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Pest categorisation of *Pulvinaria psidii*

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Abstract

The EFSA Panel on Plant Health performed a pest categorisation of *Pulvinaria psidii* (Hemiptera: Coccidae), the green shield scale, for the EU. *P. psidii* was originally described from Hawaii on *Psidium* sp. and it is now established in many countries in tropical and subtropical regions of the world. Within the EU, the pest has been reported from mainland Spain and the Canary Islands. *P. psidii* is not listed in Annex II of Commission Implementing Regulation (EU) 2019/2072. It is highly polyphagous, feeding on 230 plant species belonging to more than 70 botanical families with preference for avocado (*Persea americana*), citrus (*Citrus* spp.), coffee (*Coffea* sp.), guava (*Psidium guajava*), litchi (*Litchi chinensis*), mango (*Mangifera indica*), mulberry (*Morus* sp.) and pomegranate (*Punica granatum*). It has also been recorded feeding on some solanaceous plants: tomato (*Solanum lycopersicum*) and pepper (*Capsicum annuum*), as well as on ornamental plants. Climatic conditions and availability of host plants in southern EU countries would most probably allow this species to successfully establish and spread. Economic impact in cultivated hosts including citrus, mangoes, mulberries, as well as vegetable and ornamental crops is anticipated if establishment occurs. Indeed, *P. psidii* has already been reported causing damage to *Melia azedarach*, a widely used ornamental tree that lines streets in Valencia. There is contradictory information regarding impact in mangoes in Spain. This could be due to the relatively recent establishment of the pest. Phytosanitary measures are available to reduce the likelihood of entry and further spread. *P. psidii* meets the criteria that are within the remit of EFSA to assess for this species to be regarded as a potential Union quarantine pest.

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Keywords: green shield scale, Hemiptera, Coccidae, pest risk, plant health, plant pest, quarantine

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Figure 1: Courtesy of Chris Malumphy

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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

Pulvinaria psidii is one of a number of pests listed in Annex 1C to the Terms of Reference (ToRs) to be subject to pest categorisation to determine whether it fulfils the criteria of a potential Union quarantine pest (QP) 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 QP, risk reduction options will be identified.

1.3. Additional information

This pest categorisation was initiated following the commodity risk assessment of jasmine (*Jasminum polyanthum*) unrooted cuttings from Israel performed by EFSA PLH Panel (2020), in which *P. psidii* was identified as a relevant non-regulated EU pest which could potentially enter the EU on *J. polyanthum*.

2. Data and methodologies

2.1. Data

2.1.1. Information on pest status from NPPOs

In the context of the current mandate, EFSA is preparing pest categorisations for new/emerging pests that are not yet regulated in the EU. When official pest status is not available in the European and Mediterranean Plant Protection Organization (EPPO) Global Database (EPPO, online), EFSA consults the NPPOs of the relevant MSs. To obtain information on the official pest status for *P. psidii*, EFSA has consulted the NPPO of Spain. The results of this consultation are presented in Section 3.2.2.

2.1.2. Literature search

A literature search on *P. psidii* 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.

2.1.3. Database search

Pest information, on host(s) and distribution, was retrieved from the EPPO Global Database, 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 *Pulvinaria psidii* 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 *Pulvinaria psidii*, 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 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 QP 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 species is established and *Pulvinaria psidii* (Maskell, 1893) is the accepted scientific name.

Pulvinaria psidii (Maskell, 1893) (Figure 1) is a scale insect within the order Hemiptera and the family Coccidae. It is commonly known as green shield scale, guava mealy scale and guava soft scale. It was originally described as *Pulvinaria psidii* by Maskell (1893) from specimens collected in Hawaii (USA), on *Psidium* sp. (Germain et al., 2008). Synonyms include *Chloropulvinaria psidii*, *Pulvinaria cupaniae, P. darwiniensis*, *P. cussoniae*, *P. gymnosporiae* and *P. psidii philippina* (García Morales et al., 2016).

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

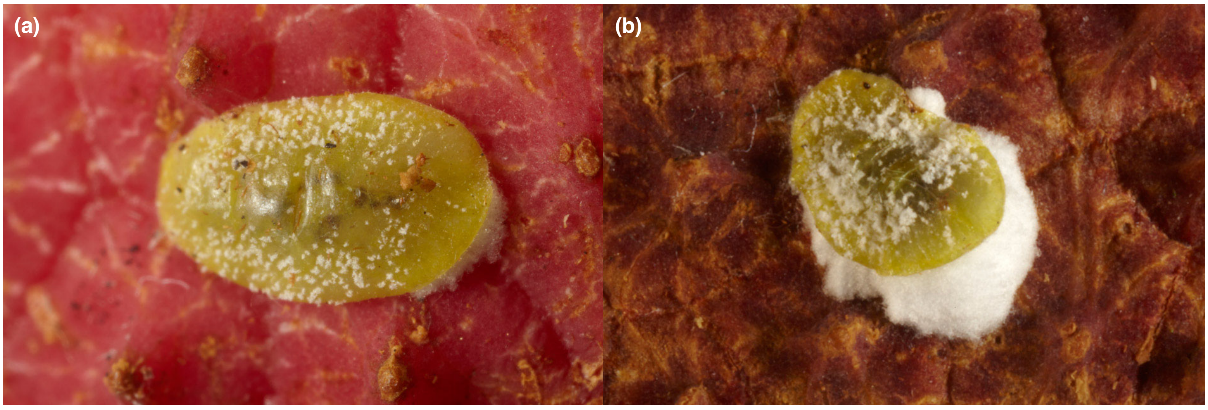

Figure 1: *Pulvinaria psidii*: (a), teneral adult female (body length 4 mm); (b), mature adult (body length 4.5 mm) female with ovisac (Source: Chris Malumphy)

3.1.2. Biology of the pest

P. psidii is parthenogenetic and males are unknown (Mau and Kessing, 1992). Hamon and Williams (1984) reported that it takes 2–3 months to complete one life cycle; in Egypt and Taiwan, it has two or three overlapping generations each year (Salama and Saleh, 1970; Bakr et al., 2012, García Morales et al., 2016). Observations in an Egyptian guava orchard suggest that the optimal temperature for development of *P. psidii* is 26.0–27.3°C, and relative humidity about 72% (Salama and Saleh, 1970; Biosecurity Australia, 2004). On guava, each female lays an average of about 200 eggs (El-Minshawy and Moursi, 1976; Mohamed et al., 2012), which are protected beneath the body of the female and a waxy ovisac that projects out posteriorly from beneath the female (El-Minshawy and Moursi, 1976, Mohamed et al., 2012). It has three nymphal instars. Table 2 summarises key features of the biology of each life stage.

Table 2: Important features of the life history strategy of *Pulvinaria psidii*

Life stage	Phenology and relation to host	Other relevant information
Egg	Eggs are deposited in an ovisac on twigs or leaves (Mau and Kessing, 1992). In Egypt, ovisacs appear throughout the year although their numbers are very low from January to April. Peak numbers of ovisacs occur in mid-June and mid-September. There can be a later, smaller peak in November or December (Bakr et al., 2012).	The formation of the ovisac and egg deposition takes 5 days (Hamon and Williams, 1984).
Nymph	First instar nymphs are known as crawlers. They move to find a suitable place to settle and feed (El-Minshawy and Moursi, 1976). On guava trees in Egypt, the numbers of nymphs peak in mid-May and mid-August (Elwan et al., 2011); further peaks are possible in September or October (Bakr et al., 2012).	The nymphal stage lasts from 50 to 70 days (Mau and Kessing, 1992).

[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 harmonised system to facilitate the management of plant and pest names in computerised databases, as well as data exchange between IT systems (Griessinger and Roy, 2015; EPPO, 2019).

Life stage	Phenology and relation to host	Other relevant information
Adult	In Egypt, the first generation occurs on guava from early March to early/mid-August; the second from early May to mid-November with a peak in mid-August. There are three overlapping generations on mango trees and ornamental plants (spring, summer, autumn) (Elwan et al., 2011; Bakr et al., 2012)	The duration of the 1st generation is 5–5.5 months (mean Temp: 20.7–21.3°C, RH: 70.7–71.9%). The 2nd generation lasts 6–6.5 months (mean Temp: 24.2–25°C, RH: 69.4–70.4%) (Elwan et al., 2011). Laboratory experiments revealed that among three constant temperatures tested (18, 24 and 30°C), highest fecundity on guava and mango trees occurred at 30°C and adult life span was 33.4 and 37.1 days respectively (Moustafa and Abd-Rabou, 2010)

3.1.3. Host range/species affected

P. psidii is a polyphagous insect which can feed on more than 230 plant species belonging to more than 70 botanical families (Appendix A provides a full host list) with preference for avocado (*Persea americana*), citrus (*Citrus* sp.), coffee (*Coffea* sp.), guava (*Psidium guajava*), litchi (*Litchi chinensis*), mango (*Mangifera indica*), mulberry (*Morus* sp.) and pomegranate (*Punica granatum*) (García Morales et al., 2016). *P. psidii* has also been recorded feeding on Solanaceae such as tomato (*Solanum lycopersicum*) and pepper (*Capsicum annuum*), and ornamental plants such as *Anthurium* sp., *Camellia* sp., *Ficus* sp., *Gardenia* sp., *Jasminum* sp. and *Nerium oleander* (García Morales et al., 2016).

3.1.4. Intraspecific diversity

No intraspecific diversity has been reported for *P. psidii*.

3.1.5. Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, visual detection is possible, and morphological and molecular identification methods are available.

Detection

Careful visual examination of plants and fruits is an effective way for the detection of *P. psidii*. Accumulation of honeydew, sooty mould and honeydew-seeking ants are general signs of phloem feeding insect infestations; they can be used to pinpoint the areas where plants may be inspected for the presence of soft scales (Camacho and Chong, 2015). *P. psidii* occurs on leaves and small young stems (Hamon and Williams, 1984) but quickly colonises flower panicles, and then fruits when they appear on the tree (Biosecurity New Zealand, 2008). *P. psidii* scales produce a mass of eggs in a cottony ovisac which is relatively easy to detect (EFSA PLH Panel, 2020). Double-sided sticky tape around stems can also be used to monitor the crawlers (Bethke and Wilen, 2010).

Symptoms

According to Swirski et al. (1997), Bakr et al. (2009), Koul and Taak (2017), EFSA PLH Panel (2021) the main symptoms of *P. psidii* infestation are:

- large quantities of honeydew egested by the scales;
- black sooty mould growing on the honeydew;
- fruit discoloration;
- plants covered with flocculent white egg sacs attached to the body of the female;
- leaf curling;
- heavy infestation causes yellowing, defoliation, reduction in fruit set and loss in plant vigour.

With the exception of the white ovisacs, these symptoms are similar to those caused by many other phloem-feeding insects and should not be considered as diagnostic.

