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Pest categorisation of *Diaphorina citri*

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Abstract

The EFSA Panel on Plant Health performed a pest categorisation of *Diaphorina citri* (Hemiptera: Liviidae) (Asian citrus psyllid) for the EU. *D. citri* is a key pest of citrus in several countries as it is a vector of serious bacterial pathogens, the putative causal agents of Huanglongbing (HLB) also known as citrus greening. Eggs are laid on tips of growing shoots on and between unfurling leaves. Females may lay more than 800 eggs during their lives. Nymphs pass through five instars. The life cycle requires from 14 to 49 days, depending upon the season. There is no diapause, but populations are low in winter. It overwinters as an adult which may live for several months. The species completes 9–10 generations/year; however, under protected conditions, up to 16 generations have been recorded. Commission Implementing Regulation (EU) 2019/2072 (Annex IIA) regulates *D. citri,* as a quarantine pest not known to occur in the EU territory. Fruits and plants for planting provide potential pathways for entry into the EU. Climatic conditions and the availability of host plants provide conditions to support establishment in the EU. The introduction of *D. citri* would have an economic impact in the EU through direct but mainly indirect effects due to potential transmission of HLB. Phytosanitary measures are available to reduce the likelihood of entry. *D. citri* satisfies the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest. *D. citri* does not meet the criteria of occurring in the EU, nor plants for planting being the principal means of spread, for it to be regarded as a potential Union regulated non-quarantine pest.

Keywords: Asian citrus psyllid, Liviidae, Huanglongbing, greening, *Citrus* spp., *Murraya paniculata*, Rutaceae

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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[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 established the previous European Union plant health regime. The Directive laid 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 was prohibited, was 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 applied 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 categorisations 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 pest 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

Aleurocanthus 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 & Sydow
Venturia nashicola Tanaka and Yamamoto

(d) Virus and virus-like organisms

Beet curly top virus (non-EU isolates)
Black raspberry latent virus
Blight and blight-like
Little cherry pathogen (non- EU isolates)
Naturally spreading psorosis
Palm lethal yellowing mycoplasm
Cadang-Cadang viroid
Citrus tristeza virus (non-EU isolates)
Leprosis
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
Rhizoecus hibisci Kawai and Takagi
Popillia japonica Newman

(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 (Kaltenbach)

(b) Viruses and virus-like organisms

Beet necrotic yellow vein virus

1.2. Interpretation of the Terms of Reference

Diaphorina 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 or those of a regulated non-quarantine pest for the area of the EU excluding Ceuta, Melilla and the outermost regions of Member States referred to in Article 355(1) of the Treaty on the Functioning of the European Union (TFEU), other than Madeira and the Azores.

Following the adoption of Regulation (EU) 2016/2031[4] on 14 December 2019 and the Commission Implementing Regulation (EU) 2019/2072 for the listing of EU regulated pests, the Plant Health Panel interpreted the original request (ToR in Section 1.1.2) as a request to provide pest categorisations for the pests in the Annexes of Commission Implementing Regulation (EU) 2019/2072[5].

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A literature search on *D. citri* was conducted at the beginning of the categorisation (on 14 May 2020) in the Web of Science bibliographic database, using the scientific name of the pest as search term. A total of 2,176 hits were found after having removed the duplicates. Relevant papers were reviewed, and further references and information were obtained from experts, as well as from citations within the references and grey literature.

[4] Regulation (EU) 2016/2031 of the European Parliament of the Council of 26 October 2016 on protective measures against pests of plants, amending Regulations (EU) No 228/2013, (EU) No 652/2014 and (EU) No 1143/2014 of the European Parliament and of the Council and repealing Council Directives 69/464/EEC, 74/647/EEC, 93/85/EEC, 98/57/EC, 2000/29/EC, 2006/91/EC and 2007/33/EC.

[5] Commission Implementing Regulation (EU) 2019/2072 of 28 November 2019 establishing uniform conditions for the implementation of Regulation (EU) 2016/2031 of the European Parliament and the Council, as regards protective measures against pests of plants, and repealing Commission Regulation (EC) No 690/2008 and amending Commission Implementing Regulation (EU) 2018/2019.

2.1.2. Database search

Pest information, on host(s) and distribution, was retrieved from the European and Mediterranean Plant Protection Organization (EPPO) Global Database (EPPO, online) and relevant publications.

Data about the import of commodity types that could potentially provide a pathway for the pest to enter the EU and about the area of hosts grown in the EU were obtained from EUROSTAT (Statistical Office of the European Communities).

