Pest categorisation of *Scirtothrips citri*

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Abstract

The Panel on Plant Health performed a pest categorisation of the citrus thrips, *Scirtothrips citri* (Moulton) (Thysanoptera: Thripidae), for the European Union (EU). This is a well-defined and distinguishable species, occurring in North America and Asia. Its precise distribution in Asia is uncertain. *S. citri* is a pest of citrus and blueberries and has been cited on over 50 different host species in 33 plant families. Whether all plants reported as hosts are true hosts, allowing population development of *S. citri*, is uncertain. *S. citri* feeds exclusively on young actively growing foliage and fruit. It is not known to occur in the EU and is listed in Annex IIAI of 2000/29/EC as a harmful organism. The international trade of hosts, as either plants for planting or cut flowers, provide potential pathways into the EU. However, current EU legislation prohibits the import of citrus plants for planting. Furthermore, measures aimed at the import of plants for planting in a dormant stage (no young foliage or fruits present) with no soil/growing medium attached, decreases the likelihood of the pest’s entry via other hosts. Considering that there are regional climatic similarities where *S. citri* occurs in the USA with climates in the EU, and taking EU host distribution into account, *S. citri* has the potential to establish in the EU, especially in citrus and blueberry growing regions around the Mediterranean where quality losses in citrus and yield losses in blueberry could occur. Phytosanitary measures are available to inhibit the likelihood of introduction of *S. citri* from infested countries. Considering the criteria within the remit of EFSA to assess its status as a potential Union quarantine pest (QP) or as a potential regulated non-quarantine pest (RNQP), *S. citri* meets with no uncertainties the criteria assessed by EFSA for consideration as a potential Union QP.

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1. Introduction

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

1.1.1. Background

Council Directive 2000/29/EC on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community establishes the present European Union plant health regime. The Directive lays down the phytosanitary provisions and the control checks to be carried out at the place of origin on plants and plant products destined for the Union or to be moved within the Union. In the Directive's 2000/29/EC annexes, the list of harmful organisms (pests) whose introduction into or spread within the Union is prohibited, is detailed together with specific requirements for import or internal movement.

Following the evaluation of the plant health regime, the new basic plant health law, Regulation (EU) 2016/2031 on protective measures against pests of plants, was adopted on 26 October 2016 and will apply from 14 December 2019 onwards, repealing Directive 2000/29/EC. In line with the principles of the above mentioned legislation and the follow-up work of the secondary legislation for the listing of EU regulated pests, EFSA is requested to provide pest categorizations of the harmful organisms included in the annexes of Directive 2000/29/EC, in the cases where recent pest risk assessment/pest categorisation is not available.

1.1.2. Terms of reference

EFSA is requested, pursuant to Article 22(5.b) and Article 29(1) of Regulation (EC) No 178/2002, to provide scientific opinion in the field of plant health.

EFSA is requested to prepare and deliver a pest categorisation (step 1 analysis) for each of the regulated pests included in the appendices of the annex to this mandate. The methodology and template of pest categorisation have already been developed in past mandates for the organisms listed in Annex II Part A Section II of Directive 2000/29/EC. The same methodology and outcome is expected for this work as well.

The list of the harmful organisms included in the annex to this mandate comprises 133 harmful organisms or groups. A pest categorisation is expected for these 133 pests or groups and the delivery of the work would be stepwise at regular intervals through the year as detailed below. First priority covers the harmful organisms included in Appendix 1, comprising pests from Annex II Part A Section I and Annex II Part B of Directive 2000/29/EC. The delivery of all pest categorisations for the pests included in Appendix 1 is June 2018. The second priority is the pests included in Appendix 2, comprising the group of Cicadellidae (non-EU) known to be vector of Pierce's disease (caused by Xylella fastidiosa), the group of Tephritidae (non-EU), the group of potato viruses and virus-like organisms, the group of viruses and virus-like organisms of Cydonia Mill., Fragaria L., Malus Mill., Prunus L., Pyrus L., Ribes L., Rubus L. and Vitis L.. and the group of Margarodes (non-EU species). The delivery of all pest categorisations for the pests included in Appendix 2 is end 2019. The pests included in Appendix 3 cover pests of Annex I part A section I and all pests categorisations should be delivered by end 2020.

For the above mentioned groups, each covering a large number of pests, the pest categorisation will be performed for the group and not the individual harmful organisms listed under “such as” notation in the Annexes of the Directive 2000/29/EC. The criteria to be taken particularly under consideration for these cases, is the analysis of host pest combination, investigation of pathways, the damages occurring and the relevant impact.

Finally, as indicated in the text above, all references to ‘non-European’ should be avoided and replaced by ‘non-EU’ and refer to all territories with exception of the Union territories as defined in Article 1 point 3 of Regulation (EU) 2016/2031.

1.1.2.1. Terms of Reference: Appendix 1

List of harmful organisms for which pest categorisation is requested. The list below follows the annexes of Directive 2000/29/EC.
Annex IIAI

(a) Insects, mites and nematodes, at all stages of their development

Aleurocactus spp.  
Anthonomus biginifer (Schenkling)  
Anthonomus signatus (Say)  
Aschistonyx eppoi Inouye  
Carposina niponensis Walsingham  
Enarmonia packardi (Zeller)  
Enarmonia prunivora Walsh  
Grapholita inopinata Heinrich  
Hisshomonus phycitis  
Leucaspis japonica Ckll.  
Listronotus bonariensis (Kuschel)

(b) Bacteria

Citrus variegated chlorosis  
Erwinia stuntii (Smith) Dye

(c) Fungi

Alternaria alternata (Fr.) Keissler (non-EU pathogenic isolates)  
Anisogromma anomala (Peck) E. Müller  
Apionspora morbosa (Schwein.) v. Arx  
Ceratocystis virescens (Davidson) Moreau  
Cercoseptoria pini-densiflora (Hori and Nambu) Deighton  
Cercospora angolensis Carv. and Mendes

(d) Virus and virus-like organisms

Beet curly top virus (non-EU isolates)  
Black raspberry latent virus  
Blight and blight-like  
Cadang-Cadang viroid  
Citrus tristeza virus (non-EU isolates)  
Leprosis

Annex IIB

(a) Insect mites and nematodes, at all stages of their development

Anthonomus grandis (Boh.)  
Cephalcia lariciphila (Klug)  
Dendroctonus micans Kugelan  
Gilphinia hercyniae (Hartig)  
Goniapterus scutellatus Gyll.  
Ips amitinus Eichhof

(b) Bacteria

Curtobacterium flaccumfaciens pv. flaccumfaciens (Hedges) Collins and Jones
(c) Fungi

Glomerella gossypii Edgerton  
Hyphoxylon mammatum (Wahl.) J. Miller  
Gremmeniella abietina (Lag.) Morelet

1.1.2.2. Terms of Reference: Appendix 2

List of harmful organisms for which pest categorisation is requested per group. The list below follows the categorisation included in the annexes of Directive 2000/29/EC.