Identification

The identification of *P. psidii* requires microscopic examination of slide-mounted adults and verification of the presence of key morphological characteristics. Detailed morphological descriptions, illustrations, and keys of adult *P. psidii* and other species of the family Coccidae can be found in Qin (1989), Qin and Gullan (1992) and Tanaka and Kamitani (2020).

Molecular techniques based on the nucleotide sequences of the mitochondrial cytochrome c oxidase subunit I (COI) gene (barcoding region) and 28S rDNA have been developed for species identification (Wang et al., 2015). GenBank contains gene nucleotide sequences for *P. psidii*.

Description

Qin and Gullan (1992) describe all the developmental stages of *P. psidii*. The egg of *P. psidii* is pale green, oval and measures 0.22 × 0.17 mm. Eggs are embedded in the cottony matter of the ovisac. The ovisac is white, and projects posteriorly at first but eventually more or less surrounds the insect and measures 4–7 mm long (El-Minshawy and Moursi, 1976). First instar nymphs (crawlers) are covered with a few spiral wax filaments (Beshr et al., 2009).

Second instar nymphs are elongate about 0.83 mm wide and characterised by having an eight-segmented antenna which is about 0.16 mm in length (El-Minshawy and Moursi, 1976). Older instars are flat and green (Nafus, 1996).

The body of the adult female is oval, relatively convex in cross-section, up to 4.5 mm long. The body of young females is green, becoming darker as they mature, and completely brown after oviposition, with fluffy white wax covering the dorsum at the time of oviposition. The ovisac produced beneath and behind the female, it is slightly convex (Miller et al., 2014). Further detailed description is available in Henderson and Crosby (2011).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

P. psidii occurs in southeast Asia, North, Central and South America, including the Antilles, Africa and Oceania (Clausen, 1978; Williams & Williams, 1988; García Morales et al., 2016; CABI, online) (Figure 2). For a detailed list of countries where *P. psidii* is present, see Appendix B.

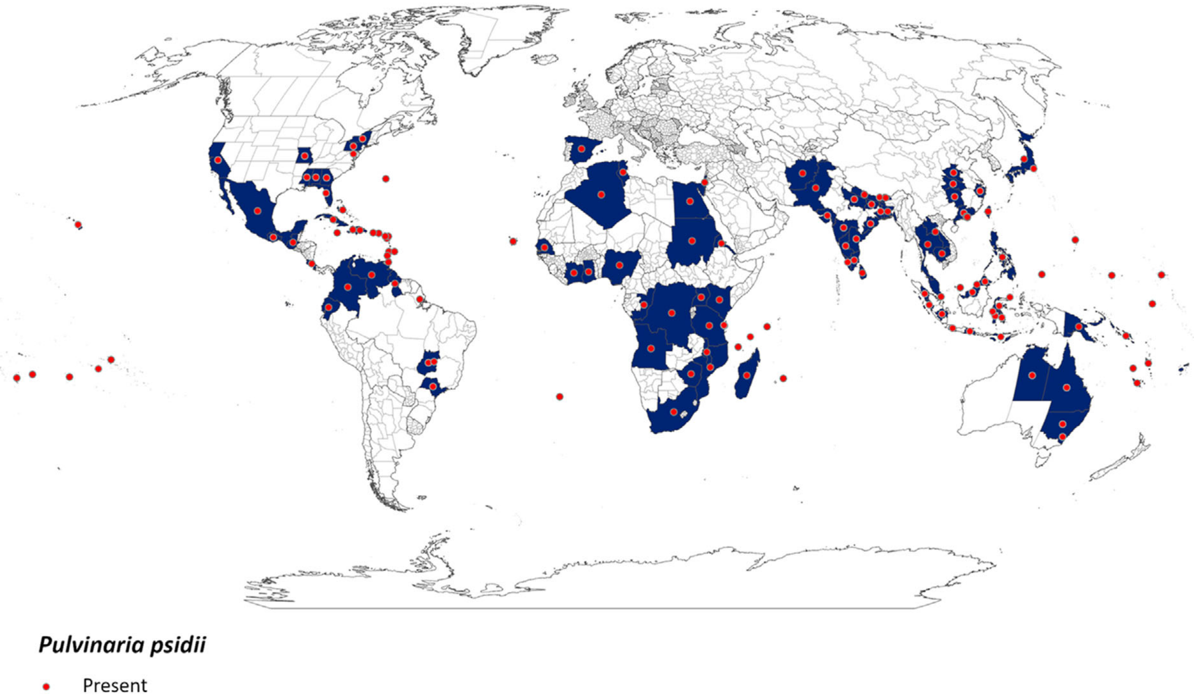

Figure 2: Global distribution of *Pulvinaria psidii* (data source: García Morales et al., 2016; CABI, online)

Records from Missouri and north-east USA may be from findings in greenhouses or other protected environments.

García Morales et al. (2016) report *P. psidii* as present in the UK based on a finding in a greenhouse in the 1920s (Green, 1928). However, it has not been found again and is considered not to be present in the UK.

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. **Yes**. *P. psidii* has been recorded in Spain in the city of Valencia and in Andalusia.

In Spain, the pest has been detected in the Canary Islands (Gómez-Menor Guerrero, 1967; Jaques and Urbaneja, 2006), which are not part of the pest risk assessment area, and in mainland Spain (Boyero et al., 2017; Rodrigo et al., 2020; Del Pino et al., 2021a,b). The Spanish NPPO confirmed its presence in Spain (Table 3) on ornamental plants in the city of Valencia and in Andalusia, where it was also found on mangoes. No formal action has been taken.

Table 3: Status of *Pulvinaria psidii* in Spain according to the information received from the NPPO

Autonomous community	Information from NPPO regarding *P. psidii*
Canary Islands	Detected on the island of Tenerife. The last record of this species is from 1986 and since that date there is no knowledge of it. We cannot consider that it is established. No phytosanitary measures are applied.
Valencia	Detected in the city of Valencia in municipally owned gardens. No measures are applied.
Andalusia	This harmful organism was notified on 19/2/2018 being detected in the mango crop. In this Service there is no evidence that it is giving problems in the cultivation of mango. No formal action has been taken.

CABI distribution maps indicate the presence of *P. psidii* in Germany (likely an invalid record, perhaps based on an interception). It has also been intercepted in USA ports between 1995 and 2012 in commodities from France and the Netherlands (Miller et al., 2014). However, there are no records of *P. psidii* being found in France or the Netherlands. Such US interceptions likely result from plant products being imported to France and the Netherlands from areas where the pest occurs and re-exported to the USA. Recent comprehensive checklists (Foldi and Germain, 2018) of Coccoidea of France do not mention *P. psidii*. Jansen (2000) reports *P. psidii* has only been found in the Netherlands during import inspections.

3.3. Regulatory status

3.3.1. Commission implementing regulation 2019/2072

P. psidii is not listed in Annex II of Commission Implementing Regulation (EU) 2019/2072, an implementing act of Regulation (EU) 2016/2031. However, the species is included in the list of pests that are regulated by the Commission Implementing Regulation (EU) 2021/419 as regards certain plants for planting of *Jasminum polyanthum* Franchet originating in Israel and Commission Implementing Regulation (EU) 2021/1936 as regards certain plants for planting of *Ficus carica* L. and *Persea americana* Mill. originating in Israel.

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

According to the Commission Implementing Regulation (EU) 2019/2072, Annex VI, introduction of several *P. psidii* hosts in the Union from certain third countries is prohibited (Table 4).

Plants for planting of *Annona* L., *Diospyros* L., *Ficus* L., *Jasminum* L., *Nerium* L., *Persea* Mill., *Prunus* L., and *Salix* L., which are hosts of *P. psidii* (Appendix A) are considered High Risk Plants for the EU and their import is prohibited pending risk assessment (EU 2018/2019).

Table 4: List of plants, plant products and other objects that are *Pulvinaria psidii* hosts whose introduction into the Union from certain third countries is prohibited (Source: Commission Implementing Regulation (EU) 2019/2072, Annex VI)

List of plants, plant products and other objects whose introduction into the Union from certain third countries is prohibited			
	Description	**CN Code**	**Third country, group of third countries or specific area of third country**
8.	Plants for planting of *Chaenomeles* Ldl., *Crateagus* L., *Cydonia* Mill., *Malus* Mill., *Prunus* L., *Pyrus* L. and *Rosa* L., other than dormant plants free from leaves, flowers and fruits	ex 0602 10 90 ex 0602 20 80 ex 0602 40 00 ex 0602 90 41 ex 0602 90 45 ex 0602 90 46 ex 0602 90 47 ex 0602 90 48 ex 0602 90 50 ex 0602 90 70 ex 0602 90 91 ex 0602 90 99	Third countries other than: Albania, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canary Islands, Faeroe Islands, Georgia, Iceland, Liechtenstein, Moldova, Monaco, Montenegro, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny federalny okrug), Northwestern Federal District (Severo-Zapadny federalny okrug), Southern Federal District (Yuzhny federalny okrug), North Caucasian Federal District (Severo-Kavkazsky federalny okrug) and Volga Federal District (Privolzhsky federalny okrug)), San Marino, Serbia, Switzerland, Turkey, Ukraine and the United Kingdom.
9.	Plants for planting of *Cydonia* Mill., *Malus* Mill., *Prunus* L. and *Pyrus* L. and their hybrids, and *Fragaria* L., other than seeds	ex 0602 10 90 ex 0602 20 20 ex 0602 90 30 ex 0602 90 41 ex 0602 90 45 ex 0602 90 46 ex 0602 90 48 ex 0602 90 50 ex 0602 90 70 ex 0602 90 91 ex 0602 90 99	Third countries, other than: Albania, Algeria, Andorra, Armenia, Australia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canada, Canary Islands, Egypt, Faeroe Islands, Georgia, Iceland, Israel, Jordan, Lebanon, Libya, Liechtenstein, Moldova, Monaco, Montenegro, Morocco, New Zealand, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny federalny okrug), Northwestern Federal District (Severo-Zapadny federalny okrug), Southern Federal District (Yuzhny federalny okrug), North Caucasian Federal District (Severo-Kavkazsky federalny okrug) and Volga Federal District (Privolzhsky federalny okrug)), San Marino, Serbia, Switzerland, Syria, Tunisia, Turkey, Ukraine, the United Kingdom and United States other than Hawaii
11.	Plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruits and seeds	ex 0602 10 90 ex 0602 20 20 0602 20 30 ex 0602 20 80 ex 0602 90 45 ex 0602 90 46 ex 0602 90 47 ex 0602 90 50 ex 0602 90 70 ex 0602 90 91 ex 0602 90 99 ex 0604 20 90 ex 1404 90 00	All third countries

