970 and the current 2023 was compared and assessed to estimate the changes associated with management practices and climatic changes. The sampling was conducted on the Chernozem soil subtype on loess at the Experimental Field of the Institute of Field and Vegetable Crops in Novi Sad. Soil organic matter (%) and soil texture were determined in 0-30 cm soil depth of the 6 cropping systems that include winter wheat, maize and soybean. Soil tillage was based on moldboard plowing and field cultivator with fertilization following the balanced method of plant requirements. Our findings indicate an average of 0.0187 t ha h ha-1 MJ-1 mm-1 in 1970 which is lower compared to 0.0226 t ha h ha-1 MJ-1 mm-1 in 2023. That represents the difference of the 0.0039 t ha h ha-1 MJ-1 mm-1 for over 50 years. Higher susceptibility for erosion in 1970 was found in the winter what monoculture and lover at 3-year crop rotation (maize-winter wheat-soybean). In 2023 greater susceptibility to erosion was also found at monoculture but lower at 2-year rotation (maize-winter wheat). Winter wheat monoculture showed a pronounced exposure to all types of erosion and degradation. This can be explained by the differences in soil cover during the year, crop residue amount in cropping systems, and the increased number of heavy rain occurrences. Results indicated a general trend of continued negative anthropogenic effects on increased erosion and the higher vulnerability of agroecosystems.

Keywords: soil degradation,erosion,chernozem,soil texture,soil organic carbon

ID ABS WEB: 136553

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

PLANT GROWTH PROMOTING BACTERIA IN ASSISTED HEAVY METAL PHYTOREMEDIATION

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Heavy metals affect agricultural soils and mining areas and are of particular threat when they are present in bioavailable forms. Such a condition can be displayed for example in rice paddy soils, in natural or constructed wetlands and in acid mine drainage.
This study focuses on the characterization of a collection of bacterial isolates for multiple plant growth promoting (PGP) activities and heavy metal (Ni, Cu, Cr, Zn) resistance. The strains Aeromonas media MORI-53, Serratia plymuthica As3-5a(5), Rhodococcus qingshengii SC26 and Pseudomonas koreensis 69RS showed PGP activities (IAA and siderophore production, ACCD activity, P solubilization and N2 fixation) also in the presence of heavy metals, resulting to be interesting strains. The characterization of heavy metal resistance revealed that A. media strain MORI-53 was resistant to 150 mM Zn(II) in growing conditions, S. plymuthica strain As3-5a(5) was able to adsorb 91.5% of Cu(II) and 40% Ni(II) by adsorption processes mediated by EPS, and R. qingshengii SC26 was able to reduce up to 98% of 50 mg L-1 Cr(VI) into its less toxic form Cr(III) during exponential growth phase. For this strain a NADP-dependent oxidoreductase activity was evidenced, and it was linked to the presence of the metal. The PGP activities of the strains were assessed on Oryza sativa (L.), used as model plant able to accumulate high concentration of heavy metals in submerged conditions.
Rice plant growth pouches assays, conducted under gnotobiotic conditions, exhibited a 50% increase in root and plant biomass as well as seed germination of inoculated plant seedlings compared to uninoculated control plants.
The present observations showed that the bacterial strains used in this study could relief plants against the inhibitory effects of Ni, Cu, Cr and Zn, probably due to the production of IAA, siderophores and ACCD activity. On-going experiments will determine plant heavy metal extraction by rice in submerged soils in the presence of the selected strains.

Keywords: bacteria,plant growth promotion,heavy metal resistance,phytoremediation

ID ABS WEB: 136914

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

EFFECT OF BIOCHAR ON HEAVY METAL SOLUBILITY AND SPECIATION IN SOILS AROUND MAJOR METALLURGICAL PLANTS IN BULGARIA

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The effects of biochar on heavy metals concentrations and soil properties in the vicinity of Aurubis-Pirdop Cu smelter and the former metallurgical steel plant were studied. Maximum permissible levels were exceeded for Cu 319-2645 mg/kg and from 92-234 mg/kg for Pb around the Aurubis-Pirdop Cu-smelter. Lead Pb (899 mg/kg) exceeded maximum permissible concentrations, regulated by Bulgarian legislation between 2 and 15 times, arsenic (As), between 3 and 6 times for the soils (pH 7-8) around the former steel plant. Incubation experiments were performed with different rates of biochar (BC), 1, 5, 10 and 20 % in a Climatic Chamber with Phytotron System. Metals were measured in water extracts and speciation was performed by Visual Minteq. For the acidic Cu-contaminated soils incubation time and BC rates led to a total decrease of Cu and Pb concentrations. In these soils, dissolved organic carbon (DOC) and pH increased with BC incubation rates. Ion speciation in the non-treated acidic soils was represented by the free Men+ ions, while with increasing incubation time and BC rates, FA2M and M-FA gel fraction species were predominant. In the acidic soils the total soluble Cu concentration decreased by ~ 70%, while free Cu species concentrations decreased to ~ 3.7%. For the soils around the steel plant there was an increase of soluble concentrations of Fe and Mn, which was attributed to elevated levels of DOC and the presence of FA2FeOH, FAMn+2G complexes. Lead was not significantly affected by the BC rate. Biochar incorporation has a positive effect both on Cu, Pb and other metals concentrations and on metal speciation in the acidic soils, however in the slightly alkaline soils around the steel plant, DOC complexation of Fe and Mn was accompanied with an overall increase of soluble concentrations, thus indicating that biochar might not produce a positive effect on major heavy metals immobilisation in neutral and alkaline soils.

Keywords: heavy metals,smelter,mine,biochar

EPOSTERS

ID ABS WEB: 137082

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

ISOLATION AND IDENTIFICATION OF HIGH EFFICIENCY DIESEL DEGRADATION STRAIN IN OIL CONTAMINATED SOIL

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In order to screen different characteristics of high-efficiency diesel degrading strains and study their degrading mechanism in different environmental condition, 7 high-efficiency diesel degrading bacterial strains were isolated from the sludge sediments in Nanjing Yangzi Petrochemical Plant. The results showed that the degradation rates of strains J-3 exceeded 50.0% of diesel.
The degradation efficiency of diesel and the degradation mechanism of strain J-3 were studied by hydroponic and soil culture methods combined with GC-MS and genome comparison techniques. The results showed that the strain could efficiently grow using diesel as its sole carbon and energy source, producing surfactant, and having stable emulsifying properties and reducing liquid surface tension. It could produce surfactant, which showed it has a stable emulsifying property and the ability to reduce liquid surface tension. The degradation efficiency of diesel under the optimal growth conditions was 62.0%. Based on the whole-genome DNA sequence analysis of the strain J-3, two genes associated with alkane oxidation were found, namely alkB, an alkane hydroxylase gene, and almA, a Long-chain alkane monooxygenase gene. These two oxidase genes may play a role in the degradation of diesel oil by strain J-3.
In addition, when the highly degraded strain J-3 and the currently well-researched strain J-7 (Bacillus) were applied to the soil remediation test of diesel pollution, the degradation efficiency of diesel were studied by Research on single bacteria and the coexistence of single bacteria and indigenous microorganisms. It was found that under the conditions of this experiment, the indigenous microorganism played a major role in the degradation of diesel fuel in soil. Under different control treatments, the degradation ability of the strain J-3 to diesel in soil was higher than that of J-7, indicating that the strain J-3 was a high-efficiency diesel degradation bacterial strain. The strain J-3 could be well used for growth in both water and soil, and could be applied to the actual bioremediation project of diesel pollution.

Keywords: oil contaminated soil,Bioremediation,Diesel,Serratia,biodegradation

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SOIL DEGRADATION AND RECOVERY IN FORESTED HEADWATER CATCHMENT AFFECTED BY ACID RAIN

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Abstract
Forest benefits in mountain catchments consider namely the reduction of drainage network connectivity, stabilization of slopes, and protection of soil and water quality. In Europe, approximately 70% of forests are controlled by management plans, and 25% are registered as forests of non-wood services with priorities in soil and water conservation. However, with commercial forestry practices, this role of forests can deteriorate. In the Czech Republic, mountain watersheds are mostly forested with dominant plantations of Norway spruce.The acid atmospheric deposition culminated there in the 1980s followed by the forest dieback and clear-cut. This paper aims to analyze the effects of acid rain and forest practices on the soil-vegetation complex in the headwaters of the Jizera Mountains. From 1982-2020, the environmental impacts of the acid load and consequent clear-cutting of spruce stands were studied in the Jizerka experimental catchment. The significant drop in tree radial growth was detected with the rising SO2 concentrations in the air, and, the loss of soil corresponded particularly with commercial forestry. Skidding the timber by wheeled tractors caused 10.3 km-1 of skid trails and the drainage density increased from 1.45 to 7.55 km-1. On the harvested runoff plots, not affected by skid trails, the loss of soil 0.007 - 0.014 mm year-1 was comparable with undisturbed forests. However, the eroded soil in skid trails reached 6.17 mm by harvesting 23,882 m3 of timber. At the catchment outlet, sediment yield reached 25% of the soil eroded. After the timber harvest, grass communities became dominant and prolonged the forest regrowth. On the whole, 156 phytosociological relevès were investigated to analyze the herb layer development: this monitoring included 53 deep, 33 medium, and 38 shallow rills, 15 plots with dead spruce stands, and 17 clear-cut spots. Using the information on higher plants only, the percentage cover of herb layer and species richness were analyzed. Natural regeneration of erosion rills was supported particularly by the development of herbaceous vegetation.

Keywords: The Jizera Mountains,mountain catchment,acid atmospheric deposition,forest dieback and harvest,soil degradation and recovery

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ENERGY PRODUCTIVITY OF POACEAE USED IN THE PHYTORREMEDIATION OF METALS IN SOIL FROM TANNERY INDUSTRIALS

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Leather production has significant economic importance in the State of Goiás. Such activity can result in land being contaminated with potentially toxic metals such as chromium (Cr) and nickel (Ni). Phytoremediation is a bioremediation technique that consists of the direct use of plants for the transfer or stabilization of all potentially toxic metals in polluted soils. Bioenergy is a sustainable energy source option, however, it is often criticized for indirect changes in land use, due to a lack of high-quality agricultural land and competing with food production. At the same time, contaminated areas remain unused. The aim of the work was to evaluate the performance of plants from the Poaceae family in the phytoremediation and energy productivity of a soil with the presence of potentially toxic metals. The experiment was carried out in an urban perimeter area in the municipality of Anicuns-GO, Brazil, located at a tannery sludge spill site. The tannery was deactivated and there was no recovery of the degraded area, and there is the presence of the potentially toxic metals chromium (Cr) and nickel (Ni). The experimental design was in randomized blocks with 5 treatments and 4 replications. The treatments were composed of: sugar cane (Saccharum officinarum), energy cane (Saccharum robustum), purple grass (Pennisetum purpureum cv Roxo), capiaçu grass (Pennisetum purpureum cv. BRS Capiaçu) and spontaneous plants. The plants were cut after 12 months of cultivation. Green biomass was analyzed; dry biomass; metal content (chromium and nickel) in soil, biomass and extraction; and energy productivity. The data were subjected to analysis of variance, Tukey test and Pearson correlation coefficient. The biomass production and energy productivity of the plants were not harmed by the high levels of Cr and Ni, and followed the order capiaçu grass > purple grass > sugar cane > energy cane > spontaneous plants. There was a high Pearson correlation (greater than 0.7) between biomass production and energy productivity with Cr extraction.

Keywords: Soil pollution,Soil remediation,Tannery sludge,Heavy metals,Chrome

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MINESOIL RESTORATION WITH PERENNIAL GRASSES IN SOUTHERN BRAZIL: CANONICAL CORRELATIONS BETWEEN SOIL BIOLOGICAL, CHEMICAL AND PHYSICAL ATTRIBUTES

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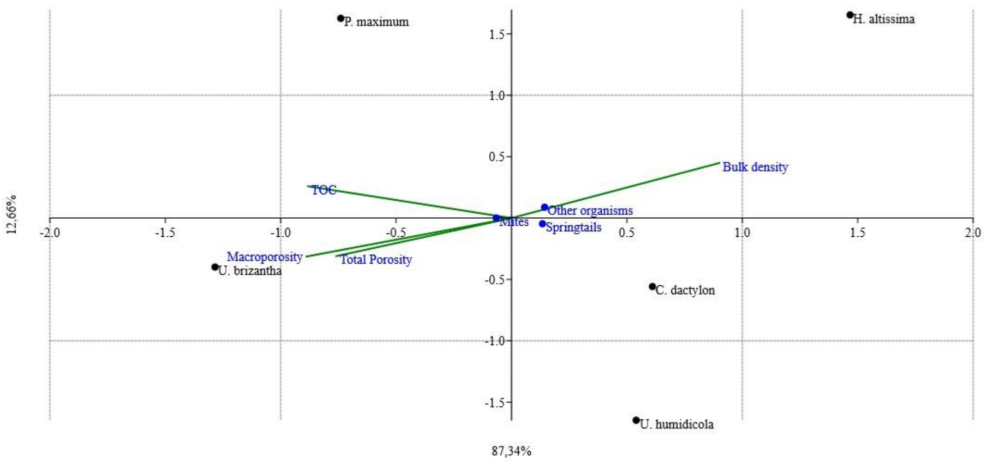
The Candiota Mine in Southern Brazil is the country's largest coal reserve. The re-establishment of vegetation and living organisms in minesoils is usually hampered by excessive soil compaction, eventual acidity, and depletion of soil organic matter. We aimed to evaluate the abundance of soil mesofauna organisms and their association with minesoil physical and chemical attributes through canonical correlation analysis as affected by revegetation species.
In 2007, a randomized block design experiment was installed in the Candiota Mine minesoil with five treatments: Hemarthria altissima, Cynodon dactylon, Panicum maximum, Urochloa humidicola and Urochloa brizantha. After 14.6 years, soil bulk density (BD), porosity, and total organic carbon (TOC) content were evaluated (0 to 10 cm layer). Sampling of fauna inhabiting the interior of the minesoil occurred in two steps: two steel cylinders (summing up 169.4 cm3) were used at each plot (20 m2) to obtain soil cores (0-10 cm layer), then the Tullgren Extraction Funnel was used to collect fauna from soil core. The holes left by the cores were used to install 2 pitfall traps (for 7 days) per plot (summing up 16.94 cm2) for sampling fauna inhabiting the litter-soil interface. Fauna data is reported as the total number of individuals collected (soil interior + litter-soil interface). These data were subjected to canonical correlation analysis (CCA).
In total, 13,198 fauna organisms (9 taxonomic groups) were found in the experimental plots, predominantly mites and springtails. The abundance of mites ranged from 1,303 in H. altissima to 2,607 in U. brizantha, and that of springtails from 393 in P. maximum to 678 in C. dactylon.
Axis 1 and 2 of the CCA explained 87.3 and 12.7% of the variation, respectively. The correlation between TOC content and total porosity and macroporosity was more prominent in U. brizantha, likely due to its higher root density. Overall, the CCA revealed incipient associations between soil mesofauna and physical attributes and TOC.



Keywords: degraded soils,fauna,long-term field experiment,total organic carbon

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AN APPROACH FOR DETERMINING THE MINIMUM DATA SET FOR SOIL CONTAMINATION ASSESSMENT: AN APPLICATION IN A FORMER OUTDOOR SHOOTING RANGE (OSR) IN SOUTHERN ITALY

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Outdoor shooting ranges (OSRs) are recreational facilities attracting the interest of several millions of people worldwide, but if after the end of activities the land is used for recreational or agricultural purposes, soil contamination can pose a serious threat to human health. In this framework, a research study funded by the Italian Ministry of University and Research (MUR) was carried out in soils of an OSR of 38500 m2 in southern Italy and aimed to determine the minimum data set for soil contamination. Different soil proximal sensing and laboratory data were collected, but this study was focused on three potentially toxic elements (PTEs), including As, Pb, and Sb measured by portable X-ray fluorescence spectrometer (pXRF) in soil samples (0-15 and 15-30 cm-depth) at 174 nodes of a regular grid (15 x 15 m) and apparent soil electrical conductivity (ECa) measured by electro-magnetic induction (EMI) along parallel transects 15 m apart. Since ECa was a more densely measured covariate than ECa, was used as external drift to improve the PTEs predictions. The PTEs data set was randomly split into a calculation (80%) and validation (20%) set to assess the effect of the number of samples on the predictive performance of the PTEs, four calculation subsets with sample size varying from 35 to 139 were created. Each subset selection was replicated three times to evaluate the robustness of the approach. PTEs data were submitted to an isometric log-ratio (ilr) transformation because As, Pb, and Sb are compositional data and, therefore, parts of a whole that constitute the soil and are not free to vary independently of the others. Kriging with external drift (KED) was used to incorporate the densely sampled ECa secondary data. The accuracy of prediction was assessed by the mean error, the root mean square error of prediction (RMSEP) and the ratio of the interquartile distance (RPIQ).

Keywords: soil contamination,,potentially toxic elements,proximal sensing,multivariate analysis,compositional data

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CAN BIOCHAR IMPROVE THE BIOREMEDIATION OF ARABLE SOILS DEGRADED BY INTENSIVE MANAGEMENT?

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Soil is an essential and limited resource, and its degradation through different processes poses a threat to its ecological functions, as well as to the sustainable development of agricultural activity. Specifically, in agricultural areas with intensive production of irrigated crops and with an arid and semi-arid climate, the use of desalinated water of marine origin and reclaimed water of residual origin results in the accumulation of boron (B) in soil and crops. Moreover, the intensive use of pesticides and fertilizers contaminates the soil and water with inorganic and organic chemical compounds, leading to a deterioration in soil quality and a reduction in production, rendering agricultural activity unsustainable. Soil bioremediation technologies have become a viable approach that promotes the transition from conventional intensive production agrosystems to more sustainable ecological production systems. On the other hand, the reuse of reconditioned organic waste for use as soil amendments in agriculture has been proposed as essential for the recovery of degraded soils. Biochar can serve as beneficial organic soil amendment while functioning as a catalyst for the bioremediation process of contaminated soils, facilitating the transformation, adsorption, and biodegradation of contaminants. This study aims to evaluate the bioremediation of contaminated agricultural soils at lab scale, integrating various strategies such as the application of biochar, composts and plant extracts. Specifically, the study explores the capacity of biochar, both independently and in combination with a compost and a plant extract, in the one hand, to facilitate the biodegradation by microorganisms of an herbicide, such as pendimethalin, and, to reduce the B concentration in the soil solution. Additionally, the study examines whether this bioremediation strategy enhances the health and quality of the soil by monitoring several soil enzyme activities (beta-glucosidase, phosphatase and urease activity) and the microbial community composition in two different degraded soils. The poster presents several preliminary results indicating the evolution of some chemical, biochemical and microbiological properties of two degraded soils throughout 180-day incubation experiment.

Keywords: SOIL BIOREMEDIATION,BIOCHAR,INTENSIVE AGRICULTURE,SOIL CONTAMINATION,SOIL MICROBIAL COMMUNITY

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IMPACT OF PAVED AND UNPAVED ROADS ON SOIL PROPERTIES IN MARIGAT, BARINGO COUNTY, KENYA

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Continuous demand for the mobility of people and goods has accelerated infrastructural developments such as roads and railway lines. Road construction not only leads to large scale spatial landscape fragmentation, but also to local changes in soil properties. Compared to countries in the Global North, road construction in the Sub-Saharan Africa is done differently. Moreover, the local effects of road construction on soil properties are seldomly studied. In Kenya, a number of new roads have been constructed in the past decade to open up areas considered landlocked and prone to insecurity issues such as cattle rustling. Baringo County is one such area that has experienced expansion in road network. Therefore, this study sought to understand the impacts of roads on soil properties in Marigat, Baringo County. We established sampling points along transects at 0m, 250m and 500m intervals from the road edges. Soil samples were obtained to a depth of 50 cm to investigate soil properties such as bulk density, saturated hydraulic conductivity, soil moisture, grain size and C/N ratio. We also conducted penetration resistance measurements along transects at 0m, 20m and 35m intervals from the road edges for paved and unpaved roads. Our preliminary results indicate that paved roads caused higher soil compactions than unpaved roads. This study contributes to understand road impacts on soil to avoid, mitigate and compensate the impact in rural Kenya.

Keywords: Road construction,Soil properties,Rural Kenya

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SOIL AND WATER CONSERVATION IN A SMALL AGRICULTURAL CATCHMENT

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Intensive farming in the Czech Republic brings fertilizers and also a manifold spectrum of plant protection substances into the arable land. Research on nitrogen, phosphorus and pesticides contents and dynamics in soil, sediment and surface water has been proceeding in experimental catchment Nemcice stream since 2019. It represents typical highland conditions in the CR, with sloping relief and intensive farming on large blocks.
Results obtained from monitoring showed a need to pay close attention to all potential contaminants in the environment, considering the transport processes in agricultural catchments and potential mutual influences on various environment components.
Limiting the entry of potentially risky substances (nutrients and pesticides) from agricultural land into the aquatic ecosystem is theoretically possible by reducing application doses or slowing down transport processes. The second option is the principle of the presented comprehensive soil and water conservation measures. The effect of complex measures consists in mitigating the effects of surface soil washing by water erosion, slowing down leaching of substances through the soil profile, improving the quality of subsurface water. The measures (e.g. strip cropping, grass belts, hedges, ditches, reservoirs, …) are multifunctional in nature, which means that in addition to limiting soil degradation and contamination of surface water bodies, they contribute to increasing water retention in the agricultural landscape, mitigating the impacts of hydrological extremes (torrential rainfall and drought) and have the potential of a positive effect on the ecological stability of the agricultural landscape. They can be implemented by farmers or in process of land consolidation.
The study was created with the support within projects QK1910282, QK21010328, SS06010290, SS06020006 and RO0223.

Keywords: soil erosion,contamination of water bodies,nutrients,pesticides,conservation measures

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4. Soil health in achieving the Sustainable Development Goals
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USE OF NATURAL-BASED REMEDIATION STRATEGY TO SUPPORT REMOVAL OF HEAVY METALS FROM SOIL

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Various methods have been explored to eliminate heavy metal pollutants from the soil environment. However many challenges has been indicated mainly to the low efficiency of the process, high expenses, long duration to achieve soil standards and and secondary environmental effects resulting from soil degradation caused by significant interference with the soil biota. As soil health became recently an important issue it is necessary to apply new, natural-based solution for soil remediation and restoration.The EU-funded SYMBIOREM project (Symbiotic, circular bioremediation systems and biotechnology solutions for improved environmental, economic and social sustainability in pollution control) aims to use the bioremediation capabilities of microorganisms, microbiomes, proteins, plants and animals to remove pollution from the environment. One of the main assumptions of nature-based remediation is the use of soil organisms as bioremediators, but also renewing the microbiome of chemically degraded soils building biological balance and supporting plant growth. This goal can achieved by many actions and in our project we are focusing on three main strategies: 1) soil augmentation with probiotic, 2) the use of prebiotics in the form of low molecular weight organic acids (LMOA) 3) modification of soil properties and supporting plant and microorganisms growth by application of biodegradable geocomposites. Findings of the preliminary greenhouse experiment with high biomass plant Miscantus sinensis and co-application of active microbes with prebiotics containing citric acids seems to be the best variant, supporting plant growth and accumulation of heavy metals in aboveground biomass.

Keywords: remediation,soil,microorganism,rhyzosphere,augumentation

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4. Soil health in achieving the Sustainable Development Goals
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EFFECTS OF SUB-SOIL PLASTIC FILM MULCH ON SOIL WATER AND SALT CONTENT AND WATER UTILIZATION BY WINTER WHEAT UNDER DIFFERENT SOIL SALINITIES

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Drought and salinity strongly restrict wheat production in saline soils in North China. The sub-soil plastic film mulching was developed from traditional mulching cultivation. However, the regulation of soil water-salt movement and the mechanism of wheat yield improvement under sub-soil plastic film mulch are rare in reports. A field experiment was conducted during the winter wheat growing seasons in 2017–2023 with four replicates in the Nanpi Eco-Agricultural Experimental Station of Chinese Academy of Sciences (elevation, 11 m). The experiment included 6 treatments combining two levels of planting patterns and three levels of soil salinity. The planting pattern treatments included no-mulch (M0) and sub-soil plastic film mulch (M1). The soil salinity levels were 1‰ (S1), 2‰ (S2), and 3‰ (S3). Main results are as follows:

1. Sub-soil plastic film mulch could reduce the soil evaporation and increase soil moisture in topsoil. Sub-soil plastic film mulch had the double effects on wheat field soil temperature with the increasing in early stage and decreasing in late stage of wheat plant. Sub-soil plastic film mulch inhibited the accumulation of topsoil salinity. The Na^+ content in stem and leaf of wheat plants was reduced under sub-soil plastic film mulch, at the same time the K^+content was increased, and Na^+/K^+ ration was decreased.
2. Sub- soil plastic film mulch promoted the establishment of wheat population, grian yield and water use efficiency of wheat. It increased seed germination rate, improved effective tiller of wintering and recovery stage, and increased dry matter accumulation and root development. It improved winter wheat yield by increasing spike number and grain number per spike. It decreased E/ET ratio and converted more soil water into plant transpiration, and water use efficiency was improved.

Keywords: soil water-salt movement,,sub-soil plastic film mulch,wheat,water use efficiency

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SOIL EROSION AND FERTILITY INTERLINKAGES IN UGANDA'S LANDSCAPE: EFFECTS OF LOCAL CLIMATE-SMART SOLUTIONS ON SOIL PROPERTIES.

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Soil degradation, particularly the depletion of soil nutrients due to erosion, is exerting significant pressure on farming systems worldwide. The Sub-Saharan countries, including Uganda's highlands, experience soil degradation primarily due to soil erosion. This causes a decline in farmland productivity and threatens smallholder farmers' livelihoods. In Uganda's highlands, farmers are introducing climate-smart solutions (CSS) to reduce erosion and improve soil fertility.
We evaluate the effect of climate-smart solutions (CSS) implemented in two of Uganda's districts on soil properties. The study area, Kabale and Rubanda districts are situated in the Kigezi subregion, southwestern Uganda. Plots were selected based on the use of CSSs against soil erosion and to maintain soil fertility and non-CSS plots susceptible to soil erosion. The CSS practised in the area were terraces, check dams, Fanya chini, Napier grasses, crop residues, selected tree species, and organic manure application for more than 15 years. The plots were selected from six different mountain hills at three positions (top, middle and bottom). At each location CSS and non-CSS plots were sampled. Soil samples were collected from 10 m × 10 m quadrat plots at a depth of 0–14 cm and 15 -30 cm.
Overall, organic matter increased in the CSS plots compared with the non-CSS plots ($p = 5.1e-9$), with higher accumulation on the bottom plots and in the upper 15 cm. Bulk density decreased in the CSS plots. CSS did not improve the saturated hydraulic conductivity measured in the lab, which was controlled by texture. Climate smart solutions enhanced chemical fertility by increasing CEC, and available P. The pH also increased to levels that enhance nutrient availability, but the position has also a significant influence. Climate smart solutions can help smallholder farmers towards soil health and increase the resilience a fertility of their farms.

Keywords: Climate-smart solutions,Soil erosion,Soil Organic Carbon,Soil Fertility,Uganda

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4. Soil health in achieving the Sustainable Development Goals
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EFFICIENCY OF COSOLVENT FLUSHING FOR THE REMEDIATION OF SOIL AND GROUNDWATER CONTAMINATED WITH NAPLS

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Contamination of the soil and groundwater with organic contaminants in the form of non-aqueous phase liquids (NAPLs) is a widespread and challenging environmental threat. Because of their high interfacial tension, low solubility and low degradation potential, NAPL releases into the subsurface persist for many decades, continuously contaminating large volumes of the groundwater and threatening the security of this vital water resource. This in turn can have severe adverse impacts on food security and human health. Cosolvent flushing has evolved as an effective and cost efficient remediation technology for the remediation of groundwater resources contaminated with non-aqueous phase liquids (NAPLs). For the successful application of this remediation technology, there is a need to accurately define the interphase mass transfer, a key processing controlling the fate of NAPLs in the groundwater. This study examines the effect of cosolvents on the interphase mass transfer of NAPLs in porous media. Two dimensional dissolution experiments are conducted to generate interphase mass transfer expressions. The experimental data are then modeled using numerically and used to develop Sherwood correlations that relate the interphase mass transfer to flushing velocity, soil properties and flushing solution composition. It is observed that the flushing solution properties such as viscosity and density directly influence the interphase mass transfer and the efficiency of the DNAPL remediation process.

Keywords: soil remediation,enhanced dissolution,NAPLs,interphase mass transfer,multiphase flow modeling

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INVESTIGATING THE INTERPLAY BETWEEN ARSENIC AND BIOCHAR: INSIGHTS FOR CONTROLLING ARSENIC LEVELS IN SOIL WITHIN RICE CROP AGRICULTURE

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This study explores the influence of different levels of arsenic and biochar on the arsenic status in soil following the harvest of two rice crops. The investigation aims to understand the interactions and effects of these factors on soil arsenic content. The results indicate significant variations in arsenic levels based on different treatments. Specifically, treatment T3, characterized by a high arsenic concentration, exhibits substantially higher arsenic content compared to other treatments involving biochar application. Conversely, treatment T7, which involves the application of iron-modified biochar with a high dose, demonstrates the lowest arsenic content. The study provides valuable insights into the complex dynamics between arsenic, biochar, and soil, contributing to our understanding of potential strategies for managing arsenic levels in agricultural soils.

Keywords: BIOCHAR,ARSENIC,RICE,HEAVY METAL,SUSTAINABILITY

ID ABS WEB: 138235

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COVER CROP AS A NEW ALTERNATIVE IN THE GREENHOUSE - DIFFERENT ORGANIC MATTER MANAGEMENT OPTIONS IN CULTIVATION

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Intensively chemicalized vegetable production results in physical, chemical and biological degradation of greenhouse soils. Soil degradation is a serious problem in today's environment, and we need to find solutions that improve crop loss, not increase costs for farmers. According to our hypothesis, nutrient utilization can be improved with appropriate organic matter management, and the harmful effects of monoculture can be reduced in the long term. The experiment was carried out in a greenhouse, on sand soil with weak humus. Five different treatments were used: Control (0.04kg/m2 N-fertilizer; MT), Cattle manure (6kg/m2; IT), Double cattle manure (12.8kg/m2; DT), Winter cover crop (0.006kg/m2; TN), Winter cover crop + Trichoderma (6g/m2 +0.002 L/m2; TT). Each treatment at the appearance of the first berry crops 10g/m2 N active ingredient. In the experiment, we used two years of soil sample data, from which we examined the POXC content of the soil, FDA activity, PHOS enzyme activity and soil nitrate content, as well as the yield. We found that mainly the cover plant treatments helped to increase the biological activity. The rich rhizosphere contributed to soil improvement by increasing organic matter and creating habitat. By the second year, FDA activity doubled for each treatment. Similar to the FDA activity, the POXC values also doubled. At the end of the growing season, soil nitrate content was significantly higher in the TN and TT treatments compared to the other treatments. Based on this, we conclude that the use of winter cover crops reduced nitrate leaching, thereby leaving more nitrogen in the soil. The nitrate content and phosphatase activity of the soil can also be related to the higher yield observed in the TT treatment.

Keywords: soil biology,Trichoderma,sand soil,soil managment,organic matter

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4. Soil health in achieving the Sustainable Development Goals
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INTEGRATIVE STRATEGIES FOR RESTORING SEVERELY DEGRADED CERRADO SOIL THROUGH SOIL AMENDMENTS

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In order to reestablish a thriving ecosystem in a degraded Cerrado biome, we are restoring a degraded site located in Southeast of Mato Grosso do Sul, Brazil. The site had suffered severe soil degradation during the construction of a Hydroelectric Power Plant (HPP) in the 1960s, which resulted in the removal of the soil's surface layer (up to 12 meters) and exposure of the subsurface layer. This has led to the complete absence of vegetation and the accumulation of soil erosion, rendering the area unstable and unsuitable for supporting any ecosystem. Our research is focused on identifying a combination of soil amendments that can effectively improve the composition of Cerrado's soil (Oxisol; Ferralsol) for restoration purposes. To achieve this goal, the area received different levels of biomass introduction and 12 treatments were implemented, ranging from no manipulation to the addition of various organic compounds, sheep residue, brushwood transposition, and native seed species. Soil samples were collected from a depth of 0.0 to 0.1 m, 24 months after the treatments were introduced. To assess microbial activity, we measured soil enzyme activity, including beta-glucosidase, phosphatase, and total enzyme activity (FDA), as well as other soil chemical attributes that can be improved by the amendments used. The vegetation cover of the experimental area was assessed using aerial images collected with a drone, and the percentage of the area of each plot was estimated. Temperature measurements were taken, with a stem thermometer, at dawn and in the afternoon, at a depth of 0.05 m, and soil moisture was also assessed by gravimetry (0 to 0.05 m). By analyzing these methods, we aim to determine which treatment will respond most favorably to the different recovery techniques and residues added. Our ultimate goal is to apply these findings to other degraded areas and restore their once-thriving ecosystems by replicating these successful methods.

Keywords: Exposed subsoil,Organic residues,Soil enzyme activity,Cerrado biome

ID ABS WEB: 138266

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

METHOD OF THE BLACK SOILS ECOLOGICAL STATE IMPROVING UNDER MILITARY AND TECHNOGENIC INFLUENCES ON AGROCOENOSES IN THE KURAKHIV TPP AREA OF DONETSK REGION

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The new method for soil degradation control and remediation of chemically contaminated black soils under military-technogenic influences has been tested. Method includes the use of elaborated effective composition of the new Smaragd chelate-humate preparation (Smaragd HGP, utility model patent 135145 UA, 2019). Method tested on soils near zones of Kurakhiv TPP industrial activities area and zones of military disturbed soils of land plots with pits from 1 m to 4 m and identification of weapons types in particular shelling from MLRS and missile strikes in conjunction with its individual characteristics and preliminary determination of the soil-plant system ecological state. Test plants - Hordeum vulgare. The priority of Cd, Pb, Zn, Cu mobile forms was established. Determined that translocation intensity of toxic metals forms a series - Zn>Cu>Pb>Cd. Under military influence, the destruction of the soil surface with the formation of craters was revealed; clogging with metal fragments, pollution with chemical substances in the places of explosions of shells and rockets. Exceeding the background levels of toxic metals Hg, Cd, Pb, Cu, Ni in the soil was established. An excess of the background content of Hg, Cd, Pb up to 1.5 times was recorded in the places of combat operations and to 7–17 times - in the places where shells hit and craters were formed. It was established that the largest number of soil craters in the studied areas were formed during shelling using the Grad installation, field and self-propelled howitzers; caliber 120 mm and mortars with 82-mm fragmentation shells and high-explosive fragmentation mines, caliber 82 mm. The plants observations established the positive influence of Smaragd HGP on the crop productivity, crop structure. The benefits of using the elaborated method are established. Recommended method implementing for farms specializing in the production of grain crops in territories with complex negative effects of the military factor and chemical pollution to restore the black soils health, reduce the intensity of chemical degradation processes.

Keywords: black soils pollution,military-technogenic influence,new method,soil degradation control,remediation

ID ABS WEB: 138278

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

DEGRADATION OF CHLORPYRIFOS IN A ANDISOL TREATED WITH VERMICOMPOSTS CO-PRODUCED WITH BIOCARBON

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The long-standing practice of pesticide use in agriculture is under scrutiny due to increasing concerns over environmental and health risks. The use of chlorpyrifos (CP), a moderately toxic pesticide with extensive effects that lasts in the environment for 10 to 120 days, it continues to be utilized in some countries. One of the toxic byproducts of chlorpyrifos decomposition is the broad-spectrum antimicrobial metabolite, 3,5,6-trichloro-2-pyridinol (TCP), which remains in the soil for a prolonged period. Bioremediation methods could include the use of microorganisms and Earthworms; and the biochar has been proposed as a potential carrier for microbes. The aim was to assess the effectiveness of using vermicompost mixed with biochar for the biological degradation of CP in an Andisol. A randomized method was used, starting with vermicompost made with 1% biochar and incubated for three months. Three treatments were set up in triplicate: a control with pesticides (T0), vermicompost with pesticides (T1), and vermicompost mixed with pine pruning biochar with CP (1.25% v/v; T2). Measurements of CE activity and pesticide residues were taken at 15, 30, and 45 days of incubation, conducted at 25 °C in the dark at field capacity. Results shown a notable increase after the 30th day in soils treated with CP. Remarkable differences in CP degradation in T2 compared to T0 between day 15 and 30. As the CP concentration decreased over the 45-day period in all treatments, the concentration of TCP increased. The CP residues in the reference soil could have caused microbial adaptation leading a decrease in CP application and suppression of the CE enzyme due to pesticide toxicity. However, microorganisms demonstrated their ability to decompose CP into a source of carbon and energy, leading to increased CE activity after 30 days. The combination of vermicompost and biochar may have aided in the microbial degradation of CP, although the possible immobilization of CP on the biochar surface needs further examination. Thanks to Project Fondecyt 1210503.

Keywords: biochar,pesticides,soil,Earthworms

ID ABS WEB: 138324

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

EFFECT OF CIRCULAR BUFFER STRIPS OF NATIVE PERENNIAL GRASSES ON WIND EROSION IN THE SOUTHERN GREAT PLAINS OF UNITED STATES

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Wind erosion is a serious challenge faced by agriculture in the Southern Great Plains, severity of which is increasing with declining Ogallala Aquifer, increasing climate extremes, poor soil health and lack of ground cover. The wind is strong early in the spring, when soil cover is less and seedlings are small, causing loss of valuable topsoil and damage to seedlings by sand abrasion. A novel concept of reintroducing tall growing native perennial grasses into center pivot irrigated agriculture developed by us was tested for moderating wind erosion. Southwest facing (predominant wind direction) wedges of two adjoining pivots, one with circular buffer strips (CBS) and the other conventional control pivot, were used for the study. Three replicates of BSNE dust samplers were installed at three different distances from edges at 5 (D1), 30 (D2) and 55 (D3) ft from southwest wedge were installed at 0.15 and 0.60m (only in 2022) were installed in both wedges. Dust samplers were also installed in the middle of outer two grass strips. Periodically or after each windstorm, dust was collected and weighed. At the same time, wind data was collected from 2D sonic anemometers. Grass buffers reduced wind erosion significantly in 2021 and amount of soil collected reduced as we moved inside from the wedge. Comparing similar distances with and without CBS, soil erosion reduced by 60 to 95% in 2021. However, in 2022 the benefit of grass buffers was not seen due to drought year and a large no till plot to the southwest of CBS pivot. Adding second BSNE at 0.60m indicated that more soil was collect in that. Overall, the data suggests that most of the soil was blown from outside the pivots and first buffer strip was efficient in collecting that soil.

Keywords: Wind Erosion,Circular Buffer Strips,Native Grasses,Regenerative technology,Ecosystem services

ID ABS WEB: 138367

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

SPATIAL VARIABILITY OF SOIL COMPACTION IN INTENSIVE VINEYARDS AND ORCHARDS

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Excessive soil compaction is a widespread soil degradation mainly caused by heavy machinery, especially when moved on the same tracks. It is generally assumed that all vineyards and orchards are highly compacted due to the intensive use of machinery. The green belt (area between the wheel tracks) and the cultivation belt (area between the plants in a row) occupy a large part of the plantations. Aim of the study was to collect initial information on soil compaction in vineyards and orchards in different parts of the rows and different soil groups in order to better plan systematic monitoring of soil compaction. 10 vineyards and 10 orchards were selected that met several. In each orchard or vineyard, compaction was measured at 5 representative sites, each in three areas in a row. Compaction was measured to a depth of 40 cm or less in shallow soils using a computerised hydraulic penetrometer. The device moves two penetrometer cones vertically while measuring and recording a penetration force of up to 500 N. Results showed that the soils of vineyards and orchards are dominated by non-compacted soils. Soil compaction in the green and cultivation belt (1537 kPa, 1546 kPa) is lower than in the belt between the wheel tracks (1761 kPa). In the green and cultivated belt the compaction increases with soil depth. On the wheel tracks compaction is highest on the surface between 0 and 10 cm and it decreases at a depth of between 10 and 25 cm, deeper down, compaction increases again. Results confirm the diversity of soil compaction within the permanent planting areas and in relation to three different tillage belts, soil type and selected soil parameters. The information gathered will help to define procedures for monitoring soil compaction in permanent plantations where plants are grown in rows, as well as measurement patterns for soil compaction on wheel tracks, in the green belt and in the cultivation belt.

Keywords: soil monitoring,soil compaction,measuring pattern,tillage belts,soil resistivity

ID ABS WEB: 139290

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

THE INTERNATIONAL NETWORK ON SOIL POLLUTION: TOWARDS THE GLOBAL GOAL OF ZERO POLLUTION

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Soil pollution is one of the main threats affecting soil health worldwide. However, soil pollution is unique to other threats such as erosion or salinization: it is difficult to perceive with the naked eye, and its effects are only visible when the level of pollution causes acute effects on the environment and human health.
The Food and Agricultural Organization's Global Soil Partnership (GSP) seized the momentum and advanced the coordination of global actions on soil pollution to address key knowledge gaps and improve technical capacities to detect, quantify, monitor and mitigate soil pollution. The publication of the Global Assessment of Soil Pollution by FAO and the United Nations Environment Programme (UNEP) in 2021 laid the foundation for developing concrete actions to achieve a zero pollution future and set a clear agenda for action. During recent global efforts to combat soil pollution, one of the proposed actions was to establish the International Network on Soil Pollution (INSOP) in 2022. This network brings together all stakeholders in an effective, coordinated, and inclusive manner to advance towards a world with Zero Pollution. The creation of this network was an urgent response to the need for a global action agenda on soil pollution.
As of today, the INSOP consists of more than 1,200 members represented from 130 countries, driving the network to achieve its 2023-2025 agenda. The INSOP is pleased to present progress on developing global soil pollutant threshold values, a summary of available legal instruments for soil pollution, a remediation action checklist, as well as the new FAO Technical Guidelines on Soil Pollution Assessment, Mapping, Monitoring and Risk Communication. Furthermore, INSOP is increasing its engagement with farming communities worldwide by training them on soil pollution prevention, adaptation, and mitigation as part of the Global Soil Doctors Programme.

Keywords: soil degradation,soil pollution,food safety,environment

ID ABS WEB: 139296

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

SOIL COPPER IN NEW ZEALAND ORCHARDS: BIOTIC IMPACTS

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Extensive use of fungicide copper (Cu) has a more recent history in New Zealand than in many other parts of the world where long-lasting Cu accumulation in soil has become a significant environmental issue. Currently in NZ, inorganic formulations of Cu are routinely applied to a range of fruit crops including organic orchards. This study investigates whether accumulation and persistence of Cu in soils adversely affects soil functionality in selected cherry, apple, kiwifruit orchards, vineyards and hop gardens. We report experimental findings from field, mesocosm and glasshouse studies on soil respiration and a range of soil biotic variables. Across the orchards, soil Cu concentrations frequently and substantially exceeded most published threshold limit concentrations for contamination that are 100 mg kg -1 (total Cu). Soil and vegetation management within and beneath rows of trees largely explained horizontal and vertical dispersion patterns of the metal in soil. Soil organic matter (SOM) played the largest role in Cu retention, as a stronger determinant than Cu of soil respiration, microbial biomass carbon and nitrogen, and earthworm toxicity and behaviour. In most cases, critical concentration where impacts could be detected approached 250 mg Cu kg -1. Significant responses to Cu were detected in plant root growth, microbial activity and earthworm, but deleterious impacts were largely mitigated by SOM content in combination with avoidance of low soil pH. It is well known that residual Cu does not significantly dissipate in the environment and the metal is likely to continue to accumulate in the orchard soils. We conclude that mitigation or amelioration of risk through management of these variables is unrealistic: sustainable soil health management in New Zealand's orchards is not viable with longer-term continued usage of inorganic Cu-fungicides.

Keywords: Copper,Soil health,Soil Organic Matter,Soil Respiration,Soil Functionality

ID ABS WEB: 139297

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

BIOCHAR AND HYDROCHAR APPLICATION INFLUENCE SOIL AMMONIA VOLATILIZATION AND THE DISSOLVED ORGANIC MATTER IN SALT-AFFECTED SOILS

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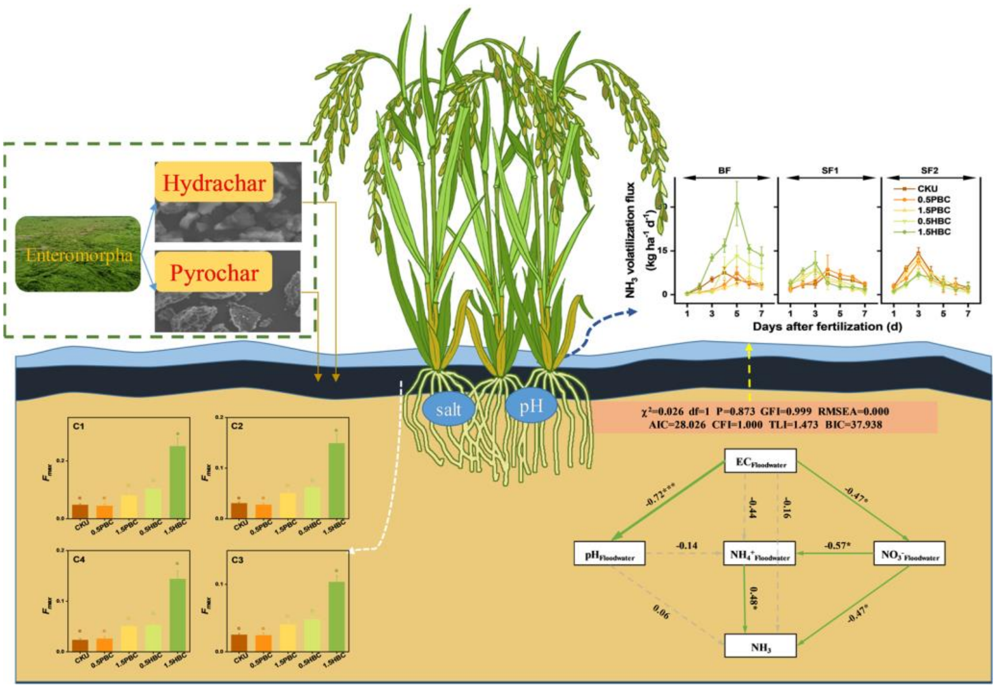
Biochar, which including pyrochar (PBC) and hydrochar (HBC), has been tested as a soil enhancer to improve saline soils. However, the effects of PBC and HBC application on ammonia (NH3) volatilization and dissolved organic matter (DOM) in saline paddy soils are poorly understood. In this research, marsh moss-derived PBC and HBC biochar types were applied to paddy saline soils at 0.5% (w/w) and 1.5% (w/w) rates to assess their impact on soil NH3 volatilization and DOM using a soil column experiment. The results revealed that soil NH3 volatilization significantly increased by 56.1% in the treatment with 1.5% (w/w) HBC compared to the control without PBC or HBC. Conversely, PBC and the lower application rate of HBC led to decreases in NH3 volatilization ranging from 2.4% to 12.1%. Floodwater EC is a dominant factor in NH3 emission. Furthermore, the fluorescence intensities of the four fractions (all humic substances) were found to be significantly higher in the 1.5% (w/w) HBC treatment applied compared to the other treatments, as indicated by parallel factor analysis modeling. This study highlights the potential for soil NH3 losses and DOM leaching in saline paddy soils due to the high application rate of HBC. These findings offer valuable insights into the effects of PBC and HBC on rice paddy saline soil ecosystems.



Keywords: saline soils,biochar,hydrochar,ammonia volatilizatio,dissolved organic matter

ID ABS WEB: 139356

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

EFFECTS OF DIFFERENT SOIL AMENDMENTS ON SOIL PROPERTIES AND SUNFLOWER GROWTH IN HETAO IRRIGATION AREA, CHINA

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Soil salinity limited agricultural development and affected ecological environment development in the Hetao Irrigation Region, Inner Mongolia, China. In this study, three amendments include flue gas desulfurization gypsum (S), humic acid (H), and biochar (C) were used for soil amelioration with sunflower planting during two years experiment. The humic acid applied before each seedling season, the rest two materials applied only once. Results showed that the three amendments all increased soil water holding capacity at depth of 0-20 cm, decreased soil salinity during sunflower growth, increased macro aggregate proportion. Humic acid treatment had the best effect on reducing soil salt content after seedling stage. Biochar decreased soil bulk density (1.34 g cm-3) and mostly increased the sunflower seed yield up to 3133-3964 kg hm-2. Humic acid addition significantly increased aggregate (>0.25mm) content up to 27.88% after the experiment, but got a lower seed yield (2607-3686 kg hm-2). The temperature in 2019 was entirely lower than the 2018, which thought to be the main reason caused the yield reduction. And the three amendments could all maintain and increased the yield than conventional cultivation. The effects of the three materials on larger scale lands and longer time need further research. This study supplied scientific guidance for developing saline agriculture in the Hetao Irrigation areas.

Keywords: Sunflower,Gypsum,Humic acid,Biochar,Soil physical properties

ID ABS WEB: 139427

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

BIO-ORGANIC FERTILIZER COMBINED WITH DIFFERENT AMENDMENTSIMPROVES NUTRIENT ENHANCEMENT AND SALT LEACHING IN SALINESOIL: A SOIL COLUMN EXPERIMENT

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Salt-affected soils frequently experience leaching and desalination issues, which severelyrestrict plant growth and water uptake. Hence, in this experiment, four treatments including CG(no amendments addition); OF (organic fertilizer addition); OH (organic fertilizer and Hekangamendment addition); and OB (organic fertilizer and fulvic acid addition) were designed to examinethe effect of organic amendment on soil chemical properties, water and salt transport, and soildesalination laws of coastal saline soil. The results showed that the addition of organic amendmentssignificantly reduced soil pH (8.47–8.52) and salt content (2.06–2.34 g/kg), while increasing soilorganic matter content, available phosphorus, and available potassium. OH treatment has a higheravailable phosphorus content than other treatments. OH and OB treatments elevated the soildesalination ratio (32.95% and 32.12%, respectively) by raising the leaching volume and leachingrate. Organic amendments significantly promoted Sodium ion(4.5–32%) and Sulfate ion(12–27%) leachingcompared to CG. Organic treatments, particularly OB treatment, not only increased the content ofsoil organic matter and available nutrients but also promoted salt ion leaching, improved soilpermeability and increased soil desalination and water leaching rates. Our results may provide atheoretical basis for revealing the desalination law of coastal saline soil.

Keywords: coastal saline soil,organic fertilizer,soil nutrient content,waterand salt migration,desalinization rate

ID ABS WEB: 139789

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

MYCOREMEDIATION OF HYDROCARBONS-CONTAMINATED SOILS: THE LIFE MYSOIL PROJECT

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Mycoremediation is a bioremediation technique, relying on the use of fungal inocula to reclaim contaminated soils. Total Petroleum Hydrocarbons (TPH) are widespread organic pollutants, and their presence is a primary cause of soil contamination in Europe. In this frame, the LIFE MySOIL project (https://lifemysoil.eu) aims to demonstrate the viability of the mycoremediation technology to remove petroleum-derived organic pollutants from aged industrial contaminated soils. Moreover, the project focuses on the appraisal of the environmental and socio-economic impact of the application of mycoremediation as compared to other technologies, as well as its ability to promote the circular economy principles through the recovery of soil and the use of agro-industrial products, like Spent-Mushrooms-Substrate (SMS), as a viable source of fungal inoculum.
The feasibility assessment of the mycoremediation process involved a sequential approach which, starting from biotreatability tests, passed through the implementation of mesocosms (1 m 3 working capacity) up to large-scale biopiles (50 m 3 working capacity). The biotreatability tests enabled the selection of two P. ostreatus strains (P24 and P80), which were then used in mesocosm experiments where they were compared with SMS from the same species for contaminant degradation performance, inoculum persistence, and impact on resident microbial communities. This contribution will focus on the results obtained in the biotreatability and mesocosm test conducted on a TPH-contaminated clay-soil collected from an Enilive Station, a mobility services hub for drivers located in Borgo Faiti (LT).

Keywords: Mycoremediation,Bioremediation,Hydrocarbons polluted soils,Scale-up process,Circular economy

ID ABS WEB: 140071

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

SOIL RIDGING COMBINED WITH BIOCHAR OR CALCIUM-MAGNESIUM-PHOSPHORUS FERTILIZER APPLICATION: ENHANCED INTERACTION WITH CA, FE AND MN IN NEW SOIL HABITAT REDUCES UPTAKE OF AS AND CD IN RICE

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Reducing the bioavailability of both cadmium (Cd) and arsenic (As) in paddy fields is a worldwide challenge. We investigated whether ridge cultivation combined with biochar or calcium-magnesium-phosphorus (CMP) fertilizer effectively reduces the accumulation of Cd and As in rice grains. Field trial showed that applying biochar or CMP on the ridges was similar to the continuous flooding, which maintained grain Cd at a low level, but grain As was reduced by 55.6%, 46.8% (Ilyou28) and 61.9%, 59.3% (Ruiyou 399). Compared with ridging alone, the application of biochar or CMP decreased grain Cd by 38.7%, 37.8% (Ilyou28) and 67.58%, 60.98% (Ruiyou399), and reduced grain As by 38.9%, 26.9% (Ilyou28) and 39.7%, 35.5% (Ruiyou 399). Microcosm experiment showed that applying biochar and CMP on the ridges decreased As in soil solution by 75.6% and 82.5%, respectively, and kept Cd at a comparably low level at 0.13–0.15 ug/L. Aggregated boosted tree (ABT) analysis revealed that ridge cultivation combined with soil amendments altered soil pH, redox state (Eh) and enhanced the interaction of Ca, Fe, Mn with As and Cd, which promoted the concerted reduction of As and Cd bioavailability. Application of biochar on the ridges enhanced the effects of Ca and Mn to maintain a low level of Cd, and enhanced the effects of pH to reduce As in soil solution. Similar to ridging alone, applying CMP on the ridges enhanced the effects of Mn to reduce As in soil solution, and enhanced the effects of pH and Mn to maintain Cd at a low level. Ridging also promoted the association of As with poorly/well-crystalline Fe/Al and the association of Cd on Mn-oxides. This study provides an effective and environmentally friendly method to decrease Cd and As bioavailability in paddy fields and mitigate Cd and As accumulation in rice grain.

Keywords: arsenic,cadmium,biochar,ridge cultivation,water regime

ID ABS WEB: 140127

4. Soil health in achieving the Sustainable Development Goals
4.12 133530 - Soil degradation control, remediation and reclamation

BIOREMEDIATION POTENTIAL OF NATIVE FUNGAL STRAINS ISOLATED FROM SOILS IN THE PUCHUNCAVÍ-VENTANAS AREA THAT EXHIBIT TOLERANCE TO HEAVY METALS

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Soil contamination by heavy metals (HM) is a problem that affects ecosystems and productive sectors, causing a decrease in biodiversity and agricultural productivity. In Puchuncaví-Ventanas (a coastal area in central Chile), an industrial complex has existed since 1960. Today, it consists of more than 20 companies, mainly a copper smelter and refinery, and coal-fired thermal power plants. Several studies have shown the presence of high concentrations of heavy metals in the surrounding soils. A promising approach to remove heavy metals from contaminated soils is fungal bioremediation. This work aims to characterize the heavy metal tolerance of 2 native fungal strains isolated from the study area. The strains studied were partially identified by comparative internal transcribed spacer (ITS) sequence analysis (Trichoderma TM1 and Mortierella LA7). Tolerance to As, Pb, Cu, Cr, Co was evaluated in in-vitro assays using Potato Dextrose Agar (PDA) culture medium and in control soils, both supplemented with increasing concentrations of each HM. Tolerance indices (TI) were determined, showing high TI for TM1 for Pb (100% at 300 and 450 ppm) and 100%, 51% and 35% for 100, 200 and 300 ppm Cu, respectively. LA7 showed high lead tolerance with TI of 63%, 58% and 71% at 300, 450 and 800 ppm and 69%, 56% and 45% at 100, 200 and 300 ppm (Cu), respectively. Morphological differences between metal treatments and controls were visualized by scanning electron microscopy. Growth in contaminated soil (under ex situ conditions) indicated that Trichoderma sp. remained viable for at least several months after application to soil, suggesting possible removal mechanisms associated with its tolerance and where a decrease in the concentration of available heavy metals (under investigation) is expected. ICP-MS and XRF analytical techniques are used for this purpose. The strains studied are attractive candidates for bioremediation strategies in heavy metal contaminated soils.
Acknowledgments: Project Fondef Idea ID22I10279

Keywords: Soil bioremediation,Heavy metal Tolerance,Trichodema,Mortierella

ID ABS WEB: 137224

4. Soil health in achieving the Sustainable Development Goals
4.13 133539 - Development of efficient soil education scheme for tomorrow

BARRIERS AND NEEDS RELATED TO SOIL EDUCATION AT PRIMARY AND SECONDARY SCHOOL LEVEL IN POLAND

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The launch of the Soil Mission campaign in the European Union initiated a new approach to problems related to soil degradation. In addition, the need to increase awareness of soils at various levels of education was understood. Our project LOESS - Literacy boost through an Operational Educational Ecosystem of Societal actors on Soil health focuses on increasing soil literacy, via developing educational offers and continuous training programmes as well as skills development activities addressing multiple actors, stakeholders and target groups connected to soil education. For this purpose, it is necessary to recognize the current level of education in the field of soil science and point out the gaps in education. The analysis of education programs at the primary and secondary level in Poland showed, that the choice of teaching methods depends on the teacher, which makes it difficult to control the form of teaching. In addition, the way in which the activities are implemented is often related to the financial capabilities of the school. This, in turn, leads to the dominance of the type of teaching by knowledge rather than by doing. Further analysis indicates that soil, is treated as an element of food production, while the programs do not mention issues related to soil as a non-renewable resource, or its role in the context of climate change such as participation in carbon sequestration. Nor was there any reference to the need for soil conservation in the context of healthy soil. Furthermore, the importance of soil in achieving the Sustainable Development Goals has not been adequately addressed. Preliminary research indicates an urgent need for changes to the core curriculum in schools at both levels of education.

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Keywords: LOESS,soil,education,primary school level,secondary school level

EPOSTERS

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4. Soil health in achieving the Sustainable Development Goals
4.13 133539 - Development of efficient soil education scheme for tomorrow

FORMAL AND INFORMAL EDUCATION IN THE FIELD OF SOILS IN POLAND – GOOD PRACTICES

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The method of managing the soil environment is key to ensuring, among others: food security, biodiversity. Rational soil management should take into account all soil functions: production, habitat and retention. This approach requires an appropriate level of soil knowledge in society. One of the goals of LOESS project is to increase knowledge about soil and develop skills in its appropriate use. Polish society acquires knowledge about soil in primary and secondary schools and as part of studies in fields closely related to soil, e.g. horticulture, agriculture, forestry, geology, environmental protection. Education is for free, as well as access to educational materials. Our study was based on an analysis of the core curriculum and a review of websites related to teaching about the soil. We used desk research and case study methods. It was shown that activating methods (e.g. experiments, field exercises) are underused at the primary and secondary levels of education. In vocational and college education (in fields related to soil education), educational offerings favor learning through practice, e.g. in specialized laboratories or using as tools eg. experimental gardens, demonstration farms. Thus, there are still too few innovative and attractive methods of teaching about soils available to the general public. It is therefore necessary to search for, develop and promote good educational practices that raise public awareness of soils. Our study identified several innovative examples of soil education in Poland that may also be applicable in other countries. We conducted a multi-faceted analysis of: Field Days - the largest agricultural event in Poland; Soil Museum in Krakow – museum and educational offer; Experimental heritage gardens in Poznan - permaculture design workshops; Integrated educational platform - educational materials taking into account active teaching methods.
Research co-financed by the EU, Project LOESS 101112707 HORIZON-MISS-2022-SOIL-01

Keywords: good practices,formal education,informal education,soil environment management,teaching methods

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4. Soil health in achieving the Sustainable Development Goals
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HOW DOES PLASTIC POLLUTION AFFECT SOIL QUALITY IN PLASTICULTURE?

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Growing crops in plastic greenhouses and mulching with plastics is one of the largest sources of microplastics in the environment around the world and especially in Serbia. Plastic waste is known for its stability and recalcitrance in the environment, so it is generally assumed that standard plastic waste is not degradable. The determination of microplastics in soil is a major challenge due to the complexity of the soil matrix. The aim of the study was to show the effects of plastic particles on the chemical, physical and biological properties of arable soils. Alluvial soils from three major river basins (Danube, Morava and Sava) in Serbia, which are most affected by seasonal flooding, were selected. Soils from MP-polluted (plasticulture) and non-polluted (open field) sites, located next to each other, were sampled in 2022 from two depths 0-15 and 15-30 cm. Preliminary results showed that the physical, chemical and biological properties of the soil were significantly affected by the presence of plastics. Plastic contamination in the soil environment has an impact on organic matter cycling, global carbon dioxide production, plant production, soil properties, water quality, etc. It is time to raise awareness that the pollution of our environment with plastic waste can lead to serious disruptions of the ecosystem and its ability to fulfil its functions, such as the production of sufficient and high-quality quantities of food.

Keywords: plastic waste,alluvial soil,soil quality,plasticulture

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4. Soil health in achieving the Sustainable Development Goals
4.13 133539 - Development of efficient soil education scheme for tomorrow

HOW TO PROMOTE SOIL EDUCATION WITH EXISTING SCHOOL CURRICULUM IN JAPAN, EXAMPLES AND LIMIT

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Japanese education curriculum for primary and secondary school hardly deals with soil. We report some cases of soil concerned practice with existing education curriculum in Japanese primary school. For example, in the 6th grade's subject "Formation and change of land", only geological aspect is focused. According to the experience of giving additional lecture on this subject, we found that explanation of the dynamics of deposition of gravels by flooding, formation of alluvial plain, and subsequent use of such land and soil by human as paddy fields is effective for students to recognize the land surface is covered with soil and supporting their life. The subject could be further expanded to cover not only natural science but also social studies and comprehensive studies of the local area, since it is comparable with Andosols on plateau and its non-paddy uses. However, implementation of systematic soil education is limited under the existing curriculum. For example, room for teaching fundamental knowledge, "what SOIL is made of?" cannot be found. Establishment of an international guideline on soil education would make teachers, government officers and others aware of the importance of soil education and would be convincing and reliable reference for future revision of education curriculum.

Keywords: soil education,education curriculum,primary school,secondary school,guideline

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4. Soil health in achieving the Sustainable Development Goals
4.13 133539 - Development of efficient soil education scheme for tomorrow

TEACHING SOIL SCIENCE BY COMBINING PRACTICE IN SCHOOL GARDENS AND UTILIZING DIGITAL TECHNOLOGIES TO ENHANCE CREATIVE AND INTERACTIVE LEARNING

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Raising awareness about soil, our most valuable, non-renewable natural resource, should be an important part of education, already from primary school, applying well-balanced theory and practice, based on the principle of "learning by doing" and utilizing the creativity of children. School gardens are an educational resource, offering nature experiences, demonstrating ecological connections, and providing space for creative projects. The outdoor environment is seen as a complementary classroom that stimulates the different interests and abilities of children and young people. The school garden is of great importance for children to experience a sense of home, identity, and a reflection of their own culture, understand ecosystems, their services, and functions. For the schoolyard to function in this way, it is important that the pupils have a great opportunity to influence how the schoolyard is designed and used. For the teacher, this includes an important didactic task to illustrate that the soil is a living system, it is an ecosystem itself with a vast biodiversity and a central role in global biogeochemical processes. At the same time, the issues of soil degradation and pollution, the transformation of soil into 'non-soil' and the global consequences of soil mismanagement shall be emphasized in an interesting and entertaining way, completing the theoretical learning and school garden practice with interactive programmes, using digital technologies, and utilizing AI resources, enhancing herewith the understanding of natural processes and the development of system thinking. Intelligent adaptive systems and learning analytics are concepts that are increasingly common in discussions about school digitalisation. Adaptive systems can be described as a digital learning environment that automatically adapts teaching and learning resources to individual students' abilities and needs. Intelligent adaptivity is when artificial intelligence (AI) is used for this adaptation. For example, AI in education can be used to monitor students' progress, understand their current strengths and difficulties, and provide timely feedback in the form of explanations and appropriate tasks. Here we suggest a novel education model for applied ecology, where soil conservation has a central role, and the programme combines practice based learning and digital technologies with AI containing elements of gamification to increase the motivation of pupils and enhance their cognitive development.

Keywords: Soil awareness, soil science, soil conservation, school gardens, biodiversity, ecosystem services, ecological education, artificial intelligence, interactive teaching, gamification

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4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

CO-CULTURE OF RICE AND AQUATIC ANIMALS ENHANCES SOIL ORGANIC CARBON: A META-ANALYSIS

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Co-culture of rice (Oryza sativa) and aquatic animals (CRAAs) is an efficient eco-agricultural model and has been widely implemented in many Asia countries. However, its impact on soil organic carbon (SOC) content has not been synthesized and the relative effects of different CRAAs practices on SOC have not been assessed. Our meta-analysis aims to synthesize the effect of diverse CRAAs regimes on SOC content based on results from field experiments. Our results showed that overall, CRAAs significantly increased SOC content by 11.6%($P < 0.05$). The highest relative effect on SOC content was found under the rice and amphibian coculture ($P < 0.05$) practice. Also, CRAAs caused a significantly higher increase in SOC content in temperate regions (19%) than in subtropical (9.7%) and tropical (12%) regions ($P < 0.05$). In addition, CRAAs were more effective in enhancing SOC content in paddy soils with low nitrogen content (total nitrogen [TN] < 1.5g/kg) or alkaline pH. Further, SOC increased more in the CRAAs with Japonica than Indica rice, increasing 17.8% and 6.1%as compared to their respective rice-monoculture controls. Random forest analysis revealed that animal type was the most important factor influencing SOC under CRAAs. Regression analysis showed that the increase in SOC content had significant positive correlations with soil pH ($P < 0.01$) but negative correlations with mean annual precipitation ($P < 0.05$). Soil TN had significant hump-shaped relationship with on CRAA-driven SOC content. These results indicate that CRAAs can significantly enhance SOC, particularly in low-N, alkaline paddy soils. Our findings suggest that CRAAs with appropriate rice and animal varieties can provide unique opportunities for soil C sequestration, while enhancing farmers' profitability.

Keywords: soil organic carbon,co-culture of rice and aquati,co-culture modes,meta-analysis

ID ABS WEB: 136197

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

BIO-ORGANIC FERTILIZER IMPROVES SOIL HEALTH IN AN ACIDIC VEGETABLE SOIL IN SOUTHERN CHINA

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Soil acidification impairs plant growth and agricultural sustainability, whereas organic fertilizers can ameliorate soil health. Nonetheless, the response of soil health especially microbial populations to bio-organic fertilization in acidified soil remains elusive. This study selected soils that underwent acidification in high tunnels, and native vegetation soils were used as controls. We investigated the effects of the sole application of inorganic fertilizers, sole application of organic fertilizers, and combined application of organic and inorganic fertilizers on the microbial diversity of rhizosphere soils of tomato (Solanum lycopersicum. L), soil chemcial and physical indicators. Results indicated that organic fertilizer enhanced bacterial network complexity, metabolic function, and convergence of the community structure of Native soils. Beneficial biomarkers were identified by linear discriminant analysis effect size screening. Soil health assessment results showed that the application of bio-organic fertilizers can increase the physical, chemical and biological fractions of acidified soil, thereby improving soil health.

Keywords: soil health,soil acidification,bio-organic fertilizer,Solanum lycopersicum

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4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

IMPACT OF SOIL HEALTH STRESS ON WATER FLUX DYNAMICS IN THE SOIL-PLANT-ATMOSPHERE CONTINUUM

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Climate change exerts pressure on soil health, with soil salinization being a significant influencing factor. Salinization can occur naturally in arid and semi-arid regions when soil surface evaporation exceeds precipitation, or due to mismanagement of soil and water resources. Climate change-induced factors, such as prolonged precipitation-free periods and sea level rise, extend salinity problems to some humid regions, particularly in coastal areas.

In addition to their impact on soil and plant health and nutrient balance, soluble salts influence water flux within the soil-plant-atmosphere continuum by affecting the hydraulic gradient. Despite this well-known influence, there is a lack of quantitative studies predicting the impact. In this study, we explore the role of changes in hydraulic gradient resulting from soluble salts on evapotranspiration from grass planted in small-scale weighing lysimeters under laboratory conditions. The lysimeters are equipped with soil moisture, potential, temperature, and electrical conductivity sensors.

To create different osmotic conditions, the lysimeters were irrigated with various water qualities, including distilled water and a 4.79 dS/m NaCl solution. The results indicated a significant reduction in cumulative evapotranspiration under osmotic influence, reaching 39% after three months of treatment application. Based on the experimental data, an empirical model has been developed to predict the reduction in actual evapotranspiration under salinity conditions. These results are crucial for improving agricultural water management under salinity stress. However, field-scale studies are essential to validate the findings and develop a robust prediction model.

Keywords: Salinization,Water Flux Dynamics,Climate Change,Agricultural Water Management

ID ABS WEB: 136364

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

EVALUATION OF THE SOIL CARBON STOCK AND ITS RELATIONSHIP WITH THE BULK DENSITY AND SHRINKAGE OF DIFFERENT VOLCANIC SOILS IN CHILE

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Land use change is the most substantial human alteration of terrestrial ecosystems, driving environmental impacts associated with the provision of ecosystem services linked to soil resources, strongly affecting the estimation of soil carbon (C) stock. This work evaluates the variation in the soil C stock of different types of volcanic soils in southern Chile, associated with different use conditions, considering the variation in soil shrinkage as a correction factor. For this, allophanic, non-allophanic and crystalline volcanic soils were collected between the La Araucanía Region (38.95°LS) to the Aysén Region (44.03°) of Chile under different uses: Native Forest (NF), Crop (C) and Grassland (G). Chemical indicators were evaluated: pH H2O, SOC; and physical: bulk density (Bd), plant available water (PAW), air capacity (AC) and Coefficient of linear extensibility (COLE). Some of the main results show that the pH varied between 4.28 and 6.92 and the SOC ranged between 1.01 and 27.92%, observing a reduction in the soil C stock (1.60 Mg C ha-1) due to the change in use NF > C as a result of soil tillage. Bd presented an opposite trend, which varied between 0.14 and 1.18 g cm-3. Soil C stock normally protected in soil aggregates reduces soil Bd, while continuous tillage activities reduce soil C stock, increase Bd, and decrease shrinkage capacity. Volcanic soils have the capacity to store 117 Mg C ha-1 in the first 0.2 m and they are sensitive to changes induced by management. In general, soil C stock estimates are made considering the soil as a rigid body without considering changes in Bd, which could affect the final soil C stock estimate.

Keywords: Soil carbon stock,variation in shrinkage,volcanic soils

ID ABS WEB: 137087

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

ASSESSING THE IMPACT OF TERRACING ON SOIL HEALTH IN SOUTHERN BRAZIL: A THREE-YEAR STUDY INVESTIGATING SOIL MICROBIAL ATTRIBUTES IN SLOPED AREAS

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Soil health is affected by its genesis and other factors related to soil use and management. Conservation practices provide benefits to the soil, such as reduced erosion, increased organic matter content and, consequently, improved soil quality and agriculture productivity. To evaluate the influence of terraces in non-till areas of Southern Brazil, ten microbiological soil attributes of 72 soil sampled points were evaluated in a principal component analysis during three years. Six months after terrace implementation (2020), it was possible to distinguish areas with and without terraces and to notice that the disturbance caused by terraces increased Basal Respiration (BR) and metabolic quotient (qCO_2), induced the disruption of soil aggregates, and facilitated access to plant residues. This stimulated the proliferation and activity of the soil microbiota, leading to a positive correlation between the terraced area and other microbiological attributes, mainly Microbial Biomass Carbon and Nitrogen. In the second year (2021), the separation of the sampled points of the two areas was maintained. In addition, there was a division of the non-terraced area into three groups, indicating the influence of the drainage ramp on the soil microbiological attributes. It is important to highlight that BR, Betaglucosidase activity and qCO_2 showed a strong positive correlation with the area without a terrace indicating higher CO_2 loss to the atmosphere. In the third year (2022), the heterogeneity of the unterraced area continued to be evidenced and most of microbiological attributes showed a positive correlation with the terraced area indicating that the terrace increases microbiological soil quality. Over the three years, there were a homogenization trend of the sampled points of the terraced area and in contrast, the non-terraced area gradually became more heterogeneous. Furthermore, the terrace induced a reduction in the metabolic quotient and an increase in the microbial activity. Our results showed the effectiveness of the terrace in maintaining soil stability and health in sloped areas.

Keywords: Soil quality indicators,soil enzymes,conservation soil practices

ID ABS WEB: 137103

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

SOIL QUALITY ASSESSMENT OF ORGANICALLY CULTIVATED PADDY IN SOUTH KOREA

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Unlike conventional agriculture which focuses on high productivity, organic agriculture that focuses on promoting biodiversity, producing sustainable crop, and minimizing environmental impact, requires the use of organic materials instead of chemical for soil management. It can affect not only soil chemical property, but also its physical and biological properties. Organic farmland can be considered healthy soil management in that it can achieve not only crop production but also biodiversity and environmental conservation. In South Korea, little research has been conducted on soil quality assessment (SQA) over the past 20 years since the early 2000s. In this study, SQA for organic paddy soil was developed, and the developed SQA was used to evaluate paddy soils quality according to the period of organic farming in South Korea. For healthy soil, we set three main soil fucntions: provision of biological habitat, production of sustainable crop, and conservation of agricultural environment. Tweleve SQ indicators were selected from 18 SQA frameworks from 12 countries: bulk density, water-stable aggregation, pH, organic matter, available phosphate, exchangeable potassium, available silicate, soil respiration rate, and soil enzyme activity (dehydrogenase, b-glucosidaese, urease, and phosphatase). Among 12 indicators, reference values were set and scores were assigned based on 5 chemical indicators for which soil database was established in South Korea. Soil quality index (SQI) was evaluated for the average period of organic farming practice as 8 years (12 sites), 3 years (10 sites), and non-organic farming (10 sites). As a result, the biological habitat provision function was high in the order of 8 years (94), non-organic (86), and 3 years (82). There was no difference in crop production function. Environment conservation function was higher in 8 years (66) than 3 years (51) and non-organic (51). Integrated SQI, which applied weight by function, was in the order of 8 years (74), non-organic (68), and 3 years (67). Further research on improvement of the scoring method considering physical and biological indicators is needed.

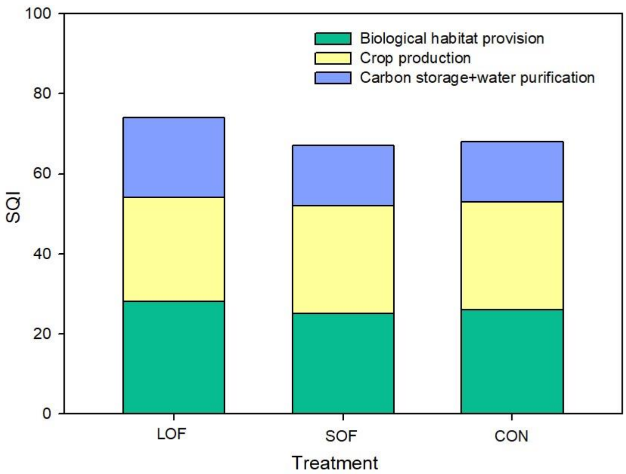

Fig. 1. Soil quality assessment by organic farming practice period in South Korea.
LOF is organic farming long-term practice paddy soil on the average of 8 years (12 sites),
SOF is organic farming short-term practice paddy soil on the average of 3 years (10 sites),
CON is non-organic farming padday soil (10 sites).

Keywords: organic agriculture,soil quality assessment,soil health,soil property,regenerative agriculture

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4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

COMPARATIVE EXAMINATION OF SOME MICROBIOLOGICAL PROPERTIES OF DIFFERENT CULTIVATED AND NATURAL GRASSLAND SOILS IN EASTERN HUNGARY

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The monitoring of intensively farmed areas and soils is a very important task. In our comparative study, we were examined three different soil types with different cultures based on some microbial properties in the Eastern Hungary region (2019-2021). The examined soil types were calcareous chernozem (Chernozems) with corn (Triticum aestivum L.) from Debrecen-Látókép - pH(H2O)=6.8; humus sandy soil (Arenosols) from Debrecen - Pallag - pH(H2O)=5.8, with fruit (Prunus cerasus L.) – and solonetz soil (Solonetz) with grassland Hajdúnánás – Tedej, pH(H2O)=6.6. The areas have received only natural rainfall. The moisture content of the soil samples was during the three years average 10-19%. We observed that during the three consecutive years the moisture content in the soil decreased in all three areas. The highest activity of saccharase (SA) (7.21 mg glucose 100g-1 24h), urease (UA) (65.34 NH4+ mg-1 100g-1 2h), and dehydrogenase activity (DA) (219.55 µg INTF g-1 2h-1) was in solonetz soil, which natural uncultivated, pasture. The phosphatase activity (PA) (14.84 P2O5 mg-1 100g-1 2h) was higher in the chernozem soil, it was almost the same for sand (6.47 P2O5 mg-1 100g-1 2h) and grass (6.69 P2O5 mg-1 100g-1 2h). The CO2 production was 18.44 on the chernozem, 15.65 on the humus sand, and 19.11 mg 100g-1 7 days-1 on the solonetz soil. Regarding the seasonality, the SA and PA was not significantly higher, while UA was significantly higher in spring. DA showed higher activity in autumn, while soil CO2 production was also in an unprovable way higher in autumn than in spring. Grasslands create a specific environment for the organisms that live in them. The large root masses of grass provide an important source of organic matter for micro-organisms. According this study, the enzyme activity and the CO2 production were also more intensive on undisturbed pasture soil utilization natural grassland than in soils under intensive cultivations.

Keywords: enzyme activity,CO2 production,chernozem,sandy soil,grassland

ID ABS WEB: 137204

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

CHANGES OF SOME CHEMICAL PARAMETERS OF SOIL WITH A DEPTH IN A LONG TERM FERTILIZATION AND TILLAGE EXPERIMENT

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The effects of agricultural management on soil properties in top-soil have been videly studied, but few studies have been examined the effects on sub-soil. In order to determine the impacts of chemical fertilization and different tillages on soil properties in subsoil, soil samples were collected from soil deeper layer in a long-term experiment, where the soil type is Chernozem. Soil samples were taken in the 20th year of the experiment, in the autumn, under maize monoculture from the crop row from 0-100 cm. The treatments were control, NPK fertilization and tillages: plowing tillage (PT), ripper tillage (RT) and strip tillage (ST). In PT sampling were from 0-500 cm deep layer. The fertilization decreased the pHKCl, and the values increased with a depth in ST and RT, but did not change in PT. Fertilization increased the available nutrients differently in various tillage systems. The highest CaCl2-NO3- was measured in plots with PT, followed by values of ST and RT and the values decreased with the depth until 60 cm, but a NO3- accumulation zone was found along the all 120-400 cm depth. The NH4+ concentration decreased with a depth, but there was no accumulation zone in deeper layer. Higher AL-P2O5 and AL-K2O were measured in the ST fertilized plots compared to values of PT and RT plots. The soluble P and K decreased with a depth differently. In plots with RT and ST a significantly decrease was measured up to 40 cm, and from that depth the concentration slightly changed. In PT the soluble P and K did not change in the depth of 0-40cm, but from that depth the nutrient concentrations significantly decreased.
In the fertilized plots of PT, ST and RT the Ca, Mg, Zn and Cu concentration were lower compared to the control. The concentration of non-supplied nutrients changed with a soil depth differently; AL-Ca and AL-Mg increased, LE-Zn did not change, and LE-Cu decreased.

Keywords: long-term experiment,subsoil,top soil,nutrients,pH

ID ABS WEB: 137869

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

FIELD-SCALE SOIL SALINITY MAPPING USING RANDOM FOREST

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Soil salinization is a prevalent form of land degradation in arid and semi-arid regions. Classical methods for salinity study are time and cost-consuming and therefore employing new techniques like digital soil mapping has become imperative. This study lays on a foundation of using random forest model for field-scale soil salinity mapping in the central part of Iran in 2018. Field studies were conducted by grid sampling designed for 130 surface samples with 100-meter intervals. Laboratory analysis was performed on samples from two predetermined uses. 1- Abandoned pistachio garden due to lack of water and 2- Pistachio garden with more than 20 years old trees with furrow irrigation system. To explain the SCORPAN equation environmental covariates; spectral indices from Landsat 8 and train attributes from DEM were prepared. Recursive feature elimination employed to simplify the model by identifying the most important environmental covariate to make random forest. The most important covariates were normalized difference salinity index, topographic wetness index, Channel Network Base Level, normalized difference vegetation index, and modified soil vegetation index. Based on 10-fold cross-validation random forest predicted soil salinity map with the coefficient of determination value (R2) of 0.56. ECe was between 2.58 to 188 dS/m with mean amount 46.95 dS/m. The highest amounts of ECe were at the middle of the field, in pistachio trees land use. Approximately 33% of the studied area were in the salinity class 4–8 dS/m, 20% fell in the 8–16 dS/m class, 15% in the 16–32 dS/m class, and 32% in the salinity class greater than 32 dS/m. All the study area was classified as hypersaline soil (ECe > 4 dS/m) which combination with the hot and arid climate demonstrate the unsuitability of the study area for agricultural purposes. The digital nature of the produced salinity map allows information to be updated at a lower cost and faster on different scales in the future.

Keywords: Digital soil mapping,Random forest,soil degradation,Soil Salinity,Spatial changes

ID ABS WEB: 137890

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

RISK OF SOIL SALINIZATION FROM IRRIGATION WITH WASTEWATER AND EFFECTS IN AVOCADO LEAVES

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Andalusia represents the 86% of the Spanish production. In this region, precipitations are scarce and erratic and limit water availability for irrigation. Meanwhile, there is a risk of saturation of local soils with toxic salts due to the poor quality of irrigation water.
The objective of the study was to investigate impact of irrigation with wastewater on the injury of Avocado leaves. EC of regenerated wastewater 2.3 times more than ground water. There are excess of sodium and chloride in wastewater comparative to groundwater at 6.5 and 7.4 correspondingly. Sodium Adsorption Ratio for groundwater and regenerated water are 8.0 and 51.9.
It is known that avocado develop severe leaf burn if the SAR of the irrigation water is more than about 6 - 10. SAR of the wastewater is 5 times more 10. That is why first way is connected with the regenerated wastewater dissolution with low mineralized natural water follow principle 1:1. The best leaf area yield was fixed in option with ground water. 50 % of regenerated water with ground water dissolution led to decreasing of leaf burn injury to slight level to 52 % cases comparative with 100% regenerated water treatment. The data obtained tell us that avocado leaves growth depression fixed most of all in the 100% treatment. The data on electrolyte leakage and cell membrane stability were obtained in order to determine the injury due to salt stress at a cellular level on the leaves of the avocado. It was established that lowest level of three pigments (Chlorophill a, b and Carotenoids) was established in the treatment with 100% regenerated water. 50% level using of mix consisted of ground and regenerated water (50/50) take intermediate indexes. The similar estimation was made after calculation of Chlorophill a+b/ Carotenoids ratio in the avocado leaves ratios. The less meanings of ratio between Chlorophill a+b and carotenoids were fixed in the treatment with regenerated waste treatment 100% option.

Keywords: SOIL SALINIZATION,AVOCADO,WASTEWATER,SOIL QUALITY,SALT STRESS

ID ABS WEB: 137934

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

QUANTIFYING COVER CROP EFFECTS ON SOIL HEALTH OF AGRICULTURAL LAND USE IN MISSISSIPPI, USA

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The use of cover crops in agricultural cultivation may enhance soil health. A field experiment was conducted to determine the effects of winter-planted cover crops and no cover crops on soil health of organic vegetable production systems in humid environments. The cover crop treatment was consisted field peas + winter rye+ hairy vetch. Soil physical, chemical, and biological properties were tested to quantify soil health. Cover crops reduced soil bulk density, and increased soil organic carbon, total nitrogen, extractable phosphorus, extractable potassium, available water content, saturated hydraulic conductivity. Based on the analytic hierarchy process, correlation analysis and expert's opinion method, soil indicators were screened and soil health assessment was conducted. Cover crops improved the soil health scores. The results can provide fundamental reference for farmers to apply cover crops in agricultural land use for improving soil health in the Southeast United States.

Keywords: soil health,cover crops,agricultural land use,organic farming

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4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

SOIL AGGREGATE STABILITY IMPROVEMENT WITH DIFFERENT ORGANIC AMENDMENTS IN AN AGRICULTURAL SOIL OF CHINA

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Aggregate stability is a commonly used indicator of soil health.Soil physical properties plays an important role in soil nutrient absorption, microbial activity and plant healthy growth. Soil management measures significantly affect soil organic matter content and aggregate size distribution. Therefore, the study of soil aggregate distribution characteristics, soil organic matter content and tomato yield under different organic amendments is of great significance for the study of soil structure. Tomato pot experiment was carried out with yellow brown loam soil in dry land as test soil. A total of eight treatments were set up: 1% biochar (B1), 3% biochar (B3), 5% biochar (B5), 3% earthworm castings (V3), 5% earthworm castings (V5), 0.1% mineral source potassium fulvic acid (F1), 0.2% mineral source potassium fulvic acid (F2), and control without amendment (CK). Biochar and earthworm manure treatment can effectively reduce soil bulk density and increase total soil porosity. The organic matter content of B5 was the highest, reaching 21.89g·kg-1. The particle size of soil aggregates treated by biochar is mainly 0.053~0.25mm, the particle size of V3, F1 and F2 is mainly > 0.25mm, and the stability of V3 aggregates is the best. Biochar, earthworm castings and mineral source potassium fulvic acid can promote tomato yield increase, among which F2 and V3 yield increase effect can reach more than 30%. The correlation analysis showed that the geometric mean diameter was significantly positively correlated with the mean weight diameter and the water stable macroaggregate content. The application of organic amendments can effectively improve the physical and chemical properties of yellow brown loam soil, promote the formation of large aggregates, improve the stability of aggregates, and promote the yield increase of tomato. Among them, the comprehensive effect of adding 0.2% mineral source potassium fulvic acid is the best, which has good application potential.

Keywords: Biochar,Vermicompost,Potassium fulvic acid,Aggregate stability,Soil management practices

ID ABS WEB: 138127

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

ORGANIC AMENDMENTS AFFECT SOIL HEALTH INDICATORS FOR SUSTAINABLE LAND MANAGEMENT

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The application of organic amendments to agricultural land is an important way to reuse organic waste. Organic amendments can improve soil quality, thereby producing a series of environmental and agricultural benefits. Differents organic amendments (calcium lignosulfonate, bio-organic fertilizer, and biochar) were used to remmediate an acid soil casued by excessive use of chemical fertilizers. In addition, two irrigation amounts (conventional irrigation and deficit irrigation) were set. We measured soil physical properties (bulk density, total porosity, field water capacity, wilting coefficient, soil available water, soil aggregates) and chemical properties (pH, available nitrogen, available phosphorus, available potassium, redox potential, exchangeable magnesium, exchangeable Calcium, total organic carbon, dissolved organic carbon, easily oxidizable organic carbon). Research findings can provide reference for the utilization of organic amendment to alleviate soil acidification under different irrigation systems.

Keywords: soil health,soil indicators,acid soil,irrigation

EPOSTERS

ID ABS WEB: 138217

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

HOW DOES MANAGEMENT OF DUAL-USE PERENNIAL GRAIN SYSTEMS AFFECT SOIL AGGREGATE STABILITY?

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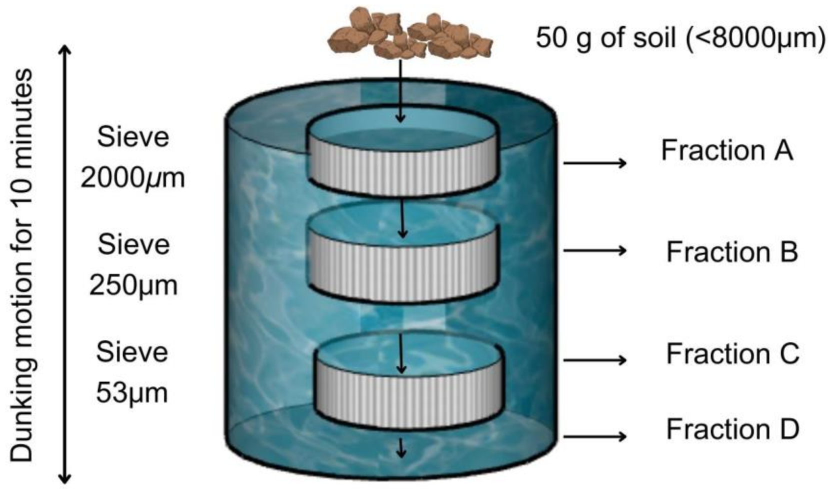
Perennial grain systems can help increase soil aggregate stability, which is a soil health indicator that plays a prominent role in building soil structure and storing organic carbon occluded within aggregates and pore networks. The objective of this study was to evaluate the effect of forage defoliation intensity in dual-use perennial grain systems on soil aggregate stability. Soil samples were collected from the 0-20 cm depth at the fourth year after establishment of Kernza Dual-Use experiments in two locations in Ohio. Trials were planted with the commercially available variety Clearwater Kernza (1504) in a randomized complete block design with four replicates and included four defoliation treatments (forage harvests) at: (i) Summer after grain harvest, (ii) Spring+Summer; (iii) Fall+Summer (iv) Spring+Summer+Fall. Soil wet aggregate stability was determined using nested sieves submerged in water to disaggregate soil through shaking. Oven-dried soils were initially sieved to particle size <8mm, then laid on top of a stack of four sieves with different opening sizes (2000, 500, 250, and 53 microm), ordered bottom-up from the smallest to the largest opening. The stack of sieves was repeatedly submerged into a bucket filled with water, for 10 minutes in 2 seconds intervals. This process was used to determine the proportion of soil-stable aggregate that remained at each sieve size. We found that there were no differences among defoliation treatments over the size and distribution of the aggregates in dual-use perennial grain systems. These results represent an opportunity for growers to sustainably intensify forage harvesting in perennial grain systems, while maintaining the productivity potential and health of these systems.



Method of Yoder (1936) to determine aggregate stability in a dunker machine

Keywords: Aggregate Stability,Soil Health,Perennial crop system,Organic carbon,Kernza

ID ABS WEB: 138333

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

EFFECT OF DIFFERENT SOURCES AND DOSES OF NITROGEN, FOLLOWING TWO DIFFERENT RECOMMENDATION SYSTEMS, ON THE DEVELOPMENT OF CORN AND COMMON BEANS

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The ONU released data that the global population jumped to 8 billion people in 2022 and projections are that these numbers will reach 9 billion in 2037. Given this scenario, food uncertainty, which already affects 260 million people in the world, increases even further and along with it sustainable production alternatives are necessary. Brazil is one of the largest producers of corn and beans in the world; For such production to be possible, the use of fertilizer on a large scale is essential. A viable strategy is to combine the rational use of fertilizers with sources that are more usable by plants. The objective of the work was to evaluate the performance of nitrogen sources in the production of corn and beans based on two more recent soil correction systems and recommendations available for the central Brazilian region. The experiment was conducted in a greenhouse at the Federal University of Goiás, Goiânia-GO, Brazil, on corn and bean crops. The experimental design was completely randomized, with 8 treatments with 5 replications and two controls with 4 replications each, for both cultures. They are: Urea, Nitratop, Nitratop + DMPSA and Super N Pro for both the Boletim 100 recommendation system and the Cerrado recommendation system. The evaluations carried out were: biometric, physiological, fresh mass, dry weight, nutrient export analysis and protein content in the plant tissue of corn and bean grains. The data were subjected to analysis of variance, Tukey test at 5% significance. Bulletin 100 was the recommendation system that showed the greatest result in production for corn, while for beans it was the Cerrado, while the Nitratop + DMPSA treatment was the best source for both crops.

Keywords: Food uncertainty,Corn,Beans,Nitrogen,Fertilizers

ID ABS WEB: 138755

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

IMPACT OF TOPSOIL MINING FOR UNFIRED MUDBRICKS ON SOIL QUALITY IN EASTERN KWAZULU-NATAL, SOUTH AFRICA

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The depth of topsoil is a significant parameter in determining soil quality (Brunel et al. 2011). Unfortunately topsoil mining for unfired bricks is widespread in most grassland areas of rural South Africa. Despite, extensive research on erosive forms of soil degradation, less attention has been given to non-erosive forms associated with land uses such as topsoil mining for mudbricks. This study therefore assessed the impact of topsoil mining associated with unfired mud bricks on selected soil quality indicators in two villages of KwaZulu-Natal, South Africa

First, local miners were interviewed to ascertain information related to topsoil mining, brickfield site identification and soil suitability for mud bricks. Two brickfields per village mined for less or equal to 5 and more than 20 years, respectively were used in this study. Experiment consisted of three treatments, that is, unmined, mined and recovering lands replicated three times. Nine soil samples were collected (0–10 cm) from each site (three composite samples per treatment) with corresponding bulk density samples taken at 0–5 cm using core rings. Soils were air-dried and sieved through a 2 mm sieve (except for soil samples used for aggregate stability) prior to fertility assessment.

The average topsoil mining depth was 30 cm. Topsoil mining increased silt fraction across all studied brickfields with an average of 45.2% in mined compared with 30.6% in unmined treatments. The response of clay fractions was variable across villages and mining time. Mining significantly decreased mean weight diameter, exchangeable bases, organic carbon, and nitrogen content and stocks and porosity while it increased bulk density.

Topsoil mining for mudbricks results in poor soil physical quality, nutrient availability and carbon storage with implications for land degradation in mud brickfields.

Keywords: Topsoil mining,land degragation,soil quality,soil organic carbon,brickfields

ID ABS WEB: 139264

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

ASSESSING SOIL HEALTH: STABILITY DYNAMICS ACROSS DIFFERENT LAND COVERS THROUGH COMPARATIVE ANALYSIS USING MULTIPLE DISRUPTION METHODS

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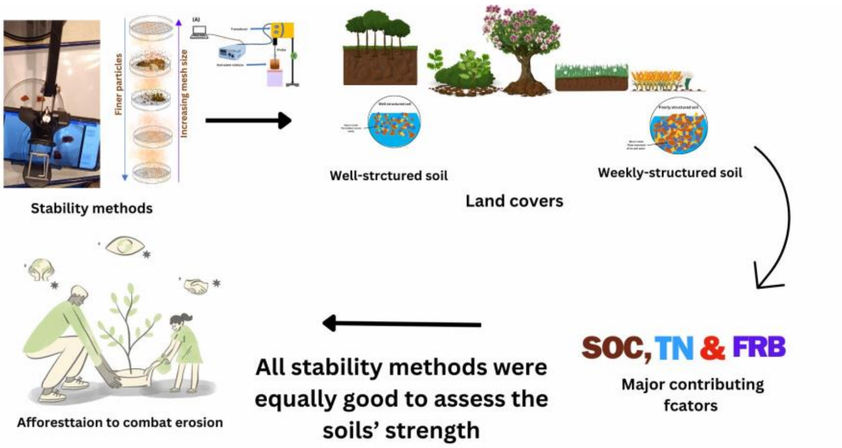
Soil stability serves as an indicator of soil health. This study examines disruptive mechanisms across forest, shrubland, and grassland covers, assessing four methods (modified Yoder MYOD, Le Bissonnais LB, Slakes App SI, and Ultrasonic agitation UA) across 0–20 and 20–40 cm soil layers to elucidate their impact on soil stability. Our investigation reveals notable disparities in aggregate stability among land covers. The results of MWD (Yod) indicated that surface and subsurface soils were in the range of 1.23–2.86 mm, which accounted for medium (0.8–1.3 mm) to very stable (>2 mm) soils. In LB tests, fast wetting (FW) demonstrated the most pronounced soil instability (MWD: 0.45 mm) followed by WS (Wet stirring) and SW (Slow wetting). Notably, the SI unveils varying stability levels, with values ranging from 0.17 to 15.08 SI. Furthermore, specific dispersion energies (SE) by the UA method showcase a diverse spectrum of soil stability responses. SE values at different stages of aggregate disruption spanned from SE10 (8.1 to 29.4 J/g), SE50 (53.0 to 193.4 J/g), and SE90 (176 to 642 J/g). Correlation analyses highlighted the significant influence of soil organic carbon (SOC), total nitrogen (TN), fine root biomass, clay content, and soil water content (SWC) on soil stability. Despite methodological variances, strong positive correlations between stability parameters and methods underscore the reliability of these assessment techniques for all types of soils. Furthermore, our findings suggest that soil under forest and shrub exhibits the highest and lowest stability, respectively. Intriguingly, despite the diverse breakdown mechanisms employed by each method, results indicate their equal efficacy in stability assessment, with some distinctions and limitations. Our study provides crucial insights into soil stability dynamics, underlining the necessity of comprehensive assessment methods to enhance our understanding of soil health.



Keywords: SOIL AGGREGATE STABILITY,SOIL STRUCTURE,Land Covers,stability methods

ID ABS WEB: 139274

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

REGENERATIVE FARMING – THE NEW APPROACH TO RESTORE AND IMPROVE SOIL HEALTH

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At present time there is an ever-increasing need to change soil cultivation practices from conventional to more ecological variants—the need to use agricultural land in a sustainable way. Sustainable farming practices refer to methods of agricultural production that are environmentally responsible, economically viable, and socially equitable. One of the most important aims of these practices is to minimize negative impacts on the environment while maintaining the land's long-term productivity together with ecosystem services and soil functions. Sustainable farming emphasizes soil conservation, water management, biodiversity preservation and increase, ethical treatment of farm workers, and adaptation to climate change. Sustainable farming practices include agroforestry, crop rotation, integrated pest management, organic farming, the use of renewable energy sources, and regenerative farming. Soil is an integral part of the environment. By adopting sustainable farming practices, farmers can contribute to a healthier environment and more resilient agricultural systems. Regenerative farming is an approach to agriculture that focuses on improving and restoring soil health and ecosystems. It involves practices such as minimal tilling, cover cropping, crop rotation, and the use of natural fertilizers to build and maintain soil health and fertility. This method aims to sequester carbon, increase biodiversity, and reduce the use of synthetic agents. Regenerative farming, following the principles of sustainability also emphasizes the importance of holistic land management, water conservation, and good agricultural practices to generate resilient, productive farming systems.

Keywords: soil cultivation,sustainable soil use,soil health,regenerative farming

ID ABS WEB: 140106

4. Soil health in achieving the Sustainable Development Goals
4.14 133547 - Landuse change impacts on soil health

ORGANIC AGRICULTURE LED BY COOPERATIVES ENHANCES SOIL HEALTH IN PADDY SOILS BY IMPROVING SOIL FERTILITY AND BIOLOGICAL INDICES

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Sustainable agricultural practices have become a major challenge for achieving more rational and efficient utilization of arable land resources in recent years. Organic farming has been promoted by farmer cooperatives to gain organic agricultural products and prevent soil degradation. However, further evaluation is needed to determine whether organic agriculture dominated by cooperatives can effectively improve soil health. Soil health under the organic management system of cooperatives was compared with the conventional management system of smallholders in southeastern China with 39 physical, chemical, biological, and environmental indicators. Results showed that the cooperative-dominated organic management system showed higher stability of aggregates, soil organic matter (SOM), available nutrients, and microbial biomass. It also significantly altered the structure of microbial communities. The soil fertility index and biological index were respectively 36.5% and 24.2% higher under the organic management system of cooperatives as compared to the conventional management system of smallholders. However, there was no significant difference in soil environmental indices between the two management modes. Edaphic indicators of bulk density, penetration resistance, mean weight diameter, SOM, dissolved organic carbon, earthworm biomass, gram-negative bacteria, and bacteria were identified by network analysis as key indicators of soil health assessment. The cooperative management system significantly enhanced soil health by 23.38% by improving soil structural stability, total and active organic carbon, and quantities of soil fauna and microorganisms. Additionally, the farmland quality index and soil health index based on all soil health indicators under the cooperative management system were respectively 4.2% and 38.3% higher than under the conventional management system. Overall, the organic agriculture system, which was dominated by cooperatives, could enhance soil health by ameliorating soil physical, chemical, and biological properties. Our findings aimed to unravel the significant contribution of organic farming under cooperatives towards enhancing soil health in intensive agricultural systems.

Keywords: Soil health,Organic agriculture,Minimum data set,Cooperatives,Farmland quality

ID ABS WEB: 136635

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

INVERTEBRATE RECOLONIZATION THROUGH PHYTOREMEDIATION IN A HEAVY METAL POLLUTED SOIL

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Sites polluted by inorganic wastes can be successfully remediated by plants to immobilize contaminants (phytostabilization) or to extract them from soil (phytoextraction). The addition of organic matter is a common practice to facilitate vegetation of inorganic substrate by improving soil physical and nutritional properties and sustaining soil biological activity. Phytoremediation field experiments were carried out on a soil/pyrite cinders mixture amended with manure. After that three different plants were considered Arundo donax L., Helianthus annuus L., and Sorghum bicolor L. for phytoremediation. The course of remediation was evaluated through chemical analysis, plant bioassays, and soil invertebrate analysis. The effect of heavy metal pollution and the success of the 3 different remediation strategies on the soil fauna community, and the soil food web were assessed by evaluating nematode community composition, functional guild abundances and diversity, maturity and soil food web indices, and QBSar in polluted soils in TorViscosa (Udine, Italy). Soil content of Pb, Ni, Cu, and Zn, soil pH, and soil texture were measured. The invertebrate community and diversity indices were strongly affected by metal soil content. Initially, the soil was almost a biological 'desert' with really few animal taxa. The data suggests that manure could affect the nematode community and other invertebrates not only by improving bacterial activity but also by introducing new nematode genera relative to the environment. Moreover, the phytoremediation procedures allow a further recolonization of the soil by invertebrates especially in the A. donax fields.

Keywords: Biodiversity,Nematode community,QBSar,Piryte polluted soil,Ecological succession

ID ABS WEB: 136760

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

MICROMAPPING OF BACTERIAL COLONIZATION ON ORGANIC AND MINERAL COMPONENTS: AN APPROACH TO STUDY SOIL BIOFILMS

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Soil biofilms play important roles in ecological processes such as carbon cycling. However, little is known about the spatial distribution of soil biofilms at the microscopic level using thematic micromaps. Therefore, the aim of this study was to analyze the spatial distribution of bacterial colonization in different degrees of decomposition of organic matter and in the mineral fraction at the microscopic level using thematic maps. Unaltered soil samples were collected in Andosols in the O-layers and in the O-A transition horizons. Sequential images were captured from the soil thin sections to construct high-resolution mosaics in plane-polarized light (PPL), cross-polarized light (XPL), and ultraviolet light (UVL). Classification models were applied to obtain thematic maps of the components studied. The degree of association was evaluated and quantified using geoprocessing tools and according to three levels of colonization area I: 1-100 μm², II: 100-1 000 μm², and III: > 1 000 μm² or biofilms, . The results suggest that bacterial communities do not associate randomly. Instead, they are associated with specific components depending on the horizon. Bacteria form biofilms on lightly decomposed organic matter in the O horizons. In contrast, in the O-A horizons, microbial colonies are associated with the highly decomposed class and the mineral fraction, but only at colonization levels I and II. This research provides a new approach to studying soil biofilms by establishing and quantifying spatial relationships with organic and inorganic components using high-resolution micromaps.

Keywords: Andosols,Soil micromorphology,Micromorphology,Spatial analysis,Classification models

ID ABS WEB: 137231

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

BIODIVERSITY OF MICROBIAL AND ARTHROPOD COMMUNITIES IN VINEYARD SOILS OF THE OLTREPÒ PAVESE AREA (NORTH-WEST ITALY).

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Knowledge of the biodiversity in vineyard soils is a prerequisite and it is as important as the most studied characteristics.
The characterization of microbial communities and soil arthropods is not part of the routine analyses carried out by farmers to correctly set up cultivation operations, although attention to this parameter is gradually increasing. However, data are still rather scarce.
The Attiv-aree - Oltrepò Biodiverso project, founded by the Cariplo Foundation, has enabled sampling to be carried out in 6 vineyards in Oltrepò Pavese with different inter-row management (permanent grass cover - PGC, tillage - T, alternate tillage - AT), using a multidisciplinary approach. Oltrepò Pavese is the largest wine-producing area in the Lombardy region, with over 12,000 hectares of vineyards (2021), and this study on soil biodiversity is the first of its kind.
The soil samples were analyzed to determine chemical, physical and geological properties. Bacterial and fungal communities were detected by NGS analysis of 16S and ITS1 DNA barcodes. The Arthropods were characterized using the QBS method and the biodiversity indices were calculated.
The results of the 2017 sampling allowed a “snapshot” of the communities in these soils. Bacterial communities are more dominant than the Fungi and Archaea about the number of species identified, while the total number of species appears to be significantly higher in AT soils than in T soils, PGC soils showing intermediate values.
The Phyla of Bacteria that are significantly more abundant are Proteobacteria, Actinobacteria and Bacterioides; the least represented are Nitrospirae, Planctomycetes, TM7 and W3.
The most abundant fungal Phylum is the Ascomycota, while the least abundant is the Mortierellomycota. The PGC soils were found to be significantly more populated by Fungi than the AT and T soils, which did not differ significantly.
Regarding the total number of Arthropods collected, no significant differences were observed between PGC and T soils. The average QBSar values were rather high (>140) in all types of soil management.

Keywords: QBSar,Fungi,Bacteria,Arthropoda,Sustainable viticulture

ID ABS WEB: 137844

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

SOIL MICROARTHROPODS RESPONSE TO PLASTIC DEBRIS AND SOIL CONDITIONS IN OLIVE TREE GROVES

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One of the big questions in soil sciences originates from the definition of soil quality, thus, from the definition of the best soil quality indicators. It is well documented that some taxa of soil fauna are essential components of soil fertility and that an excessive plastic use in agriculture leads to a reduction in the vital functions of soil fauna, in some cases causing their death, due to greater densities of meso-, micro- and nano-plastics; although more detailed research is still needed. This study aims to indirectly provide data on the toxic effects of these plastic fragments on soil fertility by using the QBS-ar and microarthropods abundance as indicators in six olive groves in the province of Chania, Crete: one of the experimental locations of the H2020 international and multidisciplinary project, MINAGRIS, to which this research is addressed. Since these methods have never been used before together to evaluate plastic effects on soil fertility, this experiment attempted to assess the feasibility of QBS-ar and abundance in this emergent scientific area. Therefore, microarthropods communities have been analyzed by extracting micro- and mesofauna for 12 days in Berlese-Tullgren funnels from two different groups of fields: 3 olive groves where plastic is used several months per year, and sometimes left onto the soil for months, and 3 olive groves where no plastic is used. All the 6 groups have similar chemical and physical characteristics. Furthermore, in every field, 3 samples (10 cm3 each) where collected. Then, by a bimestrial ecomorphological analysis, the presence/absence of the QBS-ar taxa has been researched and, at the same time, their abundance as well.