Annex IAI

(a) Insects, mites and nematodes, at all stages of their development

Group of Cicadellidae (non-EU) known to be vector of Pierce’s disease (caused by Xylella fastidiosa), such as:

1) Carneocephala fulgida Nottingham  
2) Draeculacephala minerva Ball

Group of Tephritidae (non-EU) such as:

1) Anastrepha fraterculus (Wiedemann)  
2) Anastrepha ludens (Loew)  
3) Anastrepha obliqua Macquart  
4) Anastrepha suspensa (Loew)  
5) Dacus ciliatus Loew  
6) Dacus curcurbitae Coquillet  
7) Dacus dorsalis Hendel  
8) Dacus tryoni (Froggatt)  
9) Dacus tsuneonis Miyake  
10) Dacus zonatus Saund.  
11) Epochra canadensis (Loew)

(c) Viruses and virus-like organisms

Group of potato viruses and virus-like organisms such as:

1) Andean potato latent virus  
2) Andean potato mottle virus  
3) Arracacha virus B, oca strain  
4) Potato black ringspot virus  
5) Potato virus T  
6) non-EU isolates of potato viruses A, M, S, V, X and Y (including Yo, Yn and Yc) and Potato leafroll virus

Group of viruses and virus-like organisms of Cydonia Mill., Fragaria L., Malus Mill., Prunus L., Pyrus L., Ribes L., Rubus L. and Vitis L., such as:

1) Blueberry leaf mottle virus  
2) Cherry rasp leaf virus (American)  
3) Peach mosaic virus (American)  
4) Peach phony rickettsia  
5) Peach rosette mosaic virus  
6) Peach rosette mycoplasma  
7) Peach X-disease mycoplasma  
8) Peach yellows mycoplasma  
9) Plum line pattern virus (American)  
10) Raspberry leaf curl virus (American)  
11) Strawberry witches’ broom mycoplasma  
12) Non-EU viruses and virus-like organisms of Cydonia Mill., Fragaria L., Malus Mill., Prunus L., Pyrus L., Ribes L., Rubus L. and Vitis L.
Annex IIAI

(a) Insects, mites and nematodes, at all stages of their development

Group of Margarodes (non-EU species) such as:

1) Margarodes vitis (Phillipi)
2) Margarodes vredendalensis de Klerk
3) Margarodes prieskaensis Jakubski

1.1.2.3. Terms of Reference: Appendix 3

List of harmful organisms for which pest categorisation is requested. The list below follows the annexes of Directive 2000/29/EC.

Annex IIAI

(a) Insects, mites and nematodes, at all stages of their development

Acleris spp. (non-EU)  
Amauromyza maculosa (Malloch)  
Anomala orientalis Waterhouse  
Arrhenodes minutus Drury  
Choristoneura spp. (non-EU)  
Conotrachelus nenuphar (Herbst)  
Dendrolimus sibiricus Tschetyverikov  
Diabrotica barberi Smith and Lawrence  
Diabrotica undecimpunctata howardi Barber  
Diabrotica undecimpunctata undecimpunctata Mannerheim  
Diabrotica virgifera zeae Krysan & Smith  
Diaphorina citri Kuway  
Heliothis zea (Boddie)  
Hirschmanniella spp., other than Hirschmanniella gracilis (de Man) Luc and Goodey  
Liriomyza sativae Blanchard

(b) Fungi

Ceratocystis fagacearum (Bretz) Hunt  
Chrysomyxa arctostaphyli Dietel  
Cronartium spp. (non-EU)  
Endocronartium spp. (non-EU)  
Guignardia laricina (Saw.) Yamamoto and Ito  
Gymnosporangium spp. (non-EU)  
Inonotus weirii (Murril) Kotlaba and Pouzar  
Melampsora farlowii (Arthur) Davis  

(c) Viruses and virus-like organisms

Tobacco ringspot virus  
Tomato ringspot virus  
Bean golden mosaic virus  
Cowpea mild mottle virus  
Lettuce infectious yellows virus

Longidorus diadecturus Eveleigh and Allen  
Monochamus spp. (non-EU)  
Myndus crudus Van Duzee  
Nacobbus aberrans (Thorne) Thorne and Allen  
Naupactus leucoloma Boheman  
Premonotrypes spp. (non-EU)  
Pseudopityophthorus minutissimus (Zimmermann)  
Pseudopityophthorus pruinulosus (Eichhoff)  
Scaphoideus luteolus (Van Duzee)  
Spodoptera eridania (Cramer)  
Spodoptera frugiperda (Smith)  
Spodoptera litura (Fabricus)  
Thrips palmi Kamy  
Xiphinema americanum Cobb sensu lato (non-EU populations)  
Xiphinema californicum Lamberti and Bleve-Zacheo  
Mycosphaerella larici-leptolepis Ito et al.  
Mycosphaerella populorum G. E. Thompson  
Phoma andina Turkensteen  
Phyllosticta solitaria Ell. and Ev.  
Septoria lycopersici Speg. var. malagutii Ciccarone and Boerema  
Thechaphora solani Barrus  
Treichispora brinkmanni (Bresad.) Rogers  
Pepper mild tigré virus  
Squash leaf curl virus  
Euphorbia mosaic virus  
Florida tomato virus
(d) Parasitic plants

*Arceuthobium* spp. (non-EU)

**Annex I AII**

(a) Insects, mites and nematodes, at all stages of their development

- *Meloidogyne fallax* Karssen
- *Rhizoecus hibisci* Kawai and Takagi
- *Popillia japonica* Newman

(b) Bacteria

- *Clavibacter michiganensis* (Smith) Davis et al.
  - *Ralstonia solanacearum* (Smith) Yabuuchi et al.
  - *Clavibacter sepedonicus* (Spieckermann and Kotthoff) Davis et al.

