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Pest categorisation of *Toxoptera citricida*

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Abstract

The European Commission requested EFSA to conduct a pest categorisation of *Toxoptera citricida* (Hemiptera: Aphididae), an oligophagous aphid developing and reproducing parthenogenetically on tender leaf and flower flush of citrus (Rutaceae). *T. citricida* is a taxonomic entity with reliable methods available for detection and identification. It is regulated in the EU by Council Directive 2000/29/EC where it is listed in Annex IIAI as a harmful organism whose introduction and spread into the EU shall be banned. *T. citricida* is native to tropical regions of Southeast Asia and has spread to most citrus-growing areas worldwide, except California and the Mediterranean basin, causing significant damage to citrus as it is the most efficient vector of the *Citrus tristeza virus* (CTV). *T. citricida* occurs in Madeira and, with a restricted distribution, in the north-west of the Iberian Peninsula, mostly on backyard citrus trees. This may have hindered the effectiveness of the official control measures in these areas. There are further phytosanitary measures in place in the EU in order to limit entry via traded commodities. Citrus plants for planting are regulated and are a closed pathway. However, there is uncertainty regarding host status of some non-rutaceous plants on which this aphid has been recorded and so other plant genera may provide additional pathways. The EFSA Plant Health Panel concludes that the establishment of *T. citricida* in the main EU citrus growing areas around the Mediterranean would have significant impacts because of its ability to vector CTV. Considering the criteria within the remit of EFSA to assess the status as a potential Union quarantine pest (QP), as a potential protected zone quarantine pest (PZQP) or as a potential regulated non-quarantine pest (RNQP), *T. citricida* meets with no uncertainties the criteria assessed by EFSA for consideration as a potential Union QP.

Keywords: European Union, pest risk, plant health, plant pest, quarantine, black citrus aphid, CTV, Tristeza

Requestor: European Commission

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Table of contents

1. Introduction

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

1.1.1. Background

Council Directive 2000/29/EC[1] 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[2] 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,[3] 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] Council Directive 2000/29/EC of 8 May 2000 on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community. OJ L 169/1, 10.7.2000, p. 1–112.

[2] Regulation (EU) 2016/2031 of the European Parliament of the Council of 26 October 2016 on protective measures against pests of plants. OJ L 317, 23.11.2016, p. 4–104.

[3] 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.

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

Aleurocantus spp.
Anthonomus bisignifer (Schenkling)
Anthonomus signatus (Say)
Aschistonyx eppoi Inouye
Carposina niponensis Walsingham
Enarmonia packardi (Zeller)
Enarmonia prunivora Walsh
Grapholita inopinata Heinrich
Hishomonus phycitis
Leucaspis japonica Ckll.
Listronotus bonariensis (Kuschel)
Numonia pyrivorella (Matsumura)
Oligonychus perditus Pritchard and Baker
Pissodes spp. (non-EU)
Scirtothrips aurantii Faure
Scirtothrips citri (Moultex)
Scolytidae spp. (non-EU)
Scrobipalpopsis solanivora Povolny
Tachypterellus quadrigibbus Say
Toxoptera citricida Kirk.
Unaspis citri Comstock

(b) Bacteria

Citrus variegated chlorosis
Erwinia stewartii (Smith) Dye
Xanthomonas campestris pv. *oryzae* (Ishiyama) Dye and pv. *oryzicola* (Fang. et al.) Dye

(c) Fungi

Alternaria alternata (Fr.) Keissler (non-EU pathogenic isolates)
Anisogramma anomala (Peck) E. Müller
Apiosporina morbosa (Schwein.) v. Arx
Ceratocystis virescens (Davidson) Moreau
Cercoseptoria pini-densiflorae (Hori and Nambu) Deighton
Cercospora angolensis Carv. and Mendes
Elsinoe spp. Bitanc. and Jenk. Mendes
Fusarium oxysporum f. sp. *albedinis* (Kilian and Maire) Gordon
Guignardia piricola (Nosa) Yamamoto
Puccinia pittieriana Hennings
Stegophora ulmea (Schweinitz: Fries) Sydow
Venturia nashicola Tanaka and Yamamoto& Sydow

(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
Little cherry pathogen (non- EU isolates)
Naturally spreading psorosis
Palm lethal yellowing mycoplasm
Satsuma dwarf virus
Tatter leaf virus
Witches' broom (MLO)

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)
Gonipterus scutellatus Gyll.
Ips amitinus Eichhof
Ips cembrae Heer
Ips duplicatus Sahlberg
Ips sexdentatus Börner
Ips typographus Heer
Sternochetus mangiferae Fabricius

(b) Bacteria

Curtobacterium flaccumfaciens pv. flaccumfaciens (Hedges) Collins and Jones

(c) Fungi

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

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
3) *Graphocephala atropunctata* (Signoret)

