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## Pest categorisation of *Phenacoccus solenopsis*

EFSA Panel on Plant Health (PLH),  
Claude Bragard, Francesco Di Serio, Paolo Gonthier, Josep Anton Jaques Miret,  
Annemarie Fejer Justesen, Christer Sven Magnusson, Panagiotis Milonas,  
Juan A Navas-Cortes, Stephen Parnell, Roel Potting, Philippe Lucien Reignault,  
Hans-Hermann Thulke, Wopke Van der Werf, Antonio Vicent Civera, Jonathan Yuen,  
Lucia Zappalà, Jean-Claude Gregoire, Chris Malumphy, Caterina Campese,  
Ewelina Czwieniczek, Virag Kertesz, Andrea Maiorano and Alan MacLeod

### Abstract

The EFSA Panel on Plant Health performed a pest categorisation of *Phenacoccus solenopsis* (Hemiptera: Pseudococcidae) for the European Union (EU) territory. This species is not included in EU Commission Implementing Regulation 2019/2072. *P. solenopsis* is native to North America and has spread to all continents except Antarctica. It has recently been reported from Cyprus, Greece and Italy. This mealybug is a polyphagous pest, feeding on about 300 plant species. It usually feeds on aerial plant parts, especially new growth, but also occurs on roots, and is often associated with ants. It is an economically important pest of ornamentals, such as hibiscus and lantana, glasshouse vegetable crops, mainly bell pepper, tomato and eggplant, and field crops, such as cotton. Large populations cause die-back and reduction in yield. Adult and immature *P. solenopsis* could enter the EU with imported fresh fruit, vegetables and cut flowers, although the main pathway of introduction is likely to be plants for planting. Host availability and climate suitability indicate that most of the EU would be suitable for establishment. The main natural dispersal stage is the first instar, which crawls over the plant or may be dispersed further by wind and animals. All stages may be transported over longer distances in trade. Phytosanitary measures are available and should prevent further introductions and slow the spread within the EU. *P. solenopsis* is under official control in Cyprus and has recently been reported in Greece and Italy. Assuming that these reports reflect a limited distribution, and *P. solenopsis* shortly comes under official control, it would satisfy all the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest.

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**Correspondence:** alpha@efsa.europa.eu

**Panel members:** Claude Bragard, Francesco Di Serio, Paolo Gonthier, Josep Anton Jaques Miret, Annemarie Fejer Justesen, Alan MacLeod, Christer Sven Magnusson, Panagiotis Milonas, Juan A Navas-Cortes, Stephen Parnell, Roel Potting, Philippe L Reignault, Hans-Hermann Thulke, Wopke Van der Werf, Antonio Vicent, Jonathan Yuen and Lucia Zappalà.

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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

*Phenacoccus solenopsis* is one of a number of pests listed in Annex 1 to the Terms of Reference (ToR) (Section 1.1.2) to be subject to pest categorisation to determine whether it fulfils the criteria of a regulated 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 European Commission 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 regulated pest, specific import

requirements for relevant host commodities will be identified; for pests already present in the EU additional risk reduction options to slow spread and facilitate eradication will be identified.

## 2. Data and methodologies

### 2.1. Data

#### 2.1.1. Literature search

A literature search on *Phenacoccus solenopsis* 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 and is 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 Interceptions to TRACES in May 2020.

### 2.2. Methodologies

The Panel performed the pest categorisation for *Phenacoccus solenopsis*, 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) and No. 21 (FAO, 2004).

The criteria to be considered when categorising a pest as a Union quarantine pest (QP) is given in Regulation (EU) 2016/2031 Article 3 and Annex 1 to this 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. Whilst 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 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  | Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest (article 3)  |
|---|---|
| <b>Identity of the pest (Section 3.1)</b>   | Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible?   |
| <b>Absence/presence of the pest in the EU territory (Section 3.2)</b>                       | Is the pest present in the EU territory?<br>If present, is the pest widely distributed within the EU?<br>Describe the pest distribution briefly   |
| <b>Regulatory status (Section 3.3)</b>  | If the pest is present in the EU but not widely distributed in the risk assessment area, it should be under official control or expected to be under official control in the near future. |
| <b>Pest potential for entry, establishment and spread in the EU territory (Section 3.4)</b> | Is the pest able to enter into, become established in, and spread within, the EU territory? If yes, briefly list the pathways   |
| <b>Potential for consequences in the EU territory (Section 3.5)</b>                         | Would the pests' introduction have an economic or environmental impact on the EU territory**?   |
| <b>Available measures (Specific import requirements) (Section 3.6)</b>                      | Are there measures available to prevent the entry into the EU such that the likelihood of introduction becomes mitigated?   |
| <b>Conclusion of pest categorisation (Section 4)</b>  | 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 established, or has it been shown to produce consistent symptoms and/or to be transmissible?*

**Yes**, the identity of the species is established and *Phenacoccus solenopsis* Tinsley is the accepted name. Recent molecular data provides some evidence that *P. solenopsis* may comprise a cryptic species complex (Thomas and Ramamurthy, 2014; Ahmed et al., 2015), but this requires further research and has not been proven.

*Phenacoccus solenopsis* is an insect within the Order Hemiptera and Family Pseudococcidae. It is commonly known as the cotton or solenopsis mealybug.

*Phenacoccus solenopsis* Tinsley (Figure 1), was initially described in 1898 from specimens collected in Mesilla Park, New Mexico, USA, in October 1892, from the roots and stems of *Boerhavia spicata* (Nyctaginaceae) and *Kallstroemia californica* (Zygophyllaceae), within nests of the fire ant *Solenopsis geminata* Fabricius (Hymenoptera: Formicidae), hence the specific epithet (Tinsley, 1898a). In the same year, Tinsley (1898b) provided a description of the adult female collected on the roots of *Atriplex canescens* (Amaranthaceae). The species was subsequently described under the names *Phenacoccus cevalliae* Cockerell 1902 and *gossypiphilous* Abbas, Arif and Saeed 2005, which are considered junior synonyms (García Morales et al., 2016).

Hodgson et al. (2008) suggested that three nominal species, *P. solenopsis*, *P. solani* Ferris and *P. defectus* Ferris, may be environmentally induced variants of a single species. Subsequently, *P. defectus* was synonymised with *P. solani*, and most researchers now consider *P. solenopsis* and *P. solani*, to be valid species. They can usually be easily separated in life as adult female *P. solenopsis* have distinct dorsal dark markings (Figure 1), which are absent in *P. solani*.

Thomas and Ramamurthy (2014) studied the genetic diversity in populations of *P. solenopsis* using mitochondrial cytochrome oxidase 1 (mtCO-1) sequences. The phylogenetic tree they produced with available sequences in the NCBI GenBank from different geographic regions revealed a distinct



separation between Asian and American populations. A similar result was obtained by Ahmed et al. (2015). The latter obtained *P. solenopsis* mtCOI sequences from specimens collected across China and Pakistan, and compared them with already available mtCOI sequences from additional Asian and North American countries. Genetic analysis provided evidence that *P. solenopsis* should be classified into two groups, one of which is found only in the United States and the other found in Asia. The Asian group contained nine unique haplotypes, two of which have invaded and spread across China, Pakistan, India and Vietnam.

It appears that there are two distinct evolutionary lineages of *P. solenopsis*, but further evidence is necessary to draw any reliable conclusions on the existence of a *P. solenopsis* species complex.

The EPPO code<sup>1</sup> for this species is: PHENSO (EPPO, online).



**Figure 1:** *Phenacoccus solenopsis*: teneral adult female (left), showing characteristic dark patches on the dorsum; colony of mature females (right), the dorsal markings are obscured by waxy secretions © Chris Malumphy

### 3.1.2. Biology of the pest

The biology of *P. solenopsis* has been described by Hodgson et al. (2008), Fand and Suroshe (2015) and Vennila et al. (2010). The life cycle takes between 28 and 35 days, and it has 8–12 generations annually, the number depending on temperature and host quality. Hodgson et al. (2008) reported that reproduction was always sexual although facultative parthenogenesis was observed under laboratory conditions in India (Vennila et al., 2010). It overwinters as an adult female, on the bark, the stem and branches of woody plants. It seems that it may develop underground on roots of non-woody plants (Spodek et al., 2018). It has been reported to be capable of surviving temperatures ranging from 0°C to 45°C on Okra in India (Sharma, 2007). Table 2 summarises key features of the biology of each life stage.

*P. solenopsis* colonies are frequently attended by ants and the mutualism between the red imported fire ant *Solenopsis invicta* and the mealybug has been studied by Zhou et al. (2012). The mutualism facilitates population growth and fitness of both species and may help drive the invasion success of these species when introduced to new areas.

<sup>1</sup> 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).

**Table 2:** Important features of the life history strategy of *Phenacoccus solenopsis*

| Life stage   | Phenology and relation to host   | Other relevant information  |
|--------------|--|---|
| <b>Egg</b>   | <i>P. solenopsis</i> has been reported to lay 150–600 eggs into an ovisac (Lu et al., 2008), whereas others report it is ovoviviparous (eggs hatch inside female) (Hodgson et al., 2008).  |   |
| <b>Nymph</b> | Mainly found on the young growth, including twigs, stems, leaves, flower buds and petioles. They are occasionally found on the roots of herbaceous plants and in ants' nests (Spodek et al., 2018). Females have three nymphal instars, and the males have four. The final two male nymph instars (called prepupa and pupa) do not feed. | First-instar nymphs (known as 'crawlers') are mobile and disperse by walking to other parts of the same plant or are carried on the wind or by other means (e.g. farm machinery, workers, animals) to other areas (Hodgson et al., 2008). Mealybug crawlers can live for approximately one day without feeding. When a suitable feeding site is located, they insert their stylets to feed and remain anchored to the host. |
| <b>Adult</b> | See the notes for the nymphs. Males have wings and females are wingless (neotenic and larviform).  | Facultative parthenogenetic. Adult males have no functional mouthparts and are short-lived (a few hours to 3 days) during which time they disperse by flight, although they are weak flyers, and seek a female to mate with. Adult females can live for up to 3 months (Gerson and Aplebaum, online).   |

### 3.1.3. Host range and plants affected

*P. solenopsis* is highly polyphagous, feeding on approximately 300 plant species in 65 botanical families (listed in Appendix A). The plant families containing most hosts are Amaranthaceae, Asteraceae, Cucurbitaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Malvaceae and Solanaceae. Hosts include many crops grown in the EU. However, Spodek et al. (2018) reported that some of the woody plants affected by the pest, including citrus (*Citrus* spp.), almond (*Prunus dulcis*) and grape vine (*Vitis vinifera*), are not suitable for the reproduction of *P. solenopsis* in Israel. *P. solenopsis* breeds on herbaceous plants in citrus groves and vineyards. These preferred hosts desiccate during the hot summer, and the mealybugs tend to migrate on to nearby stems of the crop plant, forming conspicuous aggregates on branches and in the canopy, but also on wooden or metal posts. Mealybug development was not observed on citrus and grapevines (Spodek et al., 2018).

There is uncertainty regarding how many of the plant species listed in Appendix A can support a self-sustaining population of *P. solenopsis*.

### 3.1.4. Intraspecific diversity

Hodgson et al. (2008) and Thomas and Ramamurthy (2014) found *P. solenopsis* exhibited considerable environmentally induced morphological variation. Recent molecular data provides some evidence that *P. solenopsis* may comprise a cryptic species complex (Ahmed et al., 2015; Chen et al., 2012; Thomas and Ramamurthy, 2014), but this requires further research and has not been proven.

### 3.1.5. Detection and identification of the pest

*Are detection and identification methods available for the pest?*

**Yes**, *P. solenopsis* can be found during visual inspection of infested consignments of host plants; adult females, ovisacs and nymphs can be found on the surface of plant foliage, stems, flowers, and fruit, and occasionally roots.

Morphological keys and molecular methods are available to identify specimens to the species level.

*P. solenopsis* is gregarious and often forms conspicuous groups on new growth (shoots, buds, flowers, fruits) of their host plants (Figure 1). They may be found on all aerial parts of the plant and show a preference for the upper parts, especially young shoots or branches carrying fruitlets (Spodek et al., 2018). They also occasionally occur on the root-collar and roots of herbaceous plants.



Symptoms resulting from large populations of mealybugs cause general weakening, distortion, chlorosis, defoliation, dieback and death of susceptible plants (Malumphy et al., 2013). Plants become covered in sooty moulds that grow on the honeydew egested by the mealybugs.

The taxonomy of Pseudococcidae is based on the morphology of the adult female. Adult female *P. solenopsis* exhibit considerable morphological variation which is discussed in Section 3.1.4. Hodgson et al. (2008) provided detailed descriptions and illustrations of adult and nymphs of both sexes. Detailed descriptions of the adult female and identification keys are provided by McKenzie (1967) for California, Williams and Granara de Willink (1992) and Granara de Willink and Szumik (2007) for Central and South America, Hodgson et al. (2008) for Asia and Ferris (1950) for North America. Hodgson et al. (2008) also provides a key to separate all the different instars of *P. solenopsis*.