(c) Fungi

- *Melampsora medusae* Thümen
- *Synchytrium endobioticum* (Schilbersky) Percival

**ANNEX I B**

(a) Insects, mites and nematodes, at all stages of their development

- *Leptinotarsa decemlineata* Say
- *Liriomyza bryoniae* (Kaltenbach)

(b) Viruses and virus-like organisms

Beet necrotic yellow vein virus

1.2. Interpretation of the Terms of Reference

*Scirtothrips citri* is one of a number of pests listed in the Appendices to the Terms of Reference (ToR) to be subject to pest categorisation to determine whether it fulfils the criteria of a quarantine pest (QP) or those of a regulated non-quarantine pest (RNQP) for the area of the European Union (EU) excluding Ceuta, Melilla and the outermost regions of Member States (MSs) referred to in Article 355 (1) of the Treaty on the Functioning of the European Union (TFEU), other than Madeira and the Azores.

Within Annex II A/I of 2000/29 EC the species is listed as *Scirtothrips citri* (Moultex). However, we assume that the given authority is a misprint which actually corresponds to Moulton, who originally described this thrips in 1909 as *Euthrips citri* (Moulton, 1909). For the purposes of this pest categorisation, the valid combination *Scirtothrips citri* (Moulton) is used.

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A literature search on *S. citri* 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. Relevant papers were reviewed, further references and information were obtained from experts, from citations within the references and grey literature.

2.1.2. Database search

Pest information, on host(s) and distribution, was retrieved from the EPPO Global Database (EPPO, 2017).

Data about the area of hosts grown in the EU were obtained from EUROSTAT (http://ec.europa.eu/eurostat/web/agriculture/data/database).

The Europhyt database was consulted for pest-specific notifications on interceptions and outbreaks. Europhyt is a web-based network launched by the Directorate General for Health and Consumers (DG...
SANCO), and is a subproject of PHYSAN (Phyto-Sanitary Controls) specifically concerned with plant health information. The Europhyt database manages 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 MSs and the phytosanitary measures taken to eradicate or avoid their spread.

2.2. Methodologies

The Panel performed the pest categorisation for *S. citri*, following guiding principles and steps presented in the EFSA guidance on the harmonised framework for pest risk assessment (EFSA PLH Panel, 2010) and as defined in the International Standard for Phytosanitary Measures No 11 (FAO, 2013) and No 21 (FAO, 2004).

In accordance with the guidance on a harmonised framework for pest risk assessment in the EU (EFSA PLH Panel, 2010), this work was initiated following an evaluation of the EU’s plant health regime. Therefore, to facilitate the decision-making process, in the conclusions of the pest categorisation, the Panel addresses explicitly each criterion for a Union QP and for a Union RNQP in accordance with Regulation (EU) 2016/2031 on protective measures against pests of plants, and includes additional information required as per the specific terms of reference received by the European Commission. In addition, for each conclusion, the Panel provides a short description of its associated uncertainty.

Table 1 presents the Regulation (EU) 2016/2031 pest categorisation criteria on which the Panel bases its conclusions. All relevant criteria have to be met for the pest to qualify either as a QP or as a RNQP. If one of the criteria is not met, the pest will not qualify. In such a case, the working group should consider the possibility to terminate the assessment early and be concise in the sections preceding the question for which the negative answer is reached. Note that a pest that does not qualify as a QP may still qualify as a regulated non-quarantine pest which needs to be addressed in the opinion.

It should be noted that the Panel’s conclusions are formulated respecting its remit and particularly with regards to the principle of separation between risk assessment and risk management (EFSA founding regulation1); therefore, instead of determining whether the pest is likely to have an unacceptable impact, the Panel will present a summary of the observed pest impacts. Economic impacts are expressed in terms of yield and quality losses and not in monetary terms, while addressing social impacts is outside the remit of the Panel, in agreement with EFSA guidance on a harmonised framework for pest risk assessment (EFSA PLH Panel, 2010).

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 | Criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest | Criterion in Regulation (EU) 2016/2031 regarding protected zone quarantine pest (articles 32–35) |
|----------------------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Identity of the pest (Section 3.1) | Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible? | Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible? | Is the identity of the pest established, 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 widely distributed within the EU? Describe the pest distribution briefly! | Is the pest present in the EU territory? If not, it cannot be a regulated non-quarantine pest. (A regulated non-quarantine pest must be present in the risk assessment area). | Is the pest present in the EU territory? If not, it cannot be a protected zone quarantine organism. |

1 Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. OJ L 31/1, 1.2.2002, p. 1–24.
### 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 to be transmissible?

Yes, *S. citri* is a well-defined insect in the order Thysanoptera, family Thripidae.

| Criterion of pest categorisation | Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest | Criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest | Criterion in Regulation (EU) 2016/2031 regarding protected zone quarantine pest (articles 32–35) |
|----------------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| **Regulatory status** (Section 3.3) | 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. | Is the pest regulated as a quarantine pest? If currently regulated as a quarantine pest, are there grounds to consider its status could be revoked? | The protected zone system aligns with the pest free area system under the International Plant Protection Convention (IPPC). The pest satisfies the IPPC definition of a quarantine pest that is not present in the PRA area (i.e. protected zone). |
| **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! | Is spread mainly via specific plants for planting, rather than via natural spread or via movement of plant products or other objects? Clearly state if plants for planting is the main pathway! | Is the pest able to enter into, become established in, and spread within, the protected zone areas? Is entry by natural spread from EU areas where the pest is present possible? |
| **Potential for consequences in the EU territory** (Section 3.5) | Would the pests’ introduction have an economic or environmental impact on the EU territory? | Does the presence of the pest on plants for planting have an economic impact, as regards the intended use of those plants for planting? | Would the pests’ introduction have an economic or environmental impact on the protected zone areas? |
| **Available measures** (Section 3.6) | Are there measures available to prevent the entry into, establishment within or spread of the pest within the EU such that the risk becomes mitigated? | Are there measures available to prevent pest presence on plants for planting such that the risk becomes mitigated? | Are there measures available to prevent the entry into, establishment within or spread of the pest within the EU such that the risk becomes mitigated? Is it possible to eradicate the pest in a restricted area within 24 months after the presence of the pest was confirmed in the PZ? |
| **Conclusion of pest categorisation** (Section 4) | A statement as to whether (1) all criteria above for consideration as a potential quarantine pest were met and (2) if not, which one(s) were not met. | A statement as to whether (1) all criteria above for consideration as a potential regulated non-quarantine pest were met, and (2) if not, which one(s) were not met. | A statement as to whether (1) all criteria above for consideration as potential protected zone quarantine pest were met, and (2) if not, which one(s) were not met. |
The citrus thrips, *S. citri* (Moulton) (Thysanoptera: Thripidae) was initially described by Moulton in 1909 from specimens collected in California, along with remarks on its life history, nature of injury, pupation site and a tobacco extract remedy (Tanigoshi and Nishio-Wong, 1982). Synonyms include *Euthrips citri* Moulton, 1909 and *Scirtothrips clivicola* Hood, 1957.

