Pest categorisation of *Russellaspis pustulans*

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Abstract

The EFSA Panel on Plant Health performed a pest categorisation of *Russellaspis pustulans* (Hemiptera: Asterolecaniidae), the oleander pit scale, for the EU. *R. pustulans* occurs widely in tropical and subtropical areas of the world and is restricted to indoor plantings in cooler temperate regions. Within the EU, it has been reported in some literature from Cyprus, Italy and Malta though not confirmed by the NPPOs. *R. pustulans* is not listed in Commission Implementing Regulation (EU) 2019/2072. It is very polyphagous, feeding on plants in 69 families and exhibits a preference for fig (*Ficus carica*) and oleander (*Nerium oleander*). *R. pustulans* was observed completing up to three generations per year in Egypt, with peaks of presence in June, October and December. The main natural dispersal stage is the first instar, which crawls over the host plant or may be dispersed further by wind and animals. Plants for planting, cut branches and fruits provide potential pathways for entry into the EU. Climatic conditions in some parts of southern EU countries are favourable and host plants are available in those areas to support establishment. However, the magnitude of impact following introduction is uncertain. Phytosanitary measures are available to reduce the likelihood of entry and further spread. *R. pustulans* does meet 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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Figure 1: Courtesy of Chris Malumphy

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1. Introduction

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

1.1.1. Background

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

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

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

1.1.2. Terms of Reference

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

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

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

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

1.2. Interpretation of the Terms of Reference

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

This pest categorisation was initiated following the commodity risk assessment of fig (Ficus carica) plants for planting from Israel performed by EFSA (EFSA PLH Panel, 2021), in which R. pustulans was identified as a relevant non-regulated EU pest which could potentially enter the EU on F. carica.

2. Data and methodologies

2.1. Data

2.1.1. Information on pest status from NPPOs

In the context of the current mandate, EFSA is preparing pest categorisations for new/emerging pests that are not yet regulated in the EU and for which, when the pest is reported in an MS, an official pest status is not always available. In order to obtain information on the official pest status for Russellaspis pustulans, EFSA has consulted the NPPOs of Cyprus, Italy and Malta. The results of this consultation are presented in Section 3.2.2.

2.1.2. Literature search

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

2.1.3. Database search

Pest information, on host(s) and distribution, was retrieved from the 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 SANTE) of the European Commission as a subproject of PHYSAN (Phyto-Sanitary Controls) specifically concerned with plant health information. TRACES is the European Commission’s multilingual online platform for sanitary and phytosanitary certification required for the importation of animals, animal products, food and feed of non-animal origin and plants into the European Union, and the intra-EU trade and EU exports of animals and certain animal products. Up until May 2020, the Europhyt database managed notifications of interceptions of plants or plant products that do not comply with EU legislation, as well as notifications of plant pests detected in the territory of the Member States and the phytosanitary measures taken to eradicate or avoid their spread. The recording of interceptions switched from Europhyt to TRACES in May 2020.

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

2.2. Methodologies

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

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

The Panel’s conclusions are formulated respecting its remit and particularly with regard to the principle of separation between risk assessment and risk management (EFSA founding regulation (EU) No 178/2002); therefore, instead of determining whether the pest is likely to have an unacceptable impact, deemed to be a risk management decision, the Panel will present a summary of the observed impacts in the areas where the pest occurs, and make a judgement about potential likely impacts in the EU. 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 derived from Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

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

3. Pest categorisation

3.1. Identity and biology of the pest

3.1.1. Identity and taxonomy

Russellaspis pustulans (Cockerell) is a scale insect within the order Hemiptera and family Asterolecaniidae. It is commonly known as oleander pit scale, akee fringed scale, fig pit scale or pustule scale. It was first described as Asterodiaspis pustulans by Cockerell in 1892 and subsequently underwent several taxonomic revisions. It comprises two subspecies: Russellaspis pustulans principe (Castel-Branco) and Russellaspis pustulans pustulans (Cockerell). However, R. pustulans principe is only recorded from São Tomé and Principe. Subspecies are rarely mentioned in the literature. It has the following synonyms: Asterodiaspis pustulans, Asterolecanium pustulans, Planchonia pustulans, Asterolecanium pustulans sambuci, Asterolecanium pustulans seychellarum, Asterolecanium sambuci.
and Asterolecanium morini. The junior synonym Asterolecanium pustulans has been widely used in the literature and is still occasionally in use, for example, CABI (online).

The EPPO code\(^1\) (Griessinger and Roy, 2015; EPPO, 2019) for this species is: ASTLPU (EPPO, online).

3.1.2. Biology of the pest

The biology of *R. pustulans* has been studied in detail in Egypt (Habib, 1943, 1953; El-Minshawy and El-Sawaf, 1971; Salama and Hamdy, 1974; Stumpf and Lambdin, 2006; Hassan et al., 2012; El-Amir et al., 2020). A summary is provided here. *R. pustulans* is parthenogenetic, males are not known, and it completes two to three generations each year, depending on environmental conditions and host plant species. Non-gravid females overwinter. The insect occurs between the 10°C winter isotherm and the 32°C summer isotherm, which, respectively, correspond to the lower developmental threshold and upper lethal temperature for eggs. On *N. oleander* females laid an average of 128 eggs each (range 66–192). However, an average of only 50–60 eggs actually hatched (Habib, 1943). El-Minshawy and El-Sawaf (1971) observed an average of 113 eggs per female on peach trees, 90 eggs per female on fig trees in winter and 194 eggs per female on fig trees in the summer. There are two nymphal instars. The average lifespan of a female is 80 days (range 73–87). The duration of the life cycle (from egg hatching to adult death) in summer ranged from 93 to 120 days, and in winter from 240 to 275 days.

\(^1\) An EPPO code, formerly known as a Bayer code, is a unique identifier linked to the name of a plant or plant pest important in agriculture and plant protection. Codes are based on genus and species names. However, if a scientific name is changed, the EPPO code remains the same. This provides a harmonised system to facilitate the management of plant and pest names in computerised databases, as well as data exchange between IT systems (Griessinger and Roy, 2015; EPPO, 2019).
Salama and Hamdy (1974) reported three generations each year (June, October and December) in Egypt and found the optimal temperature range for development to be 23–25.3°C, and relative humidity between 68% and 70%.

Feeding by the nymphs may induce shallow or deep pits at the feeding site. This pitting or galling varies with host species and is particularly noticeable on oleander (Figure 1). Similar galls induced by the pittosporum pit scale Planchonia arabidis Signoret, which is present in southern EU MS, result primarily from parenchyma multilayer tissue hyperplasia (Vovlas et al., 2013).

### Table 2: Important features of the life history strategy of *Russellaspis pustulans*

| Life stage | Phenology and relation to host | Other relevant information |
|------------|--------------------------------|---------------------------|
| **Egg**    | Typically, females lay between 66 and 194 eggs, depending on host plant and generation. | The eggs are protected beneath the scale wax cover. |
| **Larva/Nymph** | The nymphs are most abundant on the younger stems but also occur on the main trunk, branches, foliage and fruit. Feeding by the nymphs induces pitting or galling on some host plant species. | First-instar nymphs (known as ‘crawlers’) are mobile and disperse by walking to other parts of the same plant or are carried by the wind, phoresy (attached to other animals, including birds) or incidentally by machinery and agricultural workers, to other areas. Once a suitable feeding site is located, they insert their stylets to feed and remain anchored to the host. |
| **Adult**  | See the notes for the nymphs. Non-gravid females overwinter. | This species is parthenogenetic. Adults are sessile. |

### 3.1.3. Host range/species affected

*R. pustulans* is a polyphagous pest, feeding on plants belonging to 69 families. Families that contain large numbers of host plants include Apocynaceae, Fabaceae, Malvaceae, Moraceae and Rosaceae. The main hosts of economic importance of *R. pustulans* are fig (*Ficus carica*), apple (*Malus domestica*), guava (*Psidium guajava*), mango (*Mangifera indica*), olive (*Olea europaea*), peach (*Prunus persica*), pear (*Pyrus communis*), plum (*Prunus domestica*), other fruit trees and ornamental plants, especially oleander (El-Salam and Mangoud, 2001; Malumphy, 2014; EFSA PLH Panel, 2021). Appendix A provides a comprehensive list of hosts.