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)
12) *Pardalaspis cyanescens* Bezzi
13) *Pardalaspis quinaria* Bezzi
14) *Pterandrus rosa* (Karsch)
15) *Rhacochlaena japonica* Ito
16) *Rhagoletis completa* Cresson
17) *Rhagoletis fausta* (Osten-Sacken)
18) *Rhagoletis indifferens* Curran
19) *Rhagoletis mendax* Curran
20) *Rhagoletis pomonella* Walsh
21) *Rhagoletis suavis* (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 mycoplasm
7) Peach X-disease mycoplasm
8) Peach yellows mycoplasm
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 IAI

(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 Tschetverikov
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
Longidorus diadecturus Eveleigh and Allen
Monochamus spp. (non-EU)
Myndus crudus Van Duzee
Nacobbus aberrans (Thorne) Thorne and Allen
Naupactus leucoloma Boheman
Premnotrypes spp. (non-EU)
Pseudopityophthorus minutissimus (Zimmermann)
Pseudopityophthorus pruinosus (Eichhoff)
Scaphoideus luteolus (Van Duzee)
Spodoptera eridania (Cramer)
Spodoptera frugiperda (Smith)
Spodoptera litura (Fabricus)
Thrips palmi Karny
Xiphinema americanum Cobb sensu lato (non-EU populations)
Xiphinema californicum Lamberti and Bleve-Zacheo

(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
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
Thecaphora solani Barrus
Trechispora brinkmannii (Bresad.) Rogers

(c) Viruses and virus-like organisms

Tobacco ringspot virus
Tomato ringspot virus
Bean golden mosaic virus
Cowpea mild mottle virus
Lettuce infectious yellows virus
Pepper mild tigré virus
Squash leaf curl virus
Euphorbia mosaic virus
Florida tomato virus

(d) Parasitic plants

Arceuthobium spp. (non-EU)

Annex IAII

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

Meloidogyne fallax Karssen
Popillia japonica Newman
Rhizoecus hibisci Kawai and Takagi

(b) Bacteria

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

(b) Viruses and virus-like organisms

Beet necrotic yellow vein virus

1.2. Interpretation of the Terms of Reference

Toxoptera citricida 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 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.

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A literature search on *T. citricida* 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, and 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 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.

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 *T. citricida*, 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 ToRs 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 potentially qualify either as a QP or as a RNQP. If one of the criteria is not met, the pest will not qualify. A pest that does not qualify as a quarantine pest may still qualify as a RNQP which needs to be addressed in the opinion. For the pests regulated in the protected zones only, the scope of the categorisation is the territory of the protected zone, thus the criteria refer to the protected zone instead of the EU territory.

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 protected zone quarantine pest (articles 32–35)	Criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest
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 protected zone quarantine organism.	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).
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.	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 risk assessment area (i.e. protected zone).	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?
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 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?	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!

Criterion of pest categorisation	Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Criterion in Regulation (EU) 2016/2031 regarding protected zone quarantine pest (articles 32–35)	Criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest
Potential for consequences in the EU territory (Section 3.5)	Would the pests' introduction have an economic or environmental impact on the EU territory?	Would the pests' introduction have an economic or environmental impact on the protected zone areas?	Does the presence of the pest on plants for planting have an economic impact, as regards the intended use of those plants for planting?
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 the entry into, establishment within or spread of the pest within the protected zone areas such that the risk becomes mitigated? Is it possible to eradicate the pest in a restricted area within 24 months (or a period longer than 24 months where the biology of the organism so justifies) after the presence of the pest was confirmed in the protected zone?	Are there measures available to prevent pest presence on plants for planting such that the risk becomes mitigated?
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.	A statement as to whether (1) all criteria assessed by EFSA above for consideration as potential protected zone quarantine pest were met, and (2) if not, which one(s) were not met.	A statement as to whether (1) all criteria assessed by EFSA above for consideration as a potential regulated non-quarantine pest were met, and (2) if not, which one(s) were not met.

It should be noted that 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, 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).

The Panel will not indicate in its conclusions of the pest categorisation whether to continue the risk assessment process, but, following the agreed two-step approach, will continue only if requested by the risk managers. However, during the categorisation process, experts may identify key elements and knowledge gaps that could contribute significant uncertainty to a future assessment of risk. It would be useful to identify and highlight such gaps so that potential future requests can specifically target the major elements of uncertainty, perhaps suggesting specific scenarios to examine.

3. Pest categorisation

3.1. Identity and biology of the pest

3.1.1. Identity and taxonomy

Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible? (Yes or No)

Yes, *Toxoptera citricida* is a well-defined taxonomic organism for which species-specific keys exist.

The black citrus aphid, *T. citricida* (Kirkaldy, 1907) (Hemiptera: Aphididae), which had been previously known, among other names, as *Aphis citricidus*, *Aphis tavaresi*, *Myzus citricidus* and

Paratoxoptera argentiniensis (Michaud, 1998; CABI, 2017), is one of the more than 25 aphid species recorded from citrus worldwide (Hermoso de Mendoza, 1994). Although the genus name, *Toxoptera* Koch, is feminine, the feminine/masculine genus/species combination *Toxoptera citricidus* has been widely used in the literature (CABI, 2017). In the EU, *T. citricida* can be found in Madeira and the Northwest of the Iberian Peninsula, where the pest was detected in 1994 and 2002, respectively (Fernandes and de Cruz Boelpaepe, 1994; Ilharco et al., 2005). All aphid species occurring in citrus in the EU (nine species in total) can be distinguished using available taxonomic keys for adult aphids both wingless (apterae) and winged forms (alatae) (Michaud, 1998; Ilharco et al., 2005; Uygun et al., 2012).