The Europhyt database was consulted for pest-specific notifications on interceptions and outbreaks. Europhyt is a web-based network run by the Directorate General for Health and Food Safety (DG SANTÉ) of the European Commission, and is a subproject of PHYSAN (Phyto-Sanitary Controls) specifically concerned with plant health information. 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 Member States (MS) and the phytosanitary measures taken to eradicate or avoid their spread. The recording of interceptions switched from Europhyt to TRACES in May 2020. TRACES is a European Commission online platform used for the importation of plants into the European Union (It is also used for animals, animal products, food and feed of non-animal origin).

2.2. Methodologies

The Panel performed the pest categorisation for *D. citri*, following guiding principles and steps presented in the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018) and in the International Standard for Phytosanitary Measures No 11 (FAO, 2013) and No 21 (FAO, 2004).

This work was initiated following an evaluation of the EU 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 quarantine pest and for a Union regulated non-quarantine pest (RNQP) in accordance with Regulation (EU) 2016/2031 on protective measures against pests of plants, and includes additional information required in accordance with the specific TOR 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 quarantine pest or as an 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 an RNQP that 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.

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, whereas addressing social impacts is outside the remit of the Panel.

Table 1: Pest categorisation criteria under evaluation, as defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

Criterion of pest categorisation	Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	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 an RNQP. (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!
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?

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
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 RNQP were met, and (2) if not, which one(s) were not met

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, the identity of the pest is established.

Diaphorina citri Kuwayama, 1908 is an insect in the order Hemiptera, family Liviidae, that was first described in Taiwan in 1907 (Kuwayama, 1908). The species was renamed *Euphalerus citri* (Kuwayama, 1908) by Crawford, (1912); however, this modification was attributed by Hodkinson (1986) to a misidentification of *Diaphorina guttulata* Lethierry, 1890 and the name *Euphalerus citri* was never widely accepted nor used further (Ouvrard, 2020).

The genus *Diaphorina* includes 74 described species (Loginova, 1975; Hodkinson, 1980). In addition to *D. citri,* six other species of *Diaphorina* (*D. amoena* Capener, *D. auberti* Hollis, *D. communis* Mather, *D. murrayi* Kandasamy, *D. punctulate* Pettey and *D. zebrana* Capener) are reported on citrus. *D. citri* has a distinct pattern of maculation on the forewings and can be separated easily from most of the other species reported on citrus (Halbert and Manjunath, 2004).

The six other species are not known to vector any pathogen and therefore have much less impact on yield or quality than *D. citri* and are of relatively little practical importance (Halbert and Manjunath, 2004).

The EPPO code[6] (Griessinger and Roy, 2015; EPPO, 2019) for this species is DIAACI (EPPO, online).

3.1.2. Biology of the pest

D. citri adults are very active and jump when even slightly disturbed. They are commonly found aggregated on young, tender flush (the new leaves and shoots that citrus trees produce, often more than once per year) where they feed and mate. Male and female *D. citri* emerge at the same time. Mating takes place on new leaf flush during daylight hours (EPPO, 2005). After mating, gravid females must feed on young flush to produce viable eggs. Females are capable of laying more than 800 eggs during their lives; up to 1,900 eggs laid per female have been reported (Nava et al., 2007). Multiple

[6] An EPPO code, formerly known as a Bayer code, is a unique identifier linked to the name of a plant or plant pest important in agriculture and plant protection. Codes are based on genus and species names. However, if a scientific name is changed, the EPPO code remains the same. This provides a harmonised system to facilitate the management of plant and pest names in computerised databases, as well as data exchange between IT systems (Griessinger and Roy, 2015; EPPO, 2019).

matings are required during adulthood to maintain maximum female reproductive output (Wenninger and Hall, 2007). *D. citri* will mate, oviposit and develop exclusively on new flush (Moran and Buchan, 1975; Hall and Albrigo, 2007). Gravid females have an orange abdomen indicating that eggs are ready to be laid. Eggs are laid on the leaf tissue inside the folds of the unexpanded leaves, on the edges of young leaves, or at the base of leaf buds which have just begun to form. When young flush is not available, psyllid adults can usually be found on the underside of leaves feeding in the area of the leaf mid-vein. After eggs hatch, nymphs pass through five instars. They move away when disturbed but normally lead a sedentary existence clustered in groups.

Adult psyllids survive for long periods on mature leaves until new flush is present. The ability to survive on mature leaves in the absence of new flush allows psyllid adults to over-winter and populations to build up quickly on the early spring flush (Rogers and Stansly, 2012).

The development of *D. citri* is dependent upon temperature. The mean developmental period from egg to adult ranges from 49.3 days at 15°C to 14.1 days at 28°C. Optimum development occurs between 25°C and 28°C (Liu and Tsai, 2000). Under controlled conditions, populations reared on *Murraya paniculata* (Rutaceae) at 10°C and 33°C failed to develop, whereas survival of the nymphal instars 3–5 was unchanged between 15°C and 28°C. The highest intrinsic rate of increase (0.1999) and net reproductive rates (292.2) were observed at 28°C on *M. paniculata*. Between 20 and 28°C, mean adult longevity varied from 33.5 to 50.6 days. When temperatures are 12.8–15.6°C, the average longevity of adult psyllids increases to 88 days (Liu and Tsai, 2000).