### 3.1.4. Intraspecific diversity

Two subspecies are recognised: *Russellaspis pustulans principe* is restricted to São Tomé and Príncipe; *Russellaspis pustulans pustulans* is widespread in tropical and subtropical areas and appears to be more invasive.

### 3.1.5. Detection and identification of the pest

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

**Yes.** There are methods available for detection and morphological identification of *R. pustulans*.

**Detection**

Adult female scales and the galls, if present, are generally obvious enabling them to be detected by visual inspection (Figure 1).

**Identification**

The identification of *R. pustulans* requires microscopic examination of slide-mounted tenereal adult females. A key to adult females and nymphs is provided by Russel (1941) and for species found in North and South America by Stumpf and Lambdin (2006). There are no nucleotide sequences for *R. pustulans* available on GenBank.

**Symptoms**

The pest infests mainly branches and stems, but also new twigs, leaves and fruits (Moursi et al., 2007). The species typically induces circular pits of different depths on the surface of the plant.
Although deep pits can be caused on stems and branches, generally no pits occur on leaves and fruits (Caliskan et al., 2015; Moursi et al., 2007; Russell, 1941). The pits are usually more pronounced when the scales feed near the growing tips. When heavy infestations occur galls and deep pits are usually observed (Salama and Hamdy, 1974). However, depending on the host plant susceptibility and feeding location, there may be no pits. It also causes wilting of leaves and twigs, defoliation and dieback of branches, death of trees and yield loss (Abd El-Salam and Mangoud, 2001).

**Description**

The newly deposited egg is yellow in colour and gradually becomes darker before hatching. It is oval in shape and is about 0.23 mm long and 0.13 mm wide. After hatching, the first-instar nymph settles down and start secreting glassy wax filaments on the dorsal surface and around the body. The crawler grows slightly in size until it reaches about 0.43 mm long and 0.31 mm wide. Then, it casts its cuticle, antennae are greatly reduced and legs are lost. The second larval stage is easily recognised by its round shape and dark-brownish or greyish colour. It also grows in size and becomes yellow in colour (El-Minshawy and El-Sawaf, 1971). The adult scale cover or test is nearly round or oval, about 1 mm in diameter, nearly flat to convex in lateral view, translucent, showing the colour of the female body beneath. Dense white or pink wax filaments are present on the margin and dorsal areas of the cover, with dorsal filaments generally being longer than marginal ones. The female is round or oval, bright yellow, becoming brownish with age (Caliskan et al., 2015). A detailed morphological description and illustration of an adult female is provided by Stumpf and Lambdin (2006).

### 3.2. Pest distribution

#### 3.2.1. Pest distribution outside the EU

*R. pustulans* is present in tropical and subtropical areas around the world, from the Americas, Africa, Europe to Asia and the Pacific (Figure 2, Appendix B). In cooler temperate areas, the pest can be found in indoor plantings (Malumphy, 2014). The scale was found in a greenhouse at a botanical garden in the UK in 1982 (Malumphy, 1996) but there have been no records since then and it is no longer present in the UK. A report of *R. pustulans* in Australia by Malumphy (2014) is erroneous. The occurrence in New York State dates from 1923 and the species’ continued presence there is uncertain.

![Figure 2: Global distribution of Russellaspis pustulans](Data Source: CABI (online) (accessed on 10.12.2021) and literature)
3.2.2. Pest distribution in the EU

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

*R. pustulans* has a restricted distribution in the EU. It has been reported in some literature from Cyprus, Italy and Malta, though not confirmed by the NPPOs. The pest occurs in Spain (Canary Islands, which for plant health purposes are outside the risk assessment area of the EU).

*R. pustulans* is reported in Cyprus (Şişman & Ülgentürk, 2010) but has not been confirmed by the NPPO. It has been present in the Canary Islands (Spain) for at least 30 years (C. Malumphy, personal communication, 2022). For plant health purposes, the Canary Islands are outside the risk assessment area of the EU.

Stumpf & Lambdin (2006) reported *R. pustulans* as present in Italy and Malta but without providing details on the source of this information. Mazzeo et al. (2014) reviewed the exotic scale insects in Italy and did not mention *R. pustulans*. Mifsud et al. (2014) produced a comprehensive checklist of the scale insects of Malta but explicitly stated that no Maltese specimens of *R. pustulans* had been seen. The reports of *R. pustulans* occurring in Italy and Malta are therefore questionable. The Maltese Plant Protection Directorate communicated that the current status of the pest in Malta is unknown. Similarly, the Italian NPPO stated that the presence of the pest in the country is not known by regional services.

3.3. Regulatory status

3.3.1. Commission Implementing Regulation 2019/2072

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

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

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

| Description | CN Code | Third country, group of third countries or specific area of third country |
|-------------|---------|-------------------------------------------------------------------------|
| 2. Plants of […] Quercus L., with leaves, other than fruit and seeds | ex 0602 10 90 ex 0602 20 20 ex 0602 20 80 ex 0602 90 41 ex 0602 90 45 ex 0602 90 46 ex 0602 90 48 ex 0602 90 50 ex 0602 90 70 ex 0602 90 99 ex 0604 20 90 ex 1404 90 00 | Third countries other than Albania, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canary Islands, Faeroe Islands, Georgia, Iceland, Liechtenstein, Moldova, Monaco, Montenegro, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny federalny okrug), Northwestern Federal District (Severo- Zapadny federalny okrug), Southern Federal District (Yuzhny federalny okrug), North Caucasian Federal District (Severo-Kavkazsky federalny okrug) and Volga Federal District (Privolzhsky federalny okrug)), San Marino, Serbia, Switzerland, Turkey, Ukraine and the United Kingdom |
| 8. Plants for planting of […] Malus Mill., Prunus L., Pyrus L. and Rosa L., other than dormant plants free from leaves, flowers and fruits | ex 0602 10 90 ex 0602 20 20 ex 0602 20 80 ex 0602 40 00 ex 0602 90 41 ex 0602 90 45 ex 0602 90 46 | Third countries other than: specific third countries (see 2019/2072 Annex VI for details) |
List of plants, plant products and other objects whose introduction into the Union from certain third countries is prohibited