Summary descriptions of the female life stages are provided below:

- First instar nymph is yellowish, elliptical, 0.4 × 0.2 mm, with red eyes and well-developed legs.
- Second and third instar nymphs are yellowish, elliptical, about 0.75–1.00 mm and 1.00–1.73 mm long, respectively, with short marginal wax filaments.
- Adult female is yellowish, about 2–5 mm long and 2–4 mm wide, covered with a powdery white wax secretion, except for bare patches of dark grey cuticle, with three pairs of submarginal patches on the abdomen (these may appear to be one long streak) and one pair on the thorax (Figure 1). Paired segmental wax filaments extend from the margin around the body, with the terminal pair of filaments longest. An ovisac of fluffy, loose-textured wax strands is produced (McKenzie, 1967; Sartiami et al., 2016).

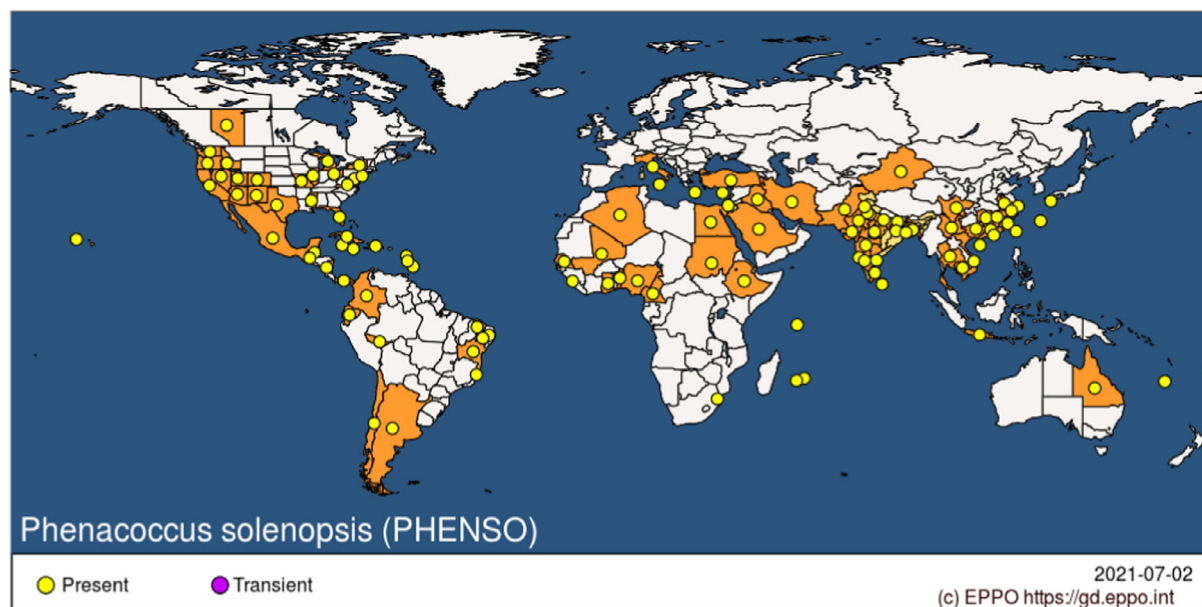
An online factsheet on *P. solenopsis* produced by Jackson and Mua (2019) provides photographs of the adults and feeding damage. Molecular diagnostic methods, based on the cytochrome c oxidase I sequence, are available to identify *P. solenopsis* with a number of accessions in Genbank.

## 3.2. Pest distribution

### 3.2.1. Pest distribution outside the EU

*P. solenopsis* is native to North America and has spread to Central and South America, the Caribbean, Africa, Asia and Oceania (see Map 2). It has recently been introduced to Europe (see Section 3.2.2 below).

Appendix B provides national and subnational records of occurrence (EPPO, online).



**Figure 2:** Global distribution of *Phenacoccus solenopsis* (Source: EPPO Global Database accessed on 2/7/2021)

### 3.2.2. Pest distribution in the EU

*Is the pest present in the EU territory? If present, is the pest widely distributed within the EU?*

**Yes**, *P. solenopsis* is present in the EU and has a restricted distribution.

- Cyprus (EPPO, 2011).
- Greece. Present in Crete (pers. com. Milonas 2020 in EFSA PLH Panel, 2021a).
- Italy. Present in Lazio region and Sicily (Sannino et al., 2019).

In the Netherlands, EPPO (online) reported the pest as absent, intercepted only.

### 3.3. Regulatory status

#### 3.3.1. Commission Implementing Regulation 2019/2072

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

It is under official control in Cyprus and has only recently been reported in Greece and Italy.

#### 3.3.2. Hosts of *Phenacoccus solenopsis* that are prohibited from entering the Union from third countries

As specified in Annex VI of 2019/2072, some plants, which are also *P. solenopsis* host plants (see Appendix A), are prohibited from entering the EU as plants for planting (Table 3).

**Table 3:** List of plants, plant products and other objects that are *Phenacoccus solenopsis* hosts whose introduction into the Union from certain third countries is prohibited (Source Commission Implementing Regulation (EU) 2019/2072, Annex VI)

| <b>List of plants, plant products and other objects whose introduction into the Union from certain third countries is prohibited</b> |  |                                    |   |
|--|--|------------------------------------|---|
|  | <b>Description</b>   | <b>CN Code</b>                     | <b>Third country, group of third countries or specific area of third country</b>  |
| 8.   | Plants for planting of [...], <i>Prunus</i> L., <i>Pyrus</i> L. and <i>Rosa</i> L., other than dormant plants free from leaves, flowers and fruits                                     | see 2019/2072 Annex VI for details | Third countries other than: specified European third countries (see 2019/2072 Annex VI for details)   |
| 9.   | Plants for planting of [...], <i>Prunus</i> L. and <i>Pyrus</i> L. and their hybrids, [...], other than seeds  |                                    | Third countries, other than: specified European third countries, specified countries bordering the Mediterranean Sea, specified Eurasian countries, Australia, Canada, New Zealand, specified parts of Russia, United States other than Hawaii (see 2019/2072 Annex VI for details) |
| 10.  | Plants of <i>Vitis</i> L., other than fruits   |                                    | Third countries other than Switzerland  |
| 11.  | Plants of <i>Citrus</i> L. [...] and their hybrids, other than fruits and seeds  |                                    | All third countries   |
| 13.  | Plants of <i>Phoenix</i> spp. other than fruit and seeds   |                                    | Algeria, Morocco  |
| 14.  | Plants for planting of the family Poaceae, other than plants of ornamental perennial grasses of the subfamilies Bambusoideae and Panicoideae and of the genera [...], other than seeds |                                    | Third countries, other than: specified European third countries, specified countries bordering the Mediterranean Sea (see 2019/2072 Annex VI for details)   |
| 15.  | Tubers of <i>Solanum tuberosum</i> L., seed potatoes   |                                    | Third countries other than Switzerland  |

|     |  |  |   |
|-----|--|--|---|
| 16. | Plants for planting of stolon- or tuber-forming species of <i>Solanum</i> L. or their hybrids, other than those tubers of <i>Solanum tuberosum</i> L. as specified in entry 15 |  | Third countries other than Switzerland  |
| 17. | Tubers of species of <i>Solanum</i> L., and their hybrids, other than those specified in entries 15 and 16   |  | Third countries other than:(a) Algeria, Egypt, Israel, Libya, Morocco, Syria, Switzerland, Tunisia and Turkey,or(b) those which fulfil the following provisions: (see 2019/2072 Annex VI for details) |
| 18. | Plants for planting of Solanaceae other than seeds and the plants covered by entries 15, 16 or 17  |  | Third countries, other than: specified European third countries, specified countries bordering the Mediterranean Sea, specified Eurasian countries (see 2019/2072 Annex VI for details)               |
| 19. | Soil as such consisting in part of solid organic substances  |  | Third countries other than Switzerland  |

Annex I of EU 2018/2019 lists high risk plants. Some of these plants are hosts of *P. solenopsis*, e.g. *Annona cherimola*, *Ficus carica*, *Nerium oleander* and *Prunus dulcis*.

### 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.*

Comment on plants for planting as a pathway.

**Yes**, *P. solenopsis* has already entered the EU. It may further enter the EU territory with imported fresh fruit, vegetables, flowers and plants for planting.

Adult females and all immature stages of *P. solenopsis* may be transported with fresh fruit, vegetables, flowers, cotton linters and plants for planting, including bulbs, tubers, tuberous roots, corms, crowns and rhizomes. Adult males are less likely to be transported than the other stages, as they are winged and may fly off when disturbed during harvesting and processing for shipment. *P. solenopsis* is polyphagous and its hosts include many crop and ornamental plants imported into the EU from areas where the mealybug occurs (see Table 4 for a summary of potential pathways). No special requirements in Annex VII relate specifically to *P. solenopsis*. However, there are some prohibitions on high risk plants. Some of them are hosts of *P. solenopsis* (Section 3.3.2) Regarding plants for planting, commodity risk assessments specifically for *Ficus carica* plants imported from Israel and for *Nerium oleander* plants imported from Turkey identified *P. solenopsis* as a pest that could be transported (EFSA, 2021a,b).

Tables 5–11 show the imported weight (100 Kg) of specific commodities between 2015 and 2020 from regions where *P. solenopsis* is known to occur, and which provide potential pathways of introduction. Detailed data on the EU 27 imports of tomatoes from countries where the pest is present can be seen in Appendix C.

Soil and growing media and soil on machinery were not considered viable options.

**Table 4:** Potential pathways for *Phenacoccus solenopsis* into the EU 27. No special requirements in Annex VII relate to *P. solenopsis*

| Pathways  | Life stage             | Relevant mitigations [e.g. prohibitions (Annex VI) or special requirements (Annex VII) within Implementing Regulation 2019/2072] |
|---|------------------------|--|
| Tomato fruit, fresh and chilled                           | Adult female, immature |  |
| Aubergine fruit, fresh or chilled                         | Adult female, immature |  |
| Cotton linters  | Adult female, immature |  |
| Roots and tubers of manioc 'cassava', fresh or chilled    | Adult female, immature |  |
| Capsicum fruits, fresh or chilled                         | Adult female, immature |  |
| Bulbs, tubers, tuberous roots, corms, crowns and rhizomes | Adult female, immature | For prohibitions, see Table 3  |
| Live tree and other plants for planting                   | Adult female, immature | For prohibitions see Table 3   |
| Cut flowers and ornamental foliage                        | Adult female, immature |  |
| Leafy vegetables and herbs, fresh or chilled              | Adult female, immature |  |

**Table 5:** Tomato fruit, fresh or chilled (CN code 0702), imported (kg) into the EU (27) from regions where *Phenacoccus solenopsis* is known to occur (Source Eurostat accessed on 13/5/2021)

| Region          | 2016       | 2017         | 2018         | 2019         | 2020         |
|-----------------|------------|--------------|--------------|--------------|--------------|
| Asia            | 728,476.61 | 1,017,542.27 | 1,082,435.27 | 1,006,835.33 | 1,256,132.98 |
| Africa          | 101,016.13 | 76,333.51    | 101,068.88   | 97,158.46    | 84,005.18    |
| North America   | 0.00       | 0.00         | 0.11         | 0.04         | 0.93         |
| Central America | 19,550.87  | 21,840.02    | 19,688.19    | 15,920.89    | 17,237.85    |
| South America   | 2.03       | 27.60        | 0.00         | 2,828.76     | 236.09       |
| Oceania         | 0.00       | 0.00         | 0.00         | 2.52         | 0.00         |
| Total           | 849,045.64 | 1,115,743.40 | 1,203,192.45 | 1,122,746.00 | 1,357,613.03 |

**Table 6:** Aubergine fruit, fresh or chilled (CN code 070930), imported (kg) into the EU (27) from regions where *Phenacoccus solenopsis* is known to occur

| Region          | 2016      | 2017      | 2018       | 2019      | 2020       |
|-----------------|-----------|-----------|------------|-----------|------------|
| Asia            | 66,485.69 | 85,828.24 | 88,563.24  | 77,201.19 | 100,309.80 |
| Africa          | 3,928.68  | 3,771.83  | 2,094.41   | 2,346.75  | 2,711.81   |
| North America   | 24.15     | 2,368.38  | 7,799.81   | 8,471.51  | 6,853.17   |
| Central America | 8,216.52  | 5,476.62  | 5,445.96   | 4,803.55  | 1,396.08   |
| South America   | 0.00      | 0.30      | 0.00       | 4.65      | 1.53       |
| Oceania         | 0.00      | 0.00      | 0.00       | 0.00      | 0.00       |
| Total           | 78,655.04 | 97,445.37 | 103,903.42 | 92,827.65 | 111,272.39 |

**Table 7:** Bulbs, tubers, tuberous roots, corms, crowns and rhizomes (CN code 0601), imported (kg) into the EU (27) from regions where *Phenacoccus solenopsis* is known to occur

| <b>Bulbs, tubers, tuberous roots, corms, crowns and rhizomes,</b> | <b>2016</b> | <b>2017</b> | <b>2018</b> | <b>2019</b> | <b>2020</b> |
|---|-------------|-------------|-------------|-------------|-------------|
| Asia  | 23,284.60   | 13,694.34   | 13,239.14   | 11,326.09   | 11,456.31   |
| Africa  | 0.00        | 0.00        | 3.26        | 1.42        | 14.27       |
| North America   | 10.48       | 5.48        | 7.18        | 409.89      | 6.97        |
| Central America   | 0.97        | 0.45        | 0.35        | 0.00        | 0.00        |
| South America   | 241.71      | 32.51       | 52.83       | 94.17       | 213.10      |
| Oceania   | 0.18        | 0.67        | 0.26        | 0.05        | 0.00        |
|   | 23,537.94   | 13,733.45   | 13,303.02   | 11,831.62   | 11,690.65   |