List of plants, plant products and other objects whose introduction into the Union from certain third countries is prohibited			
	Description	**CN Code**	**Third country, group of third countries or specific area of third country**
12.	Plants for planting of *Photinia* Ldl., other than dormant plants free from leaves, flowers and fruits	ex 0602 10 90 ex 0602 90 41 ex 0602 90 45 ex 0602 90 46 ex 0602 90 47 ex 0602 90 48 ex 0602 90 50 ex 0602 90 70 ex 0602 90 91 ex 0602 90 99	China, Democratic People's Republic of Korea, Japan, Republic of Korea and United States
18.	Plants for planting of *Solanaceae* other than seeds and the plants covered by entries 15, 16 or 17	ex 0602 10 90 ex 0602 90 30 ex 0602 90 45 ex 0602 90 46 ex 0602 90 48 ex 0602 90 50 ex 0602 90 70 ex 0602 90 91 ex 0602 90 99	Third countries other than: Albania, Algeria, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canary Islands, Egypt, Faeroe Islands, Georgia, Iceland, Israel, Jordan, Lebanon, Libya, Liechtenstein, Moldova, Monaco, Montenegro, Morocco, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny federalny okrug), Northwestern Federal District (Severo-Zapadny federalny okrug), Southern Federal District (Yuzhny federalny okrug), North Caucasian Federal District (Severo-Kavkazsky federalny okrug) and Volga Federal District (Privolzhsky federalny okrug)), San Marino, Serbia, Switzerland, Syria, Tunisia, Turkey, Ukraine and the United Kingdom

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, the pest has already entered the EU territory. It could further enter the EU territory with plants for planting, cut flowers, vegetables and fruits.

Comment on plants for planting as a pathway.

Plants for planting are one of the main pathways for *P. psidii* to enter the EU (Table 5).

Plants for planting and fruits, vegetables and cut flowers are the main potential pathways for entry of *P. psidii* (Table 5).

Table 5: Potential pathways for *Pulvinaria psidii* into the EU 27

Pathways	Life stage	**Relevant mitigations** [e.g. prohibitions (Annex VI), special requirements (Annex VII) or phytosanitary certificates (Annex XI) within Implementing Regulation 2019/2072, Commission Implementing Regulation (EU) 2021/419, Commission Implementing Regulation (EU) 2021/1936]
Plants for planting	All life stages	Plants for planting that are hosts of *P. psidii* and are prohibited to import from third countries (Regulation 2019/2072, Annex VI), are listed in Table 4. Plants for planting from third countries require a phytosanitary certificate (Regulation 2019/2072, Annex XI, Part A). Some hosts are considered high risk plants (EU 2018/2019) for the EU and their import is prohibited subject to risk assessment
Fruits, vegetables and cut flowers	All life stages	Fruits, vegetables and cut flowers from third countries require a phytosanitary certificate to be imported into the EU (2019/2072, Annex XI, Part A). However, no requirements are specified for *P. psidii*.

Annual imports of *P. psidii* hosts from countries where the pest is known to occur are provided in Appendix C.

Notifications of interceptions of harmful organisms began to be compiled in Europhyt in May 1994 and in TRACES in May 2020. As at 25/02/2022, there were no records of interception of *P. psidii* in the Europhyt and TRACES databases.

Miller et al. (2014) reports that *P. psidii* was intercepted 142 times between 1995 and 2012 on a variety of hosts at USA ports of entry with specimens originating from Australia, Barbados, Cambodia, Cook Islands, Costa Rica, Cuba, Egypt, France, Grenada, Guam, Guatemala, Hawaii, Honduras, India, Indonesia, Jamaica, Laos, Lebanon, Mexico, the Netherlands, Panama, the Philippines, Puerto Rico, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, Tonga and Vietnam. Miller et al. (2014) goes on to list countries and the host plants on which *P. psidii* has been found as interceptions by the USA (Appendix D).

As noted in Section 3.2.2, there are no reports of *P. psidii* being found in France or the Netherlands. Records reported as interceptions on plants originating from France and the Netherlands by Miller et al. (2014) are likely to be the result of infested plant products being imported to France and the Netherlands from areas where the pest occurs and then being re-exported to the USA.

In Australia, between 2000 and 2018, *P. psidii* was intercepted six times on *Nephelium lappaceum* and *Catha edulis* leaves (DAWE, 2021).

3.4.2. Establishment

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

Yes, the climate in the EU countries of southern Europe is suitable and there are many available hosts that can support establishment.

3.4.2.1. EU distribution of main host plants

P. psidii is a polyphagous pest. The main hosts of the pest cultivated in the EU between 2016 and 2020 are shown in Table 6. Among others, citrus, mangoes, avocados, tomatoes, peppers and ornamental plants are important crops in the EU.

Table 6: Crop area of *Pulvinaria psidii* key hosts in EU[(a)] in 1,000 ha (Eurostat accessed on 16/2/2022)

Crop	2016	2017	2018	2019	2020
Citrus	519.01	502.84	508.99	512.83	519.98
Tomatoes	253.95	247.95	239.48	242.52	233.20
Peppers	59.95	59.50	58.92	59.60	58.27
Avocados	12.24	12.72	13.22	17.50	19.60

(a): Statistics refer to EU 27.

3.4.2.2. Climatic conditions affecting establishment

P. psidii occurs mainly in tropical and subtropical regions in Asia, Africa, Australia, America and Macaronesia (Canary Islands). Moreover, in Europe it has been recorded in Spain in regions with a Mediterranean climate. 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 *P. psidii* has been reported.

Southern EU countries provide suitable climatic conditions for the establishment of *P. psidii*. Indeed, it is already established in a small area of mainland Spain. There is uncertainty as to whether *P. psidii* could establish in outdoors in central Europe. Establishment outdoors in Northern Europe is unlikely. Nevertheless, there is a possibility that *P. psidii* could occur in glasshouses and on indoor plantings in cooler areas.

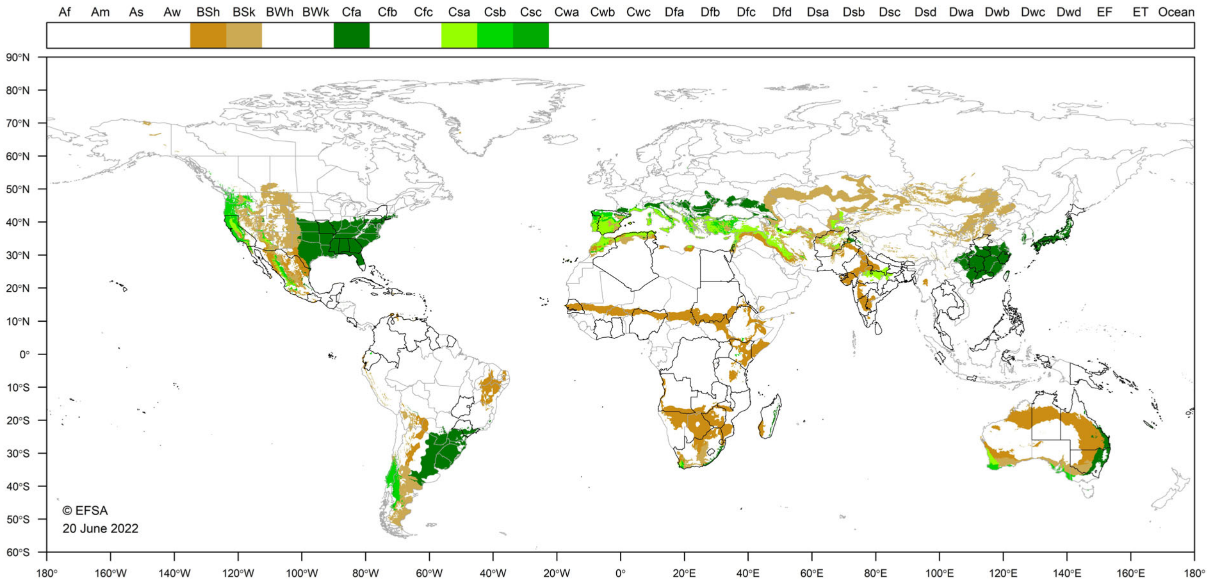

Figure 3: World distribution of Köppen—Geiger climate types that occur in the EU and which occur in countries where *Pulvinaria psidii* has been reported

3.4.3. Spread

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

Natural spread by first instar nymphs crawling or being carried by wind, other animals, or machinery, will occur locally and relatively slowly. All stages may be moved over long distances in trade of infested plant materials, specifically plants for planting, fruits, vegetables and cut flowers.

Comment on plants for planting as a mechanism of spread.
Plants for planting provide a main spread mechanism for *P. psidii* over long distances.

First instar nymphs (crawlers) may be carried to neighbouring plants by their own movement, wind (Bakr et al., 2012) or by hitchhiking on clothing, equipment or animals (EFSA PLH Panel, 2020).

Plants for planting, fruits, vegetables and cut flowers are the main pathways of spread of *P. psidii* over long distances.

3.5. Impacts

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

Yes, if *P. psidii* established more widely in the EU, it would most probably have an economic impact.

P. psidii sucks phloem sap from leaves and thin-barked shoots. When abundant it egests large amounts of honeydew on which blackish sooty mould grows, covering the leaf and fruit surfaces, causing foliage drop and making fruits unmarketable (Mau and Kessing, 1992; Mohamed et al., 2012). In south Florida, *P. psidii* caused damage to ornamental plants, especially *Ficus* sp. during the warmer months (Hamon and Williams, 1984). In Egypt it is a pest of citrus, mango, guava, and ornamentals such as *Ficus* and *Aralia* (Bakr et al., 2012; García Morales et al., 2016; EFSA PLH Panel, 2021). Concerning guava, *P. psidii* is reported as one of the most important pests (El-Serafi et al., 2004; Moustafa and Abd-Rabou, 2010). In Pakistan it is a serious pest of mango (Mohyuddin and Mahmood, 1993) while in Bangladesh it has become an increasingly serious pest of guava and citrus (Bhuiya, 1998). In the tropical South Pacific region *P. psidii* is a serious pest of *Citrus*, *Coffea*, *Capsicum* and *Ficus* plants (Bhuiya, 1998). In Hawaii, in 1892, coffee plants were almost totally destroyed (Pemberton, 1964). In Israel, *P. psidii* is reported mainly in litchi and mango and on ornamental plants (EPPO, online). It is an insect of economic interest present in natural ecosystems of the Sierra de los Órganos in Mexico (Novoa et al., 2011).