| Description                                                                 | CN Code               | Third country, group of third countries or specific area of third country                                                                 |
|-----------------------------------------------------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| ex 0602 90 47                                                               | ex 0602 90 48         |                                                                                                                                         |
| ex 0602 90 50                                                               | ex 0602 90 70         |                                                                                                                                         |
| ex 0602 90 91                                                               | ex 0602 90 99         |                                                                                                                                         |
| 9. Plants for planting of [...] Malus Mill., Prunus L. and Pyrus L. and their hybrids, and Fragaria L., other than seeds | ex 0602 10 90         | Third countries other than: specific third countries (see 2019/2072 Annex VI for details)                                            |
| ex 0602 20 20                                                               | ex 0602 90 30         |                                                                                                                                         |
| ex 0602 90 41                                                               | ex 0602 90 45         |                                                                                                                                         |
| ex 0602 90 46                                                               | ex 0602 90 48         |                                                                                                                                         |
| ex 0602 90 50                                                               | ex 0602 90 70         |                                                                                                                                         |
| ex 0602 90 91                                                               | ex 0602 90 99         |                                                                                                                                         |
| 10. Plants of Vitis L., other than fruits                                   | 0602 10 10            | Third countries other than Switzerland                                                                                                 |
| 0602 20 10                                                                 | ex 0604 20 90         |                                                                                                                                         |
| ex 1404 90 00                                                               | ex 0602 20 20         |                                                                                                                                         |
| 11. Plants of Citrus L., [...] and their hybrids, other than fruits and seeds | ex 0602 10 90         | All third countries                                                                                                                     |
| ex 0602 20 20                                                               | ex 0602 90 30         |                                                                                                                                         |
| ex 0602 20 30                                                               | ex 0602 90 45         |                                                                                                                                         |
| ex 0602 20 80                                                               | ex 0602 90 46         |                                                                                                                                         |
| ex 0602 90 47                                                               | ex 0602 90 48         |                                                                                                                                         |
| ex 0602 90 50                                                               | ex 0602 90 70         |                                                                                                                                         |
| ex 0602 90 91                                                               | ex 0602 90 99         |                                                                                                                                         |
| ex 0602 20 90                                                               | ex 1404 90 00         |                                                                                                                                         |
| 18. Plants for planting of Solanaceae other than seeds and the plants covered by entries 15, 16 or 17 | ex 0602 90 30         | Third countries other than: Albania, Algeria, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canary Islands, Egypt, Faeroe Islands, Georgia, Iceland, Israel, Jordan, Lebanon, Libya, Liechtenstein, Moldova, Monaco, Montenegro, Morocco, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny federalny okrug), Northwestern Federal District (Severo-Zapadny federalny okrug), Southern Federal District (Yuzhny federalny okrug), North Caucasian Federal District (Severo-Kavkazsky federalny okrug) and Volga Federal District (Privolzhsky federalny okrug)), San Marino, Serbia, Switzerland, Syria, Tunisia, Turkey, Ukraine and the United Kingdom |
| ex 0602 90 45                                                               | ex 0602 90 46         |                                                                                                                                         |
| ex 0602 90 48                                                               | ex 0602 90 50         |                                                                                                                                         |
| ex 0602 90 70                                                               | ex 0602 90 91         |                                                                                                                                         |
| ex 0602 90 99                                                               | ex 0602 90 99         |                                                                                                                                         |

High Risk plant regulation 2018/2019 includes temporary prohibition of *Acacia*, *Albizia*, *Annona*, *Bauhinia*, *Caesalpinia*, *Cassia*, *Crataegus*, *Diospyros*, *Ficus carica*, *Jasminum*, *Malus*, *Nerium*, *Persea*, *Prunus*, *Quercus*, *Robinia* and *Salix*, which are hosts of *R. pustulans*, pending risk assessment.
3.4. Entry, establishment and spread in the EU

3.4.1. Entry

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

Yes, the pest has already entered the EU territory. It could further enter the EU territory with plants for planting and fruits, although some host plants for planting are prohibited, closing some potential pathways (Table 3).

Comment on plants for planting as a pathway

Plants for planting, cut branches, cut foliage and fruits are the main potential pathways for entry of *R. pustulans* (Table 4).

Plants for planting, cut branches, cut foliage and fruits are the main potential pathways for entry of *R. pustulans* (Table 4).

**Table 4:** Potential pathways for *Russellaspis pustulans* into the EU 27

| Pathways                      | Life stage  | Relevant mitigations [e.g. prohibitions (Annex VI), special requirements (Annex VII) or phytosanitary certificates (Annex XI) within Implementing Regulation 2019/2072] |
|-------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Plants for planting           | Nymphs, adults | The import of some host plants of *R. pustulans* for planting from third countries is not allowed (Regulation 2019/2072, Annex VI), (Table 3) while there are many other hosts that can be imported to the EU with a phytosanitary certificate. |
| Cut branches, cut foliage and fruits | Nymphs, adults | A phytosanitary certificate is required to import fresh fruits, cut branches, cut foliage into the EU (2019/2072, Annex XI, Part A and B) unless exempt by being listed in 2019/2072 Annex XI, Part C. However, no specific requirements are set for *R. pustulans*. As not all, but only a proportion of imported consignments are liable to be physically inspected, this requirement does not preclude the entry of *R. pustulans*. |

There is a derogation for *F. carica* ((EU) 2020/1213) and for *Persea americana* ((EU) 2021/1936) plants coming from Israel. A commodity risk assessment for *F. carica* plants for planting from Israel, indicated with 95% certainty, that between 95.85% and 100% of imported plants would be free of *R. pustulans* (EFSA PLH Panel, 2021).

**Table 5:** EU 27 annual imports of fresh produce of main hosts from countries where *Russellaspis pustulans* is present (see Appendix B), 2016-2020 (in 100 kg) Source EUROSTAT accessed on 1/14/2022

| Crop                | HS code | 2016  | 2017  | 2018  | 2019  | 2020  |
|---------------------|---------|-------|-------|-------|-------|-------|
| Apples              | 0808 10 | 172,168.39 | 257,956.04 | 281,930.12 | 143,755.57 | 120,871.61 |
| Apricots            | 0809 10 00 | 53,858.53 | 46,519.43 | 68,502.49 | 48,880.34 | 104,477.48 |
| Coconuts            | 0801 | 228,735.23 | 288,014.39 | 265,479.54 | 286,034.73 | 268,262.13 |
| Eggplants           | 0709 30 00 | 74,574.02 | 93,386.48 | 100,900.39 | 90,105.63 | 109,185.45 |
| Figs                | 0804 20 10 | 105,859.46 | 120,052.05 | 128,787.9 | 145,672.66 | 162,760.84 |
| Mangos, guavas      | 0804 50 00 | 2,019,240.54 | 2,235,587.09 | 2,642,399.41 | 2,749,644.73 | 3,060,308.6 |
| Peaches             | 0809 30 90 | 14,052.02 | 11,999.09 | 25,397.18 | 7,300 | 66,185.24 |
| Pears               | 0808 30 | 116,415.7 | 130,887.3 | 185,407.06 | 147,761.46 | 213,213.56 |
| Plums               | 0809 40 05 | 13,227.63 | 32,113.76 | 16,325.3 | 11,745.48 | 28,177.99 |
| Sapodilla           | 0810 90 20 | 73,974.3 | 78,312.88 | 93,026.21 | 100,513.4 | 104,431.65 |

Notifications of interceptions of harmful organisms began to be compiled in Europhyt in May 1994 and in TRACES in May 2020. As at 08 February 2022, there were no records of interception of *R. pustulans* in the Europhyt and TRACES databases.
3.4.2. Establishment

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

Yes, *R. pustulans* is already reported from Cyprus, Italy and Malta.

Southern EU countries provide suitable environmental conditions (climate and hosts) for the establishment of *R. pustulans*, which is already reported from the above MSs.

It is unlikely that the insect could establish outdoors in central and northern EU countries, although it could occur in greenhouses and on indoor plantings in such areas.

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

3.4.2.1. EU distribution of main host plants

*R. pustulans* is a polyphagous pest and feeds on plants belonging to 69 families (EFSA PLH, 2021). The main hosts of the pest cultivated in the EU 27 between 2016 and 2020 are shown in Table 6. Among others, figs, apples, plums, peaches, pears and olives are highly economically important in the EU.