**Table 8:** Cotton linters (CN code 140420) imported (kg) into the EU (27) from regions where *Phenacoccus solenopsis* is known to occur

| <b>Cotton linters</b> | <b>2016</b> | <b>2017</b> | <b>2018</b> | <b>2019</b> | <b>2020</b> |
|-----------------------|-------------|-------------|-------------|-------------|-------------|
| Asia                  | 43,548.73   | 115,624.31  | 88,878.39   | 83,691.35   | 90,632.74   |
| Africa                | 400.00      | 296.42      | 608.38      | 132.94      | 87.99       |
| North America         | 56,181.45   | 32,472.85   | 16,629.25   | 7,933.06    | 19,150.08   |
| Central America       | 0.00        | 0.00        | 0.00        | 0.00        | 0.00        |
| South America         | 13,493.54   | 62,260.87   | 68,605.72   | 65,491.66   | 64,750.33   |
| Oceania               | 0.00        | 0.00        | 0.00        | 0.00        | 0.00        |
|                       | 113,623.72  | 210,654.45  | 174,721.74  | 157,249.01  | 174,621.14  |

**Table 9:** Fresh, chilled, frozen or dried roots and tubers of manioc 'cassava' (CN code 071410), imported (kg) into the EU (27) from regions where *Phenacoccus solenopsis* is known to occur

|                 | <b>2016</b> | <b>2017</b> | <b>2018</b> | <b>2019</b> | <b>2020</b> |
|-----------------|-------------|-------------|-------------|-------------|-------------|
| Asia            | 14,984.63   | 11,192.93   | 20,188.01   | 47,612.53   | 69,083.05   |
| Africa          | 8,004.89    | 13,055.09   | 17,750.91   | 20,433.65   | 45,015.23   |
| North America   | 0.00        | 0.00        | 0.01        | 0.61        | 2.01        |
| Central America | 303.22      | 0.00        | 311.46      | 793.75      | 787.97      |
| South America   | 2,685.43    | 3,200.44    | 2,648.93    | 7,792.67    | 7,636.22    |
| Oceania         | 0.00        | 0.00        | 0.00        | 0.00        | 0.00        |
|                 | 25,978.17   | 27,448.46   | 40,899.32   | 76,633.21   | 122,524.48  |

**Table 10:** Fresh or chilled fruits of the genus *Capsicum* or *Pimenta* (CN code 070960), imported (kg) into the EU (27) from regions where *Phenacoccus solenopsis* is known to occur

| <b>Region</b>   | <b>2016</b> | <b>2017</b> | <b>2018</b>  | <b>2019</b> | <b>2020</b>  |
|-----------------|-------------|-------------|--------------|-------------|--------------|
| Asia            | 882,016.17  | 849,417.36  | 1,003,658.42 | 841,294.12  | 993,485.36   |
| Africa          | 14,751.34   | 19,484.00   | 14,928.88    | 8,037.57    | 6,759.77     |
| North America   | 405.23      | 250.75      | 259.13       | 428.28      | 451.26       |
| Central America | 4,193.66    | 4,069.63    | 5,043.99     | 4,734.71    | 3,630.07     |
| South America   | 124.57      | 48.43       | 69.57        | 46.99       | 17.77        |
| Oceania         | 0.05        | 1.01        | 0.00         | 0.00        | 0.00         |
|                 | 901,491.02  | 873,271.18  | 1,023,959.99 | 854,541.67  | 1,004,344.23 |

**Table 11:** Live tree and other plants, bulbs and roots, cut flowers and ornamental foliage (CN code 06), imported (kg) into the EU (27) from regions where *Phenacoccus solenopsis* is known to occur

| Region          | 2016         | 2017         | 2018         | 2019         | 2020         |
|-----------------|--------------|--------------|--------------|--------------|--------------|
| Asia            | 715,804.19   | 740,339.94   | 834,848.27   | 917,663.77   | 964,560.64   |
| Africa          | 883,724.55   | 883,780.50   | 620,636.08   | 590,941.17   | 654,714.19   |
| North America   | 286,490.71   | 254,708.77   | 227,613.35   | 216,327.76   | 175,542.89   |
| Central America | 637.48       | 188.66       | 891.65       | 6,520.69     | 5,308.10     |
| South America   | 574,893.44   | 580,622.93   | 632,649.07   | 645,607.43   | 589,575.30   |
| Oceania         | 7,817.69     | 7,823.61     | 10,441.77    | 7,365.74     | 7,029.60     |
|                 | 2,469,368.06 | 2,467,464.41 | 2,327,080.19 | 2,384,426.56 | 2,396,730.72 |

Notifications of interceptions of harmful organisms began to be compiled in Europhyt in 1994 and in TRACES in May 2020. As of 14 April 2021 there were 6 records of interceptions of *Phenacoccus solenopsis* in the Europhyt historical database (2001, 2002, 2004 and 2018 interceptions) on the following plants: *Manihot esculenta*, *Annona reticulata*, *Annona* sp. *Lantana camara*, *Psidium guajava*, *Ocimum basilicum*. This species was intercepted in the UK on multiple occasions during the last decade on fresh herbs and vegetables imported from Africa, the Middle East and Asia (Malumphy et al., 2013). The main trade pathways were *Ocimum basilicum* from Israel and Jordan, and *Solanum melongena* from Kenya.

### 3.4.2. Establishment

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

**Yes**, *P. solenopsis* has established in Cyprus and Italy, and was reported from Greece. Biotic factors such as host availability, and abiotic factors such as climate suitability suggest that large areas of the EU would be suitable for 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 3.4.2.1 and climatic factors in 3.4.2.2.

Although adult females and all immature stages of *P. solenopsis* may be transported with fresh fruit, vegetables, flowers and cotton linters, the likelihood of transfer to a suitable host following entry is low as the mealybugs have a relatively low natural dispersal potential. Plants for planting, including bulbs, tubers, tuberous roots, corms, crowns and rhizomes, present a much higher risk of establishment.

#### 3.4.2.1. EU distribution of main host plants and plants affected

As noted above, and in Appendix A, *P. solenopsis* is polyphagous, feeding on a wide range of ornamentals, vegetable and fruit crops and cotton. Cultivated plants such as almond, basil, bell pepper, citrus, eggplant, grapevine, maize, olive, sage, sorghum and tomato, are grown in central and southern EU.

Table 12 shows the harvested area of key hosts and food plants cultivated in the EU 27 in recent years. Detailed production data of host plants in the EU 27 can be found in Appendix D.

**Table 12:** Harvested area of some *Phenacoccus solenopsis* hosts in EU 27, 2016–2020 (thousand ha). Source EUROSTAT (accessed on 15/5/2021)

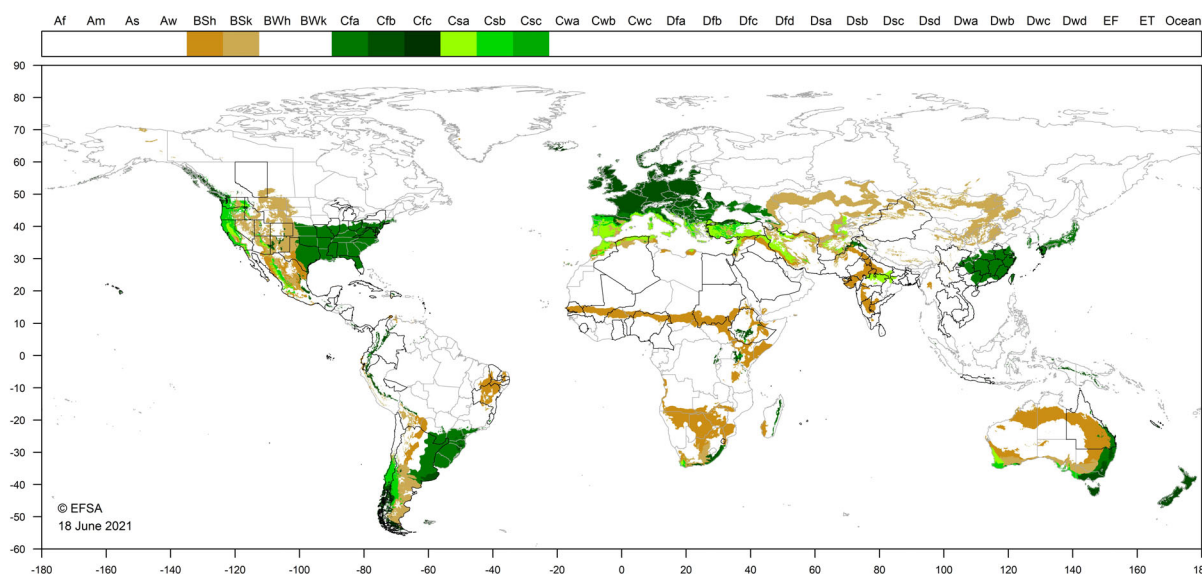
| Crop         | Code  | 2016   | 2017   | 2018   | 2019   | 2020   |
|--------------|-------|--------|--------|--------|--------|--------|
| Tomatoes     | V3100 | 246.80 | 240.87 | 239.55 | 235.14 | 236.46 |
| Eggplants    | V3210 | 21.58  | 20.73  | 21.44  | 20.63  | 21.36  |
| Peppers      | V3600 | 57.59  | 57.47  | 56.27  | 59.68  | 59.66  |
| Cotton fibre | I2300 | 301.34 | 326.12 | 345.64 | 361.78 | 350.07 |



### 3.4.2.2. Climatic conditions affecting establishment

*P. solenopsis* is most frequently reported from tropical and subtropical regions in the Americas, Middle East, Asia and Africa. However, it is reported to occur in India in areas which experience temperatures that range from 0°C to 45°C (Sharma, 2007). What is remarkable is that it has been found in the Canadian prairies in Alberta on the roots of *Artemisia frigida* and *Rosa arkansana* in the nests of six species of ant (Newton et al., 2011). Two of these ant species are very common throughout the EU: yellow meadow ant *Lasius flavus* and black garden ant *Lasius niger*. The significance of this finding is unclear. It may indicate that *P. solenopsis* could survive in ant’s nests, feeding on plant roots, in northern temperate areas of the EU which experience sub-zero winters. It is likely to only occur at low population densities in such areas.

*P. solenopsis* can establish in southern and central Europe and there is uncertainty regarding establishment in Northern areas.



**Figure 3:** World distribution of eight Köppen–Geiger climate types that occur in the EU and which occur in countries where *Phenacoccus solenopsis* has been reported

### 3.4.3. Spread

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

*P. solenopsis* is a free-living organism that appears to be spreading and/or there have been multiple introductions within the EU. Natural spread by the first instars crawling or being carried by wind, other animals, or machinery, will occur locally and relatively slowly. In Israel, during dry periods it has been recorded migrating from herbaceous hosts, on which it breeds, to woody orchard plants and vineyards.

*Comment on plants for planting as a mechanism of spread.*

Adult females and immatures can be carried on plants for planting.

### 3.5. Impacts

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

**Yes**, adults and immatures are harmful to a range of plants and economic impacts are expected, particularly to glasshouse vegetable crops such as bell pepper, eggplants, and tomato, and field crops, such as cotton. Environmental impacts are also possible, as the mealybug can feed on a range of native herbaceous plants.

The main economic impact has been reported on cotton, with 30–60% yield losses in India and Pakistan (Fand and Suroshe, 2015). Infested cotton plants become stunted, growth appears to stop and most plants look dehydrated. In severe outbreaks, the bolls fail to open, and defoliation occurs (including the loss of flower buds, flowers and immature bolls) (Hodgson et al., 2008).

It is also an economic pest of tomato, eggplant and bell peppers grown in glasshouses in Israel, as *P. solenopsis* prefers to feed on the young shoots and branches carrying fruitlets (Spodek et al., 2018). On tomatoes the pest causes foliar yellowing, leaf wrinkling, puckering and severe damage, resulting in death (Ibrahim et al., 2015). Ornamental plants can lose value due to sooty moulds growing on honeydew egested by the mealybug.

In Cyprus, *P. solenopsis* was found mainly in private gardens on ornamental plants. It had a high impact to *Antirrhinum majus*, *Chrysanthemum*, *Hibiscus sinensis*, *Hibiscus syriacus*, *Lantana camara*, *Lycianthes rantonnetii*, *Myoporum laetum*, *Petunia*, *Pittosporum tobira*, *Osteospermum*, *Portulaca oleraceae* and a medium impact to *Abelmoschus esculentus*, *Gaillardia aristata*, *Leucophyllum frutescens*, *Solanum lycopersicum*, *Solanum melongena*, *Trachelospermum jasminoides* and *Vitis vinifera* (Malumphy et al., 2013).

### 3.6. Available measures and/or potential specific import requirements and limits of mitigation measures

Are there measures available to prevent the entry into the EU (and spread for pests already present) such that the risk becomes mitigated?