Keywords: Soil fertility,QBS-ar application,Microarthropods,Microplastics,Agricultural soills

ID ABS WEB: 138014

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

SOIL BIODIVERSITY MONITORING IN THE OPEN LANDSCAPE ACROSS AUSTRIA WITH A FOCUS ON EARTHWORMS AND SOIL MICROORGANISMS: OPPORTUNITIES AND CHALLENGES

J. ZALLER [1], M. MITTMANNSGRUBER [1], E. GRUBER [1], E. WIEDENEGGER [1], D. MONOSHYN [1], Y. MURAOKA [1], K. PASCHER [2], S. SCHINDLER [3], R. MURUGAN [4]

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Systematic monitoring of soil biodiversity and soil health is still in its infancy in Europe. In this project (BodenBiodiv) we build on existing biodiversity monitoring programs in Austria that focus on aboveground biodiversity but do not take soil biota into account (such as the BINATS Biodiversity-Nature-Safety or ÖBM-K Austrian Biodiversity Monitoring of the Cultural Landscape projects). The aim of the BodenBiodiv project is to determine the causes of various indicators of soil biodiversity in the agricultural landscape. The project covers three objectives. First, a systematic monitoring of earthworms in the agricultural landscape will be established in 200 quadrants (625 x 625 m) throughout Austria, in which arable and/or grassland areas will be sampled. Lists of the earthworm species present, their abundance and biomass as well as a distribution map will be compiled. In addition, a manual for future surveys on national monitoring of soil biodiversity will be compiled using harmonized terminology as a supplement to the existing monitoring manuals in Austria. Secondly, we will analysis factors that determine the occurrence of earthworms. Therefore, site characteristics (land use, altitude, climatic variables) and soil properties (pH value, nutrient concentrations, moisture content, carbon content, soil microorganisms) will be linked to the recorded earthworm parameters. Thirdly, a Red List of earthworms for Austria will be compiled on the basis of historical and current data and expert opinions. BodenBiodiv also makes it possible to estimate the influence of climatic variables on soil biodiversity. By incorporating data from existing biodiversity monitoring programs, we can expand our understanding of the interactions between below-ground and above-ground biodiversity.

Keywords: earthworms,soil microorganisms,monitoring,long-term

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4. Soil health in achieving the Sustainable Development Goals
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Keywords: earthworms,soil microorganisms,monitoring,long-term

ID ABS WEB: 138232

4. Soil health in achieving the Sustainable Development Goals
4.15 133566 - Soil fauna as a tool to improve soil health assessment

EARTHWORMS OF GEORGIA AND THEIR SPECIES COMPOSITION

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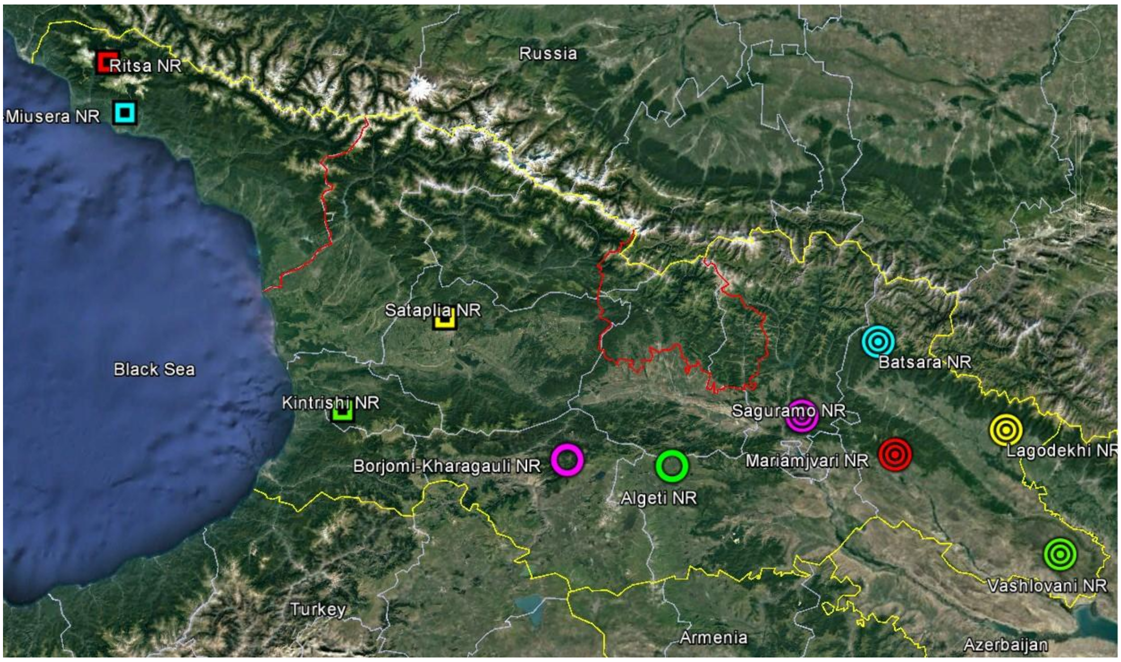
Biologically, soil ecosystems support a diversity of soil fauna, including micro- and macrofauna. Appropriate caution is necessary when choosing organisms for use as bioindicators.
Taking into account the worldwide importance of the problem of improving the quality of agricultural and food products, the interest of scientists in improving and recultivating soils is quite understandable. This explains the purpose of this work, which tries to show the results of research conducted to study soil inhabitants and their life activities in Georgia. The importance of earthworms' life activity in the processes of soil improvement and formation is well known. Earthworms are one of the most important groups of soil inhabitants, affecting the structure and chemical properties of the soil. That's why interest in studying this group is rising day by day. The long-term faunal studies show that the species composition of earthworms in Georgia is represented by 89 species belonging to 13 genera. The genus Dendrobaena stands out for its species diversity: 26 species (29.21%), the second genus Allolobophora with 16 species (17.98%), and the third genus with 12 species (13.5%) is Eisenia. About 46 species of earthworms registered in Georgia (51.7%) are recognised as endemic species of the Caucasus (Kvavadze, 1999). High endemism of Caucasian earthworms is induced by the climate in the Caucasus region.
Turkish earthworms show strong similarity to the fauna of Georgia (34 taxa, 40.96%) (Misirlioglu et al., 2018). Of the 18 species distributed both in Georgia and Turkey, the majority belong to Caucaso-Anatolian categories, and all of them belong to the genera Dendrobaena, which make this region one of the most important centres of endemism of these genera (Omodeo, Rota 1999, Csuzdi et al. 2006). Considering the growing interest, it was decided to investigate the species diversity in several Georgian reserves: Algety, Mariamdzvary, Kintrishi, Sataplia, Borjom-Kharagauli, Lagodekhi, Vashlovani and Saguramo Natural Reserves. Based on the fact Algeti Nature Reserve is the most inhabited by earthworms.



Keywords: Soil biodiversity,Earthworms,Soil ecology,Soil quality,Soil fauna

ID ABS WEB: 136088

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

RESEARCH ON THE INFLUENCE MECHANISM OF BIOMASS MATERIALS ON NITROGEN TRANSFORMATION IN SALINE SOIL

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Aiming at the current situation of soil salinization barriers in Hetao Irrigation District, which restrict crop quality improvement and nutrient efficiency.Through indoor cultivation experiments with different biomass materials and fertilizer dosages, combined with indicators such as mineralization rate and nitrification rate, Revealed the mechanism of biomass materials on nitrogen transformation in saline farmland under different salt environments.The research results indicate that: (1) Within 0-3 days of cultivation, the nitrogen mineralization rate of various treatments in saline soil of different degrees decreased rapidly. Adding straw and biochar can both increase the mineralization rate of slightly and moderately saline alkali soil in the early stage of cultivation, but it will inhibit the mineralization rate of slightly saline soil in the later stage, and has no significant effect on the mineralization rate of moderately saline soil in the later stage of cultivation. The addition of straw and biochar has a promoting effect on nitrogen mineralization in severely saline soil throughout the entire cultivation period; (2) Within 0-7 days of cultivation, the nitrogen nitrification rate of mild saline alkali soil gradually increased, followed by a downward trend. Moderately saline soil showed a gradual decrease throughout the entire cultivation period. Adding straw will inhibit nitrification in the whole incubation period of mild and severe salinized soil, and nitrification in the early incubation period of moderate salinized soil, thus increasing the soil ammonium nitrogen fixation. Adding biochar can promote nitrification in mild and severe salinized soil, inhibit nitrification in moderate salinized soil, and increase soil nitrate nitrogen content. Adding straw will inhibit nitrification in the whole incubation period of mild and severe salinized soil, and nitrification in the early incubation period of moderate salinized soil, thus increasing the soil ammonium nitrogen fixation.The research results can provide technical support for nitrogen fixation and emission reduction and development and utilization of reserve land resources in saline and alkaline farmland along the Yellow River.

Keywords: Biomass materials,saline soil,Nitrogen conversion

ID ABS WEB: 136254

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen
for climate-smart and sustainable agriculture

USING SOIL MICROORGANISMS TO IMPROVE THE FERTILISER CAPACITY OF ANAEROBIC DIGESTATE

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Anaerobic digestate is a nutrient rich slurry by-product derived from biogas production, often used as a fertiliser due to its high nitrogen content. However, nitrogen losses from its application can lead to environmental pollution. In a laboratory experiment, the addition of high organic carbon materials to digestate-amended soil as a potential means to stimulate microbial immobilisation of digestate supplied nitrogen was investigated. Soil was incubated in pots for five months with digestate (equivalent to 250kgN/ha). The impact of adding carbon into the digestate (equivalent to 540kgC/ha) as either glycerol, straw, woodchip, or biochar on soil microbial and chemical parameters was quantified. Glycerol amended soils had significantly higher microbial biomass compared to digestate alone during the first month and at 30 days after application had a 4x higher on average microbial N. The digestate+straw treatment resulted in a significantly greater nitrogen immobilisation compared to digestate alone after three months of incubation. The digestate+woodchip had a 2x higher mean microbial N after 5 months, whilst the biochar amendment did not stimulate significant nitrogen immobilisation at any time. These results suggest that mixing a labile to moderately labile organic carbon amendment, such as straw, with digestate has the greatest potential to reduce nitrogen losses following digestate application through microbial immobilisation.

Keywords: biogas residues,nitrogen immobilisation,microbial biomass

ID ABS WEB: 136407

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

GREENHOUSE GAS EMISSIONS AND CARBON SEQUESTRATION DURING A TRANSITION TO ORGANIC AGRICULTURE

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Mitigating greenhouse gas (GHG) emissions and preserving soil carbon are both imperative for ensuring the success of sustainable crop production. The importance of understanding the relationship between GHG emissions and soil carbon are heightened in nonconventional agriculture practices, such as organic farming, where we are still unclear of the comprehensive ecological effects. Organic farming has many environmental benefits that are not present in conventional agriculture systems, making it a potentially valuable alternative. In order to address climate change and food security for future generations, we first must have an understanding of the complete effects of organic agriculture. Our research aims to identify a cropping system that will reduce GHG emissions during the organic transitional period while estimating the effects on carbon sequestration. Our hypothesis is that within a transition to organic agriculture management, conventional tillage will have an increased loss of carbon to the atmosphere as greenhouse gas, when compared to reduced tillage and integrated crop-livestock systems. This presentation covers the results from our ongoing field experiment in Lacombe, Alberta, Canada, which aims to quantify the effects of three cropping systems on soil carbon and GHG emissions. A fully-phased crop rotation study with a randomized complete block design with four block replicates was established to evaluate conventional tillage, reduced tillage, and an integrated crop-livestock system. Weekly gas sampling using the gas chamber method has been conducted to determine nitrous oxide, methane, and carbon dioxide fluxes. To understand nutrient dynamics in the system, soil samples will be analyzed for carbon, total nitrogen, nitrate, and ammonium concentrations. Results for cumulative fluxes in each treatment were determined throughout the first growing season during the transition to organic management, and these results will be discussed and interpreted during this presentation.

	Tillage system	Spring	In-season (optional)	Fall	Total in one growing season	Total in a four-year rotation
1	**Conventional tillage system**	**All crop phases:** • Cultivation • A rod weeder	**All crop phases:** • Rotary hoe (when necessary)	**All crop phases:** • Cultivation	**All crop phases:** 3 passes + optional in-season	12 passes + optional in-season
2	**Reduced tillage system**	**All crop phases except the second year GM phase:** • Cultivation • A rod weeder	**Only wheat and pea phases:** • Rotary hoe only (when necessary)	No cultivation	**Wheat and pea phases:** 2 passes + optional in-season **Oat with underseeded sweet clover phase:** 2 passes **The second year GM phase:** No cultivation	6 passes + optional in-season
3	**Integrated crop-livestock system**	**Wheat and the first year of the three-year GM phases:** • Cultivation • A rod weeder	**Wheat phase:** • Rotary hoe (when necessary)	**Wheat phase:** • Cultivation	**Wheat phase:** 3 passes + optional in-season **Three-year GM phase:** 2 passes only in the first year of the GM phase	5 passes + optional in-season

Keywords: Organic Agriculture,Greenhouse Gas Emissions,Soil Carbon Dynamics,Soil Health,Climate change mitigation

ID ABS WEB: 136439

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen
for climate-smart and sustainable agriculture

METHANE EMISSION FROM PADDY FIELD AS INFLUENCED BY DIFFERENT IRRIGATION AND NITROGEN TREATMENTS

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Reasonable water and nitrogen management is an effective way to reduce methane (CH4) emission in paddy fields. In order to reveal the water and nitrogen management mode for reducing CH4 flux in paddy fields and the influencing factors of CH4 flux, field experiments were conducted to investigate the CH4 flux, soil organic acid content and the composition and abundance of microbial community under different irrigation and nitrogen treatments, and then the relationships between CH4 flux and organic acid content and the composition and abundance of microbial community were analyzed. (1) RI (ridge irrigation) and AI (alternate wetting and drying irrigation) can reduce CH4 emission compared with CI (flooding irrigation), and the CH4 emission in CU (40% controlled release urea replacing normal urea) was lower than that of NU (normal urea). (2) Under CI mode, NU decreased the oxalic acid content by 17.3% compared with CU. Under NU treatment, AI decreased the tartaric acid content by 25.9% and 27.4% compared with CI and RI, and the citric acid content by 13.6% compared with RI, respectively. (3) CO2-reduction methanogenesis pathway driving from Methanosarcina barkeri was the key pathway and core specie of CH4 production. AI can reduce CH4 emission more effectively than RI by inhibiting the growth of Methanosarcina barkeri in paddy soil. (4) The contents of oxalic acid, tartaric acid, malic acid and fumaric acid contents in soils significantly affected CH4 flux in paddy field. Thus AICU treatment was a suitable mode of water and nitrogen management to reduce CH4 emission.

Keywords: Microbial community abundance,Methane emission,Organic acid,Paddy soil

ID ABS WEB: 136468

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

THE EFFECT OF INCORPORATION, SURFACE APPLICATION AND INHIBITOR USAGE ON AMMONIA EMISSIONS APPLYING UREA FERTILIZER ON SANDY SOIL

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In 2016, the EU adopted the National Emissions reduction Commitments Directive (NEC Directive), which includes emission reduction obligations for ammonia (NH3) for all European country. As agriculture is responsible for 95% of NH3 emissions, this target cannot be achieved without more efficient use of fertilizers and accurate measurement and assessment of the impact of different factors on NH3 emissions.
We set up two experiments, where we investigated the NH3 emission after using urea as fertilizer at two different doses (150 and 180 kg ha-1 Nitrogen active ingredient). In a laboratory experiment we examined the effect of incorporation, surface application and usage of inhibitor, and in a filed pot experiment the effect of inhibitor usage was studied. For both experiment, sandy soil was used (humus content: 0.78 and 0.79 % at 0-20 and 20-40 cm depth, respectively).
In the laboratory experiment NH3 emissions (after surface application, without inhibitor) reached a maximum in four days and then started to decrease. In contrast, when the inhibitor-treated fertilizer was applied, the peak was slightly delayed, occurring only on the sixth day. The usage of inhibitor reduced most effectively soil NH3 emissions, with the magnitude of emissions in these treatments being comparable to the control treatment (where no urea applied). In the case of the surface application of non-inhibitor-treated urea, even a 30 kg ha-1 increase in active ingredient resulted in a significantly detectable difference in soil NH3 emissions.
In the field pot experiment, we found that after application of urea fertilizer, NH3 emission increased significantly compared to the pre-fertilization condition, and this increased NH3 emission lasted for about two weeks.
In the first week, the average NH3 emission was highest in the 180 kg ha-1 urea treatment, which showed significant differences compared to the control and 180 kg ha-1 urea+inhibitor treatments. Lower average emissions were measured in the urea+inhibitor treatments than in the non-inhibitor urea treatments applied at similar doses.

Keywords: N fertilization,NH3 emission,ejp soil

ID ABS WEB: 136660

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

COMPARING METHODS OF QUANTIFYING PLANT AVAILABLE N FOR SUSTAINABLE SYNTHETIC N FERTILISER PRACTISES TO REDUCE NO3 LEACHING, NH3 AND N2O EMISSIONS IN BABYLEAF SPINACH PRODUCTION SYSTEMS.

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Extensive work has already been conducted on optimal N cycle inhibitors (NCI) and synthetic N fertiliser use in cereal systems. However, the short growth cycle (4-6 weeks) and multiple within-season harvests for babyleaf spinach, has implications for dynamics of soil N availability, potentially revealing novel relationships between indices of plant- available N. This work aims to apply strategies for minimising N loss from soil in cereal systems to babyleaf spinach crops for sustainable production.
1 mol KCl extraction and subsequent analysis of soil NH3-N and NO3-N is the industry standard for fertiliser rate recommendation. The inability of this method to estimate potentially available N (which becomes available via mineralization over time) limits this method. Consequently, we aimed to evaluate the ability of chemical, physical and biological methods to predict actual N supply of 15 UK soils (varied past fertiliser regimes (CAN, Nitram, FYM, spent mushroom compost)) whilst growing spinach over four weeks. This work aims to improve the way that fertiliser rates are recommended, to reduce N loss from soils whilst retaining yields.
Taking the best of these methods forward, they were used in field trials to quantify the amount of plant available N before fertilization. The trials were established to examine the interactive effects of N fertiliser application rate and nitrification inhibitor (NI) (nitrapyrin). NCIs are an effective solution to reducing NO3 leaching and gaseous emissions from soil, without reducing crop yields. The objective of this trial is to determine whether a reduction in N fertiliser application can be achieved without losing marketable yield, whilst quantifying the efficacy of NIs as a tool for reducing N losses from soil.
Together this new approach to synthetic N fertiliser inputs for babyleaf spinach has allowed a 27- 37% reduction in fertiliser application rates whilst maintaining the same yields. Future research will introduce high carbon organic amendments (straw and spent cooking oil) to act as a low cost alternative to NCIs.

Keywords: Nitrogen,Spinach,Nitrogen cycle inhibitor,Mineralization,Field trial

ID ABS WEB: 136675

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

LONG-TERM RESILIENCE OF SOIL ORGANIC CARBON STOCKS TO CLIMATE CHANGE THROUGH TILLAGE AND RESIDUE MANAGEMENT

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The innovative approach to sustainable farming has been developed on the basis of research carried out and it is the significant impact of soil health on agricultural productivity. The long-term stationary field experiment was established at Vytautas Magnus University Experimental Station at 54°52’50” N latitude and 23°49’41” E longitude on Plansoils in 1999.
The aim this study was initiated to evaluate the effects of long-term reduced tillage and no-tillage in combination with the use of plant residues and cover crops for green manure on soil organic carbon (SOC) and CO2 emissions. Soil tillage systems and other complex measures in permanent crop rotation influenced the accumulation of SOC. In plots without straw reduced tillage systems SD, NTCC and NT increased SOC poll in the 0-25 cm soil layer by 23.1-29.1 % compared with that in conventional tillage. Straw retention in these treatments increased SOC poll by 19.5-31.0 %. Reduced tillage systems SD, NTCC and NT intensified the accumulation of SOC and humification was observed.
Different farming methods have been analyses, with a particular focus on the effects of straw management and different tillage systems, including deep and shallow ploughing, as well as no-till farming. Straw removal or chopping combined with other tillage systems has been observed to lead to significant increases in soil organic carbon. This increase not only contributes to reducing CO2 emissions but also increases soil resilience. As a result, better crop growth and yields have been consistently observed. It is recognized that the adoption of these practices is vital to maintaining healthy and productive soils, which is essential in the face of the growing challenges of climate change. The research underlines the importance of sustainable farming practices that priorities soil and environmental health
The research was financed by EJP SOIL program SOMPACS/2022.

Keywords: Reduced Tillage,Sustainable Farming Practices,Carbon Sequestration,CO2 Emissions,Soil Organic Carbon

ID ABS WEB: 136710

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

SOIL-FRIENDLY NITROGEN FERTILIZATION FOR CHILI PEPPER PRODUCTION UNDER ORGANIC FARMING

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The reduction of fertilizer input is a major need in agricultural practices to achieve a sustainable food production chain and to improve the soil health. The Nitrates EU Directive brings the focus on nitrogen supply in agriculture and the importance of its careful use. In this regard, the organic farming provides an environmental-friendly approach of circular economy for horticultural production. Nevertheless, the optimization of nitrogen supply is still crucial to avoid its leaching.
In line with this need, the main goal of the MOMA project (granted by PSR 2014-2020 – Mis. 16.2, Tuscany Region, Italy) is the development of a sustainable strategy for chili pepper production, assuring an optimal nitrogen supply to meet the producer expectations and the soil quality preservation. The experiment was carried out at Azienda Agricola Marco Carmazzi (Italy), one of the main chili pepper producers in Europe, in an open-field cultivation with several cultivars of Capsicum spp.. During the first year of monitoring (spring-autumn 2023), after the soil application of manure and green compost, plants were fertigated with fluid vinasse. The physical and chemical soil properties, including nitrogen content, were monitored alongside the soil enzyme activities and stoichiometry, determined as an indicator of nutrient cycling. In parallel, plant health status using both nondestructive (i.e., optical proximal and remote sensors) and destructive (i.e., lab quantification) measurements was assessed. In this work, the data obtained during the first year of experiment are presented and their implication will drive the strategy for the second year of activities. The MOMA project will provide guidelines for farmers, promoting a sustainable and soil-friendly use of nitrogen fertilization.

Keywords: horticulture,enzyme stoichiometry,nitrogen supply,nitrogen cycle,optical sensors

ID ABS WEB: 137044

4. Soil health in achieving the Sustainable Development Goals
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DIFFERENTIAL EFFECTS OF CELLULOSE AND STARCH ON POST-HARVEST SOIL N RETENTION: AN INCUBATION STUDY WITH FOUR DIFFERENT SOILS

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Post-harvest mineralization cause mineral nitrogen (N) accumulation in the soil after harvest, leading to the high N losses both in the form of nitrate to groundwater and nitrous oxide (N2O). High-carbon amendments (HCA), such as cellulose and starch, have shown great potential to immobilize excess mineral N by stimulating microbial biomass growth and activity at ambient temperatures and in specific soils. However, it is not clear yet whether the N immobilization of these HCAs can be harnessed under realistic climatic conditions and in different soils. To elucidate the effect of cellulose and starch on N immobilization during the post-harvest period, we conducted a 98-day laboratory incubation experiment with four different agricultural soils. A typical post-harvest scenario was created by adding ammonium equivalent to 50 kg NH4+-N ha-1 to the soil prior to application of the HCAs, which were then applied at a rate equivalent to 4 t C ha-1. Five different treatments were implemented for each agricultural soil: without nitrogen and HCA application (Blank), application of NH4+-N, but no HCA (Control), and then NH4+-N applied with cellulose (Cellulose), starch (Starch), or a combination of cellulose (2 t C ha-1) and starch (2 t C ha-1) (Cellulose+Starch), respectively. After 98 days of incubation, all HCA treatments had significantly lower nitrate levels in all four soils compared to Blank and Control. The faster decomposition of starch in the early stages of incubation led to a faster reduction in nitrate content than in the Cellulose and Cellulose+Starch treatments, but also to faster remineralization in the later incubation stages, leading to an increase again in mineral N in the Starch treatment. In contrast, the decomposition rate of cellulose was lower, but there was also no significant increase in mineral N after 98 days of incubation. This suggests that cellulose is more suitable than starch for long-lasting stimulation of microbial N immobilization under post-harvest conditions in the four different soils.

Keywords: High carbon soil amendments,Soil nitrogen immobilization,Nitrate leaching,Greenhouse gases

ID ABS WEB: 137102

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

METHANE AND NITROUS OXIDE EMISSIONS FROM RICE PADDY WITH DIFFERENT SOIL MANAGEMENT

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The objectives of this study were to evaluate emissions of methane (CH4) and nitrous oxide (N2O) from rice paddy with different soil management during the growing season and determine optimum soil management for mitigation of CH4 and N2O emissions. Four treatments including conventional (NPK), compost manure (CM), combination of NPK and CM (NPK+CM), and the control (C) were installed on a paddy soil. The rice (Oryza sativa L.) was transplanted on June 9th 2023. Gas samples for CH4 and N2O were collected from June 10th 2023 to September 26th 2023 date twice in every week. The daily CH4 fluxes increased during the submerged period but decreased during the mid-season drainage. The order of cumulative CH4 emissions from the greatest to the least was NPK+CM>NPK>CM>C. The greater cumulative CH4 emissions in NPK compared to CM might be due to different growth characteristics of rice plant between both treatments. Daily N2O fluxes were variable during the submerged period but dramatically increased in all treatments during the mid-season drainage. The order of cumulative N2O emissions from the greatest to the least was NPK+CM>NPK>CM>C. The cumulative N2O emissions in NPK was greater compared to CM, because more inorganic nitrogen which was a source of N2O production was supplied with NPK. Among three soil managements including CM, NPK, and CM+NPK, the least CH4 and N2O emissions were observed in CM in this study. Further research on soil management for mitigation of both CH4 and N2O emissions should be conducted for long-term experiment.

Keywords: Methane,Nitrous oxide,Paddy soil,Soil management

ID ABS WEB: 137219

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

LONG-TERM LIMING MITIGATES THE POSITIVE RESPONSES OF SOIL CARBON MINERALIZATION TO WARMING AND LABILE CARBON INPUT

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Liming, as a common soil amelioration practice worldwide, has the potential to alleviate acidification and enhance soil productivity. However, the impacts of liming on the temperature sensitivity (Q10) of soil organic carbon (SOC) mineralization and its response to labile C input remain unclear. To fill the knowledge gap, soil samples were collected from a long-term (10 years) field trial with unlimed and limed treatments. These soil samples were incubated at 15 and 25 °C for 42 days, amended with or without 13C-labeled glucose. Results demonstrated that liming increased SOC mineralization by 25-58%, but decreasing its response to warming, resulting in lower Q10, as compared to the unlimed soil. Long-term liming increased bacterial richness and Shannon diversity as well as their response to warming which were associated with reductions in Q10. Furthermore, the decreased Q10 due to liming was strongly associated with the decreased response of bacterial oligotrophs/copiotrophs ratio, b-glucosidase and xylosidase activities to temperature. These results indicated the importance of microbes play a pivotal role in regulating SOC mineralization in response to liming and temperature. Labile C addition had a strong impact on Q10 in the unlimed soil, but only marginal significance in the limed soil. Overall, these findings provide compelling evidence that liming has the potential to mitigate the positive response of SOC mineralization to warming and labile C input, thereby facilitating SOC sequestration in agroecosystems, particularly under global climate change scenarios.

Keywords: Acidification amelioration,Temperature sensitivity ,Microbial diversity,Oligotrophs/ copiotrophs, Enzyme activity

EPOSTERS

ID ABS WEB: 137789

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

LONG-TERM FERTILIZER POSTPONING PROMOTES SOIL ORGANIC CARBON SEQUESTRATION IN PADDY SOILS BY ACCELERATING LIGNIN DEGRADATION AND INCREASING MICROBIAL NECROMASS

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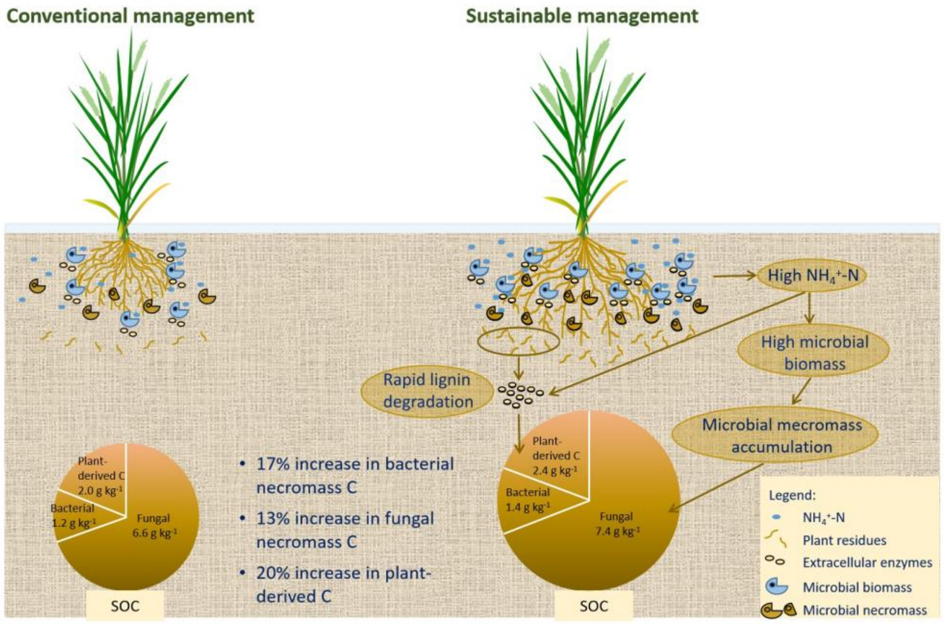
Soil organic matter (SOM) in paddy soils is critical for achieving high crop yield sustainability and mitigating climate change. Our previous study revealed that long-term fertilizer postponing (FP) increases yield by improving SOM. Therefore, in this study, the mechanism by which fertilizer postponing increase SOM were investigated through a long-term experiment (11 years). Long-term FP significantly increased SOM (by 14.5%) by increasing root residue input. FP increased soil phenol oxidation and peroxidase activity but did not affect glucosidase activity, indicating that FP accelerated lignin degradation rather than cellulose degradation. Metagenome analysis also showed that FP significantly increased the relative abundance of lignin degradation genes, such as soil catalase, cytochrome c peroxidase, and peroxidase genes, by activating the growth of related microorganisms. In addition, long-term FP significantly increased bacterial necromass C (by 17%) and fungal necromass C (by 13%) by improving microbial biomass. Redundancy analysis and random forest model further revealed that lignin degradation genes (representing the contribution of lignin) and bacterial necromass C were dominant in plant- and microbe-derived C, respectively. We confirmed that the soil NH4+-N content was the main driving factor for high lignin degradation and microbial necromass variation. Structural equation model and random forest model revealed that soil carbon sequestration was mainly through the increase of lignin degradation and microbial necromass under high root residues input and soil NH4+-N content. Overall, our findings suggest that long-term FP is a sustainable agricultural management strategy that improves SOM by accelerating lignin degradation and increasing microbial necromass.



Keywords: Fertilizer postponing,Soil organic carbon,Lignin degradation,Microbial necromass,Microbial community structure

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4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

MICROBIAL MECHANISMS OF LONG-TERM FERTILIZER POSTPONING FOR PROMOTING SOIL ORGANIC CARBON SEQUESTRATION IN PADDY SOILS

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Soil organic carbon (SOC) sequestration in paddy soils is crucial for achieving high crop yields and mitigating climate change. Long-term fertilizer postponing (FP) has been shown to be an effective agricultural management to improve grain yield potential and soil fertility. However, the mechanism of FP improving soil fertility is still unclear. Therefore, in this study, we used metagenomics sequencing and 13C-phospholipid-derived fatty acid (13C-PLFA) to elucidate the microbial mechanism of FP for SOC sequestration from the perspective of both plant residual C and living root-released C. According to plant residual C, FP significantly increased soil organic matter (SOM) content by 14.5%, mainly by increasing root biomass and affecting the conversion of root residues to SOM. FP increased the relative abundance of lignin-degrading genes by activating the growth of associated microorganisms, thereby increasing lignin-degrading enzyme activities. In addition, FP significantly increased bacterial necromass C (by 17%) and fungal necromass C (by 13%) by elevating soil ammonium nitrogen (NH4+-N) content. According to living root-released C, FP did not affect the ability of plants to assimilate photosynthetic C in the rice panicle initiation stage (PI) and heading stage (HS), but significantly reduced the loss of photosynthetic C in PI. Photosynthetic C loss was significantly and positively correlated with the microbial biomass and community. FP significantly reduced the total 13C-PLFA content in the panicle initiation stage, where the dominant microorganisms were bacteria. However, FP significantly increased the total 13C-PLFA content in HS, where the dominant microorganisms were fungi. Therefore, long-term fertilizer postponing enhances SOC sequestration by altering the microbial community structure to reduce the loss of root-released Cand accelerating lignin degradation to increase microbial necromass C content.

Keywords: Fertilizer postponing,Soil organic carbon,Lignin degradation,Microbial necromass,Microbial community structure

ID ABS WEB: 137797

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen
for climate-smart and sustainable agriculture

THE EFFECT OF SOIL MICROBIAL RESIDUES-MEDIATED NITROGEN CONSERVATION AND SUPPLY DURING THE GROWING SEASON ON NITROGEN UPTAKE BY WHEAT

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Microbial residue nitrogen can indicate soil quality and is crucial for soil nitrogen retention and supply. However, it is still unclear how the dynamic changes in soil microbial residue nitrogen affect crop nitrogen uptake in agricultural practice. Based on a long-term wheat-maize rotation experiment with different nitrogen application rates (150 kg N/ha, 200 kg N/ha, and 300 kg N/ha), 15N-labeled nitrogen fertilizer was applied during the wheat season to track the dynamics of soil microbial residue nitrogen and its mediated fertilizer nitrogen. The results showed that nitrogen addition was beneficial to the accumulation of microbial residue nitrogen (mainly fungal microbial residue nitrogen). Its contribution rate to soil total nitrogen is 54.87–56.55%, and the fertilizer nitrogen allocated to it accounts for 27.10–47.50% of the remaining fertilizer nitrogen in the soil. Ultimately, 6.77–10.24% of the nitrogen fertilizer applied remained in the soil as microbial residue nitrogen. In addition, microbial residue nitrogen is mainly mineralized during the jointing and filling stages of wheat. In a word, the accumulation and mineralization of soil microbial residue nitrogen during the application of 200 kg N/ha better guaranteed the uptake of nitrogen by wheat, which provided a reliable basis for guiding farmland fertility improvement and nitrogen fertilizer reduction in the North China Plain.

Keywords: Microbial residue nitrogen,15N-labeled nitrogen,Nitrogen uptake

ID ABS WEB: 137941

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen
for climate-smart and sustainable agriculture

PADDY SOIL NITROGEN DYNAMICS DRIVE NITROGEN USE EFFICIENCY VARIATION BETWEEN YANGTZE RIVER BASIN AND NORTHEAST CHINA

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Yangtze River Basin and Northeast China account for 36% of the Chinese rice cultivation area, yet considerable spatial disparities in nitrogen use efficiency (NUE) existed between these regions. This study interrogates the soil nitrogen (N) dynamics underlying these regional NUE variations, a subject hitherto underexplored. By a case study in two sites and later a region scale samples, we determined the discrepancies in soil N flows and its driving factors between Yangtze River Basin and Northeast China. Initial field studies at Wuchang (Northeast China) and Changshu (Yangtze River Basin) indicated Wuchang's superior NUE alongside reduced ammonia volatilization. Subsequent soil replacement pot-scale experiments further demonstrated that both apparent and 15N-traced NUE were higher, whereas 15N fertilizer losses were lower in Wuchang-soil irrespective of site, suggesting soil types contribute to differences in soil N retention capacity and cause NUE discrepancies between two sites. Moreover, process-scale results revealed Changshu's amplified reactive N losses-attributable to significantly elevated rates of gross N mineralization, nitrification, and denitrification. It suggested that the N mineralization dynamics, possibly driven by inherent soil properties, contributed significantly to the observed NUE discrepancies. Expanding to a regional scope with 36 and 24 paddy soil samples from the Yangtze River Basin and Northeast China, respectively, reinforced these site-specific observations, with the former displaying enhanced long-term N mineralization potential, highlighting the pivotal role of soil N mineralization in determining regional NUE disparities. Correlations between soil properties—such as total N, pH, C/N ratio, and clay content—and N mineralization characteristics further elucidated the inherent factors of differentiated regional N dynamics. This comprehensive analysis not only elucidates the soil-mediated factors influencing NUE disparities, but also advances the development of region-specific, rapid N mineralization prediction models, contributing significantly to climate-smart and sustainable agricultural practices.

Keywords: Rice cultivation,Nitrogen use efficiency,Soil nitrogen mineralization,Reactive nitrogen losses,Soil physiochemical properties

ID ABS WEB: 139159

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

IRON FERTILIZATION AND SOIL CARBON SEQUESTRATION IN RICE PADDIES

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Iron (Fe) fertilization of the ocean mitigates global warming by sequestering carbon dioxide (CO2) in phytoplankton, but the effect of Fe fertilization on carbon (C) sequestration in arable soils remains unknown. Iron is often added to rice paddies as blast furnace slag (BFS), a byproduct of steel manufacturing used as a silicate fertilizer to improve productivity. However, BFS also contains large amounts of Fe oxides, which might promote C sequestration by forming complexes with organic matter. First, to estimate the effect of continuous Fe addition via BFS on soil organic C (SOC) stock, soils were nationally sampled in South Korea. A strong positive correlation between SOC and extractable Fe and available Si concentrations was found, which might presume that the periodic BFS application contributed to an increase in SOC stock. Second, to confirm the effect of Fe addition on SOC stock increase, the effect of BFSs, which have different mixing rates of Fe oxides (0-5%, wt wt-1) on the respired C loss was investigated via incubation test. Finally, to verify the effect of Fe addition on SOC stock changes, three different Fe-enhanced silicate fertilizers were applied for rice cultivation, and SOC stock changes were estimated using the net ecosystem C budget. Silicate fertilization significantly increased net primary production (NPP) by 18-20% over the control, and this NPP was more highly increased with increasing Fe addition. Silicate fertilizer application highly decreased the respired C loss by 15-30% over the control. As a result, silicate fertilizer application increased around 0.67 Mg C ha-1 of SOC stock over the control during rice cultivation, but this C stock was more highly increased with increasing Fe addition. In conclusion, Fe-enhanced silicate fertilizer might be more effective in improving SOC stock and crop productivity in rice paddies.

Keywords: silicate fertilizer,net ecosystem carbon budget,net primary production,soil respiration

ID ABS WEB: 139268

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

THE EFFECT OF INCORPORATION, SURFACE APPLICATION AND INHIBITOR USAGE ON AMMONIA EMISSIONS APPLYING UREA FERTILIZER ON SANDY SOIL

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In 2016, the EU adopted the National Emissions reduction Commitments Directive (NEC Directive), which includes emission reduction obligations for ammonia (NH3) for all European country. As agriculture is responsible for 95% of NH3 emissions, this target cannot be achieved without more efficient use of fertilizers and accurate measurement and assessment of the impact of different factors on NH3 emissions.
We set up two experiments, where we investigated the NH3 emission after using urea as fertilizer at two different doses (150 and 180 kg ha-1 Nitrogen active ingredient). In a laboratory experiment we examined the effect of incorporation, surface application and usage of inhibitor, and in a filed pot experiment the effect of inhibitor usage was studied. For both experiment, sandy soil was used (humus content: 0.78 and 0.79 % at 0-20 and 20-40 cm depth, respectively).
In the laboratory experiment NH3 emissions (after surface application, without inhibitor) reached a maximum in four days and then started to decrease. In contrast, when the inhibitor-treated fertilizer was applied, the peak was slightly delayed, occurring only on the sixth day. The usage of inhibitor reduced most effectively soil NH3 emissions, with the magnitude of emissions in these treatments being comparable to the control treatment (where no urea applied). In the case of the surface application of non-inhibitor-treated urea, even a 30 kg ha-1 increase in active ingredient resulted in a significantly detectable difference in soil NH3 emissions.
In the field pot experiment, we found that after application of urea fertilizer, NH3 emission increased significantly compared to the pre-fertilization condition, and this increased NH3 emission lasted for about two weeks.
In the first week, the average NH3 emission was highest in the 180 kg ha-1 urea treatment, which showed significant differences compared to the control and 180 kg ha-1 urea+inhibitor treatments. Lower average emissions were measured in the urea+inhibitor treatments than in the non-inhibitor urea treatments applied at similar doses.

Keywords: urea fertilizer,inhibitor,incorporation,NEC directive

ID ABS WEB: 139286

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

MITIGATING METHANE EMISSIONS AND CARBON FOOTPRINT IN RICE-WHEAT ROTATION SYSTEM BY STRAW CENTRALIZED RETURNING UNDER RAINFED CONDITIONS

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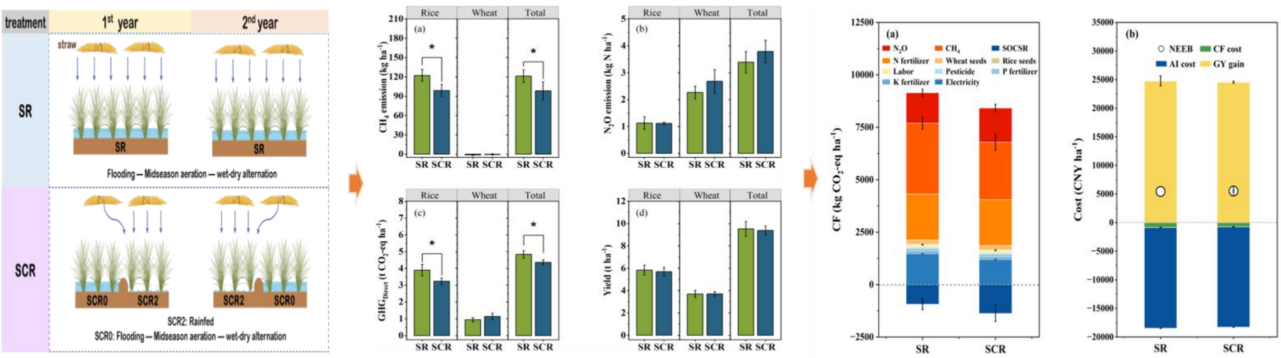
Numerous studies have reported that straw return before rice transplanting stimulates substantial CH4 emissions. It is urgent to explore novel modes of returning straw and corresponding field management to mitigate CH4 emissions without compromising yield. We conducted a 2-year field experiment, including two wheat straw returning modes [conventional straw evenly-plowed returning (SR), and straw centralized returning (SCR)], to evaluate greenhouse gas (GHG) emissions, crop yields, carbon footprint (CF), and net ecosystem economic benefit (NEEB) in the rice-wheat rotation system. The results showed that the GHG emissions contributed the most to annual CF, accounting for 59% and 62% in SR and SCR, respectively. Mean CF in SCR was 7.0 t CO2-eq ha–1 yr–1, with 14% lower than that in SR, which was attributed to the significantly lower annual CH4 (by 19%) during the rice seasons. The lower soil water contents might partly regulate the CH4 emissions by decreasing DOC contents (12–14%) and increasing the soil Eh, which resulted in a lower CH4 production (45–46%) and production/oxidation ratio in SCR. Annually, the total yields of rice and wheat were 9.53 t ha–1 and 9.38 t ha–1 in SR and SCR, respectively, indicating the comparable yield gains between them. Nevertheless, the relatively lower agricultural input costs and carbon footprint costs in SCR, thus leaving the NEEB increased by 83 CNY ha–1 relative to SR. The findings indicate that straw centralized returning under rainfed conditions in the rice season could reduce both CH4 emissions and carbon footprint while sustaining food security and economic benefit in the rice-wheat rotation system.



Keywords: GHG emissions,straw returning,crop yields,net ecosystem economic benefit,carbon footprint

ID ABS WEB: 139348

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

WARMING BUT NOT ELEVATED CO2 DEPLETES SOIL ORGANIC CARBON IN TEMPERATE RICE PADDY

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Climate change has the potential to impact soil organic carbon (SOC) stock in rice paddy, as elevated air temperature and atmospheric carbon dioxide concentration ([CO2]) can alter both major carbon (C) input (i.e. net primary production, NPP) and output (i.e. heterotrophic respiration). However, most climate change experiments investigated the response of either biomass productivity or C decomposition rate. We used two types of open-top chambers representing present conditions (+0'C, +0 ppm) and projected climate change conditions (+2'C, +200ppm) to investigate the net effect of climate change on SOC stock in rice paddy. Additional chambers with elevated temperature (+2'C, +0 ppm) were installed to isolate the individual effects of temperature and [CO2]. Changes in SOC stock were assessed using net ecosystem C balance (NECB) analysis, where the balance between C input and output indicates SOC stock changes. Compared to the present conditions, climate change did not change grain yield due to trade-off between the contrasting effects of elevated temperature and [CO2] on grain yield components. NPP during the fallow season significantly decreased, as the impact of increased temperature outweighed that of elevated [CO2]. However, during the cropping season, rice NPP remained unchanged. The climatic change conditions significantly stimulated SOC mineralization by 157-429% over the present conditions, particularly as CO2 during the fallow season, due to pronounced stimulating effect of warmer temperature. Consequently, the climate change conditions led to a substantial decrease (119-271%) in NECB values compared to the present conditions, due to the dominant effect of warmer temperatures. Our findings demonstrate that rice paddies represent positive feedback on climate change, because accelerated C release from warmed soils will override C gains from NPP. Therefore, to reduce the expected SOC depletion in rice paddy under changing climate, conservation soil management practices during cold and dry fallow season should be implemented.

Keywords: climate change,temperature,open-top chamber,SOC stock,rice paddy

ID ABS WEB: 140050

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

IMPROVING NITROGEN RECOMMENDATIONS TO PROMOTE PROFITABILITY, GRAIN QUALITY, AND NITROGEN USE EFFICIENCY IN TWO-ROW MALTING BARLEY

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As the demand and cultivation of two-row malting barley (Hordeum vulgare L.) increases in the Northern Great Plains of the United States, updated N recommendations are increasingly necessary. Not only does N play a role in grain yield, but it also impacts grain malting characteristics including protein and kernel plump. Historically, nitrogen fertilizers were applied with the goal of optimizing yield; however, as the point of maximum yield is reached, nitrogen efficiency per unit of grain decreases. To combat this barley nutrient recommendations were developed to maximize profitability by ensuring nutrients, especially nitrogen, are applied at rates which maximize use efficiency and grain quality, thereby reducing unnecessary over application. Two experimental sites were established in eastern North Dakota during the both the 2020 and 2021 growing seasons. Treatments consisted of five fertilizer rates from 0 to 180 kg N ha-1 and two malting barley cultivars. Soil samples to be analyzed for NO3-N were taken prior to planting and N credit estimates from the previous crop were considered to determine the total known available N (TKAN) in the soil. It was determined there was a strong relationship between N rate and grain yield along with a strong positive correlation between N rate and grain protein. No significant interactions between N rate and kernel plump were noted. When the relationship between relative grain yield and TKAN was modeled using a best-fit regression, it was determined maximum yield was attained at 210 kg TKAN ha-1 with a grain protein of 128 g kg-1, meeting malting quality requirements. When factoring in grain value and cost of urea fertilizer, the TKAN range needed to produce the crop at the highest profitability and N use efficiency was lower than TKAN of maximum yield, ranging from 89 to 190 kg TKAN ha-1.

Keywords: Nitrogen use efficiency,Economic optimum nitrogen rate,Nitrogen fertilizer,Malting barley

ID ABS WEB: 140101

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen
for climate-smart and sustainable agriculture

CEREAL-LEGUME INTERCROPPING FOR ENHANCING SOIL FERTILITY IN SUSTAINABLE AGRICULTURE

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The intercropping of legumes with cereals offers scope for developing energy-efficient and sustainable agriculture. Legume supported systems have a high potential for mitigating climate change through the reduction of fossil fuel use and GHG emissions, as well as increasing C sequestration. Long-term intercropping increases soil C sequestration compared to monoculture, with the changes in C storage ranging from -0.020 to 0.184 t C/ha/yr. Intercropping increases crop yields and it provides several ecological services such as pest, disease and weed control, soil biodiversity, and it has positive effects on nutrient use efficiency and soil quality.
The aim of this research was to examine the influence of intercropping on some soil properties. Two-year trials (2021-2023) were carried out on the experimental fields of the IFVCNS. Treatments: intercropping (winter wheat + forage pea)-I; winter wheat-WW; forage pea-FP; control-C. Soil samples were taken in autumn and in May.
The lowest K content was found in WW variant, 2.21 % and was significantly lower compared to FP (2.67 %). The content of K in I variant was 2.31 %. The P content was the highest in the FP (2.71 %), and the lowest in the WW variant (2.10 %). The content of P in the I variant was 2.31%. Total N content was the lowest in the WW (0.16 %) and in the C variant (0.17%). The results from the FP and I variant were 0.18 %.
The lowest SOC content was obtained in WW (12.7 g/kg) and then in the C variant (13.33 g/kg). The highest SOC content was in FP, 13.90 g/kg, and in the I variant, 13.83 g/kg. Although the SOC content was slightly higher, positive C balance cannot be found automatically, it takes many years. Long term results will be climate change mitigation and a significant contribution to climate neutrality through enhanced C sequestration. Intercropping as well as single legume crop are a good options for enhancing soil fertility.

Keywords: soil,intercropping,organic carbon,legumes

ID ABS WEB: 140109

4. Soil health in achieving the Sustainable Development Goals
4.16 133568 - Managing soil carbon and nitrogen for climate-smart and sustainable agriculture

COMPARING CONVENTIONAL AND ORGANIC CROPPING SYSTEMS WITH PROCESS-BASED MODELLING AND FUZZY LOGIC IN FINLAND

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Reducing nitrate (NO3) leaching, nitrous oxide (N2O) emissions, and soil organic carbon (SOC) losses are prominent environmental challenges for European agriculture. Organic farming practices are expected to promote soil health and are expanded the share of cultivated lands in Europe, even though with inconsistent findings on the effects on soil biogeochemical properties, biodiversity, and N emissions. This study utilizes the process-based ARMOSA crop model to investigate the impact of alternative farming practices on SOC dynamics, NO3 leaching, and N2O emissions in crop and livestock production farms for the current climate. The South Savo region of Finland was chosen as indicative of continental subarctic climates (Köppen-Geiger classification). Soil for simulation was loamy sand (sand 76%, clay 4%, silt 20%), or sandy texture and it was classified as Aquic Haplocryod (Finland Soil Taxonomy), with SOC of 3.5%, C/N ratio of 17, and pH of 6.2 (water) in 0-30 cm soil layer
Five-year crop rotations have been designed according to prevalent conventional and organic practices in the area. In the crop production farms, rotation included cereals (with fodder pea in the organic farm), oilseed rape and grass, while in the livestock farm, the rotations consisted of two years of cereals followed by a 3-year fescue and timothy meadow (with clover in the organic farm). Nine scenarios were simulated involving the different combinations of residue management strategies (retained/removed) and fertilization sources in the conventional systems (mineral fertilizers alone or with slurry integration) and in the organic systems (slurry/green manure/meat and bone meal-based commercial organic fertilizer).
Results from each scenario have been aggregated using a fuzzy logic-based composite index, the Sommit index, which assesses the trade-off between crop yield, N2O emissions, NO3 leaching, and soil organic carbon stock on a scale from 0 (bad) to 1 (good). This index, adaptable to specific contexts, facilitates a sensitive evaluation of interdependent variations within the trade-off components during scenario transitions, offering insights crucial for informed agricultural decision-making

Keywords: process-based crop model, trade-off analisys,fuzzy-logic index,organic farming,management strategies

ID ABS WEB: 136596

4. Soil health in achieving the Sustainable Development Goals
4.17 133569 - Revitalization of mining residue deposits

THE ORCHID DUMP – A PARTICULAR SITE IN A HISTORICAL AS MINING AREA. SOILS AND VEGETATION

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In the Sudetes, there are numerous mineralization zones where ores were mined in the past. Historical mining produced waste dumps with high concentrations of toxic elements. One of such sites is Zloty Stok where gold and arsenic were mined over centuries. The largest (2.4 ha) mine dump in this area, called Orchid Dump, will be described. The dump is built of metamorphic rocks, mainly gneisses, schists, amphibolites, and crystalline limestone. They contain various As-rich minerals, such as arsenopyrite and loelingite, as well as different metal-bearing minerals. Soil parent material consists of weathered mine rocks, admixture of exogenous soil used for reclamation and humified plant residues.
Our research confirmed that soils and habitats on the dump are highly heterogeneous. Arsenic concentrations in 50 topsoil samples ranged 230-55,000 mg/kg (median 9800 mg/kg). Potentially soluble arsenic, extracted with 0.43 M HNO3, constituted 5.6-87% of total As, with a median 32%, and currently soluble As, extracted in 1 M NH4NO3, was below 8 mg/kg, making <0.001-5.5% of total As, with a median 0.012%. Sequential extraction according to Wenzel, indicated that As was mainly present in amorphous Fe oxides-bound and residual fractions. Each of them constituted 30-60% of total As, depending on weathering stage of As-bearing minerals. Despite high concentrations of toxic elements, the Orchid Dump is a unique and precious site in terms of nature, protected as ecological site. Its most important ecosystems are xerothermic calamine meadows (Violetea calaminariae) with several protected plant species, that form mosaics with scattered heathlands and other associations. The dump owes its name to large population of Orchis mascula L. Most plants growing on the dump, including grass, are capable of arsenic avoidance. Typical As concentrations in Agrostis capillaris shoots were in the range 1.8-15.4 mg/kg (median 5.4 mg/kg), although single individuals accumulated more As in their shoots (35.9-115 mg/kg). Various mechanisms of As avoidance are involved there, however a hypothesis on its genetically-determined character has not been confirmed.

Keywords: mine waste, arsenic, solubility, plants, uptake

ID ABS WEB: 137817

4. Soil health in achieving the Sustainable Development Goals
4.17 133569 - Revitalization of mining residue deposits

POSSIBLE CAUSES OF THE SUCCESS/FAILURE OF RIPARIAN FOREST RESTORATION PROJECTS AFTER THE BREAKDOWN OF THE FUNDÃO DAM (MARIANA/BRAZIL)

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Almost eight years after the collapse of the Fundão dam, which impacted the Doce river basin up to the Atlantic Ocean, results of restoration actions on areas impacted by tailings still need to be better understood. Although the actions developed by the Renova Foundation have resulted in satisfactory seedling mortality rates (general average of 45%), especially when considering the unprecedented physical, chemical, and biological conditions of tailing deposits, a general standard explanatory of this mortality does not exist. Given the complexity of factors that interfere with the establishment and growth of seedlings, which vary significantly in time and space, a multicriteria analysis (MCA) was tested as a tool for identifying explanatory patterns of mortality. The study addressed forest restoration activities carried out on 268 work units on 65 rural properties, located in the municipalities of Mariana and Barra Longa, where direct planting of native seedlings was carried out. The analysis of groupings of properties by typologies and region (Mariana -Upstream, Mariana-Downstream and Barra Longa) revealed that different initial parameters demonstrated a greater cause and effect relationship with the mortality rates of the seedlings. In Mariana-Upstream, factors such as high waste thickness and slope of the margins, inadequate planting time, low concentration of phosphorus and base saturation, fewer rainy days and high incidence of livestock seem to have a more relevant effect on seedling mortality. On the other hand, in Barra Longa (35Km downstream), the flatter terrain and river morphology, less porous soils, location and width of restored forest, greater precipitation volume (including heavy rains that resulted in flooding events), better explained the mortality. The results indicate that concerning large-scale ecosystem restoration studies, AMC must be carried out in a regionalized manner, reflecting environmental heterogeneity and variation in study parameters. These must be weighted according to the characteristics of each region, avoiding the dilution of their effects by considering the entire study area as homogeneous.

Keywords: tailings, seedling mortality, large-scale ecosystem, restoration

ID ABS WEB: 137971

4. Soil health in achieving the Sustainable Development Goals
4.17 133569 - Revitalization of mining residue deposits

TECHNOSOLS IN ARTIFICIAL WETLANDS IN MINING LANDSCAPES: EFFECT OF HYDROTHERMAL GEOLOGICAL MATERIALS

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In this study, three profiles were analyzed inside the tailing dam: the PA profile under waterlogging conditions, the PB profile under periodic conditions of wastewater saturation, and the PC profile without waterlogging conditions. And a natural profile of the soil around the Tailings dam.
The analyzes carried out were: micromorphological (thin sections observed under a petrographic microscope) to detect the development of soil structure and other pedofeatures; fertility properties (pH, organic matter, available phosphorus, exchangeable bases, cation exchange capacity, electrical conductivity); mineralogical by X-ray Diffraction; total chemical composition Ti, Ca, K, Fe, As, Pb, Zn, Cu and Mn.
Irrigation of tailings with wastewater promoted biological aggregation and porosity of the soil matrix introduced nutrients and improved the soil ecological quality of hydromorphic Technosols. Saturation with wastewater hinders the oxidation of primary sulfides in hydromorphic Technosols, thus preventing acidification and the mobilization of heavy metal contaminants. The abundant hydrothermal clay minerals of hydrothermal origin in Technosols have a beneficial effect on the development of pedogenetic properties and processes.
The main micromorphological characteristics of wetland Technosols are the development of a biogenic structure and voids associated with organic materials, mainly root tissues. Primary sulfides remain unaltered in the Technosols irrigated with wastewater, while incipient oxidation of sulfides was observed in the non-irrigated tailings. Kaolinite and illite are the main components of the clay mineralogy in all profiles; Additionally, chlorite and smectite are detected in Technosols.
The organic matter content in Technosols is low; However, we consider the potential to form clay organic compounds that can improve soil quality. Furthermore, Technosols have adequate properties for plant growth, except for conductivity. They were not irrigated with cationic sewage and available P.

Keywords: Technosol,Hydrothermal,Clay Minerals,Soil quality,micromorphology

ID ABS WEB: 138117

4. Soil health in achieving the Sustainable Development Goals
4.17 133569 - Revitalization of mining residue deposits

INFLUENCE OF THE APPLICATION OF BY-PRODUCTS OF LIMESTONE MINING ON SOIL CHEMICAL ATTRIBUTES

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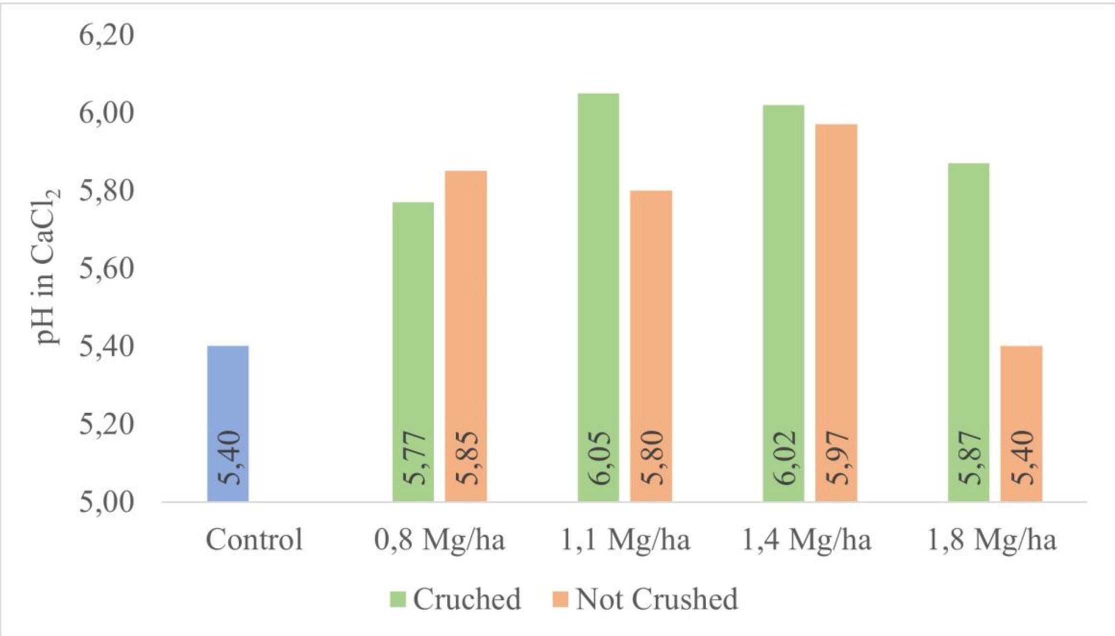
Limestone is one of the main agricultural inputs used in the agriculture of tropical regions. It has the power to neutralize acidity, which is the main inhibiting characteristic of oxisols, and it is also a source of nutrients such as Calcium and Magnesium. As it is a rock powder, its mining produces a residue that has chemical characteristics similar to those found in limestone, which can be classified as a by-product with high potential for agronomic use. Therefore, this study aims to evaluate the potential of using the by-product of limestone mining in improving the chemical attributes of the soil. The treatments consisted of 4 increasing doses of by-product equivalent to 0.8, 1.1, 1.45, and 1.8 Mg/ha, with ten repetitions, in a completely randomized experimental design, arranged in two factors, crushed and uncrushed residue. The application of limestone mining residue proved to be efficient in improving soil chemical attributes. When evaluating the influence of the application on the levels of Calcium, Magnesium, and Base Saturation, the treatment with 1.8 Mg ha-1 uncrushed showed higher values than the other treatments. The control treatment had the worst indices, and the other treatments were statistically equal and positioned above the control treatment and below the treatment with 1.8 Mg kg/ha uncrushed. The limestone mining residue showed potential for the improvement of soil chemical attributes and can be used as a soil conditioner.



Keywords: BY-PRODUCTS, mining waste, soil chemistry, pH

ID ABS WEB: 140130

4. Soil health in achieving the Sustainable Development Goals
4.17 133569 - Revitalization of mining residue deposits

DEVELOPMENT A DIRECT HG QUANTIFICATION METHOD BY THERMAL DECOMPOSITION, AMALGAMATION, AND ATOMIC ABSORPTION SPECTROPHOTOMETRY IN ABANDONED TAIL DAMS OF MINING OPERATIONS IN THE ATACAMA REGION, CHILE

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As a result of the gold extractive activities carried out in the Atacama region, large quantities of Hg were accumulated in tail dams, generating a negative impact in the human health and ecosystems.
In order to quantify the total Hg present in soil samples, is necessary to create a new analytical method adapted to high Hg concentration.
This study has been promoted by the regional government of Atacama, framed in the Minamata Convention on Mercury, 2013.
For the determination of total Hg, a Milestone DMA-80 direct analyzer was used. This equipment combines thermal decomposition, amalgamation, and atomic absorption spectrophotometry.
The instrumental analytical method is adjusted with the official methods established in EPA 7473, ASTM D-6722-01 and D-7623-10. Our results provide satisfactory values of linearity ($r2 > 0,99$) sensitivity (between 0,0492 and 0,0007 ng), precision (0,52% RSD for repeteability and 0,47% RSD for reproducibility), accuracy (recovery of $99,4 \pm 8,4\%$), while the LOD is 0,0015 ug/Kg and LOQ is 0.0030 ug/Kg.
The selected tailings dams are located in the Atacama region: Inca de Oro 1 and 2 (26°45'S-69°54'W) both located in Chañaral, Pabellón (27°39'S-70°14'W) and Totoralillo (27°36'S-70°14'W) located in Tierra Amarilla, Bruzzone and Briceño, (28°27'S-71°10'W) both located in Huasco.
Samples were taken from the surface of the tailings (0-5 cm) and at depth (50 cm), and mechanically processed to homogenize particle size and disaggregate it before analysis.
Given the high concentration of Hg in samples, it was diluted using Al2O3 and then suspended in MilliQ water (by mechanical agitation, 300 seconds,900 RPM). Aliquots of 300µL of this suspension were taken in triplicate for Hg quantification.
Thus, the total Hg contents in the suspension were obtained, subsequently recalculating the Hg concentration in the tailings, finding concentrations ranging from 0,94 mg/kg (Briceño Tailings) to 876 mg/kg (Pabellón Tailings) compared to the accepted maximum concentration in industrial soils of 43 mg/kg (U.S Superfund Contamination Site Program).
Acknowledgments: Project FIC Atacama Code BIP40045269

Keywords: Mercury, Tailing dams, New Analytical Method, Amalgamation, Minamata

ID ABS WEB: 136215

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

CONTROLLABLE PREPARATION AND APPLICATION OF NANOMETER FE-CARBON FUNCTIONAL MATERIALS IN SOIL REMEDIATION

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The nZVI-based remediation technology is limited by the dense oxide shell, which hinders electron transfer and requires a feasible solution. Specifically, nZVI is a promising persulfate (PS) activator whose dense oxide shell inhibits electron transfer to PS. Therefore, we introduced sulfurized and phosphorus-doped biochar to break up the original oxide shell and formed a mixed shell containing FeS and FePO4. We found that Fe core had a faster diffusion rate relative to the shell, triggering multiple Kirkendall effect that caused the vacancies to flow inward and merge into radial “lemon-slice-like” nanocracks. The crack facilitated the rapid outward transfer of electrons and Fe2+ through the mixed shell to activate PS, resulting in effective dechlorination (90.6%) and mineralization (85.4%) of TCE. At the same time, SnZVI@PBC gradually lacked electrons, and then extracted electrons from TCE to achieve non-free radical degradation. This study provided a mechanism understanding for the formation and application of nanocracks induced by multiple Kirkendall effect on nZVI. Moreover, PnZVI@PBC was prepared using phosphate and phosphorus-doped biochar to cooperatively amplify the Kirkendall effect between Fe0 and the shell, and the Kirkendall effect between Fe0 and Cr(VI) was further amplified through the nanocracks, thus changing the adsorption configuration and shortening the electron transport channel. Based on this, the nZVI surface and internal electrodisplacement reactions were accelerated to achieve almost complete Cr(VI) reduction (97.0%). Surprisingly, we observed a distinct hollow core structure enriched with Cr(III), indicating that PnZVI@PBC synchronized the immobilization, detoxification, and oxidation resistance of Cr(VI) for sustainable repair. In summary, the Kirkendall strategy based on non-metallic elements and the advanced mechanism of enhancing the electric displacement reaction on nZVI provided the possibility for a wide range of repair applications.

Keywords: soil remediation, Kirkendall effect, nanocrack,Fe-carbon functional materials, electron transfer

ID ABS WEB: 135976

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

QUALITATIVE CHARACTERIZATION AND INFLUENCE OF ORGANIC MATTER ON THE TRANSFER OF POTENTIALLY HARMFUL TRACE ELEMENTS IN THE SOIL-PLANT SYSTEM

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Trace elements are chemical elements found in low concentration in the environment, including: (1) essential elements for plants and/or animals (such as Cu, Zn, and Mn), which can frequently cause human deficiency (common for Mo and Se) and toxicity when concentrations are below or above certain thresholds, respectively; and (2) elements without identified biological role that only pose a human health risk when concentrations are above a certain threshold value (such as As, Cd, and Pb). Transfer of these elements from soils to plants occurs through various processes, depending on element speciation and then, leading to varied bioavailabilities. Agricultural practices have the potential to influence the transfer of trace elements, serving as a potential lever for addressing environmental and health concerns. Notably, exogenous organic matter may act as a reactive surface and thus control the retention and bioavailability of trace elements in soils. Quantifying and qualifying accurately its role is therefore crucial for adapting agricultural management practices.

In this context, the objective was to characterize the exogenous organic matter and to assess the impact of its application on the transfer of trace elements from soil to plants in uncontaminated and gradually contaminated agricultural soils. For this purpose, we investigated the effects of exogenous organic matter application (cow manure, green waste compost, and crop residues) in a greenhouse experiment where maize was cultivated on four Belgian agricultural soils exhibiting diverse contamination levels and origins. The experiment included trace element quantification in soil, organic matter, and plant samples and characterization of exogenous organic matter mixed with soil, by nuclear magnetic resonance (solid state 13C NMR), pyrolysis coupled with gas chromatography and mass spectrometry (py-GC-MS) and Rock-Eval. Results showed that both soil and exogenous organic matter highlighted some different chemical characteristics depending on the modalities considered. Those differences observed are promising for a better understanding of the relationship between organic matter and trace elements and therefore for the adaptation of agricultural management practices.

Keywords: Trace element,Soil-plant,Organic matter,Solid state 13C NMR,Rock-Eval

ID ABS WEB: 136201

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

A NOVEL TOOL FOR TRACING WATER SOURCES OF STREAMFLOW IN A MIXED LAND-USE CATCHMENT

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Tracing water sources of streamflow in a mixed land-use catchment is critical for predicting pollutant emissions from various human activities to streams but remains a major challenge. A rain event based field monitoring study was conducted in the Jieliu catchment located in the hilly area of central Sichuan Province, southwest China. The ratio of the maximum fluorescence intensities (Fmax) of the two humic-like dissolved organic matter (DOM) components at excitation/emission wavelengths of 255 (315)/415 nm (component 1; C1) and 260 (375)/ 480 nm (component 2; C2) was proposed as a tracer for quantifying streamflow water sources. Satisfactory performance of using the Fmax(C1)/Fmax(C2) ratio in hydrograph separation of streamflow at the outlet of a forest sub-catchment was verified by through comparison with the hydrograph separation results based on δ18O data. The Fmax(C1)/Fmax(C2) ratio was then applied to estimate the contributions of rainwater and pre-event water sources under different land use types to the streamflow in an agro-forest sub-catchment and the entire catchment. The hydrograph separation results using the Fmax(C1)/Fmax(C2) ratio can be used to support the optimization of water resource management and the quantification of pollutant loadings from major water sources to streams at the catchment scale.

Keywords: Dissolve organic matter,Fluorescence,Water source,Tracer,Land-use

ID ABS WEB: 136230

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

ASSESSING COMBINED TOXICITY EFFECTS OF EMERGING POLLUTANTS AND HEAVY METALS ON E. CRYPTICUS IN SOIL ECOSYSTEM

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Emerging pollutants pose a formidable threat to soil ecosystems, necessitating a profound understanding of their individual and combined impacts. This study explores the toxicity of benzopyrene, anthracene , diuron, carbofuran, and heavy metals Cu and Cr) on E. crypticus , assessing binary and combined mixture effects using EC50 values. Individual pollutants exhibit diverse toxicity levels (1.84 to 78 mg/kg), highlighting their varied ecological implications. Binary mixtures involving benzopyrene and anthrac ene or diuron display reduced toxicity, while their ternary combination showcases the lowest toxicity (EC50 = 3.245 ± 0.213 mg/kg). Cu and Cr individually present higher toxicity (275.8 mg/kg and 222 mg/kg, respectively), with combined effects diverging from individual profiles (EC50 = 190 mg/kg). Combining Cu or Cr with carbofuran demonstrates diminished toxicity compared to singular carbofuran (EC50 = 2.408 mg/kg). Remarkably, the trio of Cu, Cr, and carbofuran manifests intermediate toxicity (EC50 = 2.11 5 mg/kg). These findings elucidate intricate interactions within pollutant mixtures, suggesting potential antagonistic or synergistic effects on E. crypticus.
Understanding combined toxicity is pivotal for accurate risk assessments and effective environmentalmanagement strategies, underscoring the complexity of soil ecosystem responses to emergingcontaminants.

Keywords: emerging pollutants, soil toxicity, Enchytraeus crypticus, organic pollutants, heavy metal

ID ABS WEB: 136412

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

FIXATION OF CESIUM BY GRANITE-ORIGIN SOIL

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Radionuclides, including 134Cs, 137Cs, 131I, 238Pu, and 140Ba, are released through nuclear accident, nuclear test, and radioactive waste disposal, leading to potential soil contamination. Among them, 137Cs is a particularly harmful radioactive element due to its emission of high energy beta particles and gamma rays, combined with a half life of 30.1 years. The chemical properties of 137Cs are similar to those of potassium (K), rending it highly soluble and mobile in groundwater. However, the adsorption and fixation of Cs to minerals, notably weathered micas, may reduce its mobility. The soil used in this study was collected from the C horizon of the soil developed from a Mesozoic mica granite, was air-dried, and was prepared by passing through a 2 mm standard sieve. The texture, mineralogy, cation exchange capacity (CEC), pH, water soluble cation and anion, and organic matter of the soil sample were determined (Dixon and White, 1996). The Cs adsorption properties of the soil sample were evaluated via adsorption kinetic and isotherm experiments employing a batch method. To investigate the soil sample`s irreversible Cs adsorption characteristics, the desorption experiments were also conducted at 1mM of potassium (K). The sample displayed a CEC of 1.34 cmolc kg-1, organic matter content of 0.53% and sandy loam texture. Quartz, hydroxy-interlayered vermiculite, vermiculite, and kaolinite were identified as the major mineral components. The quantity of adsorbed Cs exhibited a sharp increase in the initial 3 h and subsequently progressively reached a state of equilibrium after 24 h. The dual-site Langmuir model (r2 = 0.9988) showed a very good fit for the adsorption isotherm suggesting the existence of multiple adsorption sites for Cs with distinct adsorption capacity. The Cs desorption only occurred when it reached 0.035% of CEC despite the presence of the competing ion (K+). The fixation of Cs on frayed edge sites, primarily ascribed to weathered mica and interpretable via the dual-site Langmuir model, may contribute the irreversible adsorption.

Keywords: Adsorption and Desorption,Mineralogy,Frayed edge,dual-site Langmuir model

ID ABS WEB: 136763

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

TRANSFER AND DISTRIBUTION OF ANTIBIOTIC RESISTANCE GENES IN THE SOIL-PEANUT SYSTEM RECEIVING MANURE FOR YEARS

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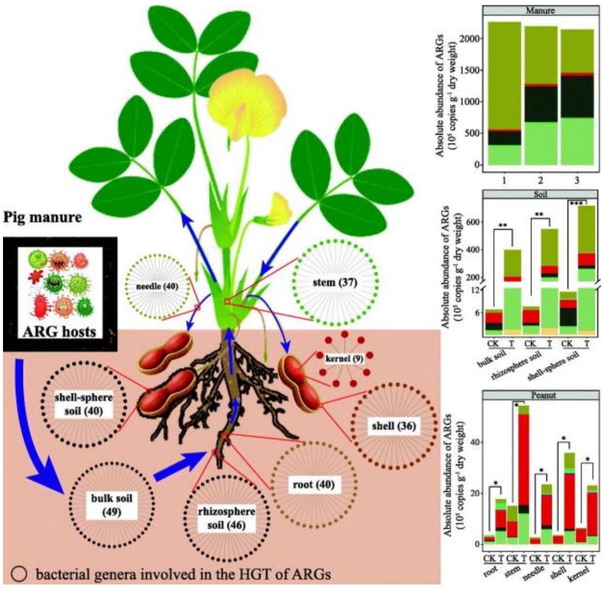
Antibiotic resistance gene (ARG)-contaminated food from manure application is gaining widespread interest, but little is known about the distribution and uptake of ARGs in peanuts that are subjected to manure routinely. The application of manure can increase the risk of ARG contamination in peanut kernels, the long-term positioning experiment of 7-year results that the application of manure increased the abundance of ARGs in soil and peanuts by 59–72 and 4–10 fold, respectively. The abundance of ARGs from high to low was as follows: manure, shell-sphere soil, rhizosphere soil, bulk soil, stems, shells, needles, kernels, and roots. Compared to the bulk soil, higher concentrations of ARGs were detected in the rhizosphere and shell-sphere soil, which was because root exudates (e.g., sugars and organic acids) and shell exudates (e.g., amino acids and flavonoids) of peanuts may have recruited microorganisms, including ARB, and provided nutrients for microbial growth.Source-tracker analyses were used to investigate the potential source of ARGs in peanut kernels, which revealed that the ARGs in peanut kernels may be primarily absorbed by the roots from the soil. The spread of ARGs from soil to peanut kernels was driven by horizontal gene transfer (HGT) involving 143 genera, the majority of these 143 genera were Proteobacteria (41) followed by Firmicutes (35) and Actinobacteriota (32). The HGT of ARGs was the primary factor in the spread of ARGs, and Proteobacteria were the primary agents of HGT between different parts of peanut plants. Additionally, Compared to the Control treatment, norank Chloroplast in the Cyanobacteria phylum was the only significantly enriched genus among four potential hosts in the peanut kernel in the Manure treatment, it was the most important contributor to the abundance of ARGs in peanut kernels. Overall, our findings fill a gap in our understanding of the distribution patterns of ARGs in peanut plants and the migratory pathways of ARGs from soil to peanut kernels.



Keywords: Bacterial community,Horizontal gene transfer,Root uptake,Shell uptake,Source tracker

ID ABS WEB: 136764

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

THE BACKGROUND CONTENT OF HYDROCARBONS IN TUNDRA SOILS

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The global ecological problems associated with the transboundary transfer of pollutants as well as regional and local sources of environmental pollution currently require new approaches to the assessment of specific environmental cases in natural biogeocenoses. Natural environments are overloaded with hydrocarbons (HCs). At present, no oil field is free of waste.
In the Komi Republic, large oil fields are being intensively developed. The increase in the production of crude HCs significantly complicates the ecological situation in this region. Anthropogenically degraded soils are widely distributed in the production areas of oil fields, at the sites of prospecting and geophysical drilling, and along the oil pipelines and transport lines.
Tundra soils from European North-East of Russia (Republic of Komi) were studied. The concentration of HCs in the soil samples was determined by the fluorescence intensity of the hexane extract measured on the Fluorat-02 liquid analyser. It was found that the background content of HCs in tundra soils is determined by the peculiarities of granulometric composition of parent material, as well as by the location of the soils in geochemically autonomous and subordinate landscapes.
The main amounts of HCs is accumulated in organogenic horizons: the largest, as a rule, in soils of river valleys (Fluvisols), on flat depressions, poorly drained river slopes and gentle slopes (Histosols, Gleysols and Retisols); the smallest – in watersheds (Podzols). Differentiation of HCs by genetic horizons is more pronounced in loamy automorphic soils and less – in sandy soils. All soils are characterised by an eluvial-illuvial distribution of HCs in the profile.
This work was supported by the grant of the Russian Science Foundation (No. 24-24-00144).

Keywords: Soil monitoring,Pollutants,Arctic,Geochemistry

ID ABS WEB: 137310

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

IN SITU DISCRIMINATION AND CULTIVATION OF ACTIVE DEGRADERS IN SOILS BY GENOME-DIRECTED CULTIVATION ASSISTED BY SIP- RAMAN-ACTIVATED CELL SORTING

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The identification and in situ cultivation of functional-yet-uncultivable microorganisms are important to confirm inferences regarding their ecological functions. Here, we developed a new method that couples Raman-activated cell sorting (RACS), stable-isotope probing (SIP), and genome-directed cultivation (GDC)—namely RACS-SIP-GDC—to identify, sort, and cultivate the in situ active toluene degraders from a complex microbial community in petroleum-contaminated soil. Using SIP, we successfully identified the active toluene degrader Pigmentiphaga, the single cells of which were subsequently sorted and isolated by RACS. We further successfully assembled the genome of Pigmentiphaga based on the metagenomic sequencing of 13C-DNA and single-cell genomic sequencing of sorted cells, which was confirmed by gyrB gene comparison and average nucleotide identity determination. Additionally, the genotypes and phenotypes of this degrader were directly linked at the single-cell level, and its complete toluene metabolic pathways in petroleum-contaminated soil were reconstructed. Based on its unique metabolic properties uncovered by genome sequencing, we modified the traditional cultivation medium with antibiotics, amino acids, carbon sources, and growth factors (e.g., vitamins and metals), achieving a successful cultivation of RACS-sorted active degrader Pigmentiphaga sp. Our results implied that RACS-SIP-GDC is a state-of-the-art approach for the precise identification, targeted isolation, and cultivation of in situ functional microbes from complex communities in natural habitats. RACS-SIP-GDC can be used to explore specific and targeted organic-pollution-degrading microorganisms in situ at the single-cell level and provide new insights into their biodegradation mechanisms.

Keywords: Raman-activated cell sorting,stable-isotope probing,genome-directed cultivation,active toluene degrader,single-cell genomic sequencing

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ID ABS WEB: 137750

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

RHIZOSPHERE ENRICHMENT AND CROP UTILIZATION OF SELENIUM AND METALS IN TYPICAL PERMIAN SOILS OF ENSHI

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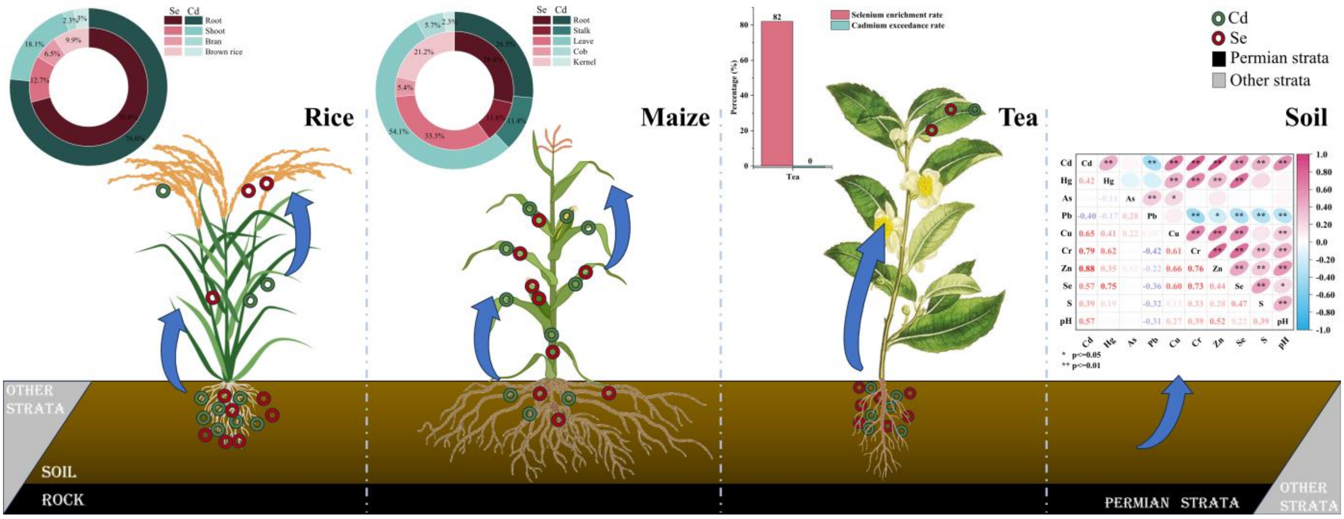
Permian soils in Enshi, a selenium (Se) enriched area, exhibit high background levels of cadmium (Cd), posing risks to Se-enriched agriculture. This study aims to understand the enrichment and behavior of Se, Cd, and other heavy metals in rhizosphere soils and crops. Soil samples from Enshi were analyzed, and the fractions of Se and Cd were assessed. Results showed higher Se (5.3 mg/kg) and Cd (8.22 mg/kg) concentrations in overlying soils. Se was mainly in organic-bound form (61.3%), while Cd was predominantly in the exchangeable state (62.5%). High Cd lability (75.5%) and pollution (52%) were observed in soils. Tea had the highest Se enrichment (82%) without exceeding Cd limits. Rice and maize had lower Se enrichment (9.6% and 6.0%) but higher Cd exceedance rates (61.3% and 48.5%). Edible parts of rice were more affected by soil factors than maize and tea. This study provides insights into the geochemical behavior and agronomic accumulation of Se and Cd in Enshi's high-Se and high-Cd areas, contributing to the production of safe Se-rich agricultural products.



Keywords: Selenium,heavy metal,Agricultural products,Permian parents,Rhizhesphere

ID ABS WEB: 137843

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

PERSISTENCE OF ORGANOCHLORINE PESTICIDES AND THEIR RELATIONSHIP WITH HEAVY METALS IN SOILS OF AGRICULTURAL AREAS IN BRAZIL

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Organochlorine pesticides (OCP) are persistent organic pollutants used to control endemic diseases in agriculture of tropical regions. In Brazil, they were widely used from the 1940s - 1990s. However, despite being banned in 2005, some are still detected in the soil, in some cases increasing the concentrations of heavy metals (HM). We evaluated the occurrence of OCP in soils of agricultural areas and its relationship with HM. Five soil samples at 0-20 cm depth were collected in each area: red roses (CA1) and chrysanthemum (CA2), and three samples in a native forest area (NFA), in Northeast, Brazil, during the dry and rainy periods, and quantified the concentration of Cd, Cu, Mn, Pb and Zn, as well as a-BHC, b-BHC, g-BHC, d-BHC, Heptachlor, Aldrin, Heptachlor epoxide, g-Chlordane, a-Chlordane, Endosulfan, 4,4-DDE, Dieldrin, Endrin, 4,4 DDD, trans-Nonachlor, Endrin aldehyde, Endosulfan sulfate, 4,4 DDT, Endrin ketone and Methoxychlor detected by gas chromatography with electron capture detector (GC-ECD). The results were subjected to ANOVA and Tukey's test ($p < 0.05$). The relationship between OCP and HM was verified using Spearman's correlation ($p<0.05$). The summed concentration of OCP (ng g-1) (sum OCP) ranged from 3.33 to 29.78 (CA1), from 18.56 to 202.97 (CA2) and 5.42 to 10.34 (NFA), with no difference between the sampling periods, however, CA2 area had the highest concentrations of OCP. The levels of Cd, Mn, and Zn were positively correlated with d-BHC, Aldrin, 4,4 DDD, Endrin aldehyde and Endrin ketone. Zn also had a positive correlation with Methoxychlor and, Cu had a positive correlation with Aldrin, Endosulfan, 4,4 DDD and Endrin aldehyde. We therefore found that even after almost two decades of banning these compounds in Brazil, they can still be detected in the soil and favoring the increase of HM concentration. Our results reinforce that soil contamination by OCP residues should be considered in soil quality assessments, given the potential harmful effects of these substances on the environment and human health

Keywords: Emerging contaminants,Occurrence,Soil contamination,Pollutants

ID ABS WEB: 137955

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

DYNAMIC OF CARBAMAZEPINE AND ITS MAIN METABOLITES IN SOIL-PLANT SYSTEM

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Carbamazepine (CBZ) is a pharmaceutically active antiepileptic compound that can be introduced into the agroecosystem through irrigation with wastewater purified using tertiary treatments.
In this greenhouse study, we focused on the fate of CBZ and its metabolites in the soil-plant system.
To simulate pharmaceuticals accumulation in soils, the experimental design involved the use of two waters spiked with 200 and 600 ppb of CBZ.
Irrigation was carried out in pots with and without basil plants in order to evaluate the effect of the plant on the behavior of CBZ and its degradation products.
The results showed a lower concentration of CBZ and its metabolites (acridine and carbamazepine-10,11-epoxide) in soils with basil plants compared to control one and the presence of the aforementioned organic contaminants in the roots and aerial parts of basil. These results are due to the positive role of the basil rhizosphere in the degradation of this compound and/or plant in the removal of the contaminant by absorption processes.
The observed morphological parameters (plant height, number of leaves, fresh and dry weight and chlorophyll content) were not affected by CBZ, even at high concentrations. In view of the low concentration of CBZ in the effluents of wastewater treatment plants, far lower than that used in the present experiment, basil can be considered suitable for irrigation with purified wastewater. To exclude risks of toxicity for humans and environment, further ecotoxicological and biochemical studies are necessary.

Keywords: pharmaceuticals,degradation products,soil,basil,carbamazepine

ID ABS WEB: 137976

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

ROLE OF ORGANIC MATTER, IRON OXIDES AND ALUMINOSILICATE CONTENT ON CHEMICAL PHYSICAL INTERACTIONS BETWEEN CIPROFLOXACIN AND ANDISOL SOIL

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The widespread use of antibiotics, such as Ciprofloxacin (CIP), to treat infectious diseases in humans and animals has raised significant environmental concerns due to the presence of these drugs in soils. This study investigates the occurrence and adsorption of Ciprofloxacin in soil, shedding light on the environmental implications associated with antibiotic use. The objective is to establish the role of different soil components, such as organic matter (OM) and iron oxides (FexOy), in the adsorption of ciprofloxacin in Andisol soils. This understanding helps establish the environmental consequences associated to the extensive use of antibiotics. The Andisol soil of Santa Bárbara (SB) series and chemically treated substrates without organic matter (SB1) and without organic matter and iron oxides (SB2) were characterized.
Adsorption isotherms reveal the presence of two types of adsorption sites in the SB soil: instantaneous and time-dependent. The Langmuir-Freundlich model effectively explains the observed cooperative adsorption, while the Freundlich model aligns well with the experimental data from SB1 and SB2 samples. SB1 exhibits a higher adsorption capacity but lower intensity compared to SB2. The removal of OM and FexOy notably influences the adsorption behavior, resulting in lower capacities compared to the original SB soil.
In brief, this study emphasizes the complex interaction between CIP and soil components, highlighting the significance of OM and FexOy in the adsorption capacity of antibiotics. Understanding these interactions is crucial for developing strategies to minimize environmental impact and sustainably manage antibiotic residues in soil. Further research in this field is essential for preserving environmental and human health, contributing to the well-being of the planet by expanding our knowledge of antibiotic-soil interactions.

Keywords: SOIL ORGANIC MATTER,CIPROFLOXACIN,IRON OXIDES,KINETICS AND ADSORPTION

ID ABS WEB: 138034

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

BIODEGRADABILITY OF CONVENTIONAL AND BIOBASED POLYMERS IN SOIL UNDER FIELD CONDITIONS

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Plastic production is increasing every year, and most of plastics are manufactured as a single-use items. This causes them quickly to end up as waste that is often stored in landfills. If waste management is not adequate, they can be accumulated and transported to other ecosystems, such as rivers, streams, lakes, or soil. Plastic concentration on soil is believed to be significantly higher than in aqueous environments, however, soil remains an often-overlooked player in plastic pollution. In the last decades, the impact of conventional petroleum-based plastics and microplastics has gained more prominence in the scientific community, and recently, bioplastics have emerged as one of the most promising alternatives to reduce the use of conventional polymers. Despite this, the environmental consequences of the accumulation of these novel bioplastics have not been extensively studied.
This work studies the degradation of two types of bioplastics (PLA and PHB) and a conventional plastic (PP) under natural conditions. For this purpose, 10x10 cm plastic film squares were cut into strips and buried into the soil inside nylon mesh bags with a pore size of 200 µm. Recovery of plastics was conducted at three, five, and six months after the experiment started. Humidity and temperature conditions were monitored. Once collected, samples were washed with distilled water, removed from the nylon mesh bags, and visually evaluated for signs of degradation. FT-IR analysis was performed to assess changes in the functional groups of the plastics compared with the original material.
Visually, PHB was the only plastic that suffered degradation and loss of material. Pieces of this plastic were broken into many fragments, in this way, the formation of micro and nanoplastics were confirmed after three months. PLA and PP had no signs of degradation after six months exposure. FT-IR analyses, currently in progress, will determine whether modifications to the functional groups have occurred. The results will be presented in the poster.

Keywords: Bioplastic,Biodegradation,Microplastic,Pollution,Polymer

ID ABS WEB: 140043

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

HEAVY METALS DRIVE MICROBIAL COMMUNITY ASSEMBLY PROCESS IN FARMLAND WITH LONG-TERM BIOSOLIDS APPLICATION

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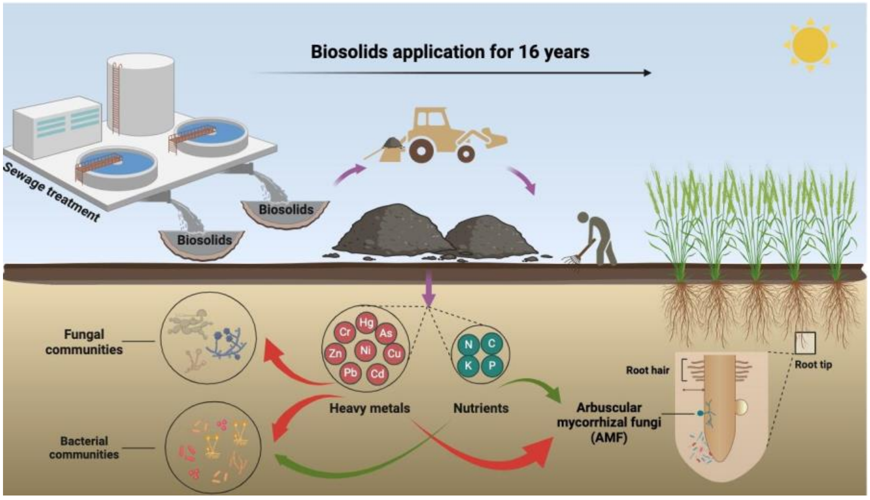
Biosolids are considered an alternative to chemical fertilizers due to their rich nutrients. However, long-term biosolids application can lead to heavy metals accumulation, which severely affects soil microbial community compositions. The factors influencing soil microbial community assembly were explored under a 16-year long-term experiment with biosolids applications. Our results indicated that biosolids application significantly increased fungal richness while not for bacterial and arbuscular mycorrhizal (AM) fungal richness. Besides, biosolids application significantly affected soil bacterial, fungal compositions and AM fungal community. Soil microorganisms were clustered into different modules with bacterial and AM fungal communities were affected by both organic matter and heavy metals, while fungal communities were affected by heavy metals (Cr, Ni, and As). The soil bacterial community assembly was dominated by stochastic processes while the fungal and AM fungal community assemblies were mainly driven by deterministic processes. Random forest analysis showed that heavy metals were identified as major drivers (Hg, Cu, Cd, and Zn for bacteria, Pb and Cr for fungi, and As and Ni for AM fungi) of the community assembly process. Overall, our study highlights the significant role of heavy metals in shaping microbial community dynamics and gives a guide for controlling biosolids application.



Keywords: Biosolids,Heavy metals,Soil microbial community,Community assembly process

ID ABS WEB: 140068

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

METABOLIC EVALUATION OF THE ROOT-SOIL SYSTEM OF COCOA (THEOBROMA CACAO L.) WITH A VIEW TO DETERMINING POSSIBLE RELATIONS BETWEEN THIS AND CADMIUM FRACTIONS IN RHIZOSPHERIC SOILS OF COCOA CROPS

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Cadmium (Cd) is a heavy metal present in soils and has no biological function at the human or ecosystemic level. Cocoa cultivation in Colombia is experiencing difficulties due to the presence of this heavy metal in its soils, which affects the Cd content in the final products and therefore human health. Different investigations have been reported that have addressed this problem, however, little is known about the metabolic dynamics of the cocoa root-soil system, especially in those systems that present different behaviors in the fractions and contents of cadmium in the soil. For this reason, the objective of this project is to evaluate the metabolic dynamics of the root-soil system of cocoa (Theobroma cacao L.), with a view to determining possible relations between this and the cadmium fractions in rhizospheric soils in cocoa crops areas of the Department of Santander, Colombia. For this purpose, the physicochemical characteristics, fractions and cadmium content in soils will be evaluated, as well as the cadmium content in the respective plant tissues. The variations in the metabolic profiles present in the roots of cocoa plants and in the rhizospheric soils will be characterized. Likewise, the metabolic and enzymatic activity in the soils will be evaluated. Finally, the relationships between the different parameters determined will be analyzed globally, with a view to understanding the metabolic dynamics of the root-soil system. As well as, to promote spaces for feedback and collaborative work at national and international level, which allow the generation of regulations, standardization and governance around the management of soils with the presence of heavy metals, as well as the maximum limits allowed in food and soils. Special attention should be paid to countries where this problem has not yet been addressed in depth, putting public health, ecosystems and food safety at risk.

Keywords: Heavy metals,Environmental health,Food safety,Pollutants,Rhizosphere

ID ABS WEB: 140116

4. Soil health in achieving the Sustainable Development Goals
4.18 133571 - Contaminants of Emerging Concerns in Soil: Occurrence, Fate and Transport, Toxicity and Remediation

SEASONAL CHANGES IN SOIL BIOLOGICAL ACTIVITY AND FUNCTIONAL DIVERSITY IN RESPONSE TO THE PRESENCE OF SELECTED EMERGING POLLUTANTS

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There has been a systematic increase in livestock production in recent years, generating organic waste and by-products that, if not properly managed, can pose a significant threat to the soil environment. So far, animal manure has been studied mainly in terms of its fertilizing value, i.e. beneficial effects on soil properties and crop yield. However, increased and repeated application of such fertilizers, and improper management or disposal, may result in the introduction of a broad spectrum of contaminants e.g. pathogens, pesticide residues and emerging pollutants (veterinary pharmaceuticals, antibiotic resistance genes or steroid hormones). The impact of the latter substances on the soil is so far not well recognized, so research has been undertaken to assess changes in soil biological activity and functional diversity in the area of intensive livestock (i.e. poultry) production. Seasonal changes in the soil environment under poultry farming pressure were an additional factor analysed.
Soil samples were collected from the top layer of two arable fields in spring and autumn 2021 respectively. Soil microbial activity was determined by analysing enzymatic activity, respiration, microbial biomass and nitrifying activity. The diversity and the metabolic potential of the microbial community was determined using the Biolog EcoPlateTM method and the average well colour development (AWCD), richness (R), Shannon diversity (S) and evenness (E). In addition, metabolic (qCO_2) and microbial (MicQ) quotients were calculated and the contents of selected trace elements, anions and pharmaceuticals were analysed.
The EcoPlate results showed no statistically significant metabolic differences (S, R, E) between the communities studied, only differences in growth itself (AWCD). However, substantial differences were observed in phosphatases, nitrifying activity and microbial biomass, as well as in qCO_2 and MicQ quotients. In general, lower microbial activity was observed in the soil from the field with the manure pile, where excess nutrients and pharmaceutical residues (ciprofloxacin, enrofloxacin, carbamazepine and metoclopramide) were found.
This study was supported by the National Science Centre, Poland, under grant no. 2019/35/B/NZ7/04394.

Keywords: soil health,poultry farming,microbial activity,functional diversity,pharmaceuticals

ID ABS WEB: 136413

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

A SOUND INVESTIGATION OF N2O EMISSIONS FOLLOWING FERTILIZATION UNDER COMPACTED SOILS

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Soils under agricultural production are a major source of nitrous oxide (N2O) emissions primarily through denitrification and nitrification pathways. Recently, emissions appeared to be strictly related to soil structure characteristics, which may also play a substantial role in the emission pathways. Among these characteristics, the extent to which soil compaction impacts N2O emissions is still debated. To investigate this, a two-year lysimeter experiment was set up under five different cultivation systems with four replicates each: bare soil (BS), conventional (CV), conventional + cover crop (CC), conservation with shallow soil compaction (0-25 cm, CA1), and conservation with deep soil compaction (25-45 cm, CA2). Maize (2022) and grain sorghum (2023) were grown as the main crop and fertilized using solid digestate (300 kg N ha-1). In this timespan, continuous automatic measurements of N2O emissions were collected using a non-steady state through-flow chamber system and an FTIR gas analyzer, allowing to measure up to seven fluxes for each chamber per day. In this study, we focused on the intra-daily emissions in the 30 days following fertilization. The relative importance of nitrification and denitrification to the flux of N2O was hinted at by concurrently measuring the soil NOx emissions and the water-filled pore space (WFPS) and soil temperature measured in the 0-30 cm profile. Further, soil samples at 0-5 cm and 5-15 cm depths were taken in each lysimeter in the 30-day period for a total of 320 soil samples and analyzed for pH and ammonia and nitrate pool dynamics. This comprehensive approach aims to provide valuable insights into the complex relationship between soil compaction, cultivation systems, and N2O emissions in the critical period post-fertilization.

Keywords: nitrification,nitrogen pool dynamics,flux,soil compaction,emission pathways

ID ABS WEB: 136465

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

DIFFERENT TILLAGE AND FERTILIZATION AFFECT N2O EMISSION OF ARABLE SOILS

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Measuring greenhouse gas emissions of arable soils is essential to evaluate mitigating techniques in climate-smart agriculture. Anthropogenic disturbances, like tillage operations and different fertilizations, alter soil nitrogen cycle and greenhouse gas emissions like N2O effluxes in the short- and even longer term.
We measured N2O emissions by the dynamic chamber method in two different long-term field experiments on chernozem-type soils from 2019 through 2022. In the tillage experiment, we compared the soil derived emissions under the conventional mouldboard ploughing (MP) and the conservational shallow cultivation (SC) and no tillage (NT) treatments, while in the fertilizer experiment we measured on NPK fertilized and organic manured parcels. Besides N2O emission, we determined the main environmental drivers, like soil temperature (Ts), soil water content (SWC) and soil chemical parameters like soil organic carbon (SOC), total nitrogen (Ntot), ammonium-nitrogen (NH4-N), nitrate-nitrogen (NO3-N) and pH.
Based on our results from the tillage experiment, major N2O emission occured due to denitrification in the upper soil layer. The mean SWC and the nitrogen form values were the highest under NT, causing elevated N2O emission compared to SC or MP parcels. In addition, soil pH was the lowest under NT, hence it also contributed in soil biological processes and in the elevated emission. Regarding the fertilizer experiment, rather NPK fertilization than organic manure had major effect on N2O emission of soil caused by higher soil Ntot and NO3-N cotents.
The research was funded by the Sustainable Development and Technologies National Programme of the Hungarian Academy of Sciences (FFT NP FTA).

Keywords: N2O emission,tillage,fertilization,long-term field experiment,soil water content

ID ABS WEB: 137007

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

CONSEQUENCES OF TIMBER HARVESTING TECHNIQUES ON SOIL NITROUS OXIDE FLUXES OF TEMPERATE FOREST SOILS SUSCEPTIBLE TO COMPACTION

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Under natural conditions temperate forests are a sink for CO2 and methane while soil emissions of nitrous oxide (N2O) are low. Rewetting events and freeze-thaw cycles are known triggers for N2O emission. However, ground-based harvesting systems disturb soil conditions and can significantly increase soil N2O emissions. Logging causes severe soil compaction, soil displacement, and incorporation of organic matter (OM). These changes in soil optimize denitrification conditions. Incorporated OM in the soil matrix delivers carbon and nitrogen compounds, while oxygen gets limited due to reduced soil porosity and gas diffusivity. Soil disturbance is particularly strong and long-lasting in compaction-prone silty and loamy soils.
In an empirical study, we compare the effects of harvester-forwarder with and without tracks (HF/HFt) and cable-yarding with motor-manual-felling (CMM) on the microbial community (MBC), nitrogen balance, and N2O fluxes. N2O soil flux rates are measured with a trace gas analyzer (Li-Cor), either manually at the recently thinned stands, or continuously at plots that were thinned in 2016. Changes in the MBC were determined by phospholipid fatty acids and microbial biomass analysis. Supplementary soil analyses provide estimates for nitrogen availability and turnover.
Results show a significant impact the applied harvesting techniques on soil N2O fluxes of both skid trails and CCM corridors, compared to the control plots at the thinned stand. Our findings indicate that OM translocation and aggregation play a key role in the changes of soil N2O fluxes. In an irrigation experiment, CCM sections with high amounts of particular OM showed greater N2O fluxes than HFt skid trails. Areas with loose topsoil structure showed a tendency for elevated N2O emissions after rewetting. In a transect across a skid trail measured one day after precipitation, N2O fluxes were 2-fold higher in the middle mound compared to the ruts. Our findings underline that soil compaction is a central concern, but it is crucial to consider logging induced soil displacement and OM incorporation in research for sustainable management methods.

Keywords: Temperate Forests,Harvesting Techniques,N2O Fluxes,Microbial Community,Soil Disturbance

ID ABS WEB: 137604

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

ROLE OF PH AND NUTRIENT SOURCE ON THE PRODUCTION AND RELEASE OF AUCUBIN, ACTEOSIDE AND CATAPOL IN HYDROPONICALLY GROWN PLANTAGO LANCEOLATA

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Nitrous oxide (N2O) emissions contribute c. 20% of total agricultural greenhouse gas (GHG) emissions in New Zealand. The incorporation of plantain (Plantago lanceolata) in pastures has reportedly reduced N2O emissions through the production of secondary compounds inducing biologically nitrification inhibition (BNI), although the mechanisms associated to their release are still unclear. The experiment aimed to understand the role of pH (4.2, 5.6 and 6.8) and nitrogen (N) source (N-NH4+, N-NO3-) on plantain's BNI metabolites. For this, plantain and ryegrass (Lolium perenne, control) were sown in rockwool cubes and after 10 days the seedlings were transferred to a hydroponic system for a period of 45 days (30 L cubic tanks, 8 plants per tank), solution N concentration and pH were revised and adjusted weekly. An additional solution medium was used to collect root exudates. The concentration of aucubin, acteoside and catalpol in root exudates, leaf and root samples were determined by high-performance liquid chromatography (HPLC) and UV-Vis detector (leaf and root) or a mass spectrometer (root exudates), and data was analysed using SAS 9.6. All three metabolites were found in higher concentrations in plantain leaves and roots, in comparison to ryegrass ($p<0.05$). Higher concentrations of acteoside were found at pH 5.6 (0.51 ± 0.008 mg/g DM for pH 5.6 and 0.45 ± 0.013 mg/g DM for pH 4.2 and 6.8, on average, respectively; $p<0.07$), and when N-NH4+ was used as N source (0.73 ± 0.007 mg mg/g DM for NH4+ and 0.40 ± 0.03 mg mg/g DM for NO3-1 treatments, respectively; $p<0.05$), reflecting that weakly acid conditions may favour the release of this metabolite. No significant differences between treatments were found for aucubin concentrations in plant tissue ($p>0.05$), and catalpol was not detected in leaves or roots. Aucubin, catapol and acteoside were not detected in root exudates, with implications for the detection methodology.

Keywords: Nitrous oxide emissions,Plantain,BNI,Mitigation,Root exudates

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ID ABS WEB: 137638

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

MECHANISMS OF DEGRADATION AND NITROGEN ADDITION ON THE ROLE OF NITRIFYING AND DENITRIFYING MICROORGANISMS IN ALPINE SOILS

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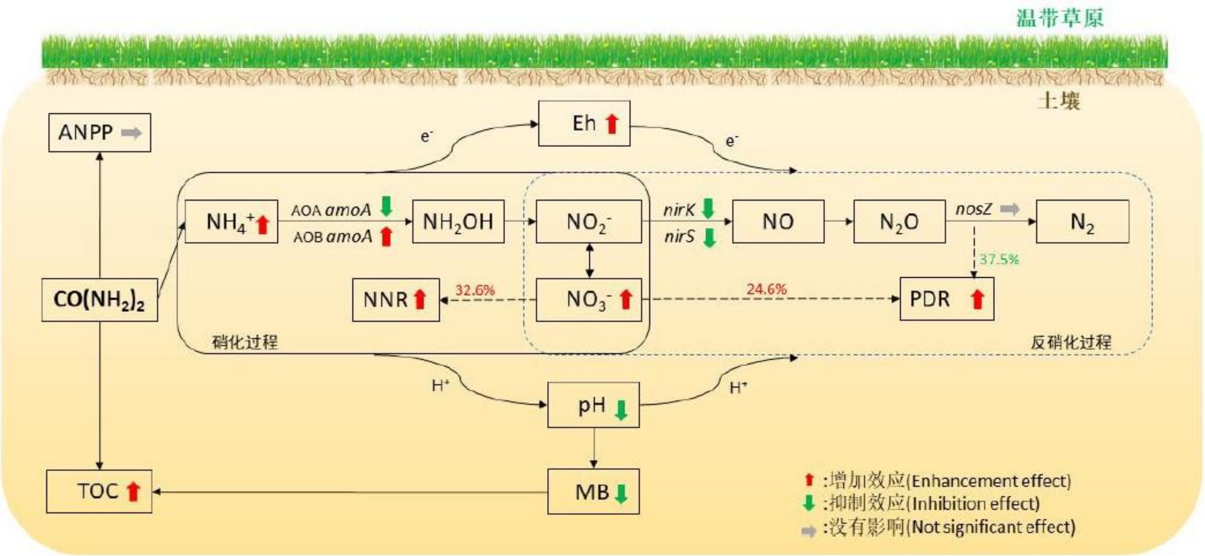
Soil enzyme activities and microbiologically regulated nitrification and denitrification processes on the Tibetan Plateau are sensitive to grassland degradation and nitrogen addition. With the aim of understanding what happened to the soil nitrification and denitrification rates under the N application gradients, we set a field experiment treated with N at 6 different rates (0, 2, 4, 8, 16, and 32 g N·m?2·yr?1) in 2014. We determined the physico-chemical properties, abundances and community structures of the nitrifiers and denitrifiers, the net nitrification rate (NNR) and the potential denitrification rate (PDR) of soil samples that were collected in 2020. In addition, we conducted a meta-analysis that collected 130 papers and 881 data sets in order to investigate the effects of different degradation levels on soil enzyme activities on the Tibetan Plateau.
Soil acidification was mainly affected by the nitrification process producing in alpine meadows. The N application could change the microorganisms that dominate the ammonia-oxidizing process from AOA to AOB. High N application decreased the nosZ gene abundance. The community compositions of AOA amoA, AOB amoA, nirS, nirK, and nosZ were not affected by the N addition, which indicates that the soil microorganisms respond to the N addition preferentially with the abundance changes rather than the community composition changes. The nitrification rate was mainly explained by the nitrifier abundance (46.3%), while the denitrification rate was mainly explained by soil environmental properties (71.1%). Significant changes in enzyme activity were observed primarily during the extreme degradation stage in the Tibetan Plateau. The results demonstrated that the NNR and PDR were mainly explained by functional genes abundances and environmental factors, respectively, in alpine meadow soil under sustained N deposition.