3.1.2. Biology of the pest

Toxoptera citricida lives almost exclusively on plants of the family Rutaceae, especially on *Citrus* spp. (Uygun et al., 2012). This aphid feeds on expanding tender shoots, leaves and flower buds of citrus plants, which remain suitable for its growth and reproduction for a period of 3–4 weeks (Michaud, 1998). Although *T. citricida* has been sporadically reported on different plants (Michaud, 1998; see Appendix A), their host status is uncertain. This is due to the fact that parthenogenetically reproducing aphids, such as *T. citricida*, are born with the embryos of their granddaughters. Therefore, without specific assays aimed at proving the suitability of these plants to sustain reproducing populations of *T. citricida*, the host status of these plants cannot be proven. In the infested areas of the EU, it has been mostly found on lemons (Ilharco et al., 2005) although this may simply reflect the most abundant *Citrus* species grown in the north-west of the Iberian Peninsula, where no commercial citrus orchards exist. Except for isolated cases in Japan, this species is always anholocyclic (= parthenogenetic reproduction throughout the year) (Uygun et al., 2012) with wingless (apterae) colonies producing winged forms (alatae) as the feeding substrate either deteriorates or becomes unsuitable (=mature) for aphid development. Therefore, colonies have a relatively narrow time window within which to mature and disperse prior to the demise of its food resource (Michaud, 1998). In an outdoor experiment in Argentina, daily fecundity of adult apterae ranged from 5 to 6 nymphs per female per day, and total fecundities between 73 and 81 nymphs (Galatoire, 1983). In the laboratory, Komazaki (1982) determined that the maximum intrinsic rate of increase for *T. citricida* occurs at 27°C, although the fecundity and net reproductive rate of individual apterae was maximal at 21.5°C. Because cool winters and hot summers limit the aphid's ability to survive and reproduce, *T. citricida* populations usually peak twice per year in subtropical regions, in spring and autumn (Michaud, 1998; Qureshi, 2010). Taking advantage of thermal updrafts and tropical storms, winged forms can be carried long distances (hundreds of kilometres). However, human-assisted dispersal most likely plays a key role in the spread of this aphid (e.g. by movements of infested hosts plants for planting). Furthermore, most colonies survive within the same orchard at low densities on asynchronous citrus leaf flush and root sprouts until a new flush cycle provides sufficient food for a population outbreak (Michaud, 1998). This aphid is considered the most efficient vector of *Citrus tristeza virus* (CTV), which is transmitted in a semi-persistent mode in which the virus is acquired and transmitted by aphids with feeding times ranging from several minutes to several hours, but usually not by brief probing (Michaud, 1998). It can also transmit the *Citrus vein enation virus*, the *Papaya ringspot virus* and the *Watermelon mosaic virus* (Panno et al., 2014; CABI, 2017).

3.1.3. Detection and identification of the pest

Are detection and identification methods available for the pest?

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

Toxoptera citricida can be detected by periodic visual inspection of new shoot growth of citrus. In addition, winged forms can be monitored by yellow traps or suction traps (EPPO, 2006; CABI, 2017).

Diagnostic characters: *T. citricida* adult apterae (1.5–2.8 mm in length) are dark, same as the closely related species *Toxoptera aurantii* (Boyer de Fonscolombe), which also occurs in the EU in citrus. However, their antennae do not present the white and black bands seen in *T. aurantii* apterous forms. Adult alatae (1.1–2.6 mm in length) can be separated from co-occurring winged aphids in citrus by the presence of a pale pterostigma in their forewings, which also present a twice branched media vein. Remarkably, the antennal segment III of these alatae is dark and contrasts with segment IV, which is partially pale (Uygun et al., 2012; EPPO, 2006; CABI, 2017).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

Toxoptera citricida is probably native to the citrus area of origin in southeast Asia (CABI, 2017). At present, it occurs throughout Oceania, eastern and southern Asia, Africa south of the Sahara, and the Americas (Figure 1).