A series of 15 new *Scirtothrips* species found on mango in Mexico were described by Johansen and Mojica-Guzman (1998) and differentiated based on the arrangement of setae. However, the 15 species were later recognised as synonyms of *S. citri* by Mound and Hoddle (2016) given that the arrangement of setae is variable within populations of *S. citri*. While molecular analysis of two genes, CO1 and 28S-D2, indicated that there is variation at a molecular level between populations, the variation is not sufficient to support the species designations of Johansen and Mojica-Guzman (1998) (Mound and Hoddle, 2016).

The genus *Scirtothrips* is comprised of over 100 described species worldwide; they can easily be distinguished from other genera within the same family (CABI, 2017) but identification to species is not easy (Mound and Palmer, 1981). Keys exist for the adults (winged males and females) of the different species within the genus (e.g. Mound and Palmer, 1981). Both morphological and molecular data can be used to distinguish species (EPPO, 2005; Hoddle et al., 2008; Mound and Hoddle, 2016; CABI, 2017).

### 3.1.2. Biology of the pest

*Scirtothrips citri* overwinters only in the egg stage (Lewis, 1973). In California, these overwintering eggs are mostly laid in the autumn during the last leaf flush of the season and they do not enter diapause (Tanigoshi and Nishio-Wong, 1982). All *Scirtothrips* spp. go through five developmental stages (EPPO, 2005; CABI, 2017): the egg, two actively feeding immature instars, known as first and second instar larvae, two non-feeding immature instars, known as prepupa and pupa, and the winged feeding adults. Munger (1942) reported that at 31°C adult female *S. citri* live for between 26 and 30 days. As with all thrips belonging to the Terebrantia suborder, *Scirtothrips* spp. females insert individual eggs into young, soft tissues of leaves, stems and fruit with their distinctive saw-like ovipositor. Where eggs are embedded relatively deeply into a host, the incision closes almost completely after the ovipositor is withdrawn (Lewis, 1973). Females typically lay around 25–35 eggs over their lifetime (Munger, 1942; University of California (UC), 1991; Smith et al., 1997) although up to 250 eggs has been reported by Tanigoshi and Nishio-Wong (1982). Virgin females produce only male offspring but fertilised females produce mostly females and some males (Lewis, 1973).

Adults of the first generation appear from February to March. First and second generations are usually discrete but successive generations overlap. Depending on temperature, up to 11 generations may develop in a year. Motile stages (larvae and adults) feed actively on tender leaves and fruit, especially under the sepals of young fruit. After completion of the second instar, some larvae drop to the ground to pupate while others pupate in crevices and curled leaves on the tree (Tanigoshi and Nishio-Wong, 1982; UC, 1991; Kerns et al., 2001). Indeed, in a study carried out in California less, than one-third of the adults in an orange orchard originated from larvae that pupated in the ground (Grout et al., 1986). Adults actively fly (Moreno et al., 1984).

Munger (1942) reported that at 25°C development from egg to adult took 16 days while at 31°C such development took just under 13 days. The lower development threshold for *S. citri* is 14.6°C and 300 degree days are necessary for a generation to be completed (UC, 1991). A constant temperature of 37.5°C prevented egg hatching and moulting to the second stage (Tanigoshi and Nishio-Wong, 1982).

### 3.1.3. Detection and identification of the pest

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

Yes, EPPO produced a standard addressing the detection and identification of *S. citri* (EPPO, 2005).

Detection: all developmental stages of this insect, both actively feeding and quiescent, can be found on host buds, leaves, and fruit. However, detection may be difficult as (a) eggs (bean-shaped, < 0.2 mm long) are inserted into the plant tissue; (b) larvae (spindle shaped, colourless when recently hatched and yellowish afterwards, < 0.8 mm long) undergo a moulting phase in between instars for which they usually seek refugia such as leaf veins and subaxillary pits; (c) prepupa (yellowish, with short wing pads and the four segmented antennae directed forward) and pupae (longer wing-parts
and antennae directed backward over the head) may be also found in the soil; and (d) adults (winged, yellowish, < 0.9 mm long) are minute, which makes visual detection challenging (Tanigoshi and Nishio-Wong, 1982; EPPO, 2005). Therefore, use of Berlese funnels is recommended. Furthermore, as larvae are almost exclusively localised on young growing buds, young leaves, sepals and young fruits, these organs should be examined particularly carefully (EPPO, 2005). As adult *S. citri* are attracted to white and yellow colours, yellow sticky cards can be used as a relative indicator of *S. citri* presence and activity (Kerns et al., 2001).

Symptoms: because of the typical asymmetrical piecing-sucking mouthparts of thrips, their puncturing of epidermal cells results in scabby, greyish or silvery scars on leaves and rind in citrus (Morse, 1995). In citrus in California, second instar larvae of the second generation do most of the damage when feeding under the sepals of young fruit. As the fruit grow, this damage results in a ring of scarred tissue around the fruit peduncle. Outer fruit suffers heavier symptoms than those protected in the canopy (UC, 1991; EPPO, 2005).