Keywords: Nitrification and denitrificat,Microbial community structure,Nitrogen addition,Grassland ecosystems

ID ABS WEB: 137717

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

COVER CROP SPECIES CONTROL TEMPORAL SHIFTS IN SOIL MICROBIAL COMMUNITIES AND N CYCLING

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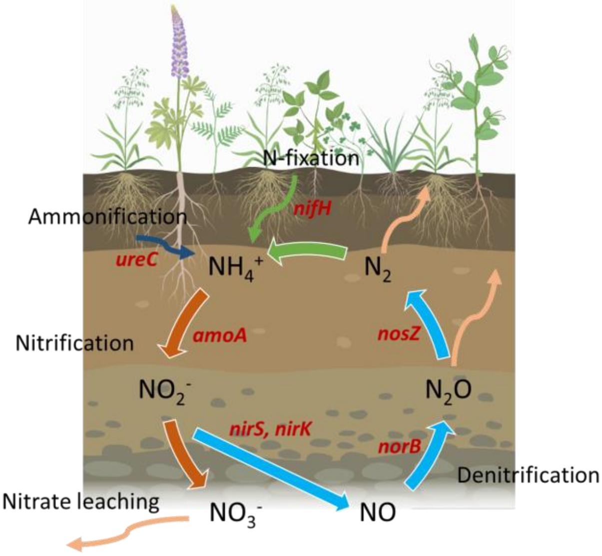
Cover crops (CC) are an essential part of sustainable nutrient management in agroecosystems. The most promising but largely unknown functions are plant controls on microbial-mediated nutrient cycles in soil and understanding this complex process can help to improve nutrient use efficiency in agroecosystems.
In long-term field experiments in Germany, we explored a very different pattern of N uptake, gaseous or leaching losses between various CC treatments. We selected the two most contrasting CCs, clover (Trifolium alexandrinum) and phacelia (Phacelia tanacetifolia), and a fallow as a control for a temporal gradient study. We investigated soil nutrients, the abundance of microbial phylogenetic markers and functional genes of the N cycle by q-PCR and composition and diversity by amplicon sequencing from bulk soil samples. Samples were taken in autumn at the peak of biomass development, after frost kill and litter decay (winter and spring), and after the germination of the following crop, maize. Clover supported significantly higher bacterial and fungal biomass than phacelia and fallow. The structure of microbial communities was significantly influenced by treatments over time. Bacterial and fungal network complexities were significantly higher in clover than in phacelia and fallow. Higher abundance of amoA genes suggests a higher potential of prokaryotic nitrification activity for clover that corresponds with higher NO3- in soil and a higher N-leaching potential compared to phacelia. Based on AOA/AOB ratio, phacelia showed a higher potential for nitrification inhibition. Both CC significantly increased the abundance of nosZ gene compared to fallow, which indicates N2O consumption in the soil and mitigation of N2O emissions.
Our results suggests that CC species have a unique fingerprint on soil microbial communities and a variable impact on their diversity, composition, network complexity and functions. Clover has a higher potential for N-fixation and mobilization but faces the risk of higher N-leaching. Phacelia has shown potential for nitrification inhibition, and both plant species reduced the nitrous oxide emission and activated a biological sink of N2O.



Keywords: cover crops,N-leaching,nitrification inhibition,N2O-emissions,soil microbial N-cycling

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COULD N2O EMISSIONS OFFSET THE C STORAGE BENEFITS OF ORGANIC SOIL AMENDMENTS IN AGRICULTURAL SOILS?

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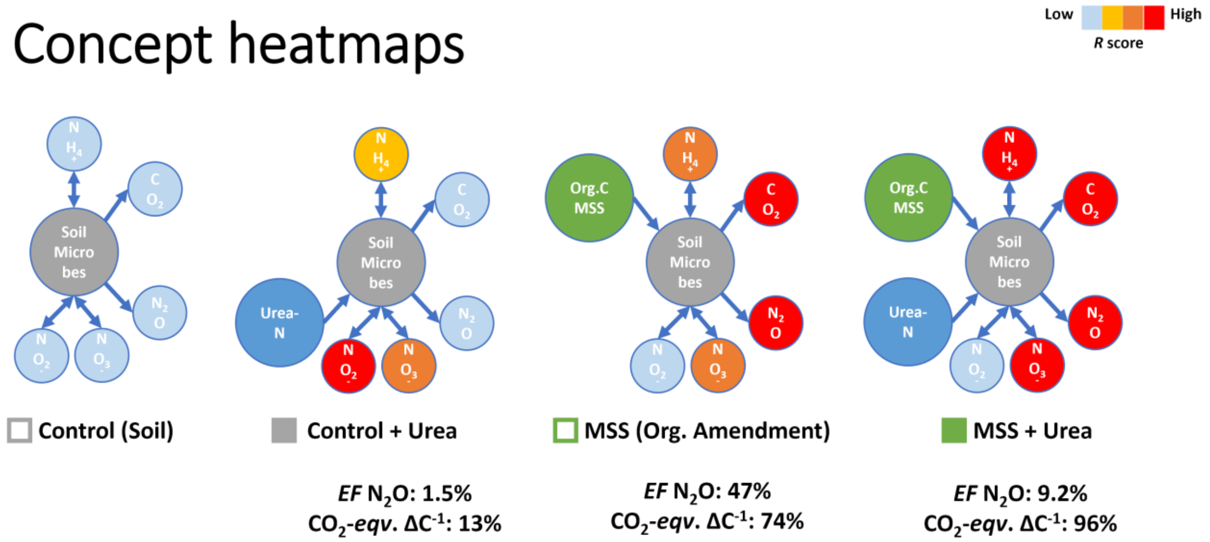
The reuse of organic waste as a soil amendment is promoted as a cost-effective solution to improve soil quality and agro-system sustainability. The effect of urban sewage sludge (with or without co-application of urea-N and biochar(BC)) on the N cycle, on the gaseous losses of soil N and C, and on the growth of selected plant species was studied. Positive effects were observed under the co-application of sewage sludge with inorganic N fertilization on soil fertility. However, the addition of readily degradable C and a gradual accumulation of NO3-, increased N2O emissions, without significant benefit to soil C storage. Co-application of urea and organic fertilization reduced the N2O emission factor by 5x compared to urban sewage sludge but remained above 1% (IPPC). The application of sewage sludge and its co-application with urea enhanced the CO2 equivalent per unit of soil C storage, by 74% and 96%, respectively, indicating the complete loss of added organic C mainly through the respiratory activity of microorganisms.



Keywords: nitrogen cycle,nitrous oxide,soil amendments,soil carbon,biochar

ID ABS WEB: 138094

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4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

COMBINATION OF TILLAGE AND FERTILIZATION INFLUENCES SOIL MICROBIAL COMMUNITY RELATED TO N2O EMISSIONS

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Reduced tillage intensity is known to increase soil organic carbon (SOC) in the topsoil. Its effect is positively related with microbial community, however conflicting results were reported regarding the impact on N2O emissions. In our study, two different tillage systems were studied in a long-term field experiment at the University of Ljubljana: no till (NT) and conventional tillage with mouldboard ploughing (CT); in combination with three different fertilization strategies: mineral fertilization (MIN), compost (ORG) and unfertilized control (CON). After 21 years, the data showed a clear increase of SOC in NT compared to CT at 0-10 cm depth (Govednik et al. 2023). Long-term mineral fertilisation increased the share of bacterial ammonia oxidisers in the total bacterial community (AOB/16S) which also coincided with the observed highest cumulative emissions in mineral fertilisation (Govednik et al. 2024 in revision). This ratio was proven to be one of the most important variables explaining cumulative N2O emissions, possibly reflecting the role of bacterial ammonia oxidisers in minerally fertilised soil (Figure 1). A higher genetic potential for N2O emissions was observed under NT than under CT, as indicated by an increased (nirK+nirS)/(nosZI+nosZII) ratio. Mentioned ratio under NT decreased in the order CON > MIN > ORG, indicating a higher N2O consumption potential in the NT-ORG treatment, which was confirmed in terms of cumulative emissions. The latter was indicated further by employing potential denitrication assay where significantly lower (N2O)/(N2O+N2) product ratio was observed in NT-ORG compared to the other treatments. Sequencing of 16S rRNA gene showed substantial differences in community composition between the two tillage systems while the impact of fertilisation remains to be further examined. Distinct patterns between different treatments were observed in terms of nosZI and nosZII metagenomic abundance and phylogenetic placement indicating an influence of long-term differential management on microbial community functional composition.

Govednik et al., Appl. Soil Ecol., 188 (2023), Article 104876, 10.1016/J.APSOIL.2023.104876
Govednik et al., Sci. Total Environ. (2024), In revision

Keywords: conservation agriculture,mineral/organic fertilization,N2O emissions,denitrification,nitrification

ID ABS WEB: 138271

4. Soil health in achieving the Sustainable Development Goals
4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

LONG-TERM CROP RESIDUE MANAGEMENT EFFECTS ON THE GREENHOUSE GAS FLUXES: AN AUSTRIAN CASE STUDY

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Most cropland soils rely on crop residues as their sole source of carbon, especially in cereal production. In the context of climate change mitigation, incorporating these residues into the soil (instead of removing them) is one popular soil management strategy to enhance the carbon input on agricultural land.
Usually, it is observed that crop residue incorporation leads to higher soil organic carbon (SOC) stocks. However, higher carbon in the soil may also modify the N2O and CH4 fluxes, since these gases are produced by microbial processes mediated by carbon availability. The effect of residue management on non-CO2 GHG fluxes has not been comprehensively assessed, what prevent us from estimating the overall effect of management strategies on the soil greenhouse gas (GHG) balance.
Here, we monitored GHG fluxes from a long-term experiment in the Marchfeld, a productive agricultural area in east Austria. In this experiment, two crop residue management strategies have been compared since 1982: removal of residues vs incorporation.
We used static manual chambers to estimate CO2, CH4 and N2O fluxes between cropland and atmosphere. In parallel, soil environmental conditions and soil nutrients were investigated. We captured flux information between 902 days with a temporal resolution of approximately 21 days between measurements. Within this period the field had a rotation of winter wheat, sorghum, and triticale.
We observed a large interannual variability in N2O fluxes, from no effect to higher emissions following incorporation of residues. Cumulative N2O emissions were enhanced by incorporating residues compared to the removal treatment. Nevertheless, this amount is relatively minor compared to the currently higher SOC stocks in the first 25 cm in the residue incorporation scenario. While our case study illustrates a trade-off scenario between GHG fluxes and SOC storage in temperate croplands, the trade-off is only a small fraction of the long-term climate mitigation benefit by incorporating residues.

Keywords: nitrous oxide,long-term field experiment,static chambers,climate change mitigation,soil C and N pools

ID ABS WEB: 140072

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4.19 133576 - Soil N2O emissions: understanding the underlying mechanisms and assessing the impact of soil management strategies

NICHE DIFFERENTIATION AND FUNCTIONAL IMPORTANCE OF AMMONIA OXIDIZERS IN AGRICULTURAL SOILS

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Ammonia oxidizers are abundant and ubiquitously distributed soil microorganisms that play an important role in the global nitrogen cycle. Despite advances in our understanding of niche differentiation and the functional importance of ammonia oxidizers over the past two decades, the recent discovery of complete ammonia oxidizers (comammox) requires novel methods to elucidate their roles and ecosystem function. Firstly, we tested the inhibitory effects of several commonly used nitrification inhibitors—acetylene, 1-octyne, 3,4-dimethylpyrazole phosphate (DMPP), 2-phenyl-4,4,5,5-tetramethylimidazoline-1-oxyl-3oxide (PTIO), and chlorate—on nitrification by ammonia-oxidizing archaea (AOA), ammonia-oxidizing bacteria (AOB) and comammox Nitrospira in two wetland soils. Secondly, we conducted a microcosm experiment to assess the functional importance of AOB, AOA, and comammox Nitrospira in nitrification and N2O emissions in agricultural soils by using the novel method previously established. Finally, we conducted 13CO2-stable isotope probing (SIP) incubation study to test the hypothesis that the competitive intensity of AOA with AOB is lineage-specific, with the greatest intensity between phylotypes within the AOA genus Nitrosocosmicus and the copiotrophic AOB. The results indicate that the combined use of acetylene, 1-octyne and DMPP is a widely applicable and effective method to distinguish the relative contribution of ammonia oxidizers to nitrification and N2O emissions in soil. The sensitivity of comammox Nitrospira clade A to 1-octyne varied across soils, highlighting that the inappropriate use of 1-octyne can lead to misestimation of comammox activity. AOA were key ammonia oxidizers in acidic and weakly alkaline agricultural soils, while AOB dominated N2O production under conditions of high inorganic ammonia input. In contrast, comammox Nitrospira always played a minor role in ammonia oxidation and N2O emissions, likely due to their low abundances, restricted cellular kinetic properties and N2O production mechanisms. Furthermore, we confirmed by using SIP incubation that the AOA phylotype susceptible to AOB competition was closely related to Nitrososphaera viennensis EN76. Taken together, this work opens research avenues for distinguishing the activity of ammonia oxidizers and is crucial for promoting sustainable nitrogen management.

Keywords: Ammonia oxidizers,Niche differentiation,Nitrous oxide emissions,Nitrification inhibitors,Nitrogen cycling

ID ABS WEB: 136490

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

DEVELOPING A ROADMAP FOR CARBON FARMING IN EUROPE

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Carbon sequestration in soils is seen as a valuable contribution to climate change mitigation. Funded by the EJP Soil, the project Road4Schemes has developed a proposal for feasible and accepted systems for carbon farming based on the current experiences in European countries. Based on stocktakes, questionnaires and workshops, the demands and needs of farmers as well as administration and research in Europe have been collected and summarized. Consequently, a roadmap for the implementation of a local, regional, or even national level has been designed. The results of the project will be presented, especially focussing on gaps in knowledge and research.

Keywords: Carbon Farming,Carbon Sequestration,Roadmap,Implementation

ID ABS WEB: 137165

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

ON-FARM ASSESSMENT OF SOIL CO2 EMISSIONS AFTER 7 YEARS OF DIFFERENT SOIL TILLAGE MANAGEMENT: PRELIMINARY RESULTS ON MAIZE (ZEA MAYS L.) CROP

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It is known that the greatest emissions of carbon dioxide (CO2) from agricultural soils are due to the frequent adoption of soil ploughing. Therefore, it is necessary to evaluate the effect of alternative soil tillage practices to "conventional" plough that allow the optimal management of carbon cycle in agricultural systems. This study aimed to verify how reduced tillage practices could represent a suitable strategy for maize cultivation to reduce soil CO2 emissions, while maintaining crop yield. A long-term experiment, established in 2017, in Ferrara (Italy) consisted in three different soil management practices: conventional tillage (CT), minimum tillage (MT) and old no tillage (ONT, 7 years), in addition new no tillage (NNT, started in 2023) has been included. All soil tillage practices were combined with the application of digestate, a soil amendment rich in nutrients used to enhance soil health. Maize was sown on March, 23rd and harvested on July, 26th 2023. Plots were replicated three times in a complete randomized blocks experimental design. The digestate has been applied on September, 28th 2022 in CT and MT before the soil tillage and on April, 28th 2023 (V6 growth stage) on NNT and ONT plots due to Regional regulation. Measurements of CO2 emissions, soil moisture and temperature were carried out using an EGM-5 portable CO2 gas analyzer and a FieldScout TDR meter, respectively at a one-week interval. Results showed that soil CO2 emissions trends were lower in MT, ONT and NNT, this improves the soil ecological service of C sink and affects the carbon balance. The reduced biomass yield observed after 7 years in ONT showed the need to improve the cropping system to maintain comparable yield to CT. Soil moisture measurements showed that MT, NNT and ONT can retain moisture better thus suggesting less need for irrigation and better resistance to drought periods and reinforcing the hypothesis that soil under conventional tillage has a lower water-holding capacity and promotes nutrients leaching.

Keywords: Soil management practices,CO2 emissions,Conservation agriculture,Carbon sequestration,No tillage

ID ABS WEB: 137232

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

GREEN MANURE APPLICATION, AS A TOOL FOR SUSTAINABLE N MANAGEMENT IN CROP ROTATIONS

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Given the increasing frequency of extreme weather conditions, the utilisation of N fertilizers is not guaranteed, and the application of reasonably adapted crop rotations is justified to maintain soil health. In our experiment, green manure crops were used in crop rotation systems, and the treatments were compared with N fertilized (80 kg ha-1) and control plots. The green manure species used in the experiments were common vetch (Vicia sativa) and oil radish (Raphanus raphanistrum var. oleiformis), and maize, triticale, and oats were used as cash crops. The experiment was set up in Hungary on humic sandy soil, in 2020 and contained four crop rotations, which allowed the evaluation of the different crop rotations in different cropyears. Precipitation had a significant effect on the biomass yield of green manure plants, which is related to the amount of CO_2 sequestered. For common vetch, dry biomass yields of 1.91, 0.28, and 0.60 t ha-1 were measured in 2020, 2021, and 2022, corresponding to an average of 2.98, 0.44, and 0.94 t CO_2 sequestered per hectare, respectively. For oil radish, the values were 3.31, 068, and 1.36 t ha-1 in the years studied, corresponding to an average of 5.16, 1.06, and 2.12 t ha-1 CO_2 sequestered, respectively. In terms of forecrop value, in favourable year (2021), both green manure treatments were more effective than fertilization in terms of yields of triticale, oats, and maize. In 2022, an exceptional drought year, green manure treatments were equivalent for oats and significantly higher for maize yield, compared to N fertilizer. In 2023, in terms of maize yield, green manure treatments continued to be equivalent to the effect of fertilization, so in terms of crop rotation efficiency, in the 4 years studied, the application of green manures replaced a total of 320 kg of N inputs, in addition to the 4.36 tonnes and 8.34 tonnes of CO_2 per hectare sequestered by green manures.

Keywords: green manure,nitrogen fertilization,biomass,yield,crop rotation

ID ABS WEB: 137364

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

EFFECTS OF 4-YEAR CONTINUOUS USE OF THE MULTIPLE INTER-TILLAGE WEEDING METHOD IN HOKKAIDO, JAPAN ON GREENHOUSE GAS BUDGET AND CARBON BUDGET

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Reducing CH_4 emission in rice paddy field is important issue in the world. Oxygen supply and plowing residues by multiple inter-tillage weeding (MIW) may effect on GHG emissions and carbon storage but there is unclear. We tested hypotheses that MIW reduces CH_4 emissions and improves carbon storage.

From 2020 to 2023, we investigated in paddy fields of Hokkaido University. We arranged 3 replicates of 4 treatments: without fertilizers and pesticides with MIW 0/2/5 times (T0/T2/T5) and CF with chemical fertilizers (340 kg N ha-1 4-year-1) and pesticides. GHGB was calculated by (Cumulative CO_2 equivalent GHG (RH (heterotrophic respiration) + CH_4 + N_2O) emissions + Coutput - NPP (net primary production) - Cinput), and NBP was calculated by (NPP + Cinput - Cumulative (RH + CH_4) emissions - Coutput). Soil temperature, redox potential (Eh), and soil physicochemical properties (NO_3^-, SO_4^{2-}, etc.) were measured. GHGs were measured by chamber methods. However, CH_4 and N_2O emissions during MIW treatments were estimated by acrylic chamber with MIW function in 2023, which were 2.31% and 2.53% of total CH_4 and N_2O emissions in T2, respectively and 6.86% and 14.6% of the total emissions in T5, respectively. Therefore, 4 years total emissions were modified by those proportions.

GHGB were T0 < T2 < CF < T5 (14.7, 17.5, 24.2, 31.2 Mg CO_2-eq ha-1 4-year-1, respectively)<Fig.1(a)>. NBP were T5 < T2 < CF < T0 (-4.73, -2.37, -1.75, -1.34 Mg C ha-1 4-year-1, respectively)<Fig.1(b)>. RH contributed 2.0 and 20 times more than CH_4 to GHGB and NBP, respectively. RH correlated with SO_4^{2-} and NO_3^-, indicating that MIW oxidized promoted RH generation. Therefore, contrary to our hypotheses MIW promoted microbial respiration and organic matter decomposition, which decreased NBP and increased GHGB. Grain yields were T0 < T2 < T5 < CF (9.56, 12.4, 13.7, 23.5 Mg ha-1, respectively). GHGI (GHGB/yield) was highest in T5 as there was not enough yield to offset GHG emissions.

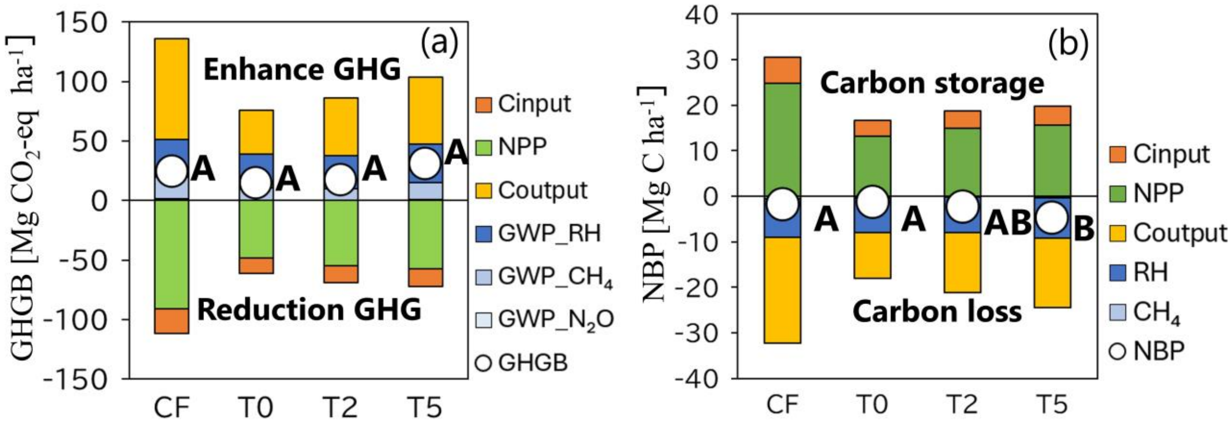

Fig.1 The results of (a) 4-year GHGB, (b) 4-year NBP.
※Error bars are standard deviations. Value with the same letters are not significantly different ($p<0.05$).

Keywords: GHG budget,Carbon budget,Tillage,Rice paddy field,Organic farming

ID ABS WEB: 137943

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

A COMPREHENSIVE ANALYSIS OF SOIL HEALTH INDICATORS IN A LONG- TERM CONSERVATION TILLAGE EXPERIMENT

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Conservation tillage (CT) is a ploughless tillage with a reduced number of operations, and its positive effect on soil functions and health is widely known. Multivariate analyses are required to choose indicators that adequately characterize the changes in soil health. However, there is little research on the comprehensive analysis of the full spectrum of soil physical, chemical, and biological properties. Therefore, we examined 21 soil parameters in a long-term CT experiment conducted in Hungary. Four pairs of similarly sized CT and conventional ploughing tillage (PT) plots were set up in 2003 on Luvisols. The soil samples were collected after 17 years. The total organic carbon (TOC) increased significantly in the 0–15 cm layer at CT sites compared to those in PT, indicating a total increase of 5.22 t per ha TOC stock. In addition, the increasing biological activity and improved soil structure were the most important processes at the CT sites. Furthermore, more complex humic substances with higher molecular weights are characteristic of water-extractable organic matter (WEOM) as a result of CT. The potentially available nitrogen, phosphorus, and potassium were also measured with a relatively high response ratio. Slowly changing parameters, such as cation exchange capacity and base saturation, are important soil physical and chemical parameters, but are not good indicators of the impact of tillage practices. Based on the principal component analysis, we suggest the use of water-extractable organic C, amino-nitrogen, water-stable aggregates, available P and K, and photometric analysis of WEOM to identify the soil-improving processes.
The authors express their cordial thanks to the National Research, Development, and Innovation Office (No. K143005) and Syngenta Hungary Ltd. for their technical and financial support.

Keywords: organic matter composition,soil biological activity,aggregate stability,carbon sequestration,reduced tillage

ID ABS WEB: 137947

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

MULTI-CRITERIA MONITORING OF SOIL C SEQUESTRATION FOR CARBON FARMING PRACTICES IN CENTRAL EUROPE

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The Central Europe Interreg Carbon Farming project is working on the introduction and adoption of carbon farming practices, business models, monitoring solutions and policies to improve the role of the agricultural sector in reducing greenhouse emissions and storing soil organic C in 9 Central Europe countries.
In this context, our aim was the study of different soil C monitoring strategies using a multi-criteria framework for the direct or indirect assessment of soil C sequestration of different C farming techniques. The monitoring strategies have been defined at different levels of complexity, so that they can be used for farmers self-assessment (visual soil assessment, VSA) and for independent audits (for 0-30 cm soil depth: C stock, enzyme activities and related Soil Quality Index, SQI).
This study was conducted on long-term field experiments (started in 1966) on Udifluventic Haplustepts, at the experimental farm of the University of Bologna (Italy); two C farming approaches were assessed: crops rotation (continuous corn, continuous wheat, wheat-corn rotation, and a nine-year rotation including wheat-corn-alfalfa rotation) and organic fertilization (manure addition, crop residues).
On average VSA, C stock and SQI values were 25±5, 42.9±13.3 Mg ha-1 and 29.0±7.7, respectively. Soil microbial biomass C (MBC) was 67.8±28.4 mg kg-1 and d13C was -23.26±1.66‰ (d13C mean value without considering the continuous corn rotation was -23.54±1.39‰, d13C-NOC). Both VSA, C stock and SQI were significantly negatively correlated to d13C-NOC (rs from -0.709 to -0.455, $p<0.05$), while VSA and C stock were positively correlated to MBC (rs=0.633 and 0.419, $p<0.05$, respectively). Our results suggest that in these soils a weak isotopic fractionation occurring during soil organic matter turnover led to improving soil quality and increase C stock. This occurred where C farming practices (i.e., nine-year rotation and manure addition) enhanced soil conditions to favour microbial biomass growth and enzyme activity efficiency.
The advantages and disadvantages of each C farming monitoring strategy were also drawn to support stakeholders in choosing the most appropriate one.

Keywords: soil C monitoring strategies,carbon farming,organic C,multi-criteria assessment,stakeholders supporting

ID ABS WEB: 138065

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

SHORT-TERM EFFECTS OF BIOCHAR AND COMPOST ON SOIL NUTRIENT CYCLING AND LETTUCE (LACTUCA SATIVA L.) YIELD IN A MEDITERRANEAN ENVIRONMENT

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Despite the use of biochar as a soil amendment has been widely studied, it is still not clear its effects on soil biochemical properties related to nutrient cycling and vegetable yield in a Mediterranean environment. To test the short-term effects of biochar, alone or in addition to compost, on soil nutrient cycling and lettuce (Lactuca sativa L.) yield, a randomized block field trial was set up within an experimental area of about 500 m2. The soil of the study area is developed from sandy and calcarenitic deposits and is classified as Calcaric Cambisols (IUSS WRB, 2022). The four treatments tested were: 1) Control (C); 2) Compost (CMP); 3) Biochar (BIO); 4) Compost-Biochar mixture (CMP+BIO). Soil sampling was performed nine months after soil amendment spreading. To evaluate the efficiency of the treatments, L. sativa was cultivated as an indicator of soil fertility. The biomass of lettuce was increased in all amended soils with respect to the control; the CMP amended soil showed the highest effect on microbial biomass activity (increase in ß-glucosidase, synthetic enzymatic index and butyrate esterase) and structure (increase in G- bacteria, total fungi and AMF), indicating that the organic matter provided by the compost is more readily mineralized than that added with the biochar. Moreover, the biochar derived from pruning wastes, resulted in the lowest metabolic quotient (qCO_2) and ecoenzymatic C:N ratio and the highest microbial quotient (qMIC), indicating the process of C immobilization into the microbial biomass and a greater limitation of N than C, offset by an increase enzyme activity involved in N-cycling. In the short-term, even if the number of well-developed plants increased in all amended soils, an unbalance of soil C and N cycling was evident with CMP and BIO amendments which was not re-equilibrated in CMP+ BIO, probably because requiring longer period. For this reason, long-term field experiments are needed for further investigations on the effect of biochar soil amendment on nutrient cycling.

Keywords: soil amendment,soil biochemical properties,soil C and N cycling,crop yield,physiological performance

ID ABS WEB: 138095

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

ASSESSING BIOCHAR FROM OLIVE PRUNINGS FOR LONG TERM SOIL RECARBONIZATION IN SPANISH OLIVE ORCHARDS: A SOIL C MODELLING APPROACH.

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The utilization of biochar derived from olive prunings presents a sustainable way for enhancing soil organic C stocks in olive orchards. This study investigates the feasibility of using biochar from olive pruning residues for recarbonising agricultural soils from olive orchards in Spain as a strategy to mitigate the impact of the whole oleiculture sector to climate change. Soil recarbonisation will be investigated by the adoption of biochar production and soil application as a negative emission technology (NET), aimed at the net removal of atmospheric CO2. As a first step, this study estimates the olive pruning residue generation in Spain to provide context for the potential impact of integrating biochar into soil management practices. Subsequently, the Roth-C model modified for amended soil is employed to project the long-term impact of incorporating biochar at two different application rates on soil organic C stocks. Preliminary results suggest that adding biochar derived from olive pruning residues has the potential to significantly augment soil organic C content in the long term. The integration of biochar into soil management practices represents a promising strategy for sustainable agriculture, with implications for mitigating the environmental impact of olive cultivation.

Keywords: Soil C sequestration,Agricultural residues,Climate-smart agricultural use,Oliviculture

ID ABS WEB: 138168

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

EFFECT OF MYCORRHIZA INOCULATION DEPENDING ON FERTILIZATION LEVEL AND SOIL TYPE AT A CENTRAL EUROPEAN FIELD TRIAL

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Due to the greater pressure on soil resources and climate worldwide, in recent years, there has been a significant increase in the use of microbial inoculants, which are expected to help reduce fertilizer demand and mobilize the potential nutrients in soils. This research presents the results of a 4-year field trial that investigated how mycorrhiza inoculants (Funneliformis, Claroideoglomus, Rhizophagus) affected soil biological indicators and corn and wheat development depending on fertilization level and soil types. The experiment was conducted on siltic Luvisols (pH=4.91; SOC=0.94%; available P=29 ppm) and silty clay Gleysols (pH=6.75; SOC=1.45%; available P=133 ppm). Conventional fertilizer levels (NPK) in the first three years and a significantly reduced fertilizer application in the fourth year were applied combined with inoculation. The root colonization of mycorrhiza, the phosphatase enzymes of soils, shoot biomass, plant height, grain yield, root neck diameter, chlorophyll, and root capacity were measured. During the four years, precipitation amount had the greatest influence on grain yield and plant development parameters, and conventional fertilizer use increased the grain yield and shoot biomass by 25% compared to reduced fertilizer use. The mycorrhiza treatment led to higher root colonization every year compared to the control but higher biomass, height, and yield differences were found only with a strong decrease of fertilizer use on the poor nutrient content Luvisols. Despite the reduction in fertilization, the root colonization did not increase, which may have been due to improved soil nutrient availability in the wetter year, so plants were not as dependent on the mycorrhiza as in drier years. The soil organic matter was decisive in the plant development because the higher easily accessible organic substrate and microbiological activity on Gleysols contributed to higher yields and reduced the effect of fertilizers and mycorrhizal inoculation. We found that, at a reduced fertilization level, using mycorrhiza inoculation in these fields was not economically profitable because it only partially replaced the yield-increasing effect of fertilizers.

Keywords: mycorrhiza,soil types,fertilizer input,soil biology,field trial

ID ABS WEB: 138225

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

AGREENA AS A TOOL TO SUPPORT SCALING CARBON FARMING IN EUROPE – TOOLS AND METHODS FOR SOIL ORGANIC CARBON QUANTIFICATION AND VERIFICATION

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Carbon farming plays a key role in climate change mitigation and promote sustainable production of food feed and fiber. Adoption of practices such as the use of cover crops, crop rotation, no-till farming, and the addition organic matter to the soil such as crop residues, may require time and significant resources to establish a successful production and are therefore overlooked at scale. The carbon credit market can prove an important tool to support farmers transition to carbon farming. Agreena is a carbon program project developer with the aim to support farmers make this transition. Our work presents the opportunities raised by the carbon markets to lead a large-scale transformation of the agricultural landscape to climate friendly solutions in Europe, by giving farmers an economic incentive to adopt carbon farming practices and increase biomass input to their soils. We showcase the tools and data used to deliver a scalable and scientifically sound methodology of soil organic carbon modelling and verification processes. We further delve in the methods for verification and quality control of all data and result outputs for the valorization of the different carbon practices implemented in individual fields.

Keywords: carbon farming,soil organic carbon modeling,carbon market

ID ABS WEB: 140058

4. Soil health in achieving the Sustainable Development Goals
4.20 133577 - Sustainable soil management and agronomic practices for carbon farming: challenges and opportunities

RESPONSE OF QUALITY INDICATORS AND SUSTAINABLE SOIL MANAGEMENT TO THE APPLICATION OF ECOLOGICAL AGRICULTURE TECHNIQUES IN COFFEE FARMERS UNDER DIFFERENT ENVIRONMENTAL CONTEXTS IN COLOMBIA

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With the objective of evaluating the response of soil quality indicators in the sustainable management and application of ecological farming techniques in coffee crops in Colombia, the following three processes were carried out: 1. Application of ecological farming techniques in coffee plantations under different coverings (banana, mandarin, and a mix of citrus fruits) in San José de Pare. 2. Application of the same techniques on soil characteristics in coffee plantations of varying ages (zero, two, and four years) in San Francisco. 3. Evaluation of the quality of the soil associated with the use of mycorrhizae in coffee plantations in Sasaima. In the three cases, physicochemical parameters of the soil, enzymatic activities of the biogeochemical cycles of carbon, nitrogen and phosphorus and abundance of functional groups associated with the same cycles were determined. Additionally, in the last two processes, microorganisms associated with the nitrogen cycle (ammonifying, proteolytic, ammonium oxidizing, nitrite oxidizing and denitrifying) were evaluated. In the first two processes the results showed modifications in the soil quality indicators as a consequence of the application of ecological agriculture techniques. In the three-process finding a significant increase in the content of carbon and phosphorus. In the first process finding a significant increase phosphate solubilizing bacteria and fungi, and cellulolytic fungi. In contrast, no significant changes were observed for enzymatic activity. For the second increased abundance of phosphate solubilizing fungi and cellulolytic fungi were found. Conversely, significant decreases in pH and b-glucosidase enzyme activity were observed. However, no statistically significant changes were found in the abundance of microorganisms in the nitrogen cycle. For the third process, the mycorrhizae inoculation significantly increased of nitrogen-fixing bacteria, phosphate-solubilizing bacteria, cellulolytic bacteria, and phosphate-solubilizing fungi. In addition, the local native mycorrhizae that were isolated by the authors showed greater benefits than those of the commercial mycorrhizae. However, the abundance of the functional groups of the nitrogen cycle did not present significant differences.

Keywords: Ecological agriculture,Agroecology,Soil quality indicators,Soil microorganisms,Soil enzyme activities

ID ABS WEB: 137319

4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

TECHNOLOGICAL INNOVATION AND RESISTANCE IN CREDIBLE CARBON FARMING

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Over the last decade, there has been a rapid development in new sensor and digital technologies, including, for example, innovations in proximal sensing and digital mapping. In terms of Carbon Farming, these developments bring both opportunities and challenges. One of the greatest challenges now is to efficiently incorporate and connect diverse new technologies into monitoring, reporting, and verification (MRV) systems required for the EU-level Carbon Farming certification scheme.

Within Credible Action, an EU-funded initiative focused on Carbon Farming, we - as one of the action's focus groups - work towards characterizing the current extent, interconnectedness, and possible future roles of innovative digital technologies in Carbon Farming. The focus group has a wide scope covering - but not limited to - proximal sensing, digital mapping, artificial intelligence, and farmers' perspective. We gather facts, perspectives, and opinions concerning what new technologies should be implemented across Europe and why, we investigate how the implementation of these technologies should be carried out, and what the constraints are that keep land (farms, forests, peatlands) users away from implementing the innovations.

Understanding this land users' perspective is our key aim, as we believe listening to the end-users' needs, ambitions, and worries is the best way to introduce and effectively maintain good Carbon Farming practices across Europe. Here I will present our recent survey of emerging technologies - digital tools and proximal sensing methods - together with their possible limitations. Then I will discuss the need for crystallization of the current and future role of innovative technologies in MRV systems. Lastly, I will discuss current and future barriers to their adoption, or technological resistance, suggesting a path forward.

Keywords: carbon farming,certification,proximal sensing,digitalization,technological resistance

ID ABS WEB: 137652

4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

APPLICATION OF ROTHAMSTED CARBON MODEL INTEGRATED GIS ON SOIL ORGANIC CARBON TURNOVER OF REGIONAL CROPLAND IN NORTH CHINA PLAIN

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Rothamsted carbon model is a model for the turnover of organic carbon in non-waterlogged top soils that allows for the effects of soil type, temperature, moisture content and plant cover on the turnover process. Since RothC model has been validated in cropland experiments in the NCP, this study develops a regional version of RothC model using ArcGIS ArcObjects for model application in this area. The regional model is tested by simulating soil organic carbon dynamics of the intensive winter wheat-summer maize cropland under different organic manure and stubble management practices in the Baiyangdian Basin of the North China Plain. RothC model has four active and one inert SOC compartments or pools: Decomposable Plant Material (DPM), Resistant Plant Material (RPM), Microbial Biomass (BIO), Humified Organic Matter (HUM) and the Inert Organic Matter (IOM). Variability of SOC and four components defined by RothC model in cropland of seventeen plain counties in the Basin in a short period of two years are calculated by a step of month. Range of increase of SOC in depth of 30 cm is 3.15-4.49 t C ha-1 in six counties, 2.11-2.44 t C ha-1 in three counties, 1.14-2.1 t C ha-1 in two counties, 0.8-1.13 t C ha-1 in three counties and 0.53-0.79 t C ha-1 in three counties, respectively, with the application of wheat and maize straw. Ranges of differences of DPM C, RPM C, BIO C, HUM C of cropland soil among above counties caused by application of straw are 0.14-0.70 C ha-1, 0.28-1.13 C ha-1, 0.04-0.27 C ha-1 and 0.04-0.12 C ha-1 respectively. Considering the performance of the regional model in calculating spatial and temporal variability of SOC, this regional could be used to evaluate the turnover of soil organic carbon on regional cropland under different field managements of promoting carbon sequestration.

Keywords: Soil organic matter,Soil C models,RothC model,GIS,North China Plain

ID ABS WEB: 137811

4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

IMPACT OF ORGANIC MANAGEMENT SYSTEM ON SOIL CARBON SEQUESTRATION IN THE CENTRAL REGION OF ITALY

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The Mediterranean area, particularly Italy, is a European biodiversity hotspot with diverse ecosystems facing climate change impacts. Agriculture, vital for food security, significantly contributes to greenhouse gas (GHG) emissions, often relying on harmful inputs like excessive synthetic chemical fertilizers and pesticides. Sustainable techniques, such as carbon (C) farming practices, are critical not only for mitigating climate change but also for improving soil health and nutrient availability while establishing a favourable environment for soil organisms by controlling soil organic C (SOC) levels. Thus, this study aims to investigate the quantity of C in the bulk mineral soil and its distribution in fractions with different stability (e.g., labile vs. recalcitrant) in three agricultural farms from different regions of Central Italy where conventional and organic management systems were compared. Furthermore, the study also develops a better understanding of the impact of organic management systems on storing C and possibly retaining it for a longer period of time than conventional systems. At each sampling site, five mineral soil samples were collected at the depths of 0-15 and 15-30 cm, to determine the total SOC stock. Additionally, the distribution of SOC in labile and recalcitrant fractions was evaluated using an acid-alkali extraction method. The results showed a dynamic response, where organically managed soils at both depths had significantly higher levels organic C compared to conventionally managed soils, but the distribution of C in labile and recalcitrant fractions does not reveal any clear trend that can be related the stability of the C in the soil system. This study is suggestive that organic management systems enhance soil C sequestration, but it is still unclear the impact of this management system on the long-term permanence of the C that leads to a decline in GHG emissions. Additional research is essential to finally evaluate the permanence of C in the soil system in relation to organic management.

Keywords: Carbon farming,Labile carbon,Organic management,Recalcitrant carbon,Soil organic carbon

ID ABS WEB: 138030

4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

IMPACT OF REDUCED TILLAGE ON SOIL C AND N POOLS AND MICROBIAL FUNCTIONAL DIVERSITY UNDER ORGANIC MANAGEMENT IN A MEDITERRANEAN ENVIRONMENT

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The conventional agricultural system, based on soil inversion tillage, is a weak system in terms of its environmental impact and low biodiversity, compared to the organic system, defined as a sustainable system that allows to enhance the soil fertility and quality and use of environment-friendly techniques such as cover cropping. The aim of this study was to assess the impact of conventional and organic agricultural systems on C and N stocks and soil quality after 14-year long-term experiment in a Mediterranean environment by focusing on C and N pools and soil quality bioindicators such as microbial biomass size and activity. For this objective, a long-term experiment (LTE) located at University of Tuscia experimental farm (Viterbo, Italy) was established in 2001 with the objective to study conventional (CONV) vs. organic (ORG) systems and ploughed (30 cm, CT) vs. reduced tillage (RT). A 3-year crop rotation [pea, durum wheat and tomato] was established in both cropping systems and replicated as a randomized block design. Soil samples were collected at two soil depths (0-15 cm and 15-30 cm). Over 14 years of management, the ORG-RT management showed an increase of 25% (+3.75 Mg C ha-1) of C stock with respect to the CONV-CT management. The soil microbial biomass and the microbial quotient were positively influenced by the ORG system, probably due to the cover crop incorporation as green manure. The sum of enzyme activity involved in the C-cycle (SEI-C) at both soil depths, showed the greatest values under ORG-RT system. Moreover, the C-cycle specific enzyme activity was influenced by tillage at 0-15 cm (RT>CT). Enzyme activities reflected the effect of system management (per unit of soil) while the tillage effect was registered only for the specific enzyme activity (per unit of organic carbon). The management system was also marked at 15-30 cm soil depth in terms of SEI-C and Phosphatase activities. LTE is an efficient tool in assessing the agricultural management sustainability.

Keywords: Soil quality,Organic management,Reduced tillage,Carbon farming,Soil organic matter

ID ABS WEB: 138068

4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

IMPACT OF COPPICE CONVERSION TO HIGH FOREST ON CLIMATE CHANGE MITIGATION. A CASE STUDY FROM BROADLEAVES FORESTS IN CENTRAL ITALY

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Under the threat of climate change for terrestrial ecosystems and the society, carbon (C) sequestration represents one of the key ecosystem services provided by forests. The capacity of forests to store additional amount of C is limited by the current increase in the demand for wood products by the increasing global population, which represents a further pressure on forest ecosystems. In this work we evaluated the mitigation potential, offered by the conversion from coppice to high forest stands, of the C at an ecosystem level but focusing on the contribution of the C stored in the top 30 cm of mineral soil. In this purpose, apart from the SOC stock, we applied an acid-alkali extraction methodology to investigate the distribution of the SOC fractions with a possible different stability (e.g., labile vs. recalcitrant). Two different forest typologies, located in the central Italian Apennine, were considered: a) beech stands (Fagus sylvatica) and b) mixed broadleaves (e.g. Ostrya carpinifolia and Fraxinus ornus). Results indicated an increase of C stored in the living biomass for beech stands two decades from the conversion and promising results regarding mixed broadleaves stands. No significant changes were observed in the SOC stock before and after almost two decades from the intervention, suggesting a minor effect of the conversion cut. The fractionation results showed a dynamic response revealing a fluctuation of C in the labile and recalcitrant organic fractions between the forest types. The variation of C measured in this study suggests that, although the amount of C stored in a forest ecosystem can increase after sustainable practices application, these variations are distributed amongst C pools with different turnover time. In conclusion, in the investigated area this type of forest intervention lead to an increase of C at an ecosystem level and seems promising for the delivery of additional ecosystem services.

Keywords: Climate change,Coppice,Forest,Mitigation,Soil organic carbon

ID ABS WEB: 138151

4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

THE SOIL CARBON STOCK UNDER NO-TILL FARMING IN RUSSIAN FOREST-STEPPE REGION

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A useful tool for climate change mitigation is the ability of soil to store organic carbon (SOC). Agricultural soils with conservation agriculture technologies have a high capacity to store SOC. One of these technologies is no-tillage. The capacity of Chernozems in SOC storage under no-tillage was tested in cooperation with the agricultural enterprise Orlovka - AIC (54.181°N, 50.322°E, Samara region, Russia), which has been using this technology for the last 12 years. Two agricultural fields were selected on the farm: no-tillage for 5 and 8 years (88 and 161 ha, respectively). The neighboring field (42 ha) under conventional tillage – ploughing was selected for comparison. In each field, 30 sites were selected for soil sampling from the topsoil (0-10 cm) and subsoil (10-30 cm). We have used model-based sampling design i.e. conditioned Latin Hypercube sampling with a range of morphometric predictors.
Compared to conventional tillage, a significant increase of SOC stocks was found in the topsoil under no-tillage during 5 and 8 years (on average by 0.57 and 0.45 kg/m^2, respectively), while for the subsoil a significant difference between treatments wasn't observed. In general, SOC stocks in the upper 30 cm layer increased by 0.61 and 0.34 kg/m^2. Consequently, the SOC accumulation rate under no-tillage could reach up to 0.43-1.22 t C/(ha*yr). However, the proposed assessment approach could lead to an overestimation of the SOC accumulation rate as it is based on comparative data analysis with conventional tillage. In this context, SOC stock dynamics under no-tillage were modelled from 2017 to 2022 using DNDC (DeNitrification-DeComposition model). The model showed that the SOC accumulation rate under no-tillage could range from 0.02 to 1.07 t C/(ha*yr) depending on the climatic conditions of the year and the type of crop. Thus, no-tillage could be a useful tool for conserving SOC stocks in a studied region.
The study was carried out within the framework of the state assignment No. 122111000095–8.

Keywords: Conservation agriculture,SOC accumulation rate,DNDC,Chernozems

ID ABS WEB: 138187

4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

COMPOST IN AGRICULTURE AS A CARBON FARMING PRACTICE: EVALUATION OF TUSCANY AGRICULTURAL SUPPLY CHAINS

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This study evaluates the impact of adopting municipal solid waste (MSW) compost as a carbon farming practice in agricultural supply chains (olive oil, wine, cereals/oilseeds and vegetables).
The MSW compost, derived from the municipal organic fraction of waste collected from the city of Florence (Tuscany, Italy), has been applied to typical crops of the Tuscany Region (olive tree, wine vine, sunflower and cardoon for the first year of research activity).
For each crop, one plot (about 1 ha) has been subjected to different treatments in three different farms: conventional fertilizer as usually applied by the farm (control), MSW-compost, and MSW-compost mixed with commercial bio-stimulants.
A three-year multidisciplinary monitoring plan (2023-2026) was planned to evaluate soil health, the physiological and functional state of the crops, and greenhouse gas (GHG) emissions from the soil.
Particular attention will be given to the potential carbon sequestration in soil by evaluating particulate and mineral-associated organic matter, and to the evaluation of eco-enzyme stoichiometry ratios.
After one year of monitoring, preliminary results demonstrated that the crops responded well to the compost treatments, with an excellent eco-physiological status, and that soil organic carbon and nitrogen stocks significantly increased.
Furthermore, the Life Cycle Assessment will identify the advantages and hotspots in each supply chain in relation to the fertilisation system.

Keywords: MSW compost,carbon sequestration,soil health,agriculture

ID ABS WEB: 138283

4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

RESTORING DEGRADED CROPLAND WITH AMP CATTLE GRAZING: A FOCUS ON SOIL CARBON FRACTIONS

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Today’s worsening climate crisis and increasing global demand for food makes agricultural sustainability an urgent priority. Employing ecological principles to manage farms as agroecosystems can help produce food more sustainably. In particular, Adaptive Multi-Paddock (AMP) cattle grazing, characterized by short grazing intervals and strategic rest periods, has emerged as a key agroecological practice that can help achieve sustainable development goals by building soil organic carbon (SOC). However, existing studies on AMP grazing often overlook the distinction between soil carbon fractions, such as minerally associated organic matter (MAOM) and particulate organic matter (POM), which play different functional roles in soil. This gap in knowledge hinders a comprehensive understanding of the practice's implications for climate change mitigation alongside other ecosystem services. To address this gap, we asked: 1) how do transitions from row crop production to AMP grazing affect the potential for soil C sequestration? And 2) how does AMP grazing influence C accrual in POM and MAOM fractions of SOM? We collected and analyzed soil samples from ten fields in Southeast Michigan USA to compare conventional corn/soybean rotations with forage-seeded fields subjected to five years of AMP cattle grazing. Topsoils (0-15 cm) in AMP-grazed pastures contained 13% higher total organic carbon compared to row crop fields. On average, AMP pastures had significantly more MAOM-C (24.15 g C / kg dry soil compared to 22.1 g C / kg dry soil in row crop fields). Notably, grazed pastures had a 15.1% higher concentration of POM-C, and 2.8-fold higher microbial biomass (measured with PLFA) than row cropped fields. Microbial turnover of POM is a known mechanism of MAOM accrual; our results thus suggest the potential for longer-term C sequestration with AMP grazing. Building on these findings, we are establishing a new, on-farm experiment to evaluate whether AMP grazing of overwintering cover crops within row crop rotations can produce similar benefits for building stable SOC fractions that could support climate change mitigation goals.

Keywords: Agricultural soils,Grazing,Carbon sequestration,Soil Management practices,Soil carbon fractions

ID ABS WEB: 138780

4. Soil health in achieving the Sustainable Development Goals
4.21 133578 - Soil carbon farming practices in the agriculture and forestry sectors

INCREASING MINERAL AND PARTICULATE ORGANIC CARBON ACROSS A GRADIENT OF REGENERATIVE MANAGEMENT

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Increasing soil organic matter and soil health has been a long standing goal of regenerative and agroecological farming methods. Practices like cover cropping and organic amendments are recognized for their potential to increase soil organic carbon and produce many co-benefits including increased water and nutrient retention. However, the capacity for carbon storage in soils varies greatly depending on local edaphic and climatic conditions, and the form of the soil carbon itself. A substantial body of research has investigated how so-called 'soil health' or 'regenerative' management affects soil carbon, often conducted at research station-based trials. While such controlled trials are essential, how multiple management strategies interact with inherent soil conditions to modify carbon fractions, mineral versus particulate, is less resolved. This gap is a critical area needed to better understand how farmers can best manage their lands for soil health and climate mitigation.

Using soil samples from 28 organic fields in the California Central Coast alongside detailed management and soil biological data, we assess how the variable adoption of soil health practices (crop rotation and diversity, cover cropping, reduced tillage, and organic amendments) influence the soil carbon fractions on lettuce farms spanning a range of edaphic conditions in our focal region. Additionally, we hone in on what practices have a particularly strong influence on the carbon stored in mineral versus particulate fractions. We demonstrate that cover cropping, continuous plant cover, and reduced disturbance may be important in driving carbon stored in both particulate and mineral fractions, while crop diversity enhances particulate organic matter.

Despite the increasing focus on microbial contributions to the mineral fraction, we find that our metrics of soil biology do not influence mineral-associated organic carbon, indicating that non-biological processes may also be crucial for increasing mineral-associated carbon.

Keywords: Soil Health Management,Soil Organic Carbon,Mineral-associated OM,Cover Cropping

ID ABS WEB: 136761

4. Soil health in achieving the Sustainable Development Goals
4.22 133580 - Sustainable grassland management for healthy soils and vice versa

INFLUENCE OF SOIL ACIDITY AND EXCHANGEABLE AL ON THE GROWTH OF TWO FORAGE LEGUMES: LOTUS PEDUNCULATUS AND LUPINUS POLYPHYLLUS

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Soil acidity and associated Al toxicity limit the growth of forage legumes in high country grasslands of New Zealand (NZ). Forage legume species that tolerate soil acidity and Al toxicity can support sustainable grassland production through increased yields and N fixation. Two species, Lotus pedunculatus (Lotus) and Lupinus polyphyllus (Lupin), have persisted in low-pH soils at agronomic trial sites and commercial farms across the NZ high country. Our objective was to examine how these species respond to soil acidity and exchangeable Al.

At Lincoln University, NZ, Lotus and Lupin were sown in 20-cm tall, 1.2 L pots of acidic high country soil to which was added 0.1 g P/L, 0.9 g S/L, 0.4 g K/L, and either 4.5 or 6.7 g lime/L in either the full pot, top half (0-9 cm), or bottom half (9-18 cm), across six randomised blocks in a glasshouse. Soil pH was 4.4, 4.9 and 5.4 and Al was 24, 2.5 and 1.5 mg/kg for 0, 4.5 and 6.7 g lime/L. Plants were thinned to one/pot, inoculated with fresh, ground nodules for Lotus and Lupin, and watered to field capacity until harvest on 10-15 May 2023, 16 weeks after sowing. Plants were divided into shoots, roots at 0-9 and 9-18 cm, dried at 65°C for 2 days, then weighed. All plants were nodulated at harvest.

Total plant dry weight (DW) and shoot to root DW ratio were higher and shoot %N was lower for Lotus than Lupin across lime rates and depths (13.2 vs. 2.9 g/plant, 5.3 vs. 1.6 and 2.4 vs. 3.3%, $p<0.001$). For both legumes, root DW was greater in the 0-9 cm than 9-18 cm horizon across lime rates (1.3 vs. 0.3 g/plant, $p<0.001$). None of these variables were affected by lime rate.

The results indicated that both Lotus and Lupin are tolerant to soil acidity (pH 4.4-5.4) and associated Al toxicity (1.5-24 mg/kg), highlighting their potential for grasslands with acid soils.

Keywords: Grasslands,Aluminium toxicity,Acidic soil,Legumes

ID ABS WEB: 136963

4. Soil health in achieving the Sustainable Development Goals
4.22 133580 - Sustainable grassland management for healthy soils and vice versa

SUSTAINABLE FERTILIZATION: THE POTENTIAL OF ROCKING AS A NUTRITIONAL ALTERNATIVE IN BRACHIARIA CROPS

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Agriculture is renewed every decade, thus prioritizing the preservation of soil quality, without harming its characteristics. Rocking, a technique of adding rock dust, is used to improve soil fertility in a sustainable way by releasing nutrients gradually. The aim of this study was to evaluate a sustainable approach in the planting of traditional forage in Brazil (Brachiaria decumbens), using rocking in order to reduce the use of chemical fertilizers. The experiment was carried out in a greenhouse at the School of Agronomy of the Federal University of Goiás (UFG), using an Oxisol with a clayey texture. Two products were used: K6 (biotite rock - 5.89% of K_2O) and HVB-K (mica schist rock - 3.47% of K_2O), both registered by the Brazilian Ministry of Agriculture. In addition to the soluble chemical, potassium chloride (KCl) as a reference. A completely randomized design was used, with three replications for each treatment. Treatments consisted of T0 (control), T1 (50% K6 dose), T2 (100% K6 dose), T3 (200% K6 dose), T4 (50% HVB-K dose), T5 (100% HVB-K dose), T6 (200% HVB-K dose), T7 (100% KCl dose). The equations were considered significant at 5% probability by the F test. The green mass result was observed significant differences indicated by the F test (7.19), with a coefficient of variation (CV) of 15.14%. At 100% dosages, T5 (HVB-K) stood out by reaching an average of 209.300 kg ha-1, surpassing T2 (K6) which recorded 182.600 kg ha-1. In the dry mass analysis, there were significant differences indicated by the F test (4.00), with a CV of 20.28%, and the T5 and T2 treatments showed statistical similarity. It was found that the HVB-K presented superior performance compared to the K6 product. Despite its higher concentration of K_2O, K6 did not guarantee efficiency in increasing Brachiaria biomass. However, both products contribute to the sustainable promotion of local agriculture.

Keywords: Rocking,Sustainable agriculture,Potassium

ID ABS WEB: 137313

4. Soil health in achieving the Sustainable Development Goals
4.22 133580 - Sustainable grassland management for healthy soils and vice versa

EFFECT OF LITTER AND SOIL ORGANIC MATTER CHEMISTRY ON SOIL C, N DYNAMICS OF ALPINE GRASSLAND ECOSYSTEM IN THE QINGHAI-TIBETAN PLATEAU

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Plant litter and soil organic matter can influence many fundamental ecosystem functions during decomposition. However, the mechanism of litter and soil organic matter chemistry effects on belowground ecological processes remains unclear, especially with regard to soil C and the N cycle in alpine ecosystems. Here we employed a combination of field survey sampling and incubation experiment to examine the influence of litter chemical diversity and soil organic matter chemical compositions on soil carbon and nitrogen transformation dynamics and greenhouse gas emissions of alpine grassland ecosystem in the Qinghai-Tibetan Plateau. Litter mixing frequently had non-additive effects on litter decomposition which showed more antagonistic effects than synergistic effects, especially in the very early stage of decomposition. Litter chemical traits and climatic factors affected the direction and magnitude of the non-additive effects. Litter treatments significantly enhanced CO2 and N2O emissions and decreased CH4 immobilization in general; soil organic C, total N, water soluble organic C, water soluble organic N, microbial biomass C, microbial biomass N, and urease activity were also enhanced, while soil total inorganic N was decreased by litter treatments. We calculated six chemical diversity indices, and found litter chemical diversity correlated with the strength of litter mixing effect on soil C and N and the incubation time is also an important factor in understanding the litter-mixing effects. Soil organic matter of five types of alpine grassland ecosystems at the molecular level was dominated by N-compounds (~32.47–51.76%), polysaccharides (~10.67–20.42%), and fatty acids (~7.03–20.33%) in the different alpine grasslands. The most abundant compounds in Soil organic matter were D-alanine (10.06–20.77%), 9-octadecenamide, (Z) (4.43–9.68%), and 13-docosenamide (1.52–14.76%) based on pyrolysis gas chromatography/mass spectrometry (Py-GC/MS). Correlation analysis showed that the N-compound abundance was negatively correlated with nitrate reductase. Polysaccharides were positively correlated with activity levels of invertase and cellulase. Fatty acids were positively correlated with polyphenol oxidase activity and negatively correlated with alkaline phosphatase activity.

Keywords: Litter chemistry,Soil organic matter chemistry,Alpine grassland ecosystem,Soil C, N dynamics,Soil greenhouse gas emissions

ID ABS WEB: 137693

4. Soil health in achieving the Sustainable Development Goals
4.22 133580 - Sustainable grassland management for healthy soils and vice versa

EVALUATING EFFECT OF PHYSICAL AND CHEMICAL CONTROL METHODS OF PTERIDIUM AQUILINUM (BRACKEN FERN) ON SOIL CHEMISTRY ON MT MULANJE AND NYIKA PLATEAU

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Mountain soils play a crucial role in mitigating climate change through carbon sequestration, regulation of water and carbon cycles. However, they are susceptible to invasive plants, particularly bracken fern (Pteridium aquilinum), which have impacts on ecosystem processes and soil communities, causing economic consequences and altering biodiversity. P. aquilinum is considered a worldwide invasive. In Malawi, P. aquilinum is found on Mt Mulanje and Nyika Plateau. There is currently limited understanding of how current control methods alter soil properties. This study aimed to evaluate the effects of physical and chemical control methods of P. aquilinum on soil chemistry on Mt Mulanje and Nyika Plateau. The four years study, investigated how chemical control treatments such as Forester, Eco-Imazypyr, & Lime application, and physical control methods including Mowing, and slashing/cutting can affect soil pH, SOC, exchangeable Ca & Mg, available P, total N and C:N ratio in the invaded areas dominated by P. aquilinum.
Two experimental plots were established at each site, and treatments were randomly assigned to plots. At least five soil samples were randomly collected before and after treatments from each quadrant at a depth of 0.15m for analysis in which selected chemical properties were determined. Soil data was subjected to statistical analysis (one way ANOVA) using Minitab 18.0 to determine the effects of the treatments on the soil chemistry. The results indicated significant differences ($P<0.05$) in soil pH and organic carbon levels after the treatments, with lime treatment displaying the highest (14.46%) pH increase and Forester indicating the highest (64.4%) SOC increase and total N in the soil. However, there were no significant differences in exchangeable calcium, magnesium and C: N ratio for both physical and chemical methods. As all treatments had significantly increased available P in the soil, physical method including Mowing had significantly increased (52.7%) soil organic carbon.
The study concluded that both physical and chemical methods, such as Forester can positively affect soil chemistry in invaded areas.

Keywords: Afro-Montane,Pteridium aquilinum,Soil chemistry,Invasive plants,Control methods

ID ABS WEB: 138270

4. Soil health in achieving the Sustainable Development Goals
4.22 133580 - Sustainable grassland management for healthy soils and vice versa

CHANGES IN SOIL-PHYSICAL PROPERTIES OF AN ANDISOL AFTER TWELVE YEARS OF DAIRY SLURRY APPLICATION

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The intensive milk production system in Chile generates a large amount of organic waste from milking parlors on a daily basis, and it is inadequate storage and/or inadequate management has a negative impact on the environment. Incorporating organic matter has favorable effects on the physical properties of soils. The objective of this study was to investigate the physical properties of an Andisol soil treated with twelve years of slurry applications. For this purpose, soil physical quality indicators were evaluated and the results were interpreted with the soil physical quality index. A completely randomized experimental design was used, with six treatments (2, 4, 6, 8, 10 and 12 years of slurry application) plus a control (without slurry application) with four replications, the experimental unit corresponded to plots of 200 m * 200 m. The study was carried out in permanent pastures composed of Lolium perenne L. and Trifolium repens L., the application rate was 150.000 L ha-1 year-1. Regarding the physical properties of the soil, in the A horizon, the application of slurry increased organic matter up to six years; between the fourth and tenth year, it favored bulk density and total porosity. In both horizons, it favored available water capacity in the plots that received eight years of application. The organic matter present in the A horizon was positively correlated with the soil porosity and available water capacity.

Keywords: wated management,productión milk,soil environment

ID ABS WEB: 140114

4. Soil health in achieving the Sustainable Development Goals
4.22 133580 - Sustainable grassland management for healthy soils and vice versa

SOIL MICROBIAL COMMUNITY STRUCTURE UNDER PERENNIAL BIOENERGY CROPS TREATED WITH DIFFERENT NITROGEN FERTILIZATION RATES

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Perennial bioenergy crops may enhance microbial community structure and soil health due to extensive root system compared to annual crops. However, long-term effect of perennial bioenergy crops receiving different N fertilization rates on microbial community structure is not well defined. We evaluated the 11-year effect of perennial bioenergy crops with various N fertilization rates as well an annual crop with recommended N rate on soil microbial properties in 2019 and 2020 in the US northern Great Plains. Perennial grasses were intermediate wheatgrass, IWG (Thinopyrum intermedium [Host] Barkworth and Dewey) and switchgrass, SG (Panicum virgatum L.) with N fertilization rates of 0, 28, 56, and 84 kg N ha-1, and annual crop was spring wheat, WH (Triticum aestivum, L.) with 80 kg N ha-1. The total fungal phospholipid fatty acid (PLFA) proportion and fungal/bacterial ratio were significantly lower under annual spring wheat than perennial grass (SG). Increased N fertilization rate linearly increased Gram-positive bacterial PLFA proportions and Gram-positive/Gram-negative bacterial ratio for IWG in 2020, but decreased PLFA proportions of arbuscular mycorrhizal fungi (AMF) for both perennial bioenergy crops in all years. The proportions of AMF neutral lipid fatty acid and Gram-negative bacterial PLFA were greater for SG than IWG, but actinomycetes and Gram-positive/Gram-negative bacterial ratio were greater for IWG. Microbial community structure varied with perennial bioenergy crops, N fertilization rates, and perennial vs. annual crop. This study showed how perennial crops impact soil biological health and how these differ from annual crops.

Keywords: Arbuscular Mycorrhizal Fungi,Intermediate wheatgrass,Switchgrass,Spring wheat,PLFA

ID ABS WEB: 136516

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

ADAPTATION AND MITIGATION OF AGRO-ZOOTECHNICAL ECOSYSTEMS TO CLIMATE CHANGE

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The protection, restoration, and management of natural and modified ecosystems have the potential to address the pressing issues related to climate change and ecosystem degradation.
The improvement of the agro-zootechnical land management is a priority for reducing greenhouse gas emission and sequester carbon, thereby limiting global warming. In addition to climate mitigation benefits, the management of agro-zootechnical lands can also affect climate resilience and adaptation, biodiversity conservation, and socio-economic and health conditions.
In this framework, the present contribution aims to evaluate the pressure induced by agro-zootechnical activities on soil ability to provide ecosystem services, with particular attention to carbon sequestration and nutrient cycles.
Sampling campaigns have been carried out from 2019 to 2023 in different natural and managed areas (forests, grasslands, agricultural and pasture soils) of the Regional Park of Migliarino, San Rossore, Massaciuccoli (Pisa, Italy).
The results highlighted a good content of organic matter (>2%) and nutrients (nitrogen and phosphorus) in all the managed areas, at each sampling time, comparable to those of the natural soils. However, the samples taken in the agro-zootechnical areas showed a greater vulnerability, as evidenced by the decrease over time in organic matter, including the stabilized one (humic substances), which may be linked to the grazing land use and to the uncontrolled presence of wild animals in the fallow areas.
This study provided important information to adequately plan the agro-zootechnical activities (timing, type and quantity of fertilizers, crop rotations, soil tillage, animal density and grazing period) to: 1. increase carbon sequestration, 2. reduce greenhouse gas emissions, 3. protect biodiversity, 4. preserve the physical-chemical-biological soil fertility, and 5. combine the sustainability objectives of agro-zootechnical systems with those of competitiveness, sustainability, and resilience to climate change.

Keywords: soil carbon sequestration,nutrient cycling,soil management,land use,ecosystem services

ID ABS WEB: 136628

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

FROM FOREST TO VINEYARD: EXPLORING CARBON STOCK AND N2O EMISSIONS IN A LAND USE CHANGE CHRONOSEQUENCE

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Over the past six decades, one-third of the world's territory has been affected by changes in land use mainly originated by agricultural practices. For instance, in Spain, large areas once covered by forests have been replaced by land for cereal cultivation. These activities result in a loss of soil carbon stocks and an increase in greenhouse gas (GHG) emissions. Bosque de Matasnos (Spain) is an estate winery where the conversion from forest to conventional cereal crops occurred 60 years ago, and the transition from cereal crops to organic vineyards took place 20 years ago. Therefore, in this site, three different land uses currently coexist: original forest, traditional cereal crops, and organically managed vineyards. As part of the LIFE-CLIMAWIN Project, the main objective of this study is to demonstrate the mitigation potential of land use change (shifting from cereal-based systems to more sustainable ones, such as organically managed vineyards), using the native forest as a reference. For this purpose, soil GHG emissions (CO2, N2O and CH4) and soil organic carbon stocks are being measured across the three land uses over a period of 2 years. In addition, general soil parameters relevant for soil fertility (e.g., pH, soil texture, carbonate content, available water content, nitrogen content) are also measured. This study presents initial findings regarding changes in carbon stocks in the three sites, showcasing the potential for reversing prior soil C losses through the adoption of regenerative soil management practices such as crop-livestock integration, where organic residues are returned to soil. Preliminary data on N2O emissions registered in the three studied sites are also presented.

Keywords: carbon sink,greenhouse gas,land use change,winery

ID ABS WEB: 137156

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

CHANGES IN CARBON POOL ON ARABLE SOIL UNDER THE DIFFERENT MANAGEMENT PRACTICES AND ITS PREDICTION USING THE ROTHC MODEL

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Studies on soil organic matter have always been important for soil environmental characterization. Soil potential to sequestrate or release organic carbon depends on various factors such as soil type, land use/management, climatic conditions, agrotechnical measures etc. The main aim of this study is to show changes in soil organic carbon (SOC) stocks and their development based on modelling by the RothC model. A valuable data set was received from the Field Experimental Station of Mendel University in Zabcice. The unequal development of SOC sequestration under the Norfolk crop rotation and Monoculture of spring barley (Hordeum vulgare L.) was documented during the modelled period of 1972-2100. The RothC model recognizes five active compartments of SOC: DPM – decomposable plant material; RPM – resistant plant material; BIO – microbial biomass; HUM – humified organic matter, and inert organic matter (IOM). Each compartment undergoes a different rate of decomposition and through a first-order process was characterized by a unique rate. Two different management scenarios (Norfolk and Monoculture) and three climatic scenarios (MPI, MRI, CMSS) were modelled. The findings revealed that SOC stocks were primarily impacted by inputs of plant residues and the application of exogenous organic materials. The prediction until 2100 indicated a declining trend in SOC stocks under the monoculture management. Moreover, the outcomes underscored that the straw incorporation and intercrops can optimise the sustainability of SOC stock and grain yield of spring barley. Results also showed that SOC stock at the end of the 20th century was approximately 66 t/ha and moderate SOC sequestration (0.09 t/ha/year) was achieved.

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Keywords: soil organic carbon modelling,climatic scenarios,crop rotation system

ID ABS WEB: 137624

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

FOREST-SPECIFIC MECHANISMS OF TROPICAL SOIL ORGANIC CARBON PRESERVATION UNDER PHOSPHORUS ENRICHMENT

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Tropical forests are sensitive to atmospheric nutrient deposition, the variation of soil organic carbon (SOC) preserving mechanism between the monoculture and the multispecies forest remains to be explored. To reveal the forest-specific properties of microbial composition and metabolism mediating biochemical selectivity for SOC preservation in response to nutrient deposition, we selected a monoculture (Acacia plantation) and a multispecies forest both with long-term (>10 a) addition of phosphorus (P) fertilizers in subtropical regions. In both wet and dry seasons, we measured SOC compounds including specific fingerprints of plant- and microbial-derived C, followed with soil abiotic and biotic properties.
We found that fungal necromass carbon was significantly decreased with P addition in both forests, but due to divergent microbial nutrient acquisition. Site-specific responses of plant substrates, microbial community composition and enzymatic activity to nutrient addition occurred between the Acacia plantation and the multispecies forest. The response of SOC preservation to P availability in the Acacia plantation was likely to be regulated by lignin oxidation and its microbial community composition; meanwhile, plant community composition might be shifted by P addition in the multispecies forest, thus plant substrate-mediated enzyme activities contributed to altering plant- and microbial-derived C in response to P availability. Tight linkages existed between mineral associated C fraction and biotic C compounds in the multispecies forest, suggesting that SOC preserved by biochemical selection could be rather susceptible to chronic P enrichment in this type of forest. These findings provide valuable insights into implications for revealing the biotic mechanisms of SOC preservation in tropical forests and offer guidance for assisting reforestation planning in the context of future nutrient application.

Keywords: Carbon sequestration,phosphorus enrichment,tropical forest,site-specific response,soil carbon components

ID ABS WEB: 137709

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

SOIL ORGANIC CARBON IN CHERNOZEM UNDER DIFFERENT AGRICULTURAL PRODUCTION SYSTEMS IN THE PROVINCE OF VOJVODINA, SERBIA

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The multiple and irreplaceable role of soil organic matter and its major constituent soil organic carbon (SOC), is well known, due to their influence on important physical, chemical, and biological soil properties. Land use management affects the SOC and its loss leads to soil degradation and emission of CO2 from the soil. This study aimed to determine the concentration and stock of SOC in organic (ORG) and conventional (CONV) production systems and to compare them to permanent pastures (PAST).

Chernozem samples (in total 72) were collected from 9 localities in Vojvodina province, Serbia, from depths 0-25 and 25-50 cm. At each site, soil samples were taken from plots under ORG, CONV, and PAST. Soil physico-chemical properties were determined. The stock of SOC (t ha-1) was calculated based on the measured SOC concentration, bulk density, and soil depth.

PAST had a significantly higher SOC concentration (25.75 ± 6.38 g kg-1 soil) concerning both production systems (ORG 17.94 ± 3.27 and CONV 18.09± 2.92), in the surface soil. The estimated SOC stock was in the same order as SOC concentration; PAST (81.41 ± 14.20 t ha-1) > CONV (61.34 ± 9.85) = ORG (58.82 ± 11.16). In the 25-50 cm soil layer, PAST SOC concentration (18.79 ± 3.45) and SOC stock (65,47 ± 10.88) were significantly higher compared to the CONV system (15.04 ± 2.89 and 52.52 ± 9.98, respectively), and there were no differences between ORG and CONV systems. In soil layer 0-50 cm, the total SOC stock was in order: PAST (148.59 ± 25.38) > ORG (113.81 ± 18.18) = CONV (113.92 ± 18.94). The greatest potential of PAST to store SOC is shown. No significant differences between SOC parameters in ORG and CONV systems indicate that for the improvements of these parameters longer period is needed. However, the positive effects of ORG production on studied plots in the subsurface soil were noticed.

Keywords: organic carbon,pasture,organic agriculture

ID ABS WEB: 137749

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

INFLUENCE OF LAND USE CHANGE ON SOIL AGGREGATION AND ORGANIC CARBON IN THE SOUTHEAST USA

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Land use change has a significant impact on soil aggregation and the dynamics of soil carbon. This study aims to examine the effects of converting land use from grassland to cropland on soil organic carbon and soil aggregate stability at the Pontotoc Ridge-Flatwoods Branch Experiment Station in Pontotoc County, Southeast USA. Soil samples were collected from natural grassland and cropland planted with cereal rye (Secale cereale L.) at two depths (0-5 cm and 5-10 cm) for measuring soil bulk density, soil aggregate size distribution and stability, as well as soil organic carbon storage. The results showed that soil organic carbon content and storage at 0-5 cm depth increased by 6% and 9%, respectively, after the land use change. In the cropland, the proportion of > 2 mm aggregates, the mean weight diameter (MWD), and geometric mean diameter (GMD) increased by 55%-901%, 43%-151%, and 58%-72%, respectively, while the fractal dimension (FD) decreased by 12%, at depths of 0-5 cm and 5-10 cm, as compared to the corresponding values in the grassland. Collectively, our results underscore the increase in soil organic carbon storage and the stability of soil aggregates resulting from the conversion of land from grassland to cropland, suggesting that planting crops such as cereal rye could serve as an effective method for augmenting carbon input into the soil within agricultural ecosystems. The findings of this study provide novel insights into the alterations in soil aggregation and the potential for soil carbon sequestration following land use changes.

Keywords: Land use,Soil aggregate,Soil organic carbon storage,Soil caron sequestration

ID ABS WEB: 137760

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

INFLUENCE OF AGRICULTURE ON SOIL PROPERTIES IN CENTRAL CHILE

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Soil chemical and physical properties, such as carbonate content (CO3-2), pH, electric conductivity, bulk density, among others, can be modified depending on agricultural practices used, e.g. the effect of irrigation water and fertilizer application on the soil. The overall objective of this study is to evaluate the effect of irrigation water from Maipo river -of high hardness-, on the chemical properties of agricultural soils (vineyard) and compare the effect on nonagricultural soils (forest of native vegetation) in an agricultural property of the Santiago basin, Chile (Csb Köeppen climate). This study consisted of the definition of six areas according to: the soil parent material (propylitic tuffs, calcareous sedimentary rocks, tuffs, and green lavas), geomorphological position (foothills), and type of use (agricultural, flora conservation). Samples were taken at different depths (maximum of 2.65 m). It was found that soils located in vineyards presented a greater percentage variation of chemical properties comparing surface vs. deep averages, due to agricultural intervention. In the case of native vegetation, properties remained relatively stable along the soil profile. However, comparing both land uses, in most cases the measurements did not show statistically significant differences. In contrast, the presence of CaCO3 in values >1.5% occurred in the sectors with vineyards at depths between 1.20 and 2.10 m. The CaCO3 formation occurred exclusively in soils parent materials of propylitic tuffs and calcareous sedimentary rocks, nevertheless, the latter had the highest CaCO3 values (>3%) compared to other parent materials. These soils have a high pH, with a high load of exchangeable cations, specifically calcium, very fine textures, and high bulk densities. In summary, the presence of CaCO3 was observed in soils intervened by agricultural activity, mainly influenced by irrigation water. Also, the origin of the parent material influenced the abundance of CaCO3.

Keywords: soil inorganic carbon,irrigation water,soil chemistry,physical properties

ID ABS WEB: 138122

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

EXPLORING THE ROLE OF DEEP ROOTING ABILITY ON SOIL CARBON ACCUMULATION IN PASTURE-RICE ROTATION SYSTEMS IN A VERTISOL

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The pasture-crop rotation is an agricultural practice performed on the same land area to obtain multiple benefits, such as improved crop yield, enhanced soil quality, environmental sustainability, and economic profitability. Urochloa humidicola forage grasses are a promising option for their use in rotational systems, given their potential to develop deep and vigorous root systems which have been associated with increased accumulation of soil organic carbon (SOC) and their capacity for high biological nitrification inhibition (BNI). The rotation system with improved rice (Oryza sativa) genotypes with deep root systems might benefit soil health, from increased SOC, and BNI, reducing nitrogen (N) losses and improving fertilizer use efficiency. The objective of the present study is to evaluate the effect of a pasture-rice rotation compared to conventional management on SOC storage in a 4-year field trial. The field trial was established at the end of 2022 at the Alliance Bioversity International & CIAT Campus in Palmira, Colombia and is comprised of eight treatments organized in a randomized complete block design with management structure. Treatments include permanent plots with two rice genotypes (HL23057, Fedearroz 60), two U. humidicola genotypes (Bh08-1149, CIAT679), being the conventional management, and four rice-pasture rotations combining the four genotypes. The trial will annually record root biomass, roots C and N content, and SOC content in topsoil and subsoil layers down to 100 cm depth. The soil is classified as a Vertisol, presented clayey texture (39.63 - 73.81% clay), with SOC content of 3.95 - 21.96 g/kg, and pH of 7.4 - 8.7, across different soil layers. Preliminary results after one year of trial establishment showed that pastures have greater root biomass, root C content and C:N ratio than rice genotypes. These preliminary findings suggest that the use of pasture-rice rotation management can result in greater accumulation of SOC than conventional crop management. Research is in progress to test this hypothesis.

Keywords: Crop rotation,Soil organic carbon,Deep roots,Root biomass,Root carbon

ID ABS WEB: 138206

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

PLOW ACCELERATES TO DECOMPOSE THE BURIED OLD HUMUS IN VOLCANIC ASH SOIL?

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Over ten thousand years, soils have been formed through events of volcanic ash deposition in Tochigi, Japan. The soil organic matter (SOM) in the past surface layer has been buried in the deeper soil. The buried humic horizons serve as a large carbon (C) reservoir. When the buried humic horizons are exposed to the surface by deep plowing and bottom plow tillage, decomposition of the exposed SOM can be accelerated through priming effects (PE), due to the increased supply of substances from fresh plant litter inputs and microbial activities. To test this, we examined the effects of (1) plow depth and (2) plow strength on the buried humus decomposition through PE.
Soil samples were collected from the volcanic soil profiles in forest site and adjacent arable sites in Tochigi, Japan. To trap the CO2 released from soils, the soils were incubated with the vials including NaOH solution in the plastic box sealed tightly after substitution of the head space air to CO2-free air. After 4 weeks, trapped whole CO2 concentrations were determined by titration. The amount of CO2 released from the buried soil were quantified through analyses of the 13C abundance and 14C content of trapped CO2 by AMS.
Plowing induced the positive PEs in the buried soils with every plow depth. Strong plowing also induced the positive PEs in the buried soils, and the CO2 amount derived from the buried humus decreased in non-plow plot compared with strong plow plot. These results show that the buried humus in volcanic soil can be accelerated to decompose through PE by plowing. However, in the both incubation studies, the values of 14C content of CO2 derived from the buried humus ranged ca. 96 – 98 pMC (30 – 190 yrBP). It was considered that relatively recent humus was decomposed by PE for short incubation, and the old humus may be stored even after plow in the buried humic soils.

Keywords: Buried humic horizon,Volcanic ash soil,plow,priming effect,C-14 dating

ID ABS WEB: 138249

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

ABOVE- AND BELOW-GROUND CARBON STORAGE OF CORN-SOYBEAN AGROFORESTRY ALLEYCROPPING PRACTICE

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Agroforestry has been identified as a partial solution to capture atmospheric carbon (C) and store it in the soil and trees for extended periods. The first objective of this study was to quantify soil C concentrations and stocks under tree buffer (TB), grass buffer (GB), grass waterways (WW), and crop field (CS, corn-(Zea mays L.)-soybean (Glycine max (L.) rotation). The second objective was to evaluate above-ground C stored in trees. Two watersheds were established in 1990 by installing GBs at 22-36-m spacing. Pin oak (Quercus palustris Muenchh.), swamp white oak (Q. bicolor Willd.), and bur oak (Q. macrocarpa Michx.) trees were planted at 3-m spacing on GBs of the TB watershed. Upper 50-cm soils were sampled using a bulk density sampler and lower 50-cm soil was collected by a Giddings probe. Growth of pin, swamp white, and bur oak were evaluated for 24 years in the TB watershed. Greater impacts of WW (113.5±12.9 Mg ha-1), TB (106±14.5 Mg ha-1), and GB (102.4±11.6 Mg ha-1) were observed compared to CS (90.9±10.2 Mg ha-1). Soil C with 10% TB and GB buffer areas within CS were 91.6 and 91.2 Mg ha-1 compared to 90 Mg ha-1 by CS alone. Soil C stocks in 2023 for 0-10-cm were +0.63, +1.06, +1.63, and +1.37% greater in CS GB, WW, and TB, than pre-treatment. Mean heights were 11.9-, 9.7-, and 8.4-m for pin, swamp white and bur oak trees. Pin oak recorded the largest above-ground biomass (483 kg tee-1) and bur oak had the lowest (130 kg tee-1). With the 3-species composition, tree biomass and carbon accumulation in a 24-year period were 22,613 and 10,854 kg ha-1. All three species appear to be suitable for watershed protection while pin oak showed promising growth and greater accumulation of biomass and carbon. The study showed long-term benefits of agroforestry alley cropping on soil carbon sequestration and C storage in tree biomass.

Keywords: Agroforestry,Grass buffers,Oak trees,Corn-soybean

ID ABS WEB: 138311

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

MODELLING CARBON SEQUESTRATION POTENTIAL OF SOILS OF GEORGIA

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The study aimed to estimate soil organic carbon sequestration potential of soils on agricultural lands in Georgia under different sustainable soil management practices. Soil carbon sequestration potential is calculated using an updated version of the Rothamsted Carbon Model (RothC) for the period 2020-2040. Modelling was carried out according to 4 different scenarios: 1) maintaining the current conditions unchanged – business as usual scenario (BAU); 2) SSM-1 involves increasing the amount of organic matter in the soil by 5% through sustainable soil management; 3) SSM-2 involves increasing the input of organic matter to the soil by 10% through sustainable soil management; 4) SSM-3 involves increasing the input of organic matter to the soil by 20% through sustainable soil management. According to the results, the soils distributed in the humid subtropical zone of Western Georgia have a high carbon accumulation potential. In addition, in case of SSM-1 scenario across the country, it is possible to sequester 0.3 million tons of organic carbon in the soils used for agricultural production, which is equivalent to 63% of the total amount of greenhouse gases released into the atmosphere from the agricultural sector of Georgia, contributing about 20% from total GHG emissions of the country.

Keywords: SOC stock,SOC sequestration,sustainable soil management,digital soil mapping,GHG emission

ID ABS WEB: 140085

4. Soil health in achieving the Sustainable Development Goals
4.23 133583 - Soil carbon sequestration and land use change

ASSESSMENT OF EXTRACELLULAR ENZYME ACTIVITY AND SOIL MICROSTRUCTURE IN GRASSLANDS OF NORTHERN IRELAND

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This work contributes to the largest baseline soil sampling project ever undertaken as part of the £45M UK government funded Soil Nutrient Health Scheme (SNHS) in Northern Ireland (NI). Investigation of the extracellular enzyme activity and soil microstructure in grassland soils across NI is being assessed as a measure of soil health. The project aims to educate farmers on the environmental and financial impacts of various land management practices, this scheme will contribute to the development of policies governing the transition to Net Zero farming in Northern Ireland.

The ongoing assessment of extracellular enzyme activity in grassland soils across Northern Ireland is generating a standard picture of average enzyme activity in soils managed as grassland for either grazing, silage or a combination of grazing and silage. This project correlates the activity of β-1,4-Glucosidase, α-Glucosidase, β-1,4-N-Acetyl-glucosaminidase and L-leucine aminopeptidase to the total carbon and nitrogen content in the soils, land management practices and pH as well as soil microstructure in a multifactorial assessment of soil health properties. This continuing work has started to identify trends in enzyme activity which correlate to total carbon and nitrogen content.

An innovative approach to assessment of soil microstructure in its natural state has been developed during this project by the use of low-vacuum scanning electron microscopy. Notable differences in soil composition between different soil types have been identified with the aim to compare this to other measures of soil health in an assessment of how beneficial soil microstructure can be in predicting other measurable soil health properties.

When complete, this vast interdisciplinary project aims to educate farmers on important issues such as sequestration of carbon in soil and loss of nutrients through surface runoff into bodies of water as a matter of environmental importance.

Keywords: Soil Health,Carbon Sequestration,Extracellular enzyme activity,Sustainability,Land use

ID ABS WEB: 136010

4. Soil health in achieving the Sustainable Development Goals
4.24 133598 - Anthropogenic drivers of soil biodiversity, its function and feedback to changes

URBAN GREENSPACES SHAPE SOIL PROTIST COMMUNITIES IN A LOCATION-SPECIFIC MANNER

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The impacts of urbanization on aboveground biodiversity are well studied, and its impact on soil microorganisms are also receiving increased attention. However, the impact of urbanization on soil protists are hardly investigated. Here, we studied how urbanization and distinct urban greenspaces affect protist communities. We used amplicon sequencing of the18S rRNA gene of samples from five types of urban greenspaces (parks, greenbelts, industrial areas, residential areas and hospital lawns), neighboring natural forests and agricultural ecosystems in Ningbo, China. We found that urban greenspaces harbored higher protist alpha-diversity than forests, while protist beta-diversity increased from agricultural systems to urban greenspaces to forests. Among the studied driving factors, bacterial community of alpha- and beta-diversity best predicted phagotrophic protist alpha- and beta-diversity in urban greenspaces, while differences in alpha- and beta-diversity of phototrophic protists were best explained by soil carbon-to-nitrogen ratio and fungal beta-diversity, respectively. Abiotic factors including total phosphorus and carbon-to-nitrogen ratio best predicted the alpha- and beta-diversity of protist parasites in urban greenspaces. The results revealed that the composition and drivers of protist communities vary between functional groups and urban ecosystems. Overall, our findings contribute to a better understanding of drivers of soil protist communities and indicate that soil protist communities and associated soil functions could be managed in predictable ways in urban greenspaces.

Keywords: Urbanization,Protists,Functional groups,Urban greenspaces,Land-use

ID ABS WEB: 137012

4. Soil health in achieving the Sustainable Development Goals
4.24 133598 - Anthropogenic drivers of soil biodiversity, its function and feedback to changes

INTENSIVE LAND-USE PRACTICES ALTER THE SOIL MICROARTHROPOD COMMUNITY

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Agricultural soils represent a large extension of terrestrial ecosystems. Intensive land-use practices can enforce pressures on soil structure, leading to erosion and compaction. These changes can impact the diversity and functionality of soil biota. Among them, microarthropods play an important role in matter cycle and in controlling the microbial component of the soil community. The present research aimed to assess whether the intensive land-use practices alter the abiotic soil properties and the microarthropod community in terms of abundance and functionality. In order to achieve the aim, forest and agricultural soils cultivated at kiwi and vineyards were collected and analysed for the main abiotic properties such as pH, water content, and carbon and nitrogen contents. Moreover, the microarthropod community was investigated. Among soil abiotic properties, only carbon content showed differences between the site type with the highest value in forest soil. Higher biodiversity of the microarthropod community was observed in forest soil. The taxonomical indices of the microarthropod community did not statistically differ between forest and agricultural soils. Nevertheless, shifts in the relative abundances of different taxa were observed, as Formicidae that was significantly more abundant in the vineyard soil. In conclusion, the present research highlighted that agricultural practices strongly reduce the carbon content in soil making the environment less suitable for a large biodiversity of microarthropods. An overall stress condition appeared in the agricultural soil, especially where vineyards were planted, with lower complexity of the community. Further investigations need to examine if different land-use practices could generate impacts into the trophic networks.

Keywords: SOIL BIODIVERSITY,AGRICULTURAL SOIL,FOREST SOIL,MICROARTHROPOD COMMUNITY,SOIL BIOTA

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ID ABS WEB: 138277

4. Soil health in achieving the Sustainable Development Goals
4.24 133598 - Anthropogenic drivers of soil biodiversity, its function and feedback to changes

THE ROLE OF EARTHWORMS IN GRASSLANDS

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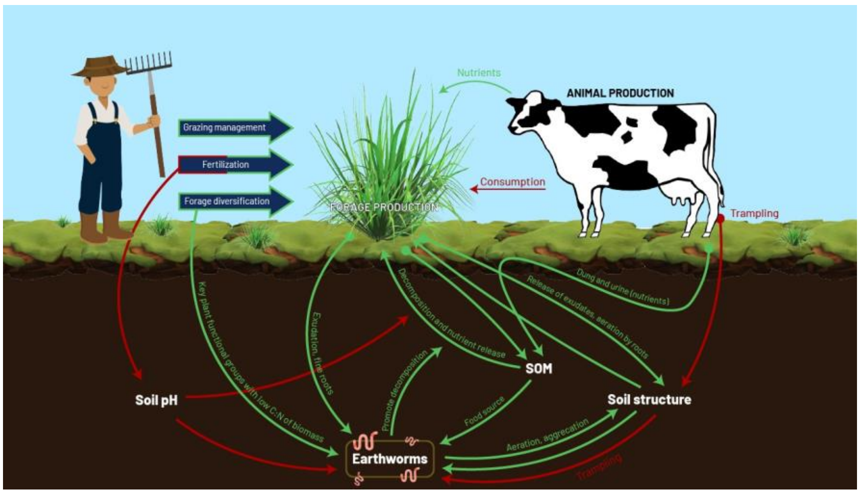
Grasslands are among the most important ecosystems for human livelihoods. Besides their irreplaceable role in human food production, grasslands provide a wide range of ecosystem services at different scales, which are often linked to earthworm activity in grasslands. The capacity of earthworms to improve soil physical properties, nutrient availability, plant biomass production, and soil water balance are well known. Specifically, a high earthworm abundance and diversity in grasslands is often related to high soil porosity and water retention, low soil compaction, formation of soil biogenic aggregates with great stability, high availability of nutrients, and accelerated soil organic matter cycling, leading to high plant biomass production. This, in turn, encourages the maintenance of large and diverse earthworm populations in grasslands.

Most of the world's grasslands are managed to sustain livestock production (as opposed to natural grasslands without human intervention). Earthworms are sensitive to agricultural management, which make them vulnerable to inadequate practices in grasslands. Fertilization, grazing management, modification of the plant community composition (i.e. introduction of improved forages, trees or legumes) can all affect earthworm communities in many direct and indirect (and often interrelated) ways. Here in a literature review, we summarize the potential of different grassland management practices and their possible effects on earthworm populations and communities in the context of sustainable management of grasslands.

Based on their importance and high sensitivity to grassland management, we encourage the inclusion of the earthworm communities among the studied factors for the assessment of grassland management practices. Further, we suggest that using earthworms as bioindicators of grassland health status is accessible by farmers and agriculture services. The development of a standardized method of earthworm assessment adapted to different edaphoclimatic conditions and types of grassland management could help to transfer scientific knowledge generated during the last decades to final users and managers of grasslands.



Keywords: Earthworms,Grassland Management,Fertilization,Soil macrofauna,Soil biology

ID ABS WEB: 136157

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

OCCURRENCE, DISTRIBUTION AND ECOLOGICAL RISK ASSESSMENT OF HERBICIDE RESIDUES IN CROPLAND SOILS FROM THE BLACK SOIL REGION OF NORTHEAST CHINA

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The black soil is regarded as a major contributor to the global food basket. However, the extensive application of herbicides over the past few decades has posed a threat to its health. With limited regional studies on herbicide residues in black soil region of China, this study aimed to provide a comprehensive understanding of herbicide residues, their characteristics, and associated ecological risks in soils across various cropland areas across whole region.

A field survey in the study area yielded a list of 58 commonly used herbicides, and 224 topsoil samples were collected for analysis using HPLC-MS/MS and GC-MS/MS. These findings were utilized to assess occurrences and spatial distribution of herbicides, as well as the ecological risks using the Risk Quotient.

Fifty-six herbicides were detected with total herbicide concentrations ranging from 1.01 to 1558.13 ng/g (mean: 227.45). Atrazine, DEA, DIA, trifluralin and butachlor were the most frequently detected herbicides, while DEA, clomazone, nicosulfuron, fomesafen, and mefenacet exhibited the highest concentrations. Despite being less frequently reported in Chinese soils, fomesafen, nicosulfuron, clomazone, and mefenacet were found widely present. The key factors identified to regulate the fate of herbicides were soil chemical properties, amount of herbicides application, and the crop type. It was observed that the predominant herbicides in the lands cultivated with various crops were nicosulfuron, atrazine, DEA and DIA in corn fields; fomesafen, clomazone and metolachor in soybean fields. The soybean soils showed highest herbicide residues, while the soil mineral contents likely adsorbed more herbicides. Although most of the compounds posed a minimal or low ecological risk, atrazine, nicosulfuron and DEA exhibited medium to high potential risks, with high RQmedian and RI values.

This study presents a comprehensive dataset on herbicide residues and ecological risks in the black soil region of China, highlighting the need for mitigation measures. It also serves as a valuable contribution to decision-making processes and technological advancements in herbicide management and risk control at the global scale.

Keywords: Herbicides,Residue characteristic,Spatial distribution,Ecological risk,black soil region of China

ID ABS WEB: 136158

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

RECONSTRUCTING MOLLISOL FORMATION PROCESSES THROUGH QUANTIFIED PEDOTURBATION

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Mollisols, also known as a type of black soils, are highly fertile soils characterized by a thick, dark surface layer rich in soil organic matter. Mollisols are not only crucial for food security but also serve as a significant carbon pool. To predict the future evolution of these valuable soil resources, it is important to understand when and how they formed. However, due to intensive mixing by animals, plants, and freeze-thaw processes, it is challenging to accurately obtain soil ages using traditional dating methods that rely on undisturbed sedimentation layers. Here, we utilized luminescence, a light-sensitive property of minerals, to address the challenge of soil mixing. We analyzed more than 2,400 luminescence ages of individual K-feldspar grains from a Mollisol profile in northeastern China. The results showed that the upper 80 cm of the soil body is currently mixed, with the mixing intensity being most intense at the soil surface and decreasing with depth. Additionally, we observed evidence of past soil mixing over the past 50,000 years. The intensity of soil mixing increased around 16,400 years ago. We infer that the paleoenvironment was favorable for forming Mollisols since then, which is significantly earlier than previously estimated.

Keywords: Mollisols,single-grain luminescence,soil genesis,pedoturbation,Northeast China

ID ABS WEB: 136204

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

INFLUENCE OF GULLY EROSION ON HYDRAULIC PROPERTIES OF BLACK SOIL-BASED FARMLAND

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Gully erosion is a severe form of water erosion worldwide. However, the influence of gully vicinity on the soil hydraulic properties has been poorly studied, hindering the understanding of their effect on crop yields. Therefore, this study hypothesizes that gully vicinity influences farmlands and aims to determine the mechanism of their influence on soil hydraulic properties and crop characteristics. The soil properties from nine gullies in cultivated lands inclined at1%, 2%, and 3% in three latitudinal regions were determined at the gully edge (EG0) and 50 m further the edge into the farmlands (EG50) at the following gully units: head, mid-upper, mid, mid-lower, and tail. Soil hydraulic properties (bulk density, saturated hydraulic conductivity, and water retention), soil penetration resistance, and soil organic matter were analyzed. The study findings indicate that the gully existence affected the soil properties at diverse range of intensities. The total-available water content, the ratio of more-available water to total-available water content, saturated hydraulic conductivity, and soil organic matter were lower, but the bulk density and soil penetration resistance were higher at EG0 compared with those at EG50. The ratio of more-available water to total-available water content in the gully vicinity was considerably lower in our study than in previous studies, indicating gully erosion substantially deteriorated the hydraulic properties. The differences in soil hydraulic properties between EG0 and EG50 were more evident in higher latitudinal region and in steeper farmlands. In addition, the lower soil organic matter and higher bulk density probably led to a 3-11% decrease in crop yield at EG0 than at EG50. In summary, this study indicates that gully erosion affects farmland not only at its boundaries but also further into its surroundings. Accordingly, managements suited to the hydraulic properties of the gully-surrounded areas may be implemented to maximize the crop yield of farmlands.

Keywords: Black soil,Soil available water content,Gully vicinity,Penetration resistance,soil organic matter

ID ABS WEB: 136231

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

STUDY ON THE SOIL FUNCTION EVALUATION AND REGIONALIZATION OF FARMLAND IN HEILONGJIANG PROVINCE, CHINA

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In this study, the research framework of Cultivated land soil function evaluation—Restrictive evaluation of soil function—Cultivated land use zoning and optimization was established. Taking Heilongjiang Province as the research area, the farmland soil function was divided into Primary Productivity, Nutrient cycling and provision, Habitat for functional and intrinsic biodiversity, Water regulation and purification, Carbon sequestration, taking 1km × 1km grid as the evaluation unit to carry out refined evaluation of the cultivated land and soil function in 2018 in Heilongjiang Province, using multi factor comprehensive evaluation, geographical detector and other analysis methods to put forward the division scheme and optimization of cultivated land use function The main conclusions are as follows: (1) This paper constructs the overall research framework of farmland soil function evaluation and zoning, the evaluation method system of soil function limitation, and the research idea of farmland utilization function division and optimization. (2) From the results of spatial distribution of soil function comprehensive evaluation, the study area shows the distribution law of high grade in the northeast and low grade in the southwest. (3) From the perspective of spatial distribution, the supply capacity of soil functions in the southwest of the study area is weak, which can not meet the demand of human society for soil functions. On the contrary, the supply capacity of soil functions in the northeast of the study area is strong and in surplus. (4) According to the results of the geographical detector, the main factors affecting the soil function of cultivated land are slope, erosion and salinization sensitivity. The natural environment and ecological security have a more significant impact on the function of cultivated land. (5) Based on the above analysis results, the cultivated land is divided into four areas: grain supply area, ecological agriculture area, balanced development area and weak functional, and the corresponding cultivated land management mode is put forward according to the regional restrictions.

Keywords: Cultivated Land,Soil Functions,Functional Partition,Heilongjiang Province,Sustainable Soil Use

ID ABS WEB: 136606

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

DIFFERENTIAL ACCUMULATION PATTERNS OF MICROBIAL NECROMASS INDUCED BY MAIZE ROOT VS. SHOOT RESIDUE ADDITION IN AGRICULTURAL BLACK SOILS

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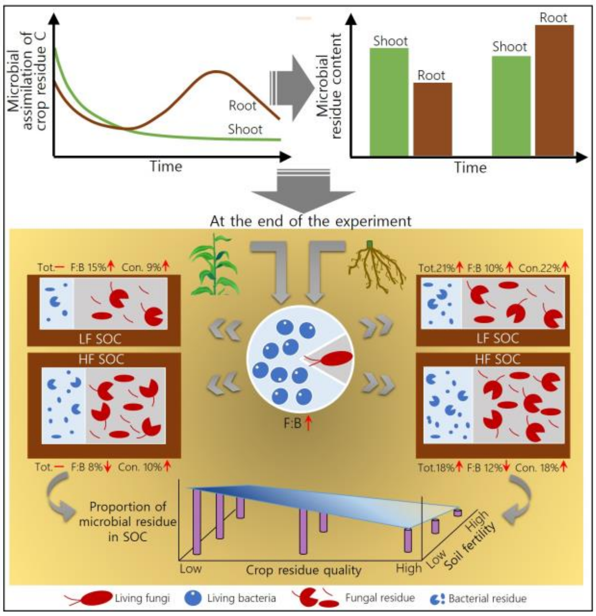
Soil organic carbon (SOC) has significant implications in regulating soil health. Emerging insights emphasize the important role of microbial anabolism in SOC storage by continuously transforming plant fragments into persistent microbial residues. However, knowledge of the sequestration pathway of root versus shoot carbon (C) is under debate. While recent studies have shown that labile shoot residue is disproportionately important for stable SOC accumulation through microbial assimilation, how plant root vs. shoot residue retention impacts microbial-derived C under different soil fertility conditions remains elusive. Here, we conducted a 500-d in situ experiment using black soils with low fertility (LF) and high fertility (HF) amended with maize root or shoot (both stem and leaf) residues. The microbial residues (amino sugar biomarkers) and microbial communities (lipid biomarkers) were analyzed at 60, 90, 150, and 500 d after the amended materials were added. The results showed that shoot residue input facilitated microbial residue accumulation more efficiently than root input before 150 d. However, at the end of the experiment, the treatment containing added root residue accumulated more microbial residues and produced a higher proportion of microbial residue in SOC, compared with shoot treatment. These results provide novel evidence that root residue can also yield SOC efficiently through the organic substrate–microbial anabolism pathway, but it depends on the decomposition period. Moreover, soil fertility plays an important role in regulating the quantity and relative composition of microbial residues. Specifically, crop residue application greatly increased the contribution of microbial residue C to SOC in the LF treatment compared to that in the HF treatment on day 500. Meanwhile, crop residue addition had a more positive effect on fungal residue accumulation in the LF soil, while it facilitated the accumulation of bacterial residue in the HF soil. These findings highlight that crop residue addition (especially root residue) is an effective approach for improving microbial-derived C sequestration in infertile soils.



Keywords: Soil organic carbon,Crop residue,Microbial necromass,Soil fertility,Black soil

ID ABS WEB: 136627

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

EFFECTS OF CONSERVATION TILLAGE ON SOIL ORGANIC CARBON SEQUESTRATION IN BLACK SOIL

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In Northeast China, conventional tillage practices caused a decline of soil organic carbon (SOC) and degradation of Black soils (Mollisols). Conservation tillage, particularly no tillage (NT), has been suggested to be an effective practice to control soil erosion and increase the SOC. Hence, we established an experiment (since 2001) to evaluate how a combination of different tillage and cropping systems could improve SOC in black soils. The total SOC storage, SOC fractions (physical and chemical), SOC stability were assessed to evaluate the effects of tillage and cropping system. Our results shows that: 1) different tillage and cropping system combinations had different effects on SOC storage; NT combined with continuous maize had the highest SOC storage among all treatments; 2) The effects of tillage on aggregate size and OC concentration mainly occurred in the surface layer (0–5 cm) while the effect of cropping system on aggregate size and OC concentration mainly occurred at deeper depths; 3) NT increased the recalcitrant carbon pool in surface layer showing the critical need for returning crop residues to maintain long-term SOC storage; 4) SOC mineralization (biological stability) appears to be related to the SOC proportion in the light fraction; 5) More than half of the increase in SOC storage due to NT existed as microbial necromass carbon storage under continuous maize which was higher than maize-soybean rotation. Our study shows that in black soils (Northeast China), NT and appropriate cropping systems can not only halt soil degradation caused by poor management but can induce substantial increases in SOC which is beneficial for SOC long-term sequestration.

Keywords: Black soil,conservation tillage,soil organic carbon

ID ABS WEB: 136770

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

INCORPORATING MANURE IN THE NO-TILL SYSTEM IMPROVES SOIL HEATH AND CROP PRODUCTION OF DEGRADED BLACK SOILS

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No-till agriculture can improve soil health, reduce erosion, and benefit the environment. Manure application is also a good way to enhance soil quality and carbon stock. However, direct applying manure to the surface of no-till field may lead to nutrient loss. In this study, we conducted laboratory simulations and field experiments to evaluate the effects of different manure application strategies in the traditional plowing and no-till system on soil health and crop production of degraded black soils. Seven strategies were investigated: traditional plowing (CK), CK + 30 t/ha manure (CKM), No-till (NT), NT + surface application of manure (NTS), NT + application of manure with disk injector (NTD), NT+ application of manure with poultry litter injector (NTP), and NT + application of manure with chisel injector (NTC). The laboratory simulation showed that, compared to CK, NT and CKM decreased or had no effect on soybean production (shoot fresh weight, shoot dry weight, and yield). While the four NT + manure strategies gave higher yields (+15% on average) and shoot dry weight (+16%). NTD performed the best with a yield improvement of 34%. Rainfall simulations showed the five NT treatments had fewer nutrient losses (total nitrogen and phosphorus) than the CK and CKM because of less leaching and runoff. NTS had higher ammonia volatilization than the CKM (+6.2%), but the NTD, NTP, and NTC had no significant difference with the CKM. Besides, NTD improved the soil aggregate stability and had beneficial effect on soil fungi diversity. Field experiments further compared the performance of NTD on corn production and quality of the degraded black soil. The first-year experiment showed that NTD reduced surface runoff, improved soil nutrients and organic matter content, and provided higher corn yields (~10%) than the NT and CK treatments. Thus, incorporating manure in the no-till system could be a promising strategy for improving soil heath and crop production of degraded black soils.

Keywords: Black soil,Manure application,No-Till system,Soil health,Crop production

ID ABS WEB: 136772

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

RESPONSE OF SOIL ENZYMATIC ACTIVITY TO PORE STRUCTURE UNDER INVERSION TILLAGE WITH ORGANIC MATERIALS INCORPORATION IN A HAPLIC CHERNOZEM

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Soil pore structure affects microbial survival environmental conditions and thus enzyme activity. The mechanisms underlying returning organic materials on soil pore structure and enzymatic activity, however, remain unclear. We therefore conducted a field experiment in 2018 in northeastern China with a chernozem soil and four treatments: CT, conventional tillage; SCT, returning maize straw incorporation with conventional tillage; SIT, returning maize straw incorporation with inversion tillage; SMIT, returning maize straw and organic manure with inversion tillage. We used X-ray computed tomography to analyze the characteristics of pore structure and extracellular enzymatic stoichiometry to evaluate the limiting factors for soil microorganisms. Inversion tillage and organic materials incorporation can alter the micromorphological structure of entire soil layer, leading to the rearrangement of soil particles and nutrients, thereby augmenting the physicochemical properties in subsoil layer. SMIT exhibited a substantial increase in the number of macropores, porosity and fractal dimension, compared to SCT and SIT. This led to a significantly increased in soil enzyme activities of carbon and nitrogen-limited in SMIT, with increases ranging from 11.67% to 40.16% and from 8.81% to 21.43%, respectively ($P < 0.05$). Analysis using structural equation modeling revealed that returning organic material was conducive to the development of soil pore structure, characterized by an increase in macropores and fractal dimension and a decrease in the Euler number, had a positive correlation with soil enzyme activity. This, in turn, led to an alleviation in microbial nitrogen limitation. These results indicate that SMIT could serve as a viable choice in enhancing soil structure and fostering a favorable environment for microbial survival. Moreover, they offer essential insights into the microbial strategies responsible for the breakdown of organic matters in Hapli-Udic Cambisol.