**Yes**, some hosts are already prohibited as plants for planting from third countries (see 3.3.2). Measures proposed by Israel for *Ficus carica* and Turkey for *Nerium oleander* plants for planting are evaluated in EFSA (2021a,b). Fresh produce imported into the EU require a phytosanitary certificate and a proportion of consignments are inspected. Additional options are available to reduce the likelihood of pest entry into the EU. Surveillance, detection, pesticide treatments, restricting plant movement are amongst measures to prevent spread.

#### 3.6.1. Identification of potential additional measures

Phytosanitary measures (prohibitions) are currently applied to some host plants for planting (see 3.3.2). Further potential control measures on hosts that are imported are listed in Table 13. For *N. oleander* and *F. carica*, see EFSA (2021a,b).

**Table 13:** Selected control measures (a full list is available in EFSA PLH Panel, 2018) for pest entry and spread in relation to currently unregulated hosts and pathways

| Special requirements summary with hyperlink (in blue) to information sheet if available | Potential control measures summary   |
|---|--|
| <a href="#">Growing plants in isolation</a>   | Production in insect proof greenhouses or isolated fields could be considered because <i>P. solenopsis</i> has a low natural dispersal potential as adult females cannot fly; measures could be applied in vicinity of growing site. |
| Chemical treatments on crops including reproductive material                            | Used to mitigate likelihood of infestation of pests susceptible to chemical treatments. Sahito et al. (2011) provides a review of pesticides against <i>P. solenopsis</i>  |
| <a href="#">Roguing and pruning</a>   | The mealybug shows a preference for new growth and pruning can reduce the population density.  |
| <a href="#">Soil treatment</a>  | A soil drench will mitigate likelihood of infestation of soil at origin  |
| Inspections   | Has been detected during import inspections (Malumphy, 2005; Malumphy et al., 2013)<br>Used to mitigate likelihood of infestation by specified pest at origin  |
| <a href="#">Chemical treatments on consignments or during processing</a>                | Used to mitigate likelihood of infestation of pests susceptible to chemical treatments   |

| Special requirements summary with hyperlink (in blue) to information sheet if available | Potential control measures summary  |
|---|---|
| <b>Physical treatments on consignments or during processing</b>                         | Used to mitigate likelihood of infestation of pests susceptible to physical treatments  |
| <b>Heat and cold treatments</b>   | Although <i>P. solenopsis</i> is reported to have a wide temperature tolerance, treatments using temperatures outside tolerable limits could be used. |
| <b>Controlled atmosphere</b>  | Used to mitigate likelihood of infestation of pests susceptible to modified atmosphere (usually applied during transport) hence to mitigate entry     |
| <b>Cleaning and disinfection of facilities, tools and machinery</b>                     | Used to mitigate likelihood of entry or spread of soil borne pests  |
| Limits on soil  | <i>P. solenopsis</i> may occur on roots, especially of herbaceous plants<br>Used to mitigate likelihood of entry or spread via pests in soil          |
| Phytosanitary certificate and plant passport  | Used to attest which of the above requirements have been applied  |

### 3.6.1.1. Biological or technical factors limiting the effectiveness of measures to prevent the entry of the pest

- *P. solenopsis* can feed on roots and is therefore difficult to detect and treat.
- *P. solenopsis* has mutualistic relations with ant colonies.
- *P. solenopsis* can feed on a wide range of hosts (approximately 300 species assigned to 65 families) although they seem unlikely to be able to sustain populations on some of the woody hosts.
- Limited effectiveness of control measures: Although both contact and systemic insecticides are available, they have not always been effective against *P. solenopsis* in Cyprus, and populations increase rapidly in the summer months (Malumphy et al., 2013). The congeneric South American bougainvillea mealybug *Phenacoccus peruvianus* was first detected in Europe in Spain in 1999, and in two decades became widespread in the Mediterranean.

## 3.7. Uncertainty

There is uncertainty regarding the abiotic requirements, area of potential establishment in the EU, rate of natural spread, frequency of root feeding and occurrence in ants' nests, level of impact to outdoor crops, environmental impacts and the effectiveness of mitigation measures.

If entering on fresh produce, there are uncertainties over the pest's ability to transfer to a suitable host following arrival in the EU. Uncertainties affecting establishment, which are common to other pests that enter, also include allee effects (effects causing reduced survival of new colonies with a small number of individuals (Tobin et al., 2011)).

Population densities of *P. solenopsis* have recently declined in Israel due to parasitism by *Aenasius arizonensis* (Girault) (Hymenoptera, Encyrtidae), which has reduced the impact (Spodek et al., 2018). *A. arizonensis* is present in Israel and Turkey but has not been recorded in the EU. There is uncertainty regarding the level of predation and parasitism by natural enemies of *P. solenopsis* already present in the EU, and whether *A. arizonensis* will spread naturally into the EU.

## 4. Conclusions

*P. solenopsis* is a highly polyphagous North American mealybug that has spread to all continents except Antarctica. It has recently been reported in the EU where it has a limited distribution. It is under official control in Cyprus and has recently been reported in Greece and Italy. Assuming that these reports reflect a limited distribution, and *P. solenopsis* shortly comes under official control, it would satisfy all the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest (Table 14).

**Table 14:** 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  |
|---|---|--|
| <b>Identity of the pest (Section 3.1)</b>   | The identity of the species is established and <i>Phenacoccus solenopsis</i> Tinsley is the accepted name.  | Recent molecular data provides some evidence that <i>P. solenopsis</i> may comprise a cryptic species complex.   |
| <b>Absence/presence of the pest in the EU (Section 3.2)</b>                             | <i>Phenacoccus solenopsis</i> is present in the EU where it has a restricted distribution (Cyprus, Greece and Italy)  | It is likely to be under-recorded due to difficulties with detection and identification.   |
| <b>Regulatory status (Section 3.3)</b>  | <i>P. solenopsis</i> is not regulated in the EU plant health regulations. It is under official control in Cyprus and has recently been reported in Greece and Italy.  | Whether or not official action will be taken against <i>P. solenopsis</i> in all EU members where the pest occurs. It is unknown if it will become regulated in the near future. |
| <b>Pest potential for entry, establishment and spread in the EU (Section 3.4)</b>       | Adult and immature <i>P. solenopsis</i> may enter the EU with imported fresh fruit, vegetables and flowers although the main pathway of introduction is likely to be plants for planting. Biotic factors (host availability) and abiotic factors (climate suitability) suggest that most of the EU would be suitable for establishment of <i>P. solenopsis</i> . The pest is a free-living organism and could spread within the EU, facilitated by movement of hosts. |  |
| <b>Potential for consequences in the EU (Section 3.5)</b>                               | Adults and nymphs are harmful to a range of plants and economic and possibly environmental impacts would be expected if <i>P. solenopsis</i> spreads in the EU.   |  |
| <b>Available measures (Section 3.6)</b>   | Some plants affected by <i>P. solenopsis</i> are already prohibited as plants for planting from third countries and produce imported into the EU require a phytosanitary certificate of which a proportion of consignments are inspected. Additional options are available to reduce the likelihood of pest entry into and spread within the EU.  |  |
| <b>Conclusion (Section 4)</b>   | Assuming that the recent reports reflect a limited distribution, and <i>P. solenopsis</i> shortly comes under official control, it would satisfy all the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest.   | It is unclear how effective any official action will be to eradicate or contain the pest.  |
| <b>Aspects of assessment to focus on/scenarios to address in future if appropriate:</b> |   |  |

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## 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                               |
| 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.     |
| 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 – *Phenacoccus solenopsis* host plants and plants affected

Source: EPPO Global Database (EPPO online) and García Morales et al. (2016).

Some of the woody host plants may not be suitable for a self-sustaining population of *P. solenopsis* (Spodek et al., 2018). Many of the 'wild weed hosts' listed below may also be cultivated as ornamentals.

| Host status                | Host name                         | Plant family   | Common name                  | Reference <sup>A</sup>       |
|----------------------------|-----------------------------------|----------------|------------------------------|------------------------------|
| <b>Cultivated hosts</b>    | <i>Abelmoschus esculentus</i>     | Malvaceae      | Okra                         | EPPO                         |
|                            | <i>Abelmoschus moschatus</i>      | Malvaceae      | Musk okra                    | EPPO                         |
|                            | <i>Anacardium occidentale</i>     | Anacardiaceae  | Cashew                       | EPPO                         |
|                            | <i>Ananas comosus</i>             | Bromeliaceae   | Pineapple                    | Spodek et al. (2018)         |
|                            | <i>Annona muricata</i>            | Annonaceae     | Soursop                      | EPPO                         |
|                            | <i>Annona squamosa</i>            | Annonaceae     | Sugar apple                  | EPPO                         |
|                            | <i>Antirrhinum majus</i>          | Plantaginaceae | Snapdragon                   | Malumphy et al. (2013)       |
|                            | <i>Azadirachta indica</i>         | Meliaceae      | Neem                         | García Morales et al. (2016) |
|                            | <i>Beta vulgaris</i>              | Amaranthaceae  | Beet                         | García Morales et al. (2016) |
|                            | <i>Cajanus cajan</i>              | Fabaceae       | Pigeon pea                   | <b>EPPO</b>                  |
|                            | <i>Capsicum annuum</i>            | Solanaceae     | Chilli, bell pepper          | <b>EPPO</b>                  |
|                            | <i>Capsicum frutescens</i>        | Solanaceae     | Chilli pepper                | Arif et al. (2009)           |
|                            | <i>Carica papaya</i>              | Caricaceae     | Papaya                       | EPPO                         |
|                            | <i>Chrysanthemum x morifolium</i> | Asteraceae     | Chrysanthemum                | Arif et al. (2009)           |
|                            | <i>Chrysanthemum sp.</i>          | Asteraceae     | Chrysanthemum                | EPPO                         |
|                            | <i>Cichorium intybus</i>          | Asteraceae     | Chicory                      | Arif et al. (2009)           |
|                            | <i>Citrullus colocynthis</i>      | Cucurbitaceae  | Bitter apple                 | Arif et al. (2009)           |
|                            | <i>Citrullus lanatus</i>          | Cucurbitaceae  | Watermelon                   | EPPO                         |
|                            | <i>Citrus aurantium</i>           | Rutaceae       | Seville orange               | Arif et al. (2009)           |
|                            | <i>Citrus limon</i>               | Rutaceae       | Lemon                        | EPPO                         |
|                            | <i>Citrus paradisi</i>            | Rutaceae       | Grapefruit                   | Spodek et al. (2018)         |
|                            | <i>Citrus sinensis</i>            | Rutaceae       | Orange                       | Arif et al. (2009)           |
|                            | <i>Cucumis melo</i>               | Cucurbitaceae  | Musk melon                   | EPPO                         |
|                            | <i>Cucumis sp.</i>                | Cucurbitaceae  |                              | García Morales et al. (2016) |
|                            | <i>Cucurbita moschata</i>         | Cucurbitaceae  | Pumpkin, butternut squash    | EPPO                         |
|                            | <i>Cucurbita sp.</i>              | Cucurbitaceae  |                              | García Morales et al. (2016) |
|                            | <i>Cyamopsis tetragonoloba</i>    | Fabaceae       | Cluster bean                 | EPPO                         |
|                            | <i>Diospyros kaki</i>             | Ebenaceae      | Japanese persimmon, kaki     | Spodek et al. (2018)         |
|                            | <i>Eruca vesicaria</i>            | Brassicaceae   | Garden rocket                | Spodek et al. (2018)         |
|                            | <i>Euphorbia pulcherrima</i>      | Euphorbiaceae  | Poinsettia                   | García Morales et al. (2016) |
|                            | <i>Ficus carica</i>               | Moraceae       | Common fig                   | Arif et al. (2009)           |
|                            | <i>Gaillardia aristata</i>        | Asteraceae     | Common gaillardia            | Malumphy et al. (2013)       |
|                            | <i>Gardenia jasminoides</i>       | Rubiaceae      | Gardenia                     | Arif et al. (2009)           |
| <i>Gossypium arboreum</i>  | Malvaceae                         | Tree cotton    | Arif et al. (2009)           |                              |
| <i>Gossypium herbaceum</i> | Malvaceae                         | Levant cotton  | García Morales et al. (2016) |                              |
| <i>Gossypium hirsutum</i>  | Malvaceae                         | Cotton         | EPPO                         |                              |

