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Pest categorisation of *Tetraleurodes perseae*

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Abstract

The EFSA Panel on Plant Health performed a pest categorisation of *Tetraleurodes perseae* (Hemiptera: Aleyrodidae), the red-banded whitefly, for the territory of the EU. *T. perseae* is a tropical and subtropical species that originated in the Neotropical region and has now spread and established in the USA (California and Florida), Israel and Lebanon. *T. perseae* is not listed in Commission Implementing Regulation (EU) 2019/2072. It is oligophagous on Lauraceae and most frequently reported on avocado (*Persea americana*), on which it is considered a minor or secondary pest. No evidence was found indicating damage to other plants. *T. perseae* larvae develop on the foliage and don't attack the fruit. The number of generations per year varies between one and ten. High populations may promote the growth of black sooty moulds on the foliage and fruit, and adults feeding on the buds can lead to deformed immature leaves and premature leaf drop. However, *T. perseae* populations are usually effectively controlled by hymenopteran parasitoids, at least one of which (*Cales noacki*) is widespread in the EU. The producers of organic avocados in the EU could encourage the use of *C. noacki*, although occasional outbreaks of *T. perseae* could temporarily impact the fruit quality. Adults disperse naturally by flying and all stages can be moved over long distances by the trade of infested plant material. Plants for planting provide potential pathways for entry and spread in the EU. Climatic conditions and availability of host plants in southern EU countries are conducive for establishment. Phytosanitary measures are available to reduce the risk. *T. perseae* satisfies all of the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest. However, this conclusion has a high uncertainty regarding magnitude of potential impact as the insect is a minor and sporadic pest in its current area of distribution.

Keywords: Avocado, invasive species, red-banded whitefly, pest risk, plant health, plant pest, quarantine

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1. Introduction

1.1. Background and Terms of Reference as provided by the requestor

1.1.1. Background

The new Plant Health Regulation (EU) 2016/2031, on the protective measures against pests of plants, is applying from 14 December 2019. Conditions are laid down in this legislation in order for pests to qualify for listing as Union quarantine pests, protected zone quarantine pests or Union regulated non-quarantine pests. The lists of the EU regulated pests together with the associated import or internal movement requirements of commodities are included in Commission Implementing Regulation (EU) 2019/2072. Additionally, as stipulated in the Commission Implementing Regulation 2018/2019, certain commodities are provisionally prohibited to enter in the EU (high risk plants, HRP). EFSA is performing the risk assessment of the dossiers submitted by exporting to the EU countries of the HRP commodities, as stipulated in Commission Implementing Regulation 2018/2018. Furthermore, EFSA has evaluated a number of requests from exporting to the EU countries for derogations from specific EU import requirements.

In line with the principles of the new plant health law, the European Commission with the Member States are discussing monthly the reports of the interceptions and the outbreaks of pests notified by the Member States. Notifications of an imminent danger from pests that may fulfil the conditions for inclusion in the list of the Union quarantine pest are included. Furthermore, EFSA has been performing horizon scanning of media and literature.

As a follow-up of the above-mentioned activities (reporting of interceptions and outbreaks, HRP, derogation requests and horizon scanning), a number of pests of concern have been identified. EFSA is requested to provide scientific opinions for these pests, in view of their potential inclusion by the risk manager in the lists of Commission Implementing Regulation (EU) 2019/2072 and the inclusion of specific import requirements for relevant host commodities, when deemed necessary by the risk manager.

1.1.2. Terms of Reference

EFSA is requested, pursuant to Article 29(1) of Regulation (EC) No 178/2002, to provide scientific opinions in the field of plant health.

EFSA is requested to deliver 53 pest categorisations for the pests listed in Annex 1A, 1B, 1D and 1E (for more details see mandate M-2021-00027 on the Open.EFSA portal). Additionally, EFSA is requested to perform pest categorisations for the pests so far not regulated in the EU, identified as pests potentially associated with a commodity in the commodity risk assessments of the HRP dossiers (Annex 1C; for more details see mandate M-2021-00027 on the Open.EFSA portal). Such pest categorisations are needed in the case where there are not available risk assessments for the EU.

When the pests of Annex 1A are qualifying as potential Union quarantine pests, EFSA should proceed to phase 2 risk assessment. The opinions should address entry pathways, spread, establishment, impact and include a risk reduction options analysis.

Additionally, EFSA is requested to develop further the quantitative methodology currently followed for risk assessment, in order to have the possibility to deliver an express risk assessment methodology. Such methodological development should take into account the EFSA Plant Health Panel Guidance on quantitative pest risk assessment and the experience obtained during its implementation for the Union candidate priority pests and for the likelihood of pest freedom at entry for the commodity risk assessment of High Risk Plants.