Identification: conventional morphological keys and a diagnostic protocol are available for the identification of adult species of *Scirtothrips*. Cleared specimens mounted on microscopic slides can be identified at a magnification factor between 100x and 600x. Characters allowing species determination based on Palmer et al. (1989) can be found in the EPPO diagnostic standard (EPPO, 2005). However, it is not possible to distinguish between immature stages of *Scirtothrips* spp. using conventional morphological techniques and molecular methods must be used (Hoddle et al., 2008).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

*Scirtothrips citri* is a Nearctic species native to the south-western United States and north-western Mexico (Tanigoshi and Nishio-Wong, 1982), it also occurs in Florida. A record of occurrence in India in Jammu (Bhagat et al., 1999) is regarded by EPPO as unreliable because at that time EPPO noted that ‘This is the only record outside America and is therefore considered very doubtful’ (EPPO, 2017). However, since the report by Bhagat et al. (1999), there have been subsequent reports of *S. citri* elsewhere in India (e.g. Sharma, 2007) and findings in other Asian countries (China, 2003 and Iran, 2007) (EPPO, 2017). However, in a 2017 checklist of thrips in India, Rachana and Varatharajan (2017) did not record *S. citri* as occurring in India.

In 2003, the UK intercepted *S. citri* from Thailand (a country where *S. citri* was not known to occur) (see Section 3.4.2 Entry, below). The reported distribution of *S. citri* is shown in Table 2 and illustrated in Figure 1. The distribution of this species in Asia is considered uncertain.

**Table 2: Global distribution of *S. citri***

| Region     | Country   | Subnational distribution       | Status                      | Reference                      |
|------------|-----------|--------------------------------|-----------------------------|--------------------------------|
| North America | Mexico   | Present, restricted distribution | EPPO (2017)                  |
|            | USA       | Present, restricted distribution | EPPO (2017)                  |
|            | Arizona   | Present, no details          | EPPO (2017)                  |
|            | California | Present, no details       | EPPO (2017)                  |
|            | Florida   | Present, no details          | EPPO (2017)                  |
|            | Nevada    | Present, no details          | Weeks et al. (2012)          |
|            | Washington | Present, no details       | CABI (2017)                  |
| Asia       | China     | Present, restricted distribution | EPPO (2017)                  |
|            | Jiangxi   | Present, no details          | EPPO (2017)                  |
| India      | Jammu & Kashmir | Present, no details | Bhagat et al. (1999)*, Satyagopal et al. (2014) |
|            | Punjab    | Present, no details          | Sharma (2007)                |
| Iran       | Present, no details | EPPO (2017) |
| Thailand   | Detected in UK from a consignment exported from Thailand | Europhyt (see Section 3.4.2 Entry) |

*: Regarded by EPPO as an unreliable record as this was the first report of *S. citri* outside of North America at the time.
3.2.2. Pest distribution in the EU

*Scirtothrips citri* is not known to occur in the EU. Its absence from the Netherlands has been confirmed by surveys (EPPO, 2017). The Belgium NPPO declares *S. citri* as absent based on the lack of pest records (EPPO, 2017).

In 2008, *S. citri* was found on a yellow sticky trap in a glasshouse within a public botanic garden in southern England, UK. Action was taken against the finding and eradication was successful (Defra, unpublished data). *S. citri* is not known to occur in the UK.

3.3. Regulatory status

3.3.1. Council Directive 2000/29/EC

The organism subject to pest categorisation is listed in Council Directive 2000/29/EC as *Scirtothrips citri*. Details are presented in Tables 3 and 4.

### Table 3: *Scirtothrips citri* in Council Directive 2000/29/EC

| Annex II, Part A | Harmful organisms whose introduction into, and spread within, all Member States shall be banned if they are present on certain plants or plant products |
|------------------|--------------------------------------------------------------------------------------------------------------------------|
| **Section I**    | Harmful organisms not known to occur in the Community and relevant for the entire Community                              |
| (a)              | Insects, mites and nematodes, at all stages of their development                                                          |
| Species          | Subject of contamination                                                                                                 |
| 27.              | *Scirtothrips citri* (Moultex)                                                                                           |
|                  | Plants of *Citrus* L, *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruit and seeds               |

(Note that the authority (Moultex) is interpreted as being (Moulton) - see 1.2)
3.3.2. Legislation addressing plants and plant parts on which *Scirtothrips citri* is regulated

### Table 4: Regulated hosts and commodities that may involve *S. citri* in Annexes III, IV, and V of Council Directive 2000/29/EC

| Annex III, Part A | Plants, plant products and other objects the introduction of which shall be prohibited in all Member States |
|-------------------|---------------------------------------------------------------------------------------------------------------|
| Description | Country of origin |
| 16 | Plants of *Citrus L.*, *Fortunella Swingle*, *Poncirus Raf.*, and their hybrids, other than fruit and seeds | Third countries |

| Annex IV, Part A | Special requirements which shall be laid down by all member states for the introduction and movement of plants, plant products and other objects into and within all member states |
|-------------------|------------------------------------------------------------------------------------------------------------------|
| Section I | Plants, plant products and other objects originating outside the community |
| Description | Special requirements |
| 16.1 | Fruits of *Citrus L.*, *Fortunella Swingle*, *Poncirus Raf.*, and their hybrids, originating in third countries | The fruits should be free from peduncles and leaves and the packaging should bear an appropriate origin mark. |
| 16.5 | Fruits of *Citrus L.*, *Fortunella Swingle*, *Poncirus Raf.*, and their hybrids, originating in third countries | Without prejudice to the provisions applicable to the fruits in Annex IV(A)(I) (16.1), (16.2) and (16.3), official statement that: (a) the fruits originate in areas known to be free from the relevant organism; or, if this requirement cannot be met; (b) no signs of the relevant organism have been observed at the place of production and in its immediate vicinity since the beginning of the last complete cycle of vegetation, on official inspections carried out at least monthly during the three months prior to harvesting, and none of the fruits harvested at the place of production has shown, in appropriate official examination, signs of the relevant organism, or if this requirement can also not be met; (c) the fruits have shown, in appropriate official examination on representative samples, to be free from the relevant organism in all stages of their development; or, if this requirement can also not be met; (d) the fruits have been subjected to an appropriate treatment, any acceptable vapour heat treatment, cold treatment, or quick freeze treatment, which has been shown to be efficient against the relevant organism without damaging the fruit, and, where not available, chemical treatment as far as it is acceptable by Community legislation. |

| Annex V | Plants, plant products and other objects which must be subject to a plant health inspection (at the place of production if originating in the Community, before being moved within the Community—in the country of origin or the consignor country, if originating outside the Community) before being permitted to enter the Community |
|-------------------|------------------------------------------------------------------------------------------------------------------|
| Part B | Plants, plant products and other objects originating in territories, other than those territories referred to in Part A |
| Section I | Plants, plant products and other objects which are potential carriers of harmful organisms of relevance for the entire Community |
| Description | |
| 1 | Plants, intended for planting, other than seeds but including seeds of [...] *Citrus L.*, *Fortunella Swingle* and *Poncirus Raf.*, and their hybrids [...] |
| 3 | Fruits of: — *Citrus L.*, *Fortunella Swingle*, *Poncirus Raf.*, *Microcitrus Swingle*, *Naringi Adans.*, *Swinglea Merr.* and their hybrids [...] |
3.4. Entry, establishment and spread in the EU