P. psidii was detected on mango crops in Andalusia in summer 2017 (MAPA, 2021). An official response from the NPPO notes that there is no evidence that it is giving problems in the cultivation of mango. However, MAPA (2021) reports *P. psidii* occasionally causing damage in mango, litchi and ornamental ficus only when densities are high. Moreover, Del Pino et al. (2021a) report that densities of *P. psidii* are increasing and the scale is becoming an important pest of mango. These differences in appreciation give rise to uncertainty regarding impact in mango, taking into account that the pest has been introduced only recently. Rodrigo et al. (2020) indicate that *P. psidii* is causing damage to *Melia azedarach*, a widely used ornamental tree that lines streets in Valencia; large amounts of dripping honeydew is a nuisance to the public.

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. Although the existing phytosanitary measures identified in Section 3.3.2 do not specifically target *P. psidii*, they mitigate the likelihood of its entry into, establishment and spread within the EU (see also Section 3.6.1).

3.6.1. Identification of potential additional measures

Phytosanitary measures (prohibitions) are currently applied to some host plants for planting (see Section 3.3.2).

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

3.6.1.1. Additional potential risk reduction options

Potential additional control measures are listed in Table 7.

Table 7: 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	Pest free place of production (e.g. place of production and its immediate vicinity is free from pest over an appropriate time period, e.g. since the beginning of the last complete cycle of vegetation, or past 2 or 3 cycles). Pest free production site.	Entry/Spread
Growing plants in isolation	Place of production is insect proof originate in a place of production with complete physical isolation.	Entry/Spread

Control measure/Risk reduction option (Blue underline = Zenodo doc, Blue = WIP)	**RRO summary**	**Risk element targeted (entry/establishment/ spread/impact)**
Managed growing conditions	Used to mitigate likelihood of infestation at origin. Plants collected directly from natural habitats, have been grown, held and trained for at least two consecutive years prior to dispatch in officially registered nurseries, which are subject to an officially supervised control regime.	Entry/Spread
Biological control and behavioural manipulation	Biological control is successfully implemented worldwide against *P. psidii*, by predators and parasitoids. *Cryptolaemus montrouzieri* is an effective predator of *P. psidii* on guava, sapota, lemon, and coffee plants (Pemberton, 1964; Mani, 2016), it is commercially available in the EU. The parasitoids *Microterys kotinskyi* and *Coccophagus scutellaris* (also available in the EU) have been reported as effective biological agents in Bermuda, Egypt, India and other countries (Mani et al., 2009; Abd-Rabou, 2011; Mani, 2016). The efficacy of a formulation of *Beauveria bassiana* (bioinsecticide) was tested in different pest stages in guava field trials (Bakr et al., 2012)	Spread/Impact
Chemical treatments on crops including reproductive material	Used to mitigate likelihood of infestation of pests susceptible to chemical treatments. The effectiveness of insecticide applications against soft scales may be reduced by the waxy coating of the adult. The efficacy of mineral oils, insect growth regulators and organophosphorus insecticides was tested in different pest stages in guava field trials (Bakr et al., 2012; Helmy et al., 2012).	Entry/Establishment / Spread/Impact
Chemical treatments on consignments or during processing	Treatments can be applied to plants or to plant products after harvest, during process or packaging operations and storage. e.g. fumigation; spraying/ dipping pesticides; surface disinfectants.	Entry/Spread
Cleaning and disinfection of facilities, tools and machinery	The physical and chemical cleaning and disinfection of facilities, tools, machinery, facilities and other accessories (e.g. boxes, pots, hand tools).	Spread
Heat and cold treatments	Controlled temperature treatments aimed to kill or inactivate pests without causing any unacceptable prejudice to the treated material itself.	Entry/Spread
Controlled atmosphere	Treatment of plants by storage in a modified atmosphere (including modified humidity, O_2, CO_2, temperature, pressure). Used to mitigate likelihood of infestation of pests susceptible to modified atmosphere (usually applied during transport) hence to mitigate entry. Controlled atmosphere storage can be used in commodities such as fresh and dried fruits.	Entry/Spread (via commodity)

3.6.1.2. Additional supporting measures

Potential additional supporting measures are listed in Table 8.

Table 8: 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/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.	Entry/Spread
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.	Entry
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)	Entry/Spread
Certified and approved premises	Mandatory/voluntary certification/approval of premises is a process including a set of procedures and of actions implemented by producers, conditioners and traders contributing to ensure the phytosanitary compliance of consignments. It can be a part of a larger system maintained by the NPPO in order to guarantee the fulfilment of plant health requirements of plants and plant products intended for trade. Key property of certified or approved premises is the traceability of activities and tasks (and their components) inherent the pursued phytosanitary objective. Traceability aims to provide access to all trustful pieces of information that may help to prove the compliance of consignments with phytosanitary requirements of importing countries.	Entry/Spread
Certification of reproductive material (voluntary/official)	Plants come from within an approved propagation scheme and are certified pest free (level of infestation) following testing; Used to mitigate against pests that are included in a certification scheme	Entry/Spread
Delimitation of Buffer zones	ISPM 5 defines a buffer zone as "an area surrounding or adjacent to an area officially delimited for phytosanitary purposes in order to minimise the probability of spread of the target pest into or out of the delimited area, and subject to phytosanitary or other control measures, if appropriate" (ISPM 5). The objectives for delimiting a buffer zone can be to prevent spread from the outbreak area and to maintain a pest free production place (PFPP), site (PFPS) or area (PFA).	Spread

Supporting measure (Blue underline = Zenodo doc, Blue = WIP)	Summary	Risk element targeted (entry/establishment/spread/impact)
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

- *P. psidii* may not be easily detected in cases where low densities occur.
- *P. psidii* is polyphagous, making the inspections of all consignments containing hosts from countries where the pest occurs difficult.
- Limited number of available registered active substances against *P. psidii*.
- Limited effectiveness of insecticides due to the presence of protective cover over the scales.

3.7. Uncertainty

The main source of uncertainty regards the magnitude of potential impact within the EU.

- There is contradictory information regarding the impact of *P. psidii* in mango in Spain.

4. Conclusions

Pulvinaria psidii satisfies all the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union QP (Table 9).

Table 9: 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 *Pulvinaria psidii* is established. Taxonomic keys based on morphology of adults exist. There are also molecular techniques for species identification.	None
Absence/presence of the pest in the EU (Section 3.2)	The pest has a restricted distribution in the EU territory (mainland Spain: the city of Valencia, and Andalusia).	None
Pest potential for entry, establishment and spread in the EU (Section 3.4)	*P. psidii* is able to further enter, become established and spread within the EU territory, especially in the southern EU MS. The main pathways are plants for planting, cut flowers, fruits, and vegetables.	None
Potential for consequences in the EU (Section 3.5)	The introduction of the pest could cause yield and quality losses on several crops and reduce the value of ornamental plants.	There is contradictory information regarding the impact of the pest on mangoes in Spain.
Available measures (Section 3.6)	There are measures available to prevent further entry, establishment and spread of *P. psidii* within the EU. Risk reduction options include inspections, chemical and physical treatments on consignments of fresh plant material from infested countries and the production of plants for import in the EU in pest free areas.	None
Conclusion (Section 4)	*P. psidii* satisfies all the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest.	
Aspects of assessment to focus on/scenarios to address in future if appropriate		

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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)

Abbreviations

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

Appendix A – *Pulvinaria psidii* host plants/species affected

Source: CABI (online, accessed on 16/2/2022), and García Morales et al. (2016). Common names derived from EPPO (online, accessed on 16/2/2022).

Host status	Host name	Plant family	Common name	Reference
Cultivated hosts	*Aizoaceae*	Aizoaceae		García Morales et al. (2016)
	Alpinia purpurata	Zingiberaceae	Red ginger	García Morales et al. (2016)
	Alpinia	Zingiberaceae		García Morales et al. (2016)
	Alstonia scholaris	Apocynaceae	Devil tree, dita bark, milk wood, scholar tree, white cheesewood	García Morales et al. (2016)
	Alternanthera ficoidea	Amaranthaceae	Carb white, rabbit meat, rabbit weed, rupturewort, sanguinaria, shoo-fly joyweed	García Morales et al. (2016)
	Annona	Annonaceae		García Morales et al. (2016)
	Anthurium cubense	Araceae		García Morales et al. (2016)
	Anthurium	Araceae		García Morales et al. (2016)
	Antidesma bunius	Phyllanthaceae	Bignay, China laurel, salamander tree	García Morales et al. (2016)
	Antidesma membranaceum	Phyllanthaceae		García Morales et al. (2016)
	Antidesma	Phyllanthaceae		García Morales et al. (2016)
	Antigonon leptopus	Polygonaceae	Bride's tears, cemetery vine, chain of love, coral vine, corallita, Mexican creeper, pink vine, St James' flower, St Michael's flower	García Morales et al. (2016)
	Aralia	Araliaceae		García Morales et al. (2016)
	Ardisia sieboldii	Primulaceae		García Morales et al. (2016)
	Artocarpus heterophyllus	Moraceae	Jackfruit	García Morales et al. (2016)
	Artocarpus integer	Moraceae	Champedak, chempedak, jack fruit, tjampedak	García Morales et al. (2016)
	Asplenium nidus	Aspleniaceae	Bird's-nest fern	García Morales et al. (2016)
	Asplenium	Aspleniaceae		García Morales et al. (2016)
	Barringtonia	Lecythidaceae		García Morales et al. (2016)
	Bidens pilosa	Asteraceae	Beggartick, blackjack, common blackjack, railway daisy, Spanish needle	García Morales et al. (2016)
	Bignonia	Bignoniaceae		García Morales et al. (2016)
	Bischofia javanica	Phyllanthaceae	Bishopwood, Java bishopwood, toog	García Morales et al. (2016)
	Blighia sapida	Sapindaceae	Achee, ackee apple, akee, aki	García Morales et al. (2016)
	Boronia serrulata	Rutaceae	Native rose, rose boronia	García Morales et al. (2016)
	Bouvardia	Rubiaceae		García Morales et al. (2016)
	Callicarpa glabra	Lamiaceae		García Morales et al. (2016)