1.2. Interpretation of the Terms of Reference

Tetraleurodes perseae is one of a number of pests relevant to Annex 1C to the Terms of Reference (ToR) to be subject to pest categorisation to determine whether it fulfils the criteria of a potential Union quarantine pest for the area of the EU excluding Ceuta, Melilla and the outermost regions of Member States referred to in Article 355(1) of the Treaty on the Functioning of the European Union (TFEU), other than Madeira and the Azores, and so inform EU decision making as to its appropriateness for potential inclusion in the lists of pests of Commission Implementing Regulation (EU) 2019/ 2072. If a pest fulfils the criteria to be potentially listed as a Union quarantine pest, risk reduction options will be identified.

1.3. Additional information

This pest categorisation was initiated following the commodity risk assessment of avocado (*Persea americana* Mill.) scions and grafted plants from Israel performed by EFSA (EFSA PLH Panel, 2021), in which *T. perseae* was identified as a relevant non-regulated EU pest which could potentially enter the EU on *P. americana*.

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A literature search on *T. perseae* was conducted at the beginning of the categorisation in the ISI Web of Science bibliographic database, using the scientific name of the pest as search term. Papers relevant for the pest categorisation were reviewed, and further references and information were obtained from experts, as well as from citations within the references and grey literature.

2.1.2. Database search

Pest information, on host(s) and distribution, was retrieved from the European and Mediterranean Plant Protection Organization (EPPO) Global Database (EPPO, online), the CABI databases and scientific literature databases as referred above in Section 2.1.1.

Data about the import of commodity types that could potentially provide a pathway for the pest to enter the EU and about the area of hosts grown in the EU were obtained from EUROSTAT (Statistical Office of the European Communities).

The Europhyt and TRACES databases were consulted for pest-specific notifications on interceptions and outbreaks. Europhyt is a web-based network run by the Directorate General for Health and Food Safety (DG SANTÉ) of the European Commission as a subproject of PHYSAN (Phyto-Sanitary Controls) specifically concerned with plant health information. TRACES is the European Commission's multilingual online platform for sanitary and phytosanitary certification required for the importation of animals, animal products, food and feed of non-animal origin and plants into the European Union, and the intra-EU trade and EU exports of animals and certain animal products. Up until May 2020, the Europhyt database managed notifications of interceptions of plants or plant products that do not comply with EU legislation, as well as notifications of plant pests detected in the territory of the Member States and the phytosanitary measures taken to eradicate or avoid their spread. The recording of interceptions switched from Europhyt to TRACES in May 2020.

GenBank was searched to determine whether it contained any nucleotide sequences for *T. perseae* which could be used as reference material for molecular diagnosis. GenBank® (www.ncbi.nlm.nih.gov/genbank/) is a comprehensive publicly available database that as of August 2019 (release version 227) contained over 6.25 trillion base pairs from over 1.6 billion nucleotide sequences for 450,000 formally described species (Sayers et al., 2020).

2.2. Methodologies

The Panel performed the pest categorisation for *T. perseae*, following guiding principles and steps presented in the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018), the EFSA guidance on the use of the weight of evidence approach in scientific assessments (EFSA Scientific Committee, 2017) and the International Standards for Phytosanitary Measures No. 11 (FAO, 2013).

The criteria to be considered when categorising a pest as a potential Union quarantine pest (QP) is given in Regulation (EU) 2016/2031 Article 3 and Annex I, Section 1 of the Regulation. Table 1 presents the Regulation (EU) 2016/2031 pest categorisation criteria on which the Panel bases its conclusions. In judging whether a criterion is met the Panel uses its best professional judgement (EFSA Scientific Committee, 2017) by integrating a range of evidence from a variety of sources (as presented above in Section 2.1) to reach an informed conclusion as to whether or not a criterion is satisfied.

The Panel's conclusions are formulated respecting its remit and particularly with regard to the principle of separation between risk assessment and risk management (EFSA founding regulation (EU)

No 178/2002); therefore, instead of determining whether the pest is likely to have an unacceptable impact, deemed to be a risk management decision, the Panel will present a summary of the observed impacts in the areas where the pest occurs, and make a judgement about potential likely impacts in the EU. While the Panel may quote impacts reported from areas where the pest occurs in monetary terms, the Panel will seek to express potential EU impacts in terms of yield and quality losses and not in monetary terms, in agreement with the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018). Article 3 (d) of Regulation (EU) 2016/2031 refers to unacceptable social impact as a criterion for quarantine pest status. Assessing social impact is outside the remit of the Panel.