Table 6: Crop area of main *Russellaspis pustulans* hosts in the EU 27 in 1,000 ha (Eurostat accessed on 14/1/2021)

| Crop    | 2016     | 2017     | 2018     | 2019     | 2020     |
|---------|----------|----------|----------|----------|----------|
| Apples  | 506.48   | 505.55   | 507.24   | 491.08   | 483.01   |
| Apricots| 72.52    | 72.23    | 72.57    | 73.22    | 76.12    |
| Eggplants| 42.96   | 41.47    | 42.49    | 41.21    | 42.3     |
| Figs    | 23.74    | 24.63    | 24.99    | 25.59    | 27.20    |
| Peaches | 156.39   | 154.06   | 150.80   | 144.78   | 135.97   |
| Pears   | 115.76   | 114.84   | 114.84   | 110.66   | 107.05   |
| Plums   | 152.79   | 153.88   | 153.43   | 154.51   | 154.87   |
| Olives  | 5,039.24 | 5,051.85 | 5,093.57 | 5,070.49 | 5,105.13 |

3.4.2.2. Climatic conditions affecting establishment

*R. pustulans* is a thermophilic insect and is distributed mainly in areas with tropical and subtropical climates in the Americas (including the Lesser Antilles), Africa, Europe, Asia, and the Pacific, and is restricted to indoor plantings in cooler temperate regions (Malumphy, 2014). Moreover, it has been reported in Cyprus (Şişman and Urgentürk, 2010) and the Canary Islands (Spain) (C Malumphy, personal communication, 2022). Records in Italy and Malta are unreliable. Figure 3 shows the World distribution of Köppen–Geiger climate types (Kottek et al., 2006) that occur in the EU and which occur in countries where *R. pustulans* has been reported. Southern EU countries provide suitable climatic conditions for the establishment of *R. pustulans*. However, Köppen–Geiger climate zones do not capture the number of frost days, which may further inform judgments about where in the EU *R. pustulans* could establish. Appendix C shows the mean number of frost days each year on a global scale for the 30-year period 1988–2017, sourced from the Climatic Research Unit high resolution gridded data set CRU TS v. 4.03 at 0.5° resolution (https://crudata.uea.ac.uk/cru/data/hrg/). A simple visual comparison of Figure 2 (global distribution of *R. pustulans*) and Appendix C indicates that *R. pustulans* occurs primarily in countries with few frost days (red colours in Appendix C). Appendix C indicates that the fewest frost days occur in southern Portugal, around the Mediterranean coast and islands in the Mediterranean; a much smaller area than suggested by Figure 3.

Habib (1943) noted that *R. pustulans* occurs between the 10°C winter isotherm, corresponding to the lower developmental threshold for eggs, and the 32°C summer isotherm, corresponding to the upper temperature for 100% mortality of eggs. Figure 4 shows the 10°C isotherm based on the winter (December, January, February) minimum temperature normals for the period 1991–2020, based on 25km grid weather data from the Joint Research Centre, indicating limits of establishment according to Habib (1943).
It is unlikely that *R. pustulans* could establish outdoors in central and northern EU countries, except for limited coastal areas. However, *R. pustulans* could occur more widely in greenhouses and on indoor plantings.

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

**Figure 4:** Winter 10°C isotherm based on the minimum temperature normals for the period 1991–2020
3.4.3. Spread

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

First instar nymphs are spread by crawling, wind, rainfall and on humans and animals. All stages may be moved over long distances by the trade of infested plant materials (plants for planting, twigs and fruits).

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

Plants for planting is one of the main pathways of spread of the pest over long distances.

The introduction of this pest to new territories over long distance is possible through the movement of infested plants for planting (e.g. fruit tree and ornamental nursery young plants), and trade of infested fruit, vegetables, cut flowers or other plant products. The USDA report that this species is commonly intercepted on imported fruit, particularly apple and mango (Miller et al., 2014).

3.5. Impacts

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

**Yes,** *R. pustulans* is harmful to fig, olive, apple, mango, guava, oleander and other crop and ornamental plants.

In addition to impacts on fig, the species is reported as a serious pest of apple in Egypt (El-Salam and Mangoud, 2001; Hassan et al., 2012), tea in Zhejiang, China (Cen, 1986), as well as of Sapodilla plum (*Achras sapota* L.) in Puerto Rico (Medina – Gaud et al., 1987). *R. pustulans pustulans* is a prohibited organism in Australia (Government of Western Australia, Department of Primary Industries and Regional Development, online).

3.6. Available measures and their limitations

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

**Yes,** although the existing phytosanitary measures identified in 3.3.2 do not specifically target *R. pustulans*, they mitigate the likelihood of its entry into, establishment and spread within the EU.

3.6.1. Identification of potential additional measures

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

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

3.6.1.1. Additional potential risk reduction options

Potential additional control measures are listed in Table 7.
Table 7: Selected control measures (a full list is available in EFSA PLH Panel, 2018) for pest entry/establishment/spread/impact in relation to currently unregulated hosts and pathways. Control measures are measures that have a direct effect on pest abundance.

| Control measure/ Risk reduction option (Blue underline = Zenodo doc, Blue = WIP) | RRO summary | Risk element targeted (entry/establishment/spread/impact) |
|---|---|---|
| Growing plants in isolation | Plants could be grown in a dedicated facility such as an insect proof greenhouse. | Entry/Spread |
| Use of resistant and tolerant plant species/varieties | Resistant plants are used to restrict the growth and development of a specified pest and/or the damage they cause when compared to susceptible plant varieties under similar environmental conditions and pest pressure. It is important to distinguish resistant from tolerant species/varieties. | Entry/Establishment/Impact |
| Roguing and pruning | Used to remove infested plant parts and mitigate pest density. | Entry/Spread/Impact |
| Plants could be grown in a dedicated facility such as an insect proof greenhouse. | Plants could be grown in a dedicated facility such as an insect proof greenhouse. | Plants could be grown in a dedicated facility such as an insect proof greenhouse. |
| Biological control and behavioural manipulation | Several species of parasitoids and predators have been recorded on *R. pustulans* (Abd-Rabou & Evans, 2010; El Amir et al., 2020). They can contribute to contain pest populations. | Spread/Impact |
| Chemical treatments on crops including reproductive material | Pesticide sprays are generally effective against crawlers and less effective against the fixed stages of *R. pustulans* because of the wax covering of its body. Issues with pesticides resistance could arise. Azadirachtin, essential oils and mineral oil proved effective in controlling *R. pustulans* (Ismail et al., 2015). | Entry/Establishment/Impact |
| Chemical treatments on consignments or during processing | Treatments can be applied to plants or to plant products after harvest, during process or packaging operations and storage, e.g. fumigation; spraying/dipping pesticides; surface disinfecants. | Entry/Spread |
| Physical treatments on consignments or during processing | Washing, brushing and other mechanical cleaning methods can be used to reduce the prevalence of the pest in the consignments to be exported or to be planted. | Entry/Spread |
| Cleaning and disinfection of facilities, tools and machinery | The physical and chemical cleaning and disinfection of facilities, tools, machinery, transport means, facilities and other accessories (e.g. boxes, pots, pallets, palox, supports, hand tools). | Entry/ Spread |
| Heat and cold treatments | Controlled temperature treatments aimed to kill or inactivate pests without causing any unacceptable prejudice to the treated material itself. | Entry/Spread |
| Controlled atmosphere | Treatment of plants by storage in a modified atmosphere (including modified humidity, *O₂*, *CO₂*, temperature, pressure). Used to mitigate likelihood of infestation of pests susceptible to modified atmosphere (usually applied during transport) hence to mitigate entry. Controlled atmosphere storage can be used in commodities such as fresh and dried fruits, flowers and vegetables. | Entry/ Spread (via commodity) |
3.6.1.2. Additional supporting measures

Potential additional supporting measures are listed in Table 8.