| Host status | Host name   | Plant family     | Common name                  | Reference <sup>A</sup>       |
|-------------|---|------------------|------------------------------|------------------------------|
|             | <i>Gossypium</i> sp.                              | Malvaceae        |                              | Fallahzadeh et al. (2014)    |
|             | <i>Helianthus annuus</i>                          | Asteraceae       | Sunflower                    | EPPO                         |
|             | <i>Hibiscus cannabinus</i>                        | Malvaceae        | Mesta                        | EPPO                         |
|             | <i>Hibiscus rosa-sinensis</i>                     | Malvaceae        | Chinese hibiscus             | EPPO                         |
|             | <i>Hibiscus sabdarifa</i>                         | Malvaceae        | Ambadi                       | EPPO                         |
|             | <i>Lactuca sativa</i>                             | Asteraceae       | Lettuce                      | Spodek et al. (2018)         |
|             | <i>Lagenaria siceraria</i>                        | Cucurbitaceae    | Bottle gourd, calabash       | EPPO                         |
|             | <i>Lagerstroemia indica</i>                       | Lythraceae       | Crape myrtle                 | Arif et al. (2009)           |
|             | <i>Lantana camara</i>                             | Verbenaceae      | Common lantana               | Arif et al. (2009)           |
|             | <i>Leucophyllum candidum</i>                      | Scrophulariaceae | Barometer bush               | Spodek et al. (2018)         |
|             | <i>Leucophyllum frutescens</i>                    | Scrophulariaceae | Texas sage                   | Spodek et al. (2018)         |
|             | <i>Luffa acutangula</i>                           | Cucurbitaceae    | Luffa, ridge gourd           | EPPO                         |
|             | <i>Luffa aegyptiaca</i>                           | Cucurbitaceae    | Sponge gourd                 | EPPO                         |
|             | <i>Luffa</i> sp.                                  | Cucurbitaceae    |                              | Fallahzadeh et al. (2014)    |
|             | <i>Lycianthes rantonnetii</i>                     | Solanaceae       | Blue potato bush             | Spodek et al. (2018)         |
|             | <i>Mangifera indica</i>                           | Anacardiaceae    | Mango                        | EPPO                         |
|             | <i>Manihot esculenta</i>                          | Euphorbiaceae    | Cassava                      | García Morales et al. (2016) |
|             | <i>Manilkara zapota</i> (= <i>Achras zapota</i> ) | Sapotaceae       | Sapodilla, sapota            | EPPO                         |
|             | <i>Mentha spicata</i>                             | Lamiaceae        | Spearmint                    | Arif et al. (2009)           |
|             | <i>Momordica charantia</i>                        | Cucurbitaceae    | Bitter gourd                 | EPPO                         |
|             | <i>Morus alba</i>                                 | Moraceae         | White mulberry               | Arif et al. (2009)           |
|             | <i>Myoporum laetum</i>                            | Scrophulariaceae | Mousehole tree               | Malumphy et al. (2013)       |
|             | <i>Nerium oleander</i>                            | Apocynaceae      | Oleander                     | Arif et al. (2009)           |
|             | <i>Nicotiana tabacum</i>                          | Solanaceae       | Tobacco                      | Arif et al. (2009)           |
|             | <i>Ocimum basilicum</i>                           | Lamiaceae        | Basil                        | Arif et al. (2009)           |
|             | <i>Olea europaea</i>                              | Oleaceae         | Olive                        | Spodek et al. (2018)         |
|             | <i>Osteospermum</i>                               | Asteraceae       | African daisy                | Malumphy et al. (2013)       |
|             | <i>Passiflora edulis</i>                          | Passifloraceae   | Passion fruit                | Spodek et al. (2018)         |
|             | <i>Pelargonium</i>                                | Geraniaceae      |                              | Spodek et al. (2018)         |
|             | <i>Pennisetum glaucum</i>                         | Poaceae          | Pearl millet                 | García Morales et al. (2016) |
|             | <i>Petunia</i>                                    | Solanaceae       | Petunia                      | Malumphy et al. (2013)       |
|             | <i>Phoenix dactylifera</i>                        | Arecaceae        | Date palm                    | Arif et al. (2009)           |
|             | <i>Piper betle</i>                                | Piperaceae       | Betel                        | Arif et al. (2009)           |
|             | <i>Pittosporum tobira</i>                         | Pittosporaceae   | Mock orange                  | Malumphy et al. (2013)       |
|             | <i>Portulaca oleracea</i>                         | Portulacaceae    | Common purlane               | Malumphy et al. (2013)       |
|             | <i>Psidium guajava</i>                            | Myrtaceae        | Guava                        | EPPO                         |
|             | <i>Plumeria rubra</i>                             | Apocynaceae      | Frangipani                   | Arif et al. (2009)           |
|             | <i>Punica granatum</i>                            | Lythraceae       | Pomegranate                  | EPPO                         |
|             | <i>Prunus dulcis</i>                              | Rosaceae         | Almond                       | Spodek et al. (2018)         |
|             | <i>Salvia officinalis</i>                         | Lamiaceae        | Sage                         | Arif et al. (2009)           |
|             | <i>Sesamum indicum</i>                            | Pedaliaceae      | Sesame                       | EPPO                         |
|             | <i>Solanum lycopersicum</i>                       | Solanaceae       | Tomato                       | EPPO                         |
|             | <i>Solanum melongena</i>                          | Solanaceae       | Aubergine, brinjal, eggplant | EPPO                         |
|             | <i>Solanum tuberosum</i>                          | Solanaceae       | Potato                       | EPPO                         |
|             | <i>Sorghum bicolor</i>                            | Poaceae          | Sorghum, jowar               | EPPO                         |

| Host status               | Host name                          | Plant family      | Common name           | Reference <sup>A</sup>       |
|---------------------------|------------------------------------|-------------------|-----------------------|------------------------------|
|                           | <i>Spinacia oleracea</i>           | Amaranthaceae     | Spinach               | Spodek et al. (2018)         |
|                           | <i>Thymus vulgaris</i>             | Lamiaceae         | Thyme                 | Spodek et al. (2018)         |
|                           | <i>Trachelospermum jasminoides</i> | Apocynaceae       | Star jasmine          | Malumphy et al. (2013)       |
|                           | <i>Verbena officinalis</i>         | Verbenaceae       | Common verbena        | Arif et al. (2009)           |
|                           | <i>Vigna radiata</i>               | Fabaceae          | Mung bean, green gram | EPPO                         |
|                           | <i>Vitis</i> sp.                   | Vitaceae          | Grape vine            | EPPO                         |
|                           | <i>Vitis vinifera</i>              | Vitaceae          | Grape vine            | EPPO                         |
|                           | <i>Zea mays</i>                    | Poaceae           | Maize                 | García Morales et al. (2016) |
|                           | <i>Ziziphus mauritiana</i>         | Rhamnaceae        | Jujube, ber           | EPPO                         |
| <b>Wild weed hosts</b>    | <i>Abutilon asiaticum</i>          | Malvaceae         | Country mallow        | EPPO                         |
|                           | <i>Abutilon fruticosum</i>         | Malvaceae         | Texas Indian mallow   | Fallahzadeh et al. (2014)    |
|                           | <i>Abutilon hirtum</i>             | Malvaceae         | Indian mallow         | Arif et al. (2009)           |
|                           | <i>Abutilon indicum</i>            | Malvaceae         | Indian abutilon       | Arif et al. (2009)           |
|                           | <i>Abutilon muticum</i>            | Malvaceae         |                       | Arif et al. (2009)           |
|                           | <i>Abutilon theophrasti</i>        | Malvaceae         | Velvet plant          | Arif et al. (2009)           |
|                           | <i>Acacia leucophloea</i>          | Fabaceae          | White barked acacia   | Arif et al. (2009)           |
|                           | <i>Acacia modesta</i>              | Fabaceae          | Phulai                | Arif et al. (2009)           |
|                           | <i>Acalypha wilkesiana</i>         | Euphorbiaceae     | Copperleaf            | Arif et al. (2009)           |
|                           | <i>Achillea</i>                    | Asteraceae        | Yarrow                | Ben-Dov (1994)               |
|                           | <i>Achyranthes aspera</i>          | Amaranthaceae     | Chaff-flower          | Arif et al. (2009)           |
|                           | <i>Acrachne racemosa</i>           | Poaceae           |                       | García Morales et al. (2016) |
|                           | <i>Adenium obesum</i>              | Apocynaceae       | Desert rose           | Spodek et al. (2018)         |
|                           | <i>Aerva javanica</i>              | Amaranthaceae     | Kapok bush            | Arif et al. (2009)           |
|                           | <i>Ageratina adenophora</i>        | Asteraceae        | Crofton weed          | García Morales et al. (2016) |
|                           | <i>Ageratum conyzoides</i>         | Asteraceae        | Billygoat-weed        | Arif et al. (2009)           |
|                           | <i>Albizia lebbek</i>              | Fabaceae          | Lebbek                | Arif et al. (2009)           |
|                           | <i>Alcea rosea</i>                 | Malvaceae         | Hollyhock             | García Morales et al. (2016) |
|                           | <i>Allamanda blanchetii</i>        | Apocynaceae       | Purple allamanda      | Spodek et al. (2018)         |
|                           | <i>Alternanthera ficoidea</i>      | Amaranthaceae     | Joseph's coat         | García Morales et al. (2016) |
|                           | <i>Althaea</i>                     | Malvaceae         |                       | García Morales et al. (2016) |
|                           | <i>Alyogyne huegelii</i>           | Malvaceae         | Lilac hibiscus        | Spodek et al. (2018)         |
|                           | <i>Amaranthus hybridus</i>         | Amaranthaceae     | Green amaranth        | García Morales et al. (2016) |
|                           | <i>Amaranthus retroflexus</i>      | Amaranthaceae     | Red-root amaranth     | Spodek et al. (2018)         |
|                           | <i>Amaranthus spinosus</i>         | Amaranthaceae     | Spiny amaranth        | García Morales et al. (2016) |
|                           | <i>Amaranthus viridis</i>          | Amaranthaceae     | Slender amaranth      | García Morales et al. (2016) |
|                           | <i>Ambrosia artemisiifolia</i>     | Asteraceae        | Common ragweed        | Ben-Dov (1994)               |
|                           | <i>Ambrosia tenuifolia</i>         | Asteraceae        | Lacy ragweed          | García Morales et al. (2016) |
| <i>Anagallis arvensis</i> | Primulaceae                        | Scarlet pimpernel | Arif et al. (2009)    |                              |

| Host status | Host name                       | Plant family   | Common name                | Reference <sup>A</sup>       |
|-------------|---------------------------------|----------------|----------------------------|------------------------------|
|             | <i>Antirrhinum</i>              | Plantaginaceae |                            | Spodek et al. (2018)         |
|             | <i>Aphelandra squarrosa</i>     | Acanthaceae    | Zebra plant                | Arif et al. (2009)           |
|             | <i>Artemisia frigida</i>        | Asteraceae     | Arctic sage                | Newton et al. (2011)         |
|             | <i>Asparagus aethiopicus</i>    | Asparagaceae   | Sprenger's asparagus       | Arif et al. (2009)           |
|             | <i>Asparagus setaceus</i>       | Asparagaceae   | Lace fern                  | Arif et al. (2009)           |
|             | <i>Asteriscus graveolens</i>    | Asteraceae     | Canary Island daisy        | Spodek et al. (2018)         |
|             | <i>Atriplex canescens</i>       | Amaranthaceae  | Chamiso                    | Tinsley (1898b)              |
|             | <i>Bassia indica</i>            | Amaranthaceae  | Indian bassia              | Arif et al. (2009)           |
|             | <i>Bauhinia purpurea</i>        | Fabaceae       | Hawaiian orchid tree       | Arif et al. (2009)           |
|             | <i>Boerhavia repens</i>         | Nyctaginaceae  | Anena                      | Arif et al. (2009)           |
|             | <i>Boerhavia spicata</i>        | Nyctaginaceae  | Creeping spiderling        | Tinsley (1898b)              |
|             | <i>Bombax ceiba</i>             | Malvaceae      | Cotton tree                | Arif et al. (2009)           |
|             | <i>Bougainvillea glabra</i>     | Nyctaginaceae  | Lesser bougainvillea       | Arif et al. (2009)           |
|             | <i>Brachychiton rupestris</i>   | Malvaceae      | Narrow-leaved bottle tree  | Spodek et al. (2018)         |
|             | <i>Broussonetia papyrifera</i>  | Moraceae       | Paper mulberry             | Arif et al. (2009)           |
|             | <i>Calendula officinalis</i>    | Asteraceae     | Common marigold            | Arif et al. (2009)           |
|             | <i>Calotropis gigantea</i>      | Apocynaceae    | Crown flower               | García Morales et al. (2016) |
|             | <i>Calotropis procera</i>       | Apocynaceae    | Apple of Sodom             | Arif et al. (2009)           |
|             | <i>Capparis decidua</i>         | Capparaceae    | Karira                     | Arif et al. (2009)           |
|             | <i>Cassia fistula</i>           | Fabaceae       | Golden shower              | Arif et al. (2009)           |
|             | <i>Celosia argentea</i>         | Amaranthaceae  | Plumed cockscomb           | Arif et al. (2009)           |
|             | <i>Centaurea cyanus</i>         | Asteraceae     | Cornflower                 | Arif et al. (2009)           |
|             | <i>Centaurea segetum</i>        | Asteraceae     | Cornflower                 | García Morales et al. (2016) |
|             | <i>Cestrum diurnum</i>          | Solanaceae     | Day-blooming jessamine     | Arif et al. (2009)           |
|             | <i>Cestrum nocturnum</i>        | Solanaceae     | Night-blooming jessamine   | Arif et al. (2009)           |
|             | <i>Cevallia sinuata</i>         | Loasaceae      | Stinging serpent           | García Morales et al. (2016) |
|             | <i>Chenopodium murale</i>       | Amaranthaceae  | Nettle-leaved goosefoot    | Arif et al. (2009)           |
|             | <i>Chenopodium album</i>        | Amaranthaceae  | White goosefoot or fat hen | Arif et al. (2009)           |
|             | <i>Chenopodium leptophyllum</i> | Amaranthaceae  | Narrowleaf goosefoot       | García Morales et al. (2016) |
|             | <i>Chromolaena odorata</i>      | Asteraceae     | Siam weed                  | García Morales et al. (2016) |
|             | <i>Chrozophora tinctoria</i>    | Euphorbiaceae  | Dyer's croton              | Spodek et al. (2018)         |
|             | <i>Cirsium arvense</i>          | Asteraceae     | Creeping thistle           | Arif et al. (2009)           |
|             | <i>Cirsium lecontei</i>         | Asteraceae     | Le Conte's thistle         | Arif et al. (2009)           |
|             | <i>Cleome viscosa</i>           | Cleomaceae     | Asian spiderflower         | Arif et al. (2009)           |
|             | <i>Clerodendrum</i>             | Lamiaceae      |                            | Spodek et al. (2018)         |
|             | <i>Codiaeum variegatum</i>      | Euphorbiaceae  | Garden croton              | García Morales et al. (2016) |
|             | <i>Coleus scutellarioides</i>   | Lamiaceae      | Coleus                     | Arif et al. (2009)           |
|             | <i>Combretum indicum</i>        | Combretaceae   | Rangoon creeper            | Arif et al. (2009)           |
|             | <i>Convolvulus arvensis</i>     | Convolvulaceae | Field bindweed             | Arif et al. (2009)           |