Table 1: Pest categorisation criteria under evaluation, as derived from Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

Criterion of pest categorisation	Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest (article 3)
Identity of the pest (Section 3.1)	Is the identity of the pest clearly defined, or has it been shown to produce consistent symptoms and to be transmissible?
Absence/presence of the pest in the EU territory (Section 3.2)	Is the pest present in the EU territory? If present, is the pest in a limited part of the EU or is it scarce, irregular, isolated or present infrequently? If so, the pest is considered to be not widely distributed.
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	Is the pest able to enter into, become established in, and spread within, the EU territory? If yes, briefly list the pathways for entry and spread.
Potential for consequences in the EU territory (Section 3.5)	Would the pests' introduction have an economic or environmental impact on the EU territory?
Available measures (Section 3.6)	Are there measures available to prevent pest entry, establishment, spread or impacts?
Conclusion of pest categorisation (Section 4)	A statement as to whether (1) all criteria assessed by EFSA above for consideration as a potential quarantine pest were met and (2) if not, which one(s) were not met.

3. Pest categorisation

3.1. Identity and biology of the pest

3.1.1. Identity and taxonomy

Is the identity of the pest clearly defined, or has it been shown to produce consistent symptoms and/or to be transmissible?

Yes, the identity of the red-banded whitefly is well established, and its scientific name is *Tetraleurodes perseae*.

Tetraleurodes perseae Nakahara is an insect within the Order Hemiptera and family Aleyrodidae. It is commonly known as red-banded whitefly. It was described by Nakahara (1995) from specimens collected from avocado (*Persea americana*) in El Salvador, Mexico and the USA, and from *Persea* sp., bay (*Laurus nobilis*) and *Litsea* sp. from Mexico. Nakahara (1995) provides detailed descriptions of all the larval instars.

The EPPO code[1] (Griessinger & Roy, 2015; EPPO, 2019) for this species is: TETLPE (EPPO, online).

[1] An EPPO code, formerly known as a Bayer code, is a unique identifier linked to the name of a plant or plant pest important in agriculture and plant protection. Codes are based on genus and species names. However, if a scientific name is changed the EPPO code remains the same. This provides a harmonized system to facilitate the management of plant and pest names in computerized databases, as well as data exchange between IT systems (Griessinger and Roy, 2015; EPPO, 2019).

3.1.2. Biology of the pest

The life cycle of *T. perseae* consists of eggs, four larval (also referred to as nymphal) instars and adults. The first larval instar has well-developed legs and crawls over the host plant in search of a suitable feeding site, usually settling a short distance from the egg (García-Palacios et al., 2016). The later three larval instars have reduced legs and are sessile. The fourth-larval instar is known as the pupa or puparium, from which the winged adult emerges. Eggs are laid on the lower surface of immature leaves, where the larval stages develop. Whitefly larvae can occur on fruit and the calyx, but this is rare (Malumphy, 2009).

The biology of *T. perseae* has been studied on avocado in California (Hoddle, 2006) and Mexico (García-Palacios et al., 2016). In California, it was found to be probably univoltine and have a distinct population peak during mid- to late summer on succulent young leaves, which are ideal for feeding and oviposition. Laboratory studies conducted at 25°C on excised avocado leaves indicated that about 43–46 days are needed by *T. perseae* to complete development from egg to adult. Demographic analyses of laboratory data indicate that *T. perseae* has a high reproductive potential with net reproductive rate and intrinsic rate of increase estimates being 21.15 ± 1.39 eggs and 0.07 ± 0.01 d^{-1}, respectively. In Mexico, it is estimated that there are up to nine generations per year with temperature and precipitation being important factors on development. This is much higher than the number of generations estimated by Hoddle (2006) and is close to the eight generations per year estimated for the related species *Tetraleurodes acaciae* (Quaintance) in Florida (Dowell, 1982). The number of adult *T. perseae* showed a positive relationship with regard to the number of vegetative buds, while the larvae had a negative relationship with regard to relative humidity.

T. perseae is under very good control in Mexico by two *Encarsia* spp. and one *Eretmocerus* sp. parasitoids (Hymenoptera: Aphelinidae) (Hoddle, 2006). In California, these Mexican parasitoids are absent, but *Cales noacki* Howard (Hymenoptera: Aphelinidae), a parasitoid released for the control of the woolly whitefly (*Aleurothrixus floccosus* (Maskell)) on *Citrus* can parasitize 30–100% of red-banded whitefly larvae (Rose and Zolnerowich, 2004; Hoddle, 2006; Subhagan Seena et al., 2020). *T. perseae* seems to be less effectively controlled by *C. noacki* in more arid interior areas of California where summer temperatures are hotter. *C. noacki* is established and widespread in the southern EU countries like France, Greece, Italy, Portugal and Spain, and is reported to provide substantial control of *A. floccosus* in citrus Spain (Jacas et al., 2010; Jacas and Urbaneja, 2010).

T. perseae is not known to vector any plant viruses (Jones, 2003).

3.1.3. Host range/Species affected

T. perseae is a pest of avocado (*Persea americana*), which is the main host. It is oligophagous on Lauraceae and hosts include *Laurus nobilis, Litsea sp., Persea* spp. and *Umbellularia californica* (Hoddle, 2006). It is not clear from the literature how frequently *T. perseae* occurs on hosts other than avocado.