Keywords: Organic material returning,Soil pore structure,Soil enzyme activity,Enzymatic stoichiometry

ID ABS WEB: 136774

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

STRAW RETURN ENHANCES THE PORE MORPHOLOGY AND SIZE DISTRIBUTION MEDIATED BY INCREASED AGGREGATE-ASSOCIATED CARBON AND NITROGEN

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The accumulation of soil organic carbon (SOC) and total nitrogen (TN) is easily accomplished by returning crop straw, which strongly affects the formation and pore structure of aggregates, especially in black soil. We returned maize straw at different rates (6000, 9000, 12 000 and 15 000 kg ha-1) for nine years to investigate its influence on the SOC and TN contents in SOC fractions of aggregates by combining the size and density fractionation, and their subsequent influence on the pore morphology and size distribution characters through using X-ray micro-computed tomography scanning (CT). The results showed that returning straw significantly increased the contents of C and N in the SOC fractions of aggregates, especially at the rate of return of 12 000 and 15 000 kg ha-1, which in turn promoted aggregate formation and stability and then amended pore structure. Pore size >0.100 mm, porosity (>0.002 mm), and morphological characteristics (anisotropy, circularity, connectivity and FD) significantly increased, but the total number of pores significantly decreased ($P < 0.05$). Our results indicated that the amendment of pore morphology and size distribution of soil aggregates was primarily controlled by the increased content of C and N in density fractions of aggregates, rather than in the aggregate sizes. And pore network reconfiguration favored the C and N storage simultaneously.

Keywords: aggregate pore structure,black soil,density fractions,water-stable aggregates,X-ray micro-computed tomogr

ID ABS WEB: 136783

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

THE THICKNESS AND VARIATION RATE OF DRYLAND BLACK SOIL IN NORTHEAST CHINA FROM 1982 TO 2022

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Clarifying the thickness and variation rate of dryland black soil is important to soil protection and food security. The missing of black soil thickness and the spatial-position inconsistent of sampling sites in different periods hinder the study of thickness and variation rate in Northeast China. In this study, we surveyed the thickness of black soil at 663 sampling sites using a novel method combining shovel and soil auger in 2022 and collected 4379 soil profiles from 1980s. The survey method was validated by comparing with the soil profile-based method. Meanwhile, we also developed a method to covert the thickness of soil genetic layer to that of black soil. Then we built models to predict thickness of black soil based on the sampling data, environment variables, and random forest algorithm. Finally, the thickness and variation rate of dryland black soil in recent 40 years were obtained. The results show that the survey method captured 91% variations of soil profile-based thickness. The thickness converting method from genetic layer the black soil layer captured 80% variations of the survey method. The accuracy of prediction models for thickness of black soil were almost the same in 2022 and 1980s with RMSEs of 26.5 cm and 26.4 cm, respectively. The prediction models tended to be overestimate (underestimate) results when the thickness is lower (higher) than 50 cm in both two periods. The average thicknesses were 43.6 cm and 54.7 cm in 2022 and 1980s, respectively. The thickness of black soil trended to decrease with a rate of 0.28 cm/year. There were differences in decreasing rate of black soil for different soil types and slope positions. The decreasing of thickness in Songnen plain area should be paid attention. This study characterizes the thickness and variation rate of dryland black soil based on large samples and machine learning method and provides technical and data support for black soil protection.

Keywords: black soil,thickness,northeast China,dryland,random forest

ID ABS WEB: 136796

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

HYPERSPECTRAL INVERSION AND DIGITAL MAPPING OF SOIL ORGANIC MATTER OF BLACK LAND IN NORTHEAST CHINA

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Soil organic matter is a key indicator of soil quality in Black land. Rapid acquisition of soil organic matter content, clarification of its relationship with environmental factors, and efficient digital mapping are crucial for the protection and utilization of Black soils. The Songliao Plain is located in the northeast region of China, which is a typical concentrated distribution area of Black soils, and is of great significance for ensuring food production in China. This study constructs a hyperspectral fast and accurate inversion method for soil organic matter, systematically revealing the correlation, causal relationship, and geographic dependence between soil organic matter and environmental factors, and exploring the influence of modeling methods and environmental variable quantities on spatial prediction and digital mapping of soil organic matter. The results indicate that: (1) Continuous wavelet transform technology can improve the correlation between soil spectra and soil organic matter content, stable competitive adaptive reweighting sampling algorithm can extract important feature information variables related to soil organic matter, improving modeling efficiency; (2) The annual average temperature is the main controlling factor affecting the spatial distribution of soil organic matter content in the Songliao Plain. Soil factors are also important factors affecting the spatial distribution of organic matter. Climate factors have the strongest impact on soil organic matter. Soil factors have the strongest direct effect on organic matter, with the path coefficient is 0.55; (3) The major direction and the minor direction of soil organic matter variations in Songliao Plain was 56°east by north and 146° east by north, respectively. The scale and location-specific variations in SOM and environmental factors were direction-specific; (4) The random forest model demonstrated the best performance in spatial prediction and digital mapping of soil organic matter. The partial least squares regression model demonstrats the worst performance, and there is a significant underestimation of low value areas.

Keywords: Black soils,Soil organic matter,Hyperspectral inversion,Environmental factors,Digital soil mapping

ID ABS WEB: 137113

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

BLACK SOILS IN NORTHEAST CHINA BASED ON LAYERED SOIL ATTRIBUTE DATA AND ARTIFICIAL NEURAL NETWORK

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The relationship between grain yield and cultivated land soil properties is a pivotal concern in grain production. Traditional grain yield prediction models typically focus on the surface soil layer (0-30cm), overlooking the interaction with deep-layer soils. This study aims to investigate the relationship between soil properties at different depths and grain yield, constructing a model that integrates vertical dimension features. The research utilizes stratified soil attribute data from various counties in the black soils of Northeast China to conduct grain yield prediction analysis. Pearson correlation analysis is employed to examine the relationship between different soil layers and grain yield. Artificial neural networks are utilized for interval prediction, and a multiple regression model is developed to construct a soil vertical dimension grain yield prediction model. The results indicate that: (1) Cation exchange capacity, clay content, organic carbon content, and total nitrogen content are significantly correlated with grain yield, with correlation coefficients of r(15-30cm)=-0.516 (p=0.000), r(30-60cm)=-0.465 (p=0.001), r(15-30cm)=-0.619 (p=0.000), r(15-30cm)=-0.573 (p=0.000). (2) The weights of stratified soil properties gradually decrease with increasing soil depth. The 30-60cm soil layer has a significant impact on grain yield formation, likely due to lower disturbance in sub-surface soil, promoting more frequent microbial activity and decomposition. (3) Compared to traditional yield prediction models, the new model's R2 increased from 0.479 to 0.553, indicating a 15.15% enhancement in the model's explanatory power for grain yield. The transformation of grain yield into interval numbers for computation has strengthened the robustness and prediction accuracy of the forecasting model, possibly due to interval numbers more effectively reflecting the comprehensive impact of factors such as soil, crops, and human activities on grain yield. Considering the vertical dimension of soil can further improve the prediction accuracy of grain yield. In the future, the monitoring and evaluation of deep soil properties should be paid attention to in the protection and management of cultivated land, so as to formulate more effective cultivated land protection measures.

Keywords: black soils,artificial neural network,vertical dimensional character,interval number,grain yield prediction model

ID ABS WEB: 137248

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

THE IMPACT OF STOVER MULCH QUANTITY ON SOIL ORGANIC CARBON ACCUMULATION MEDIATED BY MICROBIAL COMMUNITY

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Stover mulching over no-till soil is regarded as a promising practice to increase soil organic carbon (SOC) in croplands against climate change. Microorganisms play key roles in the dynamics of soil organic matter and nutrient cycling. Microbial necromass is a significant source of SOC stock and unequivocally controlled by the microbial community. Yet, a complete link that spans from agricultural practices to microbial community features, to soil necromass C, and eventually to SOC is poorly understood. Here, we conducted a 10-y corn field experiment with five treatments, which included conventional tillage (CT), no-tillage without stover (NT-0), and no-tillage with low, medium, and high amounts of stover mulching (NT-low, NT-medium, and NT-high) in northeastern China. We investigated the stocks and changes in total SOC and its microbial necromass C along a soil depth down to 40 cm, and we evaluated how SOC dynamics and stabilization processes were associated with microbial community features. We characterized microbial community diversity and structure using 16S rRNA and internal transcribed spacer (ITS) sequencing, and we characterized microbial biomass and necromass using phospholipid fatty acid and amino sugar biomarkers. Compared with conventional tillage, no-tillage with medium and high amounts of stover mulching increased SOC stocks in the upper 0-40 cm of soil by > 0.4 % per year. No-tillage treatments (without and with stover) had almost no effect on the proportion of total microbial necromass C to SOC, but greatly modified the ratio of fungal necromass C to bacterial necromass C, which increased in top layers (0-5 cm) and decreased in deep layers (10-40 cm). SOC was governed mainly by fungal necromass C, which was correlated positively with fungal biomass. Fungal necromass C, not bacterial necromass C, was more closely associated with microbial community composition. Our results suggested that no-tillage with medium stover mulching was the optimal treatment to achieve the best trade-off between stover input and SOC storage.

Keywords: stover mulching,microbial community,microbial necromass,soil organic carbon,tillage

ID ABS WEB: 137634

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

HOW GULLY EROSION DAMAGES FARMLANDS AND REDUCES GRAIN YIELD IN TYPICAL MOLLISOL REGION OF NORTHEAST CHINA

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Gully erosion damages farmlands and reduces grain yield. But at present, how gully erosion reduces arable land and grain yield is still less reported. Thus, this study, taking a typical Mollisol region Keshan County of Heilingjinag province as a case study, applied 0.4 m high-resolution remote sensing images, land use data and statistical yearbook data to extract erosion gullies, investigate farmland area damaged by gullies and address gully erosion impacts on grain yield. The results showed that the total of 3395 erosion gullies was extracted from the study area, in which the number of small erosion gullies (gully surface area is smaller than 0.5 ha), medium erosion gullies (gully surface area is between 0.5 ha and 1.4 ha) and large erosion gullies (gully surface area is larger than 1.4 ha) were 2323, 745 and 327, respectively. And mainly distributed in the western and eastern areas of Keshan county. The ratio of arable land area damaged by erosion gullies to gully surface area was 2.0 to 2.84 times. Moreover, the total farmland area in the study area damaged by all gullies was 4796.65 ha, and the averaged value damaged by each gully erosion was 1.41 ha. The reduction in grain yield by gully erosion was 22239.37 t, including 18950.29 t corn yield and 3289.08 t soybean yields. This study can provide important scientifical basis for erosion gully control in Chinese Mollisol region.

Keywords: Gully Erosion,Farmlands damage,Crop yield,High-resolution remote sensing,The Chinese Mollisol region

ID ABS WEB: 137894

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

EFFECTS OF TILLAGE ON SOIL PORE CHARACTERISTICS AND FUNCTION IN THE NORTHEAST OF CHINA

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No tillage is considered to be one of the conservationist management systems due to its environmental and agronomic benefits, and it is being increasingly adopted in northeast China. However, the effects of tillage on soil pore characteristics and its function need to be further studied, which is directly related to the application effect of no tillage in this area. The objective of this study was to investigate how tillage systems (rotary tillage, RT; subsoiling, SS; no tillage with maize straw mulch, NT) affect soil pore characteristics, which in turn affect soil water holding capacity and gas transport function. Undisturbed soil samples were collected from 0-40cm soil layer for X-ray Computed Tomography (μCT) at a resolution of 25μm and measurements of bulk density, soil water retention, air-filled porosity, and relative gas diffusivity. Compared with conventional tillage, SS showed larger total porosity and relative gas diffusivity, while NT showed smaller total porosity and relative gas diffusivity for dry soil. NT increased the available water content of 0-30cm soil depths, and within the water range, the relative gas diffusivity under NT was similar to that of RT and SS. Soil under NT created more irregular pores in 0-30cm soil layer, and the ratio of irregular porosity to regular porosity (Ir/R) was significantly higher than that under SS. The correlation analysis results showed that Ir/R was positively correlated with specific diffusivity at -6kPa matric potential. The results from this study indicate that NT leads to change pore morphology to have positive implications for soil water content and gas transport.

Keywords: No tillage,Gas diffusivity,Pore shape,Soil water content

ID ABS WEB: 137957

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

BRAZILIAN SUBTROPICAL BLACK SOILS: CARBON STOCKS AND AGRICULTURE IN THE ATLANTIC FOREST AND PAMPA BIOMES

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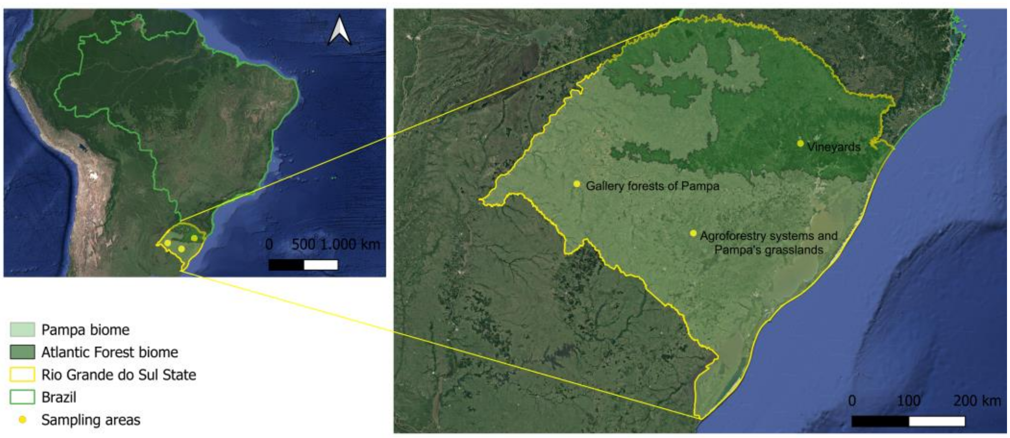
Black Soils are characterized by the dark surface horizons with high carbon content and high natural fertility. They include soils classified as Chernozems, Kastanozems, and Phaeozems in the World Reference Base. Despite their relevance in terms of food production, many concerns persist about the carbon storage potential and risk of degradation of black soils. Notably documented in China, Russia, Kazakhstan, Ukraine, the European Union, and United States and Canada, in the South America, Argentina has the most comprehensive extension and research on black soils. In Brazil they are identified as tropical, anthropic, and midlatitude black soils (FAO, 2022). The midlatitude black soils are located in southern region of Brazil, under the Atlantic Forest and Pampa biomes with a subtropical climate, and they are intensively used for fruit production and cattle farming. This study focuses on carbon stocks in the upper 0.2 m of representative Brazilian subtropical black soils. In some sites under Pampa's gallery forest the carbon stocks range from 90 to 107 Mg ha-1, with the areas accessible to cattle showing higher stocks. In natural grasslands the carbon stocks were 74.1 Mg ha-1 whilst the agroforestry systems in the adjacencies, with 1 and 3 years of management, witnessed carbon losses of 15 and 26 Mg ha-1, respectively. Agroforestry is considered a sustainable system, but tillage must be minimized to prevent significant carbon loss. In the Atlantic Forest biome, areas with vineyards of about 80 years exhibited an average carbon stock of 61 Mg ha-1, emphasizing the carbon sequestration potential of black soils under this form of agricultural use. Despite their critical role in food production and carbon sequestration, the subtropical black soils in Brazil face threats from erosion and loss of carbon in areas of agriculture and cattle production without conservation practices. Brazilian policies for agriculture must play a pivotal role for mitigation of climate change by safeguarding and enhancing soil carbon stocks.

Brazilian Subtropical Black Soils: carbon stocks and agriculture in the Atlantic Forest and Pampa biomes. Areas of soil sampling.



Keywords: Midlatitude black soils,Climate change,Pampa,Atlantic Forest

ID ABS WEB: 138092

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

PERVASIVE SOIL PHOSPHORUS LOSSES IN TERRESTRIAL ECOSYSTEMS IN CHINA

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Future phosphorus (P) shortages could seriously affect terrestrial productivity and food security. We investigated the changes in topsoil available P (AP) and total P (TP) in China's forests, grasslands, paddy fields and upland croplands during the 1980s-2010s based on substantial repeated soil P measurements (63,220 samples, in the 1980s, 2000s and 2010s) and machine learning techniques. Between the 1980s and 2010s, total soil AP stock increased with a small but significant rate of 0.13 kg P ha-1 yr-1, but total soil TP stock declined substantially (4.5 kg P ha-1 yr-1) in the four ecosystems. We quantified the P budgets of soil-plant systems by harmonizing P fluxes from various sources for this period. Matching trends of soil contents over the decades with P budgets and fluxes, we found that the P-surplus in cultivated soils (especially in upland croplands) might be overestimated due to the great soil TP pool compared to fertilization and the substantial soil P losses through plant uptake and water erosion that offset the P additions. Our findings of P-deficit in China raise the alarm on the sustainability of future biomass production (especially in forest), highlight the urgency of P re-cycling in croplands and emphasize the critical role of country-level basic data in guiding sound policies to tackle the global P crises.

Keywords: soil available phosphorus,soil total phosphorus,spatiotemporal change,digital soil mapping,phosphorus budget

ID ABS WEB: 138173

4. Soil health in achieving the Sustainable Development Goals
4.25 133607 - Black Soils: their importance for Food Security and Carbon Neutrality

SEASONAL DYNAMICS OF SOIL PH AND N TRANSFORMATION WITH 15N LABELING FERTILIZATION IN SUBTROPICAL CHINA

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Nitrogen (N) fertilization-induced soil acidification has received much attention worldwide. Nitrification and soil N mineralization are two key N cycle processes that affect soil acidification, however, the seasonal dynamics of soil pH under their combined influence remains unclear. We studied the seasonal dynamics of soil pH and N transformation using 15N tracing in field lysimeters with soils developed from different parent materials (Quaternary red clay, sandstone, and basalt). 200 kg N ha-1 yr-1 of urea was applied with maize planting. During 7-45 days after fertilization, proton (H+) production from nitrification of fertilizer N, nitrate (NO3-) leaching, and plant uptake exceeded H+ consumption by base cations exchange, resulting in a significant decline of soil pH. When nitrification decreased (after 45 days) due to the exhausted substrate, soil pH rose again. During the fallow period, neutralization by base cations exchange and mineralization of soil organic N (SON) as well as the associated release of base cations offset H+ production from nitrification of mineralized SON and thereafter led to a sustained rise of soil pH. After the one-year experiment, no significant decrease in soil pH was observed in any of the soils. In subtropical regions, with the changing of N transformation and plant growth, there is an obvious seasonal variation of soil pH after N fertilization. Parent material had little effect on the seasonal variation, which appeared to be controlled by fertilization, environmental factors (temperature and moisture), and plant uptake.

Keywords: Soil genesis,Soil acidification,Nitrogen transformation,Nitrogen isotope,Soil sustainable development

ID ABS WEB: 136583

4. Soil health in achieving the Sustainable Development Goals
4.26 133608 - Developing new models of urban soils

LONG TERM RESEARCH ON URBAN SOILS

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The complexity and dynamism of urban soils complicate analysis of their function and support of ecosystem services. Long-term studies can be a great aid for addressing this complexity allowing for evaluation of how changes are driven by variation in climate and land use and management.
In the Baltimore Ecosystem Study (BES), measurements of soil moisture and temperature, soil:atmosphere fluxes of carbon dioxide, nitrous oxide and methane, soil solution chemistry, and riparian groundwater level and chemistry have been ongoing in urban forests and grasslands since 1998. These studies have been carried out in a watershed context that integrates ecological, physical and social sciences. Watershed input/output budgets for nitrogen have shown surprisingly high retention which has led to detailed analysis of sources and sinks in these watersheds. These long-term studies have shown that urban forests and grasslands have more complex coupled carbon and nitrogen dynamics than previously thought. Urban soils have a high potential to cycle and retain, as well as to lose nitrogen and the balance between retention and loss is a complex function of social and hydrobiogeochemical processes. Basic science research on these processes, and their interactions improves our basic science understanding of soils and can lead to improved management of an important land use/land cover type.

Keywords: urban,nitrogen,greenhouse gases,riparian,grassland

ID ABS WEB: 136920

4. Soil health in achieving the Sustainable Development Goals
4.26 133608 - Developing new models of urban soils

PROPER UTILIZATION OF THE SOIL AND CARE OF BIODIVERSITY ENVIRONMENTAL DEGRADATION IS CLOSELY LINKED TO SOIL DECAY WE CREATED AN ECOLOGICAL CORRIDOR FULL OF AROMATIC PLANTS TO SUSTAIN POLLINATORS

A. DEL ROSO, M.R. BIANCHI

Liceo Scientifico MAJORANA, CAPANNORI LUCCA, ITALY

From the Proper Utilization of the Soil to the Preservation of Biodiversity

A Study on Pollinator Insects and Their Vital Role in Sustaining Plant Biodiversity and Ecosystems Health

From Words to Actions: Establishing “Buzz Lines” in Anthropized Areas
Our “Bee Garden”

Class 3A and 3B, Scientific High School “Ettore Majorana” – Capannori (LU) –
School Year 2022-2023

Introduction
A soil in its natural state provides the ecosystem services necessary for its own sustenance. Simultaneously, it is a fragile resource often regarded with insufficient awareness and diminished attention.
Environmental degradation is closely linked to soil degradation.
Out study focused on the significant decline of pollinator insects and the necessity of preserving green areas even within urban territories to provide genuine “ecological corridors” for bees.
The introduction of these spaces could also contribute to an eco-friendlier use of anthropized and degraded soils in cities.

Our Project
We conceived the idea of implementing a mini- ecological corridor to “turn words into actions” and to raise awareness among other students in the school.
The series of soil seminars provided to us by the Lions association “Antiche Valli Lucchesi” and the reading of the latest ISPRA report (see references) served as stimuli and driving forces to develop our project. To grasp the issues of impoverished soil firsthand, we conducted a series of chemical analyses in the school laboratory of the soil of our school garden, both before and after fertilization with compost produced by us. Subsequently, we researched perennial plants that bloom in summer, a period when bees struggle to forage. We selected a variety of aromatic plants and planted them to create our small “bee garden”.

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https://www.snpambiente.it/snpa/consumo-di-suolo-dinamiche-territoriali-e-servizi-ecosistemici-edizione-2022/

Keywords: BIODIVERSITY,BUZZ LINES

ID ABS WEB: 137170

4. Soil health in achieving the Sustainable Development Goals
4.26 133608 - Developing new models of urban soils

A COMPARATIVE EVALUATION OF THE ROLE OF THE ORGANO-MINERAL COLLOIDS AND THE TEXTURE OF THE FINE SOIL ON THE HYDRAULIC PROPERTIES OF COMPOSITE SOILS

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The collection and composting of food waste are a common practice for recycling bio-waste for use as a soil amendment. The hydraulic properties of a composite soil (must ensure that its water retention and transfer functions are optimal.The role of organic matter in regulating the soil carbon cycle has largely been studied and demonstrated, the role of soil-absorbing clay-organic complexes, i.e. all the colloids in controlling the main hydraulic properties of the soil: porosity, soil available water and soil hydraulic conductivity, is not known. In this study, the role of clay-organic components in the main hydraulic properties of composite soils has been questioned. Field experimental plots filled with mixtures of mineral waste and food waste compost, has been designed and carried out. Each month, Mini Disc and one BEST in situ infiltration tests are realized to determine the hydrodynamic characteristics of the composite soil. Then, soil samples (disturbed and non-disturbed) are taken per plot et per month to perform a series of classical-called physico-chemical characterization tests essentially including total organic matter (OM) content and granulometry by Laser apparatus. A performance protocol is adapted to draw the particle size distribution curve of fine particles (< 2 µm) by laser-granulometry analyses in samples containing and not containing organic matter. Interpretation of tests enable to estimate the hydraulic conductivity using the BEST method, to plot the soil retention curve according to physical properties and to deduce the soil's available water content. By assumption, the fraction of fine clay-organic components would be different from one plot to the next, and the main variable over time. In general, organic matter is destroyed before texture analysis. But here; we also carry out a soil texture analysis including OM. Then, by differentiating the two curves (with and without OM) with the laser granulometer, we obtain the size distribution of the OM particles in the complete particle size curve and evaluate its role on the measured hydraulic properties.

Keywords: Clay minerals,Organic matter,Urbanization,Compost,Soil functions

ID ABS WEB: 138149

4. Soil health in achieving the Sustainable Development Goals
4.26 133608 - Developing new models of urban soils

THE REUSES PROJECT: RESTORE URBAN SEALED SOIL FOR ALTERNATIVE ECOSYSTEM SERVICES

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The continuous urban development is propelled by social and economic needs, albeit at the expense of the earth's surface due to land consumption. Soil sealing emerges as a detrimental threat, since impermeable materials permanently cover the soil, compromising various soil ecosystem services, including the production function, carbon fixation and storage capacity, regulation of water and gas fluxes, as well as the amelioration of water and air quality. In this context, the two-year project (funded by the European Union - Next Generation EU – PRIN 2022 PNRR) centers on the possibility of reclaiming and repurposing long-sealed soils to restore their functionality and ecosystem services. The primary focus of the research is to establish urban gardens (UGs) in abandoned sealed areas by removing covers, implementing field operations, and applying specific treatments to ensure the growth of seasonal vegetables. The project is carried out in Ancona, a medium-sized city along the Adriatic coast, with a population of 100.500 inhabitants. In accordance with the Municipality, two different public abandoned areas are provided. The main stages are: i) a preliminary assessment of de-sealed soil to evaluate its morphological, physical, chemical, and biological properties and identify dysfunction, threats, and weaknesses; ii) an evaluation of compost characteristics that will be applied to promote plant growth and soil restoration; and iii) monitoring and estimating plant quality, including standard measurements required to guarantee food safety. After each crop cycle, soil characteristics assessed at the beginning of the experiment will be analysed to evaluate the effective restoration of soil capacity. This information will provide scientific guidelines for managing these areas for community UGs. Positive outcomes from the project are anticipated to yield environmental and social benefits, including the restoration and reuse of degraded and unused urban surfaces, recovery of soil functionality after de-sealing, and the establishment of new green areas for citizen use.

Keywords: Soil sealing,Urban soil restoration,Urban gardens,Soil consumption,Soil ecosystem services

ID ABS WEB: 136377

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

FIRST NATIONAL REFERENCE OF MICROPLASTIC CONTAMINATION OF FRENCH SOILS AND THE NEED FOR FURTHER MONITORING

M. PALAZOT [1], L. SOCCALINGAME [1], C. FROGER [2], C. JOLIVET [2], A. BISPO [2], M. KEDZIERSKI [1], S. BRUZAUD [1]

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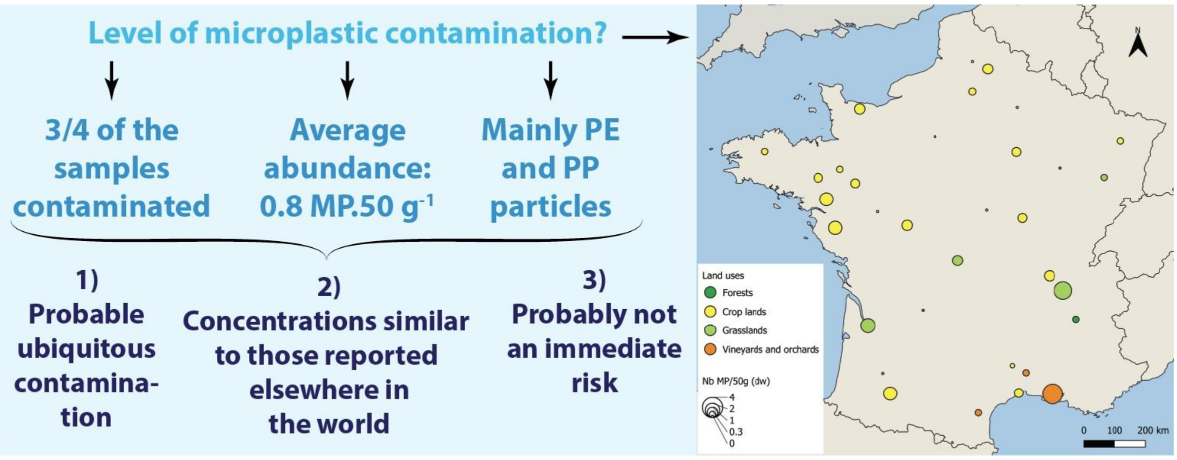
The recent emergence of studies on plastic contamination of terrestrial environments has revealed the presence of microplastics (MP) in a variety of soil types, from the most densely populated areas to the most remote ones. However, the concentrations and chemical natures of MP in soils vary between studies, and only a few ones have focused on this issue in France.
The MICROSOF project aimed to establish the first national reference to French soil contamination by microplastics. Microplastics were analyzed in thirty-three soil samples selected from the French soil quality monitoring network, mostly among agricultural areas but not only. The study collected data on the abundance of microplastics in the [315 - 5000] µm range, their chemical nature and size, as well as mass abundance estimates and other relevant information. Results demonstrated that 76% of the soil samples contained microplastics, in concentrations ranging from < 6.7 to 80 MP.kg-1 (dry soil). Most samples from croplands, grasslands and vineyards and orchards were contaminated, whereas only one sample from forest contained MP, suggesting an increased risk of microplastic contamination in soils exposed to agricultural practices. The MP abundances were not statistically different from similar studies, indicating an intermediate level of contamination in French soils. Despite the information collected from farmers about their agricultural practices through intervention reports and surveys, the sources of microplastics in soils remained unclear questioning the transfer and behavior of those contaminants in the environment. Thanks to the support of ADEME, this study gave, for the first time, an overview of soil contamination by microplastics in France, as well as the potential risks. It also advocates for an integration of microplastics analysis on national soil monitoring programs to better apprehend the presence of those compounds in soil and their potential threats to ecosystems and humans.



Keywords: Microplastics,Soil contamination,Microplastic extraction,Soil monitoring,France

ID ABS WEB: 136443

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

FIRST GLANCE OF FRENCH SOIL CONTAMINATION BY PESTICIDE RESIDUES AND THE NEED FOR BROAD-SCALE MONITORING

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The intensive use of pesticides in modern agriculture raised concerns about their environmental fate and impacts on the ecosystems. If the monitoring of those substances in water bodies has been established in Europe since the 2000's, knowledge of soil contamination by such residues is scarce. However, the few studies addressing this issue pointed out the widespread occurrence of pesticides in soils and the risk they can pose for soil biodiversity. This study investigated 111 currently used pesticides in 47 soils sampled across France, mostly from arable lands but also from forest and grasslands theoretically exempted of pesticides applications. The sampling strategy was based on the French Soil Quality Monitoring Network to evaluate the feasibility of using an existing network for pesticides monitoring in soils. The results demonstrated the widespread contamination of almost all soils samples by residues, including untreated areas such as forests and permanent grasslands. Up to 33 different substances in one soil sample were detected, at concentrations leading to a medium to high ecotoxicological risk for earthworms in arable lands. Several frequently detected residues have never been reported in the literature so far or were found at much lower detection rates. Finally, the comparison with pesticide application records provided by the farmers revealed the unexpected presence of some substance in sites where they were not applied and a longer than expected persistence of several compounds. These findings question the fate of currently used pesticides in the environment under current agricultural practices and advocate for the monitoring of pesticides in soils at broad scales. Filling the knowledge gap of pesticide presence in soil is necessary to understand the contamination of other environmental compartments and prevent their contamination. Therefore, there is a clear need to integrate pesticide analysis in national soil monitoring programs to evaluate contamination levels, which will be conducted in France. This monitoring will include both target and non-target analyses to identify all the potential molecules in soil.

Keywords: Pesticides,Soil monitoring,Persistence,Risk assessment

ID ABS WEB: 137353

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

SOIL QUALITY CLASSIFICATION BASED ON LONG-TERM DATASETS OF CLIMATE AND CROP DATA -- A CASE STUDY IN SHAANXI AND HEBEI PROVINCE, NORTH CHINA

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Regional soil surveys can provide reliable information for soil quality classification. However, while the sizes of most farms in northern China are small scale with an area less than a hectare, both data of national soil survey and the annual province monitoring of soil available nutrients with 10 km scale resolutions have limited practical application. Since annual cropland biomass depends on soil quality and climate conditions, the value of biomass measurements as an indicator of soil quality is possible. This study calculates 30-year changes of cropland biomass using satellite remote sensing data in Hebei Province dominated by irrigated cropland, and in Shaanxi Province by rainfed cropland. With relevant analysis on the contribution of climatic factors to interannual fluctuations in biomass by a county scale, ten years with suitable climate conditions for crop growth is selected out of the 30 years. The average cropland biomass in these 10 years is employed to classify soil quality of cropland into five grades respectively in rainfed cropland and irrigated cropland is with a resolution of 0.5 km in two provinces. The five grades of biomass method were compared with same grades classified by both data of national soil survey data and of province network monitoring soil available NPK. The results show that biomass soil quality classification has obvious advantages in spatio-temporal resolutions, operation cost, and the correlation between grades and crop yield. Especially, in determining medium- and low-yield cropland, the grade system using biomass method have clear practical value and application prospects for agricultural policy decisions.

Keywords: Soil quality,Soil monitoring,Dataset,classification,Remote sensing

EPOSTERS

ID ABS WEB: 137388

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

SOIL QUALITY CLASSIFICATION BASED ON LONG-TERM DATASETS OF CLIMATE AND CROP DATA -- A CASE STUDY IN SHAANXI AND HEBEI PROVINCE, NORTH CHINA

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Regional soil surveys have been proven to be reliable sources of information for classifying soil quality. However, in the northern regions of China, where small-scale farms with an area less than one hectare are prevalent, the data obtained from national soil surveys and annual province-level monitoring of soil nutrient availability at a 10 km resolution have limited practical application. As annual cropland biomass is significantly influenced by both soil quality and climate conditions, biomass measurements can be used as indicators of soil quality. Utilizing satellite remote sensing data and climate data, we calculated the changes in cropland biomass over a 30-year period in Hebei Province, which is dominated by irrigated cropland, and in Shaanxi Province, which is dominated by rainfed cropland in North China, then classified the soil quality of cropland in the two provinces into five grades based on the average cropland biomass with a resolution of 0.5 km, and compared the results with those obtained from national soil survey and province network. The results showed that the biomass soil quality classification method had obvious advantages in terms of spatial and temporal resolution, operating cost, and correlation between classification and crop yield. This classification system has clear practical value and application prospects for agricultural policy decisions in medium- and low-yield croplands.

Keywords: Soil quality,Soil monitoring,Dataset,classification,Remote sensing

ID ABS WEB: 137919

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

TOWARDS A EUROPEAN HARMONIZED SYSTEM FOR MONITORING SOIL MICROBIAL BIODIVERSITY

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Healthy soils are able to provide many ecosystem services (e.g., food provision and climate regulation), and they are generally characterized by a diverse and resilient microbial community. To constantly monitor soil health and promote its sustainable management, in 2009 the European Commission's Joint Research Centre (EC-JRC) established the European Land Use and Coverage Area Frame soil module (LUCAS Soil). Since 2018, it also measures soil biodiversity. So far the evaluation of the comparability of biodiversity data obtained from LUCAS Soil and individual EU Member States is lacking. Indeed, many factors may lead to biases, from the sampling procedure to the computational analysis.
One of the aims of the European Joint Programme on Soil (EJP SOIL) is to compare the EC with national biodiversity assessment strategies to harmonize the analytical procedures and define standard methodologies.
Over the 2022 LUCAS sampling campaign, soils from 98 locations were collected across Italy. Of these, 17 sites were sampled also following Italian strategies. DNA was extracted from soils collected in these double sampling points and bacterial 16S (V3-V4 rDNA) and fungal ITS2 regions sequenced and analysed.
Obtained data suggested that environmental variables (e.g., land cover and sampling region) have a strong significant effect on the structure of soil microbial communities, while the sampling strategy has either little or no effect. The data will be compared with the JRC's results on the same LUCAS samples (to be sequenced in 2024) to evaluate the effect of different analytical methods (e.g., DNA sequencing target and strategy). This knowledge will help defining standard procedures for setting up both a national and European monitoring networks and giving clues for data comparison and harmonization.

Keywords: Soil monitoring,Soil biodiversity,Microbiology,Harmonization of methodologies,LUCAS Soil

ID ABS WEB: 138077

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

IMPACT OF MEASUREMENT UNCERTAINTY ON SOC MONITORING IN AGRICULTURAL SOILS

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Monitoring of changes in soil organic carbon (SOC) content is gaining more attention due to accelerated climate change. It is especially important for agricultural land assessment as farmers are requested to enhance or at least maintain existing carbon stock in soil. Despite of availability of various methods and the development of analytical techniques, it is still challenging to perform precise evaluations considering the heterogeneity of soils. Thus, it is essential to quantify the impact of sampling and analytical methods on measurement results by estimating uncertainty arising from the sampling and laboratory analysis. Uncertainty from laboratory measurement is often estimated, but uncertainty caused by the sampling is rarely taken into account.
In the current study, we measured SOC content at three experimental plots located in different soil-climatic conditions using commonly applied analytical methods such as Dumas dry combustion (DC) and Walkley-Black (WB); in addition, we used loss on ignition (LOI) as an indirect estimation of SOC, which is still used for soil fertility assessment for farmers fields. Field soil sampling was conducted using a grid method in a duplicate manner, to enable uncertainty estimation. The measurement uncertainty was estimated using classical and robust analysis of variance (ANOVA and RANOVA, respectively) from set of samples consisting from 8 to 14 pairs. The study showed that sampling has a considerable contribution to the measurement uncertainty, varying from 8.75-15.79 %, as an expanded relative uncertainty, while uncertainty caused by analytical methods varied between 2.18-2.35 % for DC, 7.05-7.84 % for WB, and 11.95-12.52 % for LOI, and total measurement uncertainty varied from 11.01 to 18.37 %. Obtained values underline the significance of the selected analytical method and sampling impact on measurement uncertainty, which can challenge the monitoring process and complicate detection of small changes in SOC content, which is normally expected is short- or medium-term periods, and thus under- or overestimate sustainability of certain agricultural practices applied in a field scale.

Keywords: SOC monitoring,Soil sampling,SOC measurement,Measurement uncertainty,Uncertainty from sampling

EPOSTERS

ID ABS WEB: 138211

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

LAST STEP BEFORE THE IMPLEMENTION OF A COMPREHENSIVE MONITORING OF SOIL BIODIVERSITY FOR FRENCH SOILS

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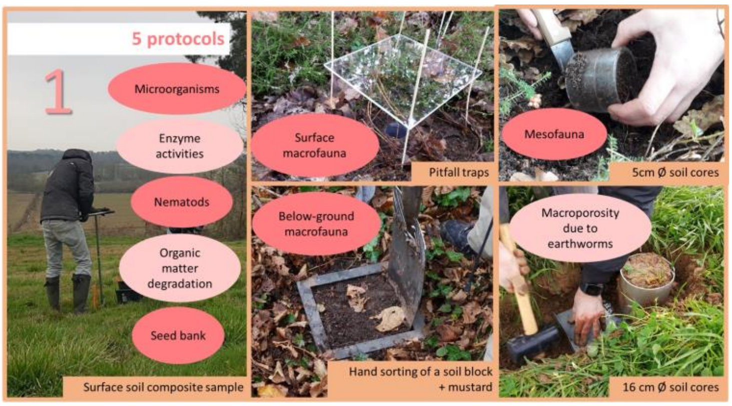
Despite its importance for human activities, soil biodiversity remains largely unknown and threatened. The French Soil Quality Monitoring Network (RMQS) has a significant impact in removing the grey areas through its survey of soil microorganisms and enzymatic activities. These survey have deepened our knowledge of the biogeography of microorganisms, the link with soil use and agricultural practices, and identified bioindicators of soil quality. But the RMQS could also support long-term monitoring of other components of soil biodiversity.
In 2017, the French office for biodiversity expressed the need to build a survey of soil biodiversity, which will be part of the larger survey of terrestrial biodiversity. A first experimentation based on the monitoring of 30 RMQS sites around France started in 2019, taking into account scientific and practical aspects. Biodiversity sampling was carried out all year long, by the same 12 teams as for the RMQS program, simultaneously with soil sampling and description. Bacteria, fungi and protists were monitored by DNA extraction and sequencing, as well as environmental DNA. Nematodes, mesofauna (particularly springtails), below-ground (earthworms) and surface (beetles and spiders) macrofauna were monitored by sampling and identification of specimens. This study demonstrated the feasibility of monitoring all components of soil biodiversity and lead to the writing of a manual of specifications. However, contrasting to soil microorganisms which can be monitored all along the year, results showed that soil fauna should be monitored during spring.
In spring 2024, a second experimentation based on the monitoring of 72 sites will start, involving 3 soil biodiversity experts teams to monitor the same groups as in the first test, from March to June. This experimentation will assess the feasibility of sampling more sites during a shorter period of time. The objective would be to reach the sampling of 180 sites per year, i.e. the routine level of sampling of the second RMQS campaign, to implement a comprehensive monitoring of soil biodiversity for French soils.



Keywords: Soil monitoring,Soil biodiversity,Monitoring network,Sampling,France

ID ABS WEB: 138279

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

SOIL HEALTH DATA CUBE FOR EUROPE AT 30 M RESOLUTION

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Monitoring basic soil health indicators such as soil organic carbon, soil chemical properties, soil pollution, soil degradation of Europe at high spatial resolution is needed for decision making and sustainable development planning at all scales from the European Union to local landowners and land managers. The study introduces the Soil Health Data Cube builded within the AI4SoilHealth project (https://cordis.europa.eu/project/id/101086179). The Data Cube stacks predicted maps of basic LUCAS soil health indicators related to soil organic carbon stocks, soil nutrients and soil structure together with covariates related to static soil forming factors such as terrain and parent material (Global Lithological DB GLiM), and time-series of dynamic factors such as climate, vegetation and human intervention (e. g. CHELSA Climate, MODIS EVI and LST long-term derivatives, Bare Soil Fraction, annual tillage index, FAPAR, NDVI). Maps of soil properties are predicted spatiotemporally at 30 m resolution for 2000-2022+ for standard depth intervals (if applicable) based on the legacy point data. The main resources for training data are European surveys such as LUCAS and GEMAS, and national legacy point datasets of the member states. Predictions are based on ensemble machine learning models using Random Forest, Artificial neural network and Catboost algorithms including per-pixel model deviance, that can be used to estimate the uncertainty. The results are compared with national soil maps such as UKSO, bodemdata.nl. The Soil Health Data Cube will be published under open data license and can be used for direct analysis for research, multi scale decision making, crop-yield modeling and management planning. Moreover, the produced data can be used to simulate impact of different climate scenarios on the soil health in Europe.

Keywords: Soil Health,Data Cube,Spatio-Temporal Modelling,Machine Learning,High Resolution Open Data

ID ABS WEB: 139354

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

A COMPARATIVE ANALYSIS OF PLS1 AND PLS2 FOR ESTIMATING SOIL PROPERTIES USING MID-INFRARED SPECTRA

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Accurate and regular assessment of the biological, physical, and chemical properties of soil is crucial to understanding soil change and to properly manage soils as a natural solution to climate change. However, it takes substantial time and cost to pretreat soils and quantify soil properties. Mid-infrared spectroscopy coupled with Partial Least Squares (PLS) can be a complementary method to the conventional wet-lab assessment of soil properties. Here we leveraged 482 soil samples with known properties and assessed their mid-infrared spectra. These soils were collected under deep-rooted plants and shallow-rooted plants across 9 sites in the United States. We built PLS1 and PLS2 models on 13 soil properties and compared the model performance (R2 and RMSE). PLS1 predicts a single property at a time, while PLS2 simultaneously predicts multiple soil properties. Overall, the PLS1 models outperformed the PLS2 models for the 13 properties tested in this study. However, during cross-validation, organic carbon, pH, calcium ion, magnesium ion, potassium ion, aluminum ion, and sand, silt, and clay content showed an R2 difference of less than 0.05 between PLS1 and PLS2. This suggests that using PLS2 can yield comparable estimation results for soil, simplifying both the calibration and prediction procedures. As follow-ups, we will include soil biological properties such as respiration, microbial biomass, and enzyme activities in models and further compare the performance between the PLS1 and PLS2 models.

Keywords: Mid-infrared spectroscopy,Partial Least Squares,Soil properties,Soil monitoring

ID ABS WEB: 140099

4. Soil health in achieving the Sustainable Development Goals
4.27 133609 - How will we monitor soils in the coming century?

DRY COMBUSTION BY THERMAL GRADIENT FOR SIMULTANEOUS DETERMINATION OF ORGANIC AND INORGANIC CARBON IN SOIL: A COMPARISON WITH TRADITIONAL METHODS IN SEVERAL ALPINE AND ALLUVIAL SOILS IN NORTHERN ITALY

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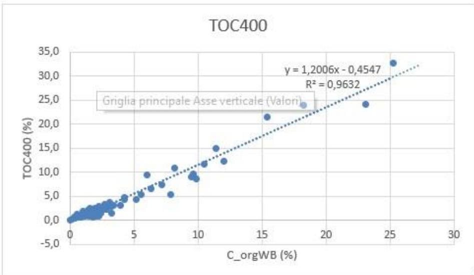
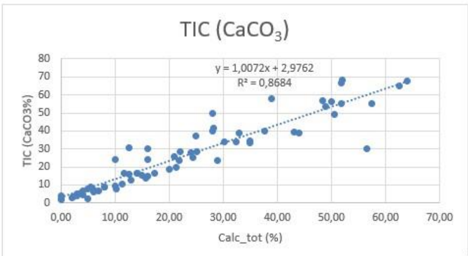
SOM is recognized as the most important indicator of soil quality and fertility. In view of the monitoring that will hopefully be implemented by the upcoming SML, reliable and environment-friendly methods are needed for the quantification of SOC. Meanwhile, comparison of methods is of utmost importance to exploit soil data collected in the past, to assess carbon stock variations in the long term with a high level of confidence. The “Temperature dependent differentiation of total carbon (TOC400, ROC, TIC900)” method has been recently published (October 2023) as European standard EN17505 and represents an evolution of the classic dry combustion method (ISO 10694:1995), allowing to analyze larger samples, overcoming the critical issue of sample homogenization, and to differentiate and determine organic and inorganic carbon in one single analytical run. Among the 589 Soil Typological Units described by the “Soil Quality Unit” of ARPAV in the 18.000 km2 of the Veneto region, within soil maps at 1:250.000 and 1:50.000 scale, 100 topsoil samples were chosen, as representatives of different soil types. Climates, landscapes and parent materials range from coastal dunes and lagoon reclamation areas to alluvial plains of different ages, from pre-glacial maximum to late Holocene, together with hilly and mountain reliefs on different lithologies, from calcareous to siliceous. 12 WRB soil groups were represented, 7 USDA soil orders and 43 subgroups. Samples from the regional soil sample archive (17,000 soil samples collected during 30 years) formerly analyzed by Walkley Black for TOC and ISO 10693 for CaCO3 were re-analyzed by the new EN17505 method in the “Soil and Waste Unit” of ARPAV lab.
Samples ranged from 1 to 328 g kg-1 organic carbon content, from absent to 685 g kg-1 CaCO3. Results showed high consistency between the different methods with recovery comparable to those reported in literature for dry combustion vs wet chemistry methods, for organic carbon (TOC400, fraction decomposing at temperature <400°C), and vs volumetric method, for inorganic carbon (TIC900).





Keywords: Soil Organic Carbon,Soil Inorganic Carbon,Dry Combustion,SOC analytical method,Soil carbonates

ID ABS WEB: 136052

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

IS SOIL QUALITY COMPATIBLE WITH SOIL ORGANIC CARBON CAPACITY OF THE ALLOPHANIC SOIL IN NORTHERN JAPAN?

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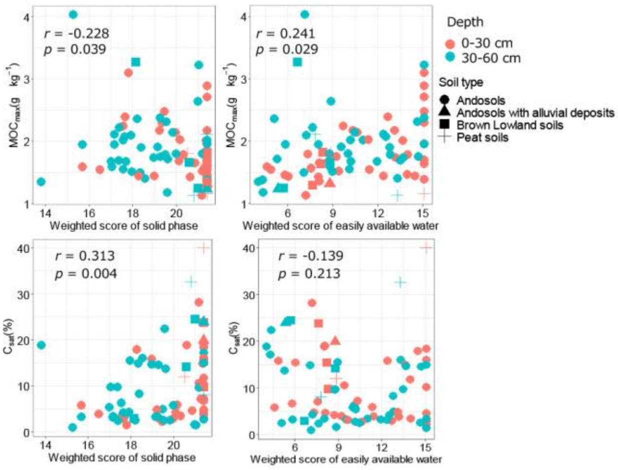
Efforts to quantify soil quality involve computing a Soil Quality Index (SQI) by assessing soil physicochemical properties. Enhanced soil management, optimizing the material cycle, aims to ameliorate soil health with organic matter (OM) input for improved properties. Augmenting carbon sequestration in soil is pivotal for enhancing soil quality and health, given the substantial carbon reservoir. The maximal quantity of mineral-associated organic carbon (MOCmax) is approximated by the clay and silt content (CS). Carbon saturation (Csat = MOC / MOCmax) is derived from MOCmax. However, Csat data in allophanic Andosols are scant, raising uncertainty about the contribution of applied OM to soil physicochemical properties. This study in northern Japan estimated MOCmax and Csat, exploring the correlation between these parameters and soil properties.
The Minimum Data Set (MDS), selected by principal component analysis, is used to calculate the SQI. Indicators in MDS are weighted according to variation magnitude, and the SQI is computed by aggregating these weighted scores. The proportion of MOC in total carbon and MOCmax are determined by referencing from precedent studies' value and formula which is directly proportional to CS.
The study's average Csat is approximately 10%, below the global arable land average. Weighted scores for the solid phase correlate positively with MOCmax and Csat, while scores for easily available moisture exhibit a significant negative correlation solely with MOCmax. Soils with high CS and high MOCmax may cause pores to be easily filled with fine particles by compaction, decreasing solid phase scores, and high MOCmax may decrease Csat. Findings suggest that OM input would not only increase soil carbon storage but also improve SQI in this region, positing an improbable carbon saturation there. Acknowledging inaccuracies in MOC and MOCmax estimations and potential MOCmax underestimation due to allophanic characteristics is imperative. Systematic collection and organization of these data would facilitate proposing a comprehensive soil health index, integrating SQI and Csat.



Keywords: soil quality,soil health,mineral-associated carbon,carbon saturation,allophanic soil

EPOSTERS

ID ABS WEB: 136255

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

MANAGEMENT IMPACT OF COVER CROPS ON SOIL HEALTH INDICATORS IN A SMALL-SCALE ORGANIC VEGETABLE PRODUCTION SYSTEM

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In intensive vegetable production systems, cover crops (CC) are usually incorporated into the soil by disking prior to the subsequent crop. In recent years, silage tarps have gained popularity amongst farmers in Quebec as a suitable tool for no-till cropping systems. Termination of CC by roller-crimping is another strategy used by organic farmers. However, these practices have not been studied extensively in vegetable cropping systems in Eastern Canada. Our main objective was to assess the impact of CC termination with or without tillage on soil health indicators. A 2-year field experiment (2022-2023) was conducted on a clay loam at a research site in Saint-Augustin-de-Desmaures, QC, Canada. In both years, a spring-seeded CC mixture was terminated mid-summer, followed by a vegetable crop. In 2022, a mixture of field peas and oats was seeded, while in 2023, the CC mixture consisted of field peas and faba beans. Treatments were arranged in a split-plot design with four blocks. Four CC termination systems (whole plot factor) were evaluated before vegetable transplanting: 1) roller-crimping, 2) flail-mowing and tarping, 3) flail-mowing and incorporation by disking, and 4) a fallow control with no-CC. The subplot factor was the fertilization rate of vegetable crops based on nitrogen recommendations (0%, 50%, and 100%). After the termination of CC, broccoli and beetroot were transplanted in 2022 and 2023, respectively. At harvest time, soil samples were collected at a 0-10 cm depth, and soil health indicators were measured using soil-based lab tests. Using CC resulted in a higher proportion of water-stable aggregates (>2mm) and a larger mean-weight diameter of stable aggregates compared to the no-CC control. Soil respiration values were higher in the treatments with CC than in the no-CC control, and soil bulk density was higher in the roller-crimped CC treatment than in the other treatments. Our results showed that establishing spring-seeded CC into organic vegetable production systems, regardless of termination methods, offers some soil health benefits in the short-term.

Keywords: Organic farming,No-till vegetables,Spring cover crops,Aggregate stability,Microbial respiration

EPOSTERS

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4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

EISENIA FETIDA AVOIDANCE FOR TOTAL SOIL COPPER IN AGRICULTURAL SOILS POLLUTED BY COPPER-BASED PESTICIDES

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Most ecotoxicological investigations assessing Cu-toxicity use metal-spiked soils, while research on real-world Cu-contaminated soils remains limited. At present, there are no studies using earthworm-based bioassays to evaluate Cu toxicity of agricultural soils contaminated with Cu-based pesticides. The main restriction for utilizing real-world contaminated soils for ecotoxicity assessment pertains to multi-metal pollution. Agricultural soils subjected to Cu-based pesticide application provide a distinctive example of soils contaminated predominantly with one metal. This study aimed to establish levels of Cu-toxicity in Cu-based pesticide polluted agricultural topsoils for earthworms. Forty topsoils (0-5 cm) from orchards and vineyards of central Chile, along with 10 soils under native wild vegetation (background soils), were sampled. Given the vital ecological role played by earthworms, a standardized avoidance bioassay utilizing Eisenia fetida was employed to gauge the impact of copper-based pesticides on the soils under study. Results showed that total copper in soils ranged between 23 and 566 mg kg-1, with toxic effects on earthworms in select soils. As determined through the avoidance response of Eisenia fetida, the effective concentration at 50% (EC50) of total soil copper was found to be 240 mg kg-1, with a 95% confidence interval of 193-341 mg kg-1. Findings of the present study are significant as the EC50 value obtained is consistent with the EC50 values derived from other investigations that utilized actual contaminated soils. Acknowledgements to ANID PIA/BASAL FB0002 and Fondecyt-Postdoctoral 3220026.

Keywords: metal toxicity,agricultural soils,pesticides,orchards,earthworms

ID ABS WEB: 137148

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

EFFECT OF LIVINGRO® TREATMENT ON SOIL HEALTH INDICATORS IN AN EXPERIMENTAL CROP PLOT IN ZARAGOZA (SPAIN).

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Assessing the soil health in agricultural areas is a fundamental task, particularly in the context of climate crisis, where soil degradation is perceived as one of the primary threats facing contemporary society. Proper management of these spaces is a priority action for maintaining food security and achieving sustainable development goals. In this regard, it is imperative to develop sustainable and effective adaptation strategies, understanding the need to promote the application of robust methodologies for monitoring various soil health indicators (physical, chemical, and biological). Thus, it is essential to promote practices and treatments aimed at enhancing soil resilience to new changing conditions. Under this paradigm, this study aims to evaluate the soil health status based on different physicochemical indicators in a representative experimental plot of nectarine cultivation in the province of Zaragoza (Spain). The study investigates the impact of a treatment based on the use of multifunctional cover crops based on LivinGro® (CCM) on these indicators. Soil samples were collected every two months over three years, evaluating different indicative properties in (i) a control zone (without CCM treatment) and (ii) a zone with CCM treatment (LivinGro®). The results show the effects of this treatment on the soil. The main analyzed properties indicate that the LivinGro®-treated zone is improving soil health, particularly in key indicators such as basal respiration, organic carbon, nitrogen, and porosity. Likewise, climatic variability, specifically existing seasonal rainfall differences, has been identified as a determining variable in the results analysis.

Keywords: Climate change,Agriculture,Soil health,Indicators,Multifuntional cover crops

ID ABS WEB: 137925

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

NEXT GENERATION BIOMONITORING VINEYARD SOILS TO SUPPORT SUSTAINABLE AGROECOSYSTEMS

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The significant inputs of agrochemicals and intensive grape production dramatically affect soil health and fertility. This work aims to identify the biotic and abiotic drivers and the keystone species influencing soil health, applying an innovative agroecological network analysis in vineyards in the function of their management and geographic location. The sampling area is in South Tyrol (Italy), one of Italy's highest-quality areas for viticulture, covering around 5380 ha (2% of the total agricultural land). Samples associated with Vitis vinifera cv. Pinot noir were collected from 42 vineyards (22 biological and 20 conventional) distributed over a geographic gradient from south to north over two seasons (spring and autumn). Samples were analyzed for the following chemical parameters: Total organic carbon (TOC), total organic nitrogen (TON), dissolved organic carbon (DOC), available phosphorus (P-Olsen), pHCaCl2, and the extractable fraction of elements. Results showed that conventional vineyards had significantly higher TOC, TON, DOC, zinc, and sulfur concentrations compared to biological vineyards ($p<0.03$), while the pHCaCl2 was significantly higher in biological vineyards compared to conventional (6.41 vs 5.98, respectively; $p<0.05$).
Regarding geographic pattern, in conventional vineyards, the TOC, TON, DOC and pHCaCl2 were significantly lower in northern areas compared to central and southern areas ($p<0.05$). In biological vineyards, the DOC was significantly higher in the northern area ($p<0.05$) compared to the central and southern areas ($p<0.05$). TOC and pHCaCl2 were significantly higher in central and southern areas compared to the northern ($p<0.05$). The TON in biological vineyards was not affected by geographic patterns. The available P was similar between the agricultural management and among the geographic areas. Further analysis will be conducted to characterize the agrochemical residues and soil biodiversity (i.e., bacteria, fungal, and fauna diversity) based on the DNA metabarcoding approach. Abiotic and biotic data will be integrated to unravel possible keystone species quality indicators using the (agro)ecological network analysis approach.

Keywords: Vineyards,soil management,Soil heath,soil biodiversity,keystone species

ID ABS WEB: 137966

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

HOW TO LINK SOIL QUALITY, SOIL HEALTH, SOIL-BASED ECOSYSTEM SERVICES, AND SOIL THREATS? THE SERENA CONCEPTUAL FRAMEWORK

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To reach the EU ambitious objective of 70% of healthy soils by 2030, we need to evaluate sustainable management practices dedicated to the restoration of degraded soils. It is then of prime importance to define what means “healthy soils”, especially regarding the older concept of “soil quality”, and the usual concept of “soil threats”; the links between these soil-related concepts remain partly unclear and may limit our ability to evaluate some management practices. In the context of the EJP SOIL programme, the SERENA consortium has proposed a framework to interconnect the key concepts like Soil Quality, Soil Health and Soil Ecosystem Services, and Soil Threats. Some definitions of these concepts have first been browsed from the literature, from which new or modified definitions have been ranked by the SERENA participants. The conceptual framework of the SIREN project has then been modified: it is mainly based on 2 interlinked boxes, representing the agricultural and socio-economic systems. Ecosystem Services (ES) are here considered i) either as a supply from the ecosystem, or ii) as a use by the socio-economic system; the latter is the part of the ES supply directly or indirectly used or experienced by the society. The latter is responsible for the pressures on the whole system: it can either increase threats on soils (through the increase of cultivated land areas or intensification of agricultural practices, for example), or improve Soil Quality, Soil Natural Capital, and ES supply (thanks to agricultural practices increasing soil carbon stocks, for example). In this framework, Soil Quality and Soil Threats are conceptualised at the interface between the ecosystem and the socio-economic system, and a Soil Health threshold – considered as a critical level of Soil Quality – helps defining whether soils are healthy or unhealthy. We hope such a framework would enhance scientific research about soil-based ecosystem services, and favor a good communication with the policy-makers and the public.

Keywords: conceptual framework,soil-based ecosystem services,Soil Natural Capital,SERENA,EJP SOIL

ID ABS WEB: 138080

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

DUAL NATURE OF SOIL STRUCTURE: THE UNITY OF AGGREGATES AND PORES

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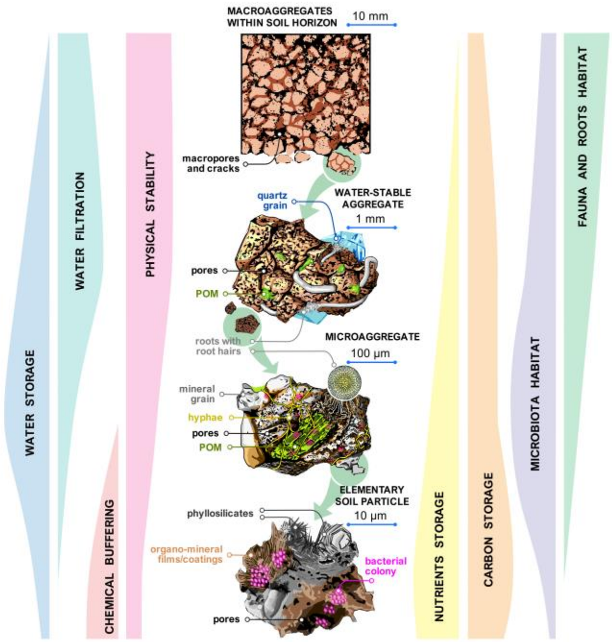
Soil is a hierarchical, self-organizing, and emergent system that supports plant and microbial growth, enables carbon sequestration, facilitates water fluxes, and provide habitat for microorganisms, all of which depend on soil structure. Recent debates have generally reduced soil functioning to geometry and topology of soil solids and pores and denied the existence and role of soil aggregates and hierarchy of solids. Here we argue that soil structure has a dual nature that essentially boils down to the interlocking of pores and solids in groupings of specific complexity and dynamics called aggregates. By comparing their architectural, chemical, and energetic parameters, we conclude that aggregates have a much higher information density than pores. Therefore, aggregates (as unity of solids and pores) perform much broader range of functions compared to pores alone, especially in long-term. A set of soil functions corresponding to each level of the soil structure hierarchy depends on aggregate type (macroaggregates, water-stable aggregates, microaggregates, and elementary soil particles) determined by their specific binding energy, dynamics, and lifetime. The introduced here energy-based concept justifies the hierarchy of soil structure, and is the base for the selecting indicators of soil functions. We understand the soil structure implying the energy-based approach: each hierarchy level corresponds to specific bonding strength of mineral and organic particles forming aggregates. The duality of soil structure is manifested not only in the relationship between pores and solids in aggregates, but also in the interactions and competition between the biological and non-biological processes that aggregate and disaggregate the structure. The view of the pore space as a transport pathway and habitat for soil living phase and plant roots, the solid-pore interface as a setting for physico-chemical and biological transformations, and aggregates as a result of these phenomena, provides a context for mechanistic understanding and process-based modeling of soil functions and health.



Keywords: soil functions,soil hierarchy,energy-based concept,self-organizing systems,soil memory

ID ABS WEB: 138112

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

DEPLOYMENT OF MOLECULAR MARKERS TO EVALUATE MICROORGANISMS LINKED TO SOIL C AND P IN AN OLIVE GROVE WITH DIFFERENT COVER CROPS

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Terrestrial ecosystems play a crucial role in providing essential services for life, but land use and management can trigger problems such as soil degradation, habitat loss and pollution. Soil microorganisms are fundamental in the biogeochemical cycles that support life and thus the fertility of agricultural systems. This research focuses on the use of molecular markers to evaluate changes in bacterial and fungal guilds linked to C and P cycling promoted by established agricultural practices in a rainfed olive grove. A trial was conducted in an intensive olive orchard with 238 trees-ha-1 (7 x 6 m spacing) at the La Chimenea Experimental Farm (IMIDRA) located in southern Madrid. Four types of soil management were tested: i) conventional tillage, ii) permanent grass cover (Brachypodium distachyon (L) P. Beauv.), iii) permanent spontaneous vegetation and iv) annual legume crop (Bitter vetch (L.) Willd). Soil sampling was carried out at four depths (0-5 cm, 5-10 cm, 10-20 cm and 20-30 cm) for the analysis of specific physical, chemical and microbiological properties. Microbiological analysis consisted of extracting DNA from soil samples and quantifying it by qPCR. The target markers we used were BFG3 and FGH3 markers for bacteria and fungi linked to beta-glucosidase activity and phoD for bacteria linked to phosphatase activity. The results indicate that the abundance of phoD and BGH3 were not significantly influenced ($p > 0.05$) by treatments, however, the abundance of FGH3 showed a clear differentiation between cover crops. The results seem to indicate that yeros and spontaneous vegetation mainly promote the abundance of fungi linked to beta-glucosidase activity in the soil.

Keywords: agricultural systems,legume crop,qPCR,Soil health indicators,Biogeochemical cycle

ID ABS WEB: 138121

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

SOIL PROPERTIES AND THEIR RELATIONSHIP WITH WINE PRODUCTION IN MAIPO VALLEY, CHILE.

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Central Chile's wine production is recognized worldwide for its quality; however, soil variability generates changes in the oenological potential of the grape berry. In this study, Entic & Fluventic Haploxerolls soils were characterized in a 100 hectares cultivated with 20-year-old Cabernet Sauvignon vines. Soil pits and soil sampling were performed and physical properties (bulk density, water retention, macroporosity, texture) up to rooting depth and chemical properties (pH, EC, OM, macro and micronutrients, CEC) were evaluated for the first two soil horizons. The spatial variability of soil properties presents normal ranges, with extreme values from 1.12 to 14.84 mg/kg of N, 5.08 to 80.9 mg/kg of P, 0.74% to 3.99% of OM and from 14.79 to 35.50 cmol (+) /kg of CEC. CEC showed a dependence on both clay and OM content, highlighting vineyard managements that consider the application of compost to the soil. As expected, the water constants (FC and PWP, water retention at -33 and -1500 kPa) showed a direct linear relationship with the level of clay in the soil, although the presence of coarse fragments determines the available water storage capacity, which varies between 38 and 140 mm. Aeration porosity showed an inverse linear relationship with clay, reaching restrictive levels with values of Clay higher than 27%. Soil characterization and clustering will allow to apply differentiated strategies for management optimization in aim to produce a high-quality wine.

Keywords: Soil variability,Soil water retention,Soil quality,Soil properties,Terroir

ID ABS WEB: 138330

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

DIGGING INTO THE EFFECTS AND IMPLICATIONS OF SOIL HEALTH MANAGEMENT PRACTICES IN A LONG-TERM RESEARCH VINEYARD IN WASHINGTON STATE, USA

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The state of Washington, USA, established the Washington Soil Health Initiative (WaSHI), which is a partnership among the Washington State Conservation Commission, the Washington State Department of Agriculture, and Washington State University. The Washington Soil Health Initiative promotes collaborative research, education, and technical assistance activities that identify, promote, and implement sound soil health stewardship practices. These practices should be economically viable and voluntary for farmers and ranchers across the diverse agricultural communities, climates, and geographies in Washington. The initiative aims to achieve this through demonstration projects and engaging in rigorous long term soil health research. Six long-term agroecological research and extension (LTARE) sites representing Washington's diverse agricultural systems were established, one being a long-term soil health research vineyard at Washington State University's Irrigated Agriculture Research and Extension Center in Prosser. The LTARE soil health research vineyard is believed to be the first publicly funded long-term research vineyard specifically designed to evaluate how management practices impact soil health, vine health, and grape and wine quality in the United States. Research conducted at the soil health vineyard is guided by industry stakeholders and seeks to recontextualize soil health metrics for vineyards in arid regions by investigating the influence of soil health building practices on young vine vigor and vineyard establishment success. Over time, we will transition our research goals to evaluate the influence of soil health building practices on vine vigor, grape yield and quality, and wine quality. This presentation will cover the development and projection of Washington's Soil Health LTARE projects, using the research vineyard site as an example.

Keywords: soil health initiative,soil health,management practices,vineyard,long-term research

EPOSTERS

ID ABS WEB: 140104

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

EVALUATION OF SOIL INDICATORS AND SOIL FUNCTIONS UNDER DIFFERENT AGRICULTURAL MANAGEMENT PRACTICES

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Agricultural management has a strong impact on soil quality, while pedo-climatic conditions set the site-specific boundaries for soil functions. Optimizing the multiple soil functions within site limitations is key for sustaining soil health and increase the soil`s resilience towards climate change. In this context, the Bodencockpit project aims to provide an easy-to-use methodology and set of practical and sensitive indicators to evaluate soil quality and management at the plot level for arable and mixed farms in Switzerland. The selected soil state indicators include: physical (bulk density (BD), air capacity (AC), visual evaluation of soil structure (VESS), penetration resistance), chemical (SOC/clay, permanganate oxidizable C, total N and P, available P, K, and Mg, pH, cation exchange capacity, base saturation) and biological (earthworms, soil respiration, microbial biomass C, enzyme activity) soil properties. Scoring curves, based on a thorough literature review, were generated to normalize and rate the indicators against critical and optimal threshold values. Normalized scores, ranging from 0 to 1, show the fulfillment of the site-specific potential of an indicator. Indicators were aggregated, where applicable, to assess water storage capacity, soil structure maintenance, C storage, nutrient cycling, and biological activity. Four long-term field experiments (LTEs) in Switzerland were sampled in spring 2023, including 14 treatments, to evaluate the impact of specific managements at optimal fertilization. The first results from eight of the tested LTE treatments indicate differences in physical soil indicators among treatments. The water storage capacity, calculated from field and air capacity, was rated 0.9-0.95, suggesting conditions close to its potential. Normalized scores for effective BD (BD+ 0.009 x clay%) were 0.58-1.0, 0.39-0.64 for AC, and 0.19-0.72 for SOC/clay. The aggregated harmonic mean of the normalized scores for the soil structure maintenance function ranged from 0.40-0.71, with highest scores for the bio-dynamic treatment. Differences among indicators and functions will further be related to soil management indices, providing a decision support tool in soil quality optimization.

Keywords: Soil quality,indicators,Soil functions,agricultural management

ID ABS WEB: 140111

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

A STATISTICAL APPROACH TO QUALITY ASSESSMENT OF POST-FLOOD SOILS OF SOUTHERN KERALA

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After the devastating floods of 2018, a detailed study was executed to assess and depict the quality of post flood soils of the Central and Southern foothills agroecological unit in Kerala. In order to work out soil quality indices, seventy five georeferenced surface samples were collected from the severely flood affected areas within the agroecological unit and characterized in the laboratory for physicochemical and biological properties. Seventeen selected soil properties, namely, bulk density, water holding capacity, water stable aggregates, per cent of sand, silt and clay, pH, EC, organic carbon, available N, P, K, Ca, Mg, S, B and acid phosphatase activity from the laboratory characterization were analyzed using Principal Component Analysis (PCA). Thus, a Minimum Data Set (MDS) of nine parameters retained in six principal components with eigen value greater than one was obtained. The selected indicators were categorized into 4 classes, viz., very poor, poor, good and very good and assigned with scores 1, 2, 3 and 4 respectively. A weighted Soil Quality Index (SQI) was developed by combining the scores after assigning appropriate weights to the parameters. Weights were assigned based on existing soil conditions, cropping pattern and agro-climatic conditions. The soils were rated as poor (<50%), medium (50-70%) or good (>70%) based on the soil quality index per cent. Soil quality was found to better in pockets with silt deposition which has resulted in moderately acid to neutral pH and relatively higher available K, Ca, Mg and B while majority of the post-flood area studied exhibited medium soil quality. <FILE IMAGE='1931_20240311170111.jpg'> Spatial variability in soil quality was mapped in ArcGIS software using the spatial analyst tool - Inverse Distance Weighted (IDW) method of interpolation.

Keywords: Soil quality index,Post flood soils,Minimum data set,Soil properties,Agroecological unit

ID ABS WEB: 140698

4. Soil health in achieving the Sustainable Development Goals
4.28 133610 - Characterizing and selecting soil health indicators at various scales

INDICATORS-BASED ASSESSMENT OF SOIL-BASED ECOSYSTEM SERVICES AT DIFFERENT SPATIAL SCALES IN EMILIA-ROMAGNA (NE ITALY)

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Spatial assessments of soil-based ecosystem services (SES) are useful frameworks providing information on ecosystem multifunctionality and to estimate effects of climate change and land use change on SESs supply. This contribution presents an indicators-based approach to SES assessment and mapping at different spatial scales in Emilia Romagna (NE Italy). At regional scale, the information from soil database has been used to assess and map standardised and re-scalable indicators of potential soil ecosystem service supply resorting to digital soil mapping and geostatistical simulations at a 100m resolution over the entire region (22510 sq. km). To tackle the multifunctionality of soil, the following SES have been considered as indicated by local stakeholders: habitat for soil biodiversity, buffering capacity, carbon sequestration, food provision, biomass provision, erosion control, water regulation and water storage. In addition, an overall soil quality index based on selected SES is assessed and mapped. A relevant feature of the approach is that is it scalable at different implementation scale. The information about SES provision is made available by the regional soil service to provide the legally binding information that each municipality must take into consideration to produce or update the General Urban Plan, which is the most important instrument of land and urban planning. Upon request of the Municipality of Forli, an ad hoc soil survey has been made to assess and map SESs at the local scale (25 m resolution in urban area) to deliver information and maps at a finer resolution taking explicitly into account the properties and services of urban and peri-urban soils along with the benefits delivered to citizens.?Our results for the local extension show by one side, the need of specifically dedicated surveys for properly quantifying SESs in an urban environment due to the inherent soil complexity, and by the other one, that, despite embedded within the urban landscape, urban soils provide important SESs to be accounted for in land development and urban design plans.

Keywords: Soil ecosystem services; Soil properties and functions; Indicators; Spatial scales; Multifunctionality?

ID ABS WEB: 136095

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

TIME FRAMES AND PEDOLOGICAL IMPLICATIONS OF AEOLIAN ACTIVITY IN THE FLUVIOGLACIAL LANDSCAPE OF THE WHITE FOREST (CENTRAL POLAND)

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The White Forest represents a fluvioglacial landscape that developed during the retreat of the ice sheet of the Middle Polish Glaciation and was transformed under periglacial conditions in the foreland of the Last Glacial Maximum. Fluvioglacial deposits form a layer of varied thickness, and their surface was affected by aeolian processes. The main phase of aeolian activity is attributed to periglacial environment, but little is known about aeolian processes during the Holocene. In this study, we aimed to identify time frames of Holocene aeolian activity and its impact on soil cover, including soil-forming processes, morphology, classification and chosen characteristics. Based on maps, LIDAR-based digital elevation model, literature data and field reconnaissance, we selected 30 locations representing different topographic positions, sediment stratigraphy, and varied intensity of aeolian processes in the past. A soil pit was done in each location. Soils were classified and described according to WRB (2022) standards and sampled. A wide spectrum of physical and chemical properties were determined using standard procedures in soil science. Additionally, radiocarbon dates were obtained for buried horizons. Our study indicates a spatially variable intensity of aeolian processes during the Holocene. The highest intensity was recorded along the valleys of the Narew and Bug rivers, while it was generally low in the interior of fluvioglacial plain. Radiocarbon dates indicate the last 1500 years as time frames of accelerated aeolian activity. Aeolian processes have significantly altered the soil cover, which is dominated by Arenosols. Complete or partial erosion of soils, deposition of eroded material on existing soils and their burial, changes in mineralogy and textural characteristics of mineral substrates and their stratigraphy (development of lithological discontinuities) were the main fingerprints of aeolian activity in the study area. As a result of these changes, the heterogeneity of the soil cover increased considerably in terms of soil-forming processes, morphology, classification, physical characteristics and pools of various substances (soil organic matter, nutrients, sesquioxides).

Keywords: landscape evolution,aeolian processes,pedogenesis,fossil soils

ID ABS WEB: 136981

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

CND NUTRITIONAL STANDARDS AND THEIR RELATIONSHIP WITH THE SOIL IN VINE PRODUCTION AREAS

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The chemical analysis of plant tissue, combined with the chemical analysis of the soil, are basic tools for evaluating the nutritional status of plants and help make recommendations for correctives and fertilizers. Thus, developed concepts of interpretation and diagnosis of nutritional status, especially those of a multivariate approach, associated with soil analyzes are necessary to advance fertilizer recommendation techniques, being complementary and alternative to long-term calibration experiments. Therefore, it is important to use current parameters, built in commercial environments that take advantage of current production bases associated with monitoring productivity and soil diagnostics and nutritional status. The study aimed to establish norms and fertility classes for the 'APPC 007 estela' vine (Vitis vinifera). To achieve the proposed objectives, productivity data and chemical analyzes of soil and leaf tissue from 95 commercial plots of 'APPC 007 estela' vine, sampled in the 2022/2023 harvest, in the region of Pilar do Sul, state of São Paulo, were used Brazil. The Nutritional Composition Diagnosis – CND methodology was used to establish standards for the nutrients N, P, K, Ca, Mg, S, B, Cu, Fe, Mn and Zn. The chemical attributes of the soil analyzed were: pH, M.O., P, K, Ca, Mg, H+Al, S-SO4, B, Cu, Fe, Mn and Zn, and those calculated as Base Sum (S.B.); Cation Exchange Capacity (C.T.C.) and Base Saturation (V%). Considering the correlation matrix, the significant correlation coefficients (r) between the CND indices in the plant presented the highest relationships between them (66%), followed by the soil (50%), with soil attributes and nutritional indices having approximately 23%. The correlations between profitability per area ($/ha) occurred positively for the nutritional indices of P and Cu, and negatively for S, Mn, Zn and CND-r^2, for soil attributes the only positive correlation was for Fe and negative for K and B. Profitability per area was more related to the nutritional indices of the plant than to those of the soil.

Keywords: Vitis spp.,Leaf diagnosis,Soil ecosystem services,Environmental factors,Human impacts

ID ABS WEB: 137254

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

THE IMPORTANCE OF AN INTEGRATED APPROACH BASED ON NATURE-BASED SOLUTIONS (NBS) TO ADDRESS THE COMPLEXITY OF LAND DEGRADATION AND RISK OF DESERTIFICATION

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Emphasizing integrated approaches based on Nature-Based Solutions (NbS) is crucial to address the complexity of land degradation phenomena and the diverse threats affecting drylands and areas at risk of desertification. This literature review moves from the experience of the Newlife4Drylands Life preparatory project to explore the potential opportunities for the application of NbS for soil management and restoration and for their medium and long term monitoring.
By employing a search strategy that included criteria such as Nature-Based Solutions, soil threats, restoration, and land degradation, the review systematically identified relevant literature from electronic databases like Scopus and Web of Science.
The results highlights the importance and complexity of scaling up successful practices against land degradation taking into account the adaptability to different contexts. It also underscore the imperative for climate-resilient NbS, tailored to bolster soil resilience amidst changing climatic conditions.
Technological advancements, such as applications from remote sensing, reveal as crucial to effective and economic feasible NbS monitoring, allowing real-time assessments for adaptive management and supporting scaling out of solutions to other contexts. In addition economic valuation of NbS, complemented by incentive programs, proves vital for garnering stakeholder and policymaker support.
The study underscores the pivotal role of NbS in sustainable soil management and restoration, offering valuable insights for future research initiatives and policy frameworks.

Keywords: Nature-Based Solutions,Drylands,Land degradation,Economic Feasibility,Technological Advancements

ID ABS WEB: 137680

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

THE TRANSPORT OF LABELLED NEAR-NATURAL COLLOIDS IN SOIL

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Ensuring the vitality of forest ecosystems necessitates a profound understanding of nutrient cycling, with a critical yet understudied aspect being the role of colloidal transport in phosphorus (P) cycling. This study delves into the largely unexplored mechanisms of colloidal transport, necessary for holistic ecosystem perspectives and numerical modeling of nutrient cycling. The complexity lies in the unknown soil source strength, motivating the need for column transport experiments under varied soil properties and hydraulic conditions.
Iron (Fe) is one of the most abundant elements found in soil colloidal fractions and possesses the advantage of featuring several stable, non-radioactive isotopes. To mimic natural colloids leaching, we isolated labeled near-natural colloids from a 57Fe-labeled agricultural soil previously used in a nutrient uptake experiment with barley. Both free and occluded soil colloids were then extracted from this labeled soil and its unlabeled control through wet sieving. Subsequent digestion and elemental analysis via ICP-MS provided insights into the feasibility and detectability of 57Fe-labeling. Notably, ICP-MS analysis unveiled an association of P, K, and Ca, which were more prevalent in the free colloid fraction, while Mg and Fe exhibited greater abundance in the occluded colloid fraction. This phenomenon could be attributed to the heightened surface area and reactivity of fine particles.
Isolated free and occluded colloids from the labeled soil were then employed in saturated column experiments. Breakthrough curves were obtained through leachate samples analyzed with Triple-Quad-ICP-MS. This research contributes to understanding colloidal transport dynamics under saturated conditions and offers insights into a novel method to use isotope label to trace colloids.

Keywords: Colloidal transport,Nutrient cycling,Isotope labeling,Wet sieving,Column experiment

ID ABS WEB: 137697

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

PH DEPENDENCE OF AS(III) OXIDATION BY POLYETHYLENEIMINE MODIFIED MAGNETIC MESOPOROUS POLYDOPAMINE NANOCOMPOSITE: ROLES OF REDOX-ACTIVE FUNCTIONAL GROUPS

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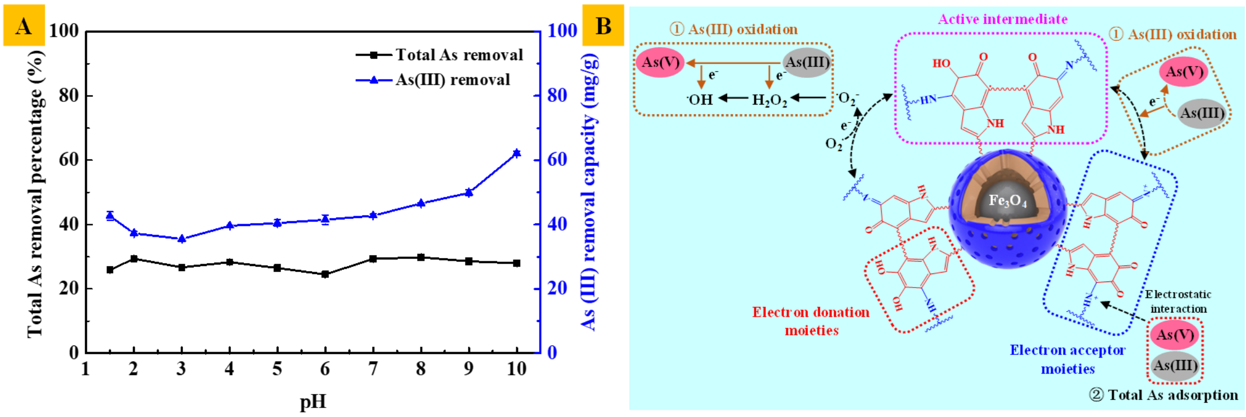
Arsenic(III) (As(III)) is recognized as one of the most hazardous heavy metal pollutants because of its characteristics including accumulation and nondegradability in soil[1]. Polydopamine (PDA), an environmentally friendly biopolymer, contains a large number of electron-rich groups (such as amino, imine, catechol, and quinone, etc.) which is a promising candidate material for As(III) pollution remediation[2]. To overcome these drawbacks of the environmental instability in PDA-based adsorbents, a novel PEI-modified magnetic mesoporous polydopamine nanocomposite (Fe3O4@mesoPDA/PEI) was prepared for As(III) adsorption. Fe3O4@mesoPDA/PEI was a uniform porous spherical structure with an average pore size of 19.70 nm. Meanwhile, the adsorption interface had abundant redox-active functional groups (i.e. catechol, quinone, and amino/imino), in favor of the highly toxic As(III) oxidation. Moreover, its magnetic saturation value was 23.7 emu/g, which could meet the demand for magnetic enrichment and separation after adsorption within a few seconds.
The adsorption behavior of As(III) was highly pH-dependent. The As(III) adsorption performance of Fe3O4@mesoPDA/PEI increased with the increase of the initial pH values while the removal capacity of total As was almost independent of the initial pH values. Notably, the adsorption capacities of total As were far lower than those of As(III) in the range of pH = 1.5-10.0, implying that the adsorption of As(III) on Fe3O4@mesoPDA/PEI involved two processes including the oxidation of As(III) to As(V) and the adsorption of As(V). The quinone group of Fe3O4@mesoPDA/PEI could directly act as the oxidant of As(III), whereas the reductive catechol group could indirectly oxidize As(III) to As(V) via inducing the production of reactive oxygen species. And indirect oxidation of catechol was the main approach for the As(III) oxidation under acidic conditions. Moreover, the electrostatic adsorption of PEI also played an important role in the adsorption of oxidized As(V). Subsequently, with the help of magnetic technology, the separation and recovery of the adsorbent could be realized, significantly reducing the environmental hazards of heavy metal As.



Keywords: AsIII,Active functional groups,pH dependence,Oxidation,Adsorption

ID ABS WEB: 137739

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

NUTRITION OF APPLE ORCHARD WITH LIVESTOCK-DERIVED FERTILISERS: DYNAMICS AND LOSSES OF SOIL MINERAL NITROGEN

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Nitrogen is a very influential macronutrient on crop development. Apple orchards require careful fertilisation, without leading to an excess of N that can be harmful, both to the crop and the environment. This study, in cooperation with the Fruit and Vegetable Growers' Association of Trentino, aimed to replace mineral fertilisers with livestock-derived amendments for apple orchard nutrition, while limiting N losses.
A three-year trial was conducted in an apple orchard of Gala in Trentino. In 2021 the field was organised in randomised plots fertilised with mineral fertiliser (once a year), cattle manure and the solid fraction of digestate from cattle slurry (once at start of the trial). The resulting three theses (MIN, MAN, DIG) were compared to an unfertilised plot (CNT). The soil was sampled on the row during the apple's vegetative cycle, the soil solution was collected using lysimeters at 60 cm, the useful depth limit for roots in this soil, and the leaves were sampled during the fruit swelling. The fruits were harvested at commercial ripening.
Both cattle manure and solid digestate ensured a gradual release of available N into the soil, mainly during the phenological phases of the crop's greatest need, even two and three years after supply. The soil mineral N dynamics in MIN followed the rainfall trend and the release of available N only occurred after flowering if the fertiliser distribution was followed by rain. In the third year, heavy rainfall in May caused an excessive release of N into the soil, which caused heavy leaching, demonstrating a sudden release of mineral N leads to nutrient loss and environmental pollution. N losses in the amended theses were comparable to CNT. N in leaves was similar between the fertilised theses and higher than in CNT. The different strategies ensured similar yield between the theses.
Fertilisation with livestock-derived amendments has proven to be the best strategy to ensure N availability over time and reduce the environmental impact.

Keywords: soil mineral nitrogen dynamics,nitrogen losses,livestock-derived fertilisers,apple orchard,crop nutrition

ID ABS WEB: 138060

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

THE IMPACT OF CLIMATE CHANGE ON SOIL QUALITY EVALUATION IN ROMANIA IN THE LAST 30 YEARS

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The assessment of soil quality in Romania is based on 17 indicators which are describing mainly the climatic conditions, terrain characteristics and soil properties. Among these factors, the most dynamic and with a major impact on the soil quality score are the climatic ones, respectively the multi-annual average value of the air temperature and the average annual amount of precipitation. For this reason and due to the fact that most studies on soil quality use the average values of these parameters from the reference interval 1961 - 1990, our study analyzes the impact of the evolution of average values of temperature and precipitation from the 1990 – 2019 period on soil quality. We used ROCADA database for the reference interval and CHELSA gridded data for the most recent interval along with 15 other previously developed layers which represent the indicators for soil quality assessment. Finaly, we analyze the results for each geographical region of Romania both for changes in soil quality classes and soil suitability for different crops. Considering that in the last analyzed interval, the annual air temperature values increased by 0.9 gr C on average, and the amount of precipitation, although it did not register significant changes in terms of quantity, changed in the sense of increasing the number of extreme events, the soil quality class also changed accordingly. The most significant changes are especially the increase of the soil quality score which can change the quality class especially in agricultural areas but also the decrease the suitability score more obviously in orchard areas. By analyzing the results, we find that by only using the new value for air temperature the soil quality score can be drastically changed, and consequently the Romanian methodology needs to be adapted to take into account the new data.
Acknowledgements. This research has benefitted from the support of the PN-III-P4-PCE-2021-1350 project, funded by the UEFISCDI program, Romania.

Keywords: climate change,soil quality,suitability

ID ABS WEB: 138079

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

EFFECT OF LONG-TERM REDUCED TILLAGE ON SELECTED SOIL BIOLOGICAL INDICATORS ON LUVISOLS IN HUNGARY

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For many decades, the soil has been cultivated intensively by machinery called conventional ploughing tillage (PT). Conservation (reduced) tillage (CT), a system that considers the environmental impact, has been introduced to minimize soil deterioration. The effect of long-term tillage experiments with CT and PT on soil biological activities has not been extensively studied in Hungary. A field study to investigate selected soil biological indicators, i.e., permanganate oxidizable carbon (POXC), Glomalin (GLOM), and Mycorrhiza colonization (MYCO), was carried out on Luvisols, Hungary, in a farmland under CT and PT treatments since 2003. POXC and GLOM were measured from the soil at 0-5, 10-15, and 20-25 cm depths during the last three growing seasons, with the crop rotation being maize I, sunflowers, and maize II. MYCO was observed from the root sampled at 0-20 cm depth. The result exhibited that crop rotation, tillage system, and soil depth considerably impacted soil biological indicators. POXC and GLOM concentrations were higher in maize I, followed by sunflowers and maize II. CT application notably increased the POXC and GLOM during the experiments. Regarding the soil depth, POXC was significantly higher at 0-5 cm depth of maize I and maize II and 0-25 cm depth of sunflowers. GLOM was markedly larger only at 0-5 cm depth. Reducing soil disturbance in CT created a more conducive soil environment and minimized the deterioration effect for soil aggregate and plant roots. This circumstance resulted in the number of root colonization in CT being notably higher than PT, 38.9 and 31.1%, respectively. The alteration of soil water content under different tillage practices remarkably influenced the POXC concentration (Pearson correlation coefficient = 0.27). In this study, we also revealed that GLOM concentration was noticeably correlated with POXC concentration (Pearson correlation coefficient = 0.76). Our results represent the development of a more naturally vertically distributed and time-balanced soil biological activity as a result of long-term reduced tillage.

Keywords: Permanganate oxidizable carbon,Glomalin,Mycorrhiza,Conservation tillage

ID ABS WEB: 138176

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

IS IT POSSIBLE TO RESTORE SOIL DEGRADED BY WILDFIRE WITHOUT MANAGEMENT? A CASE STUDY AREA IN THE MAJELLA NATIONAL PARK (ITALY)

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Projections of increased wildfire severity, attributed to warming climates and frequent droughts, heighten apprehensions regarding concurrent impacts on soil carbon and nitrogen pools. Such impacts could alter the sizes and mineralization kinetics of these pools, potentially exerting long-term effects on the resilience of forest carbon sinks and the forests' ability to recuperate from disturbances. In this context, we investigated wildfire impact on an area in the Majella National Park and we try to understand if some management could be helpful for improve soil resilience. The studied area has been affected twice by fire. The control area has been chosen considering the similar forest management. In these two areas regular field champaigns for soil sampling and to record soil respiration have been performed in 2022 and 2023 and data from each meteorological station also equipped of sensors recording soil temperature and humidity have been recorded. Two types of replicates were chosen for fire-covered sites, one closed to dead logs (nature-based solution), and another nearby as control without dead logs, in order to understand if unmanaged area could accelerate soil restoration after wildfire. Physical, chemical, and enzymatic analysis have been performed. Moreover, CO_2 emissions from the soil were measured with a chamber system, assessing the rate of CO_2 change in concentration over time. Preliminary processing of environmental parameters reveals an influence on soil respiration, with the seasonal trend showing an increase over time. Notably, soil respiration is higher in the control site than in the post-fire site. Analysis indicates that increasing temperatures act as a limiting factor for soil respiration, revealing valuable insights into the complex dynamics following a fire event. Moreover, fire leaded to complete or partial burning of organic matter and ash deposition on the soil surface. Thus, the mixing of ash and partially burnt organic materials into the soil altered soil chemistry. However, the impact of fire on soil chemical properties was highly variable and suggested an insight.

Keywords: soil respiration,nature-based solution,climate change,environmental restoration,forest fire

ID ABS WEB: 138288

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

MICROBIAL-BASED STRATEGIES FOR RESTORING SOIL FUNCTION AND ENHANCING PLANT GROWTH IN DRYLANDS

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Global environmental changes and other anthropogenic impacts are rapidly transforming the structure and functioning of ecosystems worldwide. These changes are leading to land degradation with an estimated 25 % of the global land surface being affected. The need to develop cost-effective large-scale solutions to restore degraded landscapes becomes imperative to preserve biodiversity and achieve ecosystem functionality and sustainability. Soil microorganisms control important ecosystem functions such as nutrient cycling, plant productivity and climate regulation. Thus, microbially assisted conservation and restoration has the potential to reconnect above and belowground dynamics, creating functional ecosystems that are more resilient to climate change impacts. In this research, we (i) assessed the responses of soil microbial communities to disturbance, e.g., severe fire, and extractive activities such as mining, and (ii) developed bioinoculants composed of locally sourced soil bacteria from the rhizosphere and biocrust cyanobacteria, to promote plant growth and soil fertility and enhance ecosystem capacity for global change adaptation. This presentation will showcase some key findings of these studies conducted in contrasting dryland ecosystems (shrubland-grassland in the arid zone, and subtropical/temperate forests). These outcomes include the successful translocation of whole-soil communities for inhibiting weeds, and the effective use of indigenous microbes (rhizobacteria and cyanobacteria combinations) for soil carbon sequestration, nitrogen fixation, and growth promotion of key arid and temperate plant species.

Keywords: SOIL MICROBIAL ECOLOGY,RESTORATION,LAND REHABILITATION

ID ABS WEB: 140082

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

SOIL QUALITY IMPROVEMENT DUE TO FERTILIZATION CONTRIBUTE GREATLY TO WHEAT PRODUCTIVITY

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Quantitative understanding of contributions of soil and fertilization on yield and factors driving yield increases are essential for effective prioritization of research and development. Previous estimates had limitations in distinguishing soil from climate and crop. Here, we distinguish the separate contribution of soil to yield and quantify the contribution of fertilization to soil quality and yield improvements using a comprehensive agricultural dataset comprised of 15 long-term field experiments(>30 years) for soil, climate and yield, which representing main wheat-cultivated areas in China. Key findings include: 1. Chemical fertilizers notably enhance contribution of soil on wheat yield gains, an annual yield gains rate of 52.2 kg ha-1 yr-1. 2. Contribution of soil on yield nearly doubles when organic manure or straw is added to chemical fertilization, compared to using chemical fertilizers alone. 3. Regional differences existe in how fertilization improved soil quality and contributes to yield gains. These findings underscore the vital role of soil quality in wheat yield, advocating for integrated approaches that combine chemical fertilizers with organic materials to boost soil health and crop productivity.

Keywords: soil quality,yield gain,long-term fertilization,wheat

ID ABS WEB: 140117

4. Soil health in achieving the Sustainable Development Goals
4.29 133611 - Soils and the environment

BRAZIL'S CONTRIBUTION TO THE STUDY OF ANTARCTIC SOILS: 22 YEARS OF RESEARCH

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Antarctic soils have unique characteristics and are directly influenced by the different environments existing in ice-free areas, which range from glacial to periglacial conditions. Knowledge of the pedological particularities of these environments can even contribute to monitoring climate change in that region. One of the first studies of Antarctic soils carried out by Brazilian researchers was that of Kuzmann et al. (1998), who evaluated the mineralogy of soils on King George Island. From 2002 onwards, a new stage of soil studies in the Maritime Antarctic region began, with the beginning of the activities of soil scientists from the University of Viçosa (Brazil). The objective of this work was to present the 22 years of contributions by Brazilian researchers to the study of Antarctic soils. The scientific production considered the terms "Soils" and "Antarctica" and was analyzed using bibliometric approaches, over a period of 10 years. Other actions were also analyzed in order to evaluate their impacts on studies in relation to this theme. As a result, soil maps have already been created on detailed scales covering more than 14 thousand hectares. More than 600 profiles have also been described, which allowed the creation of a soil bank with more than 3,000 samples, which is perhaps the largest soil repository in that region. This group is currently the one that publishes the most articles related to this topic, in addition to having already installed 30 soil humidity and temperature monitoring sites in different parts of Peninsular Antarctica.

Keywords: Permafrost,Climate change,Ice-free areas

ID ABS WEB: 136686

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

LONG TERM INCORPORATION OF PRICKLY PEAR CROP RESIDUES IN DIFFERENT SOIL ORGANIC MATTER FRACTIONS OF A SICILIAN SOIL UNDER DESERTIFICATION RISK

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Increasing soil organic carbon (SOC) content is vital in areas already fragile and prone to degradation such as drylands in order to maintain healthy soils able to provide ecosystem services. In such areas the aridity limits plant growth and litter inputs as well as soil organic matter (SOM) decomposition. Even if the SOC sequestration rate is low, dryland soils exhibit a high potential of SOC sequestration being far from saturation. In such scenario, the adoption of sustainable land management (SLM) practices in the long-term may reverse the ongoing trend toward degradation. Among them the incorporations of pruning residues to the soil is proved to be successful in enhancing SOC stocks. In addition, the quality of residues is also relevant in driving SOM processing, mineralization and stabilization.
We evaluated the effect of the incorporation of carbon from pruned prickly pear cladodes to the same crop soil (0-30cm). Furthermore, we investigated its distribution in the particulate organic and mineral associated organic matter fractions that as known differently contribute to the stabilization of SOC. The 13C isotope signature of the Opuntia ficus-indica (L.) Mill, which is an obligate CAM plant, was used to identify its contribute to SOC stocks. Two adjacent cactus plantation located in southern Sicily treated with different residues application rates in the last 10 years, were used. The analysis was part of the measures of adaptation investigated by the project Desert-Adapt (LIFE16 CCA/IT/000011) in areas under desertification risk.

Keywords: soil carbon sequestration,pruning residues incorporation,POM,MAOM,13C isotope signature

ID ABS WEB: 136154

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

EFFECTS OF COVER CROPS AND NITROGEN FERTILIZATION ON SOIL PHYSICAL PROPERTIES, CARBON AND NITROGEN FRACTIONS, AND WINTER WHEAT YIELD IN THE CHINESE LOESS PLATEAU: A 4-YEAR FIELD EXPERIMENT

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Cover crops (CCs) have great potentials to improve soil quality. However, the impacts of CCs as combination with nitrogen fertilization on soil physical properties and aggregated-associated carbon (C) and nitrogen (N) fractions are still not clear. A 4-yr field experiment including CCs with different species [soybean monoculture -SB, Sudan grass monoculture-SG, a mixture of both-SS, and no cover crop-CK] and different N fertilizer rates (NR) [0, 60, and 120 kg N ha-1] was conducted under winter wheat on the Loess Plateau of China. Soil physical properties and C and N fractions in bulk soils and aggregates were evaluated at 0-10, 10-20, and 20-40 cm depths. The CC, NR, and their interaction (CC×NR) had significant effects on soil BD, aggregate size distribution and stability (MWD), and C and N fractions. Compared to CK, SB and SS improved soil physical properties especially at 0-10 cm. Additionally, the incorporation of CCs significantly increased the proportions of > 5 mm aggregates and C and N fractions in both bulk soil and aggregates, especially at 0-10 and 10-20 cm depths. Soil physical properties improved more with N60 while the C and N fractions in both bulk soil and aggregates increased more with N120. The correlations between the proportion of macro-aggregates and soil C and N fractions at 0-10 and 10-20 cm indicated the positive effects of CCs on improving soil structure and fertility simultaneously. Aggregated-associated C and N fractions decreased firstly and then increased with the reduced aggregate size, and were higher in micro-aggregates than in other size classes. Compared with that in N0-CK, wheat yields increased by 98.7% in N60-SB. Taken together, the incorporation of SB residue was the best management practice for winter wheat yield and soil fertility under the reduced N fertilization.

Keywords: Cover crop,carbon and nitrogen cyclings,soil aggregation,Carbon sequestration,dryland cropping system

ID ABS WEB: 136382

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

TEMPERATURE GRADIENT EFFECTS ON SOIL ORGANIC MATTER DECOMPOSITION AT THE RHIZOSPHERE OF ANACARDIUM EXCELSUM AND GLIRICIDIA SEPIUM

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We explored how temperature impacts soil respiration rates on rhizospheric soils from Anacardium excelsum and Gliricidia sepium trees that were exposed to a microbial decomposition process after deforestation. The objective was to determine the maximum (Rmax) and field capacity (Rfc) respiration rates in soils sampled at the rhizosphere of both tree species. CO2 emissions were evaluated during soil drying, modelled by a third-degree polynomial function. At 20° and 30°C, A. excelsum presented a maximum value of CO2 emissions at a lower soil-water content than field capacity, as expected. However, this behaviour was only observed at 20°C for G. sepium. Rmax and Rfc values at 20°C were lower than at 30°C for each species, while at 30°C Rmax values of A. excelsum were higher than those observed for G. sepium. Quantifying the CO2 emitted during soil drying between Rmax and Rfc (Rmaxfc), it was observed that Rmaxfc values at 20°C were higher than at 30°C. Remarkably, Rmaxfc values at 20°C emitted for G. sepium soils where higher than those observed for A. excelsum at this temperature. Increments on Rmaxfc values were correlated to tmaxfc values or the time of soil drying required to change soil-water contents between Rmax and Rfc. No correlation was observed between Rmaxfc and Wmaxfc or the water retained in soils between Rmax and Rfc. Globally, tmaxfc values at the rhizosphere of G. sepium and A. excelsum at 20°C, was 30 and 20 times higher than those observed at 30°C, respectively. The inclusion of time as a key variable of soil organic matter (SOM) decomposition provides a different vision of soil respiration studies, which usually are focused on specific soil-water contents, such as field capacity or similar values. However, the CO2 emissions from soils are dynamic, and depend on both water and nutrient availability. The correct quantification of CO2 released to the atmosphere requires an arithmetic integration of the function that describes SOM decomposition curve over time.

Keywords: Rhizosphere,Anacardium excelsum,Gliricidia sepium,CO2,Soil microbial activity

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4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

SOIL C DYNAMICS IN A 45-YR CHRONOSEQUENCE OF GRASSLAND RESTORATION FROM DEGRADED CROPLANDS

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The establishment of temporal or permanent grasslands is postulated as a sustainable opportunity for soil restoration and increasing C sequestration in soils degraded by intensive agricultural management. This transformation involves the recovery of soil organic carbon (SOC) and a whole range of physicochemical and biological properties. Besides, the turnover rate of SOC is highly determined by the distribution and quality of the soil organic matter (SOM) in the different soil physical fractions. Here, we evaluated the accumulation and evolution of SOM quality after a chronosequence (45 years) of grassland reclamation from abandoned croplands in a humid temperate area (Galicia, NW Spain). Topsoil samples were subjected to physical fractionation to assess the distribution of free particulate OM (POM) and mineral associated OM (MAOM). SOM quality was characterized by ^{13}C NMR spectroscopy and thermal analysis (DSC/TG).
Our results indicated that deforestation and intensive cultivation entailed the loss of a significant 80 % of the C stored in the upper mineral soil (up to 30-35 cm). The POM was almost depleted, MAOM underwent significant losses (>40 %) and all OM compounds -including aromatic C- were affected. The large loss of MAOM can be attributed to the low specific surface soil area and to the labile (biodegradable) nature of the OM in this fraction. After 45 years, grassland conversion recovered a notable 68 % of the C lost in the mineral soil (mainly as MAOM), at an annual rate of 1.25 Mg C ha-1. Our findings showed that the persistence of long-term OM depends on how strongly organic compounds are adsorbed onto mineral surfaces (i.e. the specific surface area) and the biochemical nature of OM compounds. In our study, appropriate plant-soil management favoured the replenishment of the MAOM, and this fraction was an active pool in terms of C storage and biochemical quality. This study served to test current theories about changes in soil C fractions due to land use changes and soil-plant management.

Keywords: C sequestration,SOM quality,13C - RMN spectroscopy,SOM physical protection,soil restoration

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4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

USE OF AGRICULTURE AND URBAN RESIDUE TO IMPROVE SOIL FERTILITY

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One of the best practices to increase soil fertility by also mitigation the effect on climate change and by biomass and energy recovering is the composting process of biodegradable organic waste produced from urban and agricultural sectors. It is a profitable model for various plant and soils, from residential bins to large agricultural farms. In recent years, a local project has been implemented in central region (Elbasan) of Albania, where a large amount of organic agricultural waste originates. The material that was collected during a one-year project implementation was originated from Urban Gardens (UG), Urban Waste (UW), Sport Ground Grass Waste (SGGW), Tabaco Waste (TW) with an amount of about 208.3 Mg from which about 13.5 Mg. As a result, the C/N ratio of the compost which was treated with seven stages was 22:1 which can be very effective in urban and rural use. The combination of the crop reside and urban green waste result to be a valuable practice to reduce the urban and agriculture waste volume and valorize them as part of circular economy.

Keywords: Composting,Soil Fertility,Urban Waste,Agriculture Waste,Organic Carbon

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4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

EXPLORING SOIL ORGANIC CARBON PERSISTENCE FOR SUSTAINABLE LAND MANAGEMENT PRACTICES: A THERMAL ANALYSIS APPROACH

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To ensure the sustainability of an approach to maintain or increase soil organic matter, we need to understand the particularities of various soil organic carbon (SOC) fractions and their response to alterations in soil management practices. Diverse methods of SOC fractionation have been used to isolate and study SOC. Recently, soil physical fractionation has regained popularity due to its simplicity. Soil physical fractionation divides the soil in two main pools, particulate organic matter (POM) and mineral-associated organic matter (MAOM). Yet, the biochemical quality and therefore persistence of the SOC present in these two fractions remain unknown. SOC thermal fractionation provides detailed insights into composition, turnover rates, and stability mechanisms, crucial for advancing sustainable land management practices. This study aims to investigate the relationship between thermal stability and SOC persistence in bulk soil, in the POM and the MAOM fractions – emphasizing the necessity for rapid, precise, and affordable methods. To do so, we will establish a standardized thermal method for determining SOC persistence, comparing thermogravimetry, differential scanning calorimetry and a multiphase carbon and moisture determinator to explore commonalities in addressing SOC persistence. For that, a wide range of soils collected from multiple locations with various land use will be analyzed.

Keywords: soil carbon stability,thermal analysis,soil fractionation

ID ABS WEB: 137937

4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

STABILIZATION OF ORGANIC MATTER BY SHORT-RANGE ORDER MINERALS CAN BE ENHANCED BY THE ACTION OF EARTHWORMS

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Reducing loss of organic matter from soils and growing media is a great challenge for mitigation of climate change's effects. The main strategy to maintain carbon storage in soils by increasing C inputs, is becoming increasingly difficult, as a consequence of increased mineralization of amendments with warming temperatures. Reducing mineralization rate may be the key to sustain organic matter levels. Organic matter is stabilized in soil either physically and chemically through interactions with the mineral particles. In fact, soils containing clay-size short-range order minerals have much higher C content than other soils in the same environment. The extraordinary capacity of these minerals to stabilize organic matter may be utilized in the preparation of growing substrates. To this end, facilitating the contact and interactions of added organic matter and minerals is of critical importance. It is well known that earthworms are main agents in the formation of organo-mineral aggregates.
Our work aims to assess the capability of earthworms in fostering the interactions of added organic matter to short-range order minerals and hence to its stabilization.
To this purpose, in order to verify the stabilization of added organic materials to minerals we carried out a physical partition of SOC based on densitometric fractionation at the beginning and after 90 days of aerobic incubation of synthetic soils in the presence and in the absence of red earthworms (Eisenia Andrei). Soils were prepared with five mineral mixtures obtained from grounded rocks, and tested for their content of low ordered minerals either by oxalate-acid extractions and by FT-IR spectroscopy. Compost from urban waste and woodland litter were added to the minerals and incubated in controlled conditions.
Preliminary results show that carbon dioxide (CO2) evolution from soil is significantly affected by the different type of mineral substrates and organic matter sources. Earthworms initially accelerate the mineralization rate of organic inputs, but on the medium- long-term a significant reduction of CO2 emissions has been observed.