Host status	Host name	Plant family	Common name	Reference
	Callistemon	Myrtaceae		García Morales et al. (2016)
	Calycorectes ferrugineus	Myrtaceae		García Morales et al. (2016)
	Camellia sinensis	Theaceae	Tea, tea plant	García Morales et al. (2016)
	Camellia	Theaceae		García Morales et al. (2016)
	Canna indica	Cannaceae	Arrowroot canna, Indian canna	García Morales et al. (2016)
	Capsicum annuum	Solanaceae	Chilli, bell pepper, paprika, red pepper, sweet pepper	García Morales et al. (2016)
	Capsicum frutescens	Solanaceae	Bird chilli, bird pepper, Cayenne pepper, chilli, chilli pepper, hot pepper	García Morales et al. (2016)
	Carissa carandas	Apocynaceae	Caranda (plum), karanda	García Morales et al. (2016)
	Carissa macrocarpa	Apocynaceae	Carissa, Natal plum	García Morales et al. (2016)
	Carissa	Apocynaceae		García Morales et al. (2016)
	Centrosema plumieri	Fabaceae	Butterfly pea	García Morales et al. (2016)
	Ceodes grandis	Nyctaginaceae	Lettuce tree	García Morales et al. (2016)
	Chiococca alba	Rubiaceae	Milkberry	García Morales et al. (2016)
	Chrysanthemum indicum	Asteraceae	Chrysanthemum	García Morales et al. (2016)
	Chrysophyllum cainito	Sapotaceae	Star apple	García Morales et al. (2016)
	Chrysophyllum oliviforme	Sapotaceae	Satinleaf	García Morales et al. (2016)
	Cibotium	Cibotiaceae		García Morales et al. (2016)
	Cinchona	Rubiaceae		García Morales et al. (2016)
	Citrus aurantiifolia	Rutaceae	Key lime, lime, Mexican lime, West Indian lime	García Morales et al. (2016)
	Citrus aurantium	Rutaceae	Bigarade, bitter orange, Seville orange, sour orange	García Morales et al. (2016)
	Citrus limon	Rutaceae	Lemon	García Morales et al. (2016)
	Citrus maxima	Rutaceae	Bali lemon, pummelo, shaddock	García Morales et al. (2016)
	Citrus reticulata	Rutaceae	Clementine, clementine tree, mandarin, tangerine	García Morales et al. (2016)
	Citrus sinensis	Rutaceae	Sweet orange	García Morales et al. (2016)
	Citrus trifoliata	Rutaceae	Golden apple, hardy orange, trifoliate orange	García Morales et al. (2016)
	Citrus	Rutaceae		García Morales et al. (2016)
	Clerodendrum	Lamiaceae		García Morales et al. (2016)
	Clusia rosea	Clusiaceae	Autograph tree, balsam apple, balsam fig, pitch apple, Scotch attorney	García Morales et al. (2016)

Host status	Host name	Plant family	Common name	Reference
	Codiaeum	Euphorbiaceae		García Morales et al. (2016)
	Coffea arabica	Rubiaceae	Arabian coffee, coffee tree	García Morales et al. (2016)
	Coffea canephora	Rubiaceae	Congo coffee, robusta coffee	García Morales et al. (2016)
	Coffea liberica	Rubiaceae	Liberian coffee	García Morales et al. (2016)
	Coffea	Rubiaceae		García Morales et al. (2016)
	Colocasia antiquorum	Araceae	Chinese potato, cocoyam, dasheen, eddoe, Egyptian colocasia, elephant's-ear, kalo, taro, wild taro, yam	García Morales et al. (2016)
	Colocasia esculenta	Araceae	Chinese potato, cocoyam, dasheen, eddoe, Egyptian colocasia, elephant's-ear, kalo, taro, wild taro, yam	García Morales et al. (2016)
	Comocladia	Anacardiaceae		García Morales et al. (2016)
	Cordia alliodora	Boraginaceae	Ecuador laurel, onion cordia, salmwood	García Morales et al. (2016)
	Cordia myxa	Boraginaceae	Assyrian plum, sebesten, Sudan teak	García Morales et al. (2016)
	Cordia	Boraginaceae		García Morales et al. (2016)
	Cordyline fruticosa	Asparagaceae	Ti plant	García Morales et al. (2016)
	Costus spicatus	Costaceae	Spiked spiralflag ginger	García Morales et al. (2016)
	Crinum moorei	Amaryllidaceae	Natal lily	García Morales et al. (2016)
	Cussonia arborea	Araliaceae	Octopus cabbage tree	García Morales et al. (2016)
	Dahlia pinnata	Asteraceae	Dahlia, garden dahlia	García Morales et al. (2016)
	Dianthus	Caryophyllaceae		García Morales et al. (2016)
	Dimocarpus longan	Sapindaceae	Dragon's eye, longan,	García Morales et al. (2016)
	Diospyros kaki	Ebenaceae	Chinese date plum, Chinese persimmon, Japanese persimmon, kaki plum, persimmon	García Morales et al. (2016)
	Diploknema butyracea	Sapotaceae		García Morales et al. (2016)
	Dodonaea triquetra	Sapindaceae	Common hopbush	García Morales et al. (2016)
	Dodonaea	Sapindaceae		García Morales et al. (2016)
	Duranta	Verbenaceae		García Morales et al. (2016)
	Dysphania pumilio	Amaranthaceae	Clammy goosefoot, Tasmanian goosefoot	García Morales et al. (2016)
	Elettaria cardamomum	Zingiberaceae	Cardamom, cardamon	García Morales et al. (2016)
	Eriobotrya japonica	Rosaceae	Japanese medlar, loquat	García Morales et al. (2016)
	Erythrospermum candidum	Achariaceae		García Morales et al. (2016)
	Etlingera	Zingiberaceae		García Morales et al. (2016)
	Eucalyptus deglupta	Myrtaceae	Kamarere, Mindanao gum, rainbow eucalyptus, rainbow gum	García Morales et al. (2016)

Host status	Host name	Plant family	Common name	Reference
	Eugenia bullata	Myrtaceae		García Morales et al. (2016)
	Eugenia	Myrtaceae		García Morales et al. (2016)
	Euonymus frigidus	Celastraceae		García Morales et al. (2016)
	Eupatorium	Asteraceae		García Morales et al. (2016)
	Euphorbia	Euphorbiaceae		García Morales et al. (2016)
	Ficus	Moraceae		García Morales et al. (2016)
	Ficus amplissima	Moraceae		García Morales et al. (2016)
	Ficus benghalensis	Moraceae	Banyan, banyan fig, East India fig, horn fig, Indian banyan,	García Morales et al. (2016)
	Ficus benjamina	Moraceae	Benjamin's fig, ficus tree, Java fig, small-leaved rubber plant, tropical laurel, weeping fig	García Morales et al. (2016)
	Ficus boninsimae	Moraceae		García Morales et al. (2016)
	Ficus elastica	Moraceae	Assam rubber tree, Indian rubber fig, Indian rubber plant, rubber fig, rubber plant	García Morales et al. (2016)
	Ficus lyrata	Moraceae	Banjo fig, fiddle-leaf, fiddle-leaf fig	García Morales et al. (2016)
	Ficus macrophylla	Moraceae	Australian banyan, Moreton Bay fig	García Morales et al. (2016)
	Ficus membranacea	Moraceae		García Morales et al. (2016)
	Ficus racemosa	Moraceae	Cluster fig, red river fig	García Morales et al. (2016)
	Ficus religiosa	Moraceae	bo, bo tree, bodhi tree, holy fig tree, peepul, sacred fig	García Morales et al. (2016)
	Ficus retusa	Moraceae	Chinese banyan, glossy-leaf fig	García Morales et al. (2016)
	Ficus rubiginosa	Moraceae	Rusty fig	García Morales et al. (2016)
	Ficus sur	Moraceae		García Morales et al. (2016)
	Ficus thonningii	Moraceae		García Morales et al. (2016)
	Garcinia mangostana	Clusiaceae	Mangosteen	García Morales et al. (2016)
	Garcinia	Clusiaceae		García Morales et al. (2016)
	Gardenia jasminoides	Rubiaceae	Cape jasmine, Cape jessamine, common gardenia, gardenia	García Morales et al. (2016)
	Gardenia taitensis	Rubiaceae	Symbol flower, Tahitian gardenia, tiare, Tiaré flower	García Morales et al. (2016)
	Gardenia	Rubiaceae		García Morales et al. (2016)
	Gerbera	Asteraceae		García Morales et al. (2016)
	Gossypium	Malvaceae		García Morales et al. (2016)
	Guarea guidonia	Meliaceae		García Morales et al. (2016)
	Gymnosporia	Celastraceae		García Morales et al. (2016)
	Handroanthus chrysanthus	Bignoniaceae	Gold tree, golden tabebuia, yellow poui	García Morales et al. (2016)
	Hedera helix	Araliaceae	Common ivy, ivy	García Morales et al. (2016)
	Hedychium	Zingiberaceae		García Morales et al. (2016)

Host status	Host name	Plant family	Common name	Reference
	Heliconia psittacorum	Heliconiaceae	Parakeet flower, parakeet heliconia, parrot flower, parrot's plantain	García Morales et al. (2016)
	Hibiscus rosa-sinensis	Malvaceae	China rose, Chinese hibiscus, Chinese rose, Hawaiian hibiscus, rose mallow, rose of China, shoe-black plant, shoe-flower	García Morales et al. (2016)
	Hibiscus syriacus	Malvaceae	Althaea, blue hibiscus, rose of Sharon, shrubby althaea, Syrian hibiscus, Syrian ketmia	García Morales et al. (2016)
	Hibiscus	Malvaceae		García Morales et al. (2016)
	Homalocladium platycladum	Polygonaceae	Centipede plant, ribbonbush, tapeworm plant	García Morales et al. (2016)
	Ipomoea alba	Convolvulaceae	White-flowered morning glory	García Morales et al. (2016)
	Ixora chinensis	Rubiaceae	Flame of the woods, jungle flame, jungle geranium	García Morales et al. (2016)
	Ixora coccinea	Rubiaceae	Burning love, flame flower, flame of woods, jungle flame, palm of the wood	García Morales et al. (2016)
	Ixora macrothyrsa	Rubiaceae		García Morales et al. (2016)
	Ixora	Rubiaceae		García Morales et al. (2016)
	Jasminum humile	Oleaceae	Italian jasmine, Italian yellow jasmine	García Morales et al. (2016)
	Jasminum	Oleaceae		García Morales et al. (2016)
	Juncus concinnus	Juncaceae		García Morales et al. (2016)
	Kalanchoe	Crassulaceae		García Morales et al. (2016)
	Lagerstroemia indica	Lythraceae	Indian crape myrtle	García Morales et al. (2016)
	Lagerstroemia lanceolata	Lythraceae		García Morales et al. (2016)
	Lagerstroemia	Lythraceae		García Morales et al. (2016)
	Lasianthus lanceolatus	Rubiaceae		García Morales et al. (2016)
	Laurus	Lauraceae		García Morales et al. (2016)
	Lawsonia	Lythraceae		García Morales et al. (2016)
	Litchi chinensis	Sapindaceae	Litchee, litchi	García Morales et al. (2016)
	Livistona chinensis	Arecaceae	Chinese fan palm	García Morales et al. (2016)
	Ludwigia octovalvis	Onagraceae	Mexican primrose-willow, swamp primrose, water primrose	García Morales et al. (2016)
	Macaranga	Euphorbiaceae		García Morales et al. (2016)
	Mallotus philippensis	Euphorbiaceae	Kamala	García Morales et al. (2016)

