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Evaluating the impact of drought stress in Nure and Tremois barleys (*Hordeum vulgare*) treated with plant growth promoting rhizobacteria (PGPR) at seedling phase

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Introduction

Barley is the **fourth** cultivated **cereal crop** in the world, and its important is due to its economic and nutritional value. The increase of **drought events** represent some of the **major issue** for agronomical and global food security for **barley**. For **barley cultivation in temperate climate**, drought stress was traditionally associated with the flowering and caryopsis filling stages, however a **new form of drought** is now emerging in **seedling** stage **after the sowing**.

To **mitigate** the impact of **environmental stresses**, **plant growth promoting rhizobacteria (PGPR)** have been proposed to **promote nutrient absorption** and **plant growth** with the production of a range of beneficial substances, such as phytohormones, organic acids, and enzymes.

The scope of this work was to assess the impact of PGPR treatment on two cultivars of barley in seedling phase under drought stress.

Materials and Methods

Plant materials.

Barley (*Hordeum vulgare*) commercial varieties:

- Nure [(Fior 40 x Alpha2) x Baraka], Italian feeding barley with winter habitus.
- Tremois [(Dram x Aramir) x Berac] French malting barley with spring habitus.

Protocol.

1. *Germination***.** 5 days in petri dishes. first day at room condition, three days at 4°C in dark condition and the fifth day at room condition.
2. *Growing Phase***.** 19 days in pots at 24/16 °C 16/8 day/night. Barley seed were sown in pots (7*7*7 cm) with peat substrate (Klasmann, Potgrond H) and treated with 1 ml of distilled water (control) or 1mL of plant growth promoting rhizobacteria (*Ensifer adhaerens*). Barley plants were irrigated on alternate days to reach the two-leaf phenological stage (BBCH12).
3. *Drought Stress***.** RWC method for 15 days at 24/16 °C 16/8 day/night. Pots were weighted every three days.

Measurement.

- Visual scored.
- Leaves number.
- Plant heights (cm).
- Photosystem status with porometer and fluorometer. Quantum yield of PSII PhiPS2, stomatal conductance to water vapor Gsw (moles of H_2O m^{-2} s^{-1}), Electron transport rate ETR (µmol of electrons m^{-2} s^{-1}) and leaf temperature (°C).
- Fresh weights of roots and leaves (g). Plants were carefully cleaned and subjected to determination of shoot and root fresh weight.
- Dry weights of roots and leaves (g). To determinate the dry weight, shoot and root were dried in an oven at 80 ºC, for 24 h, and then removed to room temperature for 15 minutes.

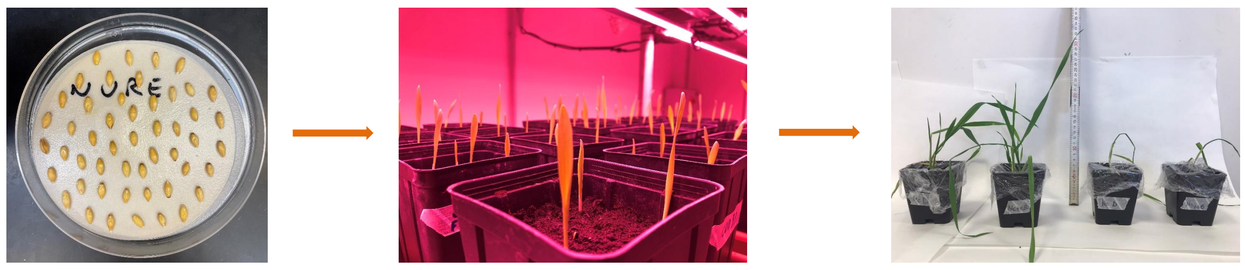

Figure 1. Tremois plants after 15 days of drought conditions.

Figure 2. Nure plants after 15 days of drought conditions

Results

The results showed that both genotypes exhibited comparable drought response, however the PGPR treatment exhibited different effects on Nure and Tremois. Precisely, **PGPR treatment increased roots dry weight** by 36.6% in **Nure** seedlings **under drought conditions** and increased roots dry weight by 31.1% in **Tremois** seedlings **in well watered conditions** (figure 3).

Concerning the **photosynthesis efficiency (PhiPS2)**, the **PGPR treatment increased** by 6.2% Tremois seedlings in **well watered and stress conditions combined** (figure 4). In both cultivars, the **PGPR treatment increased** the efficiency by 7.6% compared to **drought conditions** (figure 5).