3.1.4. Intraspecific diversity

There is no intraspecific diversity found in literature.

3.1.5. Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, detection and identification methods are available for *T. perseae*.

Detection

Visual examination of plants is an effective way for the detection of *T. perseae*. The adults with reddish-brown bands on the wings, black pupae with contrasting white wax marginal fringe found on the lower surface of the leaves, and sooty mould growing on honeydew egested by the larval stages found on the fruit, bark and upper surface of the leaves, are easily detectable. Figure 1 features a pupa of a *Tetraleurodes* species (not *T. perseae*) to show the characteristic dark pupa and white wax fringe.

Figure 1: *Tetraleurodes perseae* pupa, showing the dark pupa with marginal white wax fringe which are characteristic for many of the species in the *Tetraleurodes* genus (Source: Roy Kaspi)

Identification

The identification of *T. perseae* requires microscopic examination of slide-mounted pupa and verification of the presence of diagnostic morphological characteristics as given by Nakahara (1995). Martin et al. (2000) provide keys for the identification of whiteflies found in Europe and the Mediterranean Basin. Although it does not contain *T. perseae* it is useful for the identification to generic level and to assist with the separation of the three *Tetraleurodes* species present in the EU. One of these, *Tetraleurodes neemani* Bink-Moenen, shares the host *L. nobilis* with *T. perseae*, and is found in Cyprus and Greece.

García-Palacios et al. (2020) provide methods for the morphological and molecular identification of whiteflies (including *T. perseae*) associated with avocado at Morelos, Mexico.

Symptoms

Black sooty mould growing on foliage, bark and fruit can indicate the presence of *T. perseae*, and feeding on the buds by the adult whiteflies can lead to deformed immature leaves, which in some circumstances can lead to premature leaf drop (Hoddle, 2006). These symptoms are not specific and may be caused by other species of whitefly and sap-sucking insects.

Description

Adult *T. perseae* have conspicuous rusty, reddish-brown bands on the wings. The eggs are beige-coloured and kidney-bean shaped. The first two instars are oval, flattish and light-yellow brown; the third and fourth instars are similar in shape but larger and black (melanic). The final larval instar is 0.8–1.2 mm long and 0.6–0.9 mm wide, with a distinct white wax marginal fringe which curls upwards to partially cover the dorsal margin. Occasionally, cast exuviae may collect on the dorsal surface of the larvae; this tends to be more common for the first three instars (Nakahara, 1995; Hoddle, 2006).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

A new species of whitefly was found infesting avocado in San Diego, California (US) in 1982 but was not described as *T. perseae* until 1995. It is thought that this species originates from the Neotropical Region, in the native range of avocado, and Hoddle (2006) suggested it was native to Mexico and Central America. Nakahara (1995) recorded *T. perseae* from El Salvador, Mexico and the USA. The record for El Salvador is based on an interception in the USA on avocado imported from El Salvador and EPPO GD states that more information is needed to confirm the distribution in Central America. *T. perseae* was first detected in Israel in 2001 and in Lebanon in 2002. García-Palacios et al. (2016) recorded *T. perseae* from the Caribbean, incorrectly citing Nakahara (1995) as the source. For a list of countries where *T. perseae* is present, see Figure 2 and Appendix B.