3.4.1. Host range

The main hosts of primary concern within North America are *Citrus* and *Vaccinium corymbosum*. However, the reported host range of *S. citri* is fairly broad with more than 50 species from 33 plant families reported as hosts (Horton, 1918; Morse, 1995; CABI, 2017). Appendix A provides a list of plant species reported to be *S. citri* hosts. However, as Morse (1995) and Smith et al. (1997) note, some records may represent plant species on which *S. citri* was found casually or on which only adults were found feeding. Incidence of adults alone does not constitute evidence that the plant is a true host. A true host must allow reproduction and sustain development of all life stages.

*Rhus larina* and *Quercus* sp. are believed to be the original hosts of *S. citri* in its native California (Tanigoshi and Nishio-Wong, 1982; Morse, 1995). *S. citri* adapted to citrus, non-native plants in California, and eventually became significant pests of citrus in the early 20th Century (Moulton, 1909). *S. citri* also further adapted to *Vaccinium corymbosum* after highbush blueberry cultivars adapted to California’s climate were grown in California (Haviland et al., 2009). There is scope for the polyphagous *S. citri* to further adapt and expand its host range.

Plant legislation (Dir. 2000/29/EC), in relation specifically to *S. citri*, applies only to *Citrus* L., *Fortunella* Swingle *Poncirus* Raf. and their hybrids. Therefore other hosts are not covered.

3.4.2. Entry

Up to December 2017, there is one record of an EU interception of *S. citri* in the Europhyt database. It relates to an interception in 2003 in the UK on a consignment of *Festuca pratensis* seeds (plants for planting not yet planted) coming from Thailand. This is considered an unusual interception given that *S. citri* feeds on actively growing leaf and fruit tissues rather than grass seed.

More likely pathways for *S. citri* would be:

- plants for planting, on either young leaves or fruit (all stages), or in the associated soil/litter (prepupae and pupae),
- cut flowers with young leaves or fruit (all stages),
- fruit, most likely on young fruit (all developmental stages). Very unlikely on mature commercial fruit.

Current EU legislation prohibits the import of plants of *Citrus*, *Fortunella*, *Poncirus* and their hybrids, other than fruit and seeds from third countries. Therefore, pathways 1 and 2 can be considered as closed for citrus. For other hosts, the number of plant species that could provide a pathway via plants for planting or cut flowers is uncertain because of the lack of sound data supporting the status of plants reported as hosts (Morse, 1995; CABI, 2017). Nevertheless, *S. citri* is potentially highly polyphagous and the current measures aimed at the import of plants for planting in a dormant stage (no young foliage or fruits present) with no soil/growing medium/debris attached decreases the likelihood of *S. citri* being carried with imports of host plants.

The third pathway is considered unlikely as *S. citri* does not feed on mature commercial fruit.

Eurostat trade data do not discriminate between species of plants for planting. Fortunately, the Netherlands NPPO kindly provided EFSA with detailed trade inspection data regarding plants for planting from 2012 to 2014 (Table 5). These data show that a number of genera reported to be hosts of *S. citri* were imported into the EU as plants for planting from China, Thailand and USA over the period 2012–2014, indicating that potential pathways exist for the entry of *S. citri*. 

Is the pest able to enter into the EU territory? (Yes or No)

Yes, pathways that could allow *S. citri* to enter the EU exist.
3.4.3. Establishment

A range of plant species reported as hosts to *S. citri* occurs in the EU. For example, cultivated fruit such as *Citrus* spp, *Vitis* sp. and *Mangifera indica*, as well as on ornamental plants, e.g. *Rosa* spp., *Phoenix* spp., and wild plants, e.g., *Vaccinium* sp., *Quercus* spp. and *Abies* spp. However, from these plant species, *S. citri* has reached pest status only in highbush blueberries (*V. corymbosum*) in California and in citrus in south-western USA (UC, 1991; Haviland et al., 2009; Dreistadt et al., 2011) and Asia (Bhagat et al., 1999; Sharma, 2007). The main hosts in the EU at risk are assumed to be citrus and blueberry plants, for which the cultivated area is shown in Tables 6 and 7.

### Table 5: *Scirtothrips citri* host plants which have been imported into the EU as plants for planting from countries where *S. citri* is known to occur (Source: The Netherlands NPPO)

| Genus   | China 2012 | China 2013 | China 2014 | Thailand 2012 | Thailand 2013 | Thailand 2014 | USA 2012 | USA 2013 | USA 2014 |
|---------|-----------|-----------|-----------|---------------|---------------|---------------|----------|----------|----------|
| Laurus  |           |           |           |               |               |               |          |          |          |
| Magnolia| ✓         | ✓         | ✓         |               |               |               |          |          |          |
| Mangifera|           |           |           |               |               |               |          |          |          |
| Phoenix | ✓         | ✓         | ✓         |               |               |               |          |          |          |
| Quercus |           |           |           |               |               |               |          |          |          |
| Rosa    | ✓         | ✓         |           |               |               |               |          |          |          |
| Vaccinium|           |           |           |               |               |               |          |          |          |

### Table 6: Citrus cultivation area (10^3 ha) in the EU. Source: Eurostat (data extracted on 7 June 2017)

| Country | 2011   | 2012   | 2013   | 2014   | 2015   |
|---------|--------|--------|--------|--------|--------|
| Spain   | 317.61 | 310.50 | 306.31 | 302.46 | 298.72 |
| Italy   | 160.72 | 146.79 | 163.59 | 140.16 | 149.10 |
| Greece  | 52.06  | 50.61  | 49.88  | 49.54  | 46.92  |
| Portugal| 19.59  | 19.85  | 19.82  | 19.80  | 20.21  |
| France  | 3.77   | 3.89   | 4.34   | 4.16   | 4.21   |
| Cyprus  | 3.06   | 3.21   | 2.63   | 2.69   | 2.84   |
| Croatia | 2.12   | 1.88   | 2.17   | 2.17   | 2.21   |
| EU (28 MS)| 558.93 | 536.73 | 548.75 | 520.99 | 524.21 |