Table 8: Selected supporting measures (a full list is available in EFSA PLH Panel, 2018) in relation to currently unregulated hosts and pathways. Supporting measures are organisational measures or procedures supporting the choice of appropriate risk reduction options that do not directly affect pest abundance.

| Supporting measure | Summary | Risk element targeted (entry/ establishment/ spread / impact) |
|--------------------|---------|---------------------------------------------------------------|
| **Inspection and trapping** | Inspection is defined as the official visual examination of plants, plant products or other regulated articles to determine if pests are present or to determine compliance with phytosanitary regulations (ISPM 5). The effectiveness of sampling and subsequent inspection to detect pests may be enhanced by including trapping and luring techniques. | Establishment/ Spread |
| **Laboratory testing** | Examination, other than visual, to determine if pests are present using official diagnostic protocols. Diagnostic protocols describe the minimum requirements for reliable diagnosis of regulated pests. | Entry |
| **Sampling** | According to ISPM 31, it is usually not feasible to inspect entire consignments, so phytosanitary inspection is performed mainly on samples obtained from a consignment. It is noted that the sampling concepts presented in this standard may also apply to other phytosanitary procedures, notably selection of units for testing. | Entry |
| **Phytosanitary certificate and plant passport** | An official paper document or its official electronic equivalent, consistent with the model certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements (ISPM 5) a) export certificate (import) b) plant passport (EU internal trade) | Entry |
| **Certified and approved premises** | Mandatory/voluntary certification/approval of premises is a process including a set of procedures and of actions implemented by producers, conditioners and traders contributing to ensure the phytosanitary compliance of consignments. It can be a part of a larger system maintained by the NPPO in order to guarantee the fulfilment of plant health requirements of plants and plant products intended for trade. Key property of certified or approved premises is the traceability of activities and tasks (and their components) inherent the pursued phytosanitary objective. Traceability aims to provide access to all trustful pieces of information that may help to prove the compliance of consignments with phytosanitary requirements of importing countries. | Entry |
| **Surveillance** | Surveillance to guarantee that plants and produce originate from a Pest Free Area could be an option. | Spread |

3.6.1.3. Biological or technical factors limiting the effectiveness of measures

- Due to its small size, *Russellasspis pustulans* may not be easily detected in cases where low populations occur.
- The waxy scale covering and sessile nature of the later instar nymphs and adult female *Russellasspis pustulans* reduces the efficacy from treatments with contact insecticides.
- *Russellasspis pustulans* is polyphagous, making the inspections of all consignments containing hosts from countries where the pest occurs difficult.
3.7. Uncertainty

The main uncertainty regards the magnitude of impact of *R. pustulans* on crops and ornamental plants.

4. Conclusions

*R. pustulans* satisfies all the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest (Table 9).

Table 9: The Panel's conclusions on the pest categorisation criteria defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

| Criterion of pest categorisation | Panel’s conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest | Key uncertainties |
|---------------------------------|--------------------------------------------------------------------------------------------------|-------------------|
| Identity of the pest (Section 3.1) | The identity of the pest is established. Taxonomic keys based on morphology of female adults and nymphs exist. | None |
| Absence/presence of the pest in the EU (Section 3.2) | The pest has been reported in some literature from Cyprus, Italy and Malta, though not confirmed by the NPPOs. | None |
| Pest potential for entry, establishment and spread in the EU (Section 3.4) | *R. pustulans* is able to enter into, become established, and spread within the EU territory. The main pathways are: - plants for planting (regulated, some prohibited, some permitted) - fruits, vegetables and cut flowers (regulated, except fruits of *Cocos nucifera*). | None |
| Potential for consequences in the EU (Section 3.5) | Should *R. pustulans* be introduced into the EU, an economic impact would most likely follow. | Uncertainty about the magnitude of economic impact |
| Available measures (Section 3.6) | There are measures available to prevent the entry, establishment and spread of *R. pustulans* within the EU. Risk reduction options include the inspections and physical treatments on consignments of fresh plant material from infested countries and the production of plants for import into the EU in pest free areas. | None |
| Conclusion (Section 4) | *R. pustulans* satisfies all the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest | None |
| Aspects of assessment to focus on/scenarios to address in future if appropriate: | Reports of significant damage including on apples and olives in Egypt are not seen in neighbouring countries where *R. pustulans* occurs. Further investigation to identify reasons why severe impacts occur in Egypt would inform likely magnitude of impacts in the EU. | |

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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

PZ Protected Zone

TFEU Treaty on the Functioning of the European Union

ToR Terms of Reference

**Glossary**

**Containment (of a pest)** Application of phytosanitary measures in and around an infested area to prevent spread of a pest (FAO, 2018)

**Control (of a pest)** Suppression, containment or eradication of a pest population (FAO, 2018)

**Entry (of a pest)** Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO, 2018)

**Eradication (of a pest)** Application of phytosanitary measures to eliminate a pest from an area (FAO, 2018)

**Establishment (of a pest)** Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2018)

**Greenhouse** A walk-in, static, closed place of crop production with a usually translucent outer shell, which allows controlled exchange of material and energy with the surroundings and prevents release of plant protection products (PPPs) into the environment.

**Hitchhiker** An organism sheltering or transported accidentally via inanimate pathways including with machinery, shipping containers and vehicles; such organisms are also known as contaminating pests or stowaways (Toy and Newfield, 2010).

**Impact (of a pest)** The impact of the pest on the crop output and quality and on the environment in the occupied spatial units

**Introduction (of a pest)** The entry of a pest resulting in its establishment (FAO, 2018)
| **Pathway** | Any means that allows the entry or spread of a pest (FAO, 2018) |
|------------|---------------------------------------------------------------|
| **Phytosanitary measures** | Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO, 2018) |
| **Quarantine pest** | A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO, 2018) |
| **Risk reduction option (RRO)** | A measure acting on pest introduction and/or pest spread and/or the magnitude of the biological impact of the pest should the pest be present. A RRO may become a phytosanitary measure, action or procedure according to the decision of the risk manager |
| **Spread (of a pest)** | Expansion of the geographical distribution of a pest within an area (FAO, 2018) |
Appendix A – *Russellaspis pustulans* host plants/species affected

Source: CABI (online), Garcia Morales et al. (2016) and other literature.