Host status	Host name	Plant family	Common name	Reference
	Malvaviscus arboreus	Malvaceae	Fire dart, marsh-mallow, scarlet rose-mallow, sleeping hibiscus, sleepy mallow, Turk's cap, wax mallow, wild cotton	García Morales et al. (2016)
	Mangifera indica	Anacardiaceae	Mango	García Morales et al. (2016)
	Manilkara zapota	Sapotaceae	Bully tree, chapoti, chicle, chiku, marmalade plum, noseberry, sapodilla, sapodilla plum, sapota	García Morales et al. (2016)
	Melanthera biflora	Asteraceae	Beach sunflower	García Morales et al. (2016)
	Melastoma	Melastomataceae		García Morales et al. (2016)
	Melastomataceae	Melastomataceae		García Morales et al. (2016)
	Melia azedarach	Meliaceae	Bead tree, China berry, chinaberry tree, Indian lilac, Persian lilac, pride of India, seringa, umbrella tree, white cedar	García Morales et al. (2016)
	Meryta macrophylla	Araliaceae		García Morales et al. (2016)
	Meryta sinclairii	Araliaceae		García Morales et al. (2016)
	Metrosideros	Myrtaceae		García Morales et al. (2016)
	Miconia robinsoniana	Melastomataceae		García Morales et al. (2016)
	Monstera deliciosa	Araceae	Breadfruit vine, ceriman, hurricane plant, Mexican breadfruit, split-leaf philodendron, Swiss cheese plant	García Morales et al. (2016)
	Morinda citrifolia	Rubiaceae	Indian mulberry, noni	García Morales et al. (2016)
	Morinda	Rubiaceae		García Morales et al. (2016)
	Morus alba	Moraceae	Silkworm mulberry, white mulberry	García Morales et al. (2016)
	Morus indica	Moraceae	Japanese mulberry	García Morales et al. (2016)
	Myristica castaneifolia	Myristicaceae		García Morales et al. (2016)
	Myrtus communis	Myrtaceae	Common myrtle, myrtle, true myrtle	García Morales et al. (2016)
	Neolamarckia	Rubiaceae		García Morales et al. (2016)
	Nephelium lappaceum	Sapindaceae	Rambutan	García Morales et al. (2016)
	Nephelium ramboutan-ake	Sapindaceae	Pulasan	García Morales et al. (2016)
	Nerium	Apocynaceae		García Morales et al. (2016)
	Oleaceae	Oleaceae		García Morales et al. (2016)
	Oxera	Lamiaceae		García Morales et al. (2016)
	Palicourea domingensis	Rubiaceae		García Morales et al. (2016)
	Pandanus	Pandanaceae		García Morales et al. (2016)
	Pelargonium	Geraniaceae		García Morales et al. (2016)
	Persea americana	Lauraceae	Avocado	CABI (online)

Host status	Host name	Plant family	Common name	Reference
	Persea	Lauraceae		García Morales et al. (2016)
	Philodendron	Araceae		García Morales et al. (2016)
	Phlox	Polemoniaceae		García Morales et al. (2016)
	Photinia serratifolia	Rosaceae	Chinese hawthorn, Chinese photinia	García Morales et al. (2016)
	Pinus caribaea	Pinaceae	Cuban pine	García Morales et al. (2016)
	Piper methysticum	Piperaceae	Kava pepper bush	García Morales et al. (2016)
	Pisonia	Nyctaginaceae		García Morales et al. (2016)
	Pistacia atlantica	Anacardiaceae	Atlas pistachio, Mount Atlas mastic tree	García Morales et al. (2016)
	Pittosporum boninense	Pittosporaceae		García Morales et al. (2016)
	Pittosporum	Pittosporaceae		García Morales et al. (2016)
	Planchonella obovata	Sapotaceae		García Morales et al. (2016)
	Plumeria	Apocynaceae		García Morales et al. (2016)
	Plumeria rubra	Apocynaceae	Frangipani, red frangipani, temple tree	García Morales et al. (2016)
	Pometia pinnata	Sapindaceae	Fijian longan, island lychee, kasai, kava, langsir, matoa, taun tree	García Morales et al. (2016)
	Pouteria sapota	Sapotaceae	Mamey, mammee sapota, mammey sapote, marmelade plum	CABI (online)
	Prunus cerasifera	Rosaceae	Cherry plum, myrobalan plum	García Morales et al. (2016)
	Psidium guajava	Myrtaceae	Common guava, guava, yellow guava	García Morales et al. (2016)
	Psidium	Myrtaceae		García Morales et al. (2016)
	Psychotria asiatica	Rubiaceae		García Morales et al. (2016)
	Psychotria elliptica	Rubiaceae		García Morales et al. (2016)
	Psychotria nervosa	Rubiaceae	Seminole balsamo, wild coffee	García Morales et al. (2016)
	Psychotria	Rubiaceae		García Morales et al. (2016)
	Pteralyxia macrocarpa	Apocynaceae		García Morales et al. (2016)
	Pteridium	Dennstaedtiaceae		García Morales et al. (2016)
	Pteris biaurita	Pteridaceae		García Morales et al. (2016)
	Punica granatum	Lythraceae	Pomegranate	García Morales et al. (2016)
	Pycnandra	Sapotaceae		García Morales et al. (2016)
	Russelia	Plantaginaceae		García Morales et al. (2016)
	Salix	Salicaceae		García Morales et al. (2016)
	Sanchezia	Acanthaceae		García Morales et al. (2016)
	Scaevola floribunda	Goodeniaceae		García Morales et al. (2016)
	Scaevola gaudichaudiana	Goodeniaceae		García Morales et al. (2016)
	Schaefferia frutescens	Celastraceae	Florida boxwood	García Morales et al. (2016)
	Schefflera actinophylla	Araliaceae	Octopus tree, Queensland umbrella tree, star leaf, umbrella tree	García Morales et al. (2016)

Host status	Host name	Plant family	Common name	Reference
	Schefflera	Araliaceae		García Morales et al. (2016)
	Schima wallichii	Theaceae		García Morales et al. (2016)
	Schinus molle	Anacardiaceae	California pepper tree, pepper tree, Peruvian mastic, Peruvian mastic tree, Peruvian pepper tree	García Morales et al. (2016)
	Schinus terebinthifolia	Anacardiaceae	Brazilian pepper tree, broad-leaf pepper tree, Christmas berry, Florida holly, pepper berry, schinus	García Morales et al. (2016)
	Schinus	Anacardiaceae		García Morales et al. (2016)
	Sedum	Crassulaceae		García Morales et al. (2016)
	Solanum lycopersicum	Solanaceae	Tomato	García Morales et al. (2016)
	Spathodea campanulata	Bignoniaceae	African tulip tree, fire tree, flame of the forest, fountain tree, nandi flame tree	García Morales et al. (2016)
	Spondias dulcis	Anacardiaceae	Ambarella, golden apple, great hog plum, jew-plum, Jewish plum, otaheite apple	García Morales et al. (2016)
	Stachytarpheta	Verbenaceae		García Morales et al. (2016)
	Streblus asper	Moraceae	Sandpaper tree, toothbrush tree	García Morales et al. (2016)
	Strychnos nux-vomica	Loganiaceae	Nux-vomica poison nut, strychnine tree	García Morales et al. (2016)
	Syzygium aqueum	Myrtaceae	Watery rose apple, wax jambo	García Morales et al. (2016)
	Syzygium aromaticum	Myrtaceae	Clove, Zanzibar redhead	García Morales et al. (2016)
	Syzygium buxifolium	Myrtaceae	Boxleaf eugenia	García Morales et al. (2016)
	Syzygium calophyllifolium	Myrtaceae		García Morales et al. (2016)
	Syzygium cumini	Myrtaceae	Black plum, jambolan, jamun, Java plum, Malabar plum	García Morales et al. (2016)
	Syzygium jambos	Myrtaceae	Malabar plum, rose apple, wax jambu	García Morales et al. (2016)
	Syzygium malaccense	Myrtaceae	Long-fruited rose apple, Malay apple, mountain apple, ohia, otaheite apple, otaheite apple, pomerac	García Morales et al. (2016)
	Tamarix gallica	Tamaricaceae	French tamarisk, French tree, manna plant	García Morales et al. (2016)
	Tarenna sambucina	Rubiaceae		García Morales et al. (2016)
	Tarenna subsessilis	Rubiaceae		García Morales et al. (2016)
	Tecoma stans	Bignoniaceae	Trumpet flower, yellow elder, yellow trumpet bush, yellow-bells	García Morales et al. (2016)

Host status	Host name	Plant family	Common name	Reference
	Tecoma	Bignoniaceae		García Morales et al. (2016)
	Terminalia brassii	Combretaceae		García Morales et al. (2016)
	Tetrapanax papyrifer	Araliaceae	Chinese rice paper tree	García Morales et al. (2016)
	Thespesia populnea	Malvaceae	Cork tree, Indian tulip tree, milo, Pacific rosewood, portea oil-nut, portea tree, portia, seaside mahoe, Seychelles rosewood, umbrella tree	García Morales et al. (2016)
	Toxicodendron	Anacardiaceae		García Morales et al. (2016)
	Trema orientalis	Cannabaceae		García Morales et al. (2016)
	Uapaca kirkiana	Phyllanthaceae	Wild loquat	García Morales et al. (2016)
	Vanilla	Orchidaceae		García Morales et al. (2016)
	Violaceae	Violaceae		García Morales et al. (2016)
	Zantedeschia aethiopica	Araceae	Altar lily, arum lily, calla lily, garden calla lily, pig lily, trumpet lily, white arum lily	García Morales et al. (2016)
	Zingiber officinale	Zingiberaceae	Common ginger, garden ginger	García Morales et al. (2016)
	Zingiber	Zingiberaceae		García Morales et al. (2016)

Appendix B – Distribution of *Pulvinaria psidii*

Distribution records based on CABI (online, accessed on 16/2/2022), and García Morales et al. (2016), and other references.