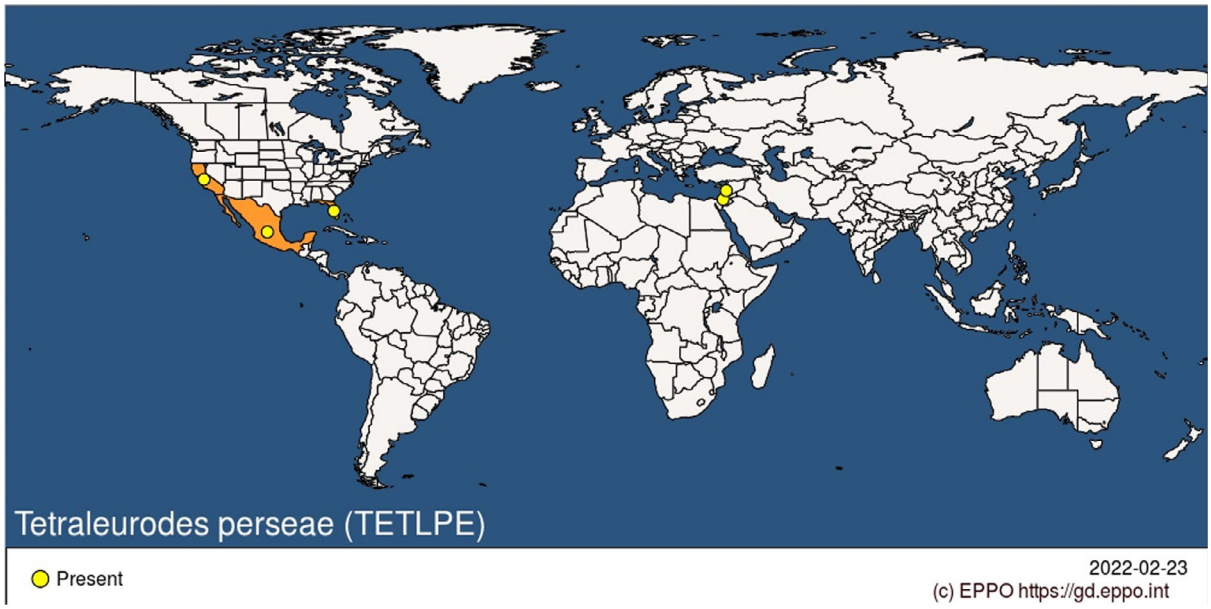

Figure 2: Global distribution of *Tetraleurodes perseae* (Source: EPPO Global Database accessed on 23 February 2022)

3.2.2. Pest distribution in the EU

Is the pest present in the EU territory? If present, is the pest in a limited part of the EU or is it scarce, irregular, isolated or present infrequently? If so, the pest is considered to be not widely distributed.

No. *T. perseae* is not known to occur in the EU.

3.3. Regulatory status

3.3.1. Commission Implementing Regulation 2019/2072

T. perseae is not listed in Annex II of Commission Implementing Regulation (EU) 2019/2072, an implementing act of Regulation (EU) 2016/2031.

3.3.2. Hosts or species affected that are prohibited from entering the Union from third countries

Laurus nobilis and *Umbellularia californica* are not included in Annex VI of Commission Implementing Regulation (EU) 2019/2072, hence their import into the EU is permitted subject to phytosanitary certificate requirements. *Persea americana* is recognized as a high risk plant whose import into the EU is prohibited pending risk assessment (EU 2018/2019).

3.4. Entry, establishment and spread in the EU

3.4.1. Entry

Is the pest able to enter into the EU territory? If yes, identify and list the pathways

Yes, pathways for entry into the EU territory exist via plants for planting and cut branches (mainly *P. americana*).

Comment on plants for planting as a pathway

Plants for planting would be the primary pathway for entry.

T. perseae can spread over long distances through infested plants for planting and cut branches (mainly avocados) (Table 2). Movement with fruits is less likely as the pest doesn't usually feed on them (EPPO, 2006) and this pathway is considered negligible. Natural dispersal occurs locally by the adults flying, or potentially over longer distances via passive transport by wind.

The EFSA Panel on Plant Health (2021) commodity risk assessment for *Persea americana* plants for planting from Israel, indicated with 95% certainty, that between 99.2% and 100% of imported bundles of scions and grafted plants, produced using specified mitigation measures, would be free of *T. perseae,* giving an overall evaluation of 'pest free with some exceptional cases'.

Table 2: Potential pathways for *Tetraleurodes perseae* into the EU 27

Pathways (e.g. host/ intended use/source)	Life stage	Relevant mitigations [e.g. prohibitions (Annex VI), special requirements (Annex VII) or phytosanitary certificates (Annex XI) within Implementing Regulation 2019/2072]
Plants for planting	Eggs and larvae	Prohibition for avocado plants for planting (EU 2018/2019), with the exception of Israel ((EU) 2021/1936). Phytosanitary certificates required for plants for planting
Cut branches with leaves	Eggs and larvae	Phytosanitary certificates required for cut branches e.g. of *Laurus* from USA (Annex XI, part A)

Notifications of interceptions of harmful organisms began to be compiled in Europhyt in May 1994 and in TRACES in May 2020. As at 8 February 2022, there were no records of interception of *T. perseae* in the Europhyt and TRACES databases.

As this pest moves on plants for planting, transfer to a suitable host is highly likely.

3.4.2. Establishment

Is the pest able to become established in the EU territory?

Yes, the pest is able to become established in the EU territory. Suitable climates occur in southern EU around the Mediterranean and there are available hosts that could support establishment.

Climatic mapping is the principal method for identifying areas that could provide suitable conditions for the establishment of a pest taking key abiotic factors into account (Baker, 2002). Availability of hosts is considered in Section 3.4.2.1. Climatic factors are considered in Section 3.4.2.2.

3.4.2.1. EU distribution of main host plants

Although *T. perseae* is oligophagous on Lauraceae (see Section 3.1.3), it is only considered a pest of avocado.