Keywords: Earthworms,Organic matter stabilization,Soil microbial biomass

EPOSTERS

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4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

THE INFLUENCE OF SEASONALITY, VEGETATION COVER, AND WILDFIRE ON THE MOLECULAR COMPOSITION OF SOIL GLOMALIN (EEG).

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Easily Extractable Glomalin (EEG) is a type of soil organic matter believed to contain mostly glycoproteins produced by mycorrhizal fungi. EEG impacts various soil ecological functions, particularly related to soil aggregation formation, stability and water repellence. Here, analytical pyrolysis (Py-GC/MS) is used to investigate EEG's molecular composition. A detailed description of the chemical composition of EEG is provided from samples extracted from soils under pine and shrubs, either impacted or not by forest fires and collected at different times. 139 compounds were identified and grouped based on their probable biogenic origin. The composition of samples collected from different plant covers and at different times of the year remained similar, whether affected by a forest fire or not. The chemical composition of EEG is mostly dominated by lipids, aromatic compounds, steranes, and hydro-aromatics, with a remarkable abundance of compounds from plant origin. Although contributions from microorganisms to EEG are not ruled out, its structure does not resemble that of glycoprotein. Instead, due to its high aromaticity and recalcitrant structure, it resembles that of humic acids. Minor changes in EEG structure can indicate environmental disruptions, such as those that occur after a wildfire. The EEG soil organic fraction is a relatively stable and heat-resistant material in nature, as long as soil temperatures remain below 200-250ºC.

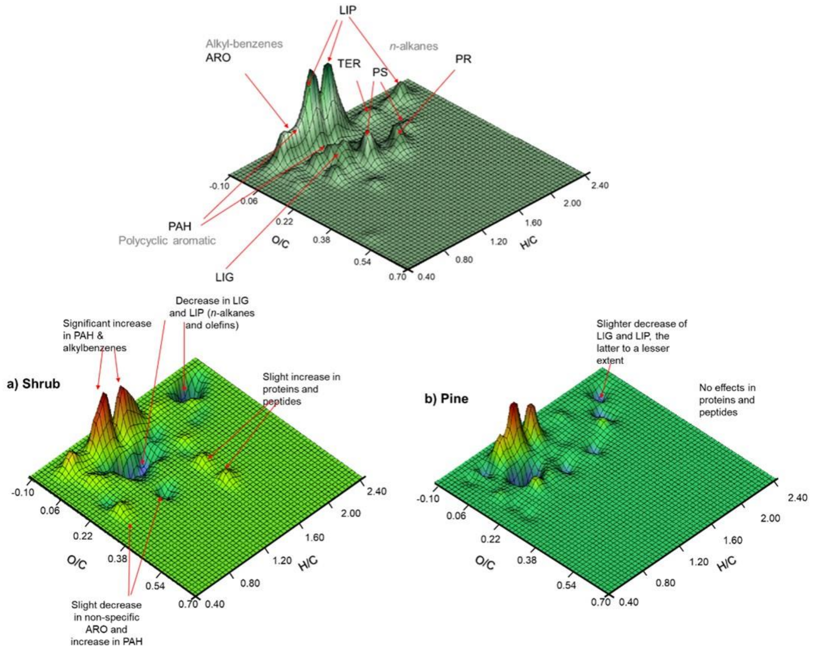

Figure 1. 3-D van Krevelen diagrams showing EEG average composition. Above: average chemical composition. Below: diagrams showing the effect of fire (control plots minus fire affected plots) for EEG extracted from soil under a) shrub and b) pine vegetation. Aromatic compounds (ARO), lignin-derived (methoxyphenols) (LIG), lipids (LIP), polycyclic aromatic hydrocarbons (PAH), protein-derived (PR), polysaccharide-derived (PS) and terpenes (TER).

Keywords: Soil organic matter,Glomalin related soil protein,Analytical pyrolysis,Wildfire

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4. Soil health in achieving the Sustainable Development Goals
4.30 133622 - Soil Organic Matter Stability as Key Driver to Soil Carbon Sequestration

RECOVERING OF SOIL ORGANIC MATTER AND ASSOCIATED C AND N LABILE FRACTION AT DIFFERENT TREE SPECIES INFLUENCE IN REGENERATED FOREST ECOSYSTEMS AFTER MINING AND FIRE DISTURBANCES

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The labile fraction of soil organic carbon (LSOC) plays a vital role in recovering soil properties and quality. The aim of study was compare labile C and N fractions, including microbial biomass C (MBC), cold-water-soluble C (WSC), water-soluble N (WSN), hot-water-extractable C (HWC), hot-water-extractable N (HWN), particulate organic carbon (POC), and particulate organic nitrogen (PON) in post-mining, post-fire, and undisturbed soils under different tree stands (Scots pine, common birch, and black alder). Nearly 30 years after the disturbance, post-mining soils were characterized by lower soil organic carbon (SOC) and total nitrogen (TN) as well as their labile fractions compared to those of post-fire and undisturbed soils. Disturbed soils had less stable SOC than undisturbed soils. Compared to the post-fire site, the higher proportion of WSC in SOC in post-mining soils suggests higher SOC turnover and leaching potential during primary succession compared to secondary succession. The post-fire soils had a similar SOC stock to undisturbed soils but differed in the C and N labile fractions stock. Post-fire soils were characterized by higher POC stocks due to charcoal admixture and lower WSN, HWC, and HWN fractions than undisturbed soils. The studied tree species differently affected the recovery of SOM properties after disturbances. Post-mining soils under alder had higher SOC, TN, and labile fractions (except MBC) than soils under birch and pine cover. However, this was not true for the post-fire site, where only WSN was higher under the alder. The soils under birch stands had the highest MBC stocks across all sites. The soils under pine had less stable SOM than those under birch and alder, which may accelerate podzolization processes. Results indicate a longer time for the recovery of C and N pools during primary succession than in secondary succession on sandy soils. Alder, as phytomelioration species that increases the C and N pools in post-fire sites, has limited usefulness.

Keywords: reforestation,wildfire,sandy soils,soil recovery,SOM labile fraction

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4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

IMPACT OF MICROPLASTIC POLLUTION ON FOREST SOIL ECOSYSTEMS IN THREE LARGEST ALLUVIAL PLAINS IN SERBIA

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Microplastic (MP) pollution is recognized as one of the biggest environmental problems due to multiple direct and indirect negative impacts on the environment. Existing research indicate that the presence of MP in the soil affects the organic matter cycle and the energy flow of terrestrial ecosystems, thus also the global production of CO2, climate, plant communities, crop production and biodiversity. There are even fewer studies dealing with the impact of MP on forest soil ecosystems. One of the first researches of the MP in the soil on the territory of Serbia is currently underway and is being carried out within the project Evaluation of the Microplastic in the Soils of Serbia - EMIPLAST - SoS. The research aimed to access the impact of MP on soil's main chemical, physical and biological properties by comparing polluted and non-polluted forest sites in the three largest alluvial plains in Serbia – Danube, Sava and Morava. Statistically significantly higher values of electrical conductivity and pH were measured in samples from polluted localities compared to unpolluted ones; while C, N and CEC were measured significantly higher in samples from unpolluted sites. Particles > 0.02 mm were significantly higher in all samples from polluted sites compared to non-polluted. Changed environmental conditions have an effect on the decomposition by soil microorganisms. Estimates of potentially mineralizable carbon and mineralization rate are statistically significantly higher at polluted sites compared to unpolluted ones in all three alluvial plains. These results support the viewpoints that can be found in the literature, namely that the presence of MP in the soil affects the cycle of organic carbon and CO2 emissions. Also, differences in estimates between polluted and unpolluted forest sites indicate that microbial communities may be using MP particles as an additional food source. In order to establish the level of the impact of MP on soil properties and microbial activity in the longer term, the study is ongoing.

Keywords: plastic waste,alluvial soil,soil quality,forest soils

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4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

EFFECTS OF MICROPLASTICS ON SELECTED PHYSICAL PROPERTIES OF AGRICULTURAL SOILS

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The global use of plastic has rapidly increased since the 1950s, becoming an indispensable part of human production and life. In 1950, the global plastic production was 1.5 million tons, but by 2020, it had grown to 367 million tons. Increased use, poor management, problems with disposal and removal of plastics from the environment have increased the pollution of soils by plastics or microplastics (MP; plastic particles smaller than 5 mm) in recent decades.
One of the most significant inputs of plastics into the soil environment is through agriculture. Agricultural plastics, various plastic materials and products, play a crucial role in modern agriculture by providing solutions for crop protection, resource conservation, and overall efficiency. Based on the studies conducted so far, researchers have raised general concerns about the long-term impact of plastic residues on agricultural land and have concluded that soils are an important sink for MP. Given the ubiquity of MP in soils, the high levels of MP and the potential for the current situation to worsen, further research into the impact and transport of MP in soils is of big importance. It is therefore crucial to investigate the effects of MP, i.e. their extent, type and content, on the physical properties of soil, especially in relation to water, which often determines the transport, adsorption and degradation of contaminants in soils and agroecosystems.
The type, size and content of MP have different effects on soil physical properties. Research has shown that MP affects soil density, hydraulic conductivity, water retention capacity and water repellency. Therefore, the aim of the study was to assess the impact of different MP types and contents on selected soil physical properties in soils with different textures. During an 8-month pot experiment we monitored soil water content changes during wetting-drying cycles. Different soil physical changes were monitored, analysed and compared.

Keywords: microplastics,soil physical properties,wetting - drying cycles

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4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

MIGRATION BEHAVIORS AND ENVIRONMENTAL RISKS OF PHTHALATE ACID ESTERS AND MICROPLASTICS FROM AGRICULTURAL FILMS

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Plastic films have become an integral part of fruit and vegetable production systems, but they are a source of phthalic acid esters (PAE) and microplastics that pose health risks to humans. Despite recent efforts, the issue of the migration and environmental fate of phthalic acid esters and microplastics derived from agricultural films remains unresolved and therefore still open for investigation. Here, we analyzed 50 agricultural films and found that their PAE concentrations varied widely from 2.59 to 282,000 mg/kg. Bis(2-ethylhexyl) phthalate was found in most agricultural plastic films analyzed, especially those made of polyvinyl chloride and metallocene polyethylene. Under the influence of sunlight and other environmental factors, agricultural plastic films age and deteriorate, releasing PAEs and turning into microplastics. Even biodegradable plastic films may not fully degrade depending on environmental conditions, and micro- and nano-plastics derived from them may persist in the environment. These microplastics often have their surfaces charged by weathering, mechanical crushing, and other environmental processes. In this regard, we quantified the fluorescence intensity of positively and negatively charged microplastics on nine different soil types to investigate the mechanism of interaction between microplastics and soil. The results showed a strong affinity for microplastic attachment to the soil, and electrostatic interactions and physical entrapment were the dominant mechanisms for microplastic attachment to the soil. In another study, we found that plants could take in microplastics through their roots and then move them to their above-ground parts. Microplastics could also get into plant leaves through stomata and cuticles. Considering these findings, we propose: (1) either rethinking the manufacturing process to reduce the concentration of PAE in agricultural plastic films or warning buyers and producers about potential risks, (2) strengthening the recycling and reuse of agricultural film waste to reduce environmental plastic pollution, and (3) finding ways to increase the rate of degradation of degradable agricultural films so that complete degradation can be achieved and microplastic pollution can be avoided.

Keywords: Microplastics,Phthalic acid esters,Soil health,Attachment,Foliar pathway

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4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

INTERACTION OF PLASTIC AND BIOPLASTIC CONTAMINATED SOIL WITH SPINACH PLANTS: EFFECTS ON NUTRIENT UPTAKE

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Plastic mulches are widely used in agriculture but their mismanagement produces microplastics (MPs) impacting the soil quality. The evaluated if the presence of MPs in soils caused changes in element availability and in their translocation and accumulation in spinaches (Spinacia oleracea L.). To achieve the aim, conventional (P) and bioplastic (B) MPs were added at 0.5%, 1% and 2% in soils where spinaches were grown. The mesocosm trial was performed in 35 pots (5 control, 5 for each percentage of B and P). Al, Ca, Fe, K, Mg, Mn, Na V and Zn were measured in soils (available fraction), roots and leaves; then translocation (TF) and bioaccumulation (BF) factors were calculated. Fe and Zn were significantly higher, Na and V significantly lower in 2%-P than in control soils. In B soils, Fe, Mn, Na, V and Zn were significantly lower at all the concentrations, Ca and Mg only at 1% than in control. Regardless of the treatment, TF>1 was calculated for all elements, excepted Ca. Particularly, Fe, Mn, Mg, V and Zn were significantly less accumulated in roots of P than control. Conversely, all elements, excepted Mg, were significantly more accumulated in roots of B than control. Regardless of the treatment, TF>1 were calculated for K, Mg, Mn, Na and Zn, and TF<1 for Al, Ca, Fe and V. For P treatments, K, Mg, Mn and Na were significantly more translocated to leaves and Zn less translocated than in control. For B treatments, Mg and Mn were significantly more translocated and K, Na and Zn less translocated than in control. In conclusion, the presence of both B-MPs and P-MPs affected soil element bioavailability, and element accumulation and translocation in spinach, although different trends were observed according to single element.

Keywords: Plastic Mulches,Microplastic,Soil contamination,Soil-Crop Relationships,Nutrient uptake

ID ABS WEB: 137213

4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

SOILPLASTIC APP TO OBSERVE PLASTICS IN SOILS

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In Europe, about 50 million tons of plastic are produced per year out of which ca 40% is processed into packaging (Plastic Europe, 2022). Packaging often ends up in landfill or in the environment after only a short or single use. Unfortunately, recycling is often inadequate, contributing to only about 10% of the European demand for plastic being met by recycled plastics (Plastics Europe, 2022). Large amounts of plastic end up in the oceans, accumulating as garbage patches and washing up on shores. However, the amounts of plastics that end up in soils is not precisely known. Scientific studies have concluded that 4 to 32 times as much plastic ends up in soils as in water bodies (Horton et al., 2017). In addition, little is known about what types of plastics enter the soil environment, and in what proportions.
The Soil Plastic App allows citizens to input observations of visible plastics and their characteristics, with a strong focus on agricultural plastics, on soils and enable to monitor the change of plastics in soils. The App runs on the citizen science Spotteron Platform and is available for iOS, Android and as a web application. This way, observations can be entered anywhere on the globe and anytime. Since December 2022, citizens have already made over 22.000 plastic observations in the SoilPlastic App. The first set of validated Austrian citizen observations between beginning of April 2023 and end of July 2023 resulted in ca 6000 observations, as part of the Austrian Citizen Science Award Project Bunter Boden. This presentation will present the first results from Austria and discuss the potential of SoilPlastic App in observing change of plastics in soils.

Keywords: plastics,citizen science,participatory research,agricultural soils,citizen observations

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4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

MICROPLASTICS IN A SOIL FROM A FARMLAND IN A MEDITERRANEAN AREA

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A device based on elutriation, a principle commonly used in sediment processing, was used to extract microplastics (MPs) from agricultural soil in Italy treated with urban compost since 2005. The extraction procedure was evaluated for both the entire soil, including the skeleton, and the fine earth (< 2 mm). The weight, count, and characterization of MPs were determined using FTIR photoacoustic spectroscopy (FTIR-PAS). The mass and number of MPs bits recovered (> 34 µm) were found to be in the same order of magnitude as those found in other soils. The main polymers identified were polystyrene, polyethylene, and polypropylene.

The study identified two main issues: firstly, the sieving procedure used to separate particles greater than 2 mm also retained lighter particles, subtracting them from the elutriation process. Secondly, the presence of soil stable aggregates was found to be responsible for the unexpected presence of MPs remaining in the device. To address these issues, two possible solutions were suggested: firstly, sampling the entire soil, including the skeleton, where the size of the largest particles size can be manageable. Secondly, breaking, before elutriation, the soil aggregates through ultrasonication and dispersion to release the plastics trapped within them.

This work is particularly relevant because sampling techniques, extraction methods, analytical procedures, and even units of measure for MPs in soil are not standardized due to the complex nature of soil as a matrix.

Keywords: Agricultural soil,Microplastics,Mediteranean area,Elutriation,FTIR-PAS

ID ABS WEB: 137901

4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

A REVIEW ON MICROPLASTICS IN EUROPEAN SOIL: OCCURRENCE, SOURCES, ANALYTICAL METHODS, AND POTENTIAL ECOLOGICAL RISK

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Pollution by microplastics in European soil is a relevant issue. The lack of knowledge of this problem is mostly because most of the studies are done in aquatic ecosystems, and just recently, terrestrial environments gained more attention. Agricultural soils are mentioned as tanks of microplastics. The complexity of detecting these little particles, no clear pathway of different types of microplastic from soil ecosystem to plant, animal, and humans, and unknown true effects on soil make prognosis imprecise, yet frightening.
In this literature review, we systematically compare last decade's studies on microplastic pollution in different Baltic Sea region countries (Denmark, Sweden, Finland, Estonia, Latvia, Lithuania, Poland, and Germany. The main focus goes on identifying the recent knowledge level and status quo of the mentioned research, mapping potential pollution sources, and identifying hotspots to get a wider view of possible ecological risks in the future of Europe.
After performing the analysis, we observed that there is a lack of information on the regional release of microplastics to agricultural soils, no clear classification of factors affecting the concentration of microplastics in soil, and no observations of possible effects on the environment in the target regions.

Keywords: microplastic,Baltic Sea region,Europe,soil,pollution

ID ABS WEB: 138097

4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

EVALUATION OF POTENTIAL ENVIRONMENTAL IMPLICATIONS OF ANAEROBIC DIGESTION OF BIOPOLYMERIC FILMS BY LCA

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The rise in environmental contamination resulting from plastic waste disposal led to the advancement of novel technologies for the production of bio-based materials. Hence, the use of biodegradable polymers in the food industry has witnessed a significant surge. Within this framework, the use of polylactic acid (PLA) and polybutylene succinate (PBS) containing cellulose nanocrystals (CNCs) extracted from hemp fibers has been considered. This study investigated the whole Life Cycle Assessment (LCA) of different biopolymeric films, focusing on the related production phase and their potential end-of-life scenarios, regardless of the film durability (i.e. a single-use packaging) and barrier performance, to counteract possible soil health threats.
In particular, PLA, PLA_20PBS (PLA/PBS blend), and PLA_PBS_3s-CNC (PLA/ PBS blend + 3% CNCs) films were examined. The investigation considered a batch anaerobic digestion (AD), at 52 °C, using municipal waste-derived digestate as inoculum. Cellulose served as a reference material. The AD was monitored over 28 days, revealing that cellulose-containing reactors exhibited enhanced biogas production, emphasizing its intrinsic biodegradability and suggesting an inhibitory effect of the synthetic biopolymeric components. The inhibition could result from their complex structure and recalcitrant nature, hindering the action of microbial consortia responsible for biomass degradation and methanogenesis.
The LCA analysis focused also on the multifaceted environmental implications of integrating biopolymers into the production of renewable energy and digestate to be used as an organic fertilizer after the composting. Remarkably, the PLA_PBS_3s-CNC formulation showed a slightly higher performance, which can be attributed to the presence of 3% CNCs, confirming the positive effect in terms of reduced environmental impact.
The enhanced biodegradability and the reduced environmental impact, suggest a potential avenue for optimizing biopolymeric formulations to both mitigate inhibitory effects on AD processes and maximize the use of naturally derived energy sources.

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Keywords: Biopolymers,Bioplastics,Life Cycle Assessment,Environmental impact,Anaerobic digestion

EPOSTERS

ID ABS WEB: 138301

4. Soil health in achieving the Sustainable Development Goals
4.31 133628 - Micro- e nanoplastics (MNPs) in soil ecosystem

THE POSSIBILITIES AND LIMITATIONS OF THE AGRICULTURAL USE OF SEWAGE SLUDGE IN THE REFLECTION OF THE AMENDMENT OF EEC DIRECTIVE 91/271

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Sewage sludge is a by-product of municipal and industrial wastewater treatment, which is produced in large quantities. It can vary widely in terms of its nutrient content and also its content of substances which are potentially harmful to the nature and human health. The disposal method and end use of the sludge produced during the sewage treatment process may differ depending on the quality and quantity parameters the sewage sludge must meet. From an economic and environmental point of view, the most suitable disposal method for sewage sludge would be to use it as a soil improvement additive (e.g. due to the decrease in the relative phosphorus content of the soil), as opposed to incineration and landfilling, however the inappropriate concentration of some components may limit the agricultural utilization. Most of the harmful substances in sewage sludge are non-biodegradable and persistent, of which micropollutants have received special attention in recent years (e.g. microplastics, active pharmaceutical ingredients), as they can have a harmful effect on the ecosystem and human health even at low concentrations (μg/kg dry matter, ng/kg dry matter). The most recent amendment of Directive 91/271 EEC pays special attention to the issue of micropollutants (e.g. the mandatory use of washing machines with microfilters in order to prevent the excessive emission of fibrous microplastics). The directive also deals with the monitoring of micropollutants during wastewater treatment and sludge treatment technologies, however, little is known about the migration and accumulation properties of micropollutants in the sewage sludge-soil system.

Keywords: Sewage sludge,91/271/EEC Directive,Agricultural use,Microplastics,Pharmaceutical ingredients

ID ABS WEB: 137200

4. Soil health in achieving the Sustainable Development Goals
4.32 133791 - Soil Research Towards Disaster Risk Reduction

SHALLOW LANDSLIDE IN AGROECOSYSTEMS: THE CASE STUDY OF OLTREPÒ PAVESE VINEYARDS (NORTHERN ITALY)

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Shallow landslides are a significant environmental problem in all contexts, but for agroecosystems this translates into soil loss and nutrient loss; both factors are extremely important for agriculture and economy. Due to climate change and extreme weather events, these processes are likely to become more widespread, thus leading to significant land abandonment. Another factor affecting shallow landslide concerns soil tillage by agricultural machinery, which, if uncontrolled, can accelerate the development of these processes. Shallow landslides are also dangerous for rural communities because of their rapidity of initiation and development and the lack of warning signs for its detection. The aim of this work is to produce an overview of shallow landslides occurred in different agroecosystems in Italy, with a focus on vineyards. Some shallow landslide inventories were analysed and compared with agricultural land use reported in CORINE Land Cover in the Italian territory. In order to analyse the role of the different agroecosystems and the related slope management technique into shallow landslide triggering the Oltrepò Pavese (Northern Italy) was selected as pilot site. The study area is one of the most important agricultural and viticultural regions in Italy. In the last 15 years, more than 2000 shallow landslides were triggered in consequence of intense rainfall events, with a density of distribution which reached more than 40% of the territory cultivated with grapevines. The work is carried out in the context of a PhD project, financed with PNRR (National Recovery and Resilience Plan) and cofounded by seven municipalities, stakeholders of the project. The final aim of the PhD project is to identify the most suitable, in terms of technical and economical suitability, Nature - based Solutions for the studied area. The scientific research results will be incorporated within the municipal planning tools and rural police regulation in order to prevent shallow landslides.

Keywords: Shallow landslide,Vineyards,Land use

ID ABS WEB: 136480

4. Soil health in achieving the Sustainable Development Goals
4.32 133791 - Soil Research Towards Disaster Risk Reduction

A RESEARCH FRAMEWORK FOR THE ASSESSMENT OF SHALLOW LANDSLIDE SUSCEPTIBILITY BASED ON SOIL FEATURES. PRELIMINARY RESULTS FROM THE ONGOING PROJECT "SOIL SHADES"

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Several research studies investigated the role of weathering processes as predisposing factors of landslides. However, most of them did not consider soils from a pedological point of view, by applying a sampling design able to catch the intrinsic vertical variability through the soil profile. This principle that is common knowledge for soil scientists, is frequently neglected by geologists and engineers. Major findings on this topic were obtained in volcanic soils involved in flow-like landslides in many geographic and climatic contexts, but other soil types have been poorly explored so far. The ongoing project "SOIL SHADES – SOIL features and pedogenic processes as predisposing factors of SHAllow landsliDES", supported by the Italian Ministry of University, is focused on an integrated multidisciplinary, multianalytical and multiscale approach applied to this purpose in a pilot catchment (Turbolo Stream) of Calabria, S Italy. This area can be considered as representative of other drainage basins in the region and in many other Mediterranean and mid-latitude contexts, based on its geological-geomorphological, pedological and environmental features. Therein we are applying traditional and innovative soil analyses together with geological, geomorphological and geotechnical investigations to assess how soil features, derived from specific weathering and pedogenic processes that modified the original properties of the parent materials through time and hence their rheological behavior, might be responsible for the triggering of shallow landslides. This approach combines field surveys at catchment, hillslope and pedon/soil profile scales (with a special focus on landslide mapping and their relations with different lithologies, landforms, soil types and other geomorphic processes) and a variety of laboratory analyses. We are using remote and proximal sensing techniques, such as drone, electromagnetic induction, electrical resistivity tomography and gamma-ray spectrometry to map the soil spatial variability. Laboratory analyses aim to assess chemical and physical properties, mineralogy, geochemistry, micromorphology, geotechnical and hydrological behavior. This work gives new insights into a deeper comprehension of the mechanisms driving landslides and associated susceptibility, hazard and risk.

Keywords: Shallow landslides,Soil features,Multidisciplinary,Proximal and remote sensing,Laboratory analyses

ID ABS WEB: 137785

4. Soil health in achieving the Sustainable Development Goals
4.32 133791 - Soil Research Towards Disaster Risk Reduction

SOILS OF THE NOVEMBER 26, 2022 CELARIO FLOW-LIKE LANDSLIDE AT THE ISCHIA ISLAND (SOUTHERN ITALY)

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On November 26, 2022, a heavy rain had a significant impact on Ischia Island in Southern Italy, leading to the triggering of numerous very rapid and destructive flow-like landslides. The municipality most affected by this event was Casamicciola Terme, resulting in 12 casualties, the evacuation of over 200 people, and considerable damage. The largest flow-slide occurred in the Celario watershed, initially starting as a small soil slip (approximately 10m3) on the top of Mt. Epomeo at an elevation of about 720 m above sea level. The initial slide evolved downslope as a flow-like landslide due to a dynamic liquefaction mechanism of pedogenized ancient debris flow deposits outcropping along the slope. The first flow stage was a debris avalanche while the second flow stage was a debris flow. The downslope evolution of the landslide involved a progressively increasing volume up to a maximum value estimated in about 40,000 m3, which moved downslope with a velocity up to 10 m/s.
The current study aimed to approach the above catastrophic landslide through an Earth Critical Zone approach aiming to understand whether soils contributed to the landslide propagation mechanisms. The study was conducted by analysing two soil profiles in two detachment crowns and the two ancient debris sediments. Our finding demonstrate that soils gave an important contribution to dynamic liquefaction and propagation mechanism because their depth and specific physical and chemical properties, especially the high sodium content on the exchange complex; in addition, we demonstrated that pedogenesis is clearly present – possibly as relict feature also in the debris flow sediments. The study reveals the crucial importance of using an ECZ based approach to analyse landslide risk at territorial scale.

Keywords: soil,landslide,risk

ID ABS WEB: 137935

4. Soil health in achieving the Sustainable Development Goals
4.32 133791 - Soil Research Towards Disaster Risk Reduction

CAN SOIL INVESTIGATION AND MICRO-TOPOGRAPHY CONTRIBUTE TO UNDERSTANDING OF SINKHOLE FORMATION? A RECENT CASE OF STUDY IN CENTRAL ITALY

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Sinkhole formation is a complex process that can be influenced by various factors, including physical landscape history and human activities. This study focused on the interrelationships between pedological-morphological elements, and the hydrogeological, geological, and environmental factors that contribute to the development of this geological hazard, emphasizing the importance of interdisciplinary research to comprehensively address the challenges posed by sinkholes in volcanic areas. Specifically, on January 31, 2023, a sinkhole occurred in the Volsini volcanic region in northern Latium, central Italy, at the bottom of the Vepe caldera, which is a small caldera nested within the Latera caldera. The soils of the area are classified as Cambic Phaeozems, developed on lacustrine, marsh, and reworked volcanic deposits. Geological, geophysical, and geochemical investigations were carried out to examine the collapse and the surrounding area to identify potential contributing factors. Soil characteristics and indicators could provide valuable information about sinkhole-prone areas and could be essential for early detection and mitigation of potential hazards. While no specific soil characteristic can definitively predict a sinkhole, certain clues and indicators can raise suspicion and warrant further investigation. Hydrological dynamics play a critical role, but soil texture and structure are also important factors that allow for rapid infiltration of rainfall and control erosion, subsidence, compaction, or settlement. Soil chemistry can help identify accumulation and translocation processes in the lower soil horizons related to water infiltration that may precede collapse development. Similarly, surface features, such as depressions or cracks in the ground, could be signs of ongoing subsurface changes. The area has been monitored using Unmanned Aerial Vehicles (UAVs) since the early stages of the sinkhole's formation and is still being monitored today. The use of UAV photogrammetry has allowed for the reconstruction of the micromorphology of the area at high-detail and to monitor in safety, the sinkhole's dimensions, changes in the water level, the stratighraphy, and the soil horizons along the sinkhole's slope.

Keywords: Risk reduction,Soil,Land degradation

ID ABS WEB: 136991

5. Soil in the circular economy
5.01 133614 - Soil needs in industrial agriculture and highly populated areas

RESPIROMETRY TEST AS A TOOL TO PREDICT THE URBAN AND AGRO-INDUSTRIAL WASTE DECOMPOSITION AND PRODUCE HIGHT-QUALITY ORGANIC COMPOSTS FOR AGRICULTURAL USE

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Urban and agro-industrial wastes may be carbon:nitrogen (C:N) ratio and nutrients imblances, excess sodium, pathogens and heavy metals, which can alter the soil fertility and contaminate the soil-water-plant system. These residues mixed with carbon rich materials, in composting process, can improve its nutritional quality and reduce contaminants. However, the large amount of waste generated and the long time requires to stabilize it can make the large-scale process costly and unfeasible. This study aimed to compare the decomposition of wastes mixture 30:1 C:N ratio, initial water content 50%, in laboratory test and in compost piles, to optimize composting factors. Sewage sludge, food waste and swine manure were mixed separately with tree pruning and grass and incubated in respirometry test at 28oC. Released CO2 was captured in NaOH solution, measured by electrical conductivity, until stabilization at 85 days, and the data adjusted to the first order equation. Compost piles were built to the dimensions 4.0 (L) x 2.5 (W) 1.5 (H) m, totaling 15 m3 organic materials, monitored for temperature, water, carbon and nitrogen contents, turned and irrigated for 60 days until final thermophilic phase. Quality parameters and contaminants of final organic composts from both processes were within the limits of Brazilian fertilizer legislation. Decomposition rates under laboratory and field conditions ranged from 20% to 30% (sludge + grass; food + grass) and 30% (sludge + pruning; food + pruning; food + grass) to 50% (sludge + grass swine + pruning, swine + grass), respectively. Decomposition final time was equal to sludge treatments, and twice as fast for food and swine waste and both structuring materials, when composting process was compared to respiromety. It can be observed that recalcitrance of the N-rich residue controls the decomposition process, and the respirometry test proved to be a good tool to scale compost process and costs, as well as to produce organic composts for sustainable agricultural use.

Keywords: sewage sludge,food waste,swine manure,urban garden waste,composting process

ID ABS WEB: 137177

5. Soil in the circular economy
5.01 133614 - Soil needs in industrial agriculture and highly populated areas

APPLICATION OF DIGESTATE FROM RURAL ANAEROBIC DIGESTERS FOR DEGRADED SOIL RESTORATION IN COLOMBIA

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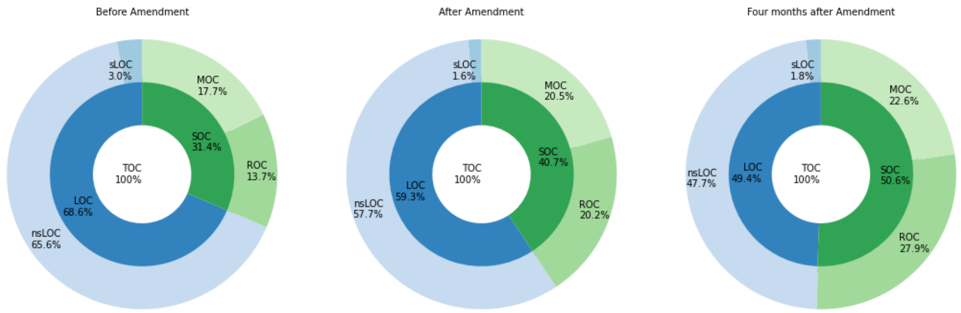
Anaerobic digestion is a promising technology to improve the living standards of rural communities, reduce environmental pollution and promote sustainable development. Apart from biogas, digestate is the other product of the anaerobic digesters and its reuse in agriculture can be as important as biogas in rural households and small farms of Latin America.
According to the UNCCD, there are more than 2 billion hectares of degraded land in the world, of which 14% is in Latin America.
In this context, this study reports the results of a first attempt to use digestate from rural digesters for degraded soil restoration in Colombia. Digestate from anaerobic digester fed with pig slurry and operating under psychrophilic temperature (15°C) was applied daily during 4 months to a degraded soil subjected to intensive cultivation for many years (latitude of 5°51'42.3'N, 72°57'51.6'W Colombia). Digestate produced daily (3 m3) was spread uniformly onto all the experimental site and the soil was subjected to no tillage nor cultivation of crops. After 4 months of daily application, the digestate spreading was stopped. During the following months, the experimental site was not used nor for cultivation, nor for grazing. Soils samples (10-20 cm depth) were collected before the start of the experiment (M1), after 4 months of daily digestate application (M2) and after 4 months from the last digestate application (M3).
Following digestate application, soil pH and cation exchange capacity significantly increased. Soil organic C significantly increased (+60% from M1 to M2) and its concentration was stable from M2 to M3. Digestate application enhanced the stable, mineral-protected and recalcitrant pools of C in soil, proving that digestate may effectively increase soil organic C content, improving soil fertility and acting in C storage and sequestration in soil (Figure 1) . All plant nutrients analyzed significantly increased after digestate application (N, available P, Ca, K, Mg, Fe, Mn, Mo). No significant threats of heavy metals accumulation were identified after digestate application.



Keywords: Circular economy,Digestate,Soil regeneration,Soil organic C pools,Waste management

ID ABS WEB: 137694

5. Soil in the circular economy
5.01 133614 - Soil needs in industrial agriculture and highly populated areas

TECHNOSOLS AND SOIL ORGANIC CARBON STORAGE IN FINE EARTH FRACTION

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Soil is a limited resource and the availability of natural soils for land reclamation and restoration is a serious issue. Moreover, they can be the key for urban areas and industrial agriculture. For these reasons, it is important to prepare technical soils (technosols) by using waste in the framework of circular economy and zero waste promoted by the European union. This type of soils is defined in the WRB as a group that combines soils whose properties and pedogenesis are dominated by their technical origin, and includes soils from wastes. These soils are usually prepared adding inorganic and organic materials. In this sense, the presence or organic carbon can help to mitigate the negative effects of climate change.
To study the presence of organic matter in technosols, an experiment was done with 16 technosols for a short period of cultivation of tomato (three months). These technosols were a combination of several inorganic materials (fine and coarse calcium carbonate grave -80% volume-) and organic wastes: sewage sludge compost, palm tree leaves, hay straw, and olive tree leaves, and peat (20% volume).
After the short period of cultivation, in the fine earth, the presence of soil organic matter was determined by two methods: Walkley-Black and Loss on Ignition. The results showed that, in general, the technosols made using compost from sewage sludge have more organic matter in the fine fraction. The type of organic matter and the size are key factors for plant nutrition, organic matter decomposition and physical and chemical interactions. Opposite, treatments with hay straw added less organic matter to the fine earth.

Keywords: Circular economy,Fine earth,Organic carbon,Technosol,Wastes

ID ABS WEB: 137832

5. Soil in the circular economy
5.01 133614 - Soil needs in industrial agriculture and highly populated areas

THE USE OF SEWAGE SLUDGE AS SOIL IMPROVERS IN THE AGRICULTURAL/FORESTRY SECTOR. A META-ANALYSIS

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Increase in the generation of solid waste and sewage sludge is linked to population growth and sustainable development, motivating investigations aimed at transforming this “waste” into a product, which is rich in organic and mineral matter. In-depth studies are essential to ensure safe use and minimize environmental risks. The main objective of the study was to carry out a systematic review following the PRISMA protocol, crucial for rigorous and transparent literary reviews. The protocol provides essential methodological guidelines for consistent documentation in systematic reviews. The research involved a systematic search on the Scopus and Web of Science platforms, using the keywords (('sewage sludge' OR 'byproduct'), AND ('urban ground' OR 'landscape' OR 'soil remediation' OR 'forestry')). The dataset obtained in this phase totaled 7.625 records. Strict inclusion criteria were applied: English-only documents, accepted and published articles, thematic area of interest, articles published from 2013 to August 2023, and studies presenting quantitative data. Duplicate articles were excluded. After these steps, 90 articles were carefully selected as eligible. So far, it can be concluded that there has been a significant increase in the number of studies, particularly in the last 6 years, which accounts for 78.9% of the total number of studies identified. It is observed that 83.3% of the studies are concentrated in America, Europe and Asia, with Brazil and China having the greatest representation, totaling 40% together. 96% of the articles compared sewage sludge, control, or other raw materials, providing a robust dataset for analysis. In this context, it can be stated that, so far, the objectives outlined have been achieved, as the proposal aims to analyze the use of sewage sludge in forestry and landscape species and in soil recovery. Around 59% of articles address these specific areas. The next phase will be to carry out a meta-analysis of the data contained in the articles in order to verify statistical correlations between the investigated elements.

Keywords: systematic review,sewage sludge,PRISMA statement,meta-analysis,soil remediation

ID ABS WEB: 140056

5. Soil in the circular economy
5.01 133614 - Soil needs in industrial agriculture and highly populated areas

FROM WASTE TO WEALTH: ENHANCING SOIL HEALTH WITH NOVEL SOIL IMPROVERS - THE WASTE4SOIL PROJECT

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The Waste4Soil project tackles the urgent need for sustainably managed food processing residues (FPR) by developing innovative recycling pathways to convert them into soil improvers. Adopting a holistic, circular, and multi-actor approach involving stakeholders across the food chain, the project aims to close specific loops, including nutrients, organic matter, and water, at the regional scale (involving 28 partners from 9 European countries and Switzerland). Key objectives include optimizing FPR collection and understanding, developing standards to support circular food systems and soil health, formulating eco-friendly soil improvers, and engaging food system actors and citizens in a circular economy.
To achieve these goals, a standardised Evaluation Framework will enable stakeholders to assess their progress towards FPR circularity, while Living Labs across Europe will facilitate collaborative research and innovation. The project's work plan, organised into eight Work Packages, encompasses activities ranging from knowledge centralisation and tool production to impact monitoring and communication.
The project's effort includes the development of a Common guideline for monitoring soil's properties and crop's performance led by the Spanish National Research Council (CSIC) and the University of Wageningen (WUR). This guideline will serve as a crucial tool for decision-makers, optimizing the utilization of processed food waste, reducing environmental risks, fostering sustainable agricultural practices, and assessing the effects of soil improvers on soil health indicators.
Waste4Soil represents a significant stride towards a more sustainable and circular approach to managing food processing residues, improving soil health, enhancing crop performance, and fortifying food systems' resilience.

Keywords: Soil Monitoring,Food Processing Residues,Sustainable Economy,Circular Economy

ID ABS WEB: 140129

5. Soil in the circular economy
5.01 133614 - Soil needs in industrial agriculture and highly populated areas

EVALUATION OF A MICROBIAL CONSORTIUM OF CHILEAN DESERT SOIL FOR TEXTILE REDUCTION

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Worldwide and nationally, there is a significant issue of contamination from textile waste lacking any reutilization or degradation plan. Approximately 100 million tons of textile solid waste are generated annually. This trend is a consequence of 'fast fashion,' which aims to sell 'disposable' clothing at a low cost, produced under a highly polluting linear lifecycle, with natural resources being used intensively and inefficiently. In Chile, less than 1% of the material used in clothing production is recycled, with 85% of textiles ending up in landfills or being incinerated. This study aims to reduce the vast amount of waste generated by this industry by employing bacterial strains with cellulolytic activity isolated from the Chilean desert soil. The capability of 35 strains to degrade textile material in liquid medium over 40 days was assessed, and 4 strains were selected for their ability to reduce the textile weight by 50%. In vitro cellulose degradation assays revealed that these 4 strains degrade over 50% of the cellulose present in textiles. This technology is environmentally friendly, promoting the sustainability of territories, minimizing environmental impact, and contributing to the circular economy through the reuse of degradation by-products. It is a harmless technology that addresses health concerns in more contaminated areas.

Keywords: TEXTILE BIODEGRADATION, TEXTILE COMPOSTING

ID ABS WEB: 140671

5. Soil in the circular economy
5.01 133614 - Soil needs in industrial agriculture and highly populated areas

URBAN LIVING LABS FOR SOIL CONSERVATION - ENHANCING CITIZEN'S FOOD SECURITY

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Soil mechanical degradation and pollution in urban and peri urban areas often represent an environmental barrier to the development of urban agriculture in available free spaces. Therefore, soil remediation is a first step to soil conservation, which can be interpreted as a set of farming methods and good practices that maintain soil health and keep the land from physical and chemical degradation, loss of biodiversity and erosion. The structure of the soil, its organic matter content, its water holding capacity and biota are key factors to cultivate good quality crops. Turning the often heavily polluted brown fields into green areas of agricultural production, urban gardens or peri-urban farms and agroforestry is a process, which requires both a wide range of public resources, involvement of private enterprises and community participation. Urban Living Labs are means for channelling of the participatory synergies of local governments, stakeholders, and civil society by establishing criteria, preferences, and innovative solutions for the development of experiences and the implementation of good practices in local and sustainable food production and their active involvement in spatial planning. The implementation of Urban Living Labs (with a strong citizen intervention) allows to draw conclusions regarding the capacity building potential of participatory methods and social innovation to solve citizen problems in different contexts (stakeholders, citizen profiles, social, cultural, economic, demographic context). This becomes even more relevant considering that the socio-economic and environmental problems to be addressed in all locations will be the same: what is the best way to extend or further extend the experiences of healthy and sustainable food production in urban, peri urban and semirural areas. Thus, conditions for urban agriculture can be assessed through data provided by the well-monitored activities of Urban Living Labs in the scope of spatial and functional benefits (urban gardens as a part of sustainable multifunctional urban space), cultural and economic benefits (urban gardens as social nodes and opportunity for business start-ups), and health benefits (urban gardens as the source of organic food and the place for physical activity). The existing urban gardens in the city will reveal potential benefits of conversion of other areas to new urban gardens taking into consideration the impact on microclimate, possible air and water pollution reduction, soil recultivation, water retention and inundation, ground water levels, floods risk reduction, and increasing biodiversity.

Keywords: urban living labs, soil degradation, soil remediation, participatory approach, urban agriculture, urban gardens, food security, multifunctional land use, biodiversity

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6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

PREDICTING GRAZING FROM MULTISPECTRAL DATA, TERRAIN, AND DIGITAL SOIL PROPERTIES USING NEURAL NETWORK ANALYSIS BASED ON SYSTEM COMPLEXITY

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Remote sensing tools along with Global Navigation Satellite System cattle collars and digital soil maps may help elucidate spatiotemporal relationships among soils, terrain, forages, and animals. However, standard computational procedures preclude systems-level evaluations across this continuum due to data inoperability and processing limitations. Deep learning, a subset of neural network analysis, may elucidate efficiency of livestock production and linkages within the livestock-grazing environment. Consequently, we applied deep learning to 1) develop predictive models for yield and forage nutrition based on vegetation indices; and 2) at pixel-levels, identify how grazing is linked to soil properties, forage growth and nutrition, and terrain attributes in silvopasture and pasture-only systems. Remotely sensed data rapidly and non-destructively estimated herbage mass and nutritive value for enhanced net and primary productivity management in livestock and grazing systems. Cattle grazed big bluestem (Andropogon gerardii Vitman) with 182% greater frequency than orchardgrass (Dactylis glomerata L.) in the pasture-only system. Real-time estimates of vegetative bands may assist in predicting grazing pressure over time and space for more efficient management of pasture resources. Cattle grazing followed distinct soil-landscape patterns, namely reduced cattle grazing preference occurred in areas of water accumulation, which highlights linkages among terrain features—soil-water movement—soil properties—forage nutrition—and animal grazing response spatially and temporally. Results from this study could be scaled to greater extents to improve grazing management among the largest land-use category in the U.S., grasslands, which would allow for sustainable intensification of forage-based livestock production to meet growing demands for environmentally responsible protein.

Keywords: silvopasture,Neural Network Analysis,Grazing Preference,Digital Soil Maps,Remote Sensing

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6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

A ROOT–SOIL DIELECTRIC APPROACH FOR NON-DESTRUCTIVE WHEAT PHENOTYPING IN ORGANIC FARMING

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Root system is an obvious target to develop crops with improved soil resource acquisition in low-input systems. Measurement of root–soil dielectric response is a promising approach for high-throughput root evaluation without plant injury and soil disturbance. As root electrical capacitance (CR*) depends on the stem properties, the efficiency of measuring CR* at flowering for whole-plant phenotyping was assessed in a two-year study in five winter wheat cultivars grown under organic conditions. Linear regression models were built to correlate CR* with plant-size parameters and flag-leaf traits (extension and SPAD chlorophyll content) at flowering, and with yield components at maturity. The plot-mean CR* was correlated with the ceptometer-based plot leaf area index (LAI), the chlorophyll quantity (LAI×SPAD) and the grain yield across the years. At plant scale, CR* was found to show the strongest positive regression with total chlorophyll in the flag leaf (flag leaf area × SPAD; R2: 0.65–0.74) and with grain mass (R2: 0.55–0.70) for each cultivar and year. Likewise, at plot scale, the regression was the strongest between CR* and the LAI×SPAD value (R2: 0.86–0.99) for the cultivars. Consequently, CR* indicated the total plant nutrient and photosynthate supply at flowering, which depended on root uptake capacity, and strongly influenced the final yield. Our results suggested that the polarization of the active root membrane surfaces was the main contributor to CR*, and that the measurement could be suitable for evaluating root size and functional intensity. In conclusion, the capacitance method can be applied for non-destructive whole-plant phenotyping, with potential to estimate root and shoot traits linked to the nutrient supply, and to predict grain yield. CR* can be incorporated into allometric models of cereal development, contributing to optimal crop management and genetic improvement. The dielectric measurement can be integrated into other proximal sensing techniques, including root visualizations and detecting vegetation indices i.e. LAI, NDVI or PRI.

The project was funded by the NKFIH, Hungary (FK-137617).

Keywords: root electrical capacitance,grain yield,nutritional status,in situ root methods,proximal sensing

ID ABS WEB: 136063

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

SOIL ELECTRICAL CONDUCTIVITY IN SATURATED PASTE EXTRACTS AND IN DIFFERENT SOIL:WATER SUSPENSIONS. MEDITERRANEAN CENTRAL CHILE

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As an alternative to measuring the electrical conductivity of the saturated paste extract (ECe), the electrical conductivity in water suspensions (EC1:X) was measured, with three different soil:water ratios and 5 replications in clay, clay loam to loam and sandy loam to sandy clay loam soils (Mollisols, Vertisols and Entisol) at Mediterranean central Chile , characterized by a Csb2Sa climate (Köeppen). The relationships between the ECe and the EC1:X were evaluated on mass/volume and volume/volume basis at laboratory (EC1:1 m/v, EC1:2.5 m/v, EC1:5 m/v, EC1:1 v/v, EC1:2.5v/v, EC1:5v/v,), as well as volume/volume in the field or in situ (EC1:1 v/v is, EC1:2.5 v/v is, EC1:5 v/v is). The relationship between the different measured EC and some soil properties (texture, pH, water content at saturation, at 33, and at 1500 kPa) was also evaluated. Elevated and significant linear correlation between ECe and EC1:X were observed (r: 0,81 to 0.92), besides to identify saline soils in the study area (ECe > 4 dS/m), the following values should be reached (dS/m):

EC1:1m/v	> 2.35	or	EC1:2.5m/v	> 1.20	or	EC1:5m/v	> 0.72
EC1:1v/v	> 2.27	or	EC1:2.5v/v	> 1.28	or	EC1:5v/v	> 0.74
EC1:1v/v is	> 2.48	or	EC1:2.5v/v is	> 1.33	or	EC1:5v/v is	> 0.74

Finally, of the variables selected by the stepwise regression analysis, the silt content is the most common in all the models, followed by the pH of the soil:water suspension (1:1m/v; 1:2,5m/v and 1:2,5v/v; 1:5v/v).

Keywords: soil salinity,in situ and laboratory measure,saturated paste extract,water suspensions

ID ABS WEB: 136166

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

SENSITIVITY ASSESSMENT OF ARTIFICIAL NEURAL NETWORK FOR SOIL ORGANIC CARBON PREDICTION USING HYPERSPECTRAL RADIOMETRIC DATA

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The aim of this study was to assess the sensitivity of hyperspectral radiometric data in the visible, near-infrared (NIR) and shortwave-infrared (SWIR) region (350–2500 nm) to soil organic carbon (SOC) content. Hyperspectral radiometric data measures reflectance of light across a range of wavelengths and has been proposed as a potential tool for predicting SOC content in soil. The study employed seven spectral indices such as Hue Index (HI), Brightness Index (BI), Colouration Index (CI), Saturation Index (SI), Soil Composition Index (SCI), Soil Organic Carbon Index (SCI), and Optimised Soil Adjusted Vegetation Index (OSAVI) based on laboratory spectral measurements of soil reflectance using an ASD FieldSpec Pro spectroradiometer, combined with laboratory chemical analyses of soil samples to determine SOC concentrations. Following this an Artificial Neural Network (ANN) model was developed to predict SOC content using spectral indices data tested for optimal model performance. Results showed that hyperspectral radiometric data was highly sensitive to SOC content, with root mean square error (RMSE) of 0.08 during calibration, 0.07 during validation and mean absolute error (MAE) of 0.06 during calibration and validation indicating that this technology could be an effective tool for accurately predicting SOC content in soil. Sensitivity assessment of ANN was carried out to find the most sensitive variables using Lek’s profile method. Results of sensitivity analysis shown SOCI and HI as most sensitive variables in prediction of SOC. These results hold potential for mapping SOC content at a large scale. In conclusion, the study highlights the potential of hyperspectral radiometric data for accurately predicting SOC content in soil. Thus, this technology in the visible, NIR and SWIR region has shown promising results, making it a valuable tool for precision agriculture and environmental monitoring.

Keywords: Hyperspectral radiometric data ,Artificial neural network ,sensitivity assessment, spectroradiometer,soil organic carbon

ID ABS WEB: 136300

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

A FIRST ITALIAN SOIL SPECTRAL LIBRARY WITH A LOW-COST NIR SPECTROMETER FOR SOIL ORGANIC CARBON PREDICTION

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Over the past two decades, visible and near-infrared (VIS-NIR) diffuse reflectance spectroscopy has gained popularity for soil analysis, because of its rapid and inexpensive acquisition methods. Recently, technological developments have allowed the fabrication of small NIR spectrometers at much lower cost than the traditional ones. Such devices are based on “micro-electromechanical systems” (MEMS), and are usually composed of an interferometer, consisting of an oscillating mirror and beam splitters, as well as an InGAs photodetector. This work aims to present a first Italian soil spectral library created using a low-cost and handheld NIR-MEMS spectrometer (Si-Ware Neospectra Scanner, bandwidth 1350-2500 nm). The library contains a total of 664 NIR spectra coming from several regions, associated with conventional laboratory analysis. 283 samples belong to forest soils (252 from A horizon, 31 from subsoil horizons), whereas 381 samples belong to agricultural soils (297 from A horizon, 84 from subsoil horizons). Some of the scanned soil samples derived from the Italian soil archives of CREA-AA Research Centre in Florence, whereas others come from different soil survey campaigns or scientific collaborations of this research group.
Partial Least Square (PLSR) and Support Vector Machine (SVM) regressions were tested to predict soil organic carbon (SOC), after a pseudo-normalization of the SOC data by log-transformation. 10 k-fold cross validation was carried out to calculate the prediction errors. PLSR provides slightly better results than SVM, in terms of R2 (0.75) and root mean square error of prediction. The accuracy increases when the PLSR model is calibrated within a specific subset, such as “topsoil in agriculture” and “topsoil in forest”. SOC prediction of subsoil horizons provides slightly lower accuracy.

Keywords: spectroscopy, pedometrics, digital soil mapping, carbon stock, soil monitoring

ID ABS WEB: 136301

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

THE RELATIONSHIP BETWEEN SOIL HYDRAULIC PROPERTIES AND PARAMETERS OF PLANT GROWTH IN A FIELD WITH SPATIALLY HETEROGENEOUS SOIL PROPERTIES

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The water available to plants depends on soil properties, which are spatially variable even at the field parcel scale. The spatial variability of plant available water is caused by the variability of soil texture, depth, the presence of rock fragments, organic matter content and dry soil bulk density, among other factors. The variability of soil properties is also reflected in plant growth. The leaf area index (LAI) is a biophysical plant parameter that reflects the environmental factors in the field and is an indicator of plant growth. Remote sensing is proving valuable for monitoring agricultural systems as it enables the calculation of plant vegetation indices by using multiple spectral bands. The normalized difference vegetation index (NDVI) is commonly used for the detection of plant activity. The aim of this study was to investigate the relationship between the maize growth measured as in-situ LAI and remotely sensed vegetation index (NDVI), and soil parameters such as plant available water, current soil water content and dry soil bulk density. Multi-layer measurements were conducted in a field with spatially variable soil properties in Šempas, located in the western part of Slovenia. Forty georeferenced measurement points were defined on the field, from each of which we obtained undisturbed soil samples to determine gravimetric soil water content, water content at pF 2.0 and dry soil bulk density. Disturbed soil samples were used to determine the water content at pF 4.2. LAI measurements were taken using a ceptometer, and a drone surveyed the entire field from which the point NDVIs were calculated.

The research was funded by the Slovenian Research and Innovation Agency (ARIS) project no. J1-4412.

Keywords: Spatial variability,Soil hydraulic properties,Plant growth,LAI,NDVI

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6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

LEAF AREA MEASUREMENTS IN EVALUATING TILLAGE METHODS IN A LONG-TERM SOIL CULTIVATION EXPERIMENT AT HUNGARY, 2016-2022

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An essential goal of crop management is to increase crop productivity and to enhance soil health within constraints imposed by economic considerations. How the soil is cultivated is crucial to achieving this objective. Regarding crop productivity, leaf area and yield are important plant parameters.
Ceptometry (Accupar LP-80), a well-established non-destructive optical assessment method, offers an in situ measurement of the canopy size (Leaf Area Index LAI).
The objective of this study was to determine the influence of tillage on LAI and yield of crops under continental climate conditions located in Józsefmajor, Northeastern Hungary. The long-term soil cultivation experiment were conducted on chernic calcic Chernozem developed on loamy clay, under no-tillage (NT), mouldboard plough (MP) and shallow cultivation (SC) tillage systems. The crop sequence in the years (2016 – 2022) was, in order maize, winter oat, soybean, winter wheat, winter oat, sunflower and barley. LAI was measured at flowering, when the foliage reached its maximum size.
Results indicated that LAI is the lowest at NT in all years but 2022 and the highest in MP in 2016, 2017, 2018 and 2020, and in SC in 2019, 2020; although treatments are not significant in 2018 and 2020, and MP-SC is not significant in 2021. Yield is the lowest at NT in most years but 2020, 2022, although 2020 is not significant, and the highest in MP in 2017, in SC in 2016, 2018, 2019, 2020, 2022. SC-MP differences are not significant in all years.
Overall, the tillage method had a significant effect on yield and mostly on ceptometer-based LAI, too. NT treatment was associated with lower LAI and yield loss compared to MP and SC treatments. The highest LAI values were generally measured in the MP treatments, while the highest yield values were generally obtained in the SC treatments.
The research was funded by the Sustainable Development and Technologies National Programme of the Hungarian Academy of Sciences (FFT NP FTA).

Keywords: in situ leaf area measurement,ceptometer,soil cultivation methods,no-tillage,grain yield

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6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

IMPACT OF SOIL CONDITIONERS ON WATER SENSORS

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In precision agriculture sensors can monitor field conditions to optimise resource input to reduce costs and improve sustainability. The global agriculture sensors market is expected to be worth 16.83 billion USD by 2030. Water content sensors are fundamental to monitor soil moisture, playing a key role in irrigation scheduling for precision agriculture. Climate-smart agriculture has also focused on improving soil moisture retention by adopting water-holding enhancement strategies such as the use of soil conditioners. However, despite “sensor deployment” and “soil conditioners” both intended to improve water use efficiency, data are lacking on the responses of soil water sensors to soil conditioners for enhanced water holding capacity. The present study assessed the effect of different soil conditioners on the performance of a range of soil water sensors. We evaluated soil moisture sensor readings taken in a sandy soil, with added biochar (2.5% w/w), compost (5% w/w), hydrogel (0.6% w/w) and water treatment residue (5% w/w). The soils were saturated and then subjected to wetting and drying cycles. Measurements were taken continuously using multiple commercial sensors: ML3 ThetaProbe and SM150T soil moisture sensors (Delta-T Devices Ltd, Cambridge, UK) as well as EC-5 soil moisture sensors (Meter Environment, Pullman, WA, United States). We observed a tendency by ML3 and SM150T sensors to underestimate water content at low water content values (actual VWC < 30%), while overestimating water content at high water content values (actual VWC > 40%), using the intrinsic manufacturer calibration. In contrast, EC-5 sensors underestimated water content at both low- and high-water contents. Using a soil specific calibration, the presence of soil conditioners exacerbated the tendency to both underestimate and overestimate the actual water content. Our results showed the need for “conditioner-specific calibrations” when soil is amended with different conditioners. The interactions between soil conditioners and water content readings taken by soil moisture sensors will be discussed in detail, along with their repeatability and accuracy.

Keywords: Soil moisture sensors,Soil conditioners,Soil amendments,Irrigation scheduling,Precision agriculture

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6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

MAPPING OF SOIL PHYSICO-CHEMICAL PARAMETERS BASED ON COMBINED FIELD- AND UAV-BASED SPECTRAL MEASUREMENTS

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Spectral tools and measurements are established techniques in Digital Soil Mapping for obtaining information on quantitative soil parameters to minimize the number of actual soil samples required from the field. Such tools can be point measurement sensors like spectroradiometers and optical imaging spectrometers (multi- or hyperspectral cameras).
In this study, we tested a combined method in a small vineyard located in Upland Balaton, Hungary. The study area is appr. 10 ha. Three different inter-row soil management were investigated (tillage, cover crops and perennial grass). The soil in the area is generally Cambisol or Luvisol, developed from loess.
Three different datasets were collected: i) field spectra measured with an ASD FieldSpec Pro spectroradiometer and laboratory analysis of 22 soil samples (referred as ‘real’ samples) from evenly distributed locations across the sample site, ii) similar spectra at a further 22 'virtual' points generated by the Conditioned Latin Hypercube Sampling method using topomorphometric (Digital Elevation Model and its derivatives) and multispectral raster layers as input, both generated from UAV surveys, and iii) spectral and topographic raster information from the aforementioned aerial measurements.
During our processing workflow, a two-step method was implemented. Firstly, a ‘ranger’ random forest based model was built to predict selected soil parameter values from spectral data of both the 'real' samples (as training data) and also for the 'virtual' points. As a second step, these predicted soil parameter values of the virtual points were used together with the laboratory measured data of the 'real' soil samples as training data to model and map the whole study site based on the spatially exhaustive aerial survey layers.
The accuracy and the uncertainty assessment of both steps were examined to evaluate the proposed method.

Keywords: digital soil mapping,proximal sensing,field spectra,uncrewed aerial vehicle,spectroradiometer

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6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

DIGITAL MAPPING AND MONITORING OF INDUSTRIALIZED URBAN SOILS

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The city of Debrecen, a rapidly industrializing lowland area poor in surface waters, where the different soil characteristics of 3 larger geographical regions have been fundamentally transformed by modern urbanization. In addition to German rolling bearing production and the automotive industry, battery production from Asia is also expanding rapidly. This obviously means the withdrawal of more than a thousand hectares of land, the paving of significant areas and the emergence of potential sources of emissions. The monitoring network implemented in the city's TÓCÓ catchment, which is the most exposed to environmental risks, aimed to meet these challenges. A geodatabase built from photogrammetry, LIDAR and satellite data was built into the urban soil model. ESRI Survey123 mobilGIS and GPS RTK survey was carried out at nearly 500 points in 5 regions with 0-0.2m surface sampling and 360 images for later identification of plant phenology and soil condition. After drying and sifting the samples, heavy metals, humus content, clay fraction analysed by NITON XRF, Agiland FTIR sensors and spectral VIS-NIR reference curves were measured and hydraulic conductivity also calculated. Based on geostatistical studies, the size of the large database was reduced to critical hot spots, which further evaluate the sediments movements and pollution risks of flash floods in urban river basin models within the framework of the monitoring. The important fact about the studies is that not only the potential risks s have to be taken into account, but also the significant watercourse revitalization completed last year, when significant ecological water supply and river bed construction with new hydraulic gauges was also carried out on TÓCÓ. These processes assume that we perform sensoring that provides quasi-real-time data collection and evaluation. The research work funded by RRF-2.3.1-21-2022-0008 project

Keywords: Sensors,Soil mapping,Soil monitoring,Remote sensing

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6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

COMPARISON OF ARTIFICIAL NEURAL NETWORK (ANN) AND PARTIAL LEAST-SQUARES REGRESSION (PLSR) FOR ESTIMATING SOIL ORGANIC CARBON BY VIS–NIR SPECTROSCOPY: A CASE STUDY IN A KIWI ORCHARD IN SOUTHERN ITALY

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Soil organic carbon (SOC) affects soil properties and processes as well as is an important sink and source of plant and microbial nutrients. Visible and near-infrared reflectance spectroscopy (Vis-NIR, 350–2500 nm) has become an important method for measuring and monitoring SOC. However, analysis of soil diffuse reflectance spectra data requires complex mathematical treatments to extract useful information and relate traditional measures of SOC concentrations to spectral data. Defining the most suitable methods for relating SOC measures to diffuse reflectance spectra is an active field of research which requires further study. The study was developed within E-Crops Project – Technology for Sustainable Digital Agriculture (National Operational Programme on R&I 2014–2020, Italy), and aimed to compare ANN and PLSR for estimating SOC by Vis–NIR spectroscopy. Topsoil (0-0.20 m) samples were collected at 126 locations within a kiwi orchard in Basilicata region (southern Italy) and analyzed for SOC concentration using a Shimadzu TOC-L analyzer. Vis-NIR reflectance spectra were measured in laboratory using an ASD FieldSpec IV 350– 2500 nm spectroradiometer. Accuracy and robustness of ANN and PLSR models were evaluated by a ten-fold cross-validation method based on R2, root mean square error (RMSE), and relative percent deviation (RPD). The dataset was randomly divided into ten equal sized groups (folds). One of the groups (10% of the dataset) was retained as validation data for testing the models, whereas the remaining groups (9 folds or about 90% of the selected data set) were used as training data. The process was repeated ten times, and each fold was used only once as validation data. The average of ten repeated processes was calculated to generate the SOC prediction models. The results showed that the prediction models obtained by ANN (mean R2= 0.94; mean RPD=4.07) performed better than those by PLSR (mean R2= 0.79; mean RPD=2.16). However, both PLSR model and ANN model were quite stable when calibration and validation sets were changed through the ten-fold cross-validation.

Keywords: Precision agriculture,Chemometrics,Proximal soil sensing,K-fold cross validation,South Italy.

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6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

IDENTIFICATION OF PRODUCTIVITY ZONES BASED ON LANDSCAPE FACTORS AND SOIL PROXIMAL SENSING DATA IN ORGANIC FARMING

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In the past few years uniform management of fields in agriculture has been gradually replaced by environmentally based management, which involves exploiting the multifunctionalities of landscapes. In cases of organic agriculture, which is a low input system, there is always a risk of lower yields. To mitigate the tradeoff between environmental benefits and lower yields, landscape features can be taken advantage of to optimize productivity in organic agriculture. For this, geodata, along with soil data measured with proximal sensing equipment was used for an organic mixed farming experimental site in Hesse, Germany. The calculation of the metrics that affect crop growth was done with satellite data in two scales: Sentinel 2 images in 10 m resolution and PLANET Scope Images in 3 m resolution for the period of 2020-2023 in the vegetation periods. The vegetation indices for the crop was calculated with the help of GIS tools and python. The soil texture was inferred with the apparent soil electrical resistivity values and the natural gamma emissions measured with the novel Geophilus proximal sensing equipment. Soil heterogeneity was then calculated based on the texture data and ground truth values of soil moisture, infiltration rates and soil organic matter content with the help of a Multi Linear Regression model. The two datasets of soil heterogeneity data and crop data were compared to identify indicators of crop growth. Then finally elevation was taken into account to identify risk areas vulnerable to erosion. Thus, with a data-driven approach, the field site was analyzed to identify zones which are relatively more productive in terms of soil quality and crop growth, as well as zones where ecosystem services like planting hedgerows are necessary to mitigate soil erosion. These zones were visualized with GIS tools resulting in maps that can be used by farmers to optimize yields by changing or modifying the management practices with respect to the yield potential of soils.

Keywords: Productivity Zones,Soil Heterogeneity,Proximal Sensing,Organic Farming,Landscape Factors

ID ABS WEB: 140090

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

MACHINE LEARNING-BASED PREDICTION OF IRON OXIDES IN SOIL B HORIZON FROM DIFFERENT TYPES OF SMARTPHONES IN JIANGXI PROVINCE, CHINA

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Iron oxides, critical indicators of soil development in the B horizon, present a challenge for traditional analysis methods such as free iron oxide (Fed), total iron (Fet), and freeness of iron (Fed/Fet*100%), which are time-consuming and increasingly impractical in the context of modern precision agriculture. This study adopts an innovative approach by using smartphones as proximal sensors to capture soil color parameters, thereby offering a rapid and accessible method for estimating soil iron oxide content. By harnessing smartphone technology to assess key soil color determinants, especially iron oxides, this study aims to surmount the limitations of traditional analysis techniques and pave the way for advancing smart agricultural practices. Five smartphones with high-resolution cameras and accurate color performance were chosen to image 150 soil samples in various lighting conditions, alongside hyperspectral scans for detailed spectral data beyond the visible spectrum. Utilizing the obtained soil data, support vector machine (SVM) and partial least squares regression (PLSR) models were developed to predict iron oxide content. For Fet, the models demonstrated moderate to strong predictive capabilities, with R2 values ranging from 0.57 to 0.66. However, the model's prediction errors, indicated by RMSE values ranging from 12.57 to 15.34 g/kg for Fet, suggest there is room for improvement in prediction accuracy. Despite this, the RPD values, ranging from 1.50 to 1.73, underscore the models' acceptable to good ability to predict soil iron oxide levels. These statistical indicators collectively affirm the potential of using smartphones as reliable tools for soil analysis in precision agriculture, albeit with some limitations in prediction precision that could be addressed through model optimization. Additionally, a comparative analysis of spectral response curves across smartphones revealed more accurate models for iron oxide estimation, with devices showing stronger spectral responses and pronounced peaks in the R band. This study demonstrates that smartphones, alongside advanced algorithms, offer a viable and efficient solution for predicting soil iron oxide content, significantly enhancing precision agriculture practices.

Keywords: Smartphone,Soil iron oxides,Soil color,Machine learning,Soil monitoring

ID ABS WEB: 140103

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

LARGE-SCALE, REAL-TIME MONITORING OF SOIL MOISTURE DYNAMICS WITH COSMIC RAYS

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Cosmic Rays Neutron Sensing (CRNS) became an increasingly important technology in Hydrology thanks to its capability of measuring soil water content in a wide area and in depth. It's based on the detection of neutrons, particles naturally flowing from space and strongly interacting with water molecules. A single CRNS probe can provide a value of soil moisture representative of a volume up to a dozen hectares and up to 50 cm deep, in real-time, positioning itself in an horizontal spatial scale in between point measurements and satellites.

The actual availability of water resources is regulated by soil characteristics, in particular its texture and structure. It is often difficult to establish the expected dynamical boundaries of the water reservoir because of the natural complexity of the soil, which can have a large variability also in small areas.

A CRNS probe offers the possibility to provide a non-invasive year-round monitoring of soil moisture dynamics of a field, while spontaneously averaging over the complexity of soil. At the same time, point-scale probes together with a soil mapping approach allow to interpret the soil-landscape model of each site, which strongly affects soil moisture dynamics and distribution, enabling to understand and validate CNRS averaged data.

Moreover, CRNS probe spatial scale is comparable with the remote sensing pixel, allowing to interpolate data between two different satellite passes, extending the spatial significance of the collected data.

We here report observations from a set of sites in Northern Italy where Finapp CRNS probes have been installed, and discuss how the integration and sinergy of Finapp CRNS with the other techniques and site-specific pedological knowledge can provide a more complete and reliable understanding of soil moisture dynamics from local to regional scale.

Keywords: Cosmic Rays Neutron Sensing,Soil Moisture Dynamics,Innovative sensing technology,Real-time,Non invasive

ID ABS WEB: 140123

6. Soil in the digital era
6.01 125400 - Applications of proximal soil sensing technologies and beyond

APPLICATION OF MACHINE LEARNING TO PROXIMAL GAMMA-RAY AND MAGNETIC SUSCEPTIBILITY SURVEYS IN THE MARITIME ANTARCTIC: ASSESSING THE INFLUENCE OF PERIGLACIAL PROCESSES AND LANDFORMS

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Maritime Antarctica (M.A.) contains the most extensive and diverse lithological exposure compared to the entire continent. Although geophysical surveys can detect and provide valuable information to understand Antarctic lithologies and their history, such surveys are scarce on this continent and, in practice, almost non-existent. The main objective was to create ternary gamma-ray and K maps using machine learning algorithms, terrain attributes, and a nested-leave-one-out cross-validation method. Additionally, we investigated the relationship between the distribution of natural radioactivity and K to gain insights into pedogeomorphological and periglacial processes and dynamics. For that, we used proximal gamma-spectrometric and data in different lithological substrates associated to terrain attributes. The geophysical variables were collected in the field from various lithological substrates, by use field portable equipment. The geophysical variables were collected in the field from various lithological substrates K using portable equipment. These variables, combined with relief data and lithology, served as input data for modeling to predict and spatially map the content of radionuclides and K by random forest algorithm (RF). The RF algorithm successfully generated detailed maps of gamma-spectrometric and K variables. The highest thorium levels were observed in elevated, flat, and west beach areas, where detrital materials from periglacial erosion came through fluvioglacial channels. Lithology and pedogeomorphological processes-controlled thorium contents. Lithology and pedogeochemical processes governed potassium levels. Pyritized-andesite areas had the highest levels due to sulfurization and associated pyrrhotite, promoting iron release. The complex interplay of various periglacial processes in the area, along with the morphometric features of the landscape, leads to the redistribution, mixing, and homogenization of surface materials, contributing to the inaccuracies in the predicted-spatialized geophysical variables.

Keywords: Pedrometry,Digital soil mapping,Cryosphere;,Geophysical

ID ABS WEB: 135967

6. Soil in the digital era
6.02 129252 - Quantifying and mapping soil functions

COMPARISON OF DIRECT AND INDIRECT APPROACHES FOR MAPPING SOIL ORGANIC CARBON STOCK

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Soil organic carbon (SOC) is a critical factor influencing global carbon cycling. Accurate estimates of its spatial distribution are essential for addressing global climate change. Digital soil mapping has demonstrated significant potential in providing precise and high-resolution spatial information about SOC across various scales. We conducted an evaluation of two soil mapping approaches for SOCD estimates in France: the direct approach (calculate-then-model) and the indirect approach (model-then-calculate). Our study utilized 916 topsoil samples (0 ~ 20 cm) from the LUCAS Soil 2018 dataset and 24 environmental covariates. We employed a random forest model and forward recursive feature selection to build spatial predictive models of SOCD using both the direct and indirect approaches. The results revealed that, with the random forest model and full covariates, both approaches demonstrated moderate performance (R^2 = 0.28 - 0.32). Through the use of forward recursive feature selection, the number of predictors was reduced from 24 to 9, leading to enhanced model performance for the direct approach (R^2 of 0.35), while no improvement was observed for the indirect approach (R^2 of 0.28). The mean SOCD of French topsoil was estimated at 5.29 and 6.14 kg m½ using the direct and indirect approaches, respectively, resulting in SOC stocks of 2.8 and 3.3 Pg, respectively. Notably, the indirect approach exhibited better performance in estimating high SOCD. These findings serve as a valuable reference for SOCD mapping.

Keywords: Digital soil mapping,Soil organic carbon density,Calculate-then-model,Model-then-calculate,Topsoils

ID ABS WEB: 137300

6. Soil in the digital era
6.02 129252 - Quantifying and mapping soil functions

GLOBAL-LOCAL: A NEW APPROACH FOR LOCAL PREDICTIONS OF SOIL ORGANIC CARBON CONTENT USING LARGE SOIL SPECTRAL LIBRARIES

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There is much interest in the use of large visible near infrared (vis–NIR) soil spectral libraries for rapid soil analysis. However, their use often provides biased predictions at local scales. We developed a new approach, GLOBAL-LOCAL, to develop spectroscopic models that can fit locally. This requires the selection of the most common spectral neighbours of a small representative set (Lab) from the target site using a combination of principal component analysis (PCA) and k-nearest neighbours, followed by selection of the calibration with the lowest root mean square error (RMSE) in predicting the Lab. The Lab samples are then added to the best calibration to derive the GLOBAL-LOCAL. This approach was evaluated by predicting the soil organic carbon (SOC) content in two different target sites; Lévis, QC, Canada (N = 111) and Maaninka, Finland (N = 101). Partial least squares regression (PLSR) was used for model development and validation. We used a combination of the spectral libraries developed by the World Agroforestry Center and International Soil Reference Information Centre (N = 3875), and by the Quebec Research and Development Centre of Agriculture and Agri-Food Canada (N = 1051). Our results showed that prediction accuracy of the GLOBAL-LOCAL for Lévis and Maaninka (RMSE = 1.41 and 3.08 g kg-1, RPIQ = 5.9 and 4.1, respectively) were better than using the global calibration (RMSE = 20.3 and 23.6 g kg-1, RPIQ = 0.41 and 0.53, respectively). The GLOBAL-LOCAL was also better or similar to site-specific calibrations (RMSE = 2.38 and 4.68 g kg-1, RPIQ = 3.5 and 2.7, respectively). Moreover, GLOBAL-LOCAL outperformed three other approaches, RS-LOCAL, the spectrum-based learner and LOCAL. The approach uses the information in the large spectral library so that it can substantially reduce analytical cost and greatly improve predictions on local scales.

Keywords: Soil spectroscopy,Local modelling,Soil organic carbon,Soil spectral library

ID ABS WEB: 137732

6. Soil in the digital era
6.02 129252 - Quantifying and mapping soil functions

HOW CLIMATE CHANGES WILL INFLUENCE SOC STOCKS IN AGRICULTURAL SOILS IN POLAND – CURRENT STATE AND PROJECTION FOR 2050 AND 2100

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Agricultural soils are significant reservoirs of organic carbon, playing a crucial role in maintaining soil fertility, water retention, and overall ecosystem health. The impact of climate change on these soils is crucial, and understanding the current state and future projections is key for sustainable land management practices. The aim here is to investigate the potential impacts of climate change on SOC stocks, considering changes in temperature and precipitation in 2050 and 2100 in Polish agricultural soils. This study quantifies present SOC stocks based on over 40,000 soil samples and assesses the impact of the projected climate change on long-term SOC stock changes in Poland, using the digital soil mapping approach. We investigated the projected changes for 2050 and 2100 under two different Representative Concentration Pathways (RCP 4.5: sustainable scenario and RCP 8.5: high-emission scenario with significant climate impacts). Initial analyses suggest complex spatial changes indicating a significant influence of climatic conditions on SOC stock dynamics and SOC stability. Our primary results allow to identify three main regions in Poland where the dynamic of SOC stock can be the highest. The largest losses of SOC may occur in the areas surrounding Wroclaw, and in the Upper Vistula Valley, the southern part of Poland. This may be caused by the increase in temperatures and decrease in precipitation in those areas. On the other hand, we observe also the increase in SOC stock in the northern part of Poland within the areas of relatively dense occurrence of organic soils. This change is linked to the increase in both temperatures and precipitation in this area. In that context, forecasts may significantly contribute to the further strategies of creation of National Soil Monitoring according to the Proposal for a Directive on Soil Monitoring and Resilience by indicating the high-priority areas or the analysis of the possibilities to reach the EU Green Deal targets.

Keywords: Soil organic carbon stocks,Climate change,Scenarios

ID ABS WEB: 137926

6. Soil in the digital era
6.02 129252 - Quantifying and mapping soil functions

MACHINE LEARNING APPLICATION TO PREDICT AND MAP SOIL ORGANIC CARBON IN THE BOHEMIAN HIGHLANDS (CZECH REPUBLIC)

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We applied the Digital Soil Mapping (DSM) approach to map soil organic carbon (SOC) content across Krasna Hora Nad Vltavou, situated in the Pribram District, Central Bohemian Region, Czech Republic. We focused on two soil layers: 0-10 cm (SOC 10) and 0-30 cm (SOC 30), employing various machine learning models. The study area covers approximately 500 km^2, characterized by elevations ranging from 268 to 574 m a.s.l., with geomorphologic classification as a Bohemian highland featuring gently undulating mountains. Predominant land cover primarily consists of arable lands with some forested areas. Utilizing data from 105 georeferenced soil profiles sampled by horizons, we analysed soil samples in the laboratory for organic carbon and total nitrogen using dry combustion. Four machine learning models Random Forest (RF), Multivariate Adaptive Regression Splines (MARS), Support Vector Regression (SVR), and Elastic Net (ENET) were employed for modeling and prediction, using environmental covariates such as geomorphometric parameters, climatic variables, and mosaic bare soil indices. Model performance assessment through 10-fold cross-validation revealed that RF consistently outperformed other models, exhibiting the lowest Mean Absolute Error (MAE) values and the highest R-squared (R^2) scores for both SOC 10 (R^2 0.79, MAE 0.32%) and SOC 30 (R^2 0.82, MAE 0.28%). While MARS provided acceptable results, ENET and SVR showed higher Root Mean Squared Error (RMSE) and lower R^2 values, indicating lower accuracy in SOC modeling and prediction. The resulting SOC 10 map displayed a range from 1.73% to 7.76% with a mean SOC content of 2.72%, while SOC 30 exhibited a narrower range (1.22% to 3.13%) with a mean value of 1.73%. This research underscores the effectiveness of machine learning in DSM for predicting and mapping SOC across diverse land cover types, emphasizing the influence of temperature and precipitation on the spatial distribution of SOC content. The findings contribute valuable insights into understanding the potential impact of climate change on the future distribution of SOC in Bohemian uplands.

Keywords: Soil Organic Carbon,Digital soil mapping,machine learning,Bohemian uplands

ID ABS WEB: 137993

6. Soil in the digital era
6.02 129252 - Quantifying and mapping soil functions

USING GEOLOGIC ENVIRONMENT-BASED SECTORIZATION: A VIS-NIRS APPROACH FOR PREDICTIVE MODELLING OF SOIL ORGANIC MATTER.

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The geological environment (GE) shapes soil formation and characteristics. Soil Spectroscopy's cost-effectiveness and eco-friendliness make it ideal for acquiring extensive datasets to quantify and map soil functions. Despite the focus on broad-scale soil property prediction models, GE-based sectorization supports targeted strategies for soil function management in research and policy context. A sectorization based on GE is expected to improve predictive power of the V-NIRS model. By reducing variability in indirect variables (climate, soil type, texture, pH, etc.) influencing the response variable, in this case, MOS an indicator of soil functioning. We evaluated the performance of the PLS V-NIRS model in a latitudinal transect with 80 sites from Maule to Araucanía regions (35°S-36°S). We compared this performance with the sectorized PLS V-NIRS model based on five different GE present in the studied transect: metamorphic (M), plutonic (P), continental sedimentary (CS), volcanic (V), and volcanic sedimentary (VS). Geospatial information from the geological map of Chile at 1:1,000,000 scale was used. The relationship between GE and MOS, pH, available Ca, and clay content, was determined with ANOVA and Tukey post hoc test with a 95% confidence level. Showing significant statistical differences ($p<0.005$) in SOM among other studied variables. Additionally, a Principal Component Analysis illustrated the grouping of GE in function of MOS, yielding two components with 72% of the total variance. Comparison results of V-NIRS PLS models demonstrated improved predictive power with sectorization. The PLS model without data treatment for the whole transect presented an R2=99.9, Rval=0.79, and Rcal=0.80, compared to the statistics of M (R2=86.5, Rval=0.94, and Rcal=0.98), P (R2=99.8, Rval=0.94, and Rcal=0.96), CS (R2= 59.5, Rval=0.89, and Rcal=0.95), V (R2=75.8, Rval=0.84, and Rcal=0.95), and VS (R2=44.5, Rval=0.98, and Rcal=0.99). These findings affirm the feasibility of sectorizing by GE to comprehend carbon dynamics and to improve predicted C models, becoming a tool to identify soil C resilient zones and formulate targeted mitigation strategies.

Keywords: Geological environment,V-NIRS,Soil organic matter,Mapping,predictive modelling

ID ABS WEB: 140121

6. Soil in the digital era
6.02 129252 - Quantifying and mapping soil functions

RELATIONSHIPS BETWEEN CARBON CONCENTRATION IN ROOTS AND THE PEDOENVIRONMENT: A STUDY WITH MACHINE LEARNING

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Roots play a fundamental role in the formation of soil organic carbon stocks. However, there is still little knowledge about how root carbon concentration responds to the pedoenvironment at a landscape scale. Therefore, our objective was to evaluate the relationships between carbon concentration in roots and the pedoenvironment using machine learning (ML). We use a database of functional root traits, Global Root Traits (GRooT), which compiles harmonized planetary information for global modeling. Root carbon concentration (CCR) was the target variable, with 5006 samples. The explanatory variables were: climate data and net primary productivity (NPP) from Chelsa; soil moisture (0-30 cm) from ERA-5; MODIS normalized difference vegetation index (NDVI); and the NASADEM digital elevation model (DEM). We eliminated redundant variables by correlation and adjusted the random forest (rf) algorithm with repeated cross-validation. We evaluated the model's performance using the concordance correlation coefficient (CCC) and mean absolute error (MAE). Additionally, we compared the rf error to the error of a null model (average). Our model achieved CCC = 0.64 and MAE = 37.02 mgC g⁻¹, a 20% smaller error compared to the null model (MAE = 44.9 mgC g⁻¹), highlighting the potential of ML techniques in modeling of complex environmental data, such as CCR. When evaluating the importance of predictors, climate stood out (>85%), especially variables associated with extreme events (e.g., temperatures in the hottest month and precipitation in the wettest month). Soil moisture was the second class most of important variables (58.3%). NPP (26.5%), NDVI (13.4%) and DEM (4.2%) were the proxies that contributed least to CCR. The heterogeneity of CCR globally justifies the association of the most important patterns with extreme events, as the size of vegetation is generally limited by water availability and temperature. This, associated with soil texture, modulates moisture levels which, in turn, condition the development of vegetation and, consequently, root biomass. Our study showed that climate and soil humidity significantly modulate CCR at a global level.

Keywords: root functional trait,GRooT,pedometry,soil organic carbon,DSM

ID ABS WEB: 136447

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales – Where to go next?

ASSESSMENT OF DSM PRODUCTS AT CONTINENTAL SCALE

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Digital Soil Mapping (DSM) products are generated for various regions, nations, continents. Most products include some accuracy metrics, some include assessment of uncertainty. Theaccuracy and uncertainty metrics typically used for DSM products do not encompass some of the elements that are necessary to assess "fitness-for-intended-use" of a map. For instance, different models can have very similar accuracy metrics but produce different soil-landscape patterns. It is important to be able to evaluate the accuracy of the patterns as well, current accuracy metrics do not do this. Additional metrics could be defined that are able to do this such the 'area of applicability', i.e. the area in covariate space where the model learns about relationships based on the training data) and the landscape heterogeneity both in the landscape itself and in covariate space.

In this study we present initial results on how to integrate the elements mentioned above in an assessment of DSM uncertainty at continental scale. The test case is Europe with input observations derived from EU-LUCAS datasets. We use a covariates space that covers the soil forming factors according to the "scorpan" model. We characterise the spatial heterogeneity of the landscape and the covariates space with commonly-used landscape metrics. Based on the results we present some practical recommendations on how to use the above elements in order to develop products for stakeholders that correspond to their intended uses.

Keywords: Digital Soil mapping,Remote sensing,Continental,Uncertainty

ID ABS WEB: 136700

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales – Where to go next?

FUNCTIONAL ASSESSMENT OF SOILGRIDS IN THE LIGHT OF AGRICULTURAL APPLICATIONS AND POSSIBLE IMPROVEMENTS.

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SoilGrids data has been used to support research activities in several scientific disciplines for regional and global studies. Among others, the success was made by the availability of harmonized data crossing administrative boundaries, uncertainty quantification and a user-friendly interface to explore and download the data. While the spatial resolution was initially too coarse for more specific local studies, e.g., precision agriculture, the higher increasing resolution of the new versions could open the path to new applications and synergies.
In this contribution we show and discuss the assessment of SoilGrids at several locations in Italy focusing on agricultural applications. The assessment is conducted based on regional soil maps and direct soil analysis conducted at the respective sites. The applications cover the use of soil parameters for calibrating soil moisture sensors, harmonizing ground and remote sensing soil moisture products, and delineating agricultural prescription maps. The integration of data collected through remote and proximal soil sensing techniques is explored to enrich the quality of the prediction.
The results show, on the one hand, the valuable information provided by SoilGrids in supporting agricultural applications. On the other hand, additional information available from agricultural studies could be integrated for further improvements of the digital map. Thus, the synergy between global digital soil mapping and precision agriculture could be considered as a valuable approach for further improvements. Standardizing the data collected at the different locations will be a key feature for exploiting these synergies.

Keywords: SoilGrids,Agricultural applications,Improved resolution,Data assessment,Global Digital Soil Mapping

ID ABS WEB: 137164

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales – Where to go next?

3D SOIL HYDRAULIC DATABASE OF HUNGARY AT 100 M RESOLUTION (HU-SOILHYDROGRIDS)

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Quantitative information on state and flux of water in the critical zone is crucial for various environmental models. The performance of models related to soil hydrological processes relies on the quality and resolution of soil hydraulic input parameters. At the European scale, the 3D soil hydraulic database of Europe at 250 m resolution (EU-SoilHydroGrids) has demonstrated its applicability in numerous studies. A comparable but larger-scale 3D soil hydraulic database, HU-SoilHydroGrids, was developed for Hungary to analyse whether there is room for accuracy improvement compared to the continental maps. This study, supported by various enhancements in the computation process, utilized advanced machine learning methods trained on the national soil hydrophysical dataset to construct pedotransfer functions (PTFs). Additionally, the set of predictors for PTFs was expanded to include additional environmental auxiliary variables. The spatial inference of these derived models utilized 100 m resolution information on primary soil properties from DOSoReMI.hu.
HU-SoilHydroGrids provides information on the most frequently used soil hydraulic properties (water content at saturation, field capacity, wilting point, saturated hydraulic conductivity, and van Genuchten parameters for water retention curve description) with national coverage at a 100-meter spatial resolution down to 2 meters for six GSM standard depth layers.
The results of the study showed that employing PTFs derived on local data, through ensemble models, and applied to both local input soil data and other environmental data yields more accurate soil hydraulic maps compared to global or continental alternatives, including the widely used EU-SoilHydroGrids.
The resulting 3D soil hydraulic database is currently available through the National Laboratory for Water Science and Water Safety for project partners to assess its functional performance in describing hydrological processes.
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Keywords: ensemble models,mapping soil hydraulic propert,sat. hydraulic conductivity,soil water retention,van Genuchten parameters

ID ABS WEB: 137195

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales – Where to go next?

EXAMINATION OF THE ATSAVI INDEX IN THE CASE OF DIFFERENT NUTRIENT SUPPLY AND TILLAGE SYSTEMS IN A SMALL PLOT LONG-TERM FIELD EXPERIMENT WITH A MULTISPECTRAL UAV

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The aim of this research was to use remote sensing used in cultivation technology to learn about our soil during the maize sowing period. Soil mapping with remote sensing will be an even more important technology in the future, because farmers need to know the exact soil parameters before and during the growing season. In this study, the data of two different long-term experiments were used to determine ATSAVI index from the soil surface without vegetation. The first experiment is aimed at examining the nutrient supply reaction of different maize hybrids in the same place with the same parameters for more than 40 years. The other experiment compares different tillage methods. During the analysis, the non-soil parts, such as weeds, maize and stem residues, were filtered out and thus the test was performed only on the soil surface. Multispectral UAV was used with RTK system with the remote sensing. RTK was used for the flight and shooting photos. The experiments were carried out at the University of Debrecen, Látókép Experimental Station. The experiment site was an excellent area for field experiments and has suitable agrotechnical biological and soil conditions. The soil type of the experiment site has homogenous calcareous chernozem. The elevation optimisation was turned on during the flight. Adjusted transformed soil-adjusted vegetation index was used for the detection and the analyses were made in QGIS and R studio software.
The ATSAVI vegetation index was higher in the strip tillage than the conventional winter plough and reduced soil tillage system (ripening tillage). The amount of nutrient supply affected the value of ATSAVI differently. In the first 3 nutrient supply levels, the value was lower than the higher nutrient supply. At the highest nutrient level, the values were higher as a result of high-dose nitrogen supplementation than as a result of lower nitrogen supplementation. Based on these results, the ATSAVI index depends on the nutrient supply and the soil tillage system.

Keywords: long-term experiment,ARSAVI,UAV,multispectral

ID ABS WEB: 137625

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales – Where to go next?

EFFICIENT SAMPLING FOR PREDICTIVE NUTRIENT MAPPING IN FARM-SCALE CROP MANAGEMENT

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Plant nutrition and balanced fertilization require very accurate information from the field at the lowest possible cost and therefore limited number of samples. It is therefore essential to optimise sampling schemes. The aim of this study is to compare widely used sampling schemes combined with variable sample size for the prediction of common soil macronutrients. Conditional Latin hypercube sampling (cLHS), feature space coverage sampling with k-means (FSCS) and simple random sampling (SRS) were compared. The effect of sampling scheme and sample size on the accuracy of predicted nutrient maps was investigated in a real case study field (35 ha) with heterogeneous soil properties. A total of 200 training points were placed in 6 grids: cLHS and FSCS with 10, 30 and 60 samples, corresponding to 1 sample per 3, 1 and 0.5 ha, respectively. For the numerical experiment with different sampling frequencies, all 200 training samples were interpolated into a set of nutrient maps, which were considered as an error-free dataset for both calibration and validation samples included in the predictive modelling. Sampling grids with variable sample sizes from 2 to 60 were created using SRS, cLHS and FSCS in combination with a pragmatic set of environmental covariates. Each network of each method was automatically generated 100 times using the same algorithm settings. These were used to make predictions using the covariates. The performance of the models was monitored.
The results show the advantage of using FSCS, which shows both less variation in prediction accuracy compared to SRS and cLHS and better results with sparse sampling.

Keywords: sampling,agronomy,uncertainty,nutrients,digital soil mapping

ID ABS WEB: 137649

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales – Where to go next?

EXPLORING THE SPATIAL VARIABILITY OF SOIL PROPERTIES USING GEOSTATISTICAL TOOLS ON A BLACKBERRY (RUBUS FLORIBUNDUS C. PRESL) FARM IN PAMPLONA, NORTE DE SANTANDER, COLOMBIA

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The cultivation of blackberries in Pamplona is distinguished by its climatic adaptability, resistance to pests, and high acceptance for fresh consumption. Despite its significance, there is limited information about the soil conditions in which the cultivation grow up. In this study, we analyzed the spatial variability of soil properties employing geostatistical tools. A systematic sampling of 26 points yielded a total of 52 soil samples from depths of 0-20 cm and 20-40 cm. Texture, gravimetric moisture (GM), bulk density (BD), real density (RD), total porosity (TP), mechanical penetration resistance (MPR), organic matter (OM), pH, and electrical conductivity (EC) were evaluated. A univariate statistical analysis described soil properties, and maps of spatial variability were generated through semivariance calculation and ordinary kriging interpolation. The soil texture was loamy-sandy, with sand percentages exceeding 65% at both depths, explaining the low moisture percentages (< 28%). The mean BD was 1.61 and 1.63 g/cm^3, while RD was 2.23 and 2.31 g/cm^3 for 0-20 cm and 20-40 cm, respectively. The average TP was 32.48% and 30.86%, and for the MPR (kg/cm^2) was 1.54, increasing to 2.06 at 0-20 cm and 20-40 cm, respectively. Soil pH varied from 5.32 at 0-20 cm and 5.03 at 20-40 cm. The soils did not exhibit salinity issues (EC<50 μs/cm). The average OM percentage was 17.72 at 0-20 cm, decreasing to 14.48 at 20-40 cm. Spatial variability of soil properties at 0-20 cm was considered moderate, except for OM, which exhibited high spatial variability. At 20-40 cm, there was a more pronounced spatial variability, with GM, pH, and OM varying significantly across the farm. At 0-20 cm, BD and MPR showed moderate spatial dependence. OM, RD, and TP exhibited strong dependence, while GM showed low dependence. At 20-40 cm, GM, BD, TP, and MPR displayed strong dependence, while RD exhibited moderate dependence. Ordinary kriging interpolation accurately estimated variables in unsampled or topographically challenging areas, with minimal margin of error.

Table 1. Distribution of soil particle size on the farm.

Variables	Depth (cm)	n	Mean	Minimum	Maximum	CV
Clay (%)	0-20	26	15,41 ± 6,06	6,2	27,8	39,33
	20-40	26	15,79 ± 5,33	2,35	24,15	33,73
Silt (%)	0-20	26	18,4 ± 4,95	7,5	28,65	26,91
	20-40	26	18,95 ± 6,5	7,5	32,5	34,32
Sand (%)	0-20	26	66,54 ± 9,58	50,15	81,5	14,4
	20-40	26	65,03 ± 10,22	47,2	82,2	15,72
Textural class	0-20	26	Sandy loam			
	20-40	26	Sandy loam			

Mean values ± standard deviation. CV: Coefficient of variation; n: number of samples

Keywords: Spatial dependence,semivariance,interpolation,kriging,cross-validation

ID ABS WEB: 137782

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales – Where to go next?

SPATIAL DISTRIBUTION OF ELEMENTS IN LATERITIC SOILS FROM A RARE SIDERITE CARBONATITE FORMATION IN THE BRAZILIAN AMAZON USING REMOTELY SENSED DATA AND TOPOGRAPHIC ATTRIBUTES

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Carbonatites are considered rare, their distribution in the crust is minimal at a global level and they have a high economic value. The Brazilian Amazon held the Morro dos Seis Lagos carbonatite complex, considered to be one of the largest known Nb deposit, with an estimated reserve around 2.9 billion tons of niobium. The occurrence of siderite carbonatite on highly weathered geomorphic surfaces has given rise to a thick lateritic crust, which hosts trace minerals containing elements with economic potential. The goal was to study the laterization process undergoing on a rare siderite carbonatite parent material by assessing the spatial distribution of Fe_2O_3, Nb, TiO_2, and W using machine learning. Amont of 341 samples including soil, sediment, and rock material were gathered from the Geological Survey of Brazil (CPRM). Covariates included remotely sensed data collected from Sentinel-2 MSI, Sentinel-1A and Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), and topographic attributes calculated from a 20-m digital elevation model (DEM). The modelling procedures were performed using the Multivariate Adaptive Regression Spline (MARS), Support Vector Machine with radial kernel (SVMRadial), and Random Forest (RF) algorithms. The optimal covariates for modeling were chosen using Recursive Feature Elimination (RFE). The most relevant covariates for the distribution of the elements contained in the laterites were evaluated using the RFE results. The models performed better in predicting W ($R2 = 0.32$), Fe_2O_3 ($R2 = 0.24$), TiO_2 ($R2 = 0.14$) using the RF model, while the MARS models showed greater ability in predicting Nb ($R2 = 0.10$). Best results for MnO ($R2 = 0.22$) were found when using SVMRadial. The importance metric provided by the RFE indicated that terrain attributes exert a greater influence on the spatial distribution of the elements studied compared to remote sensing spectral indices, thus indicating that the relief may be one of the main drivers of the pedological processes responsible for the formation of laterites in the area.

Keywords: Pedogenesis,Laterite,Poorly-accessible areas,Pedometrics,Machine learning

ID ABS WEB: 137870

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales – Where to go next?

THE CREA SOIL MAP ARCHIVE AND DIGITIZATION OF CULTURAL HERITAGE PRODUCTS

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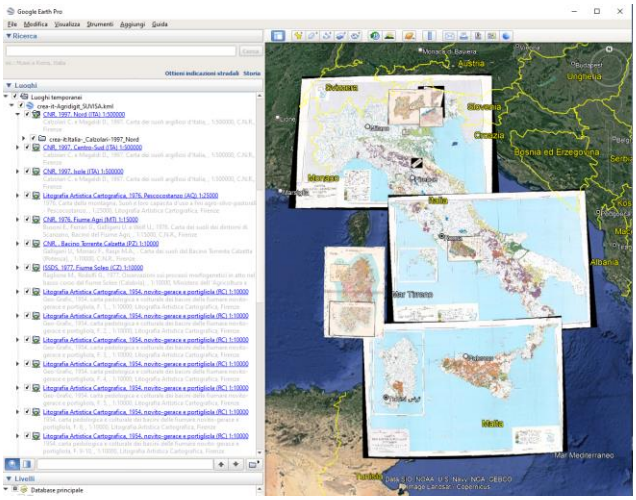
Historical soil maps are cultural heritage products wort to be preserved according to the principles of open data (FAIR - findable, accessible, interoperable, and reusable).
The CREA collection gathers hundreds of maps surveyed at various scales, from the finest detail (1:1,500) to the national scale (1: 3,125,000).
Their first digitalization has been realized within the GO PROSIT project, for the Tuscany Region, and recently within the Agridigit - SUVISA project for the whole Italian collection. Paper documents were digitized both in PDF, and geoTIFF formats.
For Tuscany, the work included 52 documents realized between 1969 and 2012 by 13 different institutions, both Italian and International, with the involvement of over 100 authors. Additionally, 18 of these maps were integrated into a web application for Digital Agriculture (https://app.geapp.net/), for free use by all Tuscan agricultural farms.
For Italy, the work interested initially 36 paper documents published between 1954 and 1985 by 14 different institutions, with the involvement of over 55 authors.
Digitized documents have been published on a Geoserver platform to expose spatial data source adopting open standards (https://crea-it-geoserver.azurewebsites.net/). GeoServer implements several Open Geospatial Consortium protocols including Web Map Service (WMS), Web Feature Service (WFS), Web Coverage Service (WCS) and Web Map Tile Service (WMTS). The platform allows also to manage Layer groups to download spatial data according to several formats, among which GoogleEarth file (KML). Furthermore, Open Geospatial Consortium protocols allow Interoperable reuse of data. For instance, the complete dataset might be accessed directly within the QGIS software without the need to download data by the WMS protocol.
Although maps vary significantly in quality and purpose of use, their digitization allows this informational heritage to be digitally preserved, public, accessible, and directly usable by means of several GIS software. Digitalization of maps is still going on and this work is thought as a contribution on how to spread ancillary maps adopting technical tools, protocols, and facilities.



Keywords: Cultural heritage,Map collection,Digital preservation,Reusability

ID ABS WEB: 137932

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales – Where to go next?

THREE-DIMENSIONAL MAPPING OF SOIL ORGANIC MATTER AT REGIONAL-SCALE IN THE BLACK SOIL AREAS WITH THE FUSION OF PROXIMAL AND REMOTE SENSING DATA USING INLA-SPDE

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Accurate 3D mapping of SOM is essential for informed agricultural practices and environmental conservation, particularly within Black Soil regions. However, current SOM mapping methodologies lack genuine 3D mapping approach, which means soil properties can be precisely quantified and uncertainty analyzed at any given coordinate (x, y, z) within a soil's volumetric matrix. Previous relevant studies predominantly rely on remote sensing as the primary source for environmental covariates, which leads to a significant limitation: the same set of remote sensing data was used across various soil depths, failing to accurately represent the unique environmental factors influencing each layer. To bridge these gaps, this study aims to incorporate depth-specific environmental factors obtained from a proximal visible-near infrared (vis-NIR) spectrometers to achieve more accurate 3D SOM mapping using INLA-SPDE in Bayesian space stochastic simulation.
In this study, a total of 481 soil samples were collected (0-100 cm depth, at 10 cm intervals) from 49 locations in Lishu County, Northeast China.The SOM content was measured using standard laboratory methods, and Vis-NIR spectra were acquired after the samples were air-dried and ground. Meanwhile, remote sensing factors including climate, soil, terrain and vegetable factors were also collected. Different combination of these proximal and remote sensing data were employed to model SOM in 3D using the INLA-SPDE algorithm. The evaluation metrics revealed the best prediction with $R2 = 0.89$ and RPD=3.03 was obtained with the fusion of both proximal and remote sensing data, while a slightly lower accuracy ($R2 = 0.86$ and RPD=2.67) was obtained when adding the vis-NIR, only. Both two working scenarios showed superior performances than the use of 3D-IDW (R2=0.43, RPD=1.15). We thus suggested the addition of Vis-NIR spectra to environmental covariates to enhance the accuracy in 3D SOM mapping. The framework this study created might bring benefit for sustainable land management practices and carbon sequestration potential evaluation in the context of global climate change mitigation strategies.

Keywords: Soil organic matter,vis-NIR,3D digital soil mapping,remote sensing,INLA-SPDE

ID ABS WEB: 137981

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales – Where to go next?

PHYSICS-CONSTRAINED MACHINE LEARNING FOR DIGITAL MAPPING OF THE ENTIRE SOIL WATER RETENTION CURVE

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The accurate characterization of soil hydraulic properties is crucial for quantifying the dynamic exchange of mass and energy between the Earth's land surface, the groundwater, and the atmosphere. Current large-scale digital maps of the soil water retention curve (SWRC) are typically developed indirectly and in a two-step process: i) the development of pedotransfer functions (PTFs) that establish relationships between basic soil properties such as textural fractions, bulk density, and organic matter content and parameters of well-known SWRC models, and ii) the application of these PTFs to basic soil property maps at different scales. While digital soil mapping (DSM) methods have shown promising results for various soil properties, their potential for direct mapping of the SWRC has not been explored. This presentation introduces a novel, physically-constrained machine learning approach designed for the direct mapping of the complete SWRC. Unlike in previous studies, our new approach does not rely on PTFs and is not limited to a specific form of the SWRC, thereby reducing uncertainties. The new approach leverages the universal approximation theorems of neural networks and is constrained by the fundamental functional properties of a SWRC. Applying this new method to 1261 soil profiles across Denmark, encompassing 4747 measured SWRCs, reveals its superior performance over established methods. The new approach allows for the aggregation of datasets with limited measured SWRC points, a capability not achievable with other methods. Additionally, it provides meaningful extrapolated values beyond the range of measured SWRC data, owing to the physical constraints imposed on the model.

Keywords: Digital soil mapping,Hybrid modeling,Soil water retention,Neural networks,Physics-informed ML

ID ABS WEB: 138291

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales – Where to go next?

A GLOBAL EXAMINATION OF ARABLE LAND MULTI-DEGRADATION

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Humanity's food security can be considerably threatened by multiple land degradation processes (or land multi-degradation), which can act simultaneously across global productive (arable) soils. However, the spatial footprint of land processes that act convergently in arable landscapes is not sufficiently understood at global scale. Consequently, here we analyze the convergence of five major degradative processes (aridity, soil erosion, vegetation decline, soil salinization, and soil organic carbon decline) in global arable lands, using large-scale spatial databases that were modelled using various GIS (Geographic Information System) techniques. Our worldwide examination of co-occurring processes showed a complex pattern of arable land multi-degradation (in terms of number and types of converging processes, explored at pixel level), largely dominated by the interaction between aridity and soil erosion across the planet. Our global findings can be useful for a better governance of soils exposed to various environmental threats, and thus for a more efficient achievement of soil-related sustainable development goals.

Keywords: land degradation,multiple processes,arable landscapes,GIS techniques,Globe

ID ABS WEB: 138580

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales – Where to go next?

KAKHOVKA DAM DAMAGE CONSEQUENCES MAPPING AND IMPACT ASSESSMENT ON BLACK SOILS IN THE SOUTH OF UKRAINE

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The biggest man-made disasters caused by Russian armed aggression is the Kakhovka Dam explosion on June 6, 2023. The dam destruction consequences were complete and partial soil flooding; settlements flooding, groundwater pollution, irrigation stopping and funktioning ecosystem changes, formed for 70 years of the Kakhovka reservoir (lake) existence.
To carry out a GIS analysis of the assessment impact on the soil we used Sentinel-2 remote sensing data in a time-varying period from the normal state to the maximum lands flooding. The moisture index made it possible the contours deciphering of fully and partially flooded. Through GIS analysis, were established the limits of the Dnipro and Inhulets rivers valleys flooding. For the impact assessment on the soil, the flooding data was combined with soil regional maps. Total estimated area of flooding is 83000 ha.
However, when assessing the overall impact of negative consequences, it is necessary to take into account the direct and indirect impact. Kakhovka lake had a strong influence on large irrigation systems with black soils. It's important to consider the probable pollution of irrigation systems (IS) due to the Inhulets River valley flooding. Many hectares of agricultural land may suffer significant degradation due to lack of irrigation and sewage pollution.
The area of negative consequences impact was estimated by map – 3.67 mil. ha. It includes: directly flooded lands, drained lands, destroyed and non-functioning IS, polluted IS, water consumption zones for social needs, etc.
More than 30 soil types were in the influence zone: Chernozems, Dark Gray podzolized, Dark Chestnut and Meadow Chernozem soils, which are Black soils according to the FAO classification . Their area is about 2.5 mil.ha.
However, there is positive point can be highlighted. When was draining the Kakhovka lake bottom, new, so-called subaquatic soils appeared. Soils flooded since the 1950s and covered with a thicker layer of silt. Among them are buried black soils. The total area of subaquatic soils is 170000 ha.

Keywords: Digital Soil Assessment,Remote sensing,War impact on soil,Digital Soil Mapping,Soil pollution

ID ABS WEB: 140100

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales – Where to go next?

GEOSPATIAL MODELING SALT-AFFECTED SOILS IN KAZAKHSTAN.

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Salt-affected soils, a pervasive issue in Kazakhstan, exert considerable constraints on agricultural productivity and environmental equilibrium. This abstract introduces a geospatial modeling initiative aimed at comprehensively assessing and mapping salt soils in Kazakhstan. The study's primary goal is to provide invaluable insights that contribute to informed decision-making in sustainable land use planning and improved agricultural practices.

The methodology integrates advanced geospatial techniques, including remote sensing, GIS mapping, and soil sampling data. These tools collectively enable the creation of a detailed and accurate representation of the distribution and severity of salt-affected soils across different regions in Kazakhstan.