| Host status | Host name                       | Plant family   | Common name            | Reference <sup>A</sup>                            |
|-------------|---------------------------------|----------------|------------------------|---|
|             | <i>Convolvulus prostratus</i>   | Convolvulaceae |                        | Arif et al. (2009)                                |
|             | <i>Corchorus depressus</i>      | Malvaceae      |                        | Arif et al. (2009)                                |
|             | <i>Corchorus neocaledonicus</i> | Malvaceae      |                        | García Morales et al. (2016)                      |
|             | <i>Corchorus trilocularis</i>   | Malvaceae      |                        | Arif et al. (2009)                                |
|             | <i>Cressa cretica</i>           | Convolvulaceae |                        | Arif et al. (2009)                                |
|             | <i>Croton bonplandianus</i>     | Euphorbiaceae  |                        | Arif et al. (2009)                                |
|             | <i>Cucumis tetragona</i>        | Cucurbitaceae  |                        | Arif et al. (2009)                                |
|             | <i>Cupania americana</i>        | Sapindaceae    |                        | García Morales et al. (2016)                      |
|             | <i>Cuscuta reflexa</i>          | Convolvulaceae | Giant dodder           | Arif et al. (2009)                                |
|             | <i>Cycas revoluta</i>           | Cycadaceae     | Sago palm              | García Morales et al. (2016)                      |
|             | <i>Cynodon dactylon</i>         | Poaceae        | Bermuda grass          | Arif et al. (2009)                                |
|             | <i>Cyperus rotundus</i>         | Cyperaceae     | Purple nutsedge        | Arif et al. (2009)                                |
|             | <i>Dalbergia sissoo</i>         | Fabaceae       | North Indian rosewood  | Arif et al. (2009)                                |
|             | <i>Datura metel</i>             | Solanaceae     | Indian thornapple      | Arif et al. (2009)                                |
|             | <i>Datura stramonium</i>        | Solanaceae     | Thorn apple            | García Morales et al. (2016)                      |
|             | <i>Daucus carota</i>            | Apiaceae       | Wild carrot            | Arif et al. (2009)                                |
|             | <i>Desmodium incanum</i>        | Fabaceae       | Creeping beggarweed    | García Morales et al. (2016) <i>Daucus carota</i> |
|             | <i>Digera muricata</i>          | Amaranthaceae  | False amaranth         | García Morales et al. (2016)                      |
|             | <i>Digera</i> sp.               | Amaranthaceae  |                        | Arif et al. (2009)                                |
|             | <i>Dimorphotheca ecklonis</i>   | Asteraceae     | Cape marguerite        | Spodek et al. (2018)                              |
|             | <i>Dodonaea viscosa</i>         | Sapindaceae    | Akeake hop bush        | Fallahzadeh et al. (2014)                         |
|             | <i>Duranta erecta</i>           | Verbenaceae    | Golden dewdrop         | Arif et al. (2009)                                |
|             | <i>Ecballium elaterium</i>      | Cucurbitaceae  | Exploding cucumber     | Spodek et al. (2018)                              |
|             | <i>Echinochloa colona</i>       | Poaceae        | Jungle rice            | Arif et al. (2009)                                |
|             | <i>Eclipta prostrata</i>        | Asteraceae     | False daisy            | García Morales et al. (2016)                      |
|             | <i>Elettaria cardamomum</i>     | Zingiberaceae  | True <i>cardamom</i>   | Arif et al. (2009)                                |
|             | <i>Eleusine indica</i>          | Poaceae        | Indian goosegrass      | Arif et al. (2009)                                |
|             | <i>Encelia farinosa</i>         | Asteraceae     | Brittlebush            | Ben-Dov (1994)                                    |
|             | <i>Enceliopsis</i>              | Asteraceae     |                        | Ben-Dov (1994)                                    |
|             | <i>Eragrostis minor</i>         | Poaceae        | Little lovegrass       | Arif et al. (2009)                                |
|             | <i>Erigeron bonariensis</i>     | Asteraceae     | Flax-leaf fleabane     | Arif et al. (2009)                                |
|             | <i>Erigeron canadensis</i>      | Asteraceae     | Horseweed              | Spodek et al. (2016)                              |
|             | <i>Eriophyllum</i>              | Asteraceae     | Woolly sunflower       | Ben-Dov (1994)                                    |
|             | <i>Eucalyptus camaldulensis</i> | Myrtaceae      | River red gum          | Arif et al. (2009)                                |
|             | <i>Eupatorium perfoliatum</i>   | Asteraceae     | Common boneset         | García Morales et al. (2016)                      |
|             | <i>Euphorbia</i>                | Euphorbiaceae  |                        | García Morales et al. (2016)                      |
|             | <i>Euphorbia chamaesyce</i>     | Euphorbiaceae  | Prostrate spurge       | Spodek et al. (2018)                              |
|             | <i>Euphorbia cotinifolia</i>    | Euphorbiaceae  | Caribbean copper plant | Arif et al. (2009)                                |
|             | <i>Euphorbia hirta</i>          | Euphorbiaceae  | Asthma-plant           | Arif et al. (2009)                                |
|             | <i>Euphorbia maculata</i>       | Euphorbiaceae  | Spotted spurge         | Spodek et al. (2018)                              |



| Host status | Host name                         | Plant family   | Common name          | Reference <sup>A</sup>       |
|-------------|-----------------------------------|----------------|----------------------|------------------------------|
|             | <i>Euphorbia serpens</i>          | Euphorbiaceae  | Matted sandmat       | Spodek et al. (2018)         |
|             | <i>Euphorbia prostrata</i>        | Euphorbiaceae  | Prostrate spurge     | Arif et al. (2009)           |
|             | <i>Euphorbia trigona</i>          | Euphorbiaceae  | African milk bush    | García Morales et al. (2016) |
|             | <i>Euploca strigosa</i>           | Boraginaceae   | Bristly heliotrope   | Arif et al. (2009)           |
|             | <i>Fagonia cretica</i>            | Zygophyllaceae | Virgin's Mantle      | Arif et al. (2009)           |
|             | <i>Ficus benghalensis</i>         | Moraceae       | Bengal fig           | Arif et al. (2009)           |
|             | <i>Ficus lacor</i>                | Moraceae       | Java fig             | Arif et al. (2009)           |
|             | <i>Ficus religiosa</i>            | Moraceae       | Sacred fig           | Fallahzadeh et al. (2014)    |
|             | <i>Ficus virens</i>               | Moraceae       | Banyan               | Arif et al. (2009)           |
|             | <i>Grewia asiatica</i>            | Malvaceae      | Phalsa               | Arif et al. (2009)           |
|             | <i>Hamelia patens</i>             | Rubiaceae      | Firebush             | Arif et al. (2009)           |
|             | <i>Heliotropium europaeum</i>     | Boraginaceae   | European heliotrope  | Arif et al. (2009)           |
|             | <i>Heliotropium strigosum</i>     | Boraginaceae   |                      | Arif et al. (2009)           |
|             | <i>Heliotropium suaveolens</i>    | Boraginaceae   | Fragrant heliotrope  | Spodek et al. (2018)         |
|             | <i>Hibiscus mutabilis</i>         | Malvaceae      | Confederate rose     | Arif et al. (2009)           |
|             | <i>Hibiscus schizopetalus</i>     | Malvaceae      | Japanese hibiscus    | García Morales et al. (2016) |
|             | <i>Hibiscus syriacus</i>          | Malvaceae      | Rose mallow          | García Morales et al. (2016) |
|             | <i>Hibiscus tiliaceus</i>         | Malvaceae      | Sea hibiscus         | Spodek et al. (2018)         |
|             | <i>Ipomoea cairica</i>            | Convolvulaceae | Mile-a-minute vine   | Arif et al. (2009)           |
|             | <i>Ipomoea tricolor</i>           | Convolvulaceae | Morning glory        | Fallahzadeh et al. (2014)    |
|             | <i>Iresine herbstii</i>           | Amaranthaceae  | Bloodleaf            | García Morales et al. (2016) |
|             | <i>Jacquemontia pentantha</i>     | Convolvulaceae | Skyblue cluster vine | Arif et al. (2009)           |
|             | <i>Jasminum cuspidatum</i>        | Oleaceae       | Pointed-leaf jasmine | Arif et al. (2009)           |
|             | <i>Jasminum sambac</i>            | Oleaceae       | Arabian jasmine      | Arif et al. (2009)           |
|             | <i>Jatropha integerrima</i>       | Euphorbiaceae  | Spicy jatropha       | García Morales et al. (2016) |
|             | <i>Kallstroemia californica</i>   | Zygophyllaceae | California caltrop   | Arif et al. (2009)           |
|             | <i>Kochia indica</i>              | Chenopodiaceae |                      | García Morales et al. (2016) |
|             | <i>Lantana montevidensis</i>      | Verbenaceae    | Trailing lantana     | Spodek et al. (2018)         |
|             | <i>Launaea nudicaulis</i>         | Asteraceae     | Bhatal               | García Morales et al. (2016) |
|             | <i>Lawsonia inermis</i>           | Lythraceae     | Henna tree           | Arif et al. (2009)           |
|             | <i>Leichhardtia nigriflora</i>    | Apocynaceae    |                      | García Morales et al. (2016) |
|             | <i>Lepidium didymum</i>           | Brassicaceae   | Lesser swine-cress   | Arif et al. (2009)           |
|             | <i>Lupinus</i>                    | Fabaceae       |                      | García Morales et al. (2016) |
|             | <i>Maireana sedifolia</i>         | Amaranthaceae  | Bluebush             | Spodek et al. (2018)         |
|             | <i>Malva parviflora</i>           | Malvaceae      | Cheeseweed mallow    | Arif et al. (2009)           |
|             | <i>Malvastrum coromandelianum</i> | Malvaceae      | False mallow         | EPPO                         |
|             | <i>Malvastrum arboreus</i>        | Malvaceae      | Wax mallow           | Arif et al. (2009)           |