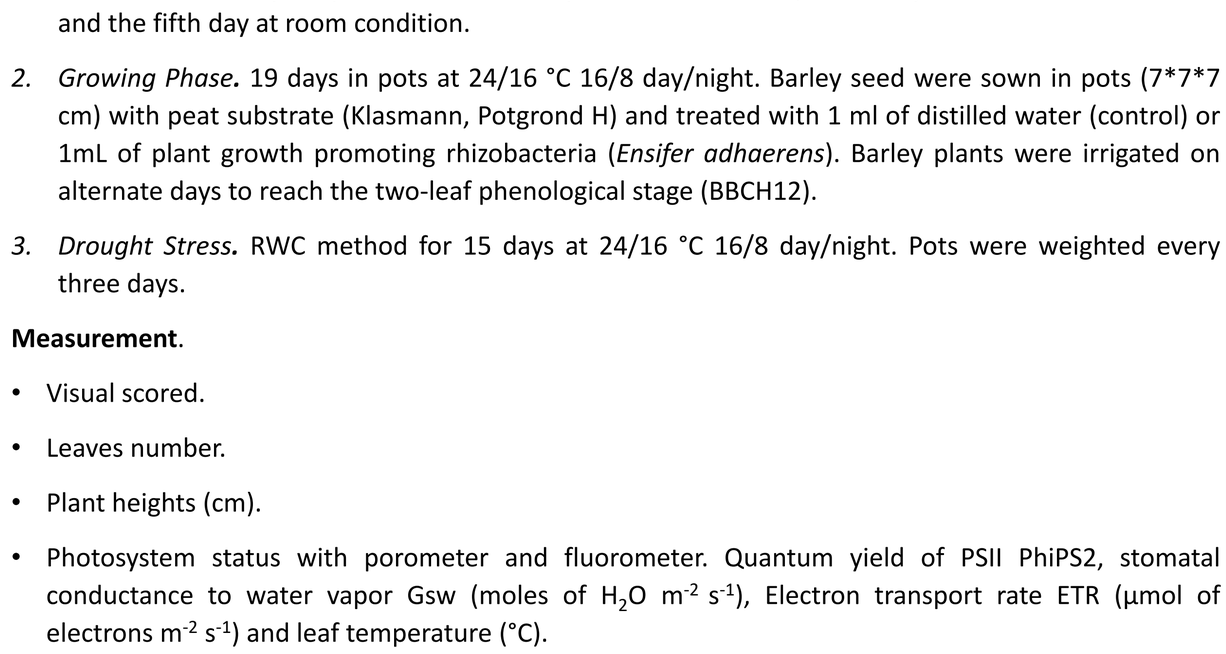

Figure 3. Result of the ANOVA test performed on the effect of treatment*stress*genotype interaction for roots dry weight (g).
[a, b, c, d] means followed by the different letters are statistically significant at P<0.05.

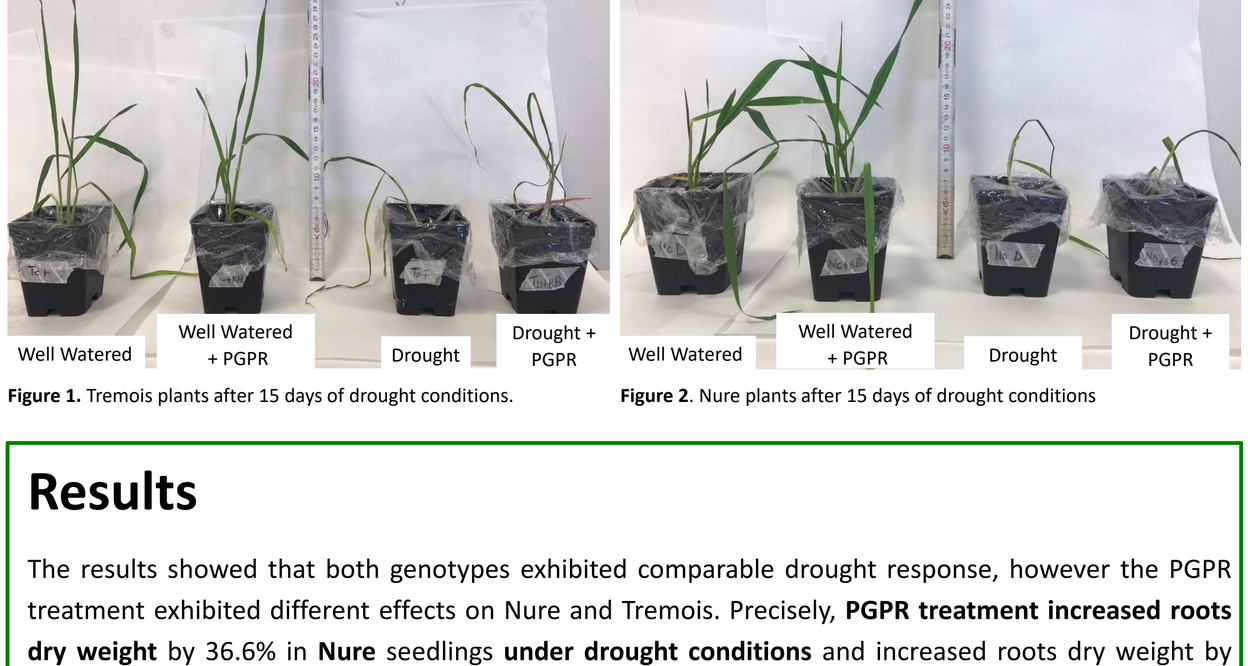

Figure 4. Result of the ANOVA test performed on the effect of the treatment*genotype interaction on photosynthesis efficiency (PhiPS2).
[a, b] means followed by the different letters are statistically significant at P<0.05.

Figure 5. Result of the ANOVA test performed on the effect of the stress*treatment interaction on photosynthesis efficiency (PhiPS2).
[a, b] means followed by the different letters are statistically significant at P<0.05.

Conclusions

The **findings** of this work suggest that the use of **PGPR** could be a useful tool for **protecting barley seedlings against drought stress in early stages of development**. However, further research is needed to fully understand the mechanisms of action to determine the optimal conditions for using this approach in open field.

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