Our findings shed light on the spatial patterns, dynamics, and key influencing factors contributing to the occurrence of salt-affected soils. By understanding the extent and severity of salt soil distribution, stakeholders in agriculture, environmental management, and policy formulation can develop targeted strategies to mitigate the impact of salinity on soil health and crop production.

This geospatial modeling approach serves as a powerful tool for predicting and managing salt-affected soils, facilitating evidence-based decision-making for sustainable land use practices. The insights gained from this study will contribute to the development of tailored solutions, empowering Kazakhstan to address the challenges posed by salt-affected soils and enhance the resilience of its agricultural landscapes.

Keywords: Geospatial Modeling,Salt-Affected Soils,Sustainable Land Management,Environmental Sustainability,Remote Sensing

ID ABS WEB: 140118

6. Soil in the digital era
6.03 129517 - Digital Soil Mapping and Assessment at different scales – Where to go next?

GLOBAL SOIL CARBON MODELS: ACCURATE ENOUGH FOR IMPORTANT DECISIONS?

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Soil organic carbon (SOC) stocks play a central role in mitigating climate change, due to their significant quantity in terrestrial ecosystems. The methods and scales used to inventory these stocks can significantly impact estimates. Therefore, our objective was to model SOC stocks in the state of Rondônia, Brazil, using machine learning techniques and compare them with national (Gomes; Vasques) and global (SoilGrids) estimates. We used 2794 soil profiles (11.76 profiles per 1000 km^2) to model SOC stocks in a 0-30 cm layer. Soil density was estimated using pedotransfer in profiles where no information was available. We used data derived from the SCORPAN model to compose our set of explanatory variables, totaling 77 predictors. We eliminated redundant and unimportant predictors using the recursive feature elimination technique. We employed the random forest (rf) algorithm and fitted the model with 80% of the data, reserving the remaining 20% for testing, performing 100 runs. Our estimates presented a mean absolute error (MAE) of 19.6 MgC ha⁻¹ and root mean square error (RMSE) of 30.4 MgC ha⁻¹, while national and global models presented MAE = 41.1 MgC ha⁻¹ and RMSE = 63.5 MgC ha⁻¹. Our estimates revealed an overestimation of national and global maps of SOC stocks (100 MgC ha⁻¹) in the central region and an underestimation (400 MgC ha⁻¹) in the southern region of Rondônia. These results are associated with regions with lower and higher concentrations of SOC, respectively. Therefore, we emphasize the importance of regional soil sampling and mapping, especially SOC, to identify storage hotspots, avoiding mistaken decisions by public policy makers that could intensify environmental problems. While national and global maps provide initial insights into SOC stock, we highlight that regional sampling and mapping are essential for more accurate assessment. Our results show how regional modeling, with local sampling, can improve SOC stock estimates, contributing to the quantification of soil carbon budgets.

Keywords: Amazon,soil organic carbon,random forest,digital soil mapping,Rondônia

ID ABS WEB: 137188

6. Soil in the digital era
6.04 129630 - Soil and viticulture

SOIL CONSERVATION IN OLD VINEYARDS: WHAT IS THE OPTIMAL LEVEL OF INTERVENTION - IS LESS MORE?

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In viticulture, the soil can be strongly influenced, compared to the possibilities of anthropogenic influence on other abiotic factors of terroir, such as climate. Old vineyards, aged over 40 years, are characterized by small areas, rare grapevine varieties, lower vigour, and yields. Old vines have a deeper, more developed root system, traditionally believed to have improved access to nutrient and water reserves, sustaining themselves with minimal human intervention. The preservation of old vineyards is invaluable for the heritage of wine-growing areas, enhancing the conservation of genetic biodiversity.
The study focused on six old vineyards identified as candidates for conservation in central Serbia, within the Tri Morave wine-growing region/PDO, known for its rich cultivation history. These vineyards, planted between 1930 and 1979, feature local grapevine varieties including Prokupac, Tamjanika, and Kavcina. Pedological investigations revealed two soil types: Eutric Cambisol (Ochric) and Haplic Vertisol. Mechanical composition was found to be linked to soil type, while pH and carbonate content were associated with the micro location. However, the content of organic matter and readily available nutrients P and K showed significant anthropogenic influence, indicating a notable deficiency in these elements. The soil is well supplied with accessible microelements (Zn, Fe, Mn), but has a very low boron content. Total copper content was high, exceeding 100 ppm at five locations due to prolonged use of copper-based fungicides. Insight into agricultural practices revealed imprecise record-keeping by owners, with old vineyards commonly left without fertilization, while pesticides are still applied.
This research indicates the degradation of old vineyard soil, emphasizing the need for deliberate intervention. Vulnerable vineyards like these deserve all contemporary available nurture to ensure their survival. In the conservation process, non-invasive 'green' measures must be implemented aiming to restore soil health. It is necessary to avoid copper-based treatments and maintain continuous soil monitoring. Critical grapevine nutrition can be achieved through judicious foliar application, avoiding deep fertilizer incorporation with the aim of preserving undisturbed soil.

Keywords: old vineyards,soil conservation,local grapevine varieties

ID ABS WEB: 137725

6. Soil in the digital era
6.04 129630 - Soil and viticulture

IMPACT OF INTRA-VINEYARD SOIL VARIABILITY ON VINEYARD IRRIGATION TRIAL

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Proper irrigation management is essential to modulate the water status of the grapevine and thus achieve high fruit quality. The effect of irrigation on the grapevine also depends on the physical and hydrological characteristics of the soil. The aim of this work was to test the effect of intra-vineyard soil spatial variability in a trial with different types of irrigation, namely Full (FI, 100% of crop evapotranspiration, ETc), deficit irrigation (DI, 40% of ETc), and Rainfed (RF, only precipitation).
The experiment was conducted in a commercial vineyard (cv. Sangiovese) located in Suvereto, Tuscany, Italy. The soil was firstly mapped by an Electromagnetic Induction (EMI) sensor, and then described by manual augerings in 9 sites. It was classified as Eutric Cambisol (Loamic), with a texture variable from Sandy Loam to Sandy Clay Loam (clay from 19 to 30%), common small and medium stoniness, and moderate redoximorphic mottles in depth (50-80 cm) in most of the augerings. According to soil mapping, augerings description and analysis, the soils of the vineyard were subdivided into 3 groups (A, B, and C), where B show the lowest apparent electrical conductivity measured by EMI sensor, around 18 mS/m versus 24-27 mS/m of zone A and C. Significant differences in Leaf Area Index (LAI) were found between the three irrigation regimes in zone A (from 0.51 to 0.74) and zone C (from 0.52 to 0.79), but not in zone B (from 0.55 to 0.57), where the lowest LAI values of FI and DI were measured. Soil B seems to have some limitations of grapevine growth and grape yield, which can overcome the effects of irrigation.

Keywords: soil proximal sensing,irrigation,soil water retention,grapevine,precision viticulture

ID ABS WEB: 137755

6. Soil in the digital era
6.04 129630 - Soil and viticulture

A NUMERICAL CLASSIFICATION APPROACH FOR THE ON-FARM MAPPING OF VINEYARD SOILS: GOODALL'S SIMILARITY INDEX AND GEOSTATISTICAL MODELING FOR THE SOIL MAP OF THE KOZLOVIC WINERY (ISTRIA, CROATIA)

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Conventional soil survey combined with soil suitability evaluation have allowed a better management of many wine-growing districts and individual wineries. The successful results of this approach rely on the ability to describe the three-dimensional distribution of soils units in space. A weakness, however, is the subjectivity introduced by the tacit knowledge that surveyors acquire during the auger-boring campaign and exploit to understand the spatial distribution of subsurface soil horizons. We sought to improve the accuracy of on-farm soil mapping by reducing the surveyor's subjectivity using Goodall's similarity index, one of three indices we have tested in previous studies for the multivariate analysis of mixed data.
The survey concerned 54-hectare vineyard of the Kozlovic winery in Momjan (Istria, Croatia) located in an undulating hilly landscape on Eocene Flysch at 110-150 m above sea level. A total of 66 locations were selected using the spatial coverage design of the R package spcosa. In the field, the morphological characteristics to a depth of 100 cm were recorded and one sample per horizon collected.
Goodall's index was determined with the program simil. Pairwise similarities were independently calculated for each variable; then they were combined by Fisher's transformation for continuous and discrete probabilities. The resulting pairwise similarity matrix was partitioned into homogeneous groups with the help of the software MATEDIT, and group centroids analysed with geostatistics to map the soil types of the farm.
The survey identified four soil types – from Calcaric Regosols to Vertic Calcaric Cambisols – that were distributed according to an altitudinal sequence influenced by erosive phenomena and partially masked by past slope arrangements. The resulting similarity values made it possible to map the soil types in detail and, at a later stage, to identify representative points where soil monoliths were extracted for a better characterization, which, suitably prepared, are now a wealth of knowledge for visitors to the winery, visually connecting wine production with the soils that support it.

Keywords: VINEYARD SOIL,ON-FARM SOIL MAPPING,SOIL SUITABILITY,MIXED DATA,GOODALL'S SIMILARITY INDEX

ID ABS WEB: 137922

6. Soil in the digital era
6.04 129630 - Soil and viticulture

ANALYSIS OF THE CHANGE IN SOIL DEPTH IN A VITICULTURAL AREA OVER THE LAST DECADES, CARRIED OUT AS PART OF THE CARG PAVIA PROJECT

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In areas of agroeconomical significance, the depth of soil available for cultivation can be negatively impacted by the mechanical action of agricultural machinery.
Multiple vineyard management techniques exist, including (a) Tillage and Total Tillage (T/TT; tillage up to 6 times/yr); (b) Permanent Grass Cover (PGC; no tillage); (c) ALTernating tillage-grass (ALT; tilling every other row).
In the Rio Vergombera catchment (Canneto Pavese, PV), an area of 0.54 km2 belonging to the CARG Pavia project, three main land uses are currently present: (a) vineyards managed through T/TT, (b) areas cultivated as vineyards in 2009 which have since spontaneously become woodlands and (c) woodlands which have existed prior to 2009.
At this location, no significant topographical or geotechnical differences are present, however the soil depth between the three aforementioned land uses varies: the average (minimum and maximum in brackets) are (a) 0.47m (0.27-1.5), (b) 1.23m (0.98-1.8) and (c) 1.57m (1.12-1.76), as measured in 2022, in 24, 6 and 3 locations respectively.
Since the usage of machinery in vineyards has been linked to higher erosion rates compared to areas where tillage was not practiced, it is plausible that the soil depth currently present older woodlands (1.57m) was the depth originally present in all land uses, which had decreased to 1.23m in all T/TT vineyards by 2009. The vineyards which were abandoned then still have similar soil depths, while this value decreases to an average of 0.47m in areas in which T/TT managements are still practiced.
In this area, intense rainfall events have caused, in the last decades, nearly yearly erosive events, which have been to blame for the formation of rills and for the transportation of soil onto the nearby street in correspondence of T/TT vineyards exclusively.
To reduce the soil loss and preserve fertility, the adoption of vineyard management techniques linked to reduced erosion rates compared to T/TT, such as ALT and PGC, could be preferrable.

Keywords: viticulture,soil depth,land use,soil loss,erosion

ID ABS WEB: 137949

6. Soil in the digital era
6.04 129630 - Soil and viticulture

ASSESSMENT OF GRAPEVINE ADAPTATION AND SOIL-BASED ECOSYSTEM SERVICES UNDER CURRENT AND CLIMATE CHANGE SCENARIOS

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Vineyards are complex agro-ecosystems that display significant spatial and temporal variability owing to their sparse and heterogeneous canopies. This research is part of the 'Integrated Climate Change Risk Modelling and Management - Ensemble of Tailored Models for Predicting Crop and Forest Productivity and Land Vulnerability under Different Climate Scenarios' project, which is a component of the National Center for Technology in Agriculture AGRITECH - Spoke 4.The study implements a multidisciplinary approach to investigate the behaviour of 'Aglianico' vines grown on two different soils in a high-quality wine production area in the Campania region (Italy). The focus is on the effects of climate change on production, quality, and ecosystem services provided by the vineyard system
The study is divided into four phases. 1. Functional homogeneous zones by combining information from the digital terrain model, NDVI by remote, EMI soil scanning, and classical soil pedological survey were defined; 2. Two years of monitoring of plants (leaf area index, leaf water potential), soil (soil water content by TDR, ECa scanning), grape quality (weight, volume, density, sugar, pH) and climatic variables; 3. Calibration/validation of a process-based model for the water balance in the soil-plant-atmosphere system; 4. Assessment of grapevine adaptation and soil-based ecosystem services under current and climate change scenarios.
Results of phase 1 and preliminary results related to phases 2, 3 and 4 are reported.

Keywords: climate change scenarios,water balance,process-based model,soil-based ecosystem services

ID ABS WEB: 138162

6. Soil in the digital era
6.04 129630 - Soil and viticulture

SR-VITIS: A USER-FRIENDLY TOOL TO SUPPORT FARMER IN ROOTSTOCK SELECTION

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This study presents the development of a user-friendly Decision Support System (Vitis) aiming to enhance farmers' awareness and support them in management choices by using programming potential.
The choice of rootstock is of great importance when planning a new vineyard. The rootstock allows to modulate the plant response, considering soil conditions, compatibility with the cultivar and production target. The Suitable Rootstock (SR) module in Vitis is developed exclusively using the Python programming language to ensure consistency and compatibility across all functionalities, such as data collection, analysis, visualization, and management. The Graphical User Interface (GUI), created with Kivy and KivyMD frameworks, is available in both desktop and mobile versions.
Starting from a set of 17 rootstocks (K5BB, SO4, 420A, 1103P, 110R, 140Ru, 101.14, 196.17, Gravesac, 41B, Fercal, M1, M2, M3, M4, 775P, 779P), identified among the most widespread in Europe, the expert system set up within SR-Vitis excludes rootstocks deemed unsuitable on a bibliographical basis, with respect to the actual pedoclimatic characteristics of the vineyard. Soil properties are entered manually by the user, and concern total limestone, salinity, pH, soil rooting depth, texture, and skeleton. The expert system also requires the insertion of the risk level with respect to stagnation and water stress phenomena, both split into three quality classes, chosen by the user according to his experience.
The output of SR-Vitis consists in the set of rootstocks considered most appropriate for the selected pedoclimatic characteristics of the area of interest. An example of application of the DSS to a farm representative of Chianti Classico area is illustrated.
The introduction of SR-Vitis will provide sector operators with practical and immediately applicable tool for optimized resource management and improved planning of new vineyards.
In the future, the system potentiality will be expanded through upgrades, new functional modules for vineyard management and integration with database. These improvements will make the DSS even more valuable for the vine-growing sector.

Keywords: DSS,Soil,Climate,Rootstock,Vitis vinifera

ID ABS WEB: 138199

6. Soil in the digital era
6.04 129630 - Soil and viticulture

CRITICAL LEVELS OF METAL TOXICITY IN NATIVE SPECIES IN VINEYARDS

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Successive applications of fungicides containing Cu, Zn and Mn lead to an accumulation of these metals in the soil, which can interfere with the development of native plants that cohabit vineyards. In this context, the critical levels (CL) of these metals in soil and plants in relation to dry mass production are not sufficiently known, especially in subtropical climates. The aim of this study was to define the CL of Cu, Zn and Mn in the tissue of plants grown between the rows and in the soil, in vineyards in the Pampa biome. To this end, the CL these metals in the plant tissue and soil of the three areas were determined: vineyard 1 (without soil turning after the first planting) (V1), vineyard 2 (soil turned after the first planting) (V2) and native field (NF) (without agricultural crops). To estimate the CL of metals in tissue and soil in relation to dry mass production, estimation models were developed using regression with plateau. Hierarchical Bayesian analysis was used to adjust the regression models. In the tissue, the CL of metals were 75, 77 and 380 mg kg-1, respectively. In general, the lowest values of Cu and Zn in the soil and tissues were observed in the NF, as well as the highest dry mass production. The lowest concentration of Mn in the tissue was in the V1 plants. The CL values in the soil were 20, 3.5 and 45 mg dm-3, respectively. V1 had the highest levels of Zn and Mn in the soil and the lowest amounts of dry mass produced. Thus, excessive applications of fungicides based on Cu, Zn and Mn not only increase their concentration in the soil and tissue, causing phytotoxicity, but also tend to reduce the richness of native species. By estimating CL values, it is possible to gain a better understanding of fungicide application management, it being a good indicator of soil toxicity and contamination.

Keywords: Pampa biome,toxicity indicator,viticulture

ID ABS WEB: 140668

6. Soil in the digital era
6.04 129630 - Soil and viticulture

BERRY MORPHOLOGY STUDIES ON FURMINT AND KÖVÉRSZ?L? GRAPE VARIETIES FROM LOESS AND VOLCANIC SOILS

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Berry morphology the discipline that analyses in detail the structure, shape, size, colour, skin, seeds and other characteristics of berries. Berry morphology plays an important role in understanding fruit development processes. Tokaj-Hegyalja is one of Hungary's most famous wine-producing regions. The area lies at the northern foot of the Zemplén Hills and is the centre of Tokaj wine production. The vineyards here have exceptional environmental and soil conditions, which give the wines their unique character. The Tokaj hills are known for their unique volcanic and loess soils, rich in minerals and with excellent drainage, which create ideal conditions for growing grapes. These soil characteristics give Tokaj wines, especially Furmint and Kövérsz?l?, their unique characteristics. The Furmint grape variety is the basis of Tokaj wines.The grape variety has a long history in the region and is one of the main ingredients of Tokaj Aszú wines. The Furmint grape is particularly well adapted to the climate and soil of the Tokaj hills. The volcanic soils and favourable climatic conditions give the Furmint grape excellent quality berries, which produce exciting and complex wines.The Kövérsz?l? grape variety also plays an important role in the palette of Tokaj wines. The difference lies in the mineral composition, water balance and temperature regulation of the soil types. The diversity of Tokaj wines is partly due to this terroir, which gives the wines of the region a unique and distinctive character. In 2023, I conducted berry morphology experiments on Furmint and Kövérsz?l? grapes. The sample was taken from loess and volcanic soils. I wanted to find out whether the berries from the different soils develop differently and whether they are affected differently by the Botritys cinerea In my experiment, 100 berries per variety and soil type were tested. I took berry sections and analysed them using digital image analysis software. I examined berry diameter, skin thickness, seed parameters, berry flesh to seed ratio and spacing.

Keywords: Berry morphology, Tokaj,Furmint, Kövérsz

ID ABS WEB: 140674

6. Soil in the digital era
6.04 129630 - Soil and viticulture

ORGANIC SOIL MANAGEMENT IN VINEYARDS BASED ON MULTIFUNCTIONAL AND PRECISION AGRICULTURAL PRACTICES AND RECYCLING OF NATURAL RESOURCES

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Monoculture of vineyards, excessively applying artificial chemical fertilizers and pesticides will result in extensive soil degradation in terms of acidification, loss of organic content, loss of soil biodiversity, degradation of the physical properties of the soil, loss of water holding capacity, and finally, turning healthy soils into non-soil. Furthermore, use of heavy machines in the vineyard causes soil compaction which inhibits the development of the root system of vines. It is important to realise, that soil is a living substance, an ecosystem where healthy soil biodiversity is a prerequisite for the maintenance biogeochemical cycles, which are the key drivers of ecosystem services provided by soils. Although the introduction and the fast development of precision agriculture has reduced the input of agrochemicals, it did not change the monoculture and did not improve the biodiversity of vineyard ecosystems. Furthermore, from an economic perspective, agrochemicals are expensive, they support a linear economy in agricultural production while important resources, such as cover crops, organic waste, and purified wastewater are not utilized. The solution is a new, complex system based on the potential multifunctionality of agriculture, organic production, complex product and service structure of a recycling, circular economy, where soil conservation and management have a central role. Out-phasing artificial chemical fertilizers and pesticides and establishing a fully recycling system in wine production has several steps in terms of wastewater purification, organic waste management, renewable energy production, cover crops, biological pest management, and developing full product structure based on available ecosystem services. Wastewater purification yields biologically clean wastewater, which is a nutrient solution for irrigation (after appropriate treatment), sewage sludge, which can be co-fermented with organic waste and produce biogas and biosolid, that can be further processed to vermicompost, a high-quality natural fertilizer for soils. Using cover crops such as legumes and herbs will supply soil nitrogen and increase the biodiversity of the vineyard and yield additional crops. In one system, including a complex product structure of the grapevine (fruit, fruit juice, wine, distilled spirits, grapeseed oil, grape skin extract, marc for animal food, marc for medical products, etc.) and services (tourism, consultancy, events) the economic viability will be secured.

Keywords: soil degradation, soil life, monoculture, cover crops, biodiversity, soil conservation, biogeochemical cycles, vermicompost, wastewater-irrigation, recycling, multifunctional agriculture, circular economy.

ID ABS WEB: 140677

6. Soil in the digital era
6.04 129630 - Soil and viticulture

A REGENERATIVE APPROACH TO SOIL HEALTH AND BIODIVERSITY IN VITICULTURE

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Mainly monocultural vineyards require intensive use of pesticides against fungal diseases (e.g., powdery mildew and grey mould) and insect pests with adverse effects on biodiversity, ecosystem functions and the human health. Growing concerns about the direct and indirect effects of pesticides and synthetic soil conditioners are putting increasing pressure on farmers to reduce their dependence on chemicals and develop sustainable, preferable organic farming systems. Certain control of pests and fungal diseases in vineyards may be achieved by short cutting certain some crops (e.g. inter-row grassing), but this approach affects above and below ground biodiversity and limits the amount of carbon stored in the soil. Thus, a wider variety of useful cover crops such as legumes with nitrogen-fixing symbionts, many herbs and spices can be beneficial, since some of them have even insect repellent properties.
Grape growers need to future-proof their production, not only by relying more on alternative pest and disease management strategies, but also by strategies to capture and store more carbon in the soil. Viticulture research has so far focused primarily on approaches to maximise the quality and quantity of grapes produced, resulting in large-scale industrial agriculture and soil depletion. What we need now is research that will also move the sector forward in terms of regenerative environmental sustainability. The term "regenerative" refers to the reconstruction of depleted agroecosystems. Therefore, designing biologically divers agroecosystems while taking measures to sequester and store more carbon in the soil, will increase soil biodiversity and even contribute to climate resilient agriculture.
The ecological restoration of previously monocultural vineyards using cover crops and forest strips creating new habitats, including windbreaks and biofilters, provides significant production benefits, which support soil health, disease prevention, and environmental sustainability. Furthermore, increasing the biodiversity of vineyards and vineyard soils is likely to enhance the development, diversity, and abundance of arbuscular mycorrhizal fungi (AMFs), which are considered essential for the healthy functioning of terrestrial ecosystems. They facilitate nutrient cycling and the supply of nutrients and water directly to colonized plants and increase tolerance to biotic and abiotic stresses and diseases being hereby an important factor for ecological intensification.

Keywords: monoculture, pesticides, soil conditioners, soil carbon sequestration, soil biodiversity, organic farming, cover crops, agroecosystems, regenerative sustainability, climate resilience, arbuscular mycorrhiza, biotic stress, abiotic stress

ID ABS WEB: 140678

6. Soil in the digital era
6.04 129630 - Soil and viticulture

COMPARISON OF PIWI AND CONVENTIONAL GRAPE VARIETIES IN THE BALATONBOGLÁR WINE DISTRICT

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In the European Union, environmental and health protection is an increasingly important requirement. The use of polluting pesticides is becoming more restricted every year. In recent years, the cost of wine grape production has been rising steadily due to the unfavourable economic trends. These challenges are difficult to meet with conventional grape varieties, the best solution is to use disease and pest resistant PIWI grape varieties, which are suitable to produce the same quality of wine with almost identical organoleptic properties as the corresponding conventional varieties. Since the choice of terroir in terms of climate, aspect and soil quality is important regarding wine quality, the Balatonboglár wine district was chosen as experimental site on the southern shore of Lake Balaton, in the Balaton wine region. In 2023, 2 PIWI (Muscaris (Solaris x Muscat Lunell) and 08-3/9 (01-1-840 (BC5) x Riesling)) varieties were compared with 2 conventional (Muscat Lunell and Riesling) varieties in the Balatonboglar wine district. We expected at least similar or identical chemical characteristics and organoleptic properties in the PIWI and the conventional control varieties. The production area is west facing. The soil- forming rocks are sandy loess, the physical soil type is sandy loam with a medium humus layer thickness and a slightly humic soil. From the surface, carbonate soil with weak alkaline chemistry. Must samples were taken at harvest and the musts were fermented into wine using the same technology under the same fermentation conditions. Must and wine samples were analysed for 44 parameters (e.g., alcohols, sugars, organic acids, amino acids, higher alcohols, polyphenols) using a Bruker Ascend 400 NMR instrument. The wines were also evaluated organoleptically. Our research gave the expected results, since no significant differences were measured between PIWI and control varieties.

Keywords: PIWI grape varieties, disease resistance, soil properties and wine quality, chemical characterization of must and wine, sensory evaluation

ID ABS WEB: 136189

6. Soil in the digital era
6.05 131572 - Advancing Quantitative Soil Classification: From Soil Profiles to a Dynamic and Comprehensive Classification System

A MULTI-LAYER NUMERICAL SOIL CLASSIFICATION SYSTEM FOR AUSTRALIA

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One of the priority areas for developing pedometrics is the hope of a numerical classification system for soil layers, horizons and profiles for the world. Progress towards this endeavour is underway through the initiation of the Global Numerical Classification System for Soil Layers and Profiles (GNCSSLP). Wadoux and McBratney (submitted) have created a surface layer numerical classification for the world. In this study, we will demonstrate a multi-layer numerical classification system for Australia.
To achieve this, a comprehensive dataset of relevant soil property maps for Australia, including soil texture, pH, organic carbon and its various fractions has been compiled. The k-means clustering algorithm was applied to generate the optimal number of k-means clusters from the one million points sampled from these maps and repeated 100 fold. A plateau in the ratio of between-cluster dispersion to within-cluster dispersion is used as the convergence criterion. The initial centroid clusters were identified from one of the replicates, and the k-means algorithm was iteratively applied across subsequent replicates to refine the centroid clusters. Subsequently, we allocated the soil properties at all locations on the maps to their nearest centroids resulting in a high-resolution numerical soil layer classification for the whole country.
With three depth-layer clustering established, we extended our classification to encompass the top 30 cm of the soil profile. This comprehensive approach marks a critical step towards the development of a unified and objective soil classification system. Our findings pave the way for a standardized global (unsupervised) numerical classification system, offering invaluable insights for soil science and its diverse applications.

Acknowledgment
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Reference
Wadoux, A., McBratney, A., 2024. A global numerical classification of the soil surface layer. Geoderma (submitted).

Keywords: numerical classification,Australia,soil layer classification,pedometrics

ID ABS WEB: 138072

6. Soil in the digital era
6.05 131572 - Advancing Quantitative Soil Classification:
From Soil Profiles to a Dynamic and Comprehensive Classification System

ELEMENTS AND STRUCTURE OF THE HUNGARIAN DIAGNOSTIC SOIL CLASSIFICATION SYSTEM

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Most national soil classification systems were developed before modern data collection and computer based processing tools were availbale. The Hungarian Diagnostic Soil Classification System (HDSCS) is based on the experiences of the traditional genetic-based system, the accumulated field and laboratory data and the pedometric eveluation and processing of them. The poster is presenting the elements (diagnostic horizons and properties), the structure and the classification key of the 15 soil types of the HDSCS. Example profiles with pictures, data and major properties will be used to introduce the units, complemented with correlation information with the World reference base for soil resources (WRB, 2015) units.

Keywords: Soil Classification,Diagnostics,Soil Types,Soil profiles,Soil horizons

ID ABS WEB: 136325

6. Soil in the digital era
6.06 133437 - Novel approaches to process-based modelling in agricultural soils

THE USE OF ABM FOR THE STUDY OF EROSION PROCESSES IN THE AGRICULTURAL LANDSCAPE OF SOUTH MORAVIA

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The paper demonstrates the possibilities of using Agent-Based Modeling (ABM) to mo-del water erosion on highly endangered land in the South Moravia region, one of the most fertile areas in the Czech Republic. Currently, soil erosion calculations in this regi-on rely on the Universal Soil Loss Equation (USLE) methodology. The erosion limits set by USLE, which determine permissible values of combined Cover and Management (CP) factors, restrict the cultivation of erosion-prone crops, such as maize, on vulne-rable areas. Moreover, the extensive surface area of individual soil blocks, resulting from post-war collectivization, land consolidation, and the loss of field-breaks and green elements, has contributed to high erosion runoff, making the resulting blocks among the largest in Europe. Efforts are underway to change this situation by dividing large soil blocks into smaller ones.
This division of soil blocks impacts the calculation of erosion according to the USLE me-thodology, primarily designed for calculating average erosion runoff for a field with one crop. It may not be accurate when multiple crops are present unless the crop chan-ge also interrupts the concentrated outflow path. Physically based models can interpret this situation, but they are more demanding in terms of input data and are specific to each sub-area.
In this paper, we demonstrate the potential of using ABM methodology to qualitatively capture the effects of soil block division (horizontal, vertical, strip cropping). This ap-proach provides general information about the relevance of designed measures in rela-tion to erosion hazards. The proposed mechanism offers retrospective guidance for possible modifications of parameters (P) in commonly used empirical models of the (R)USLE type.
Addressing these issues is a focal point of projects coordinated by the Czech Technolo-gical Agency (Center for Landscape and Biodiversity – SS02030018 and Strip Cropping as an Adaptation Measure for Optimizing Landscape Water Management – SS06010290), aligning with EU and Czech Republic strategies.

Keywords: ABM,water erosion,USLE,landscape structure

ID ABS WEB: 137781

6. Soil in the digital era
6.06 133437 - Novel approaches to process-based modelling in agricultural soils

DIGITAL MAPPING OF RELEVANT SOIL CLASSIFICATION UNITS IN HUNGARY TO SUPPORT PRECISION AGRICULTURE

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Most of the data collected for precision agriculture in Hungary comes from the top soil and does not take into account the deeper layers. Although for precision agriculture, the classification units can lead to a deeper understanding of the main drivers that limit yields. The aim of our study is to identify the major WRB and proposed Hungarian Classification (HSCS) diagnostic units applicable in a precision agricultural system under Hungarian soil and climatic conditions,and how they relate to the yield potential of a selected fields compared to other methods commonly used in precision agriculture, such as contact and non contact soil scanning methods, vegetation biomass mapping, differents surface sampling strategies . The results show that the classification units strongly correlate
with yield potential under climatic and landscape conditions of our study area and can be used to plan precision agriculture.

Keywords: Classification,Precision Agriculture,Machine Learning

ID ABS WEB: 137924

6. Soil in the digital era
6.06 133437 - Novel approaches to process-based modelling in agricultural soils

DISTRIBUTION PATTERN OF MACRO-AND MICROELEMENTS IN GRAPES OF AGLIANICO CV FROM TAURASI WINE PDO AREA (SOUTH ITALY) AND RELATIONSHIP WITH SOIL CHEMICAL AND ELEMENTAL COMPOSITION

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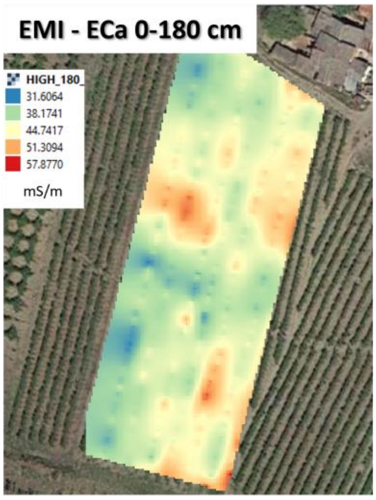
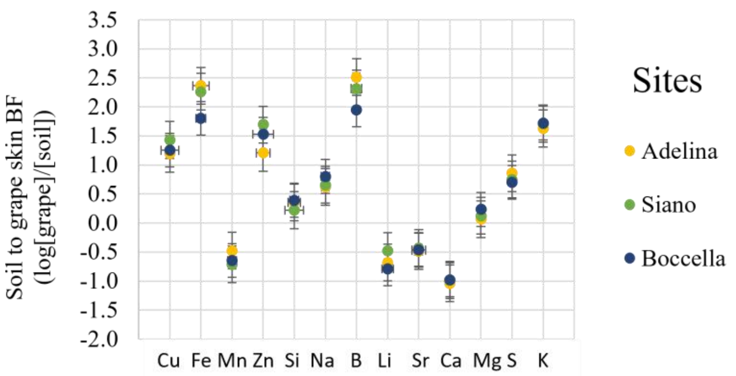
Since of the impact of berry composition on juice, must, and finally on wine composition and quality, the grapevine mineral element concentration is of concern not only for scientists but for oenologists and winemakers too. Several of research focused on grape composition rather than on wine for understanding on transfer/accumulation processes in the soil-vine system avoiding the anthropogenic source related to winemaking practises. Evaluations on the relationship between total soil element content and plant tissue composition highlighted a disconnect governing their accumulation. However, poorly investigated have been the soil-grape transfer processes under surveyed soil spatial variability contexts and application of selective extractions allowing the measurement of the soil bioavailable element (BE) content that is more appropriate for soil-plant uptake studies.
This research focused on the soil-vine system, analysing soils and Aglianico grapes from the wine production area of the Taurasi Protected Designation of Origin-PDO (South Italy). Three vineyards were selected in similar pedoclimatic environments, preliminary surveyed by electromagnetic induction (EMI) proximal sensor for soil variability identification and accordingly sampled in four points for each vineyard. Soils were sampled in triplicate while grapes were collected at harvesting from 6 plants surrounding the soil sampling points. Portable X-ray fluorescence (pXRF) spectrometry and single extraction with ammonium acetate 1M have been applied to measure the total (TE) and the BE content from soils, respectively, while the element distribution pattern of grape (skin, seed and pulp) has been determined after grape mineralization and analysis by ICP-OES spectrometer.
The multivariate analysis (PCA) based on the soil TE and BE content and that on grapes composition revealed quite homogeneous distributions among vineyards. Bioconcentration factors (BF), calculated as log transformed ratio of grape berry concentrations divided by the soil BE content, allowed to identify soil to grape berry transfer for Cu, Fe, Zn, Na, B and S in skin, seed and pulp, while accumulation was not found for Mn, Li, Sr and Ca.





Keywords: soil-plant uptake,soil bioavailable elements,grape elemental composition,vineyard soil,bioconcentration factor

ID ABS WEB: 137931

6. Soil in the digital era
6.06 133437 - Novel approaches to process-based modelling in agricultural soils

A TWO-STEP MODEL TO PREDICT TEMPORAL VARIABILITY OF SOIL HYDRAULIC PROPERTIES IN AN AGRICULTURAL FIELD WITH LOAMY SOIL

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Temporal variability in soil hydraulic properties (SHPs) in agricultural fields has been reported by several studies, but it is rarely considered in subsurface modelling. The experimental measurements for determining SHPs at multiple timescales are expensive and time-consuming. Further, obtaining parameters for existing numerical and analytical models for describing temporal variation in SHPs is difficult. Alternatively, scaling can be used to describe spatial-temporal variability of SHPs and relate them to subsurface media properties. This study aims to develop a simplified model for describing temporal variation in SHPs which relies on only a few field measurements for a loamy soil. For this, temporally variable reference soil water characteristic curves (SWRCs) and hydraulic conductivity curves (HCCs) were synthetically generated for various parameter combinations. The temporally varying SWRCs and HCCs were scaled by functional normalization approach to obtain time varying reference curves and scale factors. Using regression analysis, a two-step equation was developed to relate time-varying scale factors and the initial SHPs. The developed reference curves and equations were validated by 5-fold cross validation method. During cross validation the average percentage error in predicted van Genuchten parameters and Ksat were mostly below 10 %. The proposed method holds promise for describing temporal variation in SHPs using only the initial SHPs.

Keywords: Soil Hydraulic Properties,Temporal Scaling,Temporal Variability

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6. Soil in the digital era
6.06 133437 - Novel approaches to process-based modelling in agricultural soils

IMPACT OF DEM RESOLUTION ON HYDROLOGICAL RESPONSE SIMULATION USING NASH GIUH MODEL

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Geomorphological instantaneous unit hydrograph (GIUH) based on Nash model is considered an effective approach for modelling the hydrological process of ungauged basins in arid regions. Model parameters represent the geomorphologic details of the basin and the climatological characteristics. Geomorphologic parameters are extracted from the digital elevation model (DEM). The model output is influenced by the DEM resolutions. This study developed a modelling methodology for evaluating the impact of DEM resolutions, specifically at 20 and 30 meters, on the computed direct surface runoff hydrograph (DSRH) based on Nash GIUH model. A computer program was developed to systematically derive computed DSRH. Computed DSRH was compared with observed DSRH derived from measurements at the outlet of Agarma sub-catchment of the Wadi Kharouba in the North Western Coastal Region of Egypt for two rainfall events observed from Oct 2015 to Mar 2016. Geomorphologic information was derived from DEM of the basin and QGIS was used for data processing. The results showed that for both rainfall events, the 20 m resolution DEM consistently outperforms the 30 m resolution DEM in terms of efficiency (EFF). In the rainfall event on 16th November 2015, the 20 m resolution DEM exhibits lower errors across various metrics, including AEV, PEP, RMSE, and AAE, indicating better accuracy in simulating hydrological processes. Similar trends were observed in the rainfall event on 30th December 2015, with the 20 m resolution DEM showing higher efficiency and lower errors compared to the 30 m resolution DEM. The percentage errors in peak flow (PEP) and time to peak (PETP) are generally higher for both resolutions in the December event, suggesting increased complexity or challenges in accurately predicting hydrological responses during this event. In conclusion, the results consistently indicate that the 20 m resolution DEM provides more accurate and efficient simulations of the hydrological response compared to the 30 m resolution DEM for both rainfall events.

Keywords: GIUH,Nash model,DEM,Ungauged basins

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

WEATHERING MECHANISMS AND SOIL FORMATION IN A MORAINIC LANDSCAPE OF THE THREE LAKES REGION (SWITZERLAND)

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This study aims to better understand the evolution of soil on morainic material in the temperate regions. During the last glaciations, the Three Lakes region (Switzerland) was repeatedly covered by ice, resulting in the deposition of morainic material. Quaternary glaciations strongly reworked Molasse sediments and left a mantle of mixed autochtonous and allochtonous superficial deposits (regolith) covering the landscape. While the allochtony of the morainic material in the Swiss Plateau is not questioned, the trajectories of soil evolution are underexplored. Exploring these trajectories will provide precious information on the rate and directions of soil and landscape evolution.
10 soil profiles from 5 main sites were analysed. In addition to classical soil analysis, also the micromorphology was studied together with a quantitative assessment of macropores using computational tomography. As soil registers directional changes, micromorphological analyses of soil features are a powerful means to decipher soil evolution. The micromorphology helped us understand whether the different horizons were formed in situ or elsewhere and then transported. Additionally, using elemental analysis, we calculated various weathering indices to confirm the observed features.
The investigated soils showed a distinct accumulation of clay and silt in the B horizon. The clay accumulation is a relic feature of eluviation-illuviation processes. Indeed, hilltop sites had more clay coatings than the toeslope sites, where clays are present only in the transported form (papules). Moreover, beyond quantity, the composition of the clays also varied as a function of the topography. We observed clear brownish clay coatings in the hilltop profile, in comparison to the toeslope profile where clay accumulation was more yellow and coarser (additions of silt).

Keywords: Soil Formation,Weathering,Morainic Landscape,Micromorphology,Computational Tomography

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

EFFECT OF TOPOGRAPHIC VARIATIONS AND TILLAGE METHODS ON GULLY EROSION IN THE BLACK SOIL REGION OF NORTHEAST CHINA

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Gully erosion is considered to be a severe land degradation process around the world. The combined effects of tillage methods and topographic variation on gully erosion are poorly understood. The unequal probability area sampling method was used to investigate gullies in three farmland, geomorphic areas in the black soil region of northeastern China: low mountains and hills, tableland, and rolling hill areas. Cross-sectional measurements were used to obtain estimates of volumetric soil loss from the gullies. Digital contour maps and remote sensing images were used to obtain the topography and row direction data direction, and the Redundancy analysis (RDA) was used to analyze the contribution of different influencing factors. The results showed that tableland area had the greatest volumetric soil loss and was the most prone to develop gully erosion, followed by the low mountains and hills, and finally the rolling hill areas. Topography was the dominant control on gully erosion and volumetric soil loss and length density increased first and then decreased as a function of increase of slope gradient. Farmland with slope gradient between 15° and 20° had the most serious gully erosion. Compared to other geomorphic areas, low mountains and hills had the most gully types and the greatest variability of morphology. Surface areas and volumes were related to gully type. Different tillage methods have affected the frequency of gully occurrence. Cross-slope tillage areas were more prone to develop gully erosion than contoured tillage and up and down slope tillage areas, especially for farmlands with slope of 5 to 10°. The results suggest that gully erosion could be reduced if up and down slope tillage was used for slope gradients less than 15° and contoured tillage was used for slope gradient greater than 15°. This study demonstrates the combined effect of topographic variations and tillage methods on gully erosion, and highlights the importance of considering different tillage methods under different geographical conditions to control gully erosion.

Keywords: Soil erosion,Gully erosion,Topographical variation,Tillage practices,The Black Soil Region

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

A NEW HIGH-RESOLUTION GLOBAL TOPOGRAPHIC FACTOR DATASET CALCULATED BASED ON SRTM

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Topography is an important factor affecting soil erosion. It is measured by the combined slope length and slope steepness (LS-factor) in erosion estimation models (such as the Revised Universal Soil Loss Equation (RUSLE), and Chinese Soil Loss Equation (CSLE)). Shuttle Radar Topography Mission (SRTM), a high-resolution elevation data on a global scale, has been widely used to assess global soil erosion. However, global high-resolution LS-factor datasets based on SRTM have rarely been published. Challenges arise when attempting to extract the LS-factor on a global scale. Furthermore, existing LS-factor estimation methods necessitate projecting data from a spherical trapezoidal grid to a planar rectangle, resulting in grid size errors and high time complexity. Here, we present a global 1-arcsec resolution LS-factor dataset (DS-LS-GS1) with an improved method for estimating the LS-factor without projection conversion (LS-WPC), and we integrate it into a software tool (LS-TOOL). Validation of the Himmelblau–Orlandini mathematical surface shows that errors are less than 1%. We assess the LS-WPC method on 20 regions encompassing 5 landform types, and R2 of LS-factor are 0.82, 0.82, 0.83, 0.83, and 0.84. Moreover, the computational efficiency can be enhanced by up to 25.52%. DS-LS-GS1 can be used as high-quality input data for global soil erosion assessment and can be available at https://doi.org/10.11888/Terre.tpdc.300613.

Keywords: soil erosion,slope steepness,slope length,topographic factor,USLE/REUSLE/CSLE

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

OBLIQUE SLOPE RIDGE-FURROW TILLAGE FACTOR FOR REGIONAL SOIL EROSION MAPPING

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Ridge-furrow tillage is a widespread agricultural practice. In hilly regions, both cross-slope (contour) and up-down slope ridge-furrow tillage are employed, but oblique slope ridge-furrow tillage is more common. This method refers to a tillage direction that is neither parallel nor perpendicular to the contour lines but forms an angle with them. Previous evaluations of soil erosion generally did not take this into account. The purpose of this study is to analyze the effect of oblique slope ridge-furrow tillage on soil erosion and construct a universal method for its calculation. This method can serve as a general form capable of replacing the calculation of contour and up-down slope tillage (specific cases). Taking Nenjiang City (15211.43km2) as an example, 39 sample units were deployed based on the sampling approach. Combining remote sensing image interpretation and field investigation, we propose the process of calculating the angle of the ridge-furrow direction (the angle between the ridge-furrow direction and the contour line), followed by the computation of a correction coefficient for the ridge-furrow direction at relative contour tillage, and then deriving the factor of oblique slope ridge-furrow tillage. The results showed that high-precision interpretation of ridge-furrow direction in the region can be achieved based on remote sensing images. The average variation in the angle of ridge-furrow direction within a single field is 40.2°. Oblique slope ridge-furrow tillage is predominant, with an average factor value of 0.81. This factor, previously overlooked, leads to a 30.5% overestimation of soil erosion. Consequently, soil erosion assessments should not be confined to contour tillage alone, but should also incorporate oblique slope tillage. In addition, practical evaluations of their benefits at the field scale can be difficult, but it can be effectively conducted using a grid as the unit of analysis. The proposed method can comprehensively express the soil conservation benefits associated with ridge-furrow direction, improve the accuracy of regional soil erosion assessment, and better serve soil conservation planning.

Keywords: Oblique Ridge-Furrow Tillage,Ridge-furrow direction,Soil erosion,Soil erosion model,Soil erosion survey

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

A HYBRID, FIELD GUIDE FOR APPRAISING WATER EROSION RISK BY FARMERS AND TECHNICIANS IN MULTIPLE WOODY CROPS AND ENVIRONMENTS

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Under a climate change scenarios water erosion damages are becoming more important. However, evaluation of water erosion risk is usually model-based and complex and not appealing to end users. Paradoxically, key information to predict erosion risk can only be properly identified at farm scale with help from practitioners.
There is scope for tools allowing practitioners appraisal of water erosion risk. One successful example is Millgroom et al. (2007), based on a simplified version of RUSLE (Renard et al., 1997) to assess water erosion risk at farm scale for organic olive growers in S. Spain. Its uses four steps: 1) to divide the farm into homogenous areas; 2) to evaluate the general erosion risk by area taking into consideration, topography, crop typology and management; 3) to conduct an on-farm check for the visual symptoms of soil erosion; 4) to combine the general erosion risk (Appraisal 1) and the on-farm check (Appraisal 2) to assess the overall erosion risk. This tool proved successful among practitioners, but in its original form it is confined to a specific niche.
We present the current status of an, in progress, tool for appraising water erosion risk in valid in multiple environments and woody crops, developed in cooperation among European and Chinese teams and stakeholders. It combines a dual approach combining erosion risk estimation in field check of erosion symptoms. It is aimed for hybrid format, available either in a paper form (which remains the most operational one in many field conditions) or web-based. With this we aim to deliver:
1- a standardize tool valid across multiple environments and woody crops to evaluate water erosion risk.
2- an educational tool on prevention of water erosion.
Acknowledgements: to projects TUdi (Horizon 2020, GA 101000224), PID2019-105793RB-I00 (AEI), GOPO-SE-20-0002 (EIP-Agri).

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Milgroom et al. 2007. Land Degradation & Development, 18: 397-411.
Renard et al. 1997. Agricultural Handbook 703, USDA-ARS. Washington, DC.

Keywords: practitioners,degradation,field,woody crops,stakeholders

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

RECONSTRUCTION OF SOIL DENUDATION EVENTS AND THE DISAPPEARANCE OF LUVISOLS IN THE LOESS LANDSCAPE OF TRZEBNICA HILLS (SW, POLAND)

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Loess landscapes are very susceptible to erosion processes, which affects the stability, productivity, and transformation of soils. The Trzebnica Hills located in SW Poland are one of such areas. Using optically stimulated luminescence (OSL) dating a complete record of denudation processes in SW Poland was reconstructed. The first phase of sediment redeposition on the slopes occurred about 9.1 ka ago. Subsequent ones were attributed to the Neolithic (6.4 ± 0.3 ka), early Bronze Age (3.8 ± 0.2 ka), early and late Middle Ages (1.5 ± 0.1 ka and 0.7 ± 0.03 ka) and early Modern Period (0.4 ± 0.02 ka).
As a result of the erosion-deposition processes, the soil cover in the studied area had been strongly reshaped. The predominant Luvisols had experienced progressive erosion processes that led first to a significant shallowing of the eluvial and argic horizons (truncated Luvisols) and, after some time, to their complete removal. Further thinning of the loess mantles had caused that older sediments without pedogenic alternations like glacial tills and glaciofluvial substrates were exhumated. Therefore, soil transformation was towards reference group of Regosols. Similarly, Regosols occurred in toeslopes where freshly eroded material had been deposited, and where diagnostic horizons had not yet developed.
Based on medium-term soil erosion rates, it is calculated that the soil class in studied area may have significantly changed within 80 – 200 years, if not sooner due to progressive climate change. It is alarming and very important because erosion and soil degradation are issues specifically highlighted in the 2001 European Parliament's resolution on soil protection.

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Keywords: SOIL EROSION,LOESS,OSL DATING,LUVISOLS

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

IMPLEMENTATION OF THE WIND EROSION EQUATION INTO GIS TECHNOLOGY FOR MODELLING POTENTIAL SOIL LOSS DUE TO WIND EROSION ON AGRICULTURAL SOIL

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Wind erosion is a fundamental natural phenomenon that becomes a serious problem due to human activity and can eventually lead to desertification. This study is focused on determining the potential soil loss caused by wind erosion in agricultural fields. Additionally, it explores the implementation of biotechnical measures to control wind erosion in a specific model area located in South Moravia (Czech Republic, EU), which is affected by wind erosion. One of the method involves the use of equations and models, which, when implemented with GIS technology, become powerful tools due to their speed, visualization capabilities, and the ability to use freely accessible data. Many of these models are based on equations, but they differ in terms of regional characteristics or variations in their demands for input data. One of the most commonly used equation is the Wind Erosion Equation (WEQ), which considers soil erodibility, soil ridge roughness, climate, unsheltered length, and vegetative cover. In this study, the WEQ was implemented in ESRI ArcGIS Pro 3.0 using raster analysis techniques to determine potential soil loss due to wind. The use of the WEQ in this study represents a versatile method that can be applied in different scenarios and for various purposes. For modelling wind erosion in this study, freely available hydrometeorological data from the Czech Hydrometeorological Institute were used to determine climate factors. The unsheltered length was determined through height analysis using data from the Digital Elevation Model (DEM) and Digital Surface Model (DSM), while soil erodibility was based on laboratory analyses of the soil in the study area. Vegetation and soil ridge roughness were ignored in determining potential soil loss due to wind erosion. This study found out a reduction in potential soil loss by wind in agricultural fields by more than 70% with the optimal use of biotechnical measures for wind erosion control.

Keywords: wind erosion,Wind Erosion Equation (WEQ),soil erosion spatial modelling,GIS,wind barriers

ID ABS WEB: 137289

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

INITIATING THE PREDICT-ER: A NEW MULTIDISCIPLINARY FRAMEWORK FOR THE DEVELOPMENT OF AN EROSION PREDICTION TOOL

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Significant progress in studying and subsequent modeling of erosion processes resulted in the development of many empirical, semi-empirical, and physically-based models, ranging from simplistic equations to complex models considering multiple interacting factors. However, the ease of their use with remotely sensed data and geostatistics increased the number of models and tools that rely on globally available data and lack field activities and validation. These drawbacks limit their applicability in identifying priority areas and site-specific measures for effective soil management. Here, a new concept for developing an erosion prediction tool (Predict-Er) is presented, and the field/laboratory analyses as input for tool development are discussed. The Predict-Er brings a novel approach that combines nuclear, analytical, statistical, and remote sensing techniques to produce high-resolution field data, which will be modeled and integrated within a multilayer web GIS Predict-Er tool to enable predicting changes in soil erosion rates and sediment dynamics over various management scenarios. It aims to predict soil erosion rates and sediment yield by simulating the effects of land use/cover changes, precipitation, land management, and conservation measures. Sediment fingerprinting, integrated with other methods, is envisaged to furnish data for directing interventions in sediment management. Thus, the Predict-Er Tool facilitates decision-making processes for stakeholders aiming to implement informed conservation measures to mitigate the dual impacts of on-site and off-site consequences of soil erosion. The tool developed on representative study catchment in Serbia will be validated in Spain's catchment of different physiographic and geological characteristics and then thoroughly and continuously tested in other catchments. The Predict-Er approach enhances understanding of the complex interactions among the soil erosion drivers. It contributes to achieving sustainable development objectives, particularly aligned with the United Nations Sustainable Development Goal (SDG) targets related to responsible land use and environmental conservation.

Acknowledgment

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Keywords: Remote sensing,Sediment souce fingerprinting,Soil,Sustainable soil management

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

SATELLITE-BASED SOIL SALINITY PREDICTION USING MACHINE LEARNING IN SOUTHERN TAIWAN

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Soil salinity is a widespread environmental concern, which negatively affects plant growth, soil microbiological processes, crop yields, and the quantity of land utilized for agriculture. Impacts of climate change, including sea-level rise and prolonged drought, are predicted to exacerbate this problem and possibly spread it to presently unaffected regions in the near future, impeding agricultural sustainability. Increasing salinization poses real challenges for food security and the world's food supply system. This is also a phenomenon in Taiwan, where soil salinity is widely recognized as a primary cause of land degradation, and has a significant impact on agricultural productivity. Thus, information on soil salinity from spatiotemporal perspectives is crucial for policymakers to develop effective crop management and agricultural planning strategies. The objective of this study is to develop random forest-based models for soil salinity prediction in both space and time using long-historical in-situ observations (electrical conductivity of topsoils) and archives of Landsat satellite imageries and digital elevation model (DEM) acquired during the dry season (November to April). Specifically, the data from 2014 to 2017 were used for establishing models, leaving the 2018 data for model validation. The comparison results between predicted soil salinity results and field observations showed a good correlation between these two datasets with a correlation coefficient of 0.6. This study ultimately led to the potential application of remotely sensed data for predicting soil salinity with machine learning techniques in southern Taiwan. Such methods, providing reliable quantitative information on regional soil salinity, could be transferable to other regions worldwide for soil salinity monitoring.

Keywords: Soil salinity,Land degradation,Satellite-based monitoring,Machine learning,Spatiotemporal distribution

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

INFLUENCE OF SOIL EROSION CONTROL AGRO-TECHNOLOGIES UNDER WHEAT AND MAIZE ROTATION ON SUBSOIL COMPACTION OF MODERATELY ERODED EPICALCIC CHERNOZEM

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The main limiting factors for the fertility of arable Epicalcic Chernozems on sloped terrains in North Bulgaria are soil water erosion, subsoil compaction and crust formation due to soil structure deterioration. The effects of three agro-technologies were investigated on adjacent plots with cultivation of winter wheat and maize in rotation on moderately eroded silt loam Epicalcic Chernozem in Trastenik, Ruse district. The studied variants were: up-and-down slope traditional tillage (T0), contour traditional tillage (T1) and crop specific erosion control contour tillage (T2), which included minimum tillage, direct sowing and use of cover crop after wheat harvest, incorporated in the soil as green manure before maize sowing. The aim of the current study was to evaluate the influence of the applied agro-technologies on the subsoil compaction during the whole experiment. The soil sampling was performed in April and October each year. The soil compaction was assessed by data for bulk density (Db), total porosity (Pt) and soil aeration capacity (AC) while deterioration of soil structure was assessed by water stability of soil aggregates. All studied parameters exhibited seasonal variation due to the influence of the applied tillage, crop development, and soil moisture. Db in the upper 0-5 cm layer did not differ among the variants and was 1.31±0.1 g cm-3 in average for the whole period. The subsoil (15-20 cm) compaction was significantly higher (by 6%) in T0 (1.57±0.08 g cm-3) than in T1 and T2 (1.48 ±0.11 g cm-3). Correspondingly the opposite tendency was observed in Pt and AC. Limiting aeration conditions (AC<10%vol.) in subsoil occurred in 92% of the cases, while in T1 and T2 these were 64% and 57%, correspondingly. The compaction in T0 reached 40 cm depth while in T1 and T2 it was manifested till 20-25 cm depth.

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Keywords: subsoil compaction,soil water erosion,water stability of aggregates,tillage,crop rotation

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

WIDESPREAD SHALLOW LANDSLIDES OCCURRENCE IN THE AFTERMATH OF THE MAY 2023 EMILIA ROMAGNA (ITALY) RAINSTORMS: A RAPID MAPPING APPROACH BASED ON SENTINEL-2 IMAGES

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Rainfall, earthquake or fast snowmelt can trigger shallow landslides that significantly affect vast areas. Their sudden occurrence poses a substantial hazard, causing damage to population and infrastructures as well as economic losses. Nowadays, the accessibility to spaceborne optical sensors with medium resolution images, available immediately and free of charge, provides opportunities for a prompt mapping of shallow landslides resulting from extreme events. This study introduces a semi-automatic methodology to rapidly detect potential landslides based on the Normalized Difference Vegetation Index variation (NDVIvar) between the pre- and post- event Sentinel-2 images. The methodology consists of a GIS-based user-friendly approach that utilizes the NDVIvar coupled with geomorphological filters. During an emergency, the urgent efforts for mapping bring some limitations, such as the unavoidable use of partially cloud-covered images. A cloud filtering script developed in Google Earth Engine was also integrated to minimise the possible false positives. This innovative procedure was applied to the emergency context of the May 2023 extreme rainfalls that affected the Emilia Romagna Region. Despite the partial cloud coverage (8%), in only 5 days after acquiring Sentinel-2 post-event imagery, we generated a reliable and ready-to-use map encompassing an extensive area of approximately 4000 km^2. The density of the potential landslides is correlated with the rainfall distribution, revealing that the most affected areas showed a density of approximately 50 landslides/km^2. In an emergency stage, the limited availability of high-resolution images limited the validation of the obtained results. Despite the limited time frame, early data from web-channels, online newspapers, and a post-event field survey revealed partial positive feedback, showing a great match between the potential landslides identified and the ground truth. The results show that the proposed method is an efficient and prompt tool for emergency operations, allowing the rapid recognition and mapping of the ground effects distribution and identification of the most affected areas, representing a practical help to plan risk management activities and emergency priorities.

Keywords: Spaceborne optical imagery,Change detection,GIS-environment,Extreme event,Residual risk

ID ABS WEB: 137963

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

IMPACT OF WATER EROSION ON THE FATE OF SOIL ORGANIC CARBON IN A MEDITERRANEAN CULTIVATED CATCHMENT

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Soil erosion processes have a major impact on the fate of soil organic carbon (SOC) and on CO2 emissions to the atmosphere. There is intense debate in the scientific community on the overall impact of erosion on soil carbon storage, as two antagonistic mechanisms are implicated: i) the mobilization and lateral transport of organic carbon, potentially responsible for organic carbon destocking, and ii) the burial of organic carbon in deposition zones, potentially responsible for organic carbon storage. This work aimed to analyze the impact of water erosion processes on the redistribution and evolution of organic carbon biodegradability in a cultivated catchment in a Mediterranean context (Kamech, Cap Bon-OMERE, 2.63 km^2). In this work, we report and discuss the SOC content and biodegradability measured on i) horizons from 11 soil profiles and additional topsoil samples to represent the diversity of soil types present in the catchment, ii) suspended sediments sampled during sixteen floods at three points in the hydrographic network, according to a nesting of scales, iii) several cores taken from sediments trapped in the hillslope reservoir located at the catchment outlet. The results highlighted the low impact of water erosion processes on organic carbon levels, both a low enrichment rate during the selectivity process and negligible transport-induced degradation due to the short distances and transfer times between sources and outlet. The analysis of SOC biodegradability along the source-transport-deposit continuum showed a significant increase of SOC biodegradability in sediments trapped in the reservoir, which could be explained by the production of highly biodegradable lacustrine organic carbon.

Keywords: Soil water erosion,Soil organic carbon,Carbon fate,Cultivated catchment,Mediterranean context

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

EFFECTS OF THE 2021 SIERRA BERMEJA FIRE ON THE SOIL (SOUTHERN SPAIN)

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Since the Pliocene, Mediterranean ecosystems have been susceptible to forest fires and have been evolving with the incessant activity of this natural ecological factor. Thus, the aim of this work is to evaluate the effects produced on soils by the forest fire in Sierra Bermeja (Malaga province), in order to demonstrate how the regeneration and recovery of this environment, key in the management of its territory, is being carried out. The fire affected a serpentine environment where one of the most important fires of the last decades in the province took place, with 8,401 hectares burned. For this purpose, applied spatial remote sensing techniques, field and laboratory work, and an exhaustive search for statistical information related to the main eco-geomorphological characteristics of the burned area have been used. The results show that approximately 57.6% of Sierra Bermeja was affected by this fire, with moderate-high and high degrees of severity in most of the burned area. It should also be noted that the fire has caused significant changes in certain edaphological properties of the soils sampled. In addition, a number of areas with serious soil erosion problems have been identified.

Keywords: forest fire,RUSLE,Sierra Bermeja,Soil

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6. Soil in the digital era
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MODELING MULTIPLE SOIL EROSION PROCESSES AT PAN-EUROPEAN AND GLOBAL SCALE

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Healthy soil is essential for agriculture and ecosystem functioning. Changes in soil quality have an impact on the delivery of critical ecosystem services such as food production, water supply, and regulation. Soil erosion is notoriously ephemeral because it is dependent on the nexus of vulnerable soil, weather, and antecedent moisture levels; particularly the occurrence of climate extremes, such as big strong rainfall episodes or droughts with wind. When the right mix of events occurs, positive feedbacks can lead to erosion striking with disastrous environmental and socio-economic consequences. A situation that makes it important to better identify locations where multiple concurrent soil erosion processes may occur.

In this presentation we discuss (i) the geography of soil loss by water, wind, tillage, and crop harvesting erosion; (ii) their possible co-occurrence at EU (Borrelli et al., 2023a) and globally scale (Borrelli et al., 2023b); and (iii) how to better integrate research on soil erosion to improve modeling performances and to support decision-makers in both ex-ante and ex-post policy evaluation.

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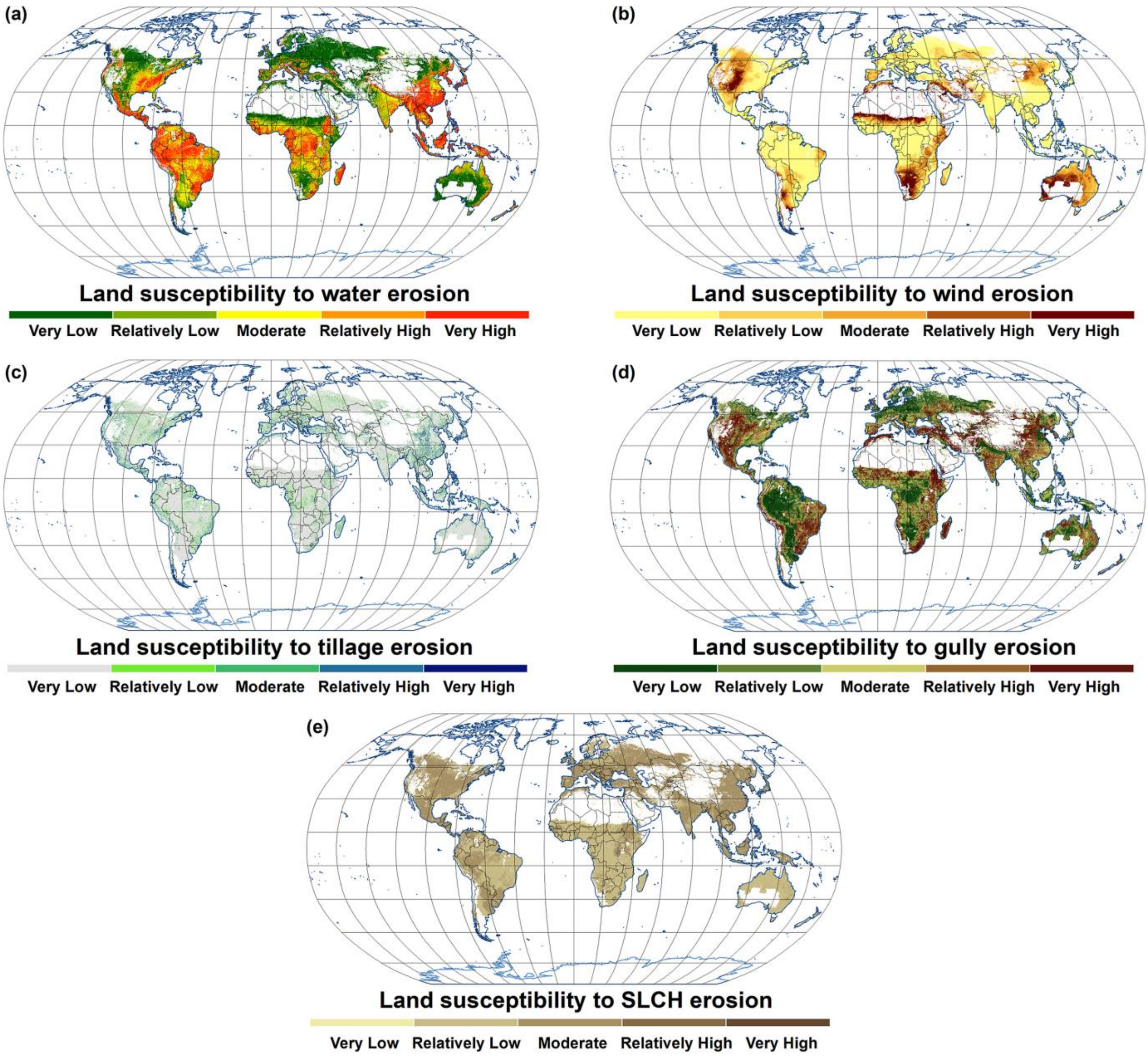

Keywords: Mitigation,European Union,CAP 2023-27,Green deal,erosion

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

COMPARING SOIL LOSS IN DIFFERENT BRAZILIAN BIOMES: APPLYING THE RUSLE MODEL FOR LARGE AREAS

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Soil water erosion is an inherent process in natural ecosystems, but human activities can dramatically increase this processes, causing several environmental and socio-economic issues. Several models have been developed to estimate soil loss due to erosion. One of the most widely used is the revised universal soil loss equation (RUSLE), an empirical model originally developed in US for agricultural soils and now applied worldwide. However, the implementation of Geographic Information Systems (GIS) and remote sensing (RS) tools has made it possible to apply RUSLE calculations to large areas with increasingly high spatio-temporal resolution. Brazil, the largest country in South America and the 5th in the world, is a global agricultural producer for several commodities exported worldwide. The northeastern and southeastern macro-regions were originally covered by different biomes such as tropical forests, savannas, and semi-arid shrublands. Over the past, these regions have undergone several land-use changes and urbanization processes. The aim of this research is to build an empirical RUSLE model for these regions, using open-source RS and GIS data. RUSLE consists of five multiplicative factors. The (R) factor was obtained from the modified Fournier index. The soil erodibility (K) factor was taken directly from the Brazilian map of soil erodibility. Remote sensing data were used to calculate slope length/steepness (LS) and the land cover (C) factors. The LS factor was obtained from the digital elevation model using the GTOPO30 program, while a 10-year record of NDVI available from MODIS data was the source for estimating the C-factor. According to the literature, the (P) factor was set to 1 due to its unpredictability over natural ecosystems and anthropized landscapes. The RUSLE model calculated from GIS and RS data will be useful for decision-making processes in soil management, land planning and environmental conservation contexts of a large region with diverse biomes such as the Brazil's Northeast and Southeast macro-regions.

Keywords: Soil conservation,Land use management,Tropical ecosystems,Empirical modelling,Soil loss equation

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

MODELING DYNAMICS OF SOIL EROSION BY WATER DUE TO CLIMATE AND SOIL ORGANIC MATTER CHANGES (1980 - 2020) IN THE SOUTHEAST OF THE EAST EUROPEAN PLAIN

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This research aims to evaluate the dynamics of soil loss through soil erosion by water in agricultural lands in steppe areas using a modification of the RUSLE2 model from the 1980s to the 2010s. The calculation was performed using a raster model of data that included a model of the slope angle, slope length, soil erodibility, rainfall and snowmelt erosivity factors, types of land use, and cover management factor. All data were taken from open sources. The average soil erosion in the territory studied amounted to 1.48 t ha year in the 1980s and 1.72 t ha year in the 2010s. The discrepancy with other studies was 12% for the level of the 1980s and 2–7% for the level of the 2010s. The main factor leading to an increase in soil loss was soil erodibility due to the loss of soil organic matter, which affected about 52% of the studied lands. The increase in the amount of soil loss occurred against a background of compensating processes: a reduction in precipitation and climate change (getting drier), as well as the overgrowth of agricultural lands with natural steppe vegetation. The modified model RUSLE2 has shown good results correlated with other studies for the research area.

Keywords: Soil Erosion By Water,Climate Change,Aridification,Spatial Modelling,East European Plain

ID ABS WEB: 138071

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

NEW APPROACHES TO ADDRESSING EROSION CONTROL IN AGRICULTURAL PRACTICE

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In the conditions of Central Europe, the soil is threatened mainly by water and wind erosion, compaction, acidification, contamination, loss of organic matter and reduction of its quality and its occupation. According to current findings, water erosion is the most extensive cause of soil degradation worldwide. In the Czech Republic, more than 60 % of agricultural land is potentially threatened by water erosion and more than 30 % by wind erosion. This is linked both to large blocks of land and intensification of agriculture and to changes in cropping preferences and the decline in livestock production. There are also significant changes in rainfall distribution, probably linked to ongoing climate change, leading to changes in the duration, frequency and magnitude of rainfall. New legislation and changes in GAEC conditions reflect the need for increased soil erosion protection. The assessment of erosion vulnerability is standardly carried out using the USLE method - the Universal Soil Loss Equation for Erosion (Wishmeier and Smith, 1978), which is the recommended method for calculating average long-term soil loss (G) in the Czech Republic and abroad. In terms of implementation of erosion control measures set according to GAEC requirements in LPIS, a new procedure has been developed for farmers to adjust cropping patterns and agronomic practices within the limits of allowable soil loss in a simple way.

The study was supported by research projects No RO 0223, QK 201010328, QK 21010191, SS 05010211 and SS 06010290.

Keywords: soil erosion,climatic change,soil conseration measures,GAEC

ID ABS WEB: 138155

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

HYDRODYNAMIC CHARACTERISTICS OF SNOWMELT RUNOFF

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Snowmelt erosion is one of the main types of erosion in cold regions at high latitudes or high altitudes. Increasing global temperatures can exacerbate snowmelt erosion. Flow velocity and flow resistance is important parameters for snowmelt erosion process and hydrological simulation. The purpose of this study was to investigate hydrodynamic characteristics of snowmelt runoff. The experiments were conducted in the furrow of the Jiusan watershed, Nenjiang County, Heilongjiang Province, China. The flow discharge and flow velocity were observed on slopes ranging from 0.5° to 2° during the snowmelt period. A total of 109 events were obtained. The measured flow velocities varied from 0.07 to 0.71 m/s, and the flow discharge rates varied from 0.008 to 1.831 X 10-3 m3/s. The results show that the flow velocity during the snowmelt period was significantly correlated with the slope gradient at the significance level of 0.05. The flow velocity increased with flow discharge as a power function. The coefficients varied with slope gradient, which indicates slope gradient had effects on the relationship between flow velocity and discharge. The Darcy-Weisbach friction factor decreased with Reynolds number as a power function at all slope gradients. Manning's formula can be applied to calculate flow velocity for the snowmelt runoff. Both Manning's n and Darcy-Weisbach friction factor were not constants, decreased with flow depth when the flow depth was less than 2 cm, and tended to stabilize when the flow depth was more than 2 cm. Hopefully, these results can be helpful for hydrological and soil erosion simulations during the snowmelt period.

Keywords: Snowmelt erosion,Flow velocity,Darcy-Weisbach friction facto,Manning coefficient

ID ABS WEB: 138166

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

EVALUATION OF WEPP (WATER EROSION PREDICTION PROJECT) HILLSLOPE MODEL USING SURFACE RUNOFF AND EROSION DATA FROM A SOIL WITH VERTIC PROPERTIES UNDER DIFFERENT CROPPING SYSTEMS

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The Water Erosion Prediction Project (WEPP) model is a physically based computer simulation program used worldwide to simulate runoff and soil erosion, both at hillslope and watershed level. However, its applications in Mediterranean pedoclimatic environment are few.

The performance of the WEPP model in simulating runoff and soil erosion was evaluated using input data from experimental plots under different soil use and management systems. The model was tested using data from a study carried out in the nineties of the last century, aimed to quantify the effects of different soil uses on runoff volume and soil loss at plot scale. The plots (75 x 15m) were in the S. Elisabetta experimental farm (Vicarello, Volterra) of the CREA-AA. In this study four treatments were compared: 1) winter wheat (Triticum durum Desf.), 2) alfalfa (Medicago sativa L.) meadow, 3) agropastoral system with Sulla (Hedysarum coronarium L.) and grazing saltbush (Atriplex halymus L.), 4) 20-year-old Mediterranean maquis. The soil is a silty clay loam Vertic Xerochrept in which shrinking and swelling phenomena regulate the hydrological behaviour.

The simulation results before and after model calibration were compared to measured runoff and soil erosion values. Both the estimated runoff and soil loss showed poor predictive capacity of the uncalibrated model, as highlighted by negative values of the Nash-Sutcliffe efficiency index. The comparison between the amount of eroded soil simulated by the uncalibrated WEPP, and the measured one, highlights how in such a pedologic environment the model overestimates soil loss.

The improvement in the predictive performance of the model after calibration, evidenced by values of RRMSE index considered “good” and “fair” when related to the more protective land uses, seems to demonstrate a satisfactory reliability of WEPP in identifying management scenarios able to mitigate soil loss.

Future WEPP application efforts need in-depth assessment, and proper calibration and parametrization of soil erodibility factors to improve erosion prediction in environments characterized by soils with a similar hydrological behaviour.

Keywords: soil erosion,modelling,WEPP,cropping systems

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6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

EROSIVE PROCESSES IN TOPOSEQUENCES IN NORTHWESTERN PARANÁ, BRAZIL

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In Northwestern Paraná, Brazil, a significant interrelationship between pedological systems and susceptibility to erosive processes is observed. A detailed study was conducted to understand this interplay, focusing on two toposequences in the municipality of Tamboara, Paraná, mapping the toposequences of the soil samples collected. This region is characterized by Cretaceous volcanic outpourings of the Serra Geral Formation, overlaid by sedimentary rocks from the Caiuá Formation. The methodological approach was based on the Bi-dimensional Analysis model of Pedological Coverage proposed by Boulet et al. (1993) with geoprocessing techniques through ArcGIS. Toposequence I, named Tamboara, comprises Ferralsol (medium texture), Haplic Lixisol, Ferralic Arenosol, and Gleysol. The presence of Haplic Lixisol and Ferralic Arenosol, even in areas with gentle slopes, increases vulnerability to erosive processes. This is evidenced by rill and gully erosion observed along the slope, which is covered with cassava crops. Toposequence II, named Anhumai, extends along a slope in the Anhumaí river valley, with the pedological system composed of Ferralsol, abrupt Haplic Lixisol, and Lithic Leptosol. The study reveals that despite the morphological characteristics of the Tamboara Plateau's relief, marked by gentle slopes, there are zones highly susceptible to erosion due to the composition and evolution of pedological systems. Particularly, concave base slopes with Ferralic Arenosol contribute significantly to this vulnerability. In the more dissected Anhumai valley, moderate to steep slope segments, coupled with lithological changes contrasting sandstone and basalt, create layers with varying resistance to weathering. This also influences slope dynamics, contributing to the high vulnerability observed. The identified pedological system reflects greater complexity in the structure and composition of this type of slope.

Keywords: Pedological system,Toposequence,GIS,Erosion,Mapping

ID ABS WEB: 138763

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

FROM PIXELS TO PREDICTIONS: HARNESSING GIS AND REMOTE SENSING FOR SOIL EROSION ASSESSMENT IN THE UMNGENI BASIN, SOUTH AFRICA

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Soil erosion is a major issue that causes significant harm globally, leading to the loss of land that can be used for agriculture and the blocking of waterways. The uMngeni basin is particularly vulnerable to soil erosion due to heavy rains that eventually cause floods. One way to estimate soil erosion is through soil modelling approaches, which provide a quantitative and realistic spatial estimate of soil erosion. This study used the Revised Universal Soil Loss Equation (RUSLE) model along with remote sensing and GIS methodologies to evaluate soil erosion risk within the uMngeni basin. The aim was to identify areas that are prone to flooding and provide useful information for disaster management. Soil physical properties, rainfall data, land use/land cover maps, and terrain attributes were integrated into GIS software to identify zones that are susceptible to erosion. The study classified the basin into six severity classes based on soil loss rates (t/ha/year): Low (0-7), Moderate (8-15), High (16-25), Very High (26-45), Severe (46-60), and Very Severe (>60). The findings revealed that the lower plain of the basin experienced minimal soil loss, primarily below 7 t/ha/year. Conversely, higher elevations in the uMngeni basin exhibited higher erosion rates, primarily influenced by topographical factors, resulting in an exceedance of 60 t/ha/year of erosion. The pixel-level assessments using the RUSLE model showed a correlation between erosion-prone zones to historical flood regions. Notably, regions surrounding the uMngeni River valley exhibited severe erosion risks exceeding 45 t/ha/year, highlighting new flood-prone regions. Therefore, these findings can provide timely insight to inform disaster management agencies' policymakers in implementing targeted soil management and conservation strategies within the basin, thereby mitigating erosion risks and fostering sustainable land use practices to minimise floods as a result of human activities.

Keywords: Soil erosion,GIS & Remote sensing,Geospatial analysis

ID ABS WEB: 140120

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

IMMEDIATE AND LONG-TERM SOIL REDISTRIBUTION RESPONSES TO WHOLE-TREE HARVESTING IN THE HUBBARD BROOK EXPERIMENTAL FOREST, NH, US

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Accelerated soil erosion and deposition processes pose major threats to soil health and ecosystem services in forested landscapes, particularly following intensive practices such as whole-tree harvest. These disturbances drastically alter soil dynamics, leading to increased soil erosion and deposition rates, which subsequently affect soil properties and carbon storage. At the Hubbard Brook Experimental Forest (HBEF) in NH, US, a whole-tree harvest experiment was conducted from 1983-1985 in a small watershed to evaluate the long-term impacts of deforestation on the carbon budget, soil properties, cycling of nutrients, and vegetation regrowth. Our prior study at HBEF assessed the impact of whole-tree harvesting on soil redistribution rates using 239+240Pu isotopes in areas covered by tree harvest residues and uncovered. We found no erosion or deposition rates on sites located at the shoulder and upper backslope that were covered by tree harvest immediately after deforestation and concerning erosion and deposition rates at the uncovered mid backslope and toeslope sites, respectively. Those findings represent an average of approximately 60 years of redistribution processes, a timespan that covers Pu measurements. In this study, we investigate the immediate and enduring impacts of such practices within the HBEF by quantifying soil erosion and deposition rates in sites with residual harvest debris compared to those cleared immediately post-harvest. This study aims to discern the protective role of woody residue against soil erosion immediately following deforestation and to track the trajectory of erosion rates through a longitudinal study extending to 2022/23. By integrating re-sampling techniques and 239+240Pu isotope analysis, our findings seek to establish a clearer understanding of soil dynamics post-harvest and contribute to the development of forest management strategies that promote soil health and carbon sequestration.

Keywords: 239+240Pu,Soil erosion rates,Soil redistribution rates,Deforestation,Re-sampling approach

ID ABS WEB: 140669

6. Soil in the digital era
6.07 133441 - Soil Erosion and Land Degradation: methods, observations and perspectives

EROSION SUSCEPTIBILITY OF VINEYARD SOILS IN THE TOKAJ WINE REGION

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The Tokaj Wine Region is situated in Northeastern Hungary, consisting approximately 5500 hectares of vineyards. The majority of the plantations, especially for quality winemaking, are cultivated on steep slopes, and around 10% of the area, mainly around the Tokaj Hill, also lies on loess-based soils. In these sites risk of erosion is considerably high. Observing the last few decades, occurrence of heavy rainfalls and long dry periods are both getting more frequent. Although weed control is increasingly done by mechanical methods considering the harmful effects of herbicides on soil microbiome, opening the soil surface also induces erosion. Through several research projects in the Tokaj Research Institute for Viticulture in Enology, we examined erosion susceptibility of soils on different vineyard sites and its connection with shallow mechanical cultivation and soil water content, which led to the design of improved soil/cover crop management regimes against erosion. During the 2018 season, two sites with loess and another with volcanic base rock were compared using Eijkelkamp 09.06 rain simulator. As treatments, artificial moisturization and presence/absence of shallow cultivation were applied. According to our measurements, the frequently cultivated surface showed much higher soil loss during the simulated rainfall. Additionally, erosion susceptibility increased if the topsoil water content was near field capacity in the beginning of the simulated rain event. As an advice to growers, we formulated that frequent topsoil cultivation better be avoided during the vegetative season, especially in the case of steep sites and physically degraded soils with lower organic matter content. Furthermore, rationally executed cover crop cultivation could have beneficial effects such as protection against erosion and better structure, while competition for available water for grape plants is negligible.

Keywords: vineyard, erosion, Tokaj

ID ABS WEB: 136279

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

DIGITAL SOIL MAPPING FOR ENHANCED SOIL ORGANIC CARBON MANAGEMENT USING ORDINARY KRIGING AND SUPPORT VECTOR MACHINE APPROACHES

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Effective management of soil organic carbon (SOC) holds immense importance in fostering sustainable agriculture and combatting climate change. In the Neyshabur plain of northeastern Iran, the pressing issue of spatially varying critically low SOC levels prompted the development of management zones (MZs) tailored for site-specific SOC management. This study involved collecting soil samples (0-0.3 m) alongside geomorphometric variables derived from a digital elevation model at 288 locations. Significant correlations ($p < 0.05$) were established between SOC and key factors such as soil pH, clay content, available phosphorus, available potassium, and vertical distance to the channel network. Utilizing support vector machine (SVM) and ordinary kriging (OK) methods, the spatial variability of SOC and its associated pedo-geomorphometric variables were used to generate digital soil maps, facilitating the creation of MZs for targeted SOC management. While the R2 and RMSE of both OK and SVM models were comparable, more accurate MZs were derived from the SVM model, as indicated by the Fuzzy Performance Index (FPI = 0.091) and Normalized Classification Entropy (NCE = 0.113) compared to OK (FPI = 0.135, NCE = 0.164). The study revealed the potential of both approaches for site-specific SOC management, yet a significant average difference of 0.8 g kg-1 SOC between SVM and OK ($p < 0.05$) was observed, particularly along transitional MZ boundaries. Consequently, the SVM-based MZs stand out, offering enhanced accuracy for precise application of organic amendments, mineral fertilizers, and management practices. These findings provide a robust framework for improving carbon sequestration and mitigating chemical contaminants in the Neyshabur plain of Iran.

Keywords: Digital Soil Mapping,Soil Organic Carbon,Management Zones,Odinary Kriging,Support Vector Machine

ID ABS WEB: 136316

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

INFLUENCE OF THE SAMPLING DESIGN IN THE SOC STOCK ESTIMATION: ACCURACY AND UNCERTAINTY IN SOIL MAPPING

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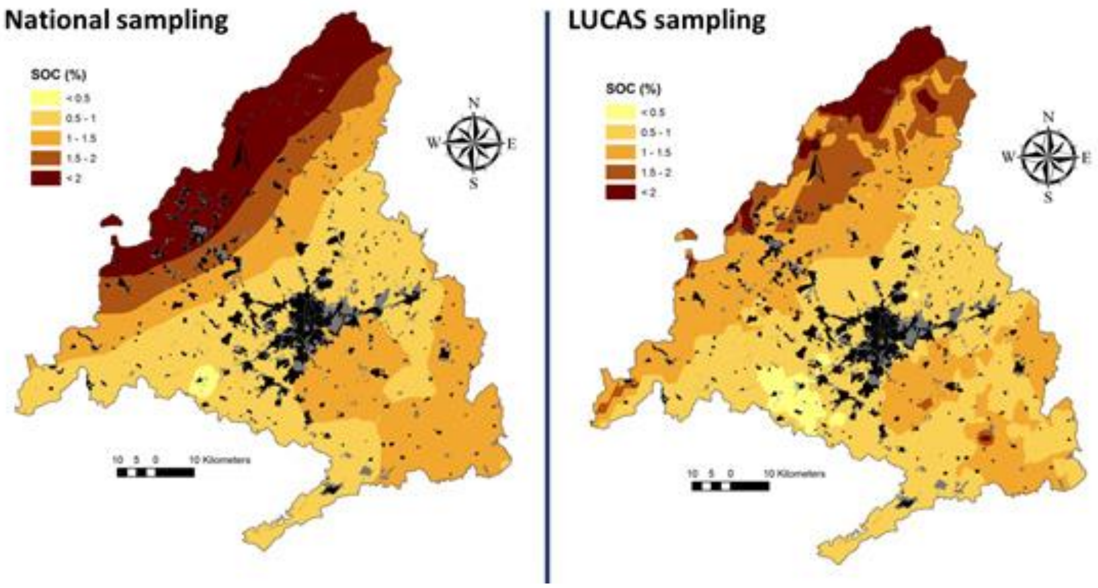
Soil organic carbon stock (SOCS) assessments are essential in the climate change mitigation role to adopt practices focused on increasing the carbon content in soils. However, this depends on the information that we have processed. While the variability in laboratory analysis methods in the determination of organic carbon are well defined, the variability in field sampling is often not known. The present study analysed the spatial distribution of SOCS and evaluated two soil sampling protocols in field. We sampled all Lucas points in the autonomous community of Madrid (Spain) and including sampling in the national network close to the Lucas locations using both sampling protocols (National and LUCAS). A total of 121 sampling plots and 242 soil analysis samples were performed. The carbon content evaluated in soil is higher in the national sampling protocol (mean 1.165%) than in the field protocol used in Lucas (mean 1.051%). were utilized to determine significant effect on sampling design (Lucas and Spanish National protocol) and no statistically significant differences were found between both sampling designs. However, ANOVA analysis ignore the spatial component. The information obtained from the Spanish national design presents a greater spatial correlation. This is possibly motivated because in the Spanish sampling were collected 21 subsamples from each plot in a surface area of 2500 m2 versus 5 subsamples in an area of 16 m2 in the Lucas field protocol. The prediction standard errors quantified the degree of uncertainty for each location on the surface. The standard errors map showed lower errors in the uncertainty kriging maps obtained with the Spanish national sampling protocol. As synthesis, the way of taking field samples, the number of subsamples, the surface sampled and the sampling depth are very important factors that must be taken into account in the determination and analysis of carbon maps.
Acknowledgment: EJP Soil project (STEROPES and CARBOSEC) and MAPA (CC22-211).



Keywords: Soil organic carbon,sampling protocols,geostatistical analysis,uncertainty kriging maps

ID ABS WEB: 136336

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

EXAMPLES OF USE OF GIPS FOR THE STUDY AND MANAGEMENT OF SOILS

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Geographic Information Systems Programs (GISP) are systems that use technology to combine the knowledge of experts and those who have experience, in a project, work or study. This technology makes it possible to manage, evaluate and visualize a large amount of information with spatial dimension, which help to better understand the various variables that affect the decisions that must be made. GISPs present some drawbacks that have motivated research on such systems to improve performance, often related to online tools.
GISP have important applications for the study of soils and the production of maps in both the cartographic and agricultural fields. Thus, they allow to generate thematic maps that represent classes of crops, types of cultivated soil, information on irrigation or climatic aspects. The ability to overlay different layers provides the capacity to combine different maps and address more complex problems by combining more information into a single map.
This work presents examples of soil maps made with ArcGIS® (licenced by University of Castilla-La Mancha) in several areas of Castilla-La Mancha (Spain). The variety in the type of maps and parameters represented (types of soils, distribution of major and trace elements, general soil properties, moisture retention properties, etc.) allows to approach the potential of this type of instruments to communicate scientific information effectively and simply.

Keywords: GIPS,SOIL MAPS,MANAGEMENTS SOIL

EPOSTERS

ID ABS WEB: 137142

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

ASSESSMENT OF SOIL ORGANIC CARBON FOLLOWING WILDFIRES IN NORTHERN EVIA, GREECE: A DIGITAL SOIL MAPPING APPROACH

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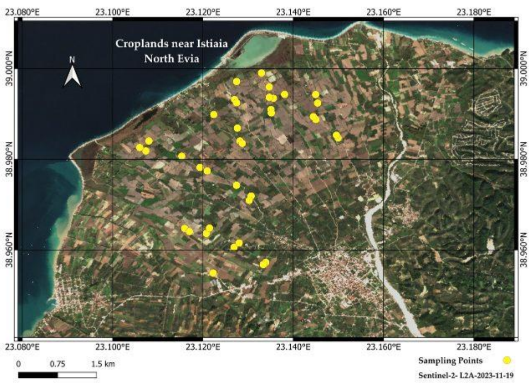
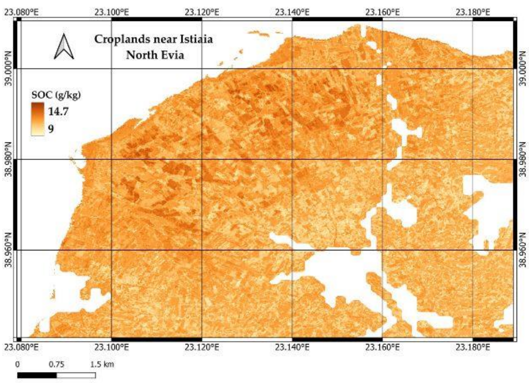
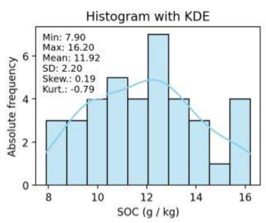
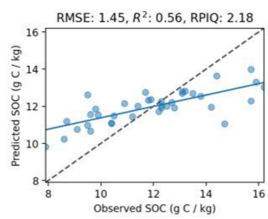
This study delves into the aftermath of a wildfire incident in August 2021, exploring its impact on soil characteristics, with a specific focus on soil organic carbon (SOC) within the diverse terrain of Northern Evia, Greece. Utilizing open Copernicus data and specifically data from the Sentinel-2 constellation, the European Digital Elevation Model (DEM), we executed a digital soil mapping analysis spanning agricultural fields affected by wildfire. The study area encompasses an area of 28 square kilometers with 45% of the crops being olive groves, 16% various grains, 10% animal feed, 10% are fallows, 4% other tree crops (e.g., nuts, figs, etc.), and rest are mostly horticulture. This area was adjacent to a mountainous terrain covered with forests that was burned down in the experienced wildfires; our goal was to map the SOC of these croplands after the wet deposition of post-fire residues. Sampling was performed by examining bare soil reflectance composites and performing clustering for the seasonal crops, while random sampling was conducted for perennial crops. We collected 40 soil samples and subsequently analyzed them in the laboratory to quantify SOC levels. To generate the map representing the conditions post-wildfire, the Random Forest (RF) learning algorithm was employed using leave-one-out cross-validation to infer SOC from Sentinel-2 and DEM data, and we masked the image using the scene classification layer of Sentinel-2 and the 2018 CORINE Land Cover data. RF attained an accuracy of estimation of RMSE 1.45 g C / kg, R2 of 0.56 and RPIQ of 2.18. Through the amalgamation of satellite-based assessments and laboratory-validated soil measurements, our research offers a comprehensive overview of the alterations in SOC distribution following the wildfire event. The detailed mapping conducted after the wildfire stands as a crucial contribution to understanding the spatial and temporal variations in soil properties and erosion susceptibility within the wildfire-affected region of Northern Evia, Greece.









Keywords: Digital Soil Mapping,Soil Organic Carbon,Copernicus,Aritificial Intelligence,Post-wildfire

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6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

NL4DL WEB TOOL: DECISION SUPPORT TOOL TO SUPPORT RESTORATION ACTIVITIES IN DEGRADED LANDS

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Processes related to land degradation have significantly increased in the last few decades which is likely to further increase if no actions are taken. The need for adopting practices to mitigate and restore degraded lands have been emphasized by the new Soil Strategy. To guide actions through a consolidated framework, a cost and time efficient approach is needed. Six pilot sites in southern Europe, selected within the NewLife4Drylands (NL4DL) project were examined, by both available field data and satellite-acquired data, for monitoring degradation and ongoing restoration activities to be improved and transferred to similar degraded sites. As part of the project, a web-based tool and a restoration protocol have been proposed with the aim of providing a reference procedure for specific degradation processes to monitor restoration activities based on nature-based solutions. This decision support tool considers various factors such as degradation processes, remotely sensed and physical indicators, and commonly used nature-based solutions. Connections between these variables, which form the basis of the logical-relational map of the tool, have been initially collected among the internal knowledge of the project and can be further developed and detailed using a larger sample of experts on the topics of different related disciplines such as soil and environmental sciences. The decision-making tool provides a workflow to guide the end-users in the field of environmental management and planning, through the identification of processes leading to land degradation, the selection of monitoring indicators viable and the most suitable nature-based solution for that particular process. The tool will be used as an input for an action protocol at local and regional scale for environmental management and planning. This kind of semantic and logic model can be used to generate a range of possible monitoring approaches, evaluating their potential effectiveness, exploiting the connections with other existing web tools for the on-the-fly calculation of remote sensing indicators and with any dedicated tool aiming to predict the impact of restoration activities.

Keywords: Land Degradation,Decision Support System,Restoration Activities,Web Tool,Soil Monitoring

ID ABS WEB: 137899

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

PRELIMINARY ASSESSMENT OF A DECISION SUPPORT TOOL FOR OPTIMIZING IRRIGATION WATER USE IN SPAIN: THE FUTURE OF FARMING LIFE PROJECT

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European agriculture is becoming increasingly dependent on irrigation as a result of climate change and agricultural intensification. At the same time, the availability of irrigation water is limited or decreasing because of recurrent droughts, while increasing reliance on non-conventional water resources poses additional pressure on agricultural productivity (e.g. soil salinity). The Future of Farming LIFE project addresses this issue by demonstrating the benefits of data-driven precision agriculture technologies and promotes their use to achieve a more intelligent water use at the field or farm scale. During 2023 the technology was deployed and tested in 30 farms in two agricultural areas in Spain in a wide range of crops. The technology consists of a field- and weather data-driven soil water and crop model that predicts soil water content throughout the growing season. Irrigation recommendations are delivered to the farmers through a mobile phone application. Self-contained sensors that monitor soil water content, bulk electrical conductivity and temperature at depths of 0.15 and 0.30 m were installed at each field and reported automatically to a central server. An analysis of the measured data and the delivered irrigation recommendations is provided and linked with agricultural management-related information and crop yield. Results show that country-specific connectivity adaptations are needed for rolling out precision farming technologies in the EU, while the implementation of the irrigation recommendations by farmers is dependent on crop type, water availability and mandatory regulations (e.g. nitrate vulnerable areas).

Keywords: irrigation,soil moisture,decision support,crop model,IoT technology

ID ABS WEB: 138027

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

DIGITAL MAPPING OF SOIL QUALITY FOR AGRICULTURAL PURPOSES IN ROMANIA

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The Romanian methodology of soil quality assessment for agricultural purposes comprises 17 factors, of which 2 are climate factors (mean annual temperatures, corrected to account for slope and aspect influences; mean annual precipitations, corrected to account for slope and soil permeability influences), 4 are terrain factors (slope, landslides, flooding, surface moisture excess) and 11 are soil factors (gleyic, stagnic properties, salinization / alkalization, texture, pollution, groundwater level, porosity, calcium carbonate content, pH, edaphic volume, humus reserve). Each factor is assigned a suitability score, ranging from 0 to 1, which varies according to the specific crops, then the scores are multiplied to obtain the soil quality index, ranging from 0 to 100. Our study performs for the first time an accurate digital mapping of the suitability factors and the resulting soil quality index for the entire Romanian territory, using recent climate data (1990-2019). The CHELSA database was used to derive the climate factors, and the 25 m EU-DEM to derive terrain slope and aspect. We further used the European LUCAS soil database to derive soil humus reserve, $CaCO_3$ content, pH, and the spatial distribution of wells water depth to interpolate the groundwater level. The other soil properties were inferred based on the digital soil map of Romania in vector format. Finally, we integrated the suitability factors and achieved the soil quality index map of Romania for the main crops. Because the multiplication procedure used to achieve the soil quality index has some limitations, we also tested other methods of factors' aggregation. All the data achieved in our study constitute a GIS database which will be made available to soil surveyors and other interested researchers and institutions, to assist them in making more accurate evaluations of agricultural land.
Acknowledgements. This research has benefitted from the support of the PN-III-P4-PCE-2021-1350 project, funded by the UEFISCDI program, Romania.

Keywords: soil quality,digital mapping,agriculture,Romania

ID ABS WEB: 139707

6. Soil in the digital era
6.08 133592 - Digital Soil Mapping, Decision Support Tools and Soil Monitoring Systems in the EU

MAPPING SOIL HEALTH AT REGIONAL SCALE: DISENTANGLING DRIVERS AND PREDICTING SPATIAL LAND USE EFFECTS

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Soil health (SH) is inherently dynamic, and its cross-scale and temporal variability presents challenges to understanding its drivers. We applied digital soil mapping (DSM) techniques to integrate SH observations with remotely-sensed data, representing the main soil forming factors and short and mid-term cropping and management, using machine learning (ML) models for regions in New York State. Four soil biological (soil organic matter, POXC, protein, and respiration) and two physical (water aggregate stability and available water capacity) soil indicators as well as a composite SH index were evaluated to 1) analyze relationships among climate, inherent soil properties, and land use to SH indicators across NY State and regions within; 2) develop data-driven models for predicting and mapping SH indicators at regional scale; and 3) use the generated models to estimate impacts from hypothetical regional land use change scenarios. The approach proved to be an effective strategy for modeling SH indicators (average R2=0.58). Disentangling the role of land use types and crop management on SH indicators explained, on average, 42% of SH variation and showed, among others, positive effects of perennial forage crops and biomass production and adverse effects of intensive vegetable production, which highlight the important role of biomass production and recycling. Modeled hypothetical land use changes at regional scale showed potential SH benefits from alternative cropping systems. Overall, geospatial application of ML models to mapping SH provides insights into its drivers, and can support management policies and interventions to improve SH.

Keywords: soil health,digital soil mapping,soil biology,soil physics

ID ABS WEB: 137150

6. Soil in the digital era
6.09 133601 - Soil information standards and systems – current initiatives and advances

GLOSIS WEB ONTOLOGY: CURRENT STATUS AND FUTURE DEVELOPMENTS

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The Global Soil Information System (GloSIS) web ontology is the latest milestone in a decade old effort towards a global soil data exchange mechanism. Following on initiatives such as the Australia-New Zealand Soil model, the ISO-28258 soil quality model, INSPIRE Soil Theme and the OGC Soil Interoperability Experiment, this web ontology proposes an operational approach to data exchange. Leveraging the W3C specifications for the Semantic Web, OGC geospatial standards and implementing the ISO domain model, GloSIS includes code-lists of soil properties, soil description vocabularies and analytical procedures. It re-uses important standards, like the SOSA, GeoSPARQL, QUDT and SKOS web ontologies, and links to existing vocabularies: DBPedia, International Chemical Number (InChi) and PubChem. The ontology uses persistent and resolvable identifiers, ensuring sustainability over time. GloSIS codelists terms are resolving to their human and machine-readable definitions in the OGC rainbow server. With its Semantic Web approach, the GloSIS web ontology fulfils the ambition for a federated system as initiated by the GlobalSoilMap and later laid out by the Global Soil Partnership in its Action Plans (Pillars 4 and 5).

A broader trend is emerging towards the adoption of the Semantic Web, making GloSIS an important component in the exchange of environmental and sensed data. The OGC now aims to publish all domain models supporting its standards as web ontologies. The JSON-FG and Agriculture Information Model specifications are precursors in this regard. Also of note is its joint work with the W3C to align SOSA with the novel Observations, Measurements and Samples (OMS) standard. This alignment opens the path for the automated generation of APIs compliant with the SensorThings API standard from knowledge graphs.

This communication reviews the GloSIS web ontology and provides future steps towards its adoption and integration with emerging technologies. GloSIS has been developed, tested and used within several European research projects. The SoilWise project is currently evaluating its fitness for the repository of the European Soil Observatory platform.

Keywords: GloSIS,Web Ontology,Linked Data,Semantic Web,Data exchange

ID ABS WEB: 137902

6. Soil in the digital era
6.09 133601 - Soil information standards and systems – current initiatives and advances

ENABLING THE EFFECTIVE EXCHANGE OF INSPIRE-COMPLIANT SOIL DATA THROUGH THE EJP SOIL IMPLEMENTATION OF THE INSPIRE GOOD PRACTICE ON GEOPACKAGE ENCODING.

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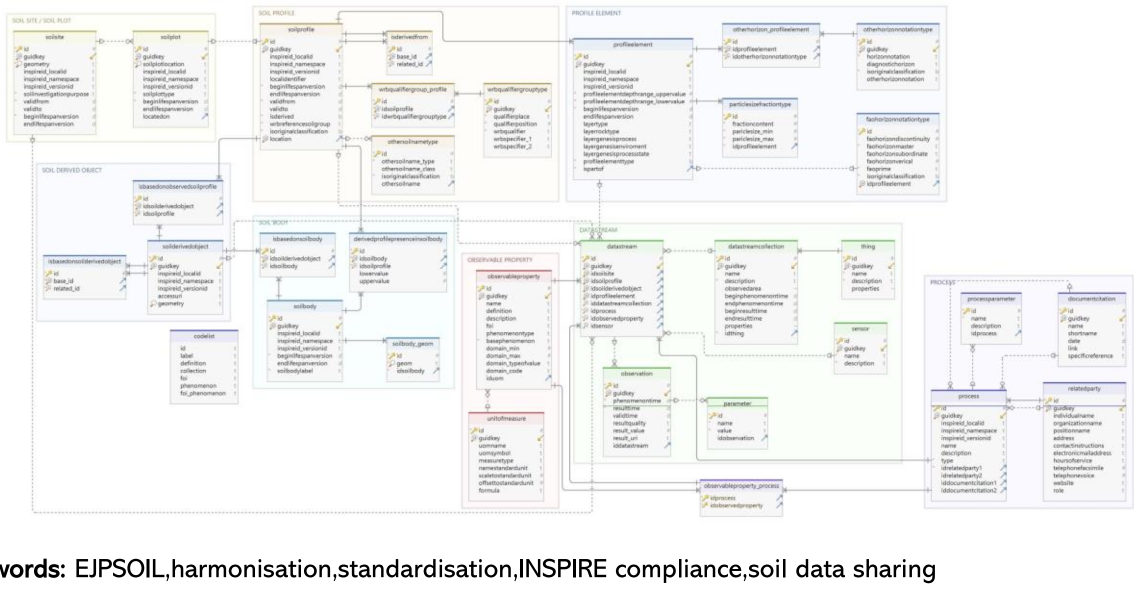
Under the H2020 European Joint Research Programme EJPSOIL (https://ejpsoil.eu/), the working package 6 aimed at supporting harmonised soil information and reporting. A so called “Software framework for a shared agricultural soil information system”, deliverable EJP SOIL_D6.4, was produced aimed at enabling transcoding and streamlining of interoperable and harmonised national agricultural soil data into ESDAC (https://esdac.jrc.ec.europa.eu/), as foreseen in the Grant Agreement, and by general terms enabling INSPIRE compliant soil data sharing. The EJPSOIL_D6.4 builds on the solid foundations of the INSPIRE Directive, taking advantage of the latest developments in the process of modernisation and simplification of its technical requirements in the wider context of the European Strategy for data and the Green Deal Data Space. Key components of the EJPSOIL_D6.4 are a streamlined soil database in GeoPackage encoding format, optimized in view of data compliance to INSPIRE; a data transformation and harmonisation processes; a semantic harmonisation and code list management procedures and tools. The GeoPackage is an SQLite database container that can store both vector and raster data as well as non-spatial data, is a portable, lightweight, and widely compatible across environments, especially efficient where connectivity and bandwidth are limited, and has the advantage to be portable, and can be used directly into GIS applications, such as QGIS. Since November 2022, with the official endorsement of a related INSPIRE Good Practice, the GeoPackage can be used as an alternative (to GML) encoding for the delivery of INSPIRE datasets. In accordance with the INSPIRE Good Practice for the “GeoPackage encoding of INSPIRE datasets”, a logical model for the GeoPackage encoding of Soil data has been developed, starting from the INSPIRE conceptual model and with reference to the classes implemented in the EJPSOIL_D6.4. The model will be made available to the wider INSPIRE community via the INSPIRE Helpdesk and will effectively become a template for those INSPIRE implementers who choose to deliver INSPIRE soil data using the geopackage format.



Keywords: EJPSOIL,harmonisation,standardisation,INSPIRE compliance,soil data sharing

ID ABS WEB: 136305

6. Soil in the digital era
6.10 133734 - The Role of Soil in Earth System Science: Data Availability, Interoperability and Critical Knowledge Gaps

IMPACT OF WILDFIRES ON METAL DYNAMICS IN NEW CALEDONIAN WETLANDS: WHAT CAN BE LEARNED FROM NICKEL AND SULFUR ISOTOPES?

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More than 30% of the continental surface area is affected by wildfires. Fires are strongly influenced by natural climatic phenomena such as El-Niño episodes and are increasing in response to the current climate change. Fires represent a real threat to the functioning of soils and the quality of water resources, as they can promote the mobility of trace metal elements and disrupt the biogeochemical cycle of sulfur in wetlands.
A drinking water catchment (DWC) in the Ile des Pins, South of the New Caledonia archipelago, has been studied after it experienced Ni contamination following a drought and wildfires in 2019. A series of dolines feed this DWC, that can be either filled with water in wet season or dry after drought. Soils developed from ultramafic rocks are naturally rich in Ni and Cr. Consequently, the Gleysols developed in the studied wetlands present significant metal contents and substantial amounts of sulfur that could indicate potential sulfidic accumulation at depth. Some studies have highlighted the risk of Acid Sulphate Soil (ASS) formation in case of wildfires in similar sulfidic wetland settings.
Water monitoring (2020-2021) in the studied burned doline showed strong acidification associated with high concentrations of Ni and SO4. The mineralogical characterization of the sediments and analysis of Ni speciation allowed evidence of Ni-hexahydrite and Ni/Fe-sulfides as the major Ni-bearing mineral species. Although sulfides are common species in wetlands, the occurrence of Ni-hexahydrite was considered to result from drought and wildfires. When the doline has been refilled, the dissolution of Ni-hexahydrite has led to high Ni concentrations at the DWC downstream of the doline. Nickel and S isotopes show that the Ni contamination at the DWC can be directly related to enhanced Ni sulfide oxidation in the Gleysol.
Droughts and wildfires in wetlands from Ile des Pins can lead to the formation of inland ASS and further cause Ni contamination of freshwater because of the naturally high Ni background.

Keywords: nickel,sulfur,wildfires,isotopes,acid sulfate soil formation

ID ABS WEB: 138130

6. Soil in the digital era
6.10 133734 - The Role of Soil in Earth System Science:
Data Availability, Interoperability and Critical Knowledge Gaps

META-ANALYSIS OF WATER-DISPERSIBLE COLLOID EXTRACTION METHODS: UNRAVELING TRENDS AND ADDRESSING METHODOLOGICAL GAPS FOR STANDARDIZATION

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Water-dispersible colloids (WDC) play a crucial role in various soil processes, including nutrient storage, transport, and release from the root zone, with implications for agricultural and forest ecosystems. Hence, it is essential to understand their dynamic behavior and characteristics. The measurement and characterization of WDC in soils establishes a foundation for understanding their properties. However, there is a lack of consensus in literature regarding the extraction method for WDC and the size range defining colloids. This study aims to uncover gaps and identify trends in the heterogeneity of conventional methods for WDC extraction reported in literature and to pinpoint suitable operations for WDC extraction. Therefore, a meta-analysis was performed, where reported data such as sample information, soil physicochemical properties, WDC content, and separation methods, were extracted from selected empirical studies (N = 27) yielding 292 datapoints. Principal component analysis was applied to 28 variables with complete data to identify the most relevant methodological variables for extracting WDC in soils. The first nine principal components (PC) cumulatively explain 85.6% of the variance in the dataset and were interpreted. Methodological variables, such as sample moisture condition, sample preparation, shaking dispersant, shaking speed, soil-dispersant ratio, separation methods, and WDC drying methods, exhibited contributions higher than the uniform contribution of the variables to the relevant PC, indicating that these variables highly influence the overall structure and patterns within the dataset. Differences in these variables were experimentally assessed using soils collected from various land uses (forest, arable, and grassland) to determine their impact on WDC content and composition. The results of this study emphasized the need for a standardized approach to WDC extraction in soils for comparability between studies. The identified influential variables and their impact on WDC in soils can contribute to addressing the methodological gaps and can serve as a foundation for improving the existing protocols for WDC extraction and its application for diverse soil environments.