Despite adaptation to temperatures typical of tropical and subtropical climates, *D. citri* can survive temperatures below 0°C (Hall et al., 2011). In experiments examining cold tolerance of *D. citri* in Japan, Ashihara (2007) found that 50% of adults survived for approximately 10 days at constant 2.5°C and 50% survived for approximately 5 days at 0°C. 20% of adults could survive –6°C for 16 h. Given these results, Ashihara (2007) suggests that adult *D. citri* should be able to survive the winter on *Murraya* in areas where the mean daily minimum temperature of the coldest month is above 5°C.

Diaphorina citri is a vector of the bacterial pathogens *Candidatus* Liberibacter asiaticus (Las), *Candidatus* Liberibacter americanus (Lam) and *Candidatus* Liberibacter africanus (Laf) (Lallemand et al., 1986; Yamamoto et al., 2006; Roberts et al., 2017; Rasowo et al., 2019; Ajene et al., 2020a), the putative causal agents of the citrus disease Huanglongbing (HLB).[7]

D. citri nymphs and adults acquire the pathogen when feeding on infected hosts. After acquisition, the bacteria enter the salivary gland where they can multiply. Subsequent feeding by the psyllid can lead to other plants becoming inoculated (Inoue et al., 2009).

Most studies on epidemiology and pathogen–vector interactions refer to Las and *D. citri*. Acquisition of Las by *D. citri* increases in proportion to the time spent on Las-infected plants. Furthermore, acquisition of Las is approximately 20% greater when it occurs during nymphal development than during the adult stage only (Pelz-Stelinski et al., 2010). Investigations using qPCR, scanning electron microscopy and fluorescence in situ hybridisation techniques confirmed the presence of Las in the salivary glands, alimentary canal, filter chamber, Malpighian tubules, haemolymph, muscle and fat tissue and ovaries of *D. citri*, indicating a systemic presence of the bacterium within psyllids following acquisition (Ammar et al., 2011a,b). Evidence for a low rate (3.6%) of transovarial transmission of Las from mother *D. citri* to progeny was reported (Pelz-Stelinski et al., 2010); In addition to transovarial transmission, a similar, low rate (2–3%) of sexual transmission from male to female *D. citri* has been reported (Mann et al., 2011).

3.1.3. Intraspecific diversity

Molecular techniques using mitochondrial cytochrome oxidase I (mtCOI) have been used to identify haplotypes and assess their distribution worldwide (Boykin et al., 2012; Clarke and Brown, 2018; Ajene et al., 2020b). No evidence for cryptic speciation for *D. citri* was found based on the mtCOI region (Boykin et al., 2012).

[7] The biology of these bacteria is such that there are challenges in culturing them (e.g. Merfa et al., 2019) and they cannot formally fulfil all Koch's postulates to prove they each cause HLB.

3.1.4. Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, an EPPO diagnostic protocol and molecular methods have been developed.

Feeding by *D. citri* can stunt and twist the young shoots of hosts, such that the growing tips present a rosetted appearance; leaves can be badly curled and may be covered with honeydew and sooty mould; leaves drop prematurely (EPPO, 2020). *D. citri* has three developmental stages: egg, five nymphal instars and adult. Plants for planting of citrus material such as budwood, grafted trees with leaves or leaf buds and rootstock seedlings can carry eggs and/or nymphs over long distances. *M. paniculata*, frequently used as an ornamental bush or hedge, is one of the best hosts of this psyllid. During inspection of plant material for the presence of *D. citri*, attention should be paid to twisted and stunted growth of young shoots (EPPO 2005). Nevertheless, shoots that are not twisted should also be inspected to check for low-level infestation.

For early detection, suction sampling devices for the capture of adults, and yellow sticky traps are mostly recommended (Aidoo et al., 2020). For regular *D. citri* management actions, the stem tap sampling of adults provides reliable information rapidly. The visual sampling of nymphs in tender shoots during the major citrus sprouting periods of the tree growing season is recommended for determinations of the number of *D. citri* generations (Monzo and Stansly, 2020). Detailed protocols for surveillance, sampling and detection are indicated in the EPPO Standard PM 9/27 (2020) and in the EFSA pest survey card (EFSA, 2019).