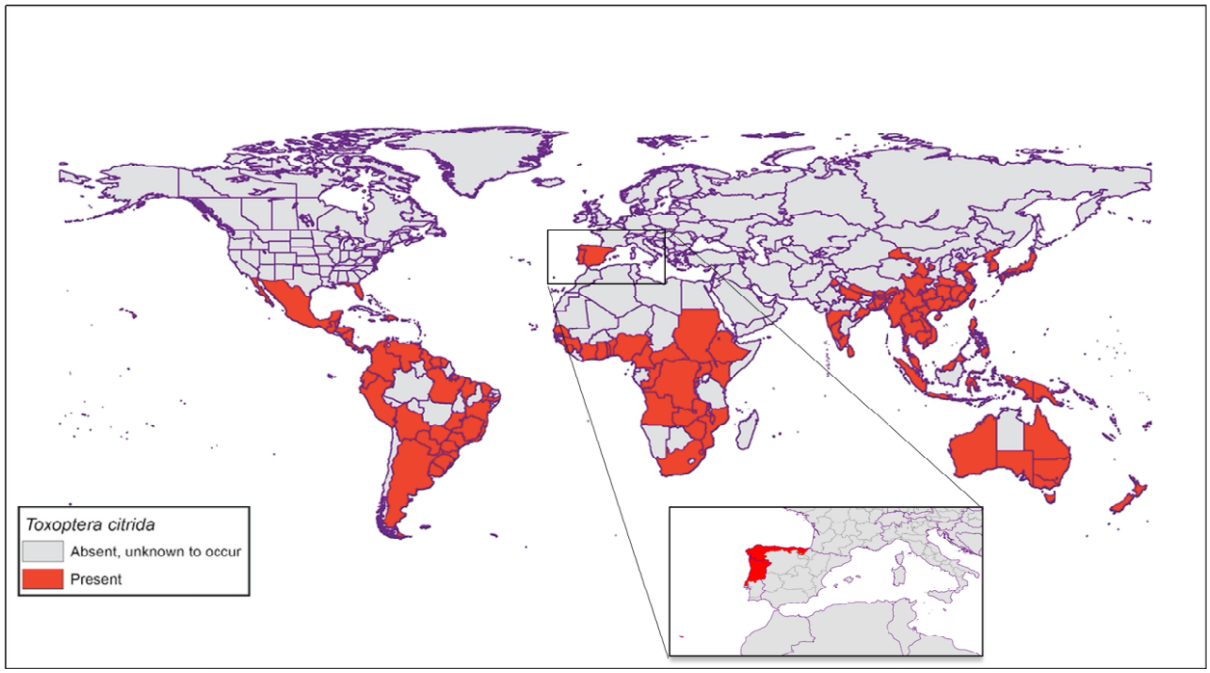

Figure 1: Global distribution map for *T. citricida*. (Source: CABI, 2017, modified)

3.2.2. Pest distribution in the EU

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

Yes, the pest is present in the EU: in Madeira, as well as in the coastal areas of northern Portugal and Northwest Spain (Galicia to the Basque Country).

After detection in Madeira in 1994 (Fernandes and de Cruz Boelpaepe, 1994), in 2002, *T. citricida* was discovered in the north of Spain (Asturias) and later, in 2003, in continental Portugal (Ilharco et al., 2005). Nowadays, the pest can be found in continental EU in the coastal area of the northwest quadrant of the Iberian Peninsula, extending from the north of the Portuguese province of Beira Litoral (Região Norte) to the Basque province of Bizkaia (Hermoso de Mendoza et al., 2008) (Figure 2).