Keywords: meta-analysis,principal component analysis,extraction,soil,colloids

ID ABS WEB: 136335

7. Soil sciences impact on basic knowledge
7.01 125430 - Advances in soil science: past, present and the future

TOOLS FOR IMPROVING LABORATORY PRACTICES IN SOIL SCIENCE AND ENVIRONMENT

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Interdisciplinary knowledge is needed to recognize the role of soil in agricultural and agri-food engineering. The subjects of Soil Science and Climatology and Environmental Science and Technology taught in the Degrees of Agricultural and Agri-Food Engineering and Enology, at the High Technical School of Agricultural Engineers of Ciudad Real (Spain), aim at knowledge of the soil as a productive and ecological factor. Laboratory practices are essential training activities in the development of skills in these soil subjects.
From the experience learnt by teachers in these activities, it is deduced that a large part of the students does not prepare for the practices before the sessions (they do not read the scripts) and limit themselves to following the guidelines of the teacher's explanation automatically, without understanding what they are doing and why they are doing it. This attitude makes it difficult the acquire of skills and turns practices into a requirement that "must be done and passed" without taking advantage of the benefits that this activity has for autonomous and directed learning. Furthermore, students do not appreciate the importance of laboratory data in soil and environmental knowledge.
In this context, the professors responsible for these subjects have developed (during the 2021-2022 and 2022-2023 academic years) tools that, when applied in the laboratories of the subjects of both degrees, allow for the improvement of the teaching-learning process in laboratory practices. To achieve this, the following tools have been used: review and improvement of the practice scripts (using symbols that identify the type of skills that are acquired), on-line test before the start of the practical sessions in the laboratory, photographs competition, posters for evaluation and final questionnaires (carried out with Microsoft Forms) to evaluate the actions of the new tools. This work explains how these tools were developed and the students' assessment of them.

Keywords: SOIL SCIENCE,ENVIRONMENT,LABORATORY TOOLS

ID ABS WEB: 137228

7. Soil sciences impact on basic knowledge
7.01 125430 - Advances in soil science: past, present and the future

THE CREA SOIL ARCHIVE, A NATIONAL COLLECTION FOR ITALY: MUNSELL SOIL COLOR AS A PROXY TO DEFINE A REPRESENTATIVE AND ROBUST SPECTRAL LIBRARY

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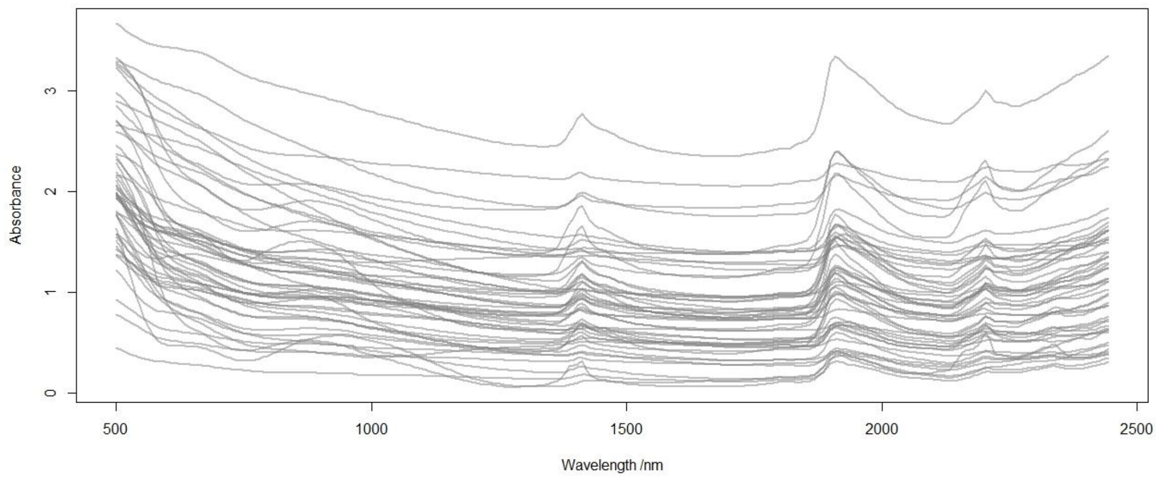
Archives storage samples for long-term preservation. Physical samples are basic elements for reference, study, and experimentation. There is an urgent need for better integrating these physical objects into the digital research data ecosystem, to support research, retrieval, analysis, reuse, preservation and scientific reproducibility.

The CREA collection, located at the Fagna Experimental Farm, Scarperia (FI), stores specimens and associated metadata. It covers all major agricultural and forestry soil landscapes in Italy for organic and mineral horizons. Parameters include particle size, pH, organic carbon, and total carbonates. For the present work, a very limited number of specimens (51) was selected based on the field described Munsell Soil Chart color. Specimen has been characterized by imaging spectroscopy using an ASD FieldSpec 3, according to the procedure defined by the Standard Protocol and Scheme for Measuring Soil Spectroscopy (IEEE SA). Further spectra elaboration allowed to obtain Cielab colors and extract the white, red, green, yellow pigment fraction and contrast value DeltaE. The selection interested 11 different projects ranging from 1986 to 2017. 10 different Hue colors were extracted, the most represented being the 10YR with 14 samples and the least the 5YR and 5PB with just one each; Value 6 resulted the most represented while 1 & 10 occurred just once; With Chroma, 1 to 4 where frequent while 5, 10 & 12 occurred once. Just one resulted to be an organic horizon (Oi) while others resulted mineral surface A horizons (11), E (2), B (19), C (10). Soil properties resulted ranging for Clay: 0.9-93 (41); Silt: 0.3-70.9 (41); Sand: 1-97.4 (41); Bulk density: 0.49-1.69 (10); pH (water): 4.9-9.3 (39); Organic carbon: 0.03-11.41 (40); Total nitrogen; 0.01-1.3 (19); Total carbonates: 0.01-72.1 (29).

Although this oriented extraction demonstrated not to perfectly represent the original dataset, it offers a first attempt to create extraction criteria to define a both limited and robust spectral library. Further development will include selections based on other soil parameters.



Keywords: Soil spectral library,Physical specimen,Sample Selection criteria,Munsell Soil Color

ID ABS WEB: 137852

7. Soil sciences impact on basic knowledge
7.01 125430 - Advances in soil science: past, present and the future

MANAGEMENT OF NITROGEN FERTILIZATION IN SUGARCANE IN NINE CONSECUTIVE CYCLES: INFLUENCE ON PRODUCTIVITY AND SOIL QUALITY

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Soil nutrient imbalances and degradation can be the result of continuous high nitrogen applications. This research was designed to evaluate the effect of ammonium nitrate rates on technological parameters and soil fertility over consecutive cycles (nine ratoons or ten cycles). The design was in randomized blocks, with four replications, in a Red Oxisol at APTA, Piracicaba-SP Brazil. Among the treatments under different N levels zero, 60, 120 and 180 kg ha-1 N, related to eight ratoons, and additionally to the subsequent harvest (9th ratoon) without nitrogen fertilization to all treatments to evaluate residual effects from previous cycles. Soil samples were collected in two periods (2016 and 2021), the last one carried out in November/2022, at depths of 0-10, 10-20 and 20-40 cm, 20 cm close to the sugarcane line. Nitrogen application during harvests 2014 to 2022, resulted in a significant increase in yield, except in relation to cycles 2015 (first ratoon), and 2021 (7th ratoon), drought conditions affected the crop yield. Medium (120 kg/ha) and high (180 kg/ha) N rates led to superior stem yields, consistently outperforming other treatments in the last years (2019, 2020, and 2022). The F-test revealed a significant difference between the medium and high N rates compared to the low (60 kg/ha) and control (zero kg/ha) treatments. In most cases, the higher nitrogen rate (180 kg/ha) resulted in a significant increase in soil acidity, including potential acidity (H + Al), and a decrease in soil fertility. Consequently, the high acidity associated with the higher N rate resulted in low N fertilizer efficiency. The residual effect was observed with the application of medium (120 kg/ha) and high (180 kg/ha) N rates. The 5th, 6th and 8th ratoons proved to be effective in agronomic terms as a result of the efficiency of residual nitrogen in the following 9th ratoon-10 cycle in the absence of N fertilization, high productivity in relation to the low N rate.

Table 1. Sugarcane productivity of the control treatment (without N application) and of the ammonium nitrate - "AN" treatments - plant cane 30, 60, 90 kg N ha^{-1} and ratoons 60, 120, 180 kg N ha^{-1}, respectively, corresponding to the low, medium and high doses of N, cycles 2014 to 2022. Residual cycle 2023 (with zero kg ha^{-1} of N fertilization)

TREATMENT	Plant 2014	1st ratoon 2015	2nd ratoon 2016	3rd ratoon 2017	4th ratoon 2018	5th ratoon 2019	6th ratoon 2020	7th ratoon 2021	8th ratoon 2022	Residual 9th ratoon 2023
	Mg ha^{-1}									
Control	104	102	111	74.6	66	75	76.0	68	73	60
AN-low	105	105	124	101	89	101	91	65	94	73
AN-medium	119	108	127	106	96	103	99	68	105	90
AN -high	123	114	128	108	96	111	96	70	104	90
*average all	113	107	122	98	88	98	90	68	94	78
**average AN	116	109	126	105	94	106	95	69	101	84
CV (%)	4	9	4	6	10	10	4	4	6	9
Pr > F (***F-test)	**0.0004**	0.3	**0.005**	**0.0001**	**0.002**	**0.005**	**0.0000**	0.3	**0.0001**	**0.0006**

*average all indicates all treatments; **average AN for N (60, 120, and 180 kg N ha^{-1}); ***bold numbers means significance probability of F-test

Table 2. Soil chemical characteristics of the control treatment (no N application) and of the ammonium nitrate - "AN" - ratoons 60, 120, 180 kg N ha^{-1}, respectively, corresponding to the low, medium and high doses of N, cycles 2014 to 2022.

Cycle	TREATMENT	O.M. g dm^{-3}	pH CaCl$_2$	P mg dm^{-3}	K	Ca	Mg	H+Al	B.S.	C.E.C.	B.S%
					mmol$_c$ dm^{-3}						
2016	Control	18.8	4.8	14.0	2.15	27.5	14.5	35.3	44.2	79.5	55.5
2016	AN-low	18.8	4.9	14.5	1.85	31.3	16.0	36.3	49.1	85.5	57.5
2016	AN medium	17.3	4.5	14.0	1.98	26.0	12.0	47.5	40.0	87.5	45.5
2016	AN-high	18.5	4.3	17.5	1.65	21.8	9.0	53.5	32.5	86.0	37.8
CV (%)		9	4	11	28	19	17	12	18	3	15
Pr > F		0.27	**0.002**	**0.04**	0.61	0.12	**0.007**	**0.002**	**0.05**	0.20	**0.01**

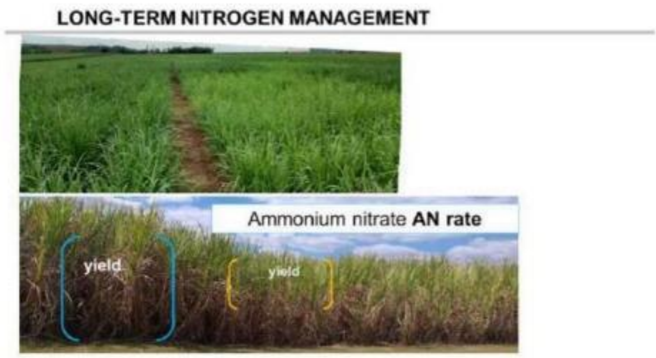

Figure 1. N rate applied in sugarcane ratoon cycle, ammonium nitrate: 0, 60, 120, and 180 kg ha^{-1}

Keywords: ammonium nitrate,nitrogen dose,residual,Saccharum spp.,soil fertility

ID ABS WEB: 139281

7. Soil sciences impact on basic knowledge
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CO-EVOLUTION OF STRUCTURE, HETEROGENEITY, AND FUNCTION DURING PEDOGENESIS

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The development of soil structure and its linkage to functions have become a major research theme boosted by the increasing threat to soil health and fertility due to climate and land-use changes. Water retention, flow of fluids, matter dispersal, habitat provision, nutrient supply, organic matter and element storage are functions of soil fundamental to the life-sustaining ecosystem services. It is well accepted that soil's functions are intimately linked to its architecture and state of aggregation, the void network, and the composition and properties of the solid–fluid biogeochemical interfaces therein. Broad consensus exists that structure develops by the synergistic action of physical, chemical, and biological processes. Inspired by these insights, we see a growing number of research activities that focus on unraveling the intricate interplay and interdependence in search of a theoretical framework that allows for a fundamental understanding of the linkage of structure and function. Substantial progress has been achieved by experimental pedogenesis and the joint application of advanced spectroscopic, microscopic, and tomographic techniques, which enabled studying structure, composition, and biogeochemical interface properties already at the submicron scale. In line with this, modeling endeavors that give feedback to the experimental designs by testing various scenarios serve to explore the factors that govern the co-evolution of structure and function, or challenge concepts in silico, considerably improved over the last decade. This presentation compiles the current understanding of the interplay of abiotic and biotic forcings for structural dynamics and its consequences on the processes and functions in soils. It builds on synthesizing the evidence, findings, and outcomes of field surveys, computer simulations, and experimental pedogenesis. The findings, based on a combination of experimental, observational, instrumental and computational methods, pave the way for a profound understanding of the intricate processes involved in the fascinating coevolution of structure and function during pedogenesis.

Keywords: Structure development,Pedogenesis,Biogeochemical interface,Ecosystem service,Biodiversity

ID ABS WEB: 140110

7. Soil sciences impact on basic knowledge
7.01 125430 - Advances in soil science: past, present and the future

THE SHAPE OF SOIL CARBON PROFILES REFLECTS CLIMATICALLY DRIVEN RATES OF DECOMPOSITION AND VERTICAL TRANSPORT

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For over four decades, scientists have suggested that soil C and C isotope profiles are shaped by both rates of decomposition and vertical transport. Despite this theoretical framework, the application of these concepts to the interpretation of the vast number of soil C profile observations remains under-studied.

Here, we examine the shape of vertical soil organic C profiles along two climate gradients: one of rainfall and one of temperature in the central United States. Due to the latest Pleistocene loess parent material, virtually all other state factors are held nearly constant.

From a reaction-transport perspective, the rate that soil C declines with depth represents the ratio of the decomposition rate constant (k) to that of the vertical transport constant (v). k should vary strongly as a function of temperature, while v should vary strongly with rainfall.

The transects allow us to test these hypotheses, and indeed show that (as hypothesized) the rate that C decreases with depth increases with decreasing rainfall (due to decreases in v), and with increasing temperature (due to increases in k).

These data confirm that (1) vertical transport of soil C is a key process in the shape, and amount, of C in soil profiles at a given depth, and (2) it has large implications for the isotope (and radiocarbon) content of soil C.

Keywords: soil carbon,transport,decomposition,climate

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7. Soil sciences impact on basic knowledge
7.01 125430 - Advances in soil science: past, present and the future

PEDOLOGY IN THE LIGHT OF SCIENTOMETRICS AND BIBLIOMETRICS

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The widespread use of online bibliographic and citation databases has brought new analytical opportunities in scientific research: it has made it possible to analyse large amounts of literature from many different bibliometric and scientometric aspects. In the last decades, a series of scientific publications have appeared that significantly extend and deepen the analysis of the development and scientific contribution of a given discipline or research topic. The analyses are also useful for presenting the focus, trends, and changes in research topics, and for mapping the disciplinary features and modifications of the field. A preliminary review of the relevant literature shows that no such analysis has yet been carried out in the field of pedology, although there have been recent publications analysing the whole field of soil science from this perspective. Pedology is gaining increasing recognition since the genesis, nature, distribution, environmental significance, the use of soil resources and soil degradation and, consequently, soil conservation and remediation came to the foreground in connection with climate change, global food crisis, water scarcity, increasing urbanisation, and ecosystem deterioration. Thus, pedology requires a transdisciplinary approach including hydrology, climatology, geology, ecology, biology, biotechnology, chemistry, physics, IT, and engineering. Furthermore, social, and economic issues of regenerative sustainability and relevant political challenges must be addressed as well. This is mirrored in the scientific literature of pedology and the closely related transdisciplinary research.
We have performed a biblio- and scientometric analysis of the literature published in the last half century (1983-2023) on pedological research using the Scopus bibliographic and citation database. Our analysis includes an analytical presentation of the relevant literature, such as chronological cross-section, trends, characteristics of literature sources, institutional and author affiliations, volumes, and proportions of literature output in each country and region, thematic diversity of publications, and the organisations that are the most important sponsors of research on this area. By using and combining the keywords in the database, we highlight the inter-, trans-, and multidisciplinary connections in pedological research and their possible changes.

Keywords: scientometrics, bibliometrics, soil science, pedology, soil conservation, regenerative sustainability

ID ABS WEB: 135498

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

GLOMALIN-MEDIATED IMMOBILIZATION OF PB IN SOIL AND SUNFLOWER ROOTS INOCULATED WITH RHIZOPHAGUS IRREGULARIS

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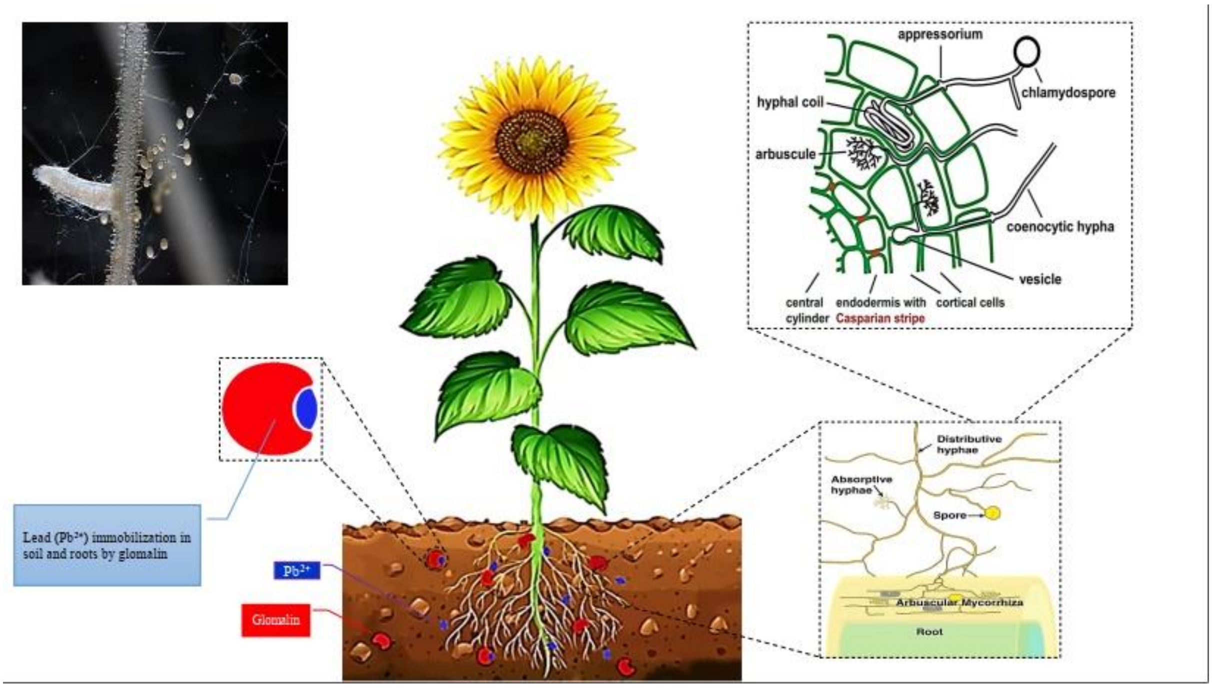
Glomalin as a specific glycoprotein is produced by the fungi belong to the Glomerales in the phylum Glomeromycota. There are evidences indicating that glomalin plays a major role in immobilization of potentially toxic elements (PTEs) in soils by making them less available to the plant roots. In this study, seeds of sunflower (Helianthus annuus L. cv. Farrokh Hybrid) were grown in pots containing sterilized soil and inoculated with mycorrhizal fungus, Rhizophagus irregularis. Three levels of Pb including 0, 500 and 1000 mg Pb per kg soil (Pb0, Pb1 and Pb2, respectively) as lead nitrate were added to the soil. The results showed that root colonization by mycorrhizal fungi causes a significant increase in the total glomalin of soil (TGS) and root (TGR). With increasing soil Pb level, the amounts of TGS and TGR were significantly declined. Compared to the zero addition of lead, the TGS was decreased by 23.26 and 33.37%, and that of TGR by 28.91 and 38.77% at Pb1 and Pb2 levels, respectively. With increasing levels of Pb, root colonization declined. The Pb translocation factor and shoot Pb concentration of mycorrhizal plants were significantly lower than that of non-mycorrhizal ones. The amounts of Pb immobilized by TGS at Pb1 and Pb2 levels were respectively 3.433 and 4.755 mg g-1 in mycorrhizal and 2.984 and 3.983 mg g-1 in non-mycorrhizal plants. Accordingly, Pb immobilized by TGR at Pb1 and Pb2 levels were 4.034 and 4.614 mg g-1 in mycorrhizal roots, respectively. Non- mycorrhizal roots had no glomalin.



Keywords: Glomalin,Immobilization,Lead,Mycorrhizal fungi,Sunflower

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7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

EFFECTS OF ORGANIC PHOSPHORUS SUPPLY ON BIOLOGICAL NITROGEN FIXATION CAPACITY BY LEGUMINOUS COVER CROPS

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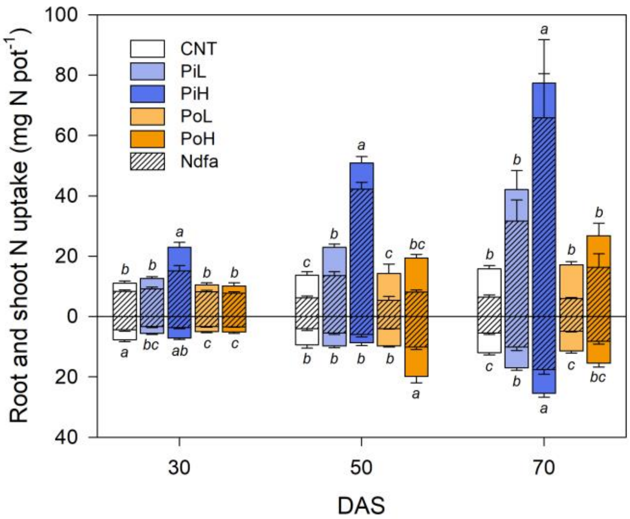
Legume cover crops are often included in agricultural rotations for enhancing soil nitrogen (N) availability and improving the productivity and sustainability of succeeding crops under low-input systems. Phosphorus (P) is a limiting nutrient in many agro-ecosystems and, apart from affecting plant growth, can also limit biological nitrogen fixation (BNF) by leguminous plants. Thus, increasing P supply can have a positive effect on BNF particularly in P-deficient soils. Whereas the effects of inorganic P (Pi) availability on the mechanisms controlling P acquisition and implications on BNF rates under low P supply are well known, there still remains a lack of evidence on role of organic P (Po) sources in controlling BNF in leguminous plants.

Rhizobia-inoculated hairy vetch (Vicia villosa Roth), widely adopted as a legume cover crop, was grown pots containing a P-poor agricultural soil amended with two levels of added P (40 and 120 mg/kg) in the form of Pi (orthophosphate) and Po (phytic acid), and an unfertilized control. We tested the hypothesis that increasing Po inputs can partially alleviate the P limitation effects on BNF because of the ability of leguminous plants to access organic P sources.

When compared to P-deficient conditions (Olsen P < 3 mg/kg) where BNF was primarily limited by plant growth rather than directly due to the high P costs of symbiotic N fixation, Pi addition substantially enhanced plant growth, nodule formation, P acquisition, and BNF efficiency. In contrast, even with the addition of the highest dose of Po, the increase in plant growth, nodule formation, P acquisition, and BNF capacity was much less expressed, indicating that hairy vetch could only minimally access Po sources over the growth period in order to alleviate the P limitation effect on BNF in under P-deficient conditions. These findings suggest that hairy vetch will not be able to provide sufficient BNF for improving soil N inputs in low-fertility cropping systems that rely on organic inputs.



Keywords: Hairy vetch,Phosphorus deficiency,Organic phosphorus,Biological nitrogen fixation,Stable isotope dilution

ID ABS WEB: 137025

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

MEDIOUNA'S LANDFILL LEACHATE (CASABLANCA, MOROCCO): ECOTOXICITY ON SOIL AND STIMULANT EFFECTS ON MEDICAGO SATIVA GROWTH

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The main landfill in Casablanca, situated in the municipality of Mediouna approximately 20 km from the economic capital, played a significant role in waste disposal from 1986 to 2022. Receiving 5,000 tons of municipal waste daily, it produced over 800,000 m3/year of leachate, posing environmental risks as it is collected in an evaporation pond.
While the conventional assessment of leachate involves chemical analyses for identifying pollutants, our investigation delves into its interactions with the ecosystem. In addition to traditional chemical analysis, phytotoxicity tests have been utilized to assess the impact of contaminants, offering valuable insights into their bioavailability and potential effects on soil contamination and plant life.
This study, conducted at the Hassan II University in Casablanca, explores heavy metal accumulation, including Pb, Cd, and Hg, in soil irrigated with varied leachate concentrations. Open-field cultivation of Medicago sativa plants involved pre-experiment soil analysis for fertility and granulometric compositions. Post-experiment analysis revealed elevated concentrations of Pb, Cd, and Hg in both plants and soil with increased leachate concentrations.
The results reveal increasing concentrations of Pb, Cd, and Hg in both plants and soil with higher leachate concentrations. For Pb in plants, concentrations ranged from 0.32 ppm (Control) to 7.05 ppm (15%). Similarly, Cd concentrations increased from <0.02 ppm (Control) to 0.08 ppm (15%), and Hg concentrations varied from <0.02 ppm (Control) to 0.03 ppm (15%). Soil Pb concentrations ranged from 0.19 ppm (Control) to 6.56 ppm (15%), Cd concentrations increased from <0.02 ppm (Control) to 0.38 ppm (15%), and Hg concentrations ranged from <0.02 ppm (Control) to 0.079 ppm (15%). Bioconcentration factor (BCF) were calculated to assess heavy metal uptake efficiency by Medicago sativa plants.
In summary, the study highlights leachate irrigation's potential impact on heavy metal accumulation, necessitating monitoring and mitigation in agricultural practices. In conclusion, vigilant monitoring and effective mitigation strategies are essential to address leachate irrigation's potential impacts on heavy metal accumulation in soil and plants.

Keywords: Leachate,Phytotoxicity test,Medicago sativa,Heavy metals,Bioconcentration factor

ID ABS WEB: 137101

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

DOSE AND INCUBATION TIME: EVALUATION OF THE IMPACT OF NZVI NANOPARTICLES ON SELENIUM FRACTION IN ANDISOL SOILS.

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The increased presence of anthropogenic nanoparticles (ENPs) in agricultural soils is due to their extensive use in various daily consumption products (1). Among the most commonly used ENPs are cerovalent iron nanoparticles (nZVI). Due to their high reactivity, these nanoparticles use various stabilization mechanisms, such as sorption, redox processes and precipitation of different analytes, which can generate imbalances in this matrix (2). Volcanic soils have an inorganic fraction and reactive organic matter, conditioning the availability of nutrients, which the presence of nZVI could increase. An example is selenium (Se), which is found in soils as selenite and selenate, chemical forms that tend to be retained in the inorganic and organic part of this matrix so that nZVI can modulate the availability of selenium, altering its bioavailability and a consequence, the nutritional quality of crops.
This study evaluated an A horizon of an Andisol soil (Santa Barbara) incubated with two doses of nZVI nanoparticles (0.5 and 1 mg/kg soil) for three months. Subsequently, Se fractionation was performed using the method described by Sposito et al to determine the impact of dose and incubation time on soil fractions. Our results indicate that the main factor in the change of Se forms was incubation above the nZVI dose. Some 66% of Se is associated with the most labile fractions, 17.4% with the organic fraction, 12% with the carbonate fraction, and only 4.6% with the residual fraction.
The addition of nZVI and subsequent incubation generated a shift from the labile and organic forms to the residual fraction, with a 2.5-fold increase in this fraction compared to the control soil, probably associated with those fractions where nZVI is established. In general terms, the carbonate fraction did not show significant differences in the study.

Keywords: nanoparticles,volcanic soils,soil fractionation

ID ABS WEB: 137122

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

NITROGEN FERTILISATION AND DEFOLIATION EFFECTS ON THE CONTRIBUTION OF RHIZODEPOSITION INTO THE FORMATION OF PARTICULATE AND MINERAL-ASSOCIATED ORGANIC MATTER

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Soil organic matter (SOM) is a crucial component for storing organic carbon (C) in terrestrial ecosystems, and thereby mitigating global climate change. The substantial release of organic compounds from living roots (rhizodeposition) is gaining recognition for its pivotal role in forming SOM pools. Rhizodeposition enhances microbial biomass with faster turnover rates, influencing SOM formation and decomposition. Rhizodeposition can be transformed into particulate organic matter (POM), but can also be stabilised into mineral-associated organic matter (MAOM) through direct adsorption onto soil minerals or via microbial necromass. This dual transformation highlights the critical role of rhizodeposition in mitigating climate change. This study aimed to examine how rhizodeposition contributed to POM and MAOM formation in a grassland affected by long-term application of nitrogen (N) fertilisation (0 vs. 40 kg N ha-1 yr-1) and defoliation frequency (3-4 vs. 6-8 clipping events year-1), and to what degree rhizodeposition was incorporated into microbial biomass. A 13CO2 pulse labelling technique was conducted at field condition over two different seasons to assess rhizodeposition and to examine the incorporation of recently produced rhizodeposition into microbial biomass, POM and MAOM fractions and the contribution of microbial necromass in the formation of POM and MAOM. Preliminary results showed that rhizodeposition increased with N fertilisation at low defoliation but decreased with increased defoliation frequency. The incorporation of rhizodeposition into microbial biomass decreased with N fertilisation but was not affected by defoliation frequency. At the time of writing, we are still waiting for results on 13C and necromass measurements in POM and MAOM fractions, but these preliminary results could suggest that rhizodeposition contributed to SOM formation more strongly via direct adsorption to soil minerals than via necromass of microbially-processed rhizodeposition. Our results should provide insightful information regarding the stabilisation of rhizodeposition into SOM pools under different grassland management practices.

Keywords: carbon stabilisation,mineral-associated,particulate organic matter,pulse labelling,rhizodeposition

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7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

ABOVE AND BELOW GROUND LACTOBACILLUS IN OLIVE ORCHARDS PLACED IN DIFFERENT SOIL FORMATIONS IN TUSCANY

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Lactic Acid Bacteria (LAB) and their prebiotic substances produce beneficial effects not only in the animal gastrointestinal tract, but also in rhizosphere soil of many plants, including olive trees. LAB in soil have the action to control pathogenic bacteria and, coming from the soil through xylem sap in olive leaves, fruits and oil they are responsible of the hydrolysis of Oleuropein, the bitter-tasting secoiridoid glucoside. Moreover, it has been shown that the diversity of LAB populations in olive fruit was dependent on the olive cultivar and the geographical origin.
In this preliminary study we investigated whether Lactobacillus spp. were present in different amount i) in soil, leaves and drupes of centenary olive trees of the same olive grove and ii) in olive groves located in soil with different lithological origins. This analysis was performed by quantitative PCR using the rpoB gene as it is considered significantly powerful in identifying the genus Lactobacillus and present in one copy per genome.
A first result is that the amount of lactobacilli decreases from the soil to the leaves and from the leaves to the drupes by approximately 1 order of magnitude, as was expected to be found.
To explore the differences between Lactobacillus amount across contrasting lithological substrate, hence the variation in Lactobacillus quantity across soil, olive cultivars and climatic zone was visualized and assessed with non-metric multi-dimensional scaling (nMDS) ordination plot of Bray-Curtis. The results of the ordinary plot showed a significant spatial autocorrelation between samples collected in the lithologies characterized by limestone pebble/gravel soil. Furthermore, the Lactobacillus amount differed between olive cultivars.
This is only a first approach to understanding the involvement of the Lactobacillus population in the olive grove ecology.

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Keywords: Soil Plant Microbe metagenome,Soil microbiome,Lactic Acid Bacteria,qPCR Soil LAB,Olive orchard

ID ABS WEB: 138135

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

CASING SOIL AS A POSSIBLE SOURCE OF GREEN MOLD CONTAMINATION IN CHAMPIGNON CULTIVATION

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Green mold disease, caused by Trichoderma spp., is the most harmful disease for edible mushroom production, such as champignons. The disease affects yield, fruit body formation, and can be spread through contaminated tools, substrate, clothing, air and insect vectors. Considering the significant degree of yield loss in mushroom production due to the appearance of the mentioned disease, the need for early, rapid and specific detection of the presence of Trichoderma spp. in casing soil is exceptional. In this study, we aimed to examine casing soil as a possible source of Trichoderma contamination, as well as to develop a novel point-of-need assay for its early screening. The casing soil samples were collected in two-time points: before applying on cultivation bags (three samples) and seven days after applications (ten samples). The samples were used for microbiological analysis using cultivation methods, as well as molecular biology analysis using the DNA metabarcoding approach and loop-mediated isothermal amplification method (LAMP). Trichoderma is cultivated from eight casing soil samples. Genomic DNA extracted from a pure Trichoderma culture was used for development of LAMP assay that is evaluated using eDNA from casing soil samples. In addition to valuable information of the diversity of casing soil fungal community, results of DNA metabarcoding confirmed the presence of Trichoderma spp. in one sample taken before, and four samples taken after application of casing soil on cultivation bags. Our results confirm that casing soil is a source of Trichoderma spp. infestation in champignon production, although there are likely multiple sources. The DNA metabarcoding approach was useful for fungal diversity studies, but limited in detecting Trichoderma spp. On the other hand, the developed point-of-need LAMP assay showed high sensitivity in early screening for Trichoderma, although its efficiency is highly dependent on the representativeness of the sample being analyzed.

Keywords: casing soil,champignon production,DNA metabarcoding,LAMP,Trichoderma

ID ABS WEB: 138551

7. Soil sciences impact on basic knowledge
7.02 129627 - Plant-soil-microbe interactions in the rhizosphere and their potential to address global agricultural challenges

THE EFFECT OF LIVESTOCK- AND UNGULATE-MADE GEODIVERSITY OF SOIL FUNGAL COMMUNITY IN DRYLANDS

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Changes in soil compaction and soil-water conditions are expected to shape the spatio-temporal patterns of soil biotic biomass and processes, and specifically, the soil biota composition and diversity. Our study aims to comprehensively investigate how livestock and wild ungulate activity impacts soil fungal communities in dryland geo-ecosystems. By assessing fungal community composition, diversity, and functionality at the phylum and order levels, we hope to gain insights into this aspect of ecosystem functioning. Therefore, the study's major objective is to assess the effect of livestock- and wild ungulate-made trampling routes on drylands' soil fungal community, at the phylum and order levels. We will examine three regions along an aridity gradient comprising of a semi-arid, an arid, and a hyper arid site; two opposing hillslope aspects composing of a north- and south-facing hillsides; and three microhabitats consisting of shrubby patches, intershrub spaces, and animal trampling routes. The study hypothesizes that soil fungal community's phyla and orders will be regulated by livestock- and wild ungulate-made trampling routes. Specifically, it is hypothesized that soil fungal community's phyla and orders that are characterized with relatively high durability to dryness conditions are most abundant in the driest region and least abundant in the moistest region, more abundant in southern aspects than in northern aspects, and most abundant in the trampling routes and least abundant in the shrubby patches. Preliminary results had demonstrated the importance of perennial shrubs' rhizosphere as a hub for fungal diversity, where the main phyla are Ascomycota, Basidiomycota, and Chytridiomycota. Hillslope aspect was found to affect the fungi community composition as and functionality. This study will contribute to the understanding of the impact of grazing and trampling on soil fungal communities and ecosystem functioning under climatic change scenarios.

Keywords: Fungi,desert ecosystems,functionality,slope orientation,gradient study

ID ABS WEB: 136219

7. Soil sciences impact on basic knowledge
7.03 130893 - Soil classification: past and present concepts and solutions

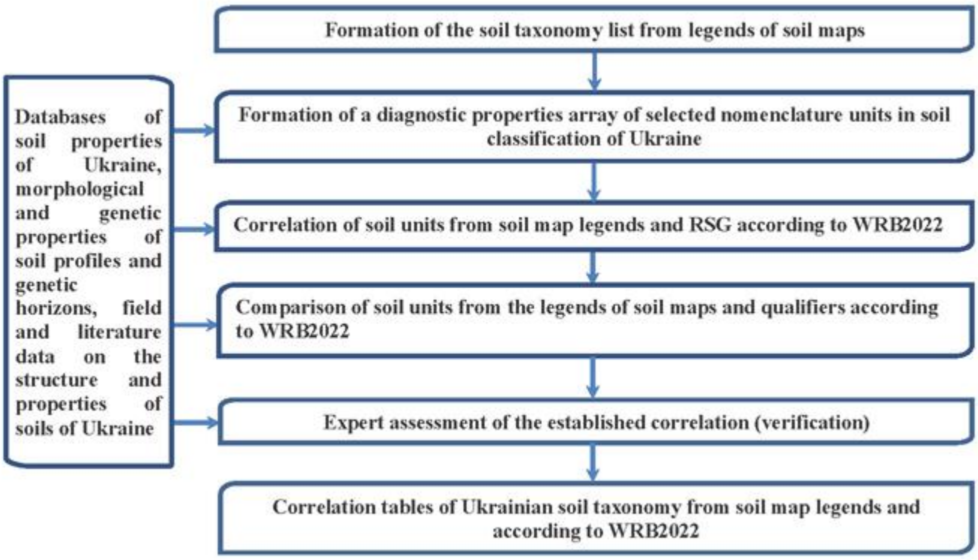
ADAPTATION OF DIAGNOSTICS AND SOIL TAXONOMY OF UKRAINIAN SOILS TO THE WRB

V. SOLOVEY, V. LEBED

NSC ISSAR named after O.N. Sokolovsky, Soil Resources Department, Kharkiv, UKRAINE

International communication of soil scientists from different countries determines the need to adapt the national nomenclature of soils to WRB. The experience of direct correlation of classification is negative due to the mismatch of their principles, differentiation on taxonomic levels due to differences in classification structures. However, both international and national classification of soils have a substantive nature of diagnosis based on morphological features and property parameters. This determines the theoretical possibility of adapting the name of soils of Ukraine to WRB through the comparison of diagnostic features and property parameters. At different times, there have been successful attempts to adapt the names of soils of the national classification to the WRB.
To determine the soils of Ukraine, 20 main diagnostic indicators are used, most of which correspond to the WRB system. To date, relative diagnostic coefficients of the genetic status of soils have been developed, which can be used as pedotransfer models to calculate certain soil properties in different parts of the profile according to WRB diagnostic depths.
Adaptation of national classification soil names to WRB is performed in the following sequence: 1) A list of national classification soil nomenclature is being formed; 2) A set of diagnostic properties and analytical characteristics is defined for each soil according to WRB; 3) Determination of the soil's belonging to the Reference Soil Group is carried out according to the defining key based on the profile morphology and the parameters of diagnostic properties; 4) The search for principal and supplementary qualifiers is carried out by comparing soil properties with WRB diagnostic criteria.
The source of information for establishing diagnostically significant soil properties is the diagnostic criteria of the national soil classification of Ukraine, the data of the Ukrainian soil information center, the results of experimental studies, etc.
The presented soil taxonomy adaptation algorithm was tested for the legends of soil maps of Ukraine at the scale of 1:750,000 and 1:200,000.

№	Soil diagnostic criteria
1	Humus (organic carbon) content
2	Cation exchange capacity
3	Base saturation
4	Content of exchangeable cations of calcium, magnesium, sodium and potassium
5	pH_{H2O}
6	Content of the "skeleton" (coarse fragments)
7	The depth of the humus profile
8	Deep of carbonates effervescene (under 10 % HCl)
9	Presence or absence of textured profile differentiation
10	Presence or absence of gleying signs
11	Localization depth of gleying signs
12	Total concentration of soluble salts
13	Granulometric composition, texture
14	Presence or absence of eluvial horizon enriched with silica
15	Presence or absence of a peat layer
16	Presence or absence of black, chestnut or brown tint in the upper horizon
17	Presence or absence of white-eye
18	Coefficient of relative humus accumulation
19	Coefficient of profile humus accumulation
20	Coefficient of organoprofile regression



Keywords: diagnostic indicators,soil properties,harmonization,soil classification,WRB

ID ABS WEB: 136455

7. Soil sciences impact on basic knowledge
7.04 131141 - Digging Deeper: exploring ways of making soil science more social

DEVELOP AND PROMOTE EDUCATIONAL TOOLS TO PROVIDE TRAINING ON THE CHALLENGES OF SOIL KNOWLEDGE AND PRESERVATION

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Since 2016, members of the French Soil Science Society (AFES) have been supporting teachers and trainers keen to enrich and consolidate their teaching on soils, through the PromoSolsEduc network (Promoting Soils in Education). Exchanges with this network of around a hundred people from general and specialized education, as well as partnership work “RMT Sols et Territoires” and “ADEME”, have contributed to the emergence of three interconnected projects aimed at integrating soil knowledge into all levels of education :
1. To facilitate exchanges of experiences between teachers and trainers, a collection of the experiences of thirty teachers and trainers entitled '24 teaching sequences for teaching soil” will be published in 2024 by EDUCAGRI editions. The book will be supported by a WEB interface to complement the teaching sequences, a dynamic map of teachers and trainers, and access to a center of documentary resources on soils.
2. Teachers' need for fun tools to engage learners on the full range of soil issues prompted ADEME to work with AFES on the design of the Fresque du Sol serious game. The game (In-class or online) was officially launched in May 2023. It already has over 4,000 players and almost 130 networked animators, progressively acquiring cross-disciplinary skills on soils. It has already been tested in various technical and general education contexts, and is currently being translated into English, Spanish and Chinese.
3. Today, it is crucial to train as many people as possible to understand and interpret soil observations in the field. We have initiated the structuring of a network of committed soil pit referents able to support teachers and trainers in understanding soil in the field. A survey has identified 45 soil pit referents. A dynamic map will enable them to be identified and contacted via the AFES website. This network of soil field referents will be closely linked to the network of participants in participatory soil science and research projects, run by AFES.

Keywords: Teaching,Training,Field,Soil,Serious Game

ID ABS WEB: 138309

7. Soil sciences impact on basic knowledge
7.04 131141 - Digging Deeper: exploring ways of making soil science more social

THE MEXICAN SOIL JUDGING CONTESTS – EXPERIENCES FROM AN EDUCATIONAL INITIATIVE FOR YOUNG SCIENTISTS

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The generational gap in the study of soil science in Mexico and Latin America, and the lack of interest of the new generations have urged the implementation of contests as an innovative strategy to attract young people to this area. The Mexican soil judging contests emerged in 2018 as a formative activity where young people implement their skills to describe, classify, and determine the potential use of soils. They also seek to encourage networking of students with researchers and distinguished institutions at a national level. In the five editions held, the participation of students and young researchers from the Mexican Society of Soil Science youth group in organizing the events has been outstanding. There have been 3 face-to-face editions (2018, 2019 and 2023) and 2 virtual editions (2020 and 2021), where 693 undergraduate and 272 graduate students have participated, reaching even abroad. The increase of participants through the editions is mainly the result of promotion in social media with dissemination materials (v.g. edaphographies project) and the offering of a preparation course prior to the competition. These competitions have proven to be motivating activities for the study of soil science in different regions throughout the country, allowing academic projection for the participants at a national level, and motivating the participation of Mexican teams in international soil judging contests.

Keywords: education,Soil contest,young scientists,inclusion

ID ABS WEB: 136224

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

CHARACTERIZATION OF LITTERS AND SOILS IN AN ITALIAN MOUNTAIN AREA BY A CHEMICAL, BIOLOGICAL AND SPECTROSCOPICAL APPROACH

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Natural soils provide a wide range of goods and services but, despite this, deforestation and forest degradation continue at an alarming rate. According to the FAOin the last 25 years, there has been a net loss of 5.2 million ha/year. In Italy, however, the forest area has increased from 5.6 million to 11.1 million ha due to the abandonment of marginal agricultural areas. Soil respiration represents from 60 to 90% of the total respiration of the forest ecosystem influencing the atmospheric CO2 balance. In this context, a study was conducted in Valle Camonica (North Italy) with the aim of evaluating the accumulation of carbon in soils and litter with different plant cover (chestnut, beech, pine). Chemical, respirometric and spectroscopic characteristics of the labile (soluble carbon) and recalcitrant (humic-like) carbon of the litter and soil were evaluated. The composition of the total carbon, assessed by 13C CPMAS NMR, highlighted the abundant presence of starch and cellulose, especially in the litters. Otherwise, aromatic compounds tend to accumulate in the soil (concentration effect). The liquid state 1H NMR analysis of the soluble and recalcitrant carbon indicates that the labile carbon is rich in low molecular weight compounds. In all soluble carbon fractions, a high percentage of carbohydrates was found, which are more concentrated in the soil layers. The humic-like carbon extracted from soil and litter of beech and chestnut were similar in the NMR profile, while pine showed higher values of aliphatic compounds (resinous) typical of this pine and the aromatic carbon content was lower. The chemical properties were correlated to the respirometric data and the labile carbon had the greatest influence on soil respiration. In conclusion, the study highlighted that vegetal cover can, even in the same climatic context but depending on its composition, influence both soil properties and the rate of mineralization, with consequences both on CO2 emissions and soil carbon storage.

Keywords: Soil organic carbon,soil respiration,1H NMR,13C CPMAS NMR,Litter

ID ABS WEB: 137335
7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

SOIL CONTEXT OR LAND COVER – WHICH FACTOR PLAYS A MORE SIGNIFICANT ROLE IN THE STABILIZATION OF SOIL ORGANIC MATTER STOCKS IN THE GORCE MOUNTAINS (SOUTHERN POLAND)

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One key strategy for mitigating climate change involves capturing carbon dioxide through photosynthesis and sequestering it in the form of belowground organic matter. Mountainous regions play a crucial role in storing organic compounds as soil organic matter (SOM) due to challenging climatic conditions that limit microbial decomposition processes. Mountains are highly susceptible to global changes such as temperature rise and change of land cover, impacting the stability and composition of soil organic matter stocks. The Gorce Mountains in southern Poland serve as a noteworthy example where land abandonment and the effects of global warming have induced substantial transformations in land cover. Additionally, the region's soil cover, typical of mountainous areas, exhibits distinct local variations in soil-forming processes. Consequently, this study aims to assess the influence of different land covers and various soil-forming processes on the SOM stocks and their stability.
Soils under different types of land cover, including ancient forests, successional forests, shrubs, meadows covered with shrub vegetation, and grasslands, and characterized by diverse soil-forming processes (Podzols and Cambisols) were examined concerning the SOM stocks and their stability. Soils under ancient forests and meadows with shrub vegetation exhibited the largest SOM stocks within the top 30 cm of depth, while successional forests had the lowest. However, the stability of SOM was more closely tied to the soil-forming process than the type of land cover. In the surface horizons of both Podzols and Cambisols, the majority of SOM was found in the form of particulate organic matter, representing a relatively unstable fraction. Conversely, the subsoil horizons in Cambisols showed a significantly higher proportion of resistant mineral-associated organic matter compared to Podzols.
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 952327 and has been supported by grants from the Priority Research Area Anthropocene and the Faculty of Geography and Geology under the Strategic Programme Excellence Initiative at Jagiellonian University.

Keywords: LULC change,Climate change,Soil Organic Matter,C sequestration,Gorce Mountains

ID ABS WEB: 137810

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

IMPACT OF ELEVATION ON SOIL ORGANIC CARBON AND THE ASSOCIATED MICROBIAL COMMUNITIES IN ALPINE ECOSYSTEMS

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Soil organic matter (SOM) plays a crucial role in the carbon (C) cycle as both a stock and a source of C. Particulate organic matter (POM) and mineral-associated organic matter (MAOM) are two forms of SOM that differ in their cycling rates. POM is fast-cycling and consists of partially decomposed plant and animal material, while MAOM is slow-cycling and composed of microbial bodies and mixed organic compounds. Microorganisms are involved in the decomposition of POM and MAOM, but microbial communities and their activities can differ between these two fractions. Moreover, different environmental conditions can significantly impact microbial communities, influencing the balance between C fractions and atmospheric C concentrations. Therefore, this study aims to compare and understand fractions dynamics and their associated organisms under different environmental conditions.
Samples were collected from two alpine sites at two elevations, with a 5 °C temperature difference: a loamy deposit at 2500 m a.s.l. and a sandy substrate at 1500 m a.s.l. Each sample was physically separated into fractions >63 (POM) and <63 microns (MAOM), and the total DNA was extracted. Preliminary results show that both sites are dominated by POM over MAOM, with POM representing ~60% of each sample. Under a climate change scenario, i.e., increasing soil temperatures, the dominance of POM may indicate higher losses of SOC due to the faster turnover associated with this fraction than in lowland soils typically dominated by MAOM. DNA extractions revealed that most (20-80%) of the DNA was associated with the MAOM fraction, usually characterised by a higher amount of C than POM. However, further analysis (i.e., quantitative PCR on taxonomical markers genes) will be conducted to determine the origin of the DNA associated with each fraction and the total C concentration. The results are expected to deepen the understanding of C fractions dynamics, highlight how these soils respond to environmental changes, and offer new tools to manage and conserve soil carbon stocks in these environments.

Keywords: Organic carbon,Carbon fractions,Soil ecology,Microbial communities

ID ABS WEB: 137907

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

MICROBIAL COMMUNITY COMPOSITION OF SOIL ORGANIC MATTER FRACTIONS OF TEMPERATE FOREST TOPSOILS AND SUBSOILS FROM HUNGARY

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The physical fractionation of soils allows the separation of diverse soil organic matter (SOM) pools having various physical and chemical properties to stabilize C. In this study the microbial community composition of SOM fractions were examined.
Topsoil (0–20 cm) and subsoil (30–50 cm) samples were collected from an Arenosol, a Chernozem and two Cambisols from Hungary. Four different SOM fractions – particulate organic matter (POM), macroaggregate-protected (MaA), microaggregate-protected (MiA) and silt- plus clay-sized (s+c) – were separated from the samples following aseptic working rules.
The environmental DNA from the bulk soils and the SOM fractions was extracted with the Qiagen DNeasy PowerSoil Kit. The V3–V4 region of the 16S rRNA gene was used for prokaryotic taxonomic diversity analysis. DNA sequencing was performed on an Illumina MiSeq platform. The mothur v1.43.0 software was used for the procession of sequence reads based on the alignment to the SILVA Release138 SSU NR database.
Results showed, that the composition of bacterial communities was dominated by phyla Actinobacteriota (13%-66%), Firmicutes (6-57%) and Proteobacteria (<33%) (and Acidobacteriota (5-16%) in the Arenosol samples).
The bacterial community composition showed high similarities among the samples derived from the same location. Soil depth and pH was another important parameter affecting the composition of bacterial communities. Although, microbiological differences derived from the different SOM fractions were less prominent, some conclusions can be drawn: 1) the proportion of the phylum Firmicutes showed a slight increase in the MaA, MiA and s+c fractions; 2) the quantity of the previously uncultured Bacillaceae, Pseudoarthrobacter and Massilia was increased in the MaA, MiA and s+c fractions and 3) the POM fractions were the most diverse, whereas the s+c fractions were the least diverse samples according to the Shannon and inverse Simpson indices.
This work was supported by the Eötvös Loránd Research Network [grant No. SA41/2021] and the National Research, Development and Innovation Fund, Hungary [project no. FK 142936].

Keywords: SOM fractions,microbial composition,DNA sequencing

ID ABS WEB: 137908

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

THE TEMPERATURE SENSITIVITY OF THE DECOMPOSITION OF ORGANIC MATTER FRACTIONS OF HUNGARIAN SOILS WITH DIFFERENT VEGETATION COVERAGE

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Understanding the relationship between environmental changes and rates of the decomposition of soil organic matter is critical for projecting changes in soil carbon fluxes under changing climate conditions. The respiration of terrestrial ecosystems, including microbial decomposition of SOM, would be more sensitive to the global warming than would gross primary productivity, hence, the investigation of the temperature sensitivity of SOM decomposition, commonly referred to as Q10, is very important for modelling changes in soil C stock.
To evaluate the temperature effect on the decay of organic matter, SOM fractions (s+c, S+A and POM) of soils from different vegetation coverage were incubated for 1 year at 15, 25 and 35 °C. Total C respired (CO2-C) through time up to 365 days was fitted with a first-order kinetic C model and the Q10 factor was calculated. The main results of the incubation of soil organic matter fractions are the follows:

- The decay constants (k, day-1) of the organic C fractions calculated based on the CO2 evaluation in the soils were the higher in the POM fractions with average k value of 2.0x10-4 at 15 °C, 4.8x10-4 25 °C, 1.8x10-3 35 °C.
- Lower k values in forest soils comparing to the grass and arable area, indicating that decomposition is inhibited - this is due to environmental factors (e. g. pH) and lower substrate quality of forests.
- The decomposition rate of all organic matter fractions increased significantly with increasing temperature. This can be clearly seen in the Q10 factor, which is the response of decomposition rate (k) to temperature (T): 3-3.5 for all fractions, with the exception of oak s+c and arable S+A. For the latter, we obtained values well above the average of 5.4 - presumably the effect of arable cultivation and ploughing, which increasingly degrades the macro- and micro-aggregates of the soil.

This work was supported by the Development and Innovation Fund of Hungary [grant No. NKFIH 132191].

Keywords: incubation,Q10 factor,decomposition rate constant,mean residence time

ID ABS WEB: 137956

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

IMPACT OF BIOCHAR APPLICATION ON SOIL MICROBIAL RESPIRATION UNDER SIMULATED CLIMATE CHANGE WITHIN A MEDITERRANEAN CROPLAND

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The application of biochar has emerged as a potential climate change mitigation strategy in agriculture; however, we still need to better understand the soil microbial responses to the joint effects of climate change and biochar in Mediterranean croplands. To fill this knowledge gap, we evaluated the effects of cumulative biochar application (20 t ha-1 yr-1) under climate change conditions in a long-term field experiment conducted in semiarid agricultural soil in Central Spain. Rainout shelters and open-top chambers were set up to simulate a 30% rainfall reduction combined with an increase of 2°C in soil temperature. The experimental treatments included unamended control soil (C), soil amended with biochar (B), unamended control soil with rainfall reduction and warming (Crr+w), and soil amended with biochar with rainfall reduction and warming (Brr+w). A series of soil incubations were set to a range of 5-35 °C for CO2 measurements, which were addressed using the fully automated system Respicond respirometer X. Results revealed that both Brr+w and Crr+w treatments exhibited higher soil respiration rates compared to B and C treatments across all temperature ranges. However, the application of biochar did not alter the temperature sensitivity of soil carbon mineralization, as evidenced by the absence of significant differences in Q10 values among the treatments. This study illustrates how the interactions between biochar amendment and future climate change scenarios influence microbial communities and its role in the global C turnover within a Mediterranean agroecosystem.

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Keywords: Biochar,Soil microbial respiration,Temperature sensitivity,Climate change,C sequestration

ID ABS WEB: 138087

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

DESTABILISATION OF ORGANIC CARBON IN MOUNTAIN SOILS AS A RESULT OF GLOBAL WARMING

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Stocks of organic carbon in mountain soils are known to be higher and more vulnerable than in lowland soils. Low temperatures in these environments tend to limit the SOC decomposition and mineralisation, leading to an increase in its residence time and its accumulation. In the context of global warming, we can expect that the environmental carbon stabilisation due to low temperature as found in alpine soils will be reduced, resulting in a positive feedback loop from global warming (increase in temperature -> environmental SOC destabilisation -> CO2 release -> increase in the greenhouse effect -> increase in temperature etc…). On the other hand, global warming may favour net primary productivity, leading to an increase in SOC inputs and thus to a negative feedback loop. The relative increase in these mineralisation vs. productivity determines the behaviour of alpine soils either as a carbon source or sink. To test this hypothesis, the “Alpages Volants” experiment involved transplanting soils from the alpine (2500 m a.s.l.) to the subalpine stage (1900 m a.s.l.), simulating a global climate warming of app. +3°C. Soil organic carbon fluxes and stocks were estimated based on respiration and carbon gas exchange (NEE) and on soil sampling seven years after transplantation to measure SOC quantity and stability using various methods (RockEval, fractionation, chemical characterisation, mean residence time). Preliminary results show a reduction in the quantity of SOC in warmed soils. This lost carbon mainly occurs as labile forms (thermally labile, WEOC, POxC) supporting the hypothesis of the potential 'carbon source' behaviour of alpine ecosystems with global warming.

Keywords: Soil Organic Matter,Alpine ecosystems,GHG emissions,Climate warming,RockEval fractionation

ID ABS WEB: 138119

7. Soil sciences impact on basic knowledge
7.05 131303 - Soil organic matter transformation, stabilization and storage

THE IMPACT OF MICROBIAL-MEDIATED PLANT HUMIFICATION PRODUCTS ON SOIL ORGANIC MATTER TRANSFORMATION

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Microbial-mediated input of plant residues and their humification products plays a key role in the transformation and sequestration of soil organic matter. This study aims to utilize 13C15N double labeling tracing technology in incubation experiments to quantify the differences in the fate and distribution contribution of the C and N of plant humification products under the mediation of different exogenous microorganisms in soil organic matter (SOM) and dissolved organic matter (DOM). The exogenous microorganisms employed include Trichoderma reesei, Trichoderma harzianum, Phanerochaete chrysosporium, and Bacillus subtilis. Additionally, a combination microbial treatment comprised of Trichoderma harzianum, Phanerochaete chrysosporium, and Bacillus subtilis was also employed. The study also aims to reveal the variation patterns of soil active organic carbon and humic carbon components in response to different exogenous microorganisms. The key conclusions of the study are:
Fungal-mediated humification products significantly improved translational immobilization in soil compared to bacterial and control groups, and the fungal treatments contributed more to DOM and stimulated soil-derived dissolved nitrogen. Trichoderma reesei treatment was the most effective in immobilizing the carbon and nitrogen derived from humification products.
Fungal-mediated humification products outperformed bacterial mediation in enhancing labile organic carbon and humic acid fractions. The treatment with Trichoderma reesei was the most effective in increasing contents of easily oxidizable organic carbon, microbial biomass carbon, and humic acid carbon. Moreover, the combination microbial treatments significantly increased fulvic acid carbon and substantially reduced humification degree in the early part of the experiment, but the three fungal treatments were effective in increasing fulvic acid carbon in the later part of the experiment.
In summary, these findings provide a theoretical basis for identifying suitable microbial regulation measures for farmland management to improve SOM transformation and humification effects. These conclusions also offer practical guidance for agricultural production and soil carbon sequestration and fertilization.

Keywords: soil organic matter,dissolved organic matter,humification products,exogenous microorganisms,humus

ID ABS WEB: 136702

7. Soil sciences impact on basic knowledge
7.06 132267 - Pedodiversity: major driving factors and influences on ecosystem features

LOCAL DIVERSITY OF SOIL FORMING PROCESSES AND ITS ENVIRONMENTAL DRIVERS: AN EXAMPLE FROM OTAVI MOUNTAINS, NORTHERN NAMIBIA

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The local pedodiversity in semi-arid tropical climate is controlled by a number of interacting factors, whose contribution to the final form of individual soil characteristics is often difficult to discern. The present study focuses on a detailed description of five different soil profiles located in the flat foothills of the Otavi Mountains, northern Namibia. A multi-proxy approach consisting of analyses of clay mineralogy, micromorphology and geochemical parameters was used to disentangle the drivers of an extraordinary local soil diversity and to identify the patterns of recent and relict pedogenesis. Significant differences in profile stratigraphy were observed in the soils studied, represented by weathered Chromic and Haplic Luvisols and humus-rich soils with mollic epipedons (Haplic Phaeozem, Calcic Kastanozem) and vertic features (Haplic Vertisol). Complex lithology, represented by in-situ weathered rocks, mainly shales and dolomites, and younger unconsolidated sediments of various origin, duration of pedogenesis and subtle changes in local topography were identified as the main factors for the sharp transitions between the patches of each soil group, while a direct effect of different management on the spatial distribution of soil classes could not be demonstrated. The soils studied differed significantly in the proportions of clay minerals and iron forms, with more advanced phases of in-situ weathering typically expressed by an increased ratio of kaolinite and crystalline iron forms, whereas younger humus-rich soils were more strongly represented by phyllosilicates with a higher proportion of smectite. The development of vertic features was mainly conditioned by the localisation of the profile in a minor local depression with prolonged water stagnation and abundance of the finest clay fraction. The dynamics of landscape processes in the area is evidenced by an important admixture of colluvial and fluvial material in the profiles, often bearing pedofeatures inherited from previous pedogenesis. Formation of the mollic horizons was probably enhanced by the admixture of aeolian loess-like material.
The study was supported by grant no. 23-05051S of the Czech Science Foundation.

Keywords: soil variability,semi-arid climate,clay mineralogy,micromorphology,soil properties

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7. Soil sciences impact on basic knowledge
7.06 132267 - Pedodiversity: major driving factors and influences on ecosystem features

SOIL AVAILABLE NUTRIENT SHAPED THE NATIONWIDE SOIL ACTIVE MICROBIOME ACROSS BIOMES

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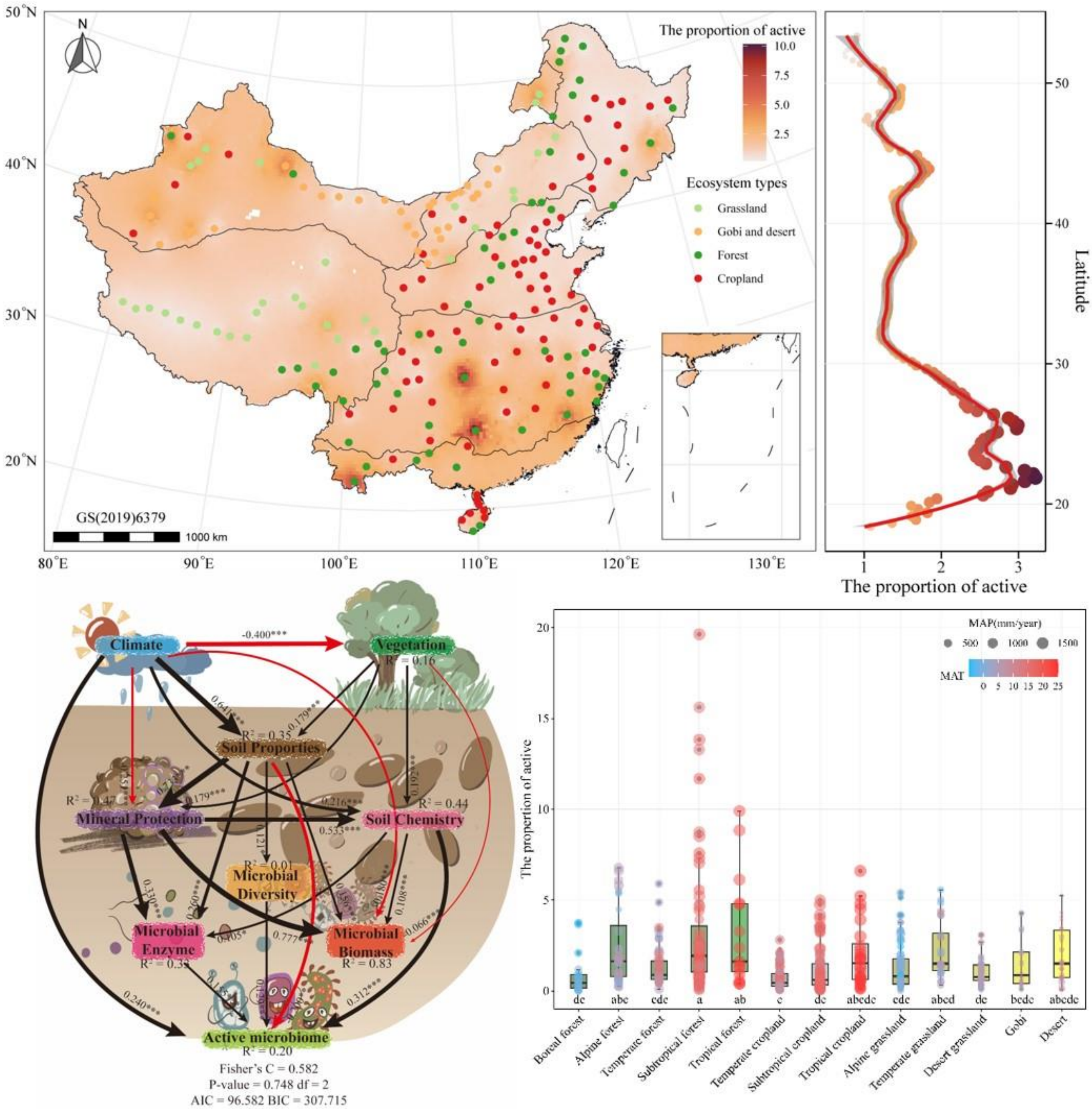
The active microbiome is the sole microbial driver of the main biogeochemical processes, which is only a tiny portion of the total microbiome. Therefore, the lack of accurately distinguishing active microbiomes and exploring the driving mechanisms on a large scale might mistakenly estimate the role microbiomes play under climate change. Here, we report the results using soils from 601 sites across four ecosystems (forest, grassland, cropland, and desert) in China. We determined the proportion of active microbiome by CTC (5-cyano-2,3-ditolyltetrazolium chloride by flow cytometry). We demonstrate that the proportion of soil active microbiome is 1.55% (ranging from 0.02% to 19.63%) in China, which was increased along the latitude. The highest proportion of active microbiome was showed in forest, and the croplands exhibited the lowest proportion of active microbiome even without significant difference with desert. Sufficient available nutrients (nitrogen and phosphorus) directly extended the proportion of active microbiome, which might be positively driven by climate change (precipitation and the minimum annual mean temperature). These findings imply that the soil original nutrient availability would affect the tiny but functional active microbiome under climate change. This underscores the importance of isolating the active component in soil microbiome–climate feedback assessments. Quantitative differentiation of active biomass offers a more accurate evaluation of ecologically relevant microorganisms actively contributing to ecosystem functions.



Keywords: soil active microbiome,biomes,CTC,soil nutrient availability,climate change

ID ABS WEB: 138175

7. Soil sciences impact on basic knowledge
7.06 132267 - Pedodiversity: major driving factors and influences on ecosystem features

HUMAN IMPACT ON SOIL DEVELOPMENT IN THE COASTAL PLAINS OF POLAND

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The main cause of anthropogenic changes in the environment along the coast of the southern Baltic Sea in Poland was hydrotechnical and regulatory works initiated already at the end of the 19th century and carried out on a large scale, e.g. construction of river channels, polders, flood banks, breakwaters, and melioration network. In this study, we analyzed 66 soil profiles from studies carried out in the years 2010-2022, representing coastal soils formed on marine and marine-riverine sediments in the following locations: Szczecin Lagoon (the reverse delta of the Swina River), Kamien Lagoon, Puck Lagoon, Vistula River delta (including its artificial mouth - Przekop). It was demonstrated that anthropogenic changes in local environmental conditions in the Baltic coastal zone caused contributed to the formation of soils with specific morphology and properties. The most important effects of direct or indirect human impact included:
- changes in direction, rate and type of sedimentation - growth of new land with alluvial soils,
- a significant increase in the heterogeneity of soil properties in vertical (multi-stratified soils) and horizontal gradients, reflecting the high dynamics of the local depositional environments,
- development of the technogenic soils made of human-altered and human-transported materials,
- occurrence of polygenetic soils,
- soil paludization together with an increase of soil salinity within polders and alluvial islands, resulting in the succession of unique and protected halophilic vegetation,
- loss of organic soils in the meliorated areas,
- the potential risk of release of potentially toxic elements into the environment due to the formation of acid sulfate soils.
The results showed that the spatial pattern of the coastal soils is more complex than indicated by the available cartographic material. The data obtained may be useful in the management of coastal areas, much of which is under protection.

Keywords: acid sulfate soils,Baltic Sea,coastal soils,soil diversity,soil transformation

ID ABS WEB: 138254

7. Soil sciences impact on basic knowledge
7.06 132267 - Pedodiversity: major driving factors and influences on ecosystem features

FIELD SCALE SOIL VARIABILITY AND ITS DIAGNOSTIC DESCRIPTION SUPPORTING PRECISION FARMING

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Field scale soil and terrain variability responsible for yield variation is not provided by the existing soil maps. This study aims to demonstrate the feasibility and inevitable nature of the field mapping to provide the data and interpreted soil information for the interpretation of biomass variation and the identification of the treatment necessary to handle the variability. A traditional approach of using remotely sensed information, high resolution terrain data and geomorphology together with field soil profile characterization, sampling and lab analysis to understand the horizontal and vertical variability of the field was used to develop a spatial soil description model capable of explaining the within field variability. This information complemented with the current surface crop conditions and the crop performance can be used to understand the acting processes and select adequate treatments for appropriate management. The soil variability is explained by WRB diagnostics. The aim was to test the diagnostic approach to explain the existing variability and test its capability to describe the differences and drive the soil management and agrotechnological approaches.
Several heterogeneous agricultural parcels have been selected for the study with different soil types and soil forming conditions. Approximately 100 Soil profiles have been opened with the depths of 100 to 150 cm. All of these profiles have been described in the field and all soil morphological features have been recorded and interpreted. Profiles have been sampled by genetic horizons and chemical and particle size analysis have been performed. Lab data and morphological characterization were interpreted together to understand and identify the soil unit and their spatial extension.
It was concluded, that WRB diagnostics can be used to describe the differences between the management zones. However, the less variable fields often have significant, but small differences between the different units, which stays within one diagnostic class. Therefor the diagnostic description does not differ, but these small differences are still need to be expressed in the management.

Keywords: Precision farming,Management zones,soil classification,soil mapping,soil forming factors

ID ABS WEB: 138091

7. Soil sciences impact on basic knowledge
7.07 133540 - The Bright Future of Pedology

MEASUREMENTS OF RADON GAS IN SOIL: NATIONAL INTERCOMPARISON OF THE CAFFARELLA PARK IN ROME. GEOPHYSICAL, GEOLOGICAL, AND LITHOLOGICAL ASPECTS OF THE SITE.

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Over the years, the measurement of radon gas in the soil has become a tool for indirectly assessing the radon risk in confined environments and providing elements of knowledge on the geology and nature of the soil in different territories. Therefore, the measurement of radon gas in soils can be considered a tool for the classification of areas that have different concentrations of radon activity. In Italy the Legislative Decree n.101/2020 (transposition European Directive 2013/59/Euratom), has sparked new interest in these topics not only from a radioprotection point of view, but also geophysical aspects of great interest. This work describes the experience of the Laboratories for the Measurement of Environmental Radioactivity of Research Institutes and Environmental Protection Agencies: CREA, ARPA Calabria, ARPA Piemonte, ARPA Val D'Aosta, and FIORAD carried out in the field for the measurements of radon gas in soil during the National Intercomparison by ASSORADON and AIRP (May 2022). The measurements were carried out in Caffarella Park (Appia Antica Regional Park), from the Alban Hills towards Rome. This area is of considerable interest for aspects of geology and for lithological differences (alluvial deposits, Pozzolanelle and Lionato Tuff of the eruptive unit, black and red pozzolans). The area was divided into two different sites (hilly and flat) where exercises were carried out to determine the concentration of radon gas in the soil, at various sampling points. Each Laboratory used different sampling techniques with soil probes approximately one meter long. Different measurement methodologies and algorithms were then compared. In this work, the results of the concentrations of radon activity in the soil (Rn-222, kBq/m3) are proposed, with an associated uncertainty for each measurement site and for each sampling point. The data were validated by the Organizers of the Intercomparison. The results obtained in the field survey showed the validity of radon gas measurements for the lithological characterization of different sites and as monitoring system, indicator of soil health and quality.

Keywords: Radon-222,Soil,Radon gas measurement method

ID ABS WEB: 140122

7. Soil sciences impact on basic knowledge
7.07 133540 - The Bright Future of Pedology

NEW WAYS OF REPRESENTING SOIL: DRAWINGS ACTORS IN SOIL'S MILIEU

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Traditional images of soil already have a difficult problem to solve, which is the familiar representational paradox of how to represent both objects and processes. All soil is said to consist of particles of three sizes —sand, silt, and clay— weathered from an original geologic parent material. However, the processes of the material can be more important to its identity than the ratio of these three constituent particles. In the case of urban soils, things happen all the time that may never happen again in human history, and its not clear which of them might recur often enough to produce the repeating patterns that taxonomic thought requires. In this sense, the end of natural history for soil is not the end of soil science, nor is it the end of taxonomic thought, it is simply the end of the long 20th century project to produce universal soil knowledge.

In order to include both material and processes in the representation of soil. We have described a new way of drawing soil both for general public but more in particular to designers that will depict a location Milieu.

To do so soil will be represented by a number of soil characters which are agents in the soil milieu. Each portrait will embrace this balance between objects and processes that we hope has pragmatic value as a faithful reflection of the material relationships elaborated. The method developed for drawing each soil portrait closely reflects a method for researching it.

In this poster, we seek to produce descriptions of soil that acknowledge the full range of human and non-human desire that participates in the process of the soil's formation and, for ethical reasons, we want to produce this portrait of the emergence of the soil's identity. These soil portraits are the set of human and non-human relationships that contribute to the soil's formation rather than the shapes that contribute to the soil's physical appearance.

Keywords: Interdisciplinary integration,Soil representation,Soil divulgation,Soil knowledge

EPOSTERS

ID ABS WEB: 140132

7. Soil sciences impact on basic knowledge
7.07 133540 - The Bright Future of Pedology

TRANSLATING SOILS THROUGH DRAWING: AN ALGORITHMIC LANGUAGE TO REPRESENT SOIL DYNAMICS

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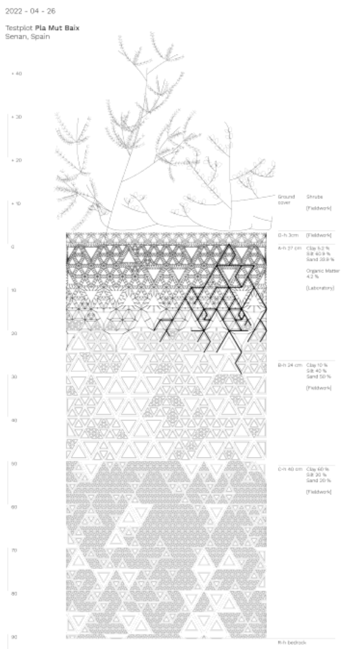
Representing the complexity of soils requires a delicate process of translation, whereby specific properties of a particular soil are abstracted into a drawing. Such representations are not neutral. In design disciplines such as landscape architecture, drawings are the basis for iterative spatial thinking. Thus, what is (or is not) included in the drawing can have dramatic effects on the eventual outcome of the design process. This is very much the case when representing the heterogenous characteristics of soils. Tools for representing soils that enable their consideration as living systems in processes of urban transformation are therefore much needed.

This poster will present a drawing language that supports the development of dynamic soil diagrams. Here, data such as soil texture, organic matter content and available water content are rigorously translated through a standardized drawing language. By representing different soil profiles consistently, it is possible to quickly compare key elements to understand the potentials of each condition. Since the drawings are developed with parametric drafting software, it is possible to quickly modify them to represent change over time or possible design iterations.

The drawing language is a simple structure that is informed by widely accepted scientific understandings of soil. This structure is of course reductive; in order to retain legibility, many of the elements that make a soil unique are not included. Such abstraction is necessary for clear design thinking. Additionally, the simplicity of the language invites ongoing revision and evolution. It is introduced as part of the first semester of the ETH Zurich Master of Landscape Architecture program and students modify the drawing language to respond to particular conditions, such as the complexities of urban soils. In this way, the drawing language adapts in response to soils that it encounters, evolving through regular use and collective input to be able to represent the heterogenous anthropogenic soils that increasingly define our urban environment.



Keywords: Interdisciplinary integration,Soil representation,Design,Soil knowledge

ID ABS WEB: 140675

7. Soil sciences impact on basic knowledge
7.07 133540 - The Bright Future of Pedology

THE GLOBAL SIGNIFICANCE OF SOIL SCIENCE EDUCATION: INNOVATIVE EDUCATIONAL APPROACHES AND LOCAL COMMUNITY IMPACTS AT THE UNIVERSITY OF TOKAJ

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Drawing on the experience of soil education at the University of Tokaj, we argue that soil education is of global importance, is a fundamental component of ecosystems vital to humanity, and is critical to ensuring a sustainable future (Koriem et al., 2023).
We want to engage in professional discourse with experts worldwide to develop effective methods and international cooperation. Soil science education in economics and viticulture focuses on the economic aspects of land use planning, which is topical in our region where the use of different volcanic soils in viticulture is intensive. The topics taught include "Soil quality and fertility," "Microclimate and terroir," and "Sustainable management." These topics have been chosen because they can significantly increase the market value of grapes and wine produced on the volcanic soils of Tokaj-Hegyalja and help position the region as a unique brand in terms of "Market value and branding."
In parallel with the definition of the training content, the university's methodological innovations have also focused on soil cultivation. Our applied pedagogical culture is based on constructivist pedagogy, where learners are active participants rather than passive recipients (Rygg, Kristin, et al. 2021) in creating and interpreting knowledge. Constructivism has been at the heart of pedagogical innovation for two decades (Sudzina, 1997). The methodology is particularly effective for subjects with an interdisciplinary approach, such as soil science (Koriem et al., 2023)
In designing the curriculum, we used prior sensitization, where local soil knowledge plays a prominent role in developing sustainable soil management practices (Currie, 2014). This knowledge can contribute to more effective soil conservation strategies and community soil management (Huynh et al., 2021). Involving local communities and considering their knowledge is essential for improving soil management practices. Combining local knowledge with scientific knowledge can help to develop sustainable soil management practices (Bleeker, 1983; Winkler Prins, 1999).
After evaluating the results of our pilot project, we concluded that Bronfenbrenner's Ecological Systems Theory is valid. Inland planning means taking into account the relationships between local communities (micro level), regional authorities (meso level), national policies (exo level), and global environmental trends (macro level).
We argue that using Adaptive Management in land planning is justified, which means that planning strategies are flexible and can adapt to changing environmental and social conditions.

Keywords: soil science education, sustainable development goals, constructivist pedagogy, problem-based learning, soil quality, microclimate, sustainable management, local community involvement, ecosystem theory, adaptive management, soil management strategies, interdisciplinary approach.

EPOSTERS

ID ABS WEB: 136002

7. Soil sciences impact on basic knowledge
7.08 133542 - Knowing topsoil to manage ecosystems

MICROBIAL ECOLOGY AND SOIL EVOLUTION

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Purpose: to try to understand how soil generates and works. Four experimental areas: dust on concrete square, 10 cm of raw construction sand on this same concrete, bare vegetable garden soil, cultured vegetable garden same soil.

Two radiation sensors were placed above these areas to measure the incoming (turned up) and departing (turned down) light - pyranometer (305-2800 nm) and pyrgeometer (4500-50000 nm) - from May to September. Temperature sensors were placed in the soil on the surface, at a depth of 5 and 10 cm (Figure 1). The soil was analyzed at the beginning (April) and at the end (August) of the experiment looking for: pH, totC, OC, totN, Ca, K, Mg and Na. With 3 samples per case, the following control trends were recorded: pH and CO decreased in bare soil, while they increased in the other three cases; total N increased in all cases except in vegetated soil; Ctot/Ntot increased il all cases except in bare soil; Ca increased and K decreased in all cases; Mg decreased in all except sand, while Na increased on cement and sand, and decreased in soil and vegetated soil.

Using the primers 16S for bacteria, 18S for Eukaryotes and ITS for fungi, the content in Operational Taxonomic Units of these categories of living organisms clearly distinguishes the dust of the concrete square from the other substrates, which in turn separate along a gradient that goes from sand to bare and cultivated soil. Some organisms definitely prefer dust on concrete (Cyanobacteria and Actinobacteria; Chloroplastida and Stramenipiles), others real garden soil (Chloroflexi and Acidobacteria; Eucaryota, Rhizaria and Amoebozoa; Glomeromycota).

The radiative balance is different in the 4 situations, with a shift in the balance towards redder emitted radiation when the complexity of the system increases. The study of these data is still ongoing, but we will have the definitive results to be presented to the Congress.

Figure 1. Right: arm with sensors above freshly sown bare soil; next to it you can see the same unsown area. Top left: arm above area with crops, next to area with bare soil. Bottom left: area with culture after two months.

Keywords: Soil microbial diversity,Evolution,Radiation Balance,Humus,Soil ecology

EPOSTERS

ID ABS WEB: 136833

7. Soil sciences impact on basic knowledge
7.08 133542 - Knowing topsoil to manage ecosystems

NEW INTERGRADES HUMIPEDONS: THE RESURRECTION OF ENTIFORMS?

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Nearly all primary biogeochemical cycles in terrestrial ecosystems predominantly happen within soils, particularly in the uppermost layers. Topsoil horizons form the humipedon that thus constitutes an interaction system and a functional transition between biotic and abiotic components.

A consortium team of specialists proposed field keys to identify and classify humus forms using descriptive and functional features as the variations in the thickness of the layers (OL, OF, OH, A), the occurrence (zoA) or not (nozA) of organo-mineral aggregates (sgA, msA, miA, meA, maA). Following the most recent classification, terrestrial humipedons spread into Terro (Mull, Moder, Mor, Amphi, Tangel), Anthropo (Agro- and Technoforms) and Parahumus (Ligno-, Rhizo-, Bryo- and Crustoforms) systems. Hence, the soil biota is at the core of the build-up of humipedon, and the A layer represents the overall engineering processe, mainly driven by plant roots and earthworms that create stable biogenic aggregates (miA, meA, maA).

Nevertheless, in regularly disturbed environments such as floodplains (Fluvisols), mountainous environments (Leptosols) and urban ecosystems (Technosol and Anthrosols), there is an intermediate step between raw materials (sediments, colluvium, recycled building debris) and stable biogenic aggregates. In such cases, the biota plays a crucial role, as do the granulometry (slab, blocks, stones, sand, etc.) and the nature (mineralogy, weathering resistance) of the parental mineral material. The French soil taxonomy has already highlighted the importance of soil texture with the J layer (from French 'jeune', young), where biogenic aggregates consist of organo-mineral aggregates, however less stable than those observed in an A layer. Consequently, the J horizon is a functional soil layer which usually evolves towards an A layer over time. Integrating this J layer in the classification of humus forms would be very useful to better describe the transition between Terro-, Anthropo- and Parahumus systems in environments containing vast amounts of raw materials. We propose to improve the current classification and add new intergrades humipedons called 'Litho' that decline in PsammoLitho, PeyroLitho and SterroLitho.

Three soil types along an elevation gradient from the direct vicinity of the Sarine River to the mature forest situated onto a terrace at a distance of 150 m (FR, Grandvillard, Switzerland). Left: willow bushes, Litho (Psammolitho) and Leptosol (Fluvic), with a J horizon (Baize and Girard 2009) ; middle: alder forest, Eumull and Calcaric Fluvisol; Right: ash and beech mature forest, Oligomull and Fluvic Cambisol.
Organic matter and sand particles are first juxtaposed (left), then the integration begins with the formation of aggregates (middle), and finally, resistant and stable aggregates are formed (left). The formation of aggregates and the integration of the organic matter progressively increase under the influence of earthworms.

Keywords: humipedon,intergrades,humus forms,Lithoforms

ID ABS WEB: 137263

7. Soil sciences impact on basic knowledge
7.08 133542 - Knowing topsoil to manage ecosystems

SOIL METAPHORS TO SHARE KNOWLEDGE AND BUILD TRANSDISCIPLINARY REPRESENTATIONS

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In his publications about soil pH and Redox, an agronomist compares the soil to a battery recharged by plants, which act as solar panels.
Zimbabwean farmers who met for a focus group discussion, said the soil is like a road that takes one to a desired destination.
In a Senegalese agroforestry landscape where the soil has been described as a granary, the tree is a pillar, which ensures the solidity of the construction depending on the spacing of the pillars. And the fallow period is the time needed to repair, build or rebuild.

Metaphors about soils are numerous and play a role in the way problems are addressed by scientists and by practical experts such as farmers.
Exploring metaphors as mental images to be shared and investigated can feed a deliberative process amongst stakeholders with different visions, knowledges and sciences.
Metaphors complement each other, sometimes they overlap. With metaphor-developing interviews and workshops, we brought experts to share their knowledge on soil and to grasp the limit of what can be explained by only one metaphor. Thus, we promote a plurality of metaphors and a kind of awakening of metaphorical consciousness, about their influence on representation and their heuristic power.
With more than 150 soil metaphors that we grouped into several sets (heritage, living being, communities, source of knowledge…), the collection continues and aims to involve scientists, farmers and other stakeholders in an active process where mental images can be co-constructed in dialogue.
Metaphor use for transdisciplinarity is like gymnastics that requires warming up and brings flexibility, that is, the ability to combine research from different disciplines. Gymnastics also brings strength, that is the capacity to change paradigm by integrating proposals from sometimes unrecognized experts called in for deeper metaphorical exploration.

Keywords: participatory research,interdisciplinarity,social-ecological dynamics

ID ABS WEB: 136214

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

AGRONOMIC APPROACHES FOR CROPPING SYSTEMS AT LOW GLOBAL WARMING POTENTIAL

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In the context of Climate Change (CC), the word resilience takes on a particular and at the same time more clearly defined meaning. As suggested by the Intergovernmental Panel on Climate Change (IPCC), agriculture, and similarly the cropping systems, can be defined as resilient to CCs to the extent that they are characterized by and are based on strategies that simultaneously have a high capacity for adaptation and mitigation, i.e. that have the ability to adapt effectively to climate CCs by reducing their negative impacts on the productivity and quality of agricultural products and at the same time the ability to reduce the effects of the chemical-physical processes that cause CCs, ultimately minimizing the emissions of greenhouse gases (GHGs) that cause the CC.
The aim of this communication is to analyze agronomic practices for their ability and effectiveness of mitigation, in other words to identify the agronomic levers through which the farmer can reduce the emission of GHGs, thus optimizing cropping systems with an integrated approach that preserves crop productivity and soil fertility, minimizing their Global Warming Potential.
The analysis of agronomic practices effective in reducing the Global Warming Potential is carried out on the basis of recent meta-analyses and on the results obtained in long-term research in progress in Italy and in particular at the experimental farm Podere 124 of CREA in Foggia (Southern Italy) concerning the management of crop residues and the comparison of conservation practices with conventional tillage and minimum-tillage in the cultivation of durum wheat.

Keywords: soil fertility,mitigation,agronomy

EPOSTERS

ID ABS WEB: 136799

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

DELIVERING, SAFE, SUSTAINABLE, TAILORED & SOCIALLY ACCEPTED SOIL IMPROVERS FROM CIRCULAR FOOD PRODUCTION PROCESSES FOR BOOSTING SOIL HEALTH: THE DELISOIL PROJECT

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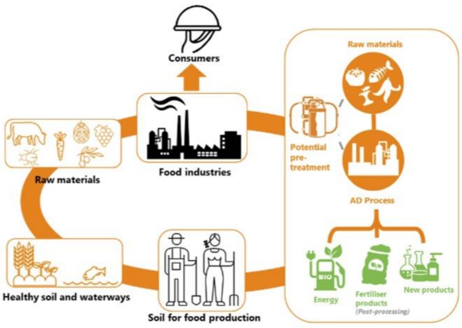
Soils are healthy when they are in good chemical, biological, and physical condition, and thus able to continuously provide their important ecosystem services. DeliSoil project is embracing the opportunity offered by the circular bioeconomy to use waste and by-products from the food industry to develop organic fertilisers with the potential to replace their mineral counterpart and improve soil health in Europe. DeliSoil's overall goal is to contribute to the European Union's Mission "A Soil Deal for Europe", by enhancing soil health and improving the sustainability of food systems. This will be achieved by developing improved recycling and processing solutions for food industry residues, to produce safe, sustainable, tailored, and societally accepted soil improvers in the EU, in collaboration with the EU Soil Observatory (EUSO) and other EU projects. DeliSoil will apply a circular bioeconomy approach to the waste hierarchy through the development of 5 regional Living Labs (LLs) focused on improving soil health in Europe. DeliSoil's LLs will include the most relevant actors along the entire food value chains and will use innovative technologies to convert residues from food processing and production industries into tailored soil improvers. Research partners and companies will evaluate the soil improvers in state-of-the-art laboratories, and landowners will test the project's solutions . The tailored soil improvers will be tested for stability, biosafety, molecular parameters, and their impacts on soil health. Their agronomical performance and environmental risks will be also assessed. Environmental footprints will also be measured for selected products. We will identify technological, legislative, financial, and social barriers and enablers for the conversion of food processing residue streams into organic soil improvers and fertilising products and use these results to analyse fairness throughout the LLs value chains. Together with stakeholders, we will build communities and create networks to facilitate knowledge sharing of DeliSoil's key exploitable results. Funded by the European Union under the Horizon Europe Program, Grant Agreement No. 101112855 (DeliSoil).



Keywords: SOIL IMPROVERS,ORGANIC FERTILISERS,SOIL HEALTH,SUSTAINABLE AGRICULTURE,CIRCULAR BIOECONOMY

ID ABS WEB: 136881

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

PRINCIPLES AND VALUES OF RESILIENT NETWORKS OF LONG-TERM SITES FOR RESEARCH ON AGRICULTURAL SUSTAINABILITY AND SOIL HEALTH

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At a time when agriculture is facing unprecedented, multifaceted and interlocking challenges, such as the imperative need to address food security and sustainable production in a context of climate change, loss of biodiversity and wilderness, ecological overshoot, crossed planetary boundaries, demographic growth, and socio-economic and political instability, more than ever, agricultural research is needed. Particularly, well-designed and well-conducted long-term studies are indispensable for a trustworthy understanding of agroecosystem function and sustainability. Hitherto, many long-term sites for agricultural research are focused on the evaluation of the effects of treatments (e.g., inorganic vs. organic fertilization) and, less often, agricultural systems (e.g., conventional, ecological, regenerative) on crop yield and environmental sustainability, mainly in terms of rationalization of inputs and degradation-improvement of soil health. Alas, in the light of the state of degradation of agricultural soils (soil is the basis of agroecosystem sustainability), emphasis must be placed on the long-term links between crop yield and soil health. To this aim, new principles and values must be incorporated, under the adaptive management paradigm, to the design and conduction of long-term agricultural studies. In the Basque Country (Spain), a network of long-term research sites has been established to assess the effect of different agricultural systems on crop yield, paying special attention to biodiversity conservation, climate change mitigation-adaptation and, primarily, the restoration of the functional integrity of the soil and the regeneration of the capacity and capability of the soil ecosystem to provide services. Some of the principles and values that have guided the design of the network are: (i) balance between short-term and long-term goals; (ii) technification directed towards sustainability; (iii) overcoming the dualism between production vs. conservation; (iv) overcoming the mechanistic, element-based orthodoxy when analysing soil health; (v) links between aboveground and belowground biota, biodiversity and resilience, abiotic and biotic components, and hierarchical processes-fluxes and emergent properties; (vi) an eco-ethical cosmovision that integrates the 3 Ps (people, planet, profit); and (vi) biomimicry-based strategies.

Keywords: Soil health,Biodiversity,Resilience,Sustainability,Intangible heritage

ID ABS WEB: 137127

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

DESIGNING POLYSACCHARIDE CAPSULES FOR FASTER POLLUTANT TRANSFORMATION BY BIOGENIC OXIDES

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Microbially produced manganese oxides (BioMnOx) are potent oxidants and adsorbents for a wide variety of environmental pollutants. BioMnOx are often more reactive than their abiotic counterparts, are formed under mild conditions, and are continuously replenished by the microbes; they are therefore a cheaper and more sustainable alternative to synthetic oxides. Encapsulation, which aids in recovery and reuse and minimizes washout of the cells and oxides, is especially favorable for such a self-regenerating system. In this study, BioMnOx encapsulation liquid-core capsules made of natural polysaccharides was investigated for the first time, in order to improve post-encapsulation pollutant oxidation kinetics. Two contaminants, glyphosate and bisphenol A, were selected as model compounds representing distinct oxidation patterns. Different capsule compositions were examined to ensure rapid diffusion with high preservation of the oxides and oxide-forming bacteria. Thanks to the strong relationship between oxidation kinetics and oxide levels, BioMnOx localized inside the capsules removed glyphosate significantly faster than suspended oxides, and their reuse for several treatment cycles was demonstrated. Bisphenol A, which is more sensitive to diffusion rates than to oxide concentrations, was removed by encapsulated BioMnOx at nearly the same speed as in suspension. Our results show that liquid-core encapsulation can allow efficient reuse of nature-based catalysts at reduced treatment times and catalyst inputs compared to suspended or gel-encapsulated configurations, ultimately making such catalysts more attractive and promoting sustainable remediation techniques.

Keywords: Organic pollutants,Remediation,Bacteria,Oxides,Polysaccharides

ID ABS WEB: 138031

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

IMPACT ON SOIL QUALITY AND LEACHEATE UNDER AVOCADO CROPS IRRIGATED WITH WASTEWATER

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Mediterranean areas are characterized by a strong spatial variability that makes the soil hydrological response highly complex. Some seasons provoke dramatic changes on soil properties determining the runoff rates, such as soil water content or soil water repellency. Regarding the adaption of water needs to local conditions, important advances have taken place in the last years thanks to the use of different parameters to evaluate the water status of soil. The hydrological response of a soil is defined by: (a) the surface characteristics; (b) the physical, chemical, and biological properties that define it, and (c) the hydrologic properties. Estimation of the water status of the soil has been widely used in soil science as a tool for quantitative analysis. Main objective of this case study was to analyze technosol and irrigation water physical and chemical properties dynamics in the pot experiment with lysimeters. Pot experiment with Avocado rootstocks was equipped with lysimeters in the facilities of the "La Mayora Experimental Field site" of the Higher Council for Scientific Research (Spain). The scheme of the pot experiment included three sources of irrigation: a) ground water; b) regenerated municipal wastewater (100%); c) mix of ground and regenerated municipal wastewater (50 / 50%). Chemical analysis data indicate that the reclaimed wastewater does not meet irrigation requirements in terms of pH, EC and due to the significant content of sodium and chlorine. Even groundwater satisfies irrigation water qualitative requirements partially. The suitability of irrigation water on pH level can be characterizes mainly as unsuitable and doubtful. Diluting regenerated wastewater with groundwater following the 50% principle led to decreasing of the potential risks for salinization of ground water connected with leaching of the leachate. The dynamics of the change in the volume of leachate is related to precipitation, the frequency of irrigation and different manifestations of the physical, mineralogical and chemical properties of technosols.

Keywords: LYSIMETERS,WASTEWATER,AVOCADO,SOIL QUALITY,IRRIGATION

ID ABS WEB: 140672

7. Soil sciences impact on basic knowledge
7.09 133552 - Nature based solution for sustainable soil and water management

NATURAL MINERAL-BASED SOIL CONDITIONERS

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In the past fifty years, the nutrient supply of soils has been severely weakened in agricultural areas, mainly due to large-scale monoculture and intensive cultivation methods based on short-term synthetic fertilizers. Soil minerals have many functions, such as increasing the nutrient absorption capacity of plants, adjusting the pH of soils, and providing nutrients to plants. Mineral based soil conditioners can be divided into two main groups according to their use and recoverability: In the soil zone (in the depth of the soil profile) and below the soil zone (deeper situated materials). The first group, materials originating from the soil zone, include:
1. materials of marshland soils (peat, marshes, moss, lime mud),
2. top layers of meadow soils (containing clay minerals and humus) and loess,
3. calcareous formations in the subsoil of higher lying fields of the saline lowland areas.

The second group, the deeper materials below the soil zone represent the most diverse category of natural mineral soil conditioners:
1. limestone (monomineral, mostly biogenic, sometimes chemical sedimentary rock, calcium carbonate content at least 90%, mostly calcite),
2. dolomite (calcium-magnesium carbonate trigonal crystalline mineral),
3. alginite (sedimentary rock composed of algae biomass and volcanic tuff), mined in the region of Gérce, Hungary,
4. zeolites (sodium calcium aluminosilicates, spacious, hollow, porous),
5. rhyolitic tuff (volcanic, high silica, sour, contain pumiceous, glassy fragments and small scoriae with quartz, alkali feldspar and biotite),
6. perlite (high-water holding capacity, felsic, by heating heavily swollen glass rock), marl (sedimentary, clay-carbonate rock),
7. bentonite (a clay-type, dominant elements may be aluminium, potassium, calcium and sodium, with a water retaining capacity of 15 - 20 times its volume),
8. potassium trachyte (high potassium spillage rock with white, sanidine crystals),
9. sanidine is the high temperature form of potassium feldspar with a general formula $K(AlSi_3O_8)$, mixture of gypsum anhydrite and lignite powder,
10. dudarite NPK (brown coal-based soil enhancer with more than 60% humic acid content mined in the Dudar area, Hungary).

Improving the soil's natural mineral content is an important part of healthy plant cultivation and essential for modern organic farming. Natural mineral soil conditioners do not conflict with each other and do not cause problems when used together. However, it is unnecessary to exceed the recommended application rates.

Keywords: mineral-based soil conditioners, marshland soils, dolomite, limestone, alginate, zeolites, rhyolitic tuff, perlite, bentonite, potassium trachyte, sanidine, dudarite, soil pH, nutrient absorption capacity

ID ABS WEB: 136680

7. Soil sciences impact on basic knowledge
7.10 133558 - Mechanisms of interaction of (harmful) substances with the soil phase

PLANTS RESPONSE TO HOUSEHOLDS ASHES IN SOILS – AN EXPERIMENTAL APPROACH WITH RAPHANUS SATIVUS AND SPINACIA OLERACEA

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Coal combustion in households generate ashes. Field observations demonstrate that people use household ashes as additives in garden soils. Thus, the aim of our study was to determine the plants response to household ashes in cultivated soils. Furthermore, the research focusing on the effect of Pseudomonas fluorescens, soil bacteria, on metal(loid)s mobilization in ash amended soils, is ongoing.
Soils were collected from arable field and from garden in central Poland. Following treatments were prepared: (a) control soils, (b) soils with 10% of ash from household 1, (c) soils with 10% of ash from household 2. Two plant species were cultivated consecutively: R. sativus and S. oleracea. Afterwards, chemical composition of soils and plants as well as soil properties were determined.
Ash from household 1 was characterized by the higher content of Ni, Cu, and Cr (up to 185 ppm of Cr) relative to ash originating from household 2. In turn, higher contents of Zn, Pb, Co, and As were noted in ash from household 2 (up to 1897 ppm of Zn) relative to household 1. The addition of household ashes to soils increased metal(loid)s content in soils. Both ashes also increased the pH, C and S content of both soils. The effect of ashes on chemical composition of plants was also observed. For example, Al content in roots and leaves of R.sativus increased in all treatments compared to control soils. In turn, zinc content in this plant species mostly increased in garden soil amended with household ash 2 (up to 74 ppm). The uptake of Al and Zn by S.oleracea was more diversified.
Our study demonstrated that addition of household ashes to soils can improve some soil properties like pH. However, household ashes are the source of metal(loid)s leading to increase of elements in plants and yield of such elements. Therefore, soil fertilization with household ashes is not recommended due to the potential toxicity effects.

Keywords: household ash,metal(loid)s,food production,garden soils,phytoavailability

ID ABS WEB: 138033

7. Soil sciences impact on basic knowledge
7.10 133558 - Mechanisms of interaction of (harmful) substances with the soil phase

COMBINATION OF IN-SITU ENHANCED SOLUBILIZATION AND CHEMICAL OXIDATION TECHNOLOGIES FOR THE REMOVAL OF DNAPLS FROM SOILS

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Contamination by low-solubility organic contaminants in the form of dense non-aqueous phase liquids (DNAPLs) is a widespread problem influencing numerous groundwater system. Over the past decades various technologies have been testing for the removal or in-situ remediation of DNAPLcontaminated subsurface systems, such as in-situ enhanced solubilization (ISES) and in-situ chemical oxidation (ISCO). This study examines the synergetic effects of combined surfactant enhanced dissolution with in-situ oxidation of a pool-dominated DNAPL sources zone entrapped in heterogeneous porous media. The experiments are used to investigate the impact of DNAPL source zone architecture, surfactant-enhanced dissolution, and permanganate oxidation on removal behavior and to assess the interaction of the surfactant-enhanced and chemical oxidation processes. Results show that enhanced removal of entrapped DNAPL mass from soil can be achieved when these two remediation processes are jointly applied. Critical factors include the contact time between the water and the solubilizing solution as well as the potential interference of the solubilizing agent with the oxidation process.

Keywords: Soil Remediation,Chemical Oxidation,DNAPLs

ID ABS WEB: 136343

7. Soil sciences impact on basic knowledge
7.11 133570 - Digging deeper: Advances in subsoil science

SAPROLITE AND REGOLITH AS CRUCIAL STRATA OF THE SUBSOILS IN THE MID-LATITUDES – EXAMPLES FROM THE BAVARIAN FOREST (GERMANY)

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Saprolite is the product of long term chemical weathering derived from underlying rock e.g. within crystalline landscapes like the Moldanubian Massif (Bavarian Forest). In these terms it is the zone of weathered rock. Regolith is known as the interplay of processes that break down rock with processes that weather and transport. Regolith as well as saprolite are controlling the properties of the critical zone as the weathered profile. In many soilscapes they function as subsoil substrates. Rock strength, regolith and saprolite thickness, hydraulic transmissivity, chemical weathering fluxes, tree rooting depth and nutrient availability all depend to some degree on the thickness and character of the weathered profile. The Bavarian Forest is presenting quite a lot of examples. In bedrock land- and soilscapes, those dominated by bare rock and soils derived from underlying rock, the interplay of processes that break down rock with processes that weather and transport regolith as well as saprolite controls the properties of both the subsoils and the critical zone. Regolith is often generated by periglacial slope processes and their deposits (PSD). PSDs cover nearly all mid- and high mountainous landscapes, even in the Mediterranean region. The genesis of Saprolite refers to Mesozoic times, often starting in the late Paleozoic, depending on the tectonic expression of landscapes. In our investigation area Saprolite genesis started in Jurassic times without any interruption until the Quaternary. Saprolite is characterized by mineralogical and geochemical parameters. The spatial variations in weathered profile characteristics are discussed. Beside sampling soil pits and cores from percussion drilling the prospection of the shallow subsurface is based on geophysical exploration, mainly Electrical Resistivity Tomography (ERT) and Ground Penetrating Radar (GPR), but also on Shallow Seismic Refraction (SSR).

Keywords: Saprolite and Regolith,Periglacial Slope Deposits,weathering fluxes,hydraulic transmissivity,geophysical prospection

ID ABS WEB: 136350

7. Soil sciences impact on basic knowledge
7.11 133570 - Digging deeper: Advances in subsoil science

THE IMPORTANCE OF SUBSOIL WHEN INVESTIGATING SOIL ORGANIC CARBON PERSISTENCE IN PERENNIAL AGROECOSYSTEMS WITHIN ALPINE VALLEYS.

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Studies on soil carbon (C) dynamics to date focus primarily on topsoil, despite an estimated ~50% of soil C being stored in subsurface soils. These deeper soil layers are thought to be dominated by C that has formed mineral-associations and is more persistent than its labile counterpart. Understanding the efficacy of this could be critical in developing practices aimed to mitigate climate change by increasing C storage in agricultural soils. The aim of this study is therefore to explore differences in soil C fractions in topsoil and subsoil in perennial agroecosystems, to gain an understanding of how C dynamics change along the soil horizon. For this purpose, soil samples at 0-30 cm and 30-60 cm were collected from four apple orchards in South Tyrol, Italy. Samples were analysed for labile C fractions (dissolved organic carbon (DOC), humic and fulvic acids (HA/FA), hot water extractable carbon (HWEC), permanganate oxidisable carbon (POXC), particulate organic matter (POM)) and the stable C fraction (mineral-associated organic matter (MAOM)).
Results indicate that soil samples taken from deeper layers contained significantly lower concentrations of labile C fractions (HWEC, POXC and POM) across all sites, with HWEC measuring up to 2 times lower in subsoil. However, when examining the MAOM, results show the proportion of stable (MAOM) to labile (POM) C was significantly higher in the subsoil, with MAOM constituting ~73% in subsoil, and just ~61% in topsoil. Furthermore, the concentration of C in the MAOM was ~2 times higher than in the POM. These results highlight the importance of subsoil in the study of soil C storage, as indicated by the larger proportion of MAOM. Furthermore, it underlines the importance of identifying and quantifying C fractions at different sampling depths and understanding their associated turnover rates. This will facilitate a deeper comprehension of C cycle dynamics within these environments and will in turn provide insight into the relevance of subsoil when studying C dynamics in agroecosystems.

Keywords: Carbon sequestration,Carbon storage,Subsoil,Carbon fractions,Apple orchards

EPOSTERS

ID ABS WEB: 136751

7. Soil sciences impact on basic knowledge
7.11 133570 - Digging deeper: Advances in subsoil science

STABILIZATION OF ORGANIC CARBON IN TOP- AND SUBSOIL BY BIOCHAR APPLICATION INTO CALCAREOUS FARMLAND

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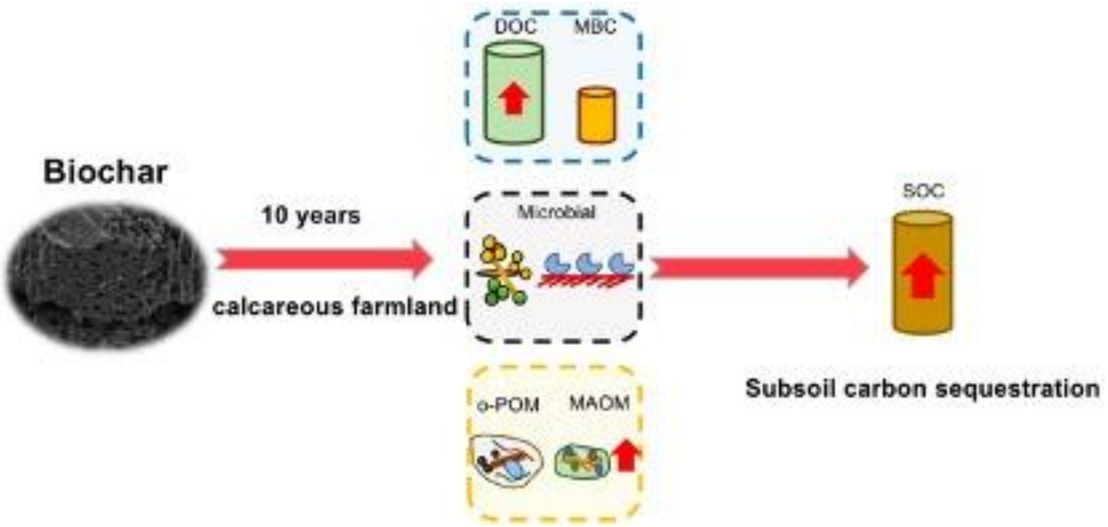
Biochar is recognized for its role in carbon sequestration and emission mitigation in farmland topsoil. However, the mechanisms by which biochar affects soil organic carbon (SOC), its composition, and stability, in the topsoil (0–20 cm) and subsoil (140–160 cm) remain unclear. Applying biochar to the calcareous farmland topsoil significantly increased the topsoil SOC contents by 33 % after a decade, with a 5 % increase in dissolved organic carbon (DOC) contents (topsoil) and a substantial increase of 162 % in subsoil DOC contents. Additionally, humic substances showed an increase of 24 % (topsoil), while low-molecular-weight water-extracted DOC exhibited a remarkable increase of 142 % in the subsoil. The application of biochar significantly increases the contents of SOC, DOC, and microbial biomass carbon (MBC) in the topsoil, as well as SOC and DOC contents in the subsoil. However, a slight decrease is observed for MBC content in the subsoil. Biochar-amended soil significantly suppressed enzyme activity in the topsoil and decreased alpha diversity in topsoil and subsoil while increasing the content of mineral-associated soil organic matter (MAOM). These observed changes are conducive to stabilizing SOC, emphasizing MAOM formation as a primary mechanism for carbon sequestration in both topsoil and subsoils. This study provides evidence that biochar contributes to the long-term organic carbon sequestration in calcareous farmland, highlighting the importance of considering both topsoil and subsoil when evaluating the dynamic impacts of biochar on SOC.