From the almost 20,000 ha of avocados cultivated in EU 27 in 2020 (Table 3), more than half correspond to Spain (14,000 ha with considerable growth), of which around 12,000 in mainland Spain (mostly in the coastal districts of the provinces of Málaga and Granada in Andalusia) and 1,700 ha in the Canary Islands (Bienvenido et al., 2021; MAPA, 2021). The area allocated to avocado production in different EU MS is rapidly increasing. Although not captured yet by Eurostat (Table 4), Italy and Spain are the only European countries with significant commercial production of avocados (Migliore et al., 2017). Italian production areas are mostly located in Sicily, those in Portugal in Algarve, and those in Greece in Crete.

There appears to be a single published finding of *T. perseae* on *L. nobilis* (Nakahara, 1995) that is not considered a main host.

Table 3: Harvested area of avocados (Code: F2300) in EU 27, 2016–2020 (thousand ha). Source EUROSTAT (accessed 14 February 2022)

MS/year	2016	2017	2018	2019	2020
Cyprus	0.09	0.08	0.10	0.10	0.10
France	0.23	0.23	0.24	0.24	0.24
Greece	0.48	0.60	0.72	1.08	1.10
Portugal	0.00	0.00	0.00	1.98	2.31
Spain	11.44	11.81	12.16	14.10	15.85

3.4.2.2. Climatic conditions affecting establishment

T. perseae is a thermophilic insect found mainly in areas with tropical and subtropical climates in parts of the Americas and Mediterranean (recently established in Israel and Lebanon). Figure 3 shows the World distribution of Köppen–Geiger climate types (Kottek et al., 2006) that occur in the EU and which occur in countries where *T. perseae* has been reported (BSh, BSk, Cfa, Csa, Csb and Csc). Southern EU MSs provide suitable climatic conditions for the establishment of *T. perseae*. It is unlikely that the whitefly could establish in the central and northern EU MS and if it did, the populations are likely to be small and have no impact. There is a possibility that *T. perseae* could occur in greenhouses and on indoor plantings in cooler areas.

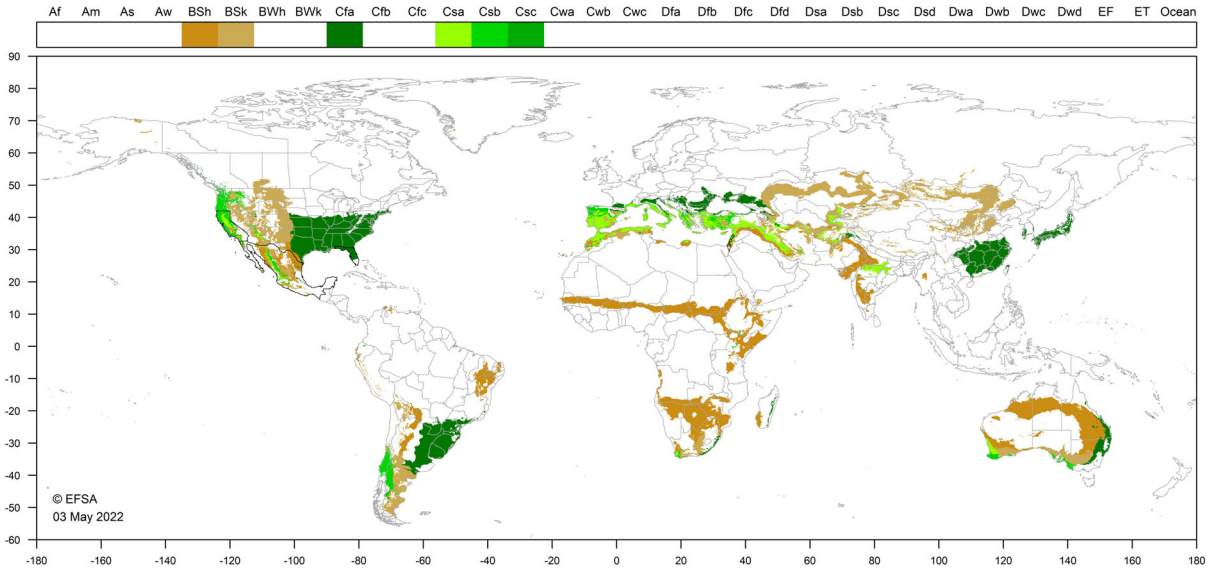

Figure 3: World distribution of Köppen–Geiger climate types that occur in the EU and which occur in sites where *Tetraleurodes perseae* has been reported

3.4.3. Spread

Describe how the pest would be able to spread within the EU territory following establishment?

Adults disperse naturally by flying and all stages (mainly the eggs and larvae) can be moved over long distances by the trade of infested plant material.

Comment on plants for planting as a mechanism of spread.

Plants for planting (mainly avocados) are the main mechanism of spread.

Natural dispersal occurs locally by adults flying, or over longer distances via passive transport by wind. *T. perseae*, particularly the eggs and larval stages which are firmly attached to the host, can be spread over long distances through infested plants for planting.