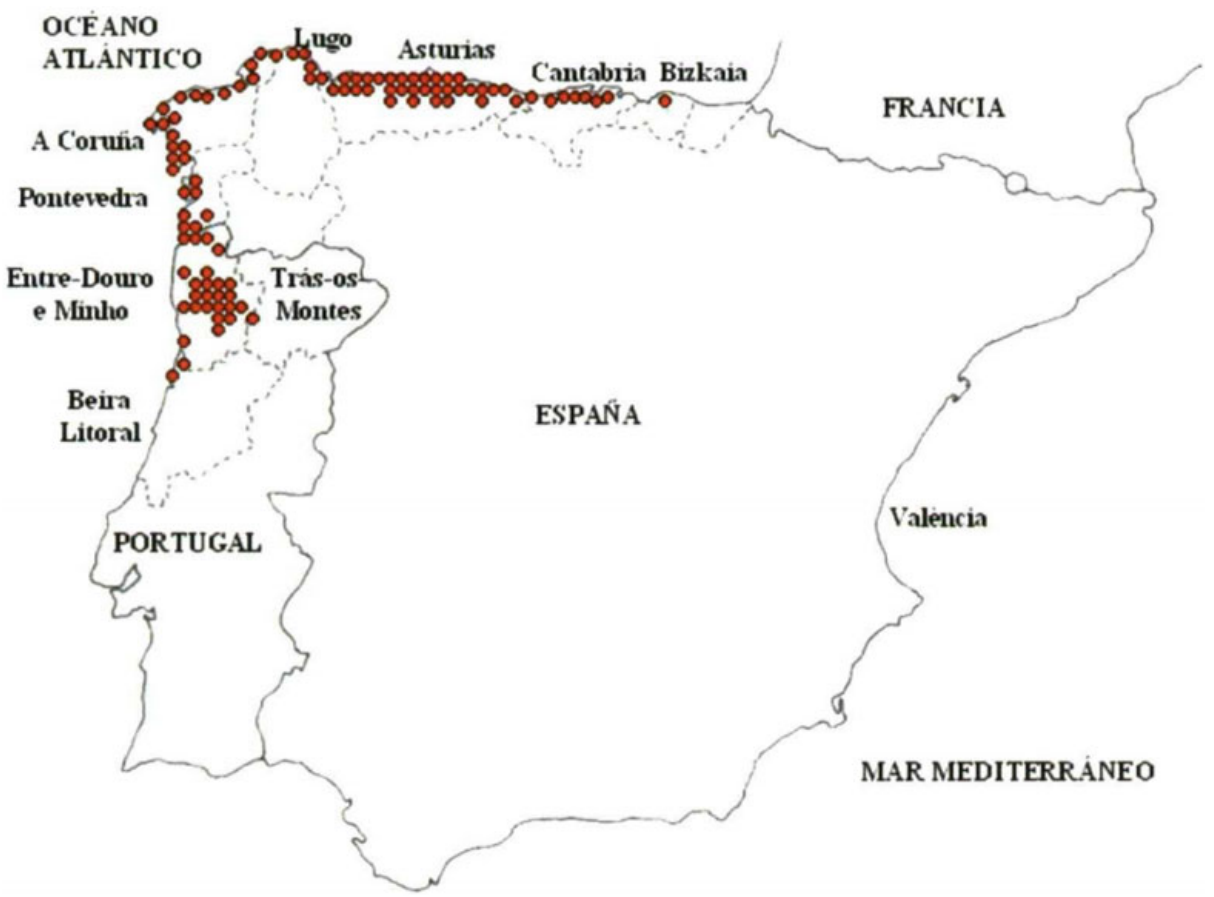

Figure 2: Distribution of *T. citricida* in the northwest of the Iberian Peninsula in 2007 (source: Hermoso de Mendoza et al., 2008). Red dots represent positive detection points

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 *Toxoptera citricida*. Details are presented in Tables 2–4.

Table 2: *Toxoptera citricida* 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
30.	*Toxoptera citricida*	Plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruit and seeds.

3.3.2. Legislation addressing plants and plant parts on which *T. citricida* is regulated

Table 3: Regulated hosts and commodities that may involve *T. citricida* 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**	
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 must 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**	
	Plants, plant products and other objects	Special requirements
16.1.	Fruits of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, originating in third countries	The fruits shall be free from peduncles and leaves and the packaging shall bear an appropriate origin mark
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 A	**Plants, plant products and other objects originating in the Community**	
I	**Plants, plant products and other objects which are potential carriers of harmful organisms of relevance for the entire Community and which must be accompanied by a plant passport**	
1.6	Fruits of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf. and their hybrids with leaves and peduncles.	

3.3.3. Legislation addressing the organisms vectored by *T. citricida* (Directive 2000/29/EC)

Table 4: Regulated organisms vectored by *T. citricida* in Annexes II of 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**		
(d)	Virus and virus-like organisms		
	Species	Subject of contamination	
7.	Citrus tristeza virus (non-European isolates)	Plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruit and seeds	
Section II	**Harmful organisms known to occur in the community and relevant for the entire community**		
(d)	Virus and virus-like organisms		
	Species	Subject of contamination	
4.	Citrus tristeza virus (European isolates)	Plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruit and seeds	
Annex II Part B	**Harmful organisms whose introduction into, and whose spread within, certain protected zones shall be banned if they are present on certain plants or plant products**		
(d)	Virus and virus-like organisms		
	Species	Subject of contamination	Protected zone(s)
1.	Citrus tristeza virus (European isolates)	Fruits of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, with leaves and peduncles	EL (except the Regional Units of Argolida and Chania), M, P (except Algarve and Madeira)

Annex IV Part A Section II	Plants, plant products and other objects originating in the community	
	Plants, plant products and other objects	Special requirements
10.	Plants of Citrus L., Fortunella Swingle, Poncirus Raf., and their hybrids, other than fruit and seeds	Official statement that: (a) the plants originate in areas known to be free from *Spiroplasma citri* Saglio et al., *Phoma tracheiphila* (Petri), Kanchaveli and Gikashvili and Citrus tristeza virus (European strains), or (b) the plants derive from a certification scheme requiring them to be derived in direct line from material which has been maintained under appropriate conditions and has been subjected to official individual testing for, at least, Citrus tristeza virus (European strains), using appropriate tests or methods in line with international standards, and have been growing permanently in an insectproof glasshouse or in an isolated cage on which no symptoms of *Spiroplasma citri* Saglio et al., *Phoma tracheiphila* (Petri) Kanchaveli and Gikashvili and Citrus tristeza virus (European strains) have been observed, or (c) the plants: — have been derived from a certification scheme requiring them to be derived in direct line from material which has been maintained under appropriate conditions and has been subjected to official individual testing for, at least Citrus tristeza virus (European strains), using appropriate tests or methods in line with international standards, and has been found in these tests, free from Citrus tristeza virus (European strains), and certified free from at least Citrus tristeza virus (European strains) in official individual tests carried out according to the methods mentioned in this indent, and — have been inspected and no symptoms of *Spiroplasma citri* Saglio et al., *Phoma tracheiphila* (Petri) Kanchaveli et Gikashvili, and Citrus tristeza virus (European strains) have been observed since the beginning of the last complete cycle of vegetation.