Region	Country	Sub-national (e.g. State)	Status	Reference
North America	Bahamas		Present, no details	García Morales et al. (2016)
	Bermuda		Present, no details	García Morales et al. (2016)
	Cuba		Present, no details	García Morales et al. (2016)
	Mexico		Present, no details	García Morales et al. (2016)
	Montserrat		Present, no details	García Morales et al. (2016)
	United States	Alabama	Present, no details	García Morales et al. (2016)
		California	Present, no details	García Morales et al. (2016)
		District of Columbia	Present, no details	García Morales et al. (2016)
		Florida	Present, no details	García Morales et al. (2016)
		Georgia	Present, no details	García Morales et al. (2016)
		Mississippi	Present, no details	García Morales et al. (2016)
		Missouri	Present, no details	García Morales et al. (2016)
		New York	Present, no details	García Morales et al. (2016)
		Pennsylvania	Present, no details	García Morales et al. (2016)
Central America	Costa Rica		Present, no details	García Morales et al. (2016)
	Guatemala		Present, no details	García Morales et al. (2016)
Caribbean	Antigua and Barbuda	Antigua	Present, no details	García Morales et al. (2016)
	Barbados		Present, no details	García Morales et al. (2016)
	Dominican Republic		Present, no details	García Morales et al. (2016)
	Grenada		Present, no details	García Morales et al. (2016)
	Guadeloupe		Present, no details	García Morales et al. (2016)
	Haiti		Present, no details	García Morales et al. (2016)
	Jamaica		Present, no details	García Morales et al. (2016)
	Martinique		Present, no details	García Morales et al. (2016)
	Puerto Rico & Vieques Island	Puerto Rico	Present, no details	García Morales et al. (2016)
	Ryukyu Islands		Present, no details	García Morales et al. (2016)
	Saint Croix		Present, no details	García Morales et al. (2016)
	Saint Kitts and Nevis Islands	Saint Kitts	Present, no details	García Morales et al. (2016)
	Saint Vincent and the Grenadines		Present, no details	García Morales et al. (2016)
	Trinidad and Tobago	Trinidad	Present, no details	García Morales et al. (2016)
	U.S. Virgin Islands		Present, no details	García Morales et al. (2016)
EU (27)	Spain		Present, no details Valencia, Andalusia	CABI (online); Boyero et al., 2017; Rodrigo et al. (2020); Del Pino et al. (2021a,b)
	Spain	Canary Islands	Present, no details	CABI (online); Gómez-Menor Guerrero (1967); Jaques and Urbaneja (2006)
Africa	Algeria		Present, no details	García Morales et al. (2016)
	Angola		Present, no details	García Morales et al. (2016)
	Ascension Island		Present, no details	García Morales et al. (2016)
	Cape Verde		Present, no details	García Morales et al. (2016)
	Comoros		Present, no details	García Morales et al. (2016)

Region	Country	Sub-national (e.g. State)	Status	Reference
	Congo		Present, no details	García Morales et al. (2016)
	Cote d'Ivoire		Present, no details	García Morales et al. (2016)
	Egypt		Present, no details	García Morales et al. (2016)
	Eritrea		Present, no details	CABI (online)
	Ghana		Present, no details	García Morales et al. (2016)
	Kenya		Present, no details	García Morales et al. (2016)
	Madagascar		Present, no details	García Morales et al. (2016)
	Malawi		Present, no details	García Morales et al. (2016)
	Mauritius		Present, no details	García Morales et al. (2016)
	Mozambique		Present, no details	García Morales et al. (2016)
	Nigeria		Present, no details	García Morales et al. (2016)
	Reunion		Present, no details	García Morales et al. (2016)
	Saint Helena		Present, no details	García Morales et al. (2016)
	Senegal		Present, no details	García Morales et al. (2016)
	Seychelles	Aldabra Island	Present, no details	García Morales et al. (2016)
		Farquhar Island	Present, no details	García Morales et al. (2016)
		Providence Island	Present, no details	García Morales et al. (2016)
	South Africa		Present, no details	García Morales et al. (2016)
	Spain	Canary Islands	Present in Tenerife	NPPO
	Sudan		Present, no details	García Morales et al. (2016)
	Tanzania		Present, no details	García Morales et al. (2016)
	Tanzania	Zanzibar Island	Present, no details	CABI (online)
	Tunisia		Present, no details	García Morales et al. (2016)
	Uganda		Present, no details	García Morales et al. (2016)
	Zimbabwe		Present, no details	García Morales et al. (2016)
Asia	Afghanistan		Present, no details	García Morales et al. (2016)
	Bangladesh		Present, no details	García Morales et al. (2016)
	Bhutan		Present, no details	García Morales et al. (2016)
	Bonin Islands		Present, no details	García Morales et al. (2016)
	Brunei		Present, no details	García Morales et al. (2016)
	Cambodia		Present, no details	CABI (online)
	China	Guangdong	Present, no details	García Morales et al. (2016)
		Henan	Present, no details	García Morales et al. (2016)
		Hong Kong	Present, no details	García Morales et al. (2016)
		Hubei	Present, no details	García Morales et al. (2016)
		Hunan	Present, no details	García Morales et al. (2016)
		Zhejiang	Present, no details	García Morales et al. (2016)
	Christmas Island		Present, no details	García Morales et al. (2016)
	India	Andhra Pradesh	Present, no details	García Morales et al. (2016)
		Bihar	Present, no details	García Morales et al. (2016)
		Gujarat	Present, no details	García Morales et al. (2016)
		Karnataka	Present, no details	García Morales et al. (2016)
		Kerala	Present, no details	García Morales et al. (2016)
		Maharashtra	Present, no details	García Morales et al. (2016)
		Odisha	Present, no details	García Morales et al. (2016)
		Sikkim	Present, no details	CABI (online)
		Tamil Nadu	Present, no details	García Morales et al. (2016)
		Uttar Pradesh	Present, no details	García Morales et al. (2016)
		West Bengal	Present, no details	García Morales et al. (2016)

Region	Country	Sub-national (e.g. State)	Status	Reference
	Indonesia	Flores	Present, no details	García Morales et al. (2016)
		Irian Jaya	Present, no details	García Morales et al. (2016)
		Java	Present, no details	García Morales et al. (2016)
		Sulawesi	Present, no details	García Morales et al. (2016)
		Sumatra	Present, no details	García Morales et al. (2016)
	Israel		Present, no details	García Morales et al. (2016)
	Japan		Present, no details	García Morales et al. (2016)
	Laos		Present, no details	García Morales et al. (2016)
	Malaysia		Present, no details	CABI (online)
		Peninsular Malaysian	Present, no details	CABI (online)
		Sabah	Present, no details	García Morales et al. (2016)
		Sarawak	Present, no details	García Morales et al. (2016)
	Nepal		Present, no details	García Morales et al. (2016)
	Pakistan		Present, no details	García Morales et al. (2016)
	Philippines		Present, no details	García Morales et al. (2016)
	Singapore		Present, no details	García Morales et al. (2016)
	Sri Lanka		Present, no details	García Morales et al. (2016)
	Taiwan		Present, no details	García Morales et al. (2016)
	Thailand		Present, no details	García Morales et al. (2016)
Oceania	Australia	Australian Capital Territory	Present, no details	García Morales et al. (2016)
		New South Wales	Present, no details	García Morales et al. (2016)
		Northern Territory	Present, no details	García Morales et al. (2016)
		Queensland	Present, no details	García Morales et al. (2016)
	Cook Islands		Present, no details	García Morales et al. (2016)
	Federated States of Micronesia	Caroline Islands	Present, no details	García Morales et al. (2016)
		Ponape Island	Present, no details	García Morales et al. (2016)
		Truk Islands	Present, no details	García Morales et al. (2016)
	Fiji		Present, no details	García Morales et al. (2016)
	French Polynesia	Tahiti	Present, no details	García Morales et al. (2016)
	Hawaiian Islands	Hawaii	Present, no details	García Morales et al. (2016)
	Kampuchea		Present, no details	García Morales et al. (2016)
	Kiribati		Present, no details	García Morales et al. (2016)
	Marshall Islands		Present, no details	García Morales et al. (2016)
	Nauru		Present, no details	CABI (online)
	New Britain		Present, no details	García Morales et al. (2016)
	New Caledonia		Present, no details	García Morales et al. (2016)
	Niue		Present, no details	García Morales et al. (2016)
	Northern Mariana Islands		Present, no details	García Morales et al. (2016)
	Palau		Present, no details	García Morales et al. (2016)
	Papua New Guinea		Present, no details	García Morales et al. (2016)
	Solomon Islands		Present, no details	García Morales et al. (2016)
	Vanuatu		Present, no details	García Morales et al. (2016)
	Western Samoa		Present, no details	García Morales et al. (2016)
	Tonga		Present, no details	García Morales et al. (2016)

Appendix C – Import data

Tables C.1–C.5.

Table C.1: Fresh or dried citrus (CN code: 0805) imported in 100 kg into the EU (27) from regions where *Pulvinaria psidii* is known to occur (Source: Eurostat accessed on 18/2/2022)

Country	2016	2017	2018	2019	2020	2021
Afghanistan				7.00		
Angola			43.00			
Antigua and Barbuda				20.00		
Australia	3,280.00	1,284.00	645.00	10,645.00	2,343.00	4,097.00
Bangladesh	228.00	230.00	160.00	322.00	1,184.00	289.00
Brazil	864,863.00	903,433.00	900,907.00	822,134.00	902,590.00	1,058,807.00
China	827,841.00	1,084,857.00	1,024,163.00	1,108,595.00	1,098,690.00	646,652.00
Colombia	44,825.00	79,401.00	123,887.00	136,915.00	172,198.00	194,963.00
Congo, Democratic Republic of						2.00
Costa Rica	4,700.00	921.00	705.00	231.00	462.00	35.00
Cuba	7,166.00	3,864.00	4,438.00	3,422.00	556.00	19.00
Dominican Republic	11,179.00	9,337.00	10,427.00	7,355.00	12,887.00	12,780.00
Ecuador	949.00	2,127.00	730.00	1,115.00	127.00	2,313.00
Egypt	1,931,587.00	2,246,999.00	2,643,272.00	2,206,933.00	2,850,746.00	3,398,717.00
Ghana	280.00	348.00	100.00			262.00
Guatemala	11,409.00	17,178.00	27,057.00	11,816.00	17,814.00	8,481.00
Guyana					24.00	
Haiti	207.00	177.00	72.00	31.00	248.00	337.00
India	247.00	1.00	450.00	89.00	255.00	22.00
Indonesia	567.00	556.00	779.00	837.00	865.00	873.00
Israel	799,118.00	969,404.00	824,602.00	812,739.00	878,713.00	780,426.00
Jamaica	3,634.00	3,325.00	676.00	2,410.00	1,647.00	2,442.00
Japan	353.00	417.00	271.00	319.00	162.00	184.00
Kenya			9.00		35.00	0.00
Lao People's Democratic Republic (Laos)	52.00	2.00			20.00	1.00
Madagascar	3.00	26.00	12.00	7.00	22.00	2.00
Malaysia	4.00	39.00	83.00	8.00		
Mexico	570,403.00	553,819.00	589,021.00	443,744.00	349,649.00	184,532.00
Nepal		1,170.00				1.00
New Zealand	0.00	13.00	205.00	355.00	0.00	0.00
Nigeria			0.00	0.00	200.00	
Pakistan			2.00	1.00		272.00
Philippines			0.00	8.00	0.00	
South Africa	5,278,831.00	5,802,018.00	6,381,125.00	6,196,838.00	7,830,148.00	7,941,164.00
Taiwan	157.00				0.00	
Tanzania, United Republic of	180.00	190.00	144.00	36.00	76.00	132.00
Thailand	426.00	1,283.00	660.00	625.00	195.00	245.00
Tunisia	175,011.00	172,516.00	125,258.00	133,950.00	75,620.00	115,587.00