The eggs are orange-coloured and almond-shaped, 0.31 (long)–0.15 (wide) mm. Eggs are laid singly inside half-folded leaves of the buds, in leaf axils and other suitable places on the young tender parts of the plant. The nymphs pass through five instars. They are light-yellow to dark-brown, bearing well-developed wing pods. Adults are 2.5 mm long with yellowish-brown body and greyish-brown legs with mottled wings held 'roof-like' over the body (Mead, 1977; EPPO 2005; Rogers and Stansly, 2012). They are usually found in large numbers on the lower sides of the leaves with heads almost touching the surface and the body raised almost to a 30° angle. The period of greatest activity of the psyllid corresponds with the periods of new growth of citrus (Mead and Fasulo, 2017).

At present, no key is available for the species of *Diaphorina* and identification is done by comparison with the description by Yang (1984).

Molecular methods have been developed for *D. citri* identification, such as mtCOI characterisation (Shafiq et al., 2018; Oke et al., 2020).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

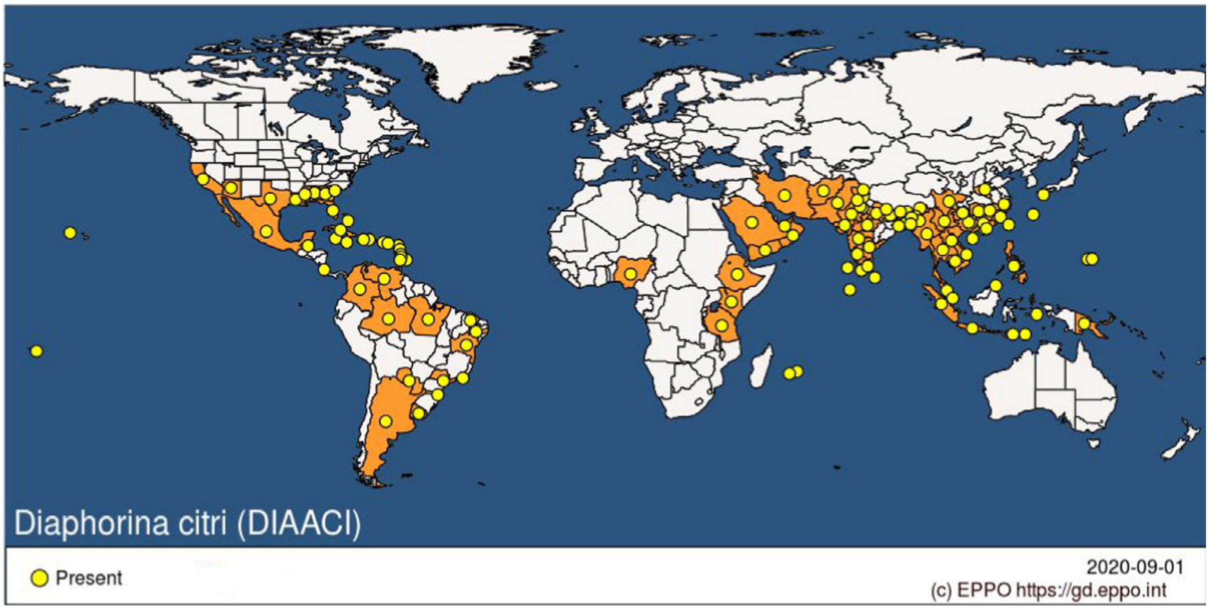

Figure 1: Global distribution map for *Diaphorina citri* (extracted from the EPPO Global Database accessed on 1.9.2020)

D. citri is considered native of south-eastern Asia. It was found in Brazil in the 1940s (Lima, 1942), expanded its range to Florida in the late 1990s (Halbert, 1998), and now infests most of the citrus-producing states of the United States, as well as Mexico, Belize, Costa Rica and much of the Caribbean and South America (Grafton-Cardwell et al., 2013) (Figure 1). Wooler et al. (1974) reported *D. citri* in Saudi Arabia. *D. citri* was recently recorded in Africa, namely in Ethiopia, Kenya, Tanzania and Nigeria (Aidoo et al., 2020; Ajene et al., 2020b; Oke et al., 2020).

For a detailed list of countries where *D. citri* is present, please see Appendix A.

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?

No. *D. citri* is not known to be present in the EU.

As noted in Section 1.2, the EU territory considered by pest categorisations does not include Ceuta, Melilla and the outermost regions of Member States referred to in Article 355(1) of the Treaty on the Functioning of the European Union (TFEU), other than Madeira and the Azores. Hence, whilst *D. citri* occurs in Martinique, Guadeloupe and Reunion (Appendix A) for the purposes of this categorisation *D. citri* is not considered to occur in the EU territory.

In the Netherlands, the pest's absence is confirmed by surveys; in Belgium and Slovenia, *D. citri* is declared absent with no pest records (EPPO, online).

3.3. Regulatory status

3.3.1. Commission Implementing Regulation 