| Host status      | Host name              | Plant family | Common name          | Reference                                |
|------------------|------------------------|--------------|----------------------|------------------------------------------|
| Cultivated hosts | Abelmoschus esculentus | Malvaceae    | Okra                 | Garcia Morales et al. (2016)             |
|                  | Abutilon               | Malvaceae    |                      | Garcia Morales et al. (2016)             |
|                  | Acacia decurrens       | Fabaceae     | Black wattle         | Garcia Morales et al. (2016)             |
|                  | Acacia farnesiana      | Fabaceae     | Casse flower         | Garcia Morales et al. (2016)             |
|                  | Acacia nilotica        | Fabaceae     | Egyptian mimosa      | Garcia Morales et al. (2016)             |
|                  | Aegilopsis chevalieri  | Rutaceae     |                      | Garcia Morales et al. (2016)             |
|                  | Afraegle paniculata    | Rutaceae     |                      | Garcia Morales et al. (2016)             |
|                  | Albizia lebbeck        | Fabaceae     | East Indian walnut   | Garcia Morales et al. (2016)             |
|                  | Alternanthera          | Amaranthaceae |                    | Garcia Morales et al. (2016)             |
|                  | Annona squamosa        | Annonaceae    | Custard apple        | Garcia Morales et al. (2016)             |
|                  | Artocarpus altilis     | Moraceae     | Breadfruit           | Garcia Morales et al. (2016)             |
|                  | Bambusa                | Poaceae      |                      | Garcia Morales et al. (2016)             |
|                  | Bauhinia tomentosa     | Fabaceae     | St Thomas tree       | Garcia Morales et al. (2016)             |
|                  | Bignonia callistegioides | Araliaceae | Lavender trumpet vine | Garcia Morales et al. (2016)             |
|                  | Blighia sapida         | Sapindaceae  | Akee apple           | CABI (online)                            |
|                  | Bougainvillea          | Nyctaginaceae|                      | Garcia Morales et al. (2016)             |
|                  | Boehmeria nivea        | Urticaceae   | China grass          | Garcia Morales et al. (2016)             |
|                  | Bombax ceiba           | Malvaceae    | Cotton tree          | Garcia Morales et al. (2016)             |
|                  | Brassica oleracea      | Brassicaceae | Cabbage              | Garcia Morales et al. (2016)             |
|                  | Bursera simaruba       | Burseraceae  | Gumbo limbo          | Garcia Morales et al. (2016)             |
|                  | Caesalpinia            | Fabaceae     | Congo pea            | Garcia Morales et al. (2016)             |
|                  | Calliandra             | Fabaceae     |                      | Garcia Morales et al. (2016)             |
|                  | Callicarpa americana   | Lamiaceae    | American beauty berry| Garcia Morales et al. (2016)             |
|                  | Cajanus cajan          | Fabaceae     | Pigeon pea           | CABI (online)                            |
|                  | Camellia sinensis      | Theaceae     | Tea                  | CABI (online)                            |
|                  | Capsicum frutescens    | Solanaceae   | Chilli pepper        | Garcia Morales et al. (2016)             |
|                  | Carica papaya          | Caricaceae   | Papaya               | Garcia Morales et al. (2016)             |
|                  | Carissa macrocarpa     | Apocynaceae  | Natal plum           | Garcia Morales et al. (2016)             |
|                  | Carissa spinarum       | Apocynaceae  | Bush plum            | Garcia Morales et al. (2016)             |
|                  | Casimiroa tetrameria   | Rutaceae     |                      | Garcia Morales et al. (2016)             |
|                  | Cassia fistula         | Fabaceae     | Drumstick tree       | Garcia Morales et al. (2016)             |
|                  | Castilloa              | Moraceae     |                      | Garcia Morales et al. (2016)             |
|                  | Casuarina equisetifolia| Casuarinaceae| Australian pine      | Garcia Morales et al. (2016)             |
|                  | Cecropia               | Urticaceae   |                      | Garcia Morales et al. (2016)             |
|                  | Ceiba pentandra        | Malvaceae    | Kapok tree           | Garcia Morales et al. (2016)             |
|                  | Celtis                 | Cannabaceae  | Hackberries          | Garcia Morales et al. (2016)             |
|                  | Cestrum nocturnum      | Solanaceae   | Night-blooming jessamine | Garcia Morales et al. (2016) |
|                  | Chrysobalanus          | Chrysobalanaceae |                      | Garcia Morales et al. (2016)             |
| Host status | Host name         | Plant family | Common name          | Reference                                |
|-------------|-------------------|--------------|----------------------|------------------------------------------|
|             | Chrysojasminum humile | Oleaceae     | Italian jasmine      | Garcia Morales et al. (2016)             |
|             | Chrysophyllum      | Sapotaceae   |                      | Garcia Morales et al. (2016)             |
|             | Citrus             | Rutaceae     |                      | Garcia Morales et al. (2016)             |
|             | Clusia rosea       | Clusiaceae   | Autograph tree       | Garcia Morales et al. (2016)             |
|             | Clerodendrum       | Lamiaceae    |                      | Garcia Morales et al. (2016)             |
|             | Cleyera japonica   | Pentaphylacaceae | Japanese cleyera  | Garcia Morales et al. (2016)             |
|             | Clitoria           | Fabaceae     |                      | Garcia Morales et al. (2016)             |
|             | Cocos nucifera     | Areaceae     | Coconut              | CABI (online)                            |
|             | Coccoloba uvifera  | Polygonaceae | Sea grape            | Garcia Morales et al. (2016)             |
|             | Coffea             | Rubiaceae    | Coffee               | CABI (online)                            |
|             | Cordia myxa        | Boraginaceae | Assyrian plum        | Garcia Morales et al. (2016)             |
|             | Crataegus          | Rosaceae     |                      | Garcia Morales et al. (2016)             |
|             | Crotalaria         | Fabaceae     |                      | Garcia Morales et al. (2016)             |
|             | Croton             | Euphorbiaceae|                      | Garcia Morales et al. (2016)             |
|             | Cupania juglandifolia | Sapindaceae |                      | Garcia Morales et al. (2016)             |
|             | Cuphea             | Lythraceae   |                      | Garcia Morales et al. (2016)             |
|             | Cydonia oblonga    | Rosaceae     | Quince               | Garcia Morales et al. (2016)             |
|             | Diospyros          | Ebenaceae    |                      | Garcia Morales et al. (2016)             |
|             | Dombeya            | Malvaceae    |                      | Garcia Morales et al. (2016)             |
|             | Dovyalis           | Salicaceae   |                      | Garcia Morales et al. (2016)             |
|             | Duranta            | Verbenaceae  |                      | Garcia Morales et al. (2016)             |
|             | Elaeagnus          | Elaeagnaceae |                      | Garcia Morales et al. (2016)             |
|             | Eranthemum         | Acanthaceae  |                      | Garcia Morales et al. (2016)             |
|             | Eriobotrya         | Rosaceae     |                      | Garcia Morales et al. (2016)             |
|             | Erythrina          | Fabaceae     |                      | Garcia Morales et al. (2016)             |
|             | Erythroxylum coca  | Erythroxylaceae |                  | Garcia Morales et al. (2016)             |
|             | Eucalyptus         | Myrtaceae    |                      | Garcia Morales et al. (2016)             |
|             | Eugenia            | Myrtaceae    |                      | Garcia Morales et al. (2016)             |
|             | Euphorbia pulcherrima | Euphorbiaceae | Christmas flower    | Garcia Morales et al. (2016)             |
|             | Ficus aurea        | Moraceae     | Golden fig           | Garcia Morales et al. (2016)             |
|             | Ficus benjamina    | Moraceae     | Weeping fig          | Garcia Morales et al. (2016)             |
|             | Ficus carica       | Moraceae     | Common fig           | Garcia Morales et al. (2016)             |
|             | Ficus drupacea     | Moraceae     | Brown woolly fig     | Garcia Morales et al. (2016)             |
|             | Ficus elastica     | Moraceae     | Indian rubber plant  | Garcia Morales et al. (2016)             |
|             | Ficus lutea        | Moraceae     | Giant-leaved fig     | Garcia Morales et al. (2016)             |
|             | Ficus minahassae   | Moraceae     | Hagimit              | Garcia Morales et al. (2016)             |
|             | Ficus religiosa    | Moraceae     | Sacred fig           | Garcia Morales et al. (2016)             |
|             | Ficus sur          | Moraceae     | Cape fig             | Garcia Morales et al. (2016)             |
|             | Ficus sycomorus    | Moraceae     | Mulberry fig         | Garcia Morales et al. (2016)             |
|             | Ficus virens       | Moraceae     | Grey fig             | Garcia Morales et al. (2016)             |
| Host status | Host name              | Plant family | Common name             | Reference                              |