3.4. Entry, establishment and spread in the EU

3.4.1. Host range

Toxoptera citricida is largely restricted to Rutaceae and specifically to the genus *Citrus*. However, it has been sporadically reported on different hosts in 27 different botanical families including Rutaceae (see Appendix A) (Michaud, 1998; Uygun et al., 2012). There is no verification that these additional records are hosts capable of sustaining a population of the aphid (CABI, 2017). Interestingly, colonies of *T. citricida* were found on the ornamental *Chaenomeles speciosa* (Rosaceae) in Asturias (northern Spain) (Hermoso de Mendoza et al., 2008), which, taken together with the list of potential hosts occurring in the EU, adds uncertainty to the actual host range of *T. citricida.*

3.4.2. Entry

Is the pest able to enter into the EU territory? (Yes or No) If yes, identify and list the pathways!

Yes, the pest has indeed already entered into the EU.

Toxoptera citricida could re-enter the EU:

- On citrus plants for planting,
- On other plants for planting which may be a host for this aphid (e.g. *Ficus carica*, *Cotoneaster* sp.), and
- Using thermal updraft air currents for passive long distance dispersal (Michaud, 1998).

Current EU legislation prohibits the import of plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruit and seeds from third countries. Therefore, this pathway can be considered as closed. The relevance of the second pathway is highly uncertain because of lack of sound data supporting the host status of these plants (CABI, 2017). As *T. citricida* is already present in the EU (widespread in Madeira and restricted distribution in northern Portugal and northwestern Spain), the aphid could naturally disperse either actively by flying (adult winged females) or passively by air currents and storms (both Alatae and Apterae).

There are no records of interception of *T. citricida* in the Europhyt database.

3.4.3. Establishment

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

Yes, indeed *T. citricida* is already established in Madeira (since 1994), and the NW of the Iberian Peninsula (since 2002).

Because *T. citricida* is parthenogenetic, its population threshold for establishment (Allee threshold) is extremely low, as for many aphids. In principle, one single female can start a new colony if it finds a host plant. The more abundant the host plants, the more likely this phenomenon.

3.4.3.1. EU distribution of main host plants

The main host are citrus plants for which the cultivated area is shown in Table 5.

Table 5: *Citrus* cultivation area (10^3 ha) in the EU. Source: Eurostat (data extracted on 7 June 2017)

Country	2011	2012	2013	2014	2015
Croatia	2.12	1.88	2.17	2.17	2.21
Cyprus	3.06	3.21	2.63	2.69	2.84
Greece	52.06	50.61	49.88	49.54	46.92
France	3,77	3.89	4.34	4.16	4.21
Italy	160.72	146.79	163.59	140.16	149.10
Portugal	19.59	19.85	19.82	19.80	20.21
Spain	317.61	310.50	306.31	302.46	298.72
EU (28 MS)	558.93	536.73	548.75	520.99	524.21

3.4.3.2. Climatic conditions affecting establishment

The life cycle of *T. citricida* is linked to the phenology of plants belonging to the genus *Citrus* (Michaud, 1998; Uygun et al., 2012). *T. citricida* can be found in almost all citrus-growing regions worldwide except California and the Mediterranean. It can occur in areas with climates similar to those prevailing in the Mediterranean basin, e.g. *Citrus*-producing regions of South Africa and Western Australia. Climatic conditions in the Mediterranean basin, especially in the regions with commercial *Citrus* production, are likely to be conducive for the establishment of this aphid.

3.4.4. Spread

Is the pest able to spread within the EU territory following establishment? (Yes or No) How?

Yes, the pest has indeed spread through the NW of the Iberian Peninsula.

RNQPs: Is spread mainly via specific plants for planting, rather than via natural spread or via movement of plant products or other objects?

Although man-assisted dispersal via plants for planting is most likely the main dispersal mechanism of *T. citricida*, winged adult females can naturally disperse by themselves and both winged and wingless forms can be passively dispersed by thermal updraft currents and storms.

T. citricida spread from the initial foci found in the northwest of the Iberian Peninsula in 2002 (Asturias) towards the south-west, reaching the Região Centro of Portugal (about 500 km along the Atlantic coast), and eastwards for about 300 km, reaching the Basque Country in 5 years (Ilharco et al., 2005; Hermoso de Mendoza et al., 2008). Whether this dispersal has been active (alatae can fly), passive (human-assisted, air currents), or a combination of both is an open question. From Figure 2, it seems very likely that the pest is going to colonise the 20,000 ha of citrus plantations in Portugal, from which it can colonise the 300,000 ha citrus-growing areas in Spain.

3.5. Impacts

Sources: impact reports and other literature

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

Yes, the pest would most likely have an impact especially in the citrus growing areas of the EU because this aphid vectors CTV.

RNQPs: Does the presence of the pest on plants for planting have an economic impact, as regards the intended use of those plants for planting?[4]

Yes, especially because this aphid vectors CTV, an important viral disease of citrus.