3.5. Impacts

Would the pests' introduction have an economic or environmental impact on the EU territory?

Yes, the introduction of *T. perseae* into the EU is likely to have a minor economic impact on avocado production.

Honeydew egested by feeding *T. perseae* larvae can promote the growth of black sooty mould on leaves, and feeding on the buds by the adults can lead to deformed immature leaves, which in some circumstances can lead to premature leaf drop (Hoddle, 2006). In Mexico, *T. perseae* has been recorded decreasing host vigour and affecting avocado production (García-Palacios et al., 2016), and can be a pest in orchards after pesticide applications have disrupted biological control by hymenopteran parasitoids

(Hoddle, 2006). However, *T. perseae* is only considered a minor or secondary pest for avocado crops in California and Mexico since the whitefly only shows up occasionally (Hoddle, 2006; García-Palacios et al., 2016). In Israel, the whitefly is rare and damage negligible, and a specific treatment scheme for *T. perseae* in avocado has not been required (EFSA PLH Panel, 2021). *T. perseae* is only a recent introduction to Israel and it may take time before an impact is observed.

The introduction of *T. perseae* into the EU is likely to have some economic impact on avocado production, but this is likely to be sporadic, as an effective biological control agent (*Cales noacki*) of the whitefly is already widely present, but cannot always be relied upon. (Hoddle, 2006).

Even though the producers of organic avocados in the EU could encourage the use of *C. noacki*, occasional outbreaks could temporarily impact the quality, e.g. due to sooty mould.

3.6. Available measures and their limitations

Are there measures available to prevent pest entry, establishment, spread or impacts such that the risk becomes mitigated?

Yes, *P. americana* is a high risk plant, other host plants for planting are managed with the requirement of phytosanitary certificate for entry into the EU. Such phytosanitary measures do not specifically target *T. perseae*, but do mitigate the likelihood of its entry into, establishment and spread within the EU.

High risk plant regulation EU 2018/2019 includes temporary prohibition of *Persea* from third countries other than Israel (Reg. 2021/1936).

Additional potential risk reduction options and supporting measures are shown in Sections 3.6.1.1 and 3.6.1.2.

3.6.1. Identification of potential additional measures

3.6.1.1. Additional potential risk reduction options

Potential additional control measures are listed in Table 4.

Table 4: Selected control measures (a full list is available in EFSA PLH Panel, 2018) for pest entry/establishment/spread/impact in relation to currently unregulated hosts and pathways. Control measures are measures that have a direct effect on pest abundance

Control measure/ Risk reduction option (Blue underline = Zenodo doc, Blue = WIP)	**RRO summary**	**Risk element targeted (entry/ establishment/ spread/impact)**
Require pest freedom	Source hosts from pest free areas	Entry/Spread
Growing plants in isolation	Description of possible exclusion conditions that could be implemented to isolate the crop from pests and if applicable relevant vectors. E.g. a dedicated structure such as glass or plastic greenhouses. Production of nursery plants in insect proof greenhouses.	Entry (reduce contamination/ infestation)/Spread/ Impact
Biological control and behavioural manipulation	Augmentative and conservation biological control exploiting hymenopteran parasitoids already present, such as *C. noacki*.	Impact
Chemical treatments on crops including reproductive material	Pesticides can be effective for whitefly control	Entry/ Establishment/ Impact

3.6.1.2. Additional supporting measures

Potential additional supporting measures are listed in Table 5.

Table 5: Selected supporting measures (a full list is available in EFSA PLH Panel, 2018) in relation to currently unregulated hosts and pathways. Supporting measures are organisational measures or procedures supporting the choice of appropriate risk reduction options that do not directly affect pest abundance

Supporting measure (Blue underline = Zenodo doc, Blue = WIP)	Summary	Risk element targeted (entry/establishment/ spread/impact)
Inspection and trapping	Inspection is defined as the official visual examination of plants, plant products or other regulated articles to determine if pests are present or to determine compliance with phytosanitary regulations (ISPM 5). The effectiveness of sampling and subsequent inspection to detect pests may be enhanced by including trapping and luring techniques.	Entry/Establishment/ Spread/Impact
Laboratory testing	Examination, other than visual, to determine if pests are present using official diagnostic protocols. Diagnostic protocols describe the minimum requirements for reliable diagnosis of regulated pests.	
Sampling	According to ISPM 31, it is usually not feasible to inspect entire consignments, so phytosanitary inspection is performed mainly on samples obtained from a consignment. It is noted that the sampling concepts presented in this standard may also apply to other phytosanitary procedures, notably selection of units for testing. For inspection, testing and/or surveillance purposes the sample may be taken according to a statistically based or a non-statistical sampling methodology.	
Phytosanitary certificate and plant passport	An official paper document or its official electronic equivalent, consistent with the model certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements (ISPM 5) a) export certificate (import) b) plant passport (EU internal trade)	
Surveillance	Surveillance to guarantee that plants and produce originate from a Pest Free Area could be an option.	Spread

3.6.1.3. Biological or technical factors limiting the effectiveness of measures

- Due to its small size, *T. perseae* may not be easily detected in cases where low densities occur.
- Limited number of available registered active substances for use in avocado.
- Lack of experience on the chemical control of *T. perseae* under EU conditions.
- The effectiveness of natural enemies already present in the EU, such as *C. noacki,* in controlling the whitefly pest.