|-------------|------------------------|--------------|-------------------------|----------------------------------------|
|             | *Flacourtia indica*    | Salicaceae   | Madagascar plum         | Garcia Morales et al. (2016)           |
|             | *Foeniculum vulgare*   | Apiaceae     | Fennel                  | Rivera Amita and Echeverría Sosa (2011) |
|             | *Gardenia*             | Rubiaceae    |                          | Garcia Morales et al. (2016)           |
|             | *Geranium*             | Geraniaceae  |                          | Garcia Morales et al. (2016)           |
|             | *Gossypium*            | Malvaceae    |                          | Garcia Morales et al. (2016)           |
|             | *Graptophyllum pictum* | Acanthaceae  | Caricature plant        | Garcia Morales et al. (2016)           |
|             | *Grevillea robusta*    | Proteaceae   | Silky oak               | CABI (online)                          |
|             | *Guazumula ulmifolia*  | Malvaceae    | West Indian elm         | Garcia Morales et al. (2016)           |
|             | *Hedera helix*         | Araliaceae   | Common ivy              | Garcia Morales et al. (2016)           |
|             | *Heliotropium arborescens* | Boraginaceae | Garden heliotrope       | Garcia Morales et al. (2016)           |
|             | *Hevea brasiliensis*   | Euphorbiaceae| Brazilian rubber tree   | Garcia Morales et al. (2016)           |
|             | *Hibiscus mutabilis*   | Malvaceae    | Confederate rose        | Garcia Morales et al. (2016)           |
|             | *Hibiscus rosa-sinensis* | Malvaceae | China rose              | Garcia Morales et al. (2016)           |
|             | *Ixora*                | Rubiaceae    |                          | Garcia Morales et al. (2016)           |
|             | *Jacaranda mimosifolia*| Bignoniaceae | Blue jacaranda         | Garcia Morales et al. (2016)           |
|             | *Jasminum sambac*      | Oleaceae     | Arabian jasmine         | Garcia Morales et al. (2016)           |
|             | *Justicia spicigera*   | Acanthaceae  | Mexican indigo          | Garcia Morales et al. (2016)           |
|             | *Kalanchoe*            | Crassulaceae |                          | Garcia Morales et al. (2016)           |
|             | *Lagerstroemia*        | Lythraceae   |                          | Garcia Morales et al. (2016)           |
|             | *Lantana*              | Verbenaceae  |                          | Garcia Morales et al. (2016)           |
|             | *Leucena leucocephala* | Fabaceae     | Leucaena                | CABI (online)                          |
|             | *Magnolia*             | Magnoliaceae |                          | Garcia Morales et al. (2016)           |
|             | *Malachra*             | Malvaceae    |                          | Garcia Morales et al. (2016)           |
|             | *Malus domestica*      | Rosaceae     | Apple                   | Abd El-Salam & Mangoud (2001)          |
|             | *Malus prunifolia*     | Rosaceae     | Snow cap                | Garcia Morales et al. (2016)           |
|             | *Mangiferia indica*    | Anacardiaceae| Mango                   | CABI (online)                          |
|             | *Manihot*              | Euphorbiaceae|                          | Garcia Morales et al. (2016)           |
|             | *Manilkara zapota*     | Sapotaceae   | Sapodilla               | CABI (online)                          |
|             | *Mentha x piperita*    | Lamiaceae    | Pepermint               | Rivera Amita and Echeverría Sosa (2011) |
|             | *Melia azedarach*      | Meliaceae    | China berry             | Garcia Morales et al. (2016)           |
|             | *Melocactus*           | Cactaceae    | Turk's cap cactus       | Garcia Morales et al. (2016)           |
|             | *Momordica balsamina*  | Cucurbitaceae| African cucumber        | Garcia Morales et al. (2016)           |
|             | *Morinda citrifolia*   | Rubiaceae    | Noni                     | Garcia Morales et al. (2016)           |
|             | *Morus alba*           | Moraceae     | Silkworm mulberry       | Garcia Morales et al. (2016)           |
|             | *Murraya exotica*      | Rutaceae     | Orange jasmine          | Garcia Morales et al. (2016)           |
|             | *Myrica cerifera*      | Myricaceae   | Candleberry             | Garcia Morales et al. (2016)           |
| Host status | Host name         | Plant family | Common name               | Reference                                      |
|-------------|-------------------|--------------|---------------------------|------------------------------------------------|
|             | Myrsine guianensis| Primulaceae  |                          | Garcia Morales et al. (2016)                   |
|             | Myrtus            | Myrtaceae    |                           | Garcia Morales et al. (2016)                   |
|             | Nerium oleander   | Apocynaceae  | Oleander                  | Garcia Morales et al. (2016)                   |
|             | Ocimum basilicum  | Lamiaceae    | Basil                     | Rivera Amita and Echeverria Sosa (2011)       |
|             | Olea europaea     | Oleaceae     | Olive tree                | EFSA PLH Panel (2021)                         |
|             | Orthosiphon       | Lamiaceae    | Cat's mustache            | Rivera Amita and Echeverria Sosa (2011)       |
|             | Papilioramthe      | Orchidaceae  |                           |                                                 |
|             | Passiflora edulis | Passifloraceae| Passion-fruit vine        | Garcia Morales et al. (2016)                   |
|             | Passiflora     | Passifloraceae| Crimson passionflower   | Garcia Morales et al. (2016)                   |
|             | Pelargonium radula| Geraniaceae  | Crowfoot geranium         | Garcia Morales et al. (2016)                   |
|             | Peltophorum       | Fabaceae     | African flame             | Garcia Morales et al. (2016)                   |
|             | Pentas lanceolata | Rubiaceae    | Egyptian star cluster    | Garcia Morales et al. (2016)                   |
|             | Persea            | Lauraceae    |                           | Garcia Morales et al. (2016)                   |
|             | Poranopsis         | Convolvulaceae| Bridal bouquet           | Garcia Morales et al. (2016)                   |
|             | Phoenix           | Areaceae     |                           | Garcia Morales et al. (2016)                   |
|             | Pinus             | Pinaceae     | Pines                     | CABI (online)                                  |
|             | Pithecellobium    | Fabaceae     |                           | Garcia Morales et al. (2016)                   |
|             | Pittosporum       | Pittosporaceae|                           | Garcia Morales et al. (2016)                   |
|             | Plumbago          | Plumbaginaceae|                           | Garcia Morales et al. (2016)                   |
|             | Plumeria          | Apocynaceae  | Frangipani                | Garcia Morales et al. (2016)                   |
|             | Prosopis          | Fabaceae     |                           | Garcia Morales et al. (2016)                   |
|             | Prunus armeniaca  | Rosaceae     | Apricot                   | Abd El-Salam and Mangoud (2001)               |
|             | Prunus avium      | Rosaceae     | Wild cherry               | Garcia Morales et al. (2016)                   |
|             | Prunus domestica  | Rosaceae     | Plum                      | Garcia Morales et al. (2016)                   |
|             | Prunus persica    | Rosaceae     | Peach                     | Garcia Morales et al. (2016)                   |
|             | Psidium guajava   | Myrtaceae    | Guava                     | Abd El-Salam and Mangoud (2001)               |
|             | Psychotria        | Rubiaceae    |                           | Garcia Morales et al. (2016)                   |
|             | Pyrus communis    | Rosaceae     | Pear                      | Garcia Morales et al. (2016)                   |
|             | Pyrostegia        | Bignoniaceae |                           | Garcia Morales et al. (2016)                   |
|             | Quercus           | Fabaceae     |                           | Garcia Morales et al. (2016)                   |
|             | Quisqualis indica | Combretaceae | Chinese honeysuckle      | Garcia Morales et al. (2016)                   |
|             | Rhus copallinum   | Anacardiaceae| Winged sumac             | Garcia Morales et al. (2016)                   |
|             | Robinia pseudoacacia| Fabaceae   | Locust tree               | Garcia Morales et al. (2016)                   |
|             | Rosa              | Rosaceae     |                           | Garcia Morales et al. (2016)                   |
|             | Russelia          | Plantaginaceae| Coral plant              | Garcia Morales et al. (2016)                   |
|             | Salix             | Salicaceae   |                           | Garcia Morales et al. (2016)                   |
|             | Sambucus          | Adoxaceae    |                           | Garcia Morales et al. (2016)                   |
|             | Sapium            | Euphorbiaceae|                           | Garcia Morales et al. (2016)                   |
|             | Schefflera         | Araliaceae   | Matchwood                 | Garcia Morales et al. (2016)                   |
| Host status | Host name | Plant family | Common name | Reference |
|-------------|-----------|--------------|-------------|-----------|
| Wild weed hosts | Asclepias | Apocynaceae | | Garcia Morales et al. (2016) |
|             | Acalypha indica | Euphorbiaceae | Indian copperleaf | Garcia Morales et al. (2016) |
## Appendix B – Distribution of *Russellaspis pustulans*