Country	2016	2017	2018	2019	2020	2021
Uganda	4.00	4.00	7.00	7.00	12.00	9.00
United States	301,229.00	231,210.00	185,707.00	177,755.00	148,609.00	113,949.00
Venezuela, Bolivarian Republic of	744.00	2,216.00	681.00			
Zimbabwe	297,551.00	328,595.00	397,906.00	348,303.00	391,869.00	434,497.00

Table C.2: Fresh or dried avocados (CN code: 080440) imported in 100 kg into the EU (27) from regions where *Pulvinaria psidii* is known to occur (Source: Eurostat accessed on 18/2/2022)

Country	2016	2017	2018	2019	2020	2021
Angola			3.85		3.54	
Australia				0.01		0.31
Brazil	44,357.36	71,040.50	68,697.61	78,673.73	48,183.83	50,803.63
Congo, Democratic Republic of	0.66	1.47	0.10	0.65		5.96
China	193.97	35.28		1.23	0.04	0.12
Colombia	152,115.55	210,139.60	251,050.33	387,367.23	663,148.97	852,152.72
Costa Rica		21.56	9.98	428.45	686.40	201.60
Cuba	109.09	73.94	41.53	131.08	34.33	56.00
Dominican Republic	53,962.41	55,001.50	52,897.18	95,531.91	100,024.05	104,078.68
Algeria						0.52
Ecuador	5.27	1,052.41	1,264.87	2,314.26	1,763.14	3,368.06
Ghana	18.48	134.58	22.64	40.45	21.88	15.33
Guatemala	46.60	4,291.98	7,487.42	17,084.09	15,383.92	24,717.30
Indonesia						0.02
Israel	301,123.91	424,267.97	370,378.23	437,318.01	345,664.24	451,393.77
India	0.04	2.06	0.52	0.06		2.35
Kenya	228,426.16	243,947.31	404,593.87	346,231.90	435,308.72	487,575.86
Madagascar					0.96	1.11
Mexico	503,687.52	445,611.06	463,741.28	767,878.48	716,092.02	750,720.48
Malaysia	0.03		47.04			0.04
Nigeria	1.06	3.15	3.18	0.51		
New Zealand	0.85	0.61			0.03	
Philippines					0.05	
Thailand	3.68	9.76	9.66	9.06	3.39	25.85
Tanzania	26,823.05	25,773.58	55,517.16	60,480.96	50,769.74	56,339.46
Uganda	1,912.57	2,195.25	2,233.81	3,364.25	3,575.68	3,343.38
United States	8,819.53	1.19	2,546.86	0.02	4.66	45.38
Venezuela	0.09	233.40	111.12	71.29		
South Africa	419,768.89	315,854.56	652,817.98	401,352.79	416,290.22	417,357.70
Zimbabwe	13,030.06	20,378.85	36,539.24	32,020.52	38,872.63	27,696.56

Table C.3: Fresh or dried guavas, mangoes and mangosteens (CN code: 080450) imported in 100 kg into the EU (27) from regions where *Pulvinaria psidii* is known to occur (Source: Eurostat accessed on 18/2/2022)

Country	2016	2017	2018	2019	2020	2021
Angola			486.65	658.15	351.50	522.66
Antigua and Barbuda			193.61			
Australia	25.72	94.18	62.92			0.01
Bangladesh	438.53	256.66	331.27	310.73	323.91	1,538.10
China	38.95	51.87	180.81	78.23	104.34	248.77
Colombia	2,321.38	2,553.75	3,139.67	6,833.02	4,131.75	5,218.98
Congo, Democratic Republic of	0.50	0.12	3.45	0.41		7.13
Costa Rica	17,281.13	19,119.58	18,368.68	12,830.62	14,950.59	22,697.44
Cuba	117.98	216.57	14.36	103.34	230.60	135.11
Dominican Republic	96,728.22	85,119.28	105,553.46	118,508.00	110,481.33	160,995.72
Ecuador	20,830.01	13,840.91	9,491.23	9,608.87	10,660.02	7,684.59
Ghana	8,896.27	9,114.51	10,672.35	11,138.06	30,296.55	15,258.17
Guatemala	5,124.01	9,771.98	25,768.70	10,953.40	8,099.52	6,680.24
Haiti			4.87			
India	5,989.34	8,148.87	9,470.36	9,315.51	7,347.61	16,575.69
Indonesia	1,981.20	2,004.36	2,926.64	2,386.27	1,406.94	1,629.72
Israel	143,726.08	140,551.30	108,353.48	121,875.16	98,143.59	124,186.49
Japan	0.66				0.01	7.66
Kenya	232.06	4.08	65.09	10.30	66.53	1,497.12
Laos	753.34	620.36	603.14	806.50	525.32	285.98
Madagascar	246.94	22.10	15.02	0.66	1.05	20.64
Malaysia	289.86	197.22	170.64	72.72	44.56	19.01
Mexico	35,095.07	40,848.36	46,001.68	50,935.79	51,841.89	46,655.48
New Zealand	0.01	0.08	0.09	0.07	0.10	0.22
Nigeria	0.78	0.10	1.13	1.95	0.03	28.59
Pakistan	17,149.78	15,912.58	21,867.43	29,207.33	16,196.50	19,707.93
Philippines	1,028.05	519.88	795.56	368.97	128.10	152.74
South Africa	8,550.13	13,015.45	9,739.99	12,116.95	8,656.28	5,777.97
Taiwan			3.48	17.34	0.92	5.28
Tanzania			0.50	1.14		0.09
Thailand	6,460.81	7,401.80	6,911.89	6,743.92	5,260.84	4,918.89
Tunisia	0.08					0.01
Uganda	257.30	452.71	360.01	662.25	389.56	669.01
United States	78,874.11	45,478.21	54,660.34	82,580.54	82,852.21	51,111.18
Venezuela	2,917.57	2,033.75	2,401.44	1,939.11	282.69	522.30

Table C.4: Tomatoes, fresh or chilled (CN code: 05440) imported in 100 kg into the EU (27) from regions where *Pulvinaria psidii* is known to occur (Source: Eurostat accessed on 18/2/2022)

Country	2016	2017	2018	2019	2020	2021
Angola		0.18				
Australia				2.52		
Brazil		27.60				
Colombia				2,828.76	236.09	689.58
Costa Rica	1,323.84	3,068.81	1,227.34	343.97	287.90	221.82
Dominican Republic	19,550.87	21,840.02	19,688.19	15,920.89	17,237.85	12,557.61

Country	2016	2017	2018	2019	2020	2021
Egypt	9,135.43	14,023.94	15,102.55	18,876.68	9,491.42	4,133.46
Ghana						1.60
India				0.01		0.79
Israel	16,739.21	10,861.22	6,392.59	782.65	138.00	913.18
Japan	13.75	8.98	13.31	45.67	34.37	2.49
Madagascar	7.31		40.00			
Malaysia						0.04
Philippines						5.23
Mexico					0.80	
Thailand	0.08	0.08	0.08	0.02	0.02	0.04
Tunisia	101,703.12	101,127.84	149,456.18	162,662	186,037.72	208,140.48
Uganda		0.12				
United States			0	0.04	0.13	0.42

Table C.5: Fresh or chilled sweet peppers (CN code: 07096010) imported in 100 kg into the EU (27) from regions where *Pulvinaria psidii* is known to occur (Source: Eurostat accessed on 18/2/2022)

Country	2016	2017	2018	2019	2020	2021
Algeria	107.77	204.47	142.72	145.58		98.25
Angola		0.10				
China				100.00		
Costa Rica		58.24				
Cuba				3.00		
Dominican Republic	159.01	197.94	424.55	475.10	147.33	73.11
Ecuador					0.25	
Ghana						0.49
India	1,479.22	1,511.72	824.40	2,989.78	1,692.78	758.98
Indonesia						0.47
Israel	219,675.87	190,775.79	175,658.87	127,218.53	79,714.19	87,683.00
Japan	1.27	3.38	0.00	3.75		
Kenya	0.16		223.20	226.46	124.77	112.97
Laos		351.15	1,037.85	722.85		0.72
Madagascar	2.94	0.47			9.21	
Mexico	20.44		9.50	118.43	75.11	16.30
Nigeria	0.55				3.44	7.58
Pakistan	124.66	32.60	100.14	335.62	119.65	82.63
South Africa	77.49	72.55	69.52	26.50	3.92	3.45
Sri Lanka	24.29	1.25	26.80	39.37		
Thailand	1.02	24.78	35.45	24.90	0.00	
Tunisia	1,929.28	3,557.67	6,724.86	3,608.72	9,916.08	15,911.61
Uganda	228.10	122.50	729.69	345.48	622.64	839.89
United States					0.09	

Appendix D – Interceptions reported by USA

Miller et al. (2014) reports interceptions of *P. psidii* from several countries on a variety of host genera, as listed below.

Country	Host
Antigua	*Chalcas*
Australia	*Ixora, Litchi*
Bahamas	*Gardenia, Psidium*
Barbados	*Euonymus, Psychotria*
Bermuda	*Bryophyllum, Campsis, Codiaeum, Duranta, Laurus, Nerium, Pittosporum, Rhododendron, Sedum, Tecoma*
Brazil	*Mammea*
China	*Dracontomelon, Gardenia, Lansium, Litchi*
China - Hong Kong	*Litchi*
Colombia	*Citrus, Eugenia*
Costa Rica	*Anthurium, Coffea, Gardenia*
Cuba	*Ficus, Litchi, Psidium*
Fiji	*Ixora*
Guatemala	*Dracaena*
India	*Coffea, Litchi, Psidium*
Indonesia	*Lagerstroemia, Myristica, Thea*
Jamaica	*Anthurium, Bidens, Citrus, Mangifera, Myristica, Phaeomena, Punica*
Japan	*Gardenia, Litchi*
Maldives	*Annona, Psidium*
Mexico	*Carissa, Chenopodium, Citrus, Diospyros, Ficus, Gardenia, Litchi, Plumeria, Psidium, Rhus, Zingiber*
Montserrat	*Psidium*
Panama	*Anthurium, Tectona*
Peru	*Mangifera*
The Philippines	*Eugenia, Gardenia, Lansium, Litchi, Psidium, Vanda*
Puerto Rico	*Gardenia*
Samoa	*Cordyline*
Singapore	*Nephelium*
Tahiti	*Alpinia, Annona, Gardenia*
Taiwan	*Dimocarpus*
Thailand	*Cordyline, Dracaena, Eugenia, Nephelium*
Trinidad	*Anthurium, Gardenia*