### Table 7: Blueberry cultivation area (10^3 ha) in the EU. Source: USHBC Report (2014)

| Country       | 2007 | 2008 | 2010 | 2014 |
|---------------|------|------|------|------|
| Poland        | 2,713| 2,794| 3,158| 3,740|
| Germany       | 1,781| 2,050| 2,146| 2,316|
| Spain         | 757  | 850  | 1,053| 1,824|
| France        | 328  | 340  | 360  | 416  |
| Netherlands   | 235  | 243  | 259  | 700  |
| Italy         | 219  | 243  | 275  | 472  |
| United Kingdom| –    | –    | –    | 380  |
| Romania       | –    | –    | –    | 140  |
| Austria       | –    | –    | –    | 86   |

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

**Yes,** hosts of *S. citri* occur in areas of the EU with suitable climatic conditions, comparable to regions in North America where *S. citri* occurs. The areas of citrus and blueberry production around the Mediterranean basin would be especially suitable for establishment of *S. citri.*
3.4.3.2. Climatic conditions affecting establishment

The Koppen–Geiger classification of climatic regions (Peel et al., 2007) in North America where *S. citri* occurs, includes regions that are also found in Europe where citrus and *Vaccinium* are grown. We assume establishment in these areas would be possible outdoors. Moreover, given the polyphagy of this thrips, its establishment under protected cultivation might also possible further north in Europe.

3.4.4. Spread

The potential for *Scirtothrips* spp. to spread naturally is relatively limited (EPPO, 2017). Although *S. citri* adults actively fly they do not move long distances between hosts (Moreno et al., 1984; UC, 1991). Long distance international spread is most likely via trade in plants or plant parts in a non-dormant stage (i.e. with actively growing leaf flush and/or young fruit).

3.5. Impacts

3.5.1. Potential pest impacts

3.5.1.1. Direct impacts of the pest

In the USA, *S. citri* is considered as a pest of citrus (e.g. Morse, 1995; CABI, 2017) and highbush blueberries (Haviland et al., 2009). In India, *S. citri* is regarded as a pest of *Citrus* and is of regional, rather than national, importance (Satyagopal et al., 2014). *S. citri* is generally not damaging to its many other hosts (UC, 1991; Haviland et al., 2009; Dreistadt et al., 2011; Haviland, 2014).

*Scirtothrips citri* feeding and oviposition in citrus does not reduce yields but can produce unacceptable cosmetic damage which may affect the marketability of fruit, at least for fresh consumption. The cosmetic damage is caused by feeding which punctures plant tissues and drains the contents of cells causing their cell walls to collapse (Lewis, 1973). Such damage in citrus often results in a conspicuous ring of scarred tissue around the apex of young fruits (Parker et al., 1995; Mound and Kibby, 1998). Oviposition damage (oviposition scars) on fruit may be a problem in early harvested

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2 See Section 2.1 on what falls outside EFSA’s remit.
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citrus fruit only. Most economic damage to fruits occurs from petal fall until the fruit are about 4 cm in diameter. Damage is greatest on fruit on the outside of the canopy (UC, 1991; EPPO, 2017). Damage in blueberry consists of curling and abnormal growth of new leaves, as well as scarring of new twigs, which would lead to lower fruit set the following year. However, fruit quality is not affected in this case (Haviland et al., 2009; Haviland, 2014).

The type of damage caused by S. citri in North America could be expected in the EU.

3.6. Availability and limits of mitigation measures

Are there measures available to prevent the entry into, establishment within or spread of the pest within the EU such that the risk becomes mitigated?

Yes, phytosanitary measures against S. citri are available to reduce the likelihood of its introduction into the EU. Further control measures are available to hamper establishment and spread of this thrips.

3.6.1. Phytosanitary measures

Phytosanitary measures are currently applied to Citrus L., Fortunella Swingle, Poncirus Raf. and their hybrids (see Section 3.3.2), however, pathways exist via other hosts. The following phytosanitary measures are available for them:

- sourcing plants for planting (and cut flowers) from pest free area (PFA), pest free place of production (PFPP), pest free site (PFS)
- introduction of plants for planting in a dormant stage with no soil attached.

3.6.2. Biological or technical factors affecting the feasibility and effectiveness of measures to prevent the entry, establishment and spread of the pest

- The minute size of S. citri hampers its detection.
- The high polyphagy of S. citri, with many potential hosts remaining unregulated with respect to S. citri.
- Development of resistance to some pesticides (Parker et al., 1995)
- Uncertainty regarding hosts and geographical distribution in Asia – a wider distribution of this thrips outside of its native range on perhaps 50 or more hosts means that there may be a high diversity of potential pathways that could facilitate entry into the EU.

3.6.3. Biological or technical factors limiting the ability to prevent the presence of the pest on plants for planting

Not applicable as not considered to be RNQP.

3.6.4. Pest Control methods

- Biological control: in its native range, S. citri has many natural enemies, mostly predatory mites.
- Chemical control: insecticides may have to be applied 2–3 months after petal-fall to protect young growing citrus fruit.
- Cultural control: avoid potential hosts near (windbreaks) or in (cover-crops) the orchard.
- Integrated pest management (IPM): economic thresholds have been established for this pest in citrus in California. These are based on the scouting fruit for infestation (% fruit with mature thrips) and damage (% scarred fruit), as well as on the presence of predaceous mites on leaves.

3.7. Uncertainty

There are two principles sources of uncertainty, the first regards hosts and the second its distribution in Asia. S. citri is highly polyphagous and phytosanitary measures are targeted on citrus. Other hosts could provide pathways but until the host status of plants on which S. citri has been recorded is established, the range of possible plants that could provide a pathway is uncertain.

Regarding the geographical distribution of S. citri in Asia, the literature is contradictory. Some authors report S. citri as a pest of citrus (e.g. Bhagat et al., 1999; Sharma, 2007) but a recent check...
list of thrips in India by Tyagi and Kumar (2016) does not include *S. citri*. The occurrence and distribution of *S. citri* in Asia remains uncertain. Nevertheless, these uncertainties do not affect the conclusions on the categorisation.