Distribution records based on CABI (online), García Morales et al (ScaleNet, online) and literature.

| Region         | Country            | Sub-national (e.g. State) | Status  | Reference                  |
|----------------|--------------------|---------------------------|---------|----------------------------|
| North America  | Anguilla           |                           | Present | CABI (online)              |
|                | Antigua and Barbuda|                           | Present | CABI (online)              |
|                | Bahamas            |                           | Present | CABI (online)              |
|                | Barbados           |                           | Present | CABI (online)              |
|                | Bermuda            |                           | Present | CABI (online)              |
|                | Costa Rica         |                           | Present | CABI (online)              |
|                | Cuba               |                           | Present | CABI (online)              |
|                | Curaçao            |                           | Present | CABI (online)              |
|                | Dominica           |                           | Present | CABI (online)              |
|                | Dominican Republic |                           | Present | CABI (online)              |
|                | El Salvador        |                           | Present | CABI (online)              |
|                | Grenada            |                           | Present | CABI (online)              |
|                | Guadeloupe         |                           | Present | CABI (online)              |
|                | Haiti              |                           | Present | CABI (online)              |
|                | Honduras           |                           | Present | CABI (online)              |
|                | Jamaica            |                           | Present | CABI (online)              |
|                | Martinique         |                           | Present | García Morales et al. (2016) |
|                | Mexico             |                           | Present | CABI (online)              |
|                | Montserrat         |                           | Present | CABI (online)              |
|                | Nicaragua          |                           | Present | CABI (online)              |
|                | Panama             |                           | Present | CABI (online)              |
|                | Puerto Rico        |                           | Present | CABI (online)              |
|                | Saint Croix        |                           | Present | García Morales et al. (2016) |
|                | Saint Kitts and Nevis |                    | Present | CABI (online)              |
|                | Saint Lucia        |                           | Present | CABI (online)              |
|                | Saint Vincent and the Grenadines | | Present | CABI (online) |
|                | Trinidad and Tobago|                           | Present | CABI (online)              |
|                | U.S. Virgin Islands |                         | Present | CABI (online)              |
|                | United States      |                           | Present | CABI (online)              |
|                | United States Florida |                    | Present | García Morales et al. (2016) |
|                | United States Louisiana |                | Present | García Morales et al. (2016) |
|                | United States New York |                        | Present | García Morales et al. (2016) |
|                | United States North Carolina |                | Present | García Morales et al. (2016) |
|                | United States Texas |                           | Present | García Morales et al. (2016) |
|                | United States Hawaii |                         | Present | García Morales et al. (2016) |
| South America  | Brazil             |                           | Present | CABI (online)              |
|                | Colombia           |                           | Present | CABI (online)              |
|                | Ecuador            |                           | Present | CABI (online)              |
|                | Guyana             |                           | Present | CABI (online)              |
|                | Peru               |                           | Present | CABI (online)              |
|                | Trinidad and Tobago|                           | Present | García Morales et al. (2016) |
|                | Venezuela          |                           | Present | CABI (online)              |
| EU (27)        | Cyprus             |                           | Present | CABI (online)              |
| Region | Country | Sub-national (e.g. State)     | Status    | Reference                        |
|--------|---------|-------------------------------|-----------|----------------------------------|
| Italy  |         |                               | Present   | Garcia Morales et al. (2016)     |
| Malta  |         |                               | Present   | Garcia Morales et al. (2016)     |
| Spain  |         | Gran Canaria                  | Present   | C Malumphy, personal communication, 2022 |
|        |         | Tenerife                       | Present   | C Malumphy, personal communication, 2022 |
| Africa |         | Cape Verde                    | Present   | Garcia Morales et al. (2016)     |
|        | Egypt   |                               | Present   | CABI (online)                    |
|        | Gabon   |                               | Present   | Garcia Morales et al. (2016)     |
|        | Kenya   |                               | Present   | Garcia Morales et al. (2016)     |
|        | Madagascar |                             | Present   | Garcia Morales et al. (2016)     |
|        | Malawi  |                               | Present   | Garcia Morales et al. (2016)     |
|        | Mauritius | Agalega islands               | Present   | Garcia Morales et al. (2016)     |
|        |         | Rodrigues island               | Present   | Garcia Morales et al. (2016)     |
|        | Mozambique |                             | Present   | Garcia Morales et al. (2016)     |
|        | São Tomé and Principe |                 | Present   | CABI (online)                    |
|        | Seychelles |                             | Present   | Garcia Morales et al. (2016)     |
|        | Sierra Leone |                           | Present   | Garcia Morales et al. (2016)     |
|        | South Africa |                         | Present   | Garcia Morales et al. (2016)     |
|        | Tanzania  |                               | Present   | Garcia Morales et al. (2016)     |
| Asia   |         | China                         | Present   | CABI (online)                    |
|        | India    |                               | Present   | CABI (online)                    |
|        | Indonesia | Irian Jaya (now Papua)         | Present   | Garcia Morales et al. (2016)     |
|        | Iran     |                               | Present   | Garcia Morales et al. (2016)     |
|        | Israel   |                               | Present   | Ben-Dov, 2012                    |
|        | Japan    | Bonin islands                 | Present   | Garcia Morales et al. (2016)     |
|        | Oman     |                               | Present   | Garcia Morales et al. (2016)     |
|        | Pakistan |                               | Present   | Garcia Morales et al. (2016)     |
|        | Saudi Arabia |                         | Present   | Garcia Morales et al. (2016)     |
|        | Sri Lanka |                               | Present   | Garcia Morales et al. (2016)     |
|        | Taiwan   |                               | Present   | CABI (online)                    |
|        | Turkey   |                               | Present   | CABI (online)                    |
|        | Yemen    |                               | Present   | Garcia Morales et al. (2016)     |
| Oceania|         | Fiji Islands                  | Present   | Garcia Morales et al. (2016)     |
|        |         | French Polynesia              | Present   | Garcia Morales et al. (2016)     |
|        |         | Kiribati                      | Present   | Garcia Morales et al. (2016)     |
|        |         | New Caledonia                 | Present   | Garcia Morales et al. (2016)     |
|        |         | Papua New Guinea              | Present   | Garcia Morales et al. (2016)     |
|        |         | Tuvalu                        | Present   | Garcia Morales et al. (2016)     |
Appendix C – Annual frost days

Source: Climatic Research Unit high resolution gridded data set CRU TS v. 4.03 at 0.5° resolution (https://crudata.uea.ac.uk/cru/data/hrg/).