Economic importance

The feeding of *T. citricida* on leaves and twigs can result in their deformation (leaf and twig rolling). In the case of flowers, it can cause a considerable blossom drop. Sooty mould can develop on the honeydew produced by the aphids when feeding, which may affect any plant organ, including fruit and causing direct damage. In addition, honeydew attracts ants, which may interfere with the activity of many aphid natural enemies. However, the main impact of *T. citricida* on citrus is due to its capacity to vector several viruses, mostly CTV, including some very aggressive CTV strains injurious even when using CTV-tolerant rootstocks. The arrival of *T. citricida* into the Mediterranean basin, where most of EU citrus production is located (Table 5), would represent a risk to the EU citrus industry, especially where trees are not grafted on tolerant rootstocks (Hermoso de Mendoza et al., 2008; Uygun et al., 2012; CABI 2017).

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, prohibition of movement of plant material from infested zones may delay spread within the EU.

RNQPs: Are there measures available to prevent pest presence on plants for planting such that the risk becomes mitigated?

Yes, production of nursery plants under physical isolation (screened houses) and application of chemical control can greatly reduce the risks associated to the movement of infested plants for planting.

[4] See section 2.1 on what falls outside EFSA's remit.

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

- The pest is already present in the EU.
- Small populations, especially on asynchronous leaf flush in citrus, may remain undetected.
- The pest can spread by natural means, either actively (winged adult females) or passively (updraft air currents, storms).
- The pest is parthenogenetic and hence has a very low population threshold for establishment, provided host plants are locally available. Indeed these aphids are born with the embryos of their granddaughters.
- Difficulties in applying current regulations. Although official surveys for presence of *T. citricida* are carried out in Portugal and Spain (both in infested and non-infested regions), 'only a very small proportion of the host plants and territories are surveyed. This, together with the lack of systematic checks of surroundings of the infested sites and risk areas, makes it impossible to assess the true distribution of the pest' (European Commission, 2009).

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

- As a vector of CTV, very low populations of *T. citricida* can be highly injurious to citrus if viruliferous.
- The number of active substances available against this pest in the EU is rather limited. Most authorised products have a limited efficacy on aphids.
- Its small size hampers early detection.
- This is a typical *r*-strategist, with explosive populations when conditions are suitable (availability of young foliage, mild temperatures).

3.5.3. Control methods

- Legal control: a citrus bud-wood certification programme is essential because of the CTV-vector status of *T. citricida*. Furthermore eradication/surveillance program are also essential.
- Cultural control: because of the same reason as before, only CTV-tolerant or resistant rootstock should be used.
- Biological control: *T. citricida* has many natural enemies and their regulation effect on its populations can be maximised by conservation biological control, either by provision of ecological infrastructures (e.g. cover crops) or by using selective pesticides.
- Chemical control: different pesticides can be used to control *T. citricida* populations. However, not many active substances are authorised in citrus against this pest and their efficacy may be limited. This method is key in order to keep aphid population as close to zero in nurseries and, importantly in pest-free facilities where mother plants are kept.

3.6. Uncertainty

The main uncertainties affecting *T. citricida* categorisation are:

- The host status of many plant species not belonging to the Rutaceae family where *T. citricida* has been found. Whether these plant species are capable of supporting full development and reproduction of this aphid has not been verified and therefore their host status is not conclusive.
- The efficacy of the official control measures against this pest, including surveillance, eradication and certification of citrus plants for planting. Almost no commercial citrus orchards exist in the infested areas of the northwestern of the Iberian Peninsula and citrus in these areas are mostly isolated backyard trees (mainly lemons). It is uncertain whether the pest-free status of the main citrus growing regions of Portugal and Spain is the result of these official measures or to a combination of biological (low dispersal capability, lack of a continuous host distribution), geographical (existence of mountains and semi-desert areas) and commercial (most citrus nurseries are located in the main citrus–growing areas of the Mediterranean) constraints.

4. Conclusions

Considering the criteria within the remit of EFSA to assess the status as a potential Union QP, as a potential PZQP or as a RNQP, *T. citricida* meets with no uncertainties the criteria assessed by EFSA for consideration as a potential Union QP (Table 6).

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

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest	Key uncertainties
Identity of the pest (Section 3.1)	The identity of the pest is established. Conventional taxonomic keys based on morphology of both winged and wingless adult females exist.	The identity of the pest is established. Conventional taxonomic keys based on morphology of both winged and wingless adult females exist.	No uncertainties
Absence/ presence of the pest in the EU territory (Section 3.2)	The pest is present in the EU territory with a restricted distribution in Portugal and Spain.	The pest is present in the EU territory with a restricted distribution in Portugal and Spain..	No uncertainties
Regulatory status (Section 3.3)	The pest is under official control (including surveillance and eradication upon detection) in Portugal and Spain.(2000/29 EC)	The pest is at present regulated as a quarantine pest.(2000/29 EC) Since its first detection in continental EU, these regulations (e.g., .certification, eradication) may have prevented entry/spread into main EU citrus growing areas of the Mediterranean.	Efficacy of official control measures. The fact that citrus in the infested areas are mostly isolated backyard trees may have affected the success of these measures.
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	The pest is already present and established in the EU. It could further spread using the following pathways: • Citrus plants for planting • Other host plants for planting • Active flying of winged adult females • Passive movement with air currents	Plants for planting is considered the main pathway for this insect rather than natural spread.	The actual status of non Rutaceae plants
Potential for consequences in the EU territory (Section 3.5)	Introduction into EU main citrus growing areas in the Mediterranean is considered as a high risk because of its status as the most efficient vector of CTV.	The presence of the pest on plants for planting has an economic impact, as regards the intended use of those plants for planting.	No uncertainties