| Host status | Host name   | Plant family   | Common name          | Reference <sup>A</sup>       |
|-------------|---|----------------|----------------------|------------------------------|
|             | <i>Malvella sherardiana</i>                                   | Malvaceae      |                      | Spodek et al. (2018)         |
|             | <i>Medicago orthoceras</i>                                    | Fabaceae       |                      | Arif et al. (2009)           |
|             | <i>Medicago polymorpha</i>                                    | Fabaceae       | California burclover | Arif et al. (2009)           |
|             | <i>Melaleuca leucadendra</i>                                  | Myrtaceae      | Weeping paperbark    | Arif et al. (2009)           |
|             | <i>Melia azedarach</i>  | Meliaceae      | Chinaberry tree      | Arif et al. (2009)           |
|             | <i>Melilotus indicus</i>                                      | Fabaceae       | Sweet clover         | Arif et al. (2009)           |
|             | <i>Mentha longifolia</i>                                      | Lamiaceae      | Horse mint           | Arif et al. (2009)           |
|             | <i>Mentha piperita</i>  | Lamiaceae      | Peppermint           | Arif et al. (2009)           |
|             | <i>Monoon longifolia</i>                                      | Annonaceae     | False ashoka         | García Morales et al. (2016) |
|             | <i>Nerium</i> sp.   | Apocynaceae    | Oleander             | Spodek et al. (2018)         |
|             | <i>Nicotiana plumbaginifolia</i>                              | Solanaceae     | Tex-Mex tobacco      | Arif et al. (2009)           |
|             | <i>Orobanche</i>  | Orobanchaceae  |                      | García Morales et al. (2016) |
|             | <i>Oxalis corniculata</i>                                     | Oxalidaceae    | Creeping woodsorrel  | Arif et al. (2009)           |
|             | <i>Parthenium hysterophorus</i>                               | Asteraceae     | Santa-Maria          | Arif et al. (2009)           |
|             | <i>Persicaria barbata</i>                                     | Polygonaceae   | Joint weed           | Arif et al. (2009)           |
|             | <i>Persicaria glabra</i>                                      | Polygonaceae   | Denseflower knotweed | Arif et al. (2009)           |
|             | <i>Petunia integrifolia</i>                                   | Solanaceae     | Violet petunia       | Fallahzadeh et al. (2014)    |
|             | <i>Phyllanthus niruri</i>                                     | Phyllanthaceae | Gale of the wind     | Arif et al. (2009)           |
|             | <i>Physalis alkekengi</i>                                     | Solanaceae     | Bladder cherry       | Arif et al. (2009)           |
|             | <i>Physalis minima</i>  | Solanaceae     | Wild cape gooseberry | García Morales et al. (2016) |
|             | <i>Pilea serpyllacea</i>                                      | Urticaceae     | Artillery stoplight  | García Morales et al. (2016) |
|             | <i>Platyschuhria integrifolia</i>                             | Asteraceae     | Basindaisy           | Arif et al. (2009)           |
|             | <i>Coleus</i> (= <i>Plectranthus</i> ) <i>scutellarioides</i> | Lamiaceae      | Coleus               | Arif et al. (2009)           |
|             | <i>Polyalthia longifolia</i>                                  | Annonaceae     | False ashoka         | Arif et al. (2009)           |
|             | <i>Portulaca</i>  | Portulacaceae  |                      | García Morales et al. (2016) |
|             | <i>Portulaca grandiflora</i>                                  | Portulacaceae  | Rose moss            | Arif et al. (2009)           |
|             | <i>Prosopis farcta</i>  | Fabaceae       | Syrian mesquite      | Spodek et al. (2018)         |
|             | <i>Prosopis juliflora</i>                                     | Fabaceae       | Long-thorn kiawe     | García Morales et al. (2016) |
|             | <i>Pyrus</i>  | Rosaceae       |                      | García Morales et al. (2016) |
|             | <i>Ricinus communis</i>                                       | Euphorbiaceae  | Castor bean          | Arif et al. (2009)           |
|             | <i>Rosa arkansana</i>   | Rosaceae       | Prairie rose         | Newton et al. (2011)         |
|             | <i>Rosa cymosa</i>  | Rosaceae       |                      | Arif et al. ((2009)          |
|             | <i>Ruellia elegans</i>  | Acanthaceae    | Red ruellia          | Spodek et al. (2018)         |
|             | <i>Ruellia squarrosa</i>                                      | Acanthaceae    | Water bluebell       | Arif et al. (2009)           |
|             | <i>Ruellia tuberosa</i>                                       | Acanthaceae    | Fever root           | García Morales et al. (2016) |
|             | <i>Rumex dentatus</i>   | Polygonaceae   | Toothed dock         | Arif et al. (2009)           |
|             | <i>Salsola imbricata</i>                                      | Amaranthaceae  |                      | Arif et al. (2009)           |
|             | <i>Salvadora oleoides</i>                                     | Salvadoraceae  |                      | Arif et al. (2009)           |
|             | <i>Salvia</i> sp.   | Lamiaceae      |                      | Fallahzadeh et al. (2014)    |
|             | <i>Scalesia atractyloides</i>                                 | Asteraceae     |                      | García Morales et al. (2016) |

| Host status | Host name                         | Plant family   | Common name               | Reference <sup>A</sup>       |
|-------------|-----------------------------------|----------------|---------------------------|------------------------------|
|             | <i>Sesbania sesban</i>            | Fabaceae       | Egyptian riverhemp        | Arif et al. (2009)           |
|             | <i>Sida acuta</i>                 | Malvaceae      | Common wireweed           | García Morales et al. (2016) |
|             | <i>Sida urens</i>                 | Malvaceae      |                           | García Morales et al. (2016) |
|             | <i>Solanum aethiopicum</i>        | Solanaceae     | Bitter tomato             | Arif et al. (2009)           |
|             | <i>Solanum americanum</i>         | Solanaceae     | American black nightshade | García Morales et al. (2016) |
|             | <i>Solanum mauritianum</i>        | Solanaceae     | Earleaf nightshade        | García Morales et al. (2016) |
|             | <i>Solanum muricatum</i>          | Solanaceae     | Pepino dulce              | García Morales et al. (2016) |
|             | <i>Solanum nigrum</i>             | Solanaceae     | Black nightshade          | Arif et al. (2009)           |
|             | <i>Solanum ptychanthum</i>        | Solanaceae     | West Indian nightshade    | García Morales et al. (2016) |
|             | <i>Solanum villosum</i>           | Solanaceae     | Hairy nightshade          | Spodek et al. (2018)         |
|             | <i>Solanum virginianum</i>        | Solanaceae     | Yellow-fruit nightshade   | Arif et al. (2009)           |
|             | <i>Sonchus oleraceus</i>          | Asteraceae     | Common sowthistle         | Arif et al. (2009)           |
|             | <i>Sorghum halepense</i>          | Poaceae        | Johnson grass             | Spodek et al. (2018)         |
|             | <i>Suaeda fruticosa</i>           | Amaranthaceae  |                           | Arif et al. (2009)           |
|             | <i>Tabernaemontana divaricata</i> | Apocynaceae    | Crape jasmine             | Arif et al. (2009)           |
|             | <i>Tagetes erecta</i>             | Asteraceae     | Mexican marigold          | García Morales et al. (2016) |
|             | <i>Tagetes patula</i>             | Asteraceae     | French marigold           | García Morales et al. (2016) |
|             | <i>Taraxacum campylodes</i>       | Asteraceae     | Common dandelion          | Arif et al. (2009)           |
|             | <i>Tecoma alata</i>               | Bignoniaceae   | Orange bells              | Spodek et al. (2018)         |
|             | <i>Tecoma stans</i>               | Bignoniaceae   | Yellow trumpetbush        | Arif et al. (2009)           |
|             | <i>Tetragonia tetragonioides</i>  | Aizoaceae      | New Zealand spinach       | Spodek et al. (2018)         |
|             | <i>Tinospora cordifolia</i>       | Menispermaceae | Heart-leaved moonseed     | Arif et al. (2009)           |
|             | <i>Tradescantia pallida</i>       | Commelinaceae  | Purple heart              | Arif et al. (2009)           |
|             | <i>Trianthema portulacastrum</i>  | Aizoaceae      | Desert horse purslane     | Arif et al. (2009)           |
|             | <i>Trianthema triquetra</i>       | Aizoaceae      | Red spinach               | Arif et al. (2009)           |
|             | <i>Tribulus terrestris</i>        | Zygophyllaceae | Goat's-head               | García Morales et al. (2016) |
|             | <i>Trichilia havanensis</i>       | Meliaceae      | Bastard lime              | García Morales et al. (2016) |
|             | <i>Medicago polyceratia</i>       | Fabaceae       |                           | Arif et al. (2009)           |
|             | <i>Tripolium pannonicum</i>       | Asteraceae     | Sea aster                 | García Morales et al. (2016) |
|             | <i>Vachellia nilotica</i>         | Fabaceae       | Gum arabic tree           | Fallahzadeh et al. (2014)    |
|             | <i>Vitex agnus-castus</i>         | Lamiaceae      | Chaste tree               | Spodek et al. (2018)         |
|             | <i>Volkameria inermis</i>         | Lamiaceae      | Glory bower               | García Morales et al. (2016) |
|             | <i>Withania somnifera</i>         | Solanaceae     | Indian ginseng            | Arif et al. (2009)           |
|             | <i>Xanthium strumarium</i>        | Asteraceae     | Rough cocklebur           | Arif et al. (2009)           |
|             | <i>Zamia furfuracea</i>           | Zamiaceae      | Cardboard palm            | Spodek et al. (2018)         |
|             | <i>Zinnia violacea</i>            | Asteraceae     | Youth-and-age             | Fallahzadeh et al. (2014)    |

## Appendix B – Distribution of *Phenacoccus solenopsis*

Distribution records based on EPPO Global Database (EPPO, online) García Morales et al. (2016) and other references.

| Region                        | Country             | Sub-national (e.g. State) | Status              |
|-------------------------------|---------------------|---------------------------|---------------------|
| North America                 | Canada              | Alberta                   | Present, no details |
|                               |                     | Veracruz                  | Present, no details |
|                               | USA                 | Arizona                   | Present, no details |
|                               |                     | California                | Present, no details |
|                               |                     | District of Columbia      | Present, no details |
|                               |                     | Idaho                     | Present, no details |
|                               |                     | Illinois                  | Present, no details |
|                               |                     | Maryland                  | Present, no details |
|                               |                     | Michigan                  | Present, no details |
|                               |                     | Mississippi               | Present, no details |
|                               |                     | Nevada                    | Present, no details |
|                               |                     | New Jersey                | Present, no details |
|                               |                     | New Mexico                | Present, no details |
|                               |                     | New York                  | Present, no details |
| Ohio                          | Present, no details |                           |                     |
| Texas                         | Present, no details |                           |                     |
| Virginia                      | Present, no details |                           |                     |
| Central America               | Belize              |                           | Present, no details |
|                               | Guatemala           |                           | Present, no details |
|                               | Panama              |                           | Present, no details |
| Caribbean                     | Cayman Islands      |                           | Present, no details |
|                               |                     |                           | Present, no details |
|                               | Cuba                |                           | Present, no details |
|                               | Dominican Republic  |                           | Present, no details |
|                               | Guadeloupe          |                           | Present, no details |
|                               | Haiti               |                           | Present, no details |
|                               | Jamaica             |                           | Present, no details |
|                               | Martinique          |                           | Present, no details |
| Saint Martin & St. Barthelemy |                     | Present, no details       |                     |
| South America                 | Argentina           | Cordoba                   | Present, no details |
|                               |                     | Corrientes                | Present, no details |
|                               |                     | Entre Rios                | Present, no details |
|                               | Brazil              | Acre                      | Present, no details |
|                               |                     | Bahia                     | Present, no details |
|                               |                     | Ceara                     | Present, no details |
|                               |                     | Espirito Santo            | Present, no details |
|                               |                     | Paraiba                   | Present, no details |
|                               |                     | Pernambuco                | Present, no details |
|                               | Chile               |                           | Present, no details |
|                               | Colombia            |                           | Present, no details |
| Ecuador                       |                     | Present, no details       |                     |
| EU (27)                       | Cyprus              |                           | Present, no details |
|                               | Greece              |                           | Present, restricted |
|                               | Italy               |                           | Present, restricted |
| Africa                        | Algeria             |                           | Present, no details |
|                               | Benin               |                           | Present, no details |
|                               | Cameroon            |                           | Present, no details |

| Region               | Country                | Sub-national (e.g. State)        | Status              |
|----------------------|------------------------|----------------------------------|---------------------|
|                      | Canary Islands (Spain) |                                  | Present, no details |
|                      | Egypt                  |                                  | Present, no details |
|                      | Ethiopia               |                                  | Present, no details |
|                      | Mali                   |                                  | Present, no details |
|                      | Mauritius              |                                  | Present, no details |
|                      | Nigeria                |                                  | Present, no details |
|                      | Reunion                |                                  | Present, no details |
|                      | Senegal                |                                  | Present, no details |
|                      | Swaziland              |                                  | Present, no details |
| Asia                 | China                  | Anhui                            | Present, no details |
|                      |                        | Fujian                           | Present, no details |
|                      |                        | Guangdong                        | Present, no details |
|                      |                        | Guangxi                          | Present, no details |
|                      |                        | Hainan                           | Present, no details |
|                      |                        | Hubei                            | Present, no details |
|                      |                        | Hunan                            | Present, no details |
|                      |                        | Jiangsu                          | Present, no details |
|                      |                        | Jiangxi                          | Present, no details |
|                      |                        | Shanghai                         | Present, no details |
|                      |                        | Sichuan                          | Present, no details |
|                      |                        | Xinjiang Uygur                   | Present, no details |
|                      |                        | Yunnan                           | Present, no details |
|                      | India                  | Andhra Pradesh                   | Present, no details |
|                      |                        | Gujarat                          | Present, no details |
|                      |                        | Haryana                          | Present, no details |
|                      |                        | Karnataka                        | Present, no details |
|                      |                        | Kerala                           | Present, no details |
|                      |                        | Madhya Pradesh                   | Present, no details |
|                      |                        | Maharashtra                      | Present, no details |
|                      |                        | Punjab                           | Present, no details |
|                      |                        | Rajasthan                        | Present, no details |
|                      |                        | Tamil Nadu                       | Present, no details |
|                      |                        | West Bengal                      | Present, no details |
|                      | Bali                   | Present, no details              |                     |
|                      | Irian Jaya             | Present, no details              |                     |
|                      | Iran                   |                                  | Present, no details |
|                      | Iraq                   |                                  | Present, no details |
|                      | Israel                 |                                  | Present, widespread |
|                      | Japan                  | Kyushu                           | Present, no details |
|                      | Malaysia               |                                  | Present, no details |
|                      | Pakistan               |                                  | Present, no details |
| Saudi Arabia         |                        | Present, restricted distribution |                     |
| Sri Lanka            |                        | Present, no details              |                     |
| Taiwan               |                        | Present, widespread              |                     |
| Thailand             |                        | Present, no details              |                     |
| Turkey               |                        | Present, no details              |                     |
| United Arab Emirates |                        | Present, no details              |                     |
| Vietnam              |                        | Present, no details              |                     |

| <b>Region</b> | <b>Country</b>            | <b>Sub-national (e.g. State)</b> | <b>Status</b>       |
|---------------|---------------------------|----------------------------------|---------------------|
| Oceania       | Australia                 | Queensland                       | Present, no details |
|               | New Caledonia             |                                  | Present, widespread |
|               | Palau                     |                                  | Present, no details |
|               | Papua New Guinea          |                                  | Present, no details |
|               | Samoa                     |                                  | Present, no details |
|               | Wallis and Futuna Islands |                                  | Present, no details |