3.7. Uncertainty

The main source of uncertainty is regarding the magnitude of potential economic impact caused by *T. perseae* to avocado production within the EU, as this is considered a secondary or minor pest in other avocado-producing regions. This uncertainty, though, does not affect the conclusions of this categorisation.

4. Conclusions

T. perseae satisfies all of the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest. However, this conclusion has a high uncertainty regarding magnitude of potential impact as the insect is a minor and sporadic pest in its current area of distribution. Table 6 provides a summary of the PLH Panel conclusions.

Table 6: The Panel's conclusions on the pest categorisation criteria defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Key uncertainties
Identity of the pest (Section 3.1)	The identity of the pest is well established. Morphological and molecular diagnostic methods are available.	None
Absence/presence of the pest in the EU (Section 3.2)	The pest is not present in the EU territory	None
Pest potential for entry, establishment and spread in the EU (Section 3.4)	*T. perseae* is able to enter into, become established, and spread within the EU territory. The main pathway is plants for planting (avocado).	None
Potential for consequences in the EU (Section 3.5)	*T. perseae* is reported to be a minor sporadic pest of avocado in California and Mexico and could have a similar economic impact in the EU.	Magnitude of potential economic impact
Available measures (Section 3.6)	There are measures available to prevent the entry, establishment and spread of *T. perseae* within the EU. Risk reduction options include the inspections and the production of plants for import into the EU in pest free areas.	None
Conclusion (Section 4)	*T. perseae* satisfies the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest. However, this conclusion has a high uncertainty regarding magnitude of potential impact as the insect is a minor and sporadic pest in its current area of distribution.	Magnitude of potential economic impact
Aspects of assessment to focus on/scenarios to address in future if appropriate:	Further study of potential impact and an estimation of the magnitude of impact could reduce uncertainties and better inform risk management decision making.	

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Abbreviations

DG SANTÉ	Directorate General for Health and Food Safety
EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization

IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
MS	Member State
PLH	EFSA Panel on Plant Health
PZ	Protected Zone
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference

Glossary

Containment (of a pest)	Application of phytosanitary measures in and around an infested area to prevent spread of a pest (FAO, 2018)
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO, 2018)
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO, 2018)
Eradication (of a pest)	Application of phytosanitary measures to eliminate a pest from an area (FAO, 2018)
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2018)
Greenhouse	A walk-in, static, closed place of crop production with a usually translucent outer shell, which allows controlled exchange of material and energy with the surroundings and prevents release of plant protection products (PPPs) into the environment.
Hitchhiker	An organism sheltering or transported accidentally via inanimate pathways including with machinery, shipping containers and vehicles; such organisms are also known as contaminating pests or stowaways (Toy and Newfield, 2010).
Impact (of a pest)	The impact of the pest on the crop output and quality and on the environment in the occupied spatial units
Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO, 2018)
Pathway	Any means that allows the entry or spread of a pest (FAO, 2018)
Phytosanitary measures	Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO, 2018)
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO, 2018)
Risk reduction option (RRO)	A measure acting on pest introduction and/or pest spread and/or the magnitude of the biological impact of the pest should the pest be present. A RRO may become a phytosanitary measure, action or procedure according to the decision of the risk manager
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO, 2018)

Appendix A – *Tetraleurodes perseae* host plants/species affected

Source: EPPO Global Database (EPPO, online) and Hoddle (2006)

Host status	Host name	Plant family	Common name	Reference
Cultivated hosts	*Laurus nobilis*	Lauraceae	Bay	Hoddle (2006)
	Litsea sp.	Lauraceae		Hoddle (2006)
	Persea americana	Lauraceae	Avocado	EPPO (online)
	Persea spp.	Lauraceae		Hoddle (2006)
	Umbellularia californica	Lauraceae	California bay	Hoddle (2006)

Appendix B – Distribution of *Tetraleurodes perseae*

Distribution records based on EPPO Global Database (EPPO, online).

Region	Country	Sub-national (e.g. State)	Status
North America	Mexico		Present, no details
	United States of America		Present, restricted distribution
		California	Present, no details
		Florida	Present, no details
Asia	Israel		Present, widespread
	Lebanon		Present, no details