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest	Key uncertainties
Available measures (Section 3.6)	There are measures available to prevent the entry into, establishment within or spread of *T. citricida* within the EU such that the risk becomes mitigated (e.g., sourcing plants from pest-free areas/places of production, production under physical isolation, chemical control, etc.).	There are measures available to prevent *T. citricida* presence on plants for planting such that the risk becomes mitigated (e.g., sourcing plants from pest-free areas/places of production, production under physical isolation, chemical control, etc.).	No uncertainties
Conclusion on pest categorisation (Section 4)	All criteria assessed by EFSA above for consideration as a potential quarantine pest are met. Although *T. citricida* is present in the EU territory, it has a restricted distribution and is under official control.	Not all criteria assessed by EFSA above for consideration as a potential regulated non-quarantine pest are met. Although *T. citricida* is present in the EU territory, it has a restricted distribution and is under official control.	No uncertainties
Aspects of assessment to focus on/ scenarios to address in future if appropriate	• Confirm host status for non-rutaceous plants on which *T. citricida* has been found. • Potential pathways (non-citrus). • A survey to update the distribution of *T. citricida* in the EU would help in reducing uncertainty about the extent of the infested area.		

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Abbreviations

DG SANCO	Directorate General for Health and Consumers
EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization
IPPC	International Plant Protection Convention
MS	Member State
PLH	EFSA Panel on Plant Health
PZQP	protected zone quarantine pest
QP	quarantine pest
RNQP	regulated non-quarantine pest TFEU Treaty on the Functioning of the European Union
ToR	Terms of Reference

Appendix A – Host records for Toxoptera citricida

Primary hosts of *T. citricida* are citrus and citrus relatives (Rutaceae) (Order Geraniales, Suborder Geraniineae, mostly in the Subfamily Aurantiodeae, Tribe Citreae) (CABI, 2017). However, there are many additional host records, which may offer a temporarily host when no new citrus leaf or flower flush is available. Therefore, there is high uncertainty about the suitability of these plants to support the complete development and reproduction of *T. citricida*. The table below has been mostly taken from Michaud (1998).

Table A.1: Host records for *T. citricida* (adapted from Michaud, 1998)

Family	Host records
Anacardiaceae	*Mangifera* sp., *Mangifera indica*, *Rhus* sp.
Bombaceae	*Bombax ceiba*
Bursaceae	*Commiphora mollis*
Cameliaceae	*Camellia japonica*
Caryophillaceae	*Dianthus* sp.
Dioscuraceae	*Dioscorea rotundata*
Ebenaceae	*Diospyros kaki*, *Diospyros* sp.
Ericaceae	*Azalea* sp., *Rhododendron* sp.
Euphorbiaceae	*Bridelia monoica*, *B. obata*, *Clutia abyssinicum*
Fagaceae	*Quercus* sp.
Flacouatiaceae	*Xylosna congestum*
Juglandaceae	*Engelhardtia spicata*
Lauraceae	*Cinnamomum camphora*, *Litsia polyantha*
Malpighiaceae	*Malpighia punicifolia*
Malvaceae	*Gossypium hirsutum*
Moraceae	*Cudrania tricuspidata*, *Ficus carica*, *F. ingens*, *F. retusa*, *Maclura cochinchinensis*
Mysinaceae	*Maesa chisea*, *Maesa* sp.
Nyctaginaceae	*Bouganvillea spectabilis*
Oxalidaceae	*Oxalis pes-caprae*
Papilionaceae	*Cassia absus*, *Cassia* sp.
Passifloraceae	*Passiflora foetida*, *Passiflora* sp.
Rosaceae	*Cotoneaster* sp. *Crataegus* sp., *Eriobotrya* sp., *Malus domestica*, *M. sylvestris*, *Pyrus communis*, *Pyrus* sp.
Rubiaceae	*Lasianthus chinensis*
Rutaceae	*Calodendron capense*, *Choisya trenata*, *Citrifortunella floridiana*, *C. microcarpa*, *Citrus* spp., *Clausena lanisum*, *Eremocitrus glauca*, *Evodia huphensis*, *Geijera parvifolia*, *Flindersia xanthoxyla*, *Fortunella* sp., *Fortunella maragarita*, *Murraya exotica*, *M. paniculata*, *Poncirus trifoliata*, *Severinia buxifolia*, *Toddalia asiática*, *Triphasia trifolia*, *Vepris undulata*, *Zanthoxylum fagara*, *Z. ornatum*, *Zanthoxylum* sp.
Ternstroemiaceae	*Schima wallichii*
Ulmaceae	*Ulmus procera*, *Trema orientalis*
Urticaceae	*Boehmeria* sp.