4. **Conclusions**

Considering the criteria within the remit of EFSA to assess the status as a potential Union QP, or as a potential RNQP, *S. citri* meets with no uncertainties the criteria assessed by EFSA for consideration as a potential Union QP (Table 8).

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)
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Abbreviations

EPPO European and Mediterranean Plant Protection Organization
FAO Food and Agriculture Organization
IPM Integrated pest management
IPPC International Plant Protection Convention
MS Member State
PFA pest free area
PFPP pest free place of production
PFS pest free site
PLH EFSA Panel on Plant Health
PZ protected zone
QP quarantine pest
RNQP regulated non-quarantine pest
TFEU Treaty on the Functioning of the European Union
ToR Terms of Reference
### Appendix A – Reported host plants of *Scirtothrips citri*

| Family          | Host (common name)                                      | Reference                                      |
|-----------------|-------------------------------------------------------|-----------------------------------------------|
| Amaranthaceae   | Amaranthus sp. (tumbleweed)                           | Morse (1995)                                  |
| Anacardiaceae   | Pistacia vera (pistachio)                             | Morse (1995)                                  |
|                 | *Rhus* sp.                                             | EPPO (2017)                                   |
|                 | *Rhus laurina* (California sumac)                      | Tanigoshi and Nishio-Wong (1982)              |
|                 | *Schinus molle* (California pepper tree)               | Morse (1995)                                  |
|                 | *Mangifera indica*                                     | Mound and Hoddle (2016)                       |
| Arecaceae       | Phoenix dactylifera (date palm)                        | Morse (1995)                                  |
| Asteraceae      | Dahlia imperialis (tree dahlia)                        | Morse (1995)                                  |
| Bignoniaceae    | Campsis radicans (trumpet vine)                        | Morse (1995)                                  |
| Boraginaceae    | Amsinckia sp. (yellow fiddleneck)                       | Morse (1995)                                  |
| Convolvulaceae  | Convolvulus sp. (wild morning-glory)                   | Morse (1995)                                  |
| Ebenaceae       | Diospyros texana (Texas persimmon)                     | Morse (1995)                                  |
| Ericaceae       | Vaccinium corymbosum (highbush blueberries)            | Haviland et al. (2009)                       |
| Euphorbiaceae   | Ricinus communis (castor bean)                         | Morse (1995)                                  |
| Fabaceae        | Erythrina sp. (coral tree)                             | Morse (1995)                                  |
|                 | Medicago sativa (lucerne)                              | EPPO (2017)                                   |
|                 | Prosopis sp. (mesquite)                                | Morse (1995)                                  |
| Fagaceae        | Quercus sp. (liveoak)                                  | Tanigoshi and Nishio-Wong (1982)              |
|                 | Quercus grisea (Mexican blue oak)                      | Morse (1995)                                  |
| Juglandaceae    | Carya illinoinensis (pecan)                            | EPPO (2017)                                   |
| Lauraceae       | Laurus sp. (laurel)                                    | Weeks et al. (2012)                           |
|                 | Persea americana (avocado)                             | Morse (1995)                                  |
|                 | Umbellularia californica (California laurel)           | Morse (1995)                                  |
| Lythraceae      | Punica granatum (pomegranate)                          | Morse (1995)                                  |
| Magnoliaceae    | Magnolia sp.                                           | EPPO (2017)                                   |
| Malvaceae       | Gossypium hirsutum (cotton)                            | EPPO (2017)                                   |
| Myrtaceae       | Myrtus communis (common myrtle)                        | Morse (1995)                                  |
| Oleaceae        | Ligustrum (privet)                                     | Morse (1995)                                  |
|                 | Olea europaea (olive)                                  | Morse (1995)                                  |
| Onagraceae      | Oenothera sp. (evening primrose)                       | Morse (1995)                                  |
| Palmae          | Phoenix dactylifera (date palm)                        | EPPO (2017)                                   |
| Pinaceae        | Abies sp. (fir)                                        | Weeks et al. (2012)                           |
| Polygonaceae    | Eriogonum sp. (buckwheat)                              | Morse (1995)                                  |
|                 | Rheum rhaponticum (rhubarb)                            | Morse (1995)                                  |
|                 | Rumex sp. (dock)                                       | Morse (1995)                                  |
| Portulacaceae   | Portulaca oleracea (purslane)                          | Morse (1995)                                  |
| Rhizophoraceae  | Rhizophora mangle (mangrove)                           | Morse (1995)                                  |
| Rosaceae        | Adenostoma fasciculatum (chamise)                      | Morse (1995)                                  |
|                 | Prunus spp.                                            | Morse (1995)                                  |
|                 | Pyrus communis (pear)                                  | Morse (1995)                                  |
|                 | Rosa sp.                                               | EPPO (2017)                                   |
|                 | *Rubus* (raspberry)                                     | Morse (1995)                                  |
| Family         | Host (common name)                          | Reference |
|---------------|--------------------------------------------|-----------|
| Rutaceae      | *Citrus limon* (lemon)                     | EPPO (2017) |
|               | *Citrus paradisi* (grapefruit)             | EPPO (2017) |
|               | *Citrus reticulata* (mandarin)             | EPPO (2017) |
|               | *Citrus sinensis* (orange)                 | EPPO (2017) |
|               | *Citroncirus* sp.                          | EPPO (2017) |
|               | *Citrus* sp.                               | EPPO (2017) |
|               | *Fortunella* sp.                           | EPPO (2017) |
|               | *Poncirus trifoliata*                      | EPPO (2017) |
|               | x *Citrofortunella microcarpa*             | EPPO (2017) |
| Salicaceae    | *Salix* sp. (willow)                       | Morse (1995) |
| Sapindaceae   | *Dodonaea viscoa* (hopbush)                | Morse (1995) |
| Simmondsiaceae| *Simmondsia chinensis* (jojoba)            | Morse (1995) |
| Solanaceae    | *Solanum* sp. (nightshade)                | Morse (1995) |
| Vitaceae      | *Vitis* sp. (grapevine)                   | EPPO (2017) |
| Zygophyllaceae| *Larrea tridentata* (creosote bush)        | Morse (1995) |