## Appendix C – EU 27 imports of tomatoes

|                        |                    | 2016              | 2017                | 2018                | 2019                | 2020                |
|------------------------|--------------------|-------------------|---------------------|---------------------|---------------------|---------------------|
| <b>Asia</b>            | Turkey             | 711,723.54        | 1,006,308.14        | 1,076,029.29        | 1,006,003.21        | 1,255,949.46        |
|                        | Israel             | 16,739.21         | 10,861.22           | 6,392.59            | 782.65              | 138.00              |
|                        | Iran               | –                 | 363.79              | –                   | –                   | 11.13               |
|                        | Japan              | 13.75             | 8.98                | 13.31               | 45.67               | 34.37               |
|                        | UAE                | –                 | 0.00                | –                   | 3.77                | –                   |
|                        | Thailand           | 0.08              | 0.08                | 0.08                | 0.02                | 0.02                |
|                        | Vietnam            | 0.03              | 0.06                | –                   | –                   | –                   |
|                        | India              | –                 | 0.00                | –                   | 0.01                | –                   |
|                        | China              | –                 | 0.00                | –                   | –                   | –                   |
|                        | Malaysia           | –                 | 0.00                | –                   | –                   | –                   |
|                        | Pakistan           | –                 | 0.00                | –                   | –                   | –                   |
|                        | Saudi Arabia       | –                 | 0.00                | –                   | –                   | –                   |
|                        | Sri Lanka          | –                 | 0.00                | –                   | –                   | –                   |
|                        | Taiwan             | –                 | 0.00                | –                   | –                   | –                   |
|                        | <b>Sum</b>         | <b>728,476.61</b> | <b>1,017,542.27</b> | <b>1,082,435.27</b> | <b>1,006,835.33</b> | <b>1,256,132.98</b> |
| <b>Africa</b>          | Senegal            | 91,850.25         | 62,281.26           | 85,804.22           | 77,820.16           | 74,513.76           |
|                        | Egypt              | 9,135.43          | 14,023.94           | 15,102.55           | 18,876.68           | 9,491.42            |
|                        | Algeria            | 30.45             | 27.56               | 161.85              | 461.62              | –                   |
|                        | Cameroon           | –                 | 0.75                | –                   | –                   | –                   |
|                        | Ethiopia           | –                 | 0.00                | 0.26                | –                   | –                   |
|                        | Mauritius          | –                 | 0.00                | –                   | –                   | –                   |
|                        | Nigeria            | –                 | 0.00                | –                   | –                   | –                   |
|                        |                    | <b>Sum</b>        | <b>101,016.13</b>   | <b>76,333.51</b>    | <b>101,068.88</b>   | <b>97,158.46</b>    |
| <b>South America</b>   | Colombia           | –                 | 0.00                | –                   | 2,828.76            | 236.09              |
|                        | Brazil             | –                 | 27.60               | –                   | –                   | –                   |
|                        | Chile              | 2.03              | 0.00                | –                   | –                   | –                   |
|                        | Argentina          | –                 | 0.00                | –                   | –                   | –                   |
|                        | Ecuador            | –                 | 0.00                | –                   | –                   | –                   |
|                        |                    | <b>Sum</b>        | <b>2.03</b>         | <b>27.60</b>        | <b>–</b>            | <b>2,828.76</b>     |
| <b>Oceania</b>         | Australia          | –                 | 0.00                | –                   | 2.52                | –                   |
|                        | <b>Sum</b>         | <b>–</b>          | <b>0.00</b>         | <b>–</b>            | <b>2.52</b>         | <b>–</b>            |
| <b>North America</b>   | Mexico             | –                 | 0                   | –                   | –                   | 0.8                 |
|                        | USA                | –                 | 0                   | 0.11                | 0.04                | 0.13                |
|                        | Canada             | –                 | 0                   | –                   | –                   | –                   |
|                        | <b>Sum</b>         | <b>–</b>          | <b>0</b>            | <b>0.11</b>         | <b>0.04</b>         | <b>0.93</b>         |
| <b>Central America</b> | Dominican Republic | 19,550.87         | 21,840.02           | 19,688.19           | 15,920.89           | 17,237.85           |
|                        | Belize             | –                 | 0.00                | –                   | –                   | –                   |
|                        | Cuba               | –                 | 0.00                | –                   | –                   | –                   |
|                        | Guatemala          | –                 | 0.00                | –                   | –                   | –                   |
|                        | Panama             | –                 | 0.00                | –                   | –                   | –                   |
|                        | <b>Sum</b>         | <b>19,550.87</b>  | <b>21,840.02</b>    | <b>19,688.19</b>    | <b>15,920.89</b>    | <b>17,237.85</b>    |

## Appendix D – Crop production in EU 27

Crop production in EU 27 by each member state, between 2016 and 2020 (Eurostat data of area cultivation/harvested/production (1,000 ha), accessed on 15/5/2021)

### Tomatoes (V3100)

| Member state/Year                         | 2016   | 2017   | 2018   | 2019   | 2020   |
|---|--------|--------|--------|--------|--------|
| Austria                                   | 0.18   | 0.18   | 0.20   | 0.20   | 0.20   |
| Belgium                                   | 0.51   | 0.52   | 0.55   | 0.57   | 0.60   |
| Bulgaria                                  | 4.20   | 5.01   | 4.52   | 5.15   | 3.09   |
| Croatia                                   | 0.37   | 0.45   | 0.49   | 0.32   | 0.40   |
| Cyprus                                    | 0.22   | 0.26   | 0.29   | 0.28   | 0.26   |
| Czechia                                   | 0.34   | 0.24   | 0.30   | 0.16   | 0.26   |
| Denmark                                   | 0.03   | 0.03   | 0.03   | 0.03   | 0.03   |
| Estonia                                   | 0.01   | 0.00   | 0.00   | 0.00   | 0.01   |
| Finland                                   | 0.11   | 0.11   | 0.10   | 0.09   | 0.10   |
| France                                    | 5.65   | 5.75   | 5.74   | 5.66   | 5.82   |
| Germany                                   | 0.34   | 0.37   | 0.40   | 0.39   | 0.38   |
| Greece                                    | 14.01  | 13.32  | 16.02  | 15.01  | 14.51  |
| Hungary                                   | 2.08   | 2.19   | 2.50   | 2.41   | 1.95   |
| Ireland                                   | 0.01   | 0.01   | 0.01   | 0.01   | 0.01   |
| Italy                                     | 96.78  | 92.67  | 97.17  | 91.41  | 99.78  |
| Latvia                                    | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   |
| Lithuania                                 | 0.57   | 0.55   | 0.57   | 0.56   | 0.56   |
| Luxembourg                                | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   |
| Malta                                     | 0.00   | 0.00   | 0.00   | 0.00   | 0.00   |
| Netherlands                               | 1.78   | 1.79   | 1.79   | 1.80   | 1.87   |
| Poland                                    | 12.42  | 12.64  | 13.11  | 13.50  | 13.60  |
| Portugal                                  | 20.85  | 20.87  | 15.83  | 16.13  | 13.53  |
| Romania                                   | 22.71  | 22.21  | 22.97  | 23.78  | 23.50  |
| Slovakia                                  | 0.68   | 0.60   | 0.59   | 0.48   | 0.22   |
| Slovenia                                  | 0.21   | 0.20   | 0.19   | 0.22   | 0.26   |
| Spain                                     | 62.72  | 60.85  | 56.13  | 56.94  | 55.47  |
| Sweden                                    | 0.04   | 0.04   | 0.04   | 0.04   | 0.05   |
| European Union - 27 countries (from 2020) | 246.80 | 240.87 | 239.55 | 235.14 | 236.46 |

### Eggplants (V3210)

| Member state/Year | 2016 | 2017 | 2018 | 2019 | 2020 |
|-------------------|------|------|------|------|------|
| Austria           | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Belgium           | 0.02 | 0.02 | 0.02 | 0.02 | 0.00 |
| Bulgaria          | 0.31 | 0.48 | 0.44 | 0.39 | 0.37 |
| Croatia           | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cyprus            | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 |
| Czechia           | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Denmark           | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Estonia           | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Finland           | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| France            | 0.73 | 0.73 | 0.80 | 0.71 | 0.79 |
| Germany           | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Greece            | 1.75 | 1.70 | 1.67 | 1.35 | 1.70 |
| Hungary           | 0.05 | 0.05 | 0.05 | 0.04 | 0.04 |

| Member state/Year                         | 2016  | 2017  | 2018  | 2019  | 2020  |
|---|-------|-------|-------|-------|-------|
| Ireland                                   | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Italy                                     | 10.13 | 9.45  | 9.76  | 9.55  | 9.51  |
| Latvia                                    | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Lithuania                                 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Luxembourg                                | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Malta                                     | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Netherlands                               | 0.11  | 0.10  | 0.11  | 0.12  | 0.13  |
| Poland                                    | 0.00  | 0.00  | 0.00  | 0.00  | 0.20  |
| Portugal                                  | 0.10  | 0.14  | 0.11  | 0.11  | 0.10  |
| Romania                                   | 4.56  | 4.42  | 4.80  | 4.81  | 4.76  |
| Slovakia                                  | 0.00  | 0.01  | 0.01  | 0.00  | 0.01  |
| Slovenia                                  | 0.02  | 0.02  | 0.02  | 0.03  | 0.03  |
| Spain                                     | 3.75  | 3.58  | 3.62  | 3.47  | 3.70  |
| Sweden                                    | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| European Union - 27 countries (from 2020) | 21.58 | 20.73 | 21.44 | 20.63 | 21.36 |

### Peppers (V3600)

| Member state/Year                         | 2016  | 2017  | 2018  | 2019  | 2020  |
|---|-------|-------|-------|-------|-------|
| Austria                                   | 0.17  | 0.18  | 0.16  | 0.16  | 0.16  |
| Belgium                                   | 0.10  | 0.10  | 0.09  | 0.10  | 0.10  |
| Bulgaria                                  | 3.66  | 3.35  | 2.95  | 3.22  | 2.72  |
| Croatia                                   | 1.35  | 1.02  | 1.02  | 0.56  | 0.69  |
| Cyprus                                    | 0.04  | 0.03  | 0.04  | 0.03  | 0.04  |
| Czechia                                   | 0.00  | 0.00  | 0.42  | 0.27  | 0.29  |
| Denmark                                   | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Estonia                                   | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Finland                                   | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  |
| France                                    | 0.84  | 0.96  | 0.95  | 0.94  | 1.17  |
| Germany                                   | 0.08  | 0.09  | 0.11  | 0.11  | 0.11  |
| Greece                                    | 3.77  | 4.03  | 3.84  | 3.39  | 4.18  |
| Hungary                                   | 2.79  | 2.57  | 1.91  | 1.85  | 1.62  |
| Ireland                                   | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Italy                                     | 8.67  | 8.29  | 7.87  | 10.28 | 10.01 |
| Latvia                                    | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Lithuania                                 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Luxembourg                                | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Malta                                     | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Netherlands                               | 1.32  | 1.32  | 1.31  | 1.50  | 1.53  |
| Poland                                    | 3.78  | 3.63  | 3.71  | 3.70  | 3.80  |
| Portugal                                  | 0.97  | 1.21  | 0.93  | 0.93  | 1.09  |
| Romania                                   | 9.93  | 9.71  | 9.96  | 10.78 | 10.01 |
| Slovakia                                  | 0.32  | 0.31  | 0.27  | 0.22  | 0.17  |
| Slovenia                                  | 0.17  | 0.16  | 0.16  | 0.20  | 0.23  |
| Spain                                     | 19.62 | 20.50 | 20.58 | 21.43 | 21.75 |
| Sweden                                    | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| European Union - 27 countries (from 2020) | 57.59 | 57.47 | 56.27 | 59.68 | 59.66 |

**Cotton fibre (I2300)**

| <b>Member state/Year</b>                         | <b>2016</b>   | <b>2017</b>   | <b>2018</b>   | <b>2019</b>   | <b>2020</b>   |
|--|---------------|---------------|---------------|---------------|---------------|
| Austria  | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Belgium  | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Bulgaria   | 4.49          | 4.81          | 3.16          | 3.46          | 3.00          |
| Croatia  | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Cyprus   | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Czechia  | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Denmark  | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Estonia  | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Finland  | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| France   | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Germany  | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Greece   | 236.04        | 258.33        | 277.36        | 292.17        | 285.37        |
| Hungary  | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Ireland  | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Italy  | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Latvia   | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Lithuania  | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Luxembourg                                       | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Malta  | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Netherlands                                      | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Poland   | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Portugal   | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Romania  | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Slovakia   | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Slovenia   | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Spain  | 60.81         | 62.98         | 65.12         | 66.15         | 61.70         |
| Sweden   | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| <b>European Union - 27 countries (from 2020)</b> | <b>301.34</b> | <b>326.12</b> | <b>345.64</b> | <b>361.78</b> | <b>350.07</b> |