Keywords: Soil organic carbon,Subsoil,Biochar,Stabilization,Transport

ID ABS WEB: 136756

7. Soil sciences impact on basic knowledge
7.11 133570 - Digging deeper: Advances in subsoil science

BIOCHAR STIMULATES INORGANIC CARBON PRECIPITATION IN THE SUBSOIL

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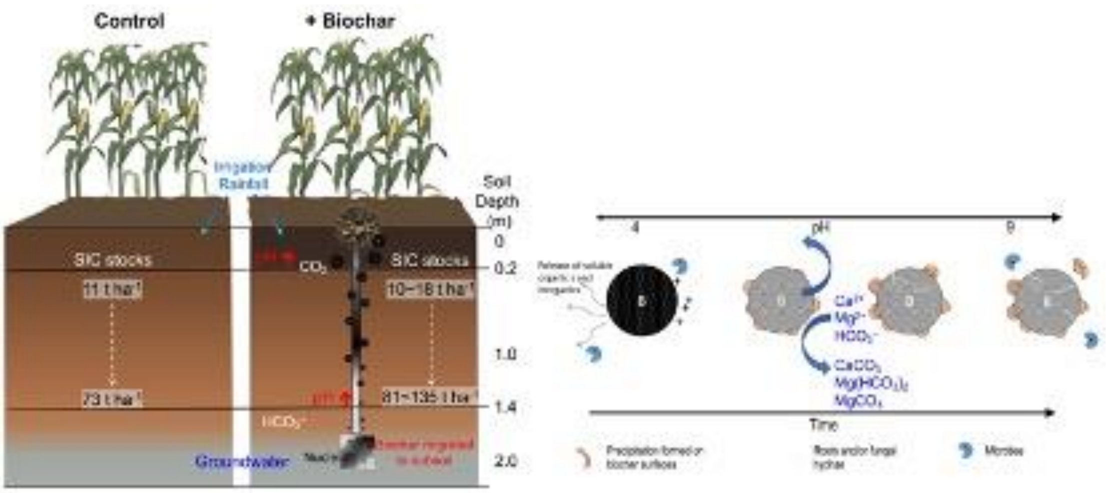
Biochar amendments add persistent organic carbon to the soil and can stabilize rhizodeposits and existing soil organic carbon (SOC), but the effects of biochar on subsoil carbon stocks have been overlooked. We quantified changes in soil inorganic carbon (SIC) and SOC to 2 m depth ten years after biochar application to calcareous soil. Biochar application at 30, 60, and 90 t ha-1 rates significantly increased SIC by 10, 38, and 68 t ha-1, respectively, with accumulation mainly occurring below 1 m. To explain SIC accumulation in subsoil with biochar amendment, the interacting mechanisms are proposed: (1) biochar amendment significantly increases subsoil pH, and (2) the transported biochar in subsoil can act as nuclei to precipitate SIC. Biochar amendment enhanced SIC by up to 80%. Thus, the effects on carbon stocks in subsoil must be understood to inform strategies for carbon dioxide removal through biochar application. Biochar incorporated into calcareous topsoil significantly stimulates soil inorganic carbon storage in the subsoil, which provides new insight into biochar's effect on soil carbon stocks and is beneficial for CO2 removal strategies. Our study provided critical knowledge on the impact of biochar application to topsoil on carbon stocks in subsoil in the long term.



Keywords: Soil inorganic carbon,Biochar,Migration,Subsoil,13C signature

ID ABS WEB: 139545

7. Soil sciences impact on basic knowledge
7.11 133570 - Digging deeper: Advances in subsoil science

SUBSOIL CONSTRAINTS FOR CROP PRODUCTION: RECENT ADVANCES, NEW TECHNOLOGIES AND PRIORITIES FOR FURTHER RESEARCH

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Globally, the existence, prevalence, and severity of subsoil constraints for crop production are under recognised and under reported. A diverse range of subsoil constraints (acidity, alkalinity, compaction, deep sand layers, gravel layers, high density horizons, nutrient deficiencies, pans, pathogens, salinity, sodicity, waterlogged horizons) may be natural features of soil profiles and some are induced by land use and management practices. The subsoil in this context is considered to be the layers of the root zone below the depth of sampling for soil analysis, which typically corresponds to soil below 10-25 cm depth, depending on the soil sampling conventions of the region. Tropical regions, in particular (in Africa, Asia, Northern Australia, and Latin America), contain large areas of deeply weathered profiles that commonly have hostile subsoils that constrain root growth. The main consequence of subsoil constraints is that water and nutrient contained in subsoils are not accessed or efficiently utilized and hence crops fail to reach their yield potential. Even when best management practices are applied to the topsoil, yield of crops is depressed by subsoil constraints. Crops may acquire up to 75% of N, 85% of P and 70% of K uptake from the subsoil if root growth is not constrained. Technologies to chemically, physically and or biologically ameliorate subsoil constraints represent a promising frontier for soil management, with the potential to substantially lift crop productivity in many parts of the world. In addition, technologies are needed to accurately sense, identify and map digitally the existence and distribution of subsoil constraints.

Keywords: water uptake,nutrient uptake,root growth,mapping,land management

ID ABS WEB: 140094

7. Soil sciences impact on basic knowledge
7.11 133570 - Digging deeper: Advances in subsoil science

A NEW NONPARAMETRIC WATER ISOTOPE MXING MODEL FOR PLANT WATER SOURCING

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The knowledge of where and when plants absorb water in soil is critical to understanding how plant cope with drought and to precision management. However, current mixing models such as MixSIAR are inaccurate and exhibit high uncertainty. To address this limitation, this study introduced a nonparametric B-spline to approximate the root water uptake pattern, thereby creating CrisPy-Spline mixing model. To evaluate the performance of CrisPy-Spline, we conducted virtual and field-based tests under various prior information and results were compared to CrisPy and MixSIAR. In the virtual tests, CrisPy-Spline demonstrated RMSE of root water uptake proportions ranges of 10.7%-38.7%, and smaller than that from MixSIAR (17.8%-43.1%). Additionally, CrisPy-Spline consistently showed the lowest uncertainties of root water uptake profiles among the three models. Further assessments through posterior predictive checking revealed accurate reconstructions of plant water isotopic distributions by CrisPy-Spline under all prior information. They displayed mean absolute error in the mean of plant water isotope composition of 18O at 0.056‰ and 0.076‰, respectively, with mean absolute errors in the standard deviations at 0.008‰ and 0.008‰, respectively. By contrast, MixSIAR exhibited higher mean absolute errors in the mean and standard deviation of plant water isotopoe composition of 18O at 0.285‰ and 0.244‰, respectively. In the field test, available soil water and fine root distribution were used as the prior information. CrisPy-Spline exhibited the least uncertainty of root water uptake among the models. Moreover, when anticipating almost zero root water uptake from a certain depth interval based on soil water availability information, only CrisPy-Spline and MixSIAR aligned with this feature. Furthermore, leave-one-out cross-validation demonstrated that CrisPy-Spline exhibited the highest expected log pointwise predictive density (-3.3) compared to MixSIAR (-4.5), indicating a superior accuracy of CrisPy-Spline. Therefore, CrisPy-Spline can be a robust tool for plant water partitioning.

Keywords: Soil hydrology,Soil physics,Soil Water,Ecohydrology,Water isotopes

ID ABS WEB: 136810

7. Soil sciences impact on basic knowledge
7.12 133581 - Soil mineralogy: current state and perspectives

SHALLOW SOILS DERIVED FROM AND UNDERLAIN BY SILICATE SOLID ROCKS IN COLD ENVIRONMENTS: PROPERTIES, MINERALOGY, AND GENESIS

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The shallow soils derived from and underlain by solid silicate rocks in the cold environments of the tundra and taiga zones of Eurasia are mostly acidic and enriched in organic matter and Fe and Al compounds. Study of these soils allows to assess: (i) patterns of initial soil formation; (ii) allochthonous or autochthonous origin of the soil fine earth, and (iii) weathering and alteration of inherited minerals in the soil profiles. Summarizing the results, several soil groups depending on the presence of phyllosilicates in the solid rocks can be considered.
(i) Inceptisols and Spodosols on the rocks with low contents/ absence of phyllosilicates. The soils have formed in the autochthonous fine earth accumulations, mostly formed due to rock disintegration. The initial stage of fine earth formation affected by biofilms was also disclosed: in the autochthonous accumulations the rock fragments remain attached to the solid rock due to the release of extracellular polymeric substances by the biofilms.
(ii) Inceptisols and Spodosols with different assemblages of inherited clay minerals. Soil mineralogy reflects the influence of the subjacent solid geology leading to the occurrence of the inherited minerals that are rare in acidic soil environment (talc, serpentine, nontronite, and saponite) in the soil profiles. Pedogenesis can enhance the weathering of the contribution of inherited minerals (micas, chlorite) into mixed-layer structures including swelling clay and vermiculite. Besides, rock weathering led to the formation of iron-clay-organic coatings on the surface of rock fragments retarding its further weathering and protecting inherited minerals.
(iii) The rare example of Gelisols that are alkaline oppositely to the groups mentioned above and that have developed from the ultramafic rock. Whereas intensive chemical weathering of inherited silicates (olivine, serpentine) led to smectite occurrence in the profile that is absent in the rock. That illustrates the scenario of soil formation slightly affected by pedogenesis, but from the “mature” fine earth due to the chemical weathering.

Keywords: Rock weathering,Pedogenesis,Inherited clay minerals,Initial soil formation,Biofilms

ID ABS WEB: 136011

7. Soil sciences impact on basic knowledge
7.13 133768 - Soils of the past for present and future

THE DYNAMICS AND HIGH-RESOLUTION DISTRIBUTION OF AL FORMS IN A DESERT PALAEOSOL (CENTRAL IRAN): ENVIRONMENTAL IMPLICATIONS

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Aluminum is one of the most important and abundant elements on Earth's surface. The dynamics of this element has been widely studied in acidic soils and in the soils of the Mediterranean bioclimatic regions while there are very limited data about the dynamics and forms of Al in Aridisols. The aim of this study was to evaluate the dynamics of Al forms in a relict palaeosol and its environmental significance in an arid setting of central Iran. The studied soil is located on an upper terrace without impacts of groundwater and alluvial materials from adjacent landforms. We investigated different forms of aluminum (total (Alt), amorphous (Alo) and crystalline (Ald)) and also the mineralogical composition of the soil using a high-resolution sampling strategy (10 cm interval). The soil has the highest content of total Al near the surface. The amount of crystalline aluminum is the highest in the middle part of the pedon and does not show any significant trend with depth while the amount of amorphous aluminum, the Allophane index (Alo+ 0.5Feo) and Alo/Ald ratio increased exponentially towards the soil surface. Mineralogical analyses revealed that the clast fraction of the soil lacks in smectite and K-feldspar minerals while smectite is abundant in fine earth fraction in the middle part of the pedon. The K-feldspar content increased exponentially towards the soil surface with a maximum content in dust-derived vesicular horizons. These findings suggest the formation of smectite in the soil environment by pedogenic processes and the addition of K-feldspar onto the soil surface by dust. Therefore, the soil experienced a profound environmental change from an environment that was characterized by chemical weathering to an environment of the accumulation of Al-bearing dust. Our study highlights the importance of the dynamics of aluminum in arid soils which must be considered for paleoenvironmental reconstructions as well as considering Al as a product of hydrolysis processes and an immobile element of weathering in soils.

Keywords: Paleoenvironment,Geochemistry,Mineralogy,Dust influx,Aridification

ID ABS WEB: 136174

7. Soil sciences impact on basic knowledge
7.13 133768 - Soils of the past for present and future

MICROBIOTA, BIOCHAR AGEING AND SOIL CHEMISTRY OF CHARCOAL KILN IN MEDITERRANEAN FORESTS

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Charcoal kilns are ancient structures used for charcoal production. The aim of this study was to describe the chemical and microbiological features of soil and charcoal particles collected in kilns platforms. Kilns from two mountain sites i.e., Gelbison and Vesole located in Southern Italy, were selected. Standard soil chemical analyses i.e., pH, organic carbon, salinity, macro- and micronutrients, were combined with next-generation sequencing techniques to describe bacterial and fungal microbiome. Charcoal species identity was studied by anthracology approach while imaging through scanning electron microscopy (SEM) combined with energy dispersive X-ray spectroscopy (EDS) was performed to characterize the topological and elemental composition of charcoal particles. Moreover, reflectance Fourier transform infrared spectroscopy (DRIFTS) was used to assess biochar surface oxidation. Finally, we also conducted a bioassay with three crops, Glycine max, Zea mays, and Solanum lycopersicum, to investigate the potential effects of the soil kiln on plant performance. Contrary to our hypothesis, the soils of charcoal kilns don't have higher pH, cation exchange capacity, and is not richer in cations i.e. N, P, K, Ca, and Mg. SEM-EDS spectra and FTIR revealed that charcoal buried in forest soil for decades undergoes substantial oxidation compared to recently produced charcoal. In fact, the O/C ratio rises considerably while the FTIR has shown the presence of oxygenated functional groups including phenolic, alcoholic, and carboxylic. Charcoal surface was selectively enriched of Ca^{2+} on the site with limestone parent rock but of Al and Si over sedimentary (flysch) substrate. The differences between the soil of the kiln and the surrounding were significant but not dramatic, both in terms of diversity and composition of taxa. Finally, the bioassay with three crops suggests the microbiome present in the kiln has a greater beneficial effect than that of external forest soil. This study revealed the unicity of kiln microsite and began to discover the long-lasting effects of charcoal accumulation in modulating soil chemistry and microbiota in forest soil.

Keywords: Anthracology,Charcoal kilns,Biochar,Terra Preta,Microbiome

ID ABS WEB: 136190

7. Soil sciences impact on basic knowledge
7.13 133768 - Soils of the past for present and future

UPPER PLEISTOCENE PRECIPITATION VARIABILITY FROM COZUMEL ISLAND (MEXICO), FROM RECORDS OF THE EPIKARSTIC (SOILS) AND KARSTIC (SPELEOTHEM) SYSTEMS

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In tropical and subtropical regions, stalagmites may represent archives of past hydroclimatic information; their carbon and oxygen isotope composition may be related to the amount of precipitation. The macro- and micromorphological characteristics of the soils may also indicate different moisture-drought Yucatan Peninsula (YP), most of these records in the karstic and epikarstic systems address the temporality corresponding to the Holocene and focus fundamentally on the evidence of the droughts that could have caused the Mayan civilization's collapse. In this study, a speleothem from the Island of Cozumel is analyzed for the first time, and we present oxygen and carbon isotopic records from that span the time interval between 22.3 and 11.8 ka BP, from the 2-meter-long stalagmite named "Chempita." The 18O values for the period between 22 and 13.8 ka BP are the slightest negative in our record, ~ -1.5 ‰ on average; these values suggest a low level of precipitation. Our data indicated an increase in precipitation over a time interval of ~440 yr between 13.8 and 13.4 ka BP with the most negative values of 18O (-3.05 ‰). For this temporality YP, there is evidence of the formation of soils with Btk horizons that present illuviation cutans related to humid conditions. For the subsequent period between 13.4 and 11.8 ka BP, the value of 18O increases; they suggest an aridization process related to the appearance of carbonate nodules in the Btk horizons of the soils. On the other hand, 13C values do not vary considerably throughout the entire record, with values that could suggest the presence of little vegetation cover, especially C4-type plants. Only in the time interval 13.8 -13.4 ka BP are the values lower, possibly because of greater humidity. These results provide a better understanding of regional precipitation variability.

Keywords: soil,epikarst,speleothem,stable isotopes,Mexico

EPOSTERS

ID ABS WEB: 136499

7. Soil sciences impact on basic knowledge
7.13 133768 - Soils of the past for present and future

PEDOLOGICAL AND MINERALOGICAL PROPERTIES OF PALAEOSOLS NEAR PRIVLAKA IN CROATIA

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The study was carried out on the pedosedimentary complex in coastal region of Croatia. The aim was to describe the pedological and mineralogical properties of the palaeosols and to compare them with the recent soils.

The field investigations comprised the definition, description and sampling of palaeosol horizons of the 8 m thick sequence of glacial-fluvial deposits, palaeosols and recent soils. The pedological analyses were carried out using standard methods. The mineralogical composition was determined using the X-ray powder diffraction method.

The pedological properties: soil texture, bulk density, porosity, pH, SOC, $CaCO_3$ of paleosols show great variations. Comparison of the properties of palaeosols with those of recent soils shows considerable differences. The palaeosols are predominantly reddish in colour and have a significant amount of carbonate concretions and rhyzoconcretions, whereas the recent soils are brownish and without carbonate redistributions. The palaeosols are characterised by a higher percentage of sand particles and a lower percentage of silt particles than the recent soils. The recent soils have higher pH values and SOC contents, and lower $CaCO_3$ contents than the palaeosols.

The mineralogical composition of palaeosols and recent soils consists of quartz and calcite with feldspars (K-feldspar and plagioclase), goethite and clay minerals (kaolinite and mica). They differ in the presence of chlorite, which was recorded only in the recent soil, while Ti- and Mn-oxides, Ch-hydroxides were only found in the palaeosols.

The results show that the palaeosols were subjected to intense pedogenesis, consisting of sequences of carbonate leaching, rubefaction and clay illuviation; which is typical of a warm and humid climate and in which stable minerals (kaolinite, Fe- and Mn- oxides and hydroxides) predominate in the sediments under oxidative conditions. In contrast to the palaeosols, the recent soil has a mineral composition that is more typical of a climate with cold, dry winters and warm, humid summers.

Keywords: palaeosol,recent soils,pedological properties,mineralogical properties,Croatia

ID ABS WEB: 137712

Topic: **7. Soil sciences impact on basic knowledge**
Sub Topic: **7.13 133768 - Soils of the past for present and future**

PALEO-GEOMORPHOLOGICAL AND MINERALOGICAL EVIDENCE FOR THE DEFINITION OF TIMING AND CLIMATE FRAMEWORK OF PALEOSOLS IN THE PALEOVULSINI VOLCANO (VULSINI VOLCANIC DISTRICT, CENTRAL ITALY)

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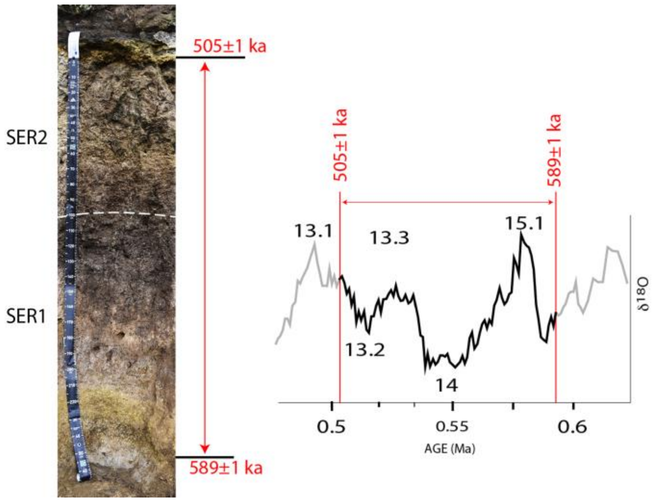
Two successive paleosols within the middle Pleistocene volcanic sequence of the Paleovulsini volcano (Vulsini Volcanic District, central Italy) have been analyzed in terms of paleo-geomorphological and mineralogical features. The paleosols, located in the eastern sector of the Vulsini District nearby Sermugnano and in hard-to-access outcrops around Civita di Bagnoregio, showed apparently similar for thickness and color variations, but different for paleo-morphological settings (planar / channel fill / slope inclined at 25°-30°). The lower paleosol (SER1) developed from a pumice fall level dated 589±1 ka and its pedogenesis was probably interrupted by a colluvial deposition, giving rise to a new cycle of pedogenesis. The C horizon of SER1 showed a trachytic composition with a primary mineralogy mainly made up of K-feldspars (sanidine), Na-feldspar (albite), Ca-clinopyroxene (augite) and phlogopite mica, associated with sparse secondary montmorillonite and pyrite, proving an alteration occurred under reducing conditions. The upper paleosol (SER2) was sealed by a non-erosive welded pyroclastic flow deposit ('nenfro') newly dated 505±1 ka. In the C horizon of SER2 are found analcimized leucite and frequent volcanic clasts of tephritic composition containing plagioclase and leucite, which indicate the deposition of a geochemically different parent material compared with the C horizon of SER1. As effect of the burial process by hot pyroclastic flow ('nenfro'), in the upper part of SER2 evidences of soil compaction, with partial lithification, and generally low content of total organic carbon were found. Based on the new date constraints, the performed analysis allowed to recognize that the development of the two paleosols occurred in an approximately 84-thousand-year time interval. However, considering that the pedogenetic processes involving SER1 and SER2 are still under study, it is difficult to exactly collocate the two paleosols within the climatic interval occurred between the beginning of MIS 15.1 and the early MIS 13.1.



Keywords: Pedogenetic processes,Buried paleosols,Mineralogy,Paleoclimate,Vulsini Volcanic District

ID ABS WEB: 137713

7. Soil sciences impact on basic knowledge
7.13 133768 - Soils of the past for present and future

BEDROCK IN THE PALEOSOLS SEQUENCE AT LATERA VOLCANO (VULSINI VOLCANIC DISTRICT, CENTRAL ITALY) TO DEFINE TIMING AND CLIMATIC FEATURES IN THE MIDDLE PLEISTOCENE (226-253 KA)

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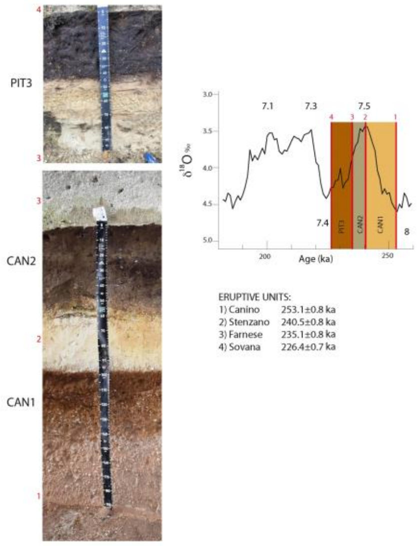
Three paleosols within the middle Pleistocene volcanic succession of the Vulsini Volcanic District (Central Italy) were investigated. Two paleosols are located near Canino in the southwestern sector, and one near Pitigliano in the northwestern sector (Latera volcano). The three paleosols are interbedded with pyroclastic deposits of the Latera volcanic activity and are well constrained in age to the 253-226 ka interval, allowing their correlation with the MIS 8 - 7.4 interval. The lower paleosol (CAN1) developed by trachytic pumice flow deposits during the 253-241 ka time interval corresponding to the late MIS 8 through MIS 7.5. The C horizon of CAN1 shows a primary mineralogy made up of prevalent sanidine, associated with plagioclase, Ca-clinopyroxene, phlogopitic mica, zeolites, and quartz, while hematite has secondary origin. The above paleosol (CAN2) developed by ash flow deposits between 241 and 235 ka, during the late MIS 7.5. Lack of quartz is observed in the C horizons of CAN2 at 65-70 cm of depth while scarce occurrence of quartz and presence of montmorillonite is found at 70-90 cm of depth. Scarcity of quartz is consistent with the trachytic composition (Si-saturated bedrock) of the C horizons. Then, the uppermost paleosol (PIT3) formed between 235 and 226 ka (an interval corresponding to the MIS 7.4 cold spell) by phonolitic pyroclastic flow bedrock made up of ash matrix, pumice lapilli and blocks with a mineral assemblage of sanidine, leucite turned in analcime, Ca-clinopyroxene, plagioclase, apatite and magnetite. In the C horizons of PIT3, the above mentioned primary minerals and pumice clasts are associated with secondary halloysite, smectite and quartz, which is likely allochthonous due to the Si-undersaturated bedrock composition. The present study provides the preliminary knowledge for the characterization of the paleoenvironmental conditions in which the pedogenetic processes produced the paleosols CAN1, CAN2 and PIT3.



Keywords: Buried paleosols,Trachytic composition,Horizon mineralogy,Paleoclimate,Vulsini Volcanic District

ID ABS WEB: 137887

7. Soil sciences impact on basic knowledge
7.13 133768 - Soils of the past for present and future

MICROMORPHOLOGICAL EVIDENCE OF PALEOENVIRONMENTAL CHANGES IN A MIDDLE PLEISTOCENE PALEOSOLS SEQUENCE OF THE VULSINI VOLCANIC DISTRICT IN CENTRAL ITALY

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The pedogenic processes occurred during the Middle Pleistocene were studied in a sequence of paleosols by integrating micromorphological observations of thin sections and SEM-EDS, with soil geochemical composition and selective extractions. The two oldest paleosols are located close to Canino (CAN1 and CAN2) while the third paleosol is near Pitigliano (PIT3). The development of CAN1, CAN2 and PIT3 occurred in different period intervals (13, 4 and 9 ka, respectively) on various pumice flow deposits of the Latera volcano. CAN1 showed a microporous structure filled by clusters of elongate phytoliths alongside concretions of Ti and Fe; large pumice fragments with signs of alteration and clay films were also observed. The A horizon of CAN2 showed large macropores and root channels filled by organic isotropic materials, while the mineral phase resulted moderately weathered (K-feldspars, pyroxenes, microcrystals of titaniferous magnetite, lava fragments). The lower pedogenic development of CAN2 vs CAN1 is confirmed by: i) higher Feo/Fed (0.37-0.43 vs 0.11-0.20) and lower Fed/Fet ratio (0.04-0.06 vs 0.11), ii) lower Alt/Sit (0.26-0.41 vs 0.42-0.50) and higher Alo-Alp/Sio. In the whole Canino sequence, the andic index (Alo+0.5 Feo) is always below 0.4%, indicating neither andic nor vitric properties, thus the soils do not meet the criteria for Andosols. In the more recent paleosol (PIT3), granular soil structure and high porosity, indicating an extensive biological activity, are associated with weakly weathered massive tuff fragments and primary minerals. In both A horizons, large amount of phytoliths were found as residues of root decomposition. In the Bw horizons, numerous anisotropic aureoles around microcrystals were observed, indicating the dissolution of Na-plagioclase. PIT3 showed andic index exceeding 0.4% in the Ab2 and Bw horizons, as well as lower contents of monovalent cations than CAN2, but similar Feo/Fed, Fed/Fet, Alt/Sit as CAN1. The pedogenesis of the three paleosols resulted well correlated with timing, but local conditions probably do not allow generalization on the climatic phases (MIS 8 - 7.4) effect on soils.

Keywords: paleosols,soil micromorphology,SEM-EDS analysis,selective extractions,soil geochemical composition

ID ABS WEB: 136287

8. Other
8.01 124518 - Assessing soil security

IS IT TIME TO CHANGE OUR THINKING ABOUT SOIL RADICALLY?

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For the sake of soil and its survival there are two aspects of thinking about it which require our attention and action urgently.

First, soil security is beginning to be recognised as a global existential challenge in its own right; and indeed as important as inter alia climate change, food security or biodiversity protection. In order to develop and disseminate that notion, which is beneficial to humanity, it is essential to take a soil-centric view. It is not enough simply to say that soil provides functions and services for other planetary and human existential purposes. Most importantly, soil is key to existence. Rather than criticising or downplaying it, we should advocate the soil-centric view with vigour and enthusiasm.

Secondly, we have developed soil science for over a hundred years and we are celebrating that dazzling century at this congress. To some degree a cursory view of soil security would imply soil with little to no human impact. Over the last thirty years we have begun to realise that the soil is finite as we have begun to run out of new areas to clear for cultivation. Principally, it is only over the the last decade we have finally realised that human forcings have begun to impact soil everywhere , not only in the places we have developed for agriculture. The realisation, that h humanity is fast becoming the most important soil-forming factor requires us to change our thinking substantially. The increase in temperature of soil profiles by at least 1C degree to depth all over the world, through human-induced climate change, will alter properties and increase the rate of soil processes everywhere. Are new genosoils currently evolving? Should our soil classification systems recognise the impact of humanity everywhere rather than tacking it on the end as an anthroposol or technosol? What should be our reference soils and the implications for assessing soil security?

Keywords: soil security,soil classification,soil centric,climate change

ID ABS WEB: 137314

8. Other
8.01 124518 - Assessing soil security

REVIEWING THE POLICY CONCERNS ON URBAN LAND SUBSIDENCE AND ITS RELATIONS TO URBAN SOIL QUALITY

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Earth is composed of soil, water and air. Among which, soil provide ground to live on and food to eat. Yet, modernization progressed by exploiting soil as epitomized in how national development efforts mostly started with paved roads. It was not until an increasing number of road/land subsidence were reported in urban areas, where there is no distinctive karst terrain with carbonate bedrock or mines nearby, that shed lights on the principal role of soil as “the ground to live on.” As land subsidence accompanies both human and economic losses in urban areas, the incidents called for serious policy attention. Water flow change (lowered groundwater level or water pipe leakage) and softened soil (soil degradation) are noted as two main causes through the government investigations. Water flow change occurs 1) when large urban construction projects like metro line extension, mega-complex building interfere with groundwater nearby or 2) water leak from damaged water pipe in supply system. Such anthropogenic interference gradually forms cavity underground that may result in road/land subsidence when surface pressure exceeds the threshold point. A frequent urban construction processes, in which soil is disturbed, compacted, and damaged, further increases hazard risks. The cases review confirmed that more land subsidence cases were reported after heavy rain in such “softened” soil areas (where composition of sandy to fine-grained soil is high and the number of deeply rooted trees is minimal). The review, thus, concludes that the urban land subsidence should be approached in two-track: a continued effort to eliminate the fundamental cause of groundwater depletion and to enhance soil quality to strengthen the surface intensity. An effective precautionary measures would include: 1) a more frequent underground investigation in soft soil areas, 2) an increased minimum distance between high-rise buildings and underground constructions, 3) an effective groundwater resource management, 4) regular maintenance of the water supply pipelines, 5) an increased green spaces with more deeply rooted trees in urban areas.

Keywords: soil security,urban area,land subsidence,soil degradation,groundwater

ID ABS WEB: 137900

8. Other
8.01 124518 - Assessing soil security

LAND USE AND LAND COVER ASSESSMENT UNDER THE SOIL SECURITY AEGIS

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Exploring the dynamics of land use land cover changes (LULCC) is essential to plan future landscapes that will reconcile the demand and maintenance of natural resources, contributing to reaching the targets of the Sustainable Development Goals. Therefore, decision-making guiding the governance of natural resources is directly linked to soil security. The present study explored spatiotemporal LULCC in an important river basin in Brazil (Rio Doce basin - RDB), where several challenges for its governance are strictly related to soil insecurity. We used LULC maps developed by the Brazilian MapBiomas project, which provides an annual time series of LULC maps from 1985 onwards and applied a pixel-by-pixel analysis to identify the presence/absence of LULCC, the modal classes of land use, as well as the variety and number of LULCC in 34 years of evaluation (1985 – 2018). Original RDB´s vegetation, Brazilian Atlantic Forest, is a top priority hot spot for biodiversity conservation and restoration. Nonetheless, pasture and agriculture currently represent the main land uses, covering around 70% of RDB. Our results show a reduction of the natural forest (-1.9 % of the total area) and pastures (-9.1%), and an increase of monoculture tree plantations (+2,83 %). LULCC had spatial variation and 50% of the basin did not present LULC changes during the studied period, especially in pasture areas known for their degraded condition. Soil insecurity caused by a history of severe exploitation for agricultural purposes has led to deforestation and governance problems related to water, energy, and food security. Soil security approach can lead the way to these challenges.

Keywords: Soil insecurity,Land use land cover,Land degradation,Brazilian river basin,Mapbiomas

ID ABS WEB: 137930

8. Other
8.02 133440 - Tailored microbiome-based solutions for a sustainable agriculture

COMBINING PHENOMICS AND GENOMICS ANALYSIS TO SUPPORT BIOPRODUCT DEVELOPMENT AND USE IN AGRICULTURE

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Environmentally sustainable practices are needed for present and future agriculture. Upcoming progress in agriculture and the food system should provide solutions to challenges posed by climate change while simultaneously reducing their environmental footprint. The European Community is committed to pursue a reduction in the use of chemicals, that impact biodiversity and soil health.
One potential solution is represented by the application of formulated bioproducts containing beneficial microorganisms which can be released in the environment to promote plant growth by means of their bio-stimulant, bio-pesticide, and/or bio-fertilizer properties. Their use, already a widely adopted practice world-wide, represents a valid and cost efficient alternative to chemicals, deemed to grow in the coming years. However, we need to increase our knowledge on the biological processes determining their efficacy in the field, to further promote their use.
In this work we explored the bio-fertilizer and bio-pesticide potential of the Paenibacillus polymyxa K16 strain, isolated from tomato roots, for its pre-market characterization as a novel bioproduct. Whole genome sequencing was used to infer its functional potential. Its phenotypic characterization was performed by standard plate methods, by phenotype microarray (carbon, nitrogen, and phosphate/sulphur utilization), and by production of volatile organic compounds.
Results showed that the K16 strain has different bio-fertilizer (conversion of nitrate in ammonia; phosphorous solubilization; siderophore production) and bio-pesticide (plate antagonism; FusaricidinB and PolymyxinB gene; production of pyrazine volatile compound) potential functions, and low presence of antibiotic resistance genes. Phenotypic analysis showed highest activity on carbon sources (with a large fraction of non-utilized compounds), but more generalised activity on phosphate/sulphur compounds. The observed genes and measured metabolic activity were connected in metabolic pathways analysis, pinpointing the features of K16 strain for nitrogen and sulphur metabolism.
Overall, different approaches were successfully used to explore properties that a novel bioproduct should possess to survive and then exert a beneficial action on plant growth. Our approach can highlight a bioproducts' inherent stimulatory, fertilizing and bio-pesticide features.

Keywords: Bioproduct,Bacteria,Multifunctionality,Genome mining,Phenotype microarray

ID ABS WEB: 138022

8. Other
8.02 133440 - Tailored microbiome-based solutions for a sustainable agriculture

ASSESSMENT OF PGP TRAITS OF BACTERIA ISOLATED FROM THE RHIZOSPHERE SOIL OF WILD MEDICINAL HERBS.

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Rhizosphere soil is rich in secondary metabolites and populated by numerous plant growth promoting (PGP) bacteria. They have different modes of action that could result in plant growth stimulation, such as nutrient availability improvement, control of pathogenic microorganisms, and production of plant hormones. Bacteria from genus Azotobacter, Bacillus, Pseudomonas and Streptomyces were isolated from the rhizosphere soil of six wild medicinal herbs, namely Achillea mile folium (yarrow), Agrimonia Eupatoria (agrimony), Plantago lanceolata (English plantain), Mentha longifolia (horse mint), Stachys sylvatica (hedge nettle), and Centaurea Jacee (brown knapweed). The main aim of this research was to assess the isolates PGP traits. Prior to that, morphological, physiological, and biochemical characterization were also performed. Out of total 36 bacterial isolates, 9 produced indole acetic acid (IAA), 10 demonstrated the ability to produce siderophores, and 27 were good producer of hydrogen cyanide (HCN). Significant number of isolates showed biostimulator potential, and the most important were Pseudomonas sp. K3/2 and K5/1, Bacillus sp. M3/1, Azotobacter sp. F1/2 and Streptomyces sp. S4/1. These isolates could serve as potential base in creation of a new microbe-based formulation.

Keywords: bacteria,growth promotion,rhizosphere,Pseudomonas,Streptomyces

ID ABS WEB: 138057

8. Other
8.02 133440 - Tailored microbiome-based solutions for a sustainable agriculture

ISOLATION AND CHARACTERIZATION OF BACTERIA FROM THE RHIZOSPHERE OF ECHINACEA (ECHINACEA PURPUREA L.)

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This study aimed to isolate and characterize bacteria belonging to the genus Azotobacter, Pseudomonas, and Bacillus from the rhizosphere of Echinacea (Echinacea purpurea L.). The characterization involved physiological assessments (such as the growth of isolates at different temperatures, acidity levels, NaCl concentrations, resistance to Cd and Pb, and the use of various carbon sources), biochemical analyses (including the production of lipase, amylase, pectinase, gelatinase, protease, and cellulose), and the characterization of plant growth promoting activities (the production of indole-3-acetic acid (IAA), siderophores, hydrogen cyanide (HCN), mineralization and solubilization of phosphorus) of the isolates.

From the rhizosphere of Echinacea, two Azotobacter isolates (designated as A17 and A18), three Pseudomonas isolates (designated as P45, P46, P47), and three Bacillus isolates (designated as B86, B87, B88) were isolated. The Azotobacter isolates exhibited notable resilience, demonstrating viability under elevated temperatures, specifically at 37°C, and a broad pH range from 5 to 9. However, it was observed that a higher concentration of Cd inhibited the growth of Azotobacter isolates. Both isolates exhibited the capacity to utilize all examined carbon sources and produced pectinase, lipase, IAA, and HCN, while also utilizing organic and inorganic phosphorus.

Pseudomonas isolates exhibited optimal growth at 10°C, and on media with pH levels of 5, 7, and 9. All Pseudomonas isolates demonstrated the ability to produce pectinase, lipase, IAA, siderophores, and HCN. Notably, these isolates could utilize both organic and inorganic phosphorus sources.

In the case of Bacillus isolates, optimal growth at 37°C, and on media with pH levels of 7 and 9, were observed. These isolates utilized glucose and galactose as carbon sources and produced all tested enzymes, IAA, siderophores, and HCN. The Bacillus isolates could utilize both organic and inorganic phosphorus sources.

This comprehensive characterization provides valuable insights into the physiological and biochemical properties of these microbial strains, contributing to the broader understanding of the potential applications of PGP microorganisms in plant growth promotion.

Keywords: Azotobacter,Bacillus,Pseudomonas,PGP,medicinal plants

ID ABS WEB: 138306

8. Other

8.02 133440 - Tailored microbiome-based solutions for a sustainable agriculture

CHANGES IN SOIL MICROBIOTA AND METABOLIC PROFILE IN PONTOSCOLEX CORETHRURUS (OLIGOCHAETA) GUT UNDER COFFEE PLANTS

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Pontoscolex corethrurus, a tropical and geophagous earthworm, is recognized for its beneficial impact on plant growth, due to its mutualistic relationship with soil microorganisms residing in its digestive tract or casts. These microorganisms are thought to play a fundamental role in key processes, such as nitrogen fixation and the production of plant growth substances, which are essential for a healthy interaction between the earthworms and plants. Despite this assumption, the specific influence of the gut microbiota of P. corethrurus on such processes has not been definitively established. Therefore, our study aimed to explore the functional potential of the microbiota within the earthworm's gut and casts, particularly in its interaction with Coffea arabica and C. canephora plants. We observed variations in soil metabolism across the foregut, hindgut, and the casts of the worm, as well as the soil under the coffee species. LEfSe analysis was performed to determine enriched bacterial genera and Picrust2 to predict functional profiling of the microbiota in soil, foregut, hindgut, and cast. This analysis revealed enriched bacterial genera in each environment, particularly noting the presence of Streptomyces and Bradyrhizobium in the foregut and hindgut. Bradyrhizobium is recognized for its nitrogen-fixing ability, as well as some Streptomyces species. Additionally, Micromonospora was identified in association with these genera. Besides, the metabolic profiles of each compartment revealed unique compounds; specifically, 1H-indole-3-acetamide, precursor of indole-3-acetic acid, was tentatively identified exclusively in the foregut, and abscisic aldehyde, precursor of abscisic acid, was identified in the hindgut under both coffee species, among others. Thus, still need to be linked to which bacteria produce these metabolites. These observations emphasize the complexity of interactions and the role of earthworms in modulating bacterial composition and the metabolic profile of the gut content, as well as the probable nitrogen fixation in the soil. Our results provide new insights into the ecological role of P. corethrurus, highlighting its contribution to soil dynamics and plant growth.

Keywords: earthworms,gut microbiota,metabolic profile,nitrogen fixation,bacteria

ID ABS WEB: 136481

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

EFFECT OF COVER CROPS IN THE FERTILITY OF GALICIAN VINEYARD SOILS, NW SPAIN

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The use of cover crops is a sustainable agricultural practice which aims at soil conservation, reducing soil erosion and loss of nutrients, and promoting soil life. This study implemented cover crops in vineyard soils to assess if they provide the necessary nutrients for the optimum vine growth, maintaining the soil fertility and allow reducing N-P-synthetic fertilizers. Three different treatments (by triplicate) were conducted at three sampling times throughout one cultivation cycle in five vineyards belonging to two Designation of Origin in NW Spain. Two different cover crops' incorporation methods were also tested: 9 surface or 36 buried cover plots. In total, 45 experimental plots have been analyzed obtaining 135 soil samples. The treatments were a) synthetic fertilizers-conventional dose, b) ½ dose-synthetic fertilizers + cover crops, c) only cover crops. Cover crops were a mix of legumes (Vicia sativa, 60%) and cereals (Avena sativa 10%, Hordeum vulgare 30%). Sampling times were at pre-seeding, spring and after mowing. Soil parameters analyzed were pH, EC, CEC, TC, TOC, macro- and micronutrients. A multifactorial statistical analysis was performed considering the three factors. As the interactions among them were not statistically significant, they were analyzed individually. Only the factor of time provided significant differences for Ca, Mg, Zn and CEC. This could be explained by the moment of sampling coinciding with different vines phenological stage, i.e., the second sampling time coincided with the moment of the greatest nutrient consumption. In addition, the parameters affected were secondary macro- and micronutrients, which are present in soil in lower concentrations, being more prone to changes. No differences among treatments and management indicated that all of them provided the same contents for soil fertility, resulting that cover crops maintained the same levels of nutrients than the synthetic fertilizers. This highlighted that the use of cover crops is a sustainable agricultural practice that may result a good alternative to traditional management in vineyards, allowing reducing the use of synthetic fertilizers.

Keywords: Sustainable agriculture,soil fertility,cereals,legumes,synthetic fertilizers

ID ABS WEB: 136643

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

THE INTERACTIVE EFFECTS OF ARBUSCULAR MYCORRHIZAL FUNGI AND RHIZOBACTERIA SYNERGISTICALLY ENHANCE MAIZE GROWTH BY IMPROVING NUTRIENT UPTAKE

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Maize (Zea mays L.) is an important crop around the world. Symbiosis with arbuscular mycorrhizal fungi (AMF) is beneficial for maize to absorb nutrients from the soil. Evidence of the interactions between AMF and soil bacteria suggests that their combined function is important in promoting soil nutrient uptake. To evaluate the effects of AMF on the bacterial community in the rhizosphere of maize, we conducted greenhouse experiments with and without AMF inoculation. Here, we first examined the response of bacteria in the rhizosphere of maize roots to AMF inoculation by 16S rRNA gene amplicon sequencing and metagenomic sequencing. Then we explored the synergistic functions between rhizosphere bacteria and AMF through synthetic community and maize plant inoculation experiments. AMF significantly increased maize biomass and nitrogen (N), phosphorus (P) and potassium (K) concentrations. Based on 16S rRNA gene amplicon sequencing and metagenomic sequencing, we found that five core bacterial genera, including Pseudomonas, Methylotenera, Flavisolibacter, Methylophilus, and Rhodococcus, were consistently enriched in the rhizosphere of maize inoculated with AMF. The five core bacterial genera were positively correlated with maize biomass and concentrations of N, P, and K. We isolated Pseudomonas, Flavisolibacter, and Rhodococcus from the rhizosphere of AMF-colonized maize and identified their function in N, P, or K metabolism. Further inoculated experiments from the synthetic community revealed that AMF and these strains synergistically enhanced maize growth and promoted NPK uptake. The cooperation between AMF and the core rhizosphere bacteria attracted by mycorrhizae significantly promotes maize growth. Our findings indicate that the synergistic effect between AMF and rhizosphere bacteria may stimulate the release of soil NPK and increase the nutrient transfer to host plants. This study provides a way to exploit AMF and bacteria interactions to overcome soil nutrient deficiencies in sustainable agriculture.

Keywords: Arbuscular mycorrhizal fungi,nutrient uptake,maize,rhizosphere bacteria

ID ABS WEB: 137221

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

RESPONSE OF SOIL GROSS NITROGEN MINERALIZATION TO FERTILIZATION PRACTICES IN CHINA'S UPLANDS

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Improving soil nitrogen (N) supply capacity is recognized as a viable solution for sustaining cereal production for food security, since more than half of N absorbed by crops comes from the soil through the gross N mineralization (GNM) process. However, significant uncertainties exist regarding GNM patterns driven by commonly used fertilization practices in croplands. Based on soils collected from 13 long-term fertilization trials spanning over 30 years across China's uplands by using the 15N dilution technique, we found that manure application led to the highest stimulation of GNM (188.7-966.1%), followed by straw (75.5-472.8%) and chemical fertilizer (6.7-389.1%), compared to unfertilized treatment. Fertilization-induced GNM changes were primarily influenced by the initial soil pH in the chemical fertilizers and straw treatments, and by soil clay content in the manure treatment. The structural equation model identified that the increases in soil pH and clay content indirectly promoted GNM by enhancing soil properties (e.g. total dissolved N) and associated microbial attributes (e.g. N-acquiring enzyme activity, bacterial and fungal biomass). These findings underscore the potential of prioritizing chemical fertilization and straw applications in high pH soils, and manure in heavier texture soils, to maximize soil N supply. This knowledge is crucial for developing policies aimed at reducing N fertilizer use and N losses in China.

Keywords: Gross N mineralization,Fertilization managements,Soil properties,Microbial biomass,Controlling factor

ID ABS WEB: 137347

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

SILICON FERTILIZATION ENHANCES PHOTOSYNTHETIC PIGMENTS CONTENTS, PHOTOSYNTHESIS RATE, AND YIELD OF SOYBEANS IN CONTRASTING SOILS

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Studies about silicon (Si) fertilization are scarce in no-Si accumulator plants such as soybeans, especially on the association between Si uptake and Si availability in soils without stress conditions. This study evaluated whether Si rates applied in contrasting soils increase Si availability in soils, Si uptake by leaves, biomass, and pod yield, and enhance physiological aspects of soybean. The experiment was conducted in pots (100 L) in a completely randomized factorial scheme with 4 Si rates (0, 250, 500, 750 kg ha-1 Si), 3 soils: Quartzipsamment (RQ), Rhodic Hapludox (LV) and Rhodic Acrudox (LVdf), and 4 repetitions from November/22 to March/23 at Piracicaba, SP, Brazil. Ca-Mg silicate was used as a Si source. All plots received the same quantities of Ca, and Mg using lime and/or MgCl2 when necessary. Net CO2 assimilation rate (A), plant transpiration (E), stomatal conductance (gs) and electron transport rate (ETR), relative water content (RWC), chorophyll a, and b (Chla, Chlb), carotenoids, and Si concentrations were evaluated in the 2nd trifoliate leaves, and dry biomass of pods (P) and stem+leaf (AP) in the phase R8. Soluble Si in 0.01 CaCl2 mol L-1 was determined in soils. ETR and gs were only influenced by soils. The rates of Si (Y) increased only Chla (Y=0.009X + 53.339, R2=0.70*), carotenoids (Y=0.003X +14.180, R2=0.79*), RWC (Y=0.008X+66,8, R2=0.78*), Si in leaves (Y=0.003X+3.637, R2=0.95*), independently of soil, and soluble Si of RQ (Y=0.006X+3.837, R2=0.89*), LV (Y=0.012X+4.667, R2=0.93*), and LVdf (Y=0.014X+7.425, R2=0.95*). The maximum A, and dry biomass of pods were obtained with 560, and 470 kg ha-1 Si, respectively (Fig 1). The dry biomass of AP was increased with Si rates for RQ, and maximum values were shown with 430, and 512 kg ha-1 Si for LV, and LVdf (Fig 1). It was concluded that increased Si rates enhance photosynthetic pigments, photosynthesis rate, and pod and biomass yield in soils with different Si availability. (Financial support: FAPESP 22/0073307).

Keywords: silicate,soil,absorption,grain,biomass

ID ABS WEB: 137356

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

CHANGES IN SOIL CHEMICAL PROPERTIES AND GREENHOUSE GAS EMISSIONS FROM PADDY SOILS AFTER ONE YEAR OF RICE HUSK BIOCHAR APPLICATION WITH OR WITHOUT ORGANIC MANURES

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The issue of increasing greenhouse gas emissions (GHGs) from rice cultivation has gained attention in recent decades. Therefore, mitigation techniques such as enhanced manure management, improved nitrogen use efficiency, and better agricultural practices must be considered to enhance agricultural production without increasing GHGs emissions. Hence, a precise pot experiment was conducted with medium- and low-fertility soils to determine the changes in the chemical properties of paddy rice soil and N2O and CH4 emissions after one year of rice husk biochar (RHB) application.
Pot experiment was conducted under greenhouse conditions from June 2023 to September 2023 at Ehime University, Japan. There were seven treatments with three replications in both soils: (1) C= control (without RHB), (2) B5= RHB 5 t ha-1, (3) B10= RHB 10 t ha-1, (4) B5: CHM= RHB 5 t ha-1 + chicken manure 5 t ha-1, (5) B5: COM= RHB 5 t ha-1 + cow manure 5 t ha-1, (6) B10: CHM= RHB 10 t ha-1 + chicken manure 5 t ha-1 and (7) B10: COM= RHB 10 t ha-1 + cow manure 5 t ha-1. The soil was amended with biochar and organic manures on the 6th of June 2022, and rice was cultivated. The results indicated that the highest grain yield was obtained by the application of B10: CHM, followed by B5: CHM and B10, through improving soil exchangeable K, available P, and soil EC in both soils. Even though B10: CHM obtained the maximum yield and significantly suppressed N2O emissions, the highest CH4 emissions were recorded in this combination for both soils. CH4 emission from B5:CHM application was not significant compared to the lowest emissions of B5 and B10 in medium-fertility soil and low-fertility soil. Overall, application of B5:CHM is acceptable to improve soil chemical properties and grain yield simultaneously without increasing GHGs, regardless of soil fertility.

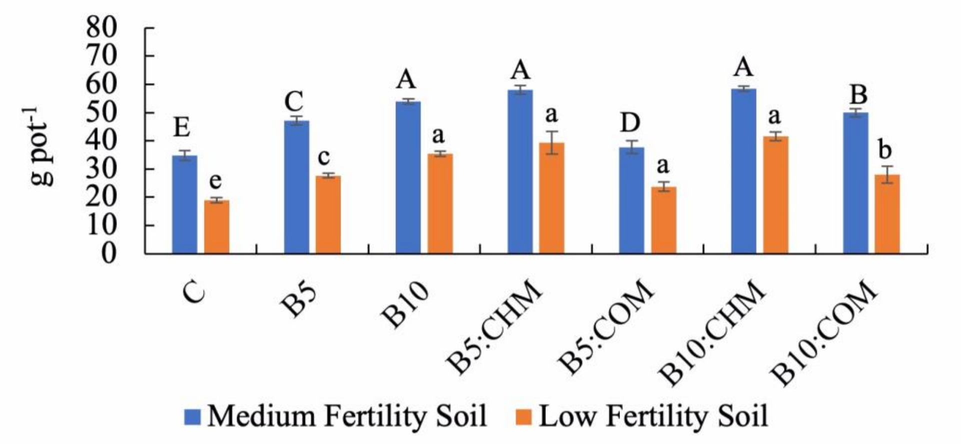

Figure 1. Grain yield under different treatments

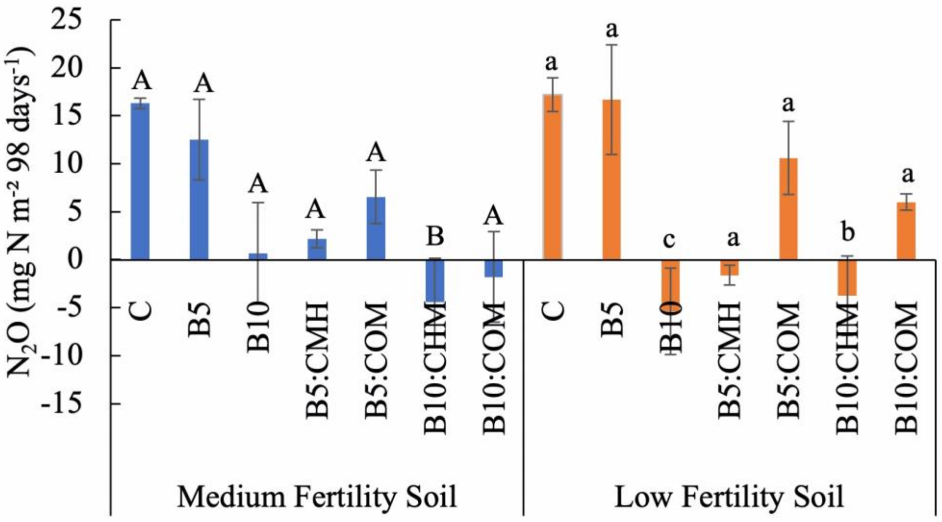

Figure 2. Cumulative N_2O emisison during pot experiment

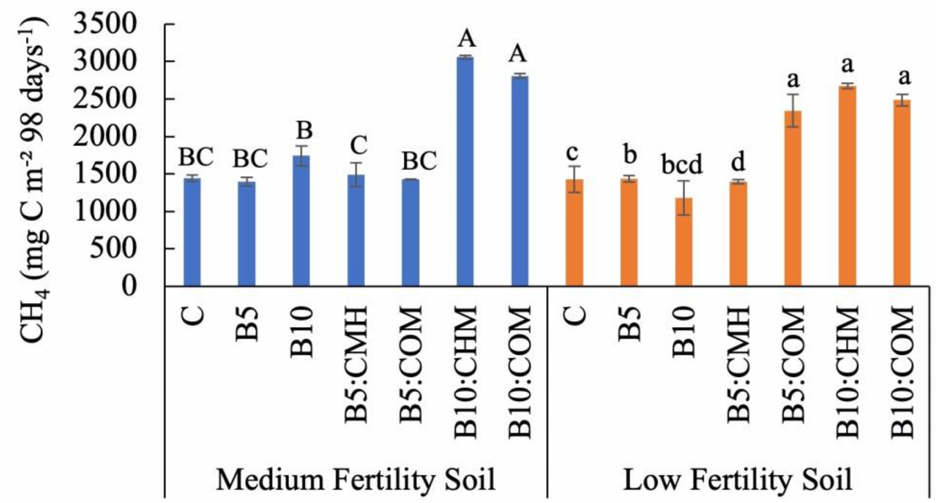

Figure 3. Cumulative CH_4 emisison during pot experiment

Keywords: Biochar,Rice,Greenhouse gas emissions,Chicken manure,Cow manure

ID ABS WEB: 137682

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

IS CONTROLLED-RELEASE N FERTILIZER USE FOR CORN A WORTHWHILE STRATEGY?

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Managing N for corn production is a key to minimizing N losses. Excessively wet spring conditions resulting from ongoing climate change exacerbate loss potential of early spring N applications. Also, a shift in available N fertilizer sources calls for an extensive evaluation of these sources across different soil conditions to update the current N best management practices. The objectives of this research are to evaluate various urea, polymer-coated urea (PCU), and PCU-urea blends and N application timing strategies in corn production and determine the agronomic and economic optimum N rate and grain yield, N use efficiency and indirectly the potential for N loss to the environment, and their cost-benefit relationship. N sources and application time were evaluated in a 3yr study in sandy (irrigated) and fine-textured soils under corn-soybean rotation at the Research and Outreach centers (ROCs) in Waseca, Lamberton, Becker and Rosemount, MN. Grain yield, the economic optimum N rate (EONR), net return, and N use efficiency were determined at each site/year. An in-situ incubation of PCU fertilizer was performed at all sites. Residual inorganic soil N was measured at post-harvest. For the fine-textured soils, grain yield was significantly affected by N source in only 2 of 3 years at Waseca with no differences at Lamberton. However, the use of PCU-Urea blends resulted in lower EONRs than Urea or PCU in fine-textured soils for the 3 growing seasons, and PCU had lower EONRs than Urea in 2023 at Lamberton. In sandy soils, grain yield was significantly affected by N source only in Rosemount 2021. Also, the split application of PCU-Urea blend had lower EONR but not necessarily greater economic net return than Urea in these sandy soils.

Keywords: Nitrogen source,Nitrogen rate,Corn yield

EPOSTERS

ID ABS WEB: 137734

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

ROCK DUST AS A NATURAL SOURCE OF POTASSIUM IN FILTER CAKE COMPOSTING

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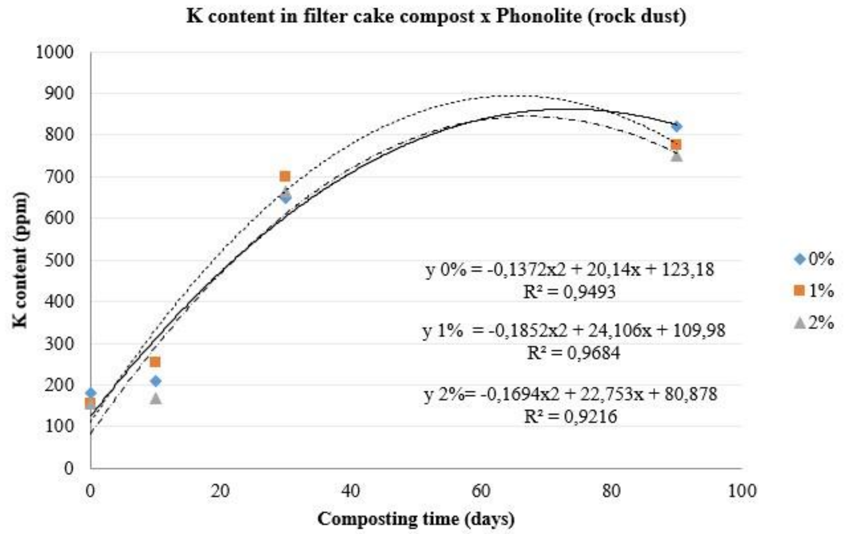
In the process of producing ethanol, a biofuel made from sugar cane, large quantities of the organic waste 'filter cake' are generated, which after composting is used as an organic fertilizer. The addition of rock dust, phonolite, to this biological process can increase the content of the nutrient potassium. Originating from silicate rocks, phonolite is a natural source of potassium, with a total content of 8% K2O and 1% K2O soluble in 2% citric acid. The aim of this study was to determine the potassium content of filter cake enriched with rock dust, phonolite, as a function of composting time. The experiment was conducted at the Biomass and Biogas Laboratory of the School of Agronomy of the Federal University of Goiás – UFG - Brazil. The treatments consisted of adding 0%, 1% and 5% rock dust to 200g samples of filter cake, packed in polyethylene bags, with different composting days: T0-0 days - raw filter cake, T1-10 days, T2-90 days, T3 - humified compost. For analysis, 3g of each treatment was added to 60ml syringes with a tube attached. 50ml of deionized water was applied to check the K content using the Mehlich-1 method. The results showed that at 10 days of composting, the highest K content was 270 mg.kg-1 with the 1% rock dust dosage. At 30 days of composting, the highest content was observed at 1% rock dust, 700 mg.kg-1. After 90 days of composting, the highest K content was observed in the treatment with 0% added K, with approximately 820 mg.kg-1, a result that may be related to the natural solubilization of the compost. The highest potassium release was observed with the 1% dosage of rock dust, which reached 900 mg.kg-1. The use of rock dust can be an alternative and sustainable source of potassium to improve the quality of composts and soils.



Keywords: Phonolite,Organic waste,Organic Fertiliser

ID ABS WEB: 137754

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

LONG-TERM ORGANIC FERTILIZATION ENHANCES POTASSIUM UPTAKE AND YIELD OF SWEET POTATO BY EXPANDING SOIL AGGREGATES-ASSOCIATED POTASSIUM STOCKS

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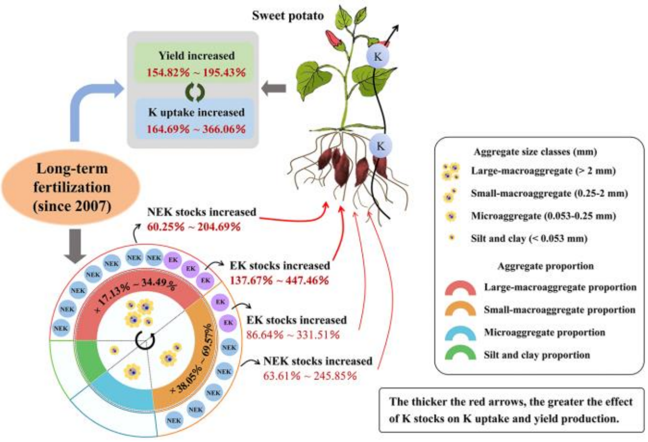
Soil health has been described as the ability of soils to sustain productivity, diversity, and environmental services of terrestrial ecosystem. As one of the essential macronutrients, potassium (K) affects soil health, and is mandatory for agricultural productivity. Fertilization is necessary for expanding soil K stocks and attaining higher plant yield. Crop straw return and organic manure application are effective and environmentally friendly methods used by farmers to improve soil structure, fertility and agricultural productivity. Sweet potato is a typical K-favoring food crop and widely grown throughout the world. However, the regulation effects of long-term organic fertilization on soil aggregates-associated K stocks and K uptake by sweet potato are less understood. Herein, a long-term fertilization experiment under peanut-sweet potato crop rotation established since 2007 including chemical fertilizer (NPK), NPK combined with commercial manure (NPK+CM), NPK combined with pig manure (NPK+PM), and NPK combined with rice straw (NPK+RS) treatments under peanut-sweet potato crop rotation was employed to further comprehend the effects of organic fertilizers application on soil aggregates-associated total potassium (TK), exchangeable potassium (EK), non-exchangeable potassium (NEK) stocks, and explore the contribution of aggregates-associated K stocks to the generation of K uptake and yield of sweet potato. Result showed that long-term fertilizer application contributed to higher yield, yield stability, and K uptake of sweet potato. NPK+PM and NPK+RS treatments both showed the best promoting effect on plant growth. NPK+PM and NPK+RS treatments showed remarkable increasement of aggregate-associated EK and NEK stocks, particularly for small-macroaggregates (0.25–2 mm) and large-macroaggregates (> 2 mm). TK, EK and NEK stocks in large and small-macroaggregates displayed positive effects on K uptake and yield for sweet potato. Pearson's correlation and random forest model analysis revealed that EK and NEK stock in large-macroaggregate were the most key factors for K uptake and yield of sweet potato under long-term fertilization. Overall, this study helps to clarify the prominent advantage of long-term fertilization with chemical fertilizers combined with organic fertilizers.



Keywords: Organic fertilizer,Plant potassium nutrition,Plant productivity,Soil aggregates,Soil potassium stocks

ID ABS WEB: 137874

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

EFFECTS OF NPK FERTILIZATION ON GROWTH AND YIELD OF 'GODEULPPAEGI' (CREPIDIASTRUM SONCHIFOLIUM)

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In order to reduce the environmental load caused by agricultural activities, such as excessive soil nutrient input, Korea government is implementing a public direct payment system that provides subsidies to farmers who use chemical fertilizers in accordance with fertilizer application standards. So far, fertilizer application standards for 104 major crops have been established, and it is necessary for other minor crops grown in Korea.
This study was carried out to establish fertilizer application standard for 'Godeulppaegi', which has no standard, Yields and responses of 'Godeulppaegi' were evaluated in different level of NPK fertilization. N, P2O5, and K2O fertilizer were applied at 0, 50, 100, 150, and 200% of the practical fertilization amount (N-P2O5-K2O = 60-44-43 kg ha^{-1}), respectively. In the N treatments, yield were the highest at N 100% treatment, and decreased with further increases in N rate. For P treatments, root growth, leaf width and weight were tended to increase with P2O5 fertilizer amount, but yield was the highest at P 150% treatment and decreased with further increases in P2O5 rate. In the K treatments, yield was the highest at K 100% treatment and decreased with further increases in K2O rate. By the regression equation between the amount of NPK fertilizer application and yield, the highest yields were obtained with the application of 91-65-37 kg ha^{-1} as N-P2O5-K2O, respectively.

Keywords: 'Godeulppaegi',Fertilization,NPK

ID ABS WEB: 137995

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

A NEW FRAMEWORK TO MODEL THE DISTRIBUTED TRANSFER AND RETENTION OF NUTRIENTS BY INCORPORATING TOPOLOGY STRUCTURE OF SMALL WATER BODIES

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Small water bodies such as interval water-flooded ditches, ponds, and streams serve as important nutrient sinks in many landscapes, especially in the multi-water continuum system. Yet watershed nutrient cycling models often fail to or insufficiently capture these waters, resulting in great uncertainty in quantifying the distributed transfer and retention of nutrients across diverse landscapes in a watershed. In this study, we present a network-based predictive framework of the nutrient transport process in nested small water bodies, which incorporates topology structure, hydrological and biogeochemical processes, and connectivity to perform a nonlinear and distributed scaling of nutrient transfer and retention. The framework was validated and applied to N transport in a multi-water continuum watershed in the Yangtze River basin. We show that the importance of N loading and retention depends on the spatial context of grid source and water bodies because of the great variation in location, connectivity, and water types. Our results demonstrate that hotspots in nutrient loading and retention could be accurately and efficiently identified through hierarchical network effects and spatial interactions. This offers an effective approach for the reduction of watershed-scale nutrient loads. This framework can be used in modeling to identify where and how to restore small water bodies for reduced non-point pollution from agricultural watersheds.

Keywords: Small water bodies,Topology structure,Nutrient loading and retention,Model framework,Multi-water continuum system

ID ABS WEB: 138126

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

FERTILIZATION MANAGEMENT IMPACTS ON GREENHOUSE GASES (GHGS) EMISSIONS FROM A CASPICUM ANNUUM L. CROPPING SYSTEM

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Arable soils contribute in a significant way to greenhouse gases (GHGs) emissions in the atmosphere through CO2 and N2O emissions due the massive use of N-based fertilizers and soil management. CO2 formation is mainly related to soil heterotrophic microbial respiration and autotrophic plant root respiration. N2O formation into the soil is mainly due to nitrification and denitrification processes, influenced by soil moisture, temperature, oxygen concentration, pH, and carbon and nitrogen content. Crop management, in particular fertilization, can affect nutrient use efficiency (NUE) and GHGs emissions. Compared to the traditional soil fertilization, fertigation allows applying nutrients through an irrigation system, synchronizing nutrient supply and crop requirement, improving water and nutrient use efficiency while decreasing leached N and fertilizer-induced N2O emissions from soil. In this work, we monitored CO2 and N2O emissions from a Caspicum annuum L. cropping system located in Southern Italy, using an automated chambers system connected to a GHGs analyser. We measured CO2 and N2O soil fluxes from June 30th to September 22nd, comparing fluxes from fertigated plots with those emitted by plots with granular fertilization. We designed the experimentation with five different treatments: zero thesis with any fertilization applied; granular fertilization with two different nitrogen level, named G70 and G100, respectively with 70% and 100% of crop nitrogen requirement; fertigation with two different nitrogen level, named F70 and F100, respectively with 70% and 100% of crop nitrogen requirement. Preliminary results indicate that fertigation led to slightly lesser N2O emissions, even though greater benefits are expected when adopting higher frequency of watering. However, interactions with the main environmental drivers – soil temperature and moisture, crop biomass and leaf area, soil and plant nutrient contents, days from irrigation and fertilization – should better quantify meaningful relationships. Cumulate N2O fluxes have been affected by N levels whereas the yield-scaled N2O emissions have been lower for the higher N dose irrespective of fertilization type.

Keywords: CO2,N2O,GHGs,Automatic chambers,Fertigation

ID ABS WEB: 138212

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

BIO-BASED AND TRADITIONAL FERTILIZATION STRATEGIES IN TWO DIFFERENT SOILS

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A bio-based fertilizer called Pellet, derived from centrifugation of patè olive cake (POC), a new peculiar solid olive mill waste, was evaluated as soil amendment.
The research was conducted at an experimental farm located near Rome, inside a tunnel, in microcosms (7 kg of soil). Two soils (H and AP) different in pH, limestone content and TOC were chosen, taking the arable layer (0-0.3 m depth). The H soil, Eutric Cambisol with sub-acid pH (6.4) was sampled on a volcanic hilly area, the AP soil, a Calcaric Cambisol with sub-alkaline pH (7.5) on an alluvial plain area.
Fertilizers based on raw Pellet or Pellet with binary fertilizer addition (NP) was compared to organo-mineral and ternary mineral (NPK) fertilizers. A control thesis without treatments was considered. Both soils and Pellet were characterized.
Lettuce (Lactuca sativa L., Salad bowl type) is the most important leafy vegetable, grown at various times of the year and in different climatic environments. It was chosen for its rapid growth and grown for 7 weeks. The following parameters were evaluated on lettuce: fresh and dry weight, height, SPAD, N content.
The results obtained were analyzed using ANOVA.
Notably, the difference between the two soils is always significant for all measured parameters. In AP soil, treatments with raw Pellet and Pellet with NP integration given the best responses in terms of biomass yield, SPAD and nitrogen content, compared to the treatments with traditional fertilizers. On the contrary, H soil showed lower biomass yield and N content compared to the mineral fertilizers and the control. This could be due to nitrogen immobilization processes, not excluding possible toxic effects due to the high phenol content of Pellet.
Our preliminary results seems to indicate that Pellet could be effectively used as an amendment on alkaline soils, while the use on acidic soils must be carefully evaluated.

Keywords: Bio-based amendment,Olive mill wastes,Patè olive cake,Pellet

ID ABS WEB: 138230

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

EVALUATION OF THE EFFECTIVENESS AND ECOTOXICITY OF NEW MOLECULES USED AS UREA-BASED SMART FERTILIZERS

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World population is increasing by almost 33% since 2019 and agricultural production will need to increase without compromising environment and food quality. In this scenario, the development of efficient, prompt and sustainable fertilization practice could be a valid support for crop productivity. The synthetic urea-based fertilizers are wide used, but the fertilization can determine environmental impacts, as nitrate contamination of groundwater and GHGs and ammonia emission. The use of “smart” fertilizers, by controlled N release, is an option to enhance N use efficiency, and decrease environmental pollution.
The purpose of CONTROL FERT project is to provide a sustainable approach to nutrient management, as required by Integrated Nutrient Management Action Plan of EU, developing, and testing new urea formulations, single and/or multilayer urea grains modified with the addition of urease and/or nitrification organic inhibitors. Preliminary test at laboratory conditions to verify N release, nitrification and urease inhibition in soil and ecotoxicity of smart fertilizers were performed. Two different soils during 14 days of incubation of prototypes were analyzed. In the laboratory experiment, fertilization rate was in accordance with the N dose used in open field. Unfertilized soil, with conventional urea and with already marketable smart urea (NBPT) was considered as controls. The urea-based smart fertilizers showed inhibition trend of nitrification and urease activity during 14 days of incubation in soil. The chemical composition and the structure of smart fertilizers affected their efficiency.
Ecotoxicological tests were performed to verify the absence of environmental hazard of smart urea prototypes in the soil.
The preliminary validation has allowed to test smart fertilizers prototypes in real farming conditions, giving reliable results and producing prototypes characterized by high TRL.

Keywords: Smart fertilizer,Soil nitrogen,Integrated nutrient management,nitrification inhibition,urease

ID ABS WEB: 138320

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

IMPROVEMENT OF SOIL PROTECTION AND CROP NUTRIENT SUPPLY IN BLUEBERRY PLANTATIONS IN WESTERN GEORGIA

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The study was conducted in Western lowlands of Georgia to assess soil fertility status and nutrient supply of blueberry plantations on acid soils under humid subtropical climate conditions. The blueberry cultivation does not have long history in Georgia; therefore, elaboration of sustainable soil management practices is essential for its profitable cultivation. Low pH and high precipitation rate require precise selection and application of fertilizers to minimize losses, but at the same time ensure adequate supply of nutrients to plants.
Soil nutrients status varied greatly among studied plantations, which directly related to existing soil management practices, plot's location and topography and also its historical use. One of the reasons of decline in soil nutrients content was soil water erosion on the slopes accelerating soil losses in the past, as after removal of previous crops arable lands often were abandoned for certain period of time. Currently, such eroded parts of the studied plots can be easily observed with removed topsoil and nutrient deficiency symptoms on blueberry plants, which was proved by soil and plant leaf nutrient status. We have tested several soil management practices including incorporation of cover crops and straw mulching, which protects soil from erosion, and supports organic matter build up in soil and regulates water and temperature in the root zone.

Keywords: soil nutrients,soil erosion,cover crops,mulching,blueberry

ID ABS WEB: 139523

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

ROLE OF PHOSPHORUS-ARSENIC INTERACTION TO THE TOXICITY AND MOBILIZATION OF ARSENIC IN THE ENVIRONMENT

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Due to natural and androgenic activities, a high concentration of arsenic (As) in the environment is linked to numerous ecological and health issues. The mobilisation, transportation, sorption and sequestration of As, especially in the soil, is strongly influenced by the availability of phosphorus (P) due to their shared chemical properties between As and P. Liberation or release of soil As often occurs due to the competition of sorption sites which often result in the mobilisation less toxic form of As i.e arsenate (As(V)). On the other hand, other prevailing environmental variables such as pH, organic materials (OM), redox potential (Eh), microorganisms, among others, facilitate the transformation of the readily available As(V) to mobile and more toxic As species i.e. As(III). This process promotes the availability of toxic environmental As and increases the chance of As phytotoxicity to the surrounding plant; Thus, it increases the potential of As toxicity along with the trophic level. In this article, we examine the significant role of P availability or fertilisation in mobilising As and its link to the proliferation of numerous environmental, agricultural, and public health issues. We also explore some advanced analytical techniques for analysing the As-P interaction in different environmental samples and suggest further research direction that will support the quest for sustainable, eco-friendly approaches to the As pollution in the environment.

Keywords: Arsenic,Environment,Toxicity,Mobilization,Phosphorus

ID ABS WEB: 140047

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

FERTILITY AND QUALITY OF SOILS AND HEALTH OF COFFEE PLANTATIONS IN FILOMENO MATA, INDIGENOUS REGION OF TOTONACAPAN, VERACRUZ, MEXICO

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Mexico is 6th place in world coffee production, 685,000 hectares planted in Chiapas, Oaxaca, Veracruz and Puebla, with 98% of the production. Until 2010, coffee was the third source of foreign exchange for the country (42% of exports); 280 thousand families depend on its cultivation. Coffee-growing areas occupy 12 states, 400 municipalities and 3,500 communities, from 250-1,500 MASL, which, together with low luminosity, cool temperature and sufficient precipitation, favor fruiting, growth and quality. The municipal coffee area is 558 ha with 1,721.60 t of coffee cherry. The soils are of volcanic origin. For better development of the coffee tree, they must have a depth of 1 meter, a loamy texture with clay crumbs, OM > 7%, pH of 4.5-5.5. In the area, the geology is sedimentary and limestone-shale rocks dominate (82%), igneous-extrusive rocks and basalts 10%. The soils are calcareous, steep, clayey, adhesive, and difficult to work, low infiltration, permeability & drainage, slightly acidic pH, high CEC and BCSR: Leptosols-84%, Regosols-8%, Acrisols-5% and Cambisols-1%. There is a deficit of N, K and little P and B due to excess Ca. Fe is abundant. There is slow decomposition of organic matter and nutritional imbalance. The foliar analysis indicates a deficit in N, Ca and other nutrients. The main variable relationships are Mg-Zn, Cu-OM, CEC-Ca, pH-N, Na-CE, Mn-B & Ca vs B-P. The (+) soil quality factors are structure and depth and (-) erosion and residue status. The (+) health factors of coffee are resistance to stress and plant diversity on farms and (-) yield and growth of coffee. There is little use of chemical inputs. Vegetable waste and organic fertilizers are recycled. Commercial polyculture and agroecological strategies is a sustainable productive strategy for small coffee growers.

Keywords: coffee plantation management,edaphic limitations,cationic relationships,coffee foliar analysis,peasant experience

ID ABS WEB: 140084

8. Other
8.03 133541 - Sustainable Soil Nutrient Management: Implications for Food, Environment, and Ecology

CROP RESIDUE CONTRIBUTIONS TO PHOSPHORUS DYNAMICS AND POTENTIAL BIO-AVAILABILITY IN A VOLCANIC SOIL OF CENTRAL MEXICO

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Phosphorus (P) deficiency is a significant challenge for agricultural productivity on many highly P-sorbing temperate soils in central Mexico. For these soils, a continuous addition of water-soluble P fertilizers is required. However, water-soluble P can be retained by Fe, Al and Ca and is virtually unavailable to most plant species. The resulting low P- efficiency, coupled with rapidly rising cost of fertilizers, has increased interest in biological cycling of P sources as crop residues. To assess the longer term effects of residue addition on soil P fractions, we added residues from bean, sorghum and avocado to an acidic soil and measured the concentrations of P forms over three months. The size of various P forms was assessed by sequential P fractionation on days 1, 45 and 90. Compared to unamended control, addition of bean ad sorghum residues increased the concentrations of resin P, microbial P, Bic Pi, NaHCO3 –Pi, and NaOH0.1 -Pi temporarily whereas amendment with avocado residues had little effect on P form concentrations. The decrease in NaHCO3 –Po and NaOH Po towards the end of experiment coincided with an increase in NaHCO3 Pi and NaOH0.1 –Pi. Microbial biomass after crop residue additions was positively related to NaOH-Pi and decreased with soil depth. This results indicate that at least some of the NaOH -Pi may be biologically available within a relatively short time (days to weeks). The concentration of various P pools was strongly affected by the properties of the residues. Residues with high total P and low C:P ratio resulted in P mineralization in the microbial biomass. Addition of low C:P residues on the other hand, may not result in high amounts of immediately available P, but the P supply is more sustained due to P release from decomposing residues and turnover of microbial biomass P.

Keywords: Crop residues,C:P ratio,P fractionation,Andisol

ID ABS WEB: 138044

8. Other
8.05 133606 - Life, agriculture, and productive systems in soils from Arctic, Antarctic and other cold regions

THE RHIZOSPHERE OF SILENE ACAULIS IN WESTERN GREENLAND: SOIL CARBON DYNAMICS AND MICROBIAL DIVERSITY

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Polar regions offer a unique opportunity to test biogeographic patterns of microbial taxonomic and functional diversity, providing indications of the future consequences of environmental change. Arctic islands and the Antarctic continent are characterised by protracted low temperatures, limited freshwater availability, seasonally dependent light conditions and restricted nutrient availability. Polar regions are facing increasing temperatures faster than elsewhere in the world due to polar amplification, challenging the native organisms which often live at their physiological limits. S. acaulis is a cushion plant playing a key role in alpine/arctic ecosystems as facilitator species and nurse plant also determining the resilience of high-latitude ecosystems to global climate change.
The present study was performed in Greenland at: Kobbefjord, Nuuk, West Greenland (64°10'36"N, 51°31'37"W) and Disko Island, Baffin Bay, off the west coast (69°44'59.99"N, 53°39'59.99"W). At Kobbefjord two sites were selected: site KA at 77 m asl and site KB at 60 m asl, 700 and 400 m from the sea, respectively. Also, three sites were selected at Disko Island: site DIA at 8 m asl, site DIB at 25 m asl, and site DIC at 81 m asl at 100, 600 and 1000 m from the sea, respectively. Permafrost is randomly present at Disko Island but not at Kobbefjord.
Soil physical (texture), chemical (total organic C, total N, inorganic N, pH, extractable C) and biochemical (microbial biomass, microbial respiration, enzymatic activities and functional diversity) properties as well as fungal community diversity and composition (DNA metabarcoding) were assessed in S. acaulis rhizospheric and bulk samples collected during Summer 2022.
A clear rhizosphere-effect is evident for almost all properties at both locations although site-specific attributes, as organic C content and pH, drive the intensity of this effect. The different latitude affects microbial activity and consequent nutrient cycling.
Finally, microbial taxonomic and functional diversity in the rhizosphere of S. acaulis will be discussed in relation to the different factors characterising this polar ecosystem.

Keywords: Silene acaulis,microbial diversity,C cycling,rhizosphere,arctic soils

ID ABS WEB: 138245

8. Other
8.05 133606 - Life, agriculture, and productive systems in soils from Arctic, Antarctic and other cold regions

SOIL PROCESSES AND ECOSYSTEM FUNCTIONALITY UNDER DIFFERENT STAGES OF AFFORESTATION IN PROGLACIAL CLIMATIC CONDITIONS (ICELAND)

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Iceland is a highly dynamic island where the cold climate and frequent natural events, including wind erosion and volcanic eruptions, exert significant influence on soil pedogenesis. Additionally, the scarcity of vegetated areas, stemming from historical mismanagement of the land over centuries, has intensified soil degradation affecting soil genesis. In the last decades, the Soil Conservation Service of Iceland and the Iceland Forest Service governmental agencies have aimed to improve soil ecosystem conditions through forest restoration. The research intended to investigate differences in abiotic and biotic factors by sampling soils undergone various stages of afforestation (years of forest restoration considered: 1982, 1999, and 2012). To achieve this, six trenches were excavated (two for each period of reforestation) to study morphological, physicochemical, and mineralogical soil properties and a range of enzyme activities and microbiological indicators (EL-FAME) were used to understand ecosystem functionality.
Soil morphology was extremely varied within each profile, showing one or multiple lithological discontinuities and buried horizons with exogenous material emphasized by different structures and colours. This was confirmed also by pH values (ranging from 2.84 to 7.02) and total organic carbon content (an average of mineral horizons of 15.58 g kg-1 and a standard deviation of 14.4) variations. The multivariate analysis using soil chemical and biochemical properties was applied to highlight differences in the three periods of reforestation, but no evidence emerged. The Fungi/Bacteria ratio suggested a major organic matter complexity in O and A horizons of soil reforested since 1982. The other microbiological and chemical parameters mainly drove the separation of horizons with different genetic designations. Even after decades of ecological succession, the restoration of Icelandic soils faces significant challenges due to the dynamic nature of the region and its extreme climatic conditions. The process demands an extended timeframe during which the impact of the reforestation becomes noticeable, confirming the limited influence exerted by vegetation and the substantial role of abiotic components in the pedogenesis and soil's functionality.

Keywords: Soil enzyme activities,Pedogenic processes,Reforested soil,Genetic horizons,Microbiological soil propertie

ID ABS WEB: 136058

8. Other
8.06 133613 - Advances in soil health monitoring

EFFECT OF IN-SITU LEACHING PROCESS ON SPATIAL DISTRIBUTION CHARACTERISTICS OF SOIL PROPERTIES IN ION-TYPE RARE EARTH MINE IN SOUTHERN JIANGXI

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This work discusses the impact of in-situ leaching mining process on the surface soil of the ion-type rare earth mine in southern Jiangxi, and analyzes its spatial characteristics from the bottom, middle and top of the abandoned mine. The results showed that soil organic matter content and available potassium content in the abandoned mine were reduced by 36.74% and 48.29% compared with the control area, respectively. The contents of NH4+-N and SO42- in the soil of abandoned mines were 55.58 times and 1.36 times higher than those in the control area. The soil pH dropped by 0.39 units compared with the control. The distribution of rare earth elements in the abandoned mine was consistent with the control, and the total amount of rare earth elements in the abandoned mine and the control area were 1.47 times and 1.77 times the background value of the total amount of rare earth elements in the soil in Jiangxi Province, respectively. The content of Zn, Pb, Cr, and Cd in the soil of the abandoned mine was significantly lower than the control, which decreased by 39.50%, 44.28%, 43.18%, and 64.84%, respectively. In terms of spatial distribution, the soil organic matter content in the middle and top of the abandoned mine was significantly lower than the bottom, but the soil ammonium nitrogen content was significantly higher than the bottom, which was 10.55 times and 7.86 times that of the bottom, respectively. The pH of the soil at the top of the abandoned mine was significantly lower than 0.11 units at the bottom and 0.17 units at the middle. Therefore, the top area of the abandoned mine is the area most seriously affected by mining, and low soil fertility, leaching agent residues, and soil acidification are the main problems faced by the abandoned mine.

Keywords: Abandoned rare earth mines,In-situ leaching,Soil acidification,Rare earth elements,Non-rare earth heavy metals

ID ABS WEB: 136060

8. Other
8.06 133613 - Advances in soil health monitoring

ENABLING CITIZEN SCIENCE BY USING CELL PHONE CAMERA FOR SOIL COLOR MEASUREMENT TO ESTIMATE SOIL ORGANIC CARBON CONTENT

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Soil organic carbon (SOC) is one of the most important indicators for soil health. However, lab analysis for SOC is costly. It is well known that SOC level is reflected in the color of the soil. Experienced soil surveyors can estimate the SOC level visually. However, it takes years of training to be able to do that. The objective of this study is to establish a method to quantify SOC content by using soil color measured with cell phone images. Soil samples were taken from transects in two sites in Canada. These samples were measured for SOC in an analytical lab. A set of subsamples were prepared under different conditions (smoothed versus unsmoothed surface, 2 mm versus 63 micro m sieved, wet versus dry). Soil color was measured with a FieldSpec 4 SpectroRadiometer (reference method). The samples were than place beside a standard color plate and pictures were taken using a cell phone. The measured color parameters with the FieldSpec and the RGB values in the photo (after adjusted based on the standard color plate) were converted to the hue, chrome and value in the Munsell soil color space. It was found that the soil color value measured with the FieldSpec and the cell phone picture methods were very well correlated. However, the cell phone method showed a negative bias in soil color values, likely due to its less ideal lighting conditions. SOC content was significantly correlated with the soil color values measured with both the FieldSpec 4 and the cell phone picture methods. Smoothed surface was better than unsmoothed surface, dry sample was better than wet sample while the differences with sieve size was small. The results suggest that it is possible to use soil color measured with cell phone image to estimate SOC. This enables citizen science for examine the spatial pattern of SOC at the field scale and the change of SOC over time.

Keywords: Soil health indicator,Soil organic matter,Munsell soil color

ID ABS WEB: 137773

8. Other
8.06 133613 - Advances in soil health monitoring

MITIGATION OF ENVIRONMENTAL DAMAGE BY MONITORING CHEMICAL-BIOLOGICAL INDICES OF DISTURBED SOIL

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The Soil Biodiversity platform has invited researchers, politicians, decision-makers, industries, and states to seriously consider soil biodiversity conservation, including all kinds of microorganisms: 'The maintenance of soil biodiversity is essential to both the environment and agricultural industries.' Moreover, since 2015, the 'Cross-Sector Biodiversity Initiative (CSBI)' has presented a platform for the development and sharing of 'good practices' to be implemented concerning the protection and restoration of 'biodiversity' in extractive activities. This platform is a collaborative tool to access the knowledge and collective experience of experts in the sector. It provides practical guidance, innovative approaches, and examples to support mitigation operationalizing. In addition, CSBI has developed some guides to limit, as far as possible, the negative impacts on the biodiversity of development projects and activate the processes of mitigating the damage and recovery of biodiversity.
Our study aimed to assess the severity of soil disturbance in an industrial area using chemical-biological indicators and to suggest mitigation and restoration activities.
For soil quality restoration, it was necessary to encourage land management practices to increase the levels of organic matter and soil biodiversity. In particular, minimum soil tillage and no-tillage practices to maintain soil cover, improve its structure, maintenance, and increase of perennial plants, and finally, careful/limited use of fertilizers.
The chemical-biological indices after one year have highlighted a clear improvement in the state of health of the soil in chemical-physical, microbiological, and entomo-fauna terms. The soil and its entire community of living beings can adapt and react to difficulties.

Keywords: disturbed soil,industrial activity,mitigation,chemical-biological indices,fertility, biodiversity

ID ABS WEB: 138280

8. Other
8.06 133613 - Advances in soil health monitoring

MICROPLASTIC OCCURRENCE IN URBAN SOILS OF THE CITY OF CHILLÁN CHILE.

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Plastics, formed by carbon and hydrogen atoms, have transformed modern life. Yet, their extensive production and mismanagement lead to the accumulation of microplastics (MP) in urban soils, posing concerns for human health and ecosystems. This study assesses microplastic presence in Chillán, Chile's urban soils, identifying areas with higher concentrations and potential environmental and health impacts. Conducted in January-February 2023, systematic soil samplings covered the entire urban area on a 500m grid. Sieved samples underwent microplastic extraction, identified and classified using stereomicroscope and electron microscope. Of 174 points evaluated, 166 (95.4%) contained microplastics. Among 4849 identified, 3297 (67.99%) were fibers, 1552 (32%) fragments, and 5.17% of points had over 100 microplastics. The prevalence of microplastics in 95.4% of points highlights urgent action needs to comprehend their environmental and health impacts in urban soils. Dominance of fibers (67.99%) and fragments (32%) underscores microplastic diversity in the city, originating from textiles and daily human activities. The significant fragment presence suggests larger plastic degradation in surroundings. Nine points with high microplastic concentrations (5.17%) pinpoint critical contamination areas, emphasizing precise geolocation importance. Urgency to address Chillán's urban soil microplastic pollution is evident, requiring effective waste management, public awareness, and robust environmental policies to combat this growing threat.

Keywords: Plastic soil,human health,soil environment

ID ABS WEB: 140131

8. Other
8.07 133620 - Soil Ambitions: Driving soil health into national and international policy

EVALUATING THE INTERVENTIONS FOR HEALTHY AND MORE RESILIENT SOILS WITHIN THE ITALIAN CAP STRATEGIC PLAN

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Under the Common Agricultural Policy (CAP) 2023-2027, the impacts of the different interventions (i.e. direct payments, interventions for certain market sectors and rural development support) will be evaluated across the European Union (EU) according to the common Performance Monitoring and Evaluation Framework (PMEF).
Each CAP Strategic Plan (CSP) specifies interventions and requirements and the expected results to be assessed by using the criteria, the common indicators, and other rules established in the regulations.
Indeed, healthy and more resilient soils are essential for achieving climate neutrality, reversing biodiversity loss, providing healthy food and maintaining viable rural areas. Therefore, how to evaluate and improve the soil-related CSP interventions deserves the full attention of policy makers, evaluators, farmers, advisors, researchers, and other stakeholders.
However, according to the scientific literature and lessons learned from previous evaluations, monitoring and evaluating processes of soil-related policy interventions are still extremely challenging due to a serious knowledge gap on soil health and resilience. To date, there is no binding overarching framework at EU level that strategically defines specific policy priorities or parameters for soil protection.

This work aims to provide theoretical insights and practical suggestions for the development of those components of the monitoring and evaluation system of the Italian CSP which are significantly linked to soil-related issues. In the absence of a comprehensive methodological framework, the analysis will be based on different data sources: literature reviews, EU websites (including the EU CAP Network website with its Evaluation Knowledge Bank) and evaluation guidelines and reports at the EU and national level.
The results will open avenues for evaluation of the Italian CSP soil-based interventions by clarifying the methodological steps to be included in the evaluation designs. They will also allow the formulation of the proposed of soil-related evaluation questions which national and regional managing authorities could include in their terms of reference for independent evaluators.

Keywords: Common Agricultural Policy,Monitoring and evaluation,CAP Strategic Program,sustainable soil management

ID ABS WEB: 136858

8. Other
8.08 133822 - Peatlands in a changing world

EXAMINING THE INFLUENCES AND TEMPORAL VARIATIONS OF SOIL GREENHOUSE GAS EMISSIONS IN AN OIL PALM PLANTATION ON TROPICAL PEATLAND

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Currently, there is still a significant gap in data regarding the temporal variations in greenhouse gas (GHG) emissions from oil palm plantations on peatland. This gap hinders our understanding of how GHG emissions and their influencing factors vary over time in such ecosystems. To bridge this knowledge gap, a study was conducted focusing on the relationship between ground water level (GWL) and soil GHG emissions over time. The study involved measuring soil carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emissions in an oil palm plantation on tropical peatland, spanning across different stages of oil palm growth, from young to mature palms. These emissions were monitored monthly using a closed chamber method, from January 2010 to December 2017. Key findings include a notable decrease in soil N_2O emissions as the palms aged, particularly when the soil water-filled pore space (WFPS) was between 70 to 96%, indicating complete denitrification. The study also revealed that GWL significantly affects soil WFPS and CO_2 emissions ($p<0.05$), especially in younger plantations. The study also found that GWL had a significant impact on soil WFPS and CO_2 emissions, but this was predominantly in younger plantations, suggesting that in older plantations, root activity might be a more influential factor in soil respiration than GWL. Soil CH_4 emissions were observed to increase with the age of the palms, with the impact of WFPS on CH_4 emissions being more significant than that of GWL ($p<0.05$), possibly attributed to the lower GWL at the study site. This research elucidates the dynamic relationships among GWL, WFPS, and soil GHG emissions, which vary with the age of the oil palms. The insights gained from this study are crucial for formulating effective strategies to mitigate GHG emissions from tropical peatlands, considering the dynamic nature of this ecosystem.

Keywords: water-filled pore space,ground water level,carbon dioxide,methane,nitrous oxide

ID ABS WEB: 136959

8. Other
8.08 133822 - Peatlands in a changing world

THE APPARENT TEMPERATURE SENSITIVITY (Q10) OF PEAT SOIL RESPIRATION: A SYNTHESIS STUDY

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The temperature sensitivity (Q10) of soil respiration is a critical parameter in soil carbon dynamics modeling; yet the regulating factors and the underlying mechanisms of Q10 in peat soils remain unclear. To address this gap, we conducted a comprehensive synthesis data analysis from 87 peatland sites spanning boreal, temperate, and tropical zones, and investigated the spatial distribution pattern of Q10 and its correlation with climate conditions, soil properties, and hydrology. Findings revealed distinct Q10 values across climate zones: boreal peatlands exhibited the highest Q10, trailed by temperate and then tropical peatlands. Latitude presented a positive correlation with The Q10, while mean annual air temperature and precipitation revealed a negative correlation. A noteworthy discovery was the pronounced negative relationship between the soil carbon-to-nitrogen ratio (C/N) and Q10, echoing the carbon-quality temperature hypothesis that decomposition is more temperature-sensitive in low-quality than in high-quality carbon. However, the relationship between C/N and Q10 varied significantly between peat types. Our data analyses also revealed that Q10 was influenced by soil moisture levels, with significantly lower values observed for peat soils under wet than dry conditions. Essentially, boreal and temperate peatlands seem more vulnerable to global warming-induced soil organic carbon decomposition than tropical counterparts, with wet peatlands showing higher climate resilience.

Keywords: Temperature sensitivity,Q10,soil respiration,peatland,soil properties

ID ABS WEB: 137118

8. Other
8.08 133822 - Peatlands in a changing world

CHEMICAL CHARACTERISTICS OF A TROPICAL PEAT SOIL PROFILE IN SARAWAK, MALAYSIA

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Tropical peatlands in Malaysia, covering about 2.5 million hectares, play a crucial role in the region's ecosystem dynamics. Approximately 26.8% of these peatlands have been transformed for agricultural use, involving land clearing, drainage, compaction, and fertilization, significantly impacting their peat soil characteristics. However, the understanding of these impacts is limited and inconsistent, influenced by varying vegetation and environmental conditions. This study focuses on the chemical properties of a tropical peat profile within the Maludam peat dome in Sarawak, Malaysia. The objective is to deepen our knowledge of the chemical processes in this coastal peat dome, which is characterized by diverse vegetation types: Mixed Peat Swamp (MPS), Alan Batu (ABt), and Alan Bunga (ABg) forests. It was observed that the MPS forest, located at the dome's edge, exhibits higher levels of humification compared to the ABt and ABg forests, where woody materials are more prevalent at greater soil depths. Using Principal Component Analysis (PCA) as an ordination method, the study reveals that the decomposition and nutrient status of the peat soil profile are key factors influencing its chemical characteristics in the Maludam peat dome. Decomposition significantly affects MPS soils, while nutrient status is more influential in both ABt and ABg soils. The variation in nutrient status among these vegetation types indicates a transition in vegetation over time, which, together with the peat water quality, contributes to the diverse chemical properties observed in the peat profile. Understanding these variations in peat soil characteristics is essential for developing effective science-based or nature-based solutions for managing and conserving tropical peatlands.

Keywords: Chemical characteristics,Peat decomposition,Peat nutrient,Peat swamp forest,Tropical peatland

ID ABS WEB: 137121

8. Other
8.08 133822 - Peatlands in a changing world

INFLUENCE OF PEAT HUMIFICATION DEGREE ON SOIL CO_2 AND CH_4 EMISSIONS ACROSS DIFFERENT LAND USES IN TROPICAL PEATLANDS

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In Malaysia, approximately 26.8% of tropical peatlands have undergone conversion from peat swamp forests to agricultural land. This conversion impacts the quality and quantity of peat humification subsequently affecting the magnitude of greenhouse gas (GHG) production. Our study aimed to assess the influence of land use changes on peat soil organic matter (SOM), particularly reflected in humification degree (HD) and its correlation with the potential production of carbon dioxide (CO_2) and methane (CH_4). We conducted laboratory incubations under aerobic and anaerobic conditions, analyzing different forest types. Peat soil samples were collected at intervals of 0–25, 25–50, 50–75, and 75–100 cm, with HD evaluated based on the atomic ratio of C/N. Alan Batu forested site (ABt F) exhibited lower CO_2 production rates (7.60 and 13.11 mg kg-1 d-1) compared to oil palm plantations (ABt OPP) with rates of 17.58 and 28.83 mg kg-1 d-1 in aerobic and anaerobic conditions, respectively. In contrast, the Alan Bunga forest (ABg F) showed higher aerobic CO_2 production (11.90 mg kg-1 d-1) than its corresponding plantation (ABg OPP, 9.11 mg kg-1 d-1). Similarly, anaerobic CO_2 production rates followed a distinct pattern, with ABg F at 27.38 mg kg-1 d-1, significantly greater than ABg OPP at 15.43 mg kg-1 d-1. Anaerobic CH_4 production potentials were higher in the order ABt OPP > ABg F > ABg OPP > ABt OPP. The differences in production potentials were attributed to varying HD among the forest types. ABg F, with the lowest C/N ratio and higher total nitrogen (N) content across depths, indicated greater humification. In contrast, plantation peat had lower total N content, reflecting a lower HD due to the decomposition of N-enriched SOM into humic substances. Our findings highlight the importance of considering HD variations among forest types to understand the factors influencing CO_2 and CH_4 production in tropical peatlands. This is particularly relevant when evaluating the effects of land-use changes on litter input and subsequent GHG emissions.

Keywords: HUMIFICATION,PRODUCTION POTENTIALS,CARBON DIOXIDE,METHANE,TROPICAL PEATLANDS

ID ABS WEB: 137214

8. Other
8.08 133822 - Peatlands in a changing world

EFFECT OF LIMING ON MACRONUTRIENTS IN TROPICAL PEAT SOIL: A 5-YEAR FIELD STUDY

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Agronomic challenges in tropical peatland are often hindered by high soil acidity and low fertility which can adversely affect the availability and uptake of essential macronutrients by plants. Liming has become a common agricultural practice to improve soil pH in peat soils. However, optimal lime rates for both productivity and cost-effectiveness remain challenging due to its substantial soil buffer capacity. Thus, a 5-year field experiment was conducted in an oil palm plantation on tropical peatland to evaluate the effects of different lime application rates on soil macronutrients. Calcium carbonate ($CaCO3$) was uniformly applied within a 2-meter radius of the palm circle according to the following lime rates: without lime as Control (L0), 3 t ha-1 (L1), 6 t ha-1 (L2) and 12 t ha-1 (L3). The study measured soil nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg) in each treatment group. Results showed that liming had significantly increased soil pH from 3.5 to 4.0 ($p<0.001$). The increase in soil pH corresponded with a significant increase in both total Ca ($p<0.001$) and Mg ($p<0.05$) in soil. The application of lime significantly decreased the soil's total P and K in L1 ($p<0.05$). However, total levels of N remained unaffected ($p>0.05$). This study highlights the importance of selecting the appropriate lime rates in oil palm cultivation in peatland to improve the soil nutrient availability for plants.

Keywords: Calcium carbonate,Nitrogen,Phosphorus,Potassium,Calcium

ID ABS WEB: 137336

8. Other
8.08 133822 - Peatlands in a changing world

AEROBIC METHANOTROPHY POTENTIAL IN DIFFERENT TROPICAL PEAT SWAMP FOREST TYPES IN MALUDAM NATIONAL PARK, SARAWAK, MALAYSIA

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Tropical peat swamp forests are important for carbon storage, but their water-saturated condition creates a favourable condition for methane (CH4) production. Methanotrophs are responsible for CH4 oxidation (methanotrophy), thus are key players in the CH4 cycle. Current research lacks a deep understanding of methanotrophy across various tropical peat swamp forest types. This study investigates the methanotrophy potential in three distinct forest types within a tropical peat dome in Sarawak, Malaysia. Sampling was conducted in July 2023 (dry season) in the Maludam National Park, Sarawak, Malaysia. Peat sample was collected from the topsoil (0-10 cm depth) of three different forest types namely, Mixed Peat Swamp (MPS), Alan Batu (ABt), and Alan Bunga (ABg) forests. Methanotrophy potential was assessed by incubation in 100 mL vial supplemented with 2-3% v/v CH4. Soil pH, total carbon (C) and nitrogen (N), inorganic N, and total phosphorus (P) were determined. Soil pH across different forest types was comparable, ranging from 3.90-3.95. Although total C and N were relatively similar between MPS and ABt forest, they were relatively lower ($p<0.05$) in ABg forest. Total P differed significantly ($p<0.01$) across all forest types with the highest concentration in MPS, followed by ABt, and ABg forest. Incubation results demonstrated that the methanotrophy potential differed significantly ($p<0.05$) across all forest types. The highest methanotrophy potential was observed in MPS forest (0.35 ± 0.07 µmol g dw soil-1 day-1), while ABg forest (0.05 ± 0.02 µmol g dw soil-1 day-1) showed the least methanotrophy. A strong correlation was found between methanotrophy potential and N, particularly ammonium (NH4+), and a relationship with total P was observed. This study suggests a significant correlation between methanotrophy potential and soil chemical properties across different tropical peat swamp forest. Nevertheless, validation of pmoA gene abundance using quantitative polymerase chain reaction analysis will be conducted to provide a deeper insight into the regulation of CH4 filter function provided by methanotrophs in different tropical peat swamp forest types.

Keywords: Aerobic methanotrophy,Tropical Peat Swamp Forest,Incubation,pmoA

EPOSTERS

ID ABS WEB: 137338

8. Other
8.08 133822 - Peatlands in a changing world

ASSESSING THE IMPACT OF LONG-TERM MINERAL FERTILIZER USE ON GROUNDWATER NUTRIENTS: A COMPARATIVE STUDY IN AN OIL PALM PLANTATION AND A DRAINED SECONDARY FOREST ON TROPICAL PEATLAND

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Nutrients from fertilizers, when not absorbed by trees or attached to soil particles, can dissolve and be lost through surface run-off, denitrification, and leaching processes. These substances accumulate in surface water and subsequently seep into groundwater, contributing to the deterioration of groundwater quality. Particularly in peat soils, which are highly porous, there is a significant risk of leaching losses from applied fertilizers. In oil palm agroecosystems, where high fertilizer inputs are crucial for maintaining yields, there exists a potential environmental threat particularly to clean water sources and aquatic ecosystems if excess nutrients migrate to waterways. Despite this, research into the long-term effects of fertilizer use on groundwater quality, especially in oil palm plantations located on tropical peatlands, remains limited. This study, therefore, aims to examine the long-term effects of fertilizer use on groundwater nutrients in an oil palm plantation (Elaeis guineensis) situated in tropical peatland, comparing it with a nearby drained secondary forest in Sibu town, Sarawak, Malaysia. Groundwater samples were collected from installed monitoring wells across 12 blocks of the oil palm plantation (OPP) (Q1-Q12) and the drained secondary forest (DSF) between January 2011 and December 2017. Sampling resumed from October 2021 to March 2022 following the planting of second-generation oil palms. The results showed that long-term fertilizer application increased groundwater pH in the OPP, particularly after the replanting of second-generation palms, compared to the DSF. Moreover, the concentrations of potassium (K+) and chloride (Cl-) in groundwater were consistently higher in the OPP than in the DSF throughout both wet and dry seasons, likely due to the leaching of these elements from soil into groundwater post-fertilization. This study is the first to evaluate and provide baseline data on the long-term impact of mineral fertilizer use on groundwater nutrients, aiming to contribute to the conservation of groundwater quality and sustainability of oil palm cultivation in tropical peatlands.

Keywords: Peat,Groundwater Nutrient,Mineral Fertilizer,Oil palm,Soil and water conservation

ID ABS WEB: 137758

8. Other
8.08 133822 - Peatlands in a changing world

DEEP COLLAR INSERTION METHOD FOR SOIL RESPIRATION COMPONENT SEPARATION IN AN OIL PALM PLANTATION ON TROPICAL PEATLAND IN SARAWAK, MALAYSIA

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The second-largest source of carbon (C) in terrestrial ecosystems is soil respiration (Rs), accounting for nearly one-fifth of atmospheric carbon dioxide. Peatlands possess a significant proportion of the global soil carbon pool, estimated at approximately 35% or 600 PgC. Hence, the process of Rs generated from peatlands holds great significance within the context of the global carbon cycle. Studies have been conducted to quantify autotrophic (Ra) and heterotrophic (Rh) respirations separately under field conditions to gain better understanding of the below-ground C dynamics. Among the various methods used, the root exclusion technique is a popular because it is easy to use and cost-effective. A field study using the root exclusion method was conducted at an oil palm plantation on tropical peatland in Sarawak, Malaysia. The study plot consists of four different nitrogen (N) rates: without N, 31.1 kg N ha-1 yr-1, 62.2 kg N ha-1 yr-1, and 124.3 kg N ha-1 yr-1. Investigations were conducted on soil CO2 emissions, soil CO2 profiles, and physicochemical properties by soil depth. Soil CO2 emissions from Rh chambers were found to be greater (mean 3047.4 mg CO2-C m-2 h-1) than those from Rs chambers soils (mean 1782.4 mg CO2-C m-2 h-1). On the other hand, the average soil CO2 concentrations by depth in the Rs and Rh chambers were 43198.11 ppm and 20553.36 ppm, respectively, greater than in the Rs chamber. The bulk density of Rh chamber soils was significantly larger than that of Rs chamber soils, with mean values of 0.4 g cm-1 and 0.26 g cm-1, respectively. Certain soil layers in Rh chamber soils had slightly higher moisture contents than in Rs chamber soil; this might raise Rh. In this study, nitrogen fertilization had no significant effect on CO2 emissions in the Rh or Rs chamber soils. Separating Rs into its autotrophic and heterotrophic components in the field is typically challenging because of the multiple biological and ecological processes that govern them.

Keywords: Microbial respiration,Heterotrophic respiration,Soil respiration partitioning,root-trenching,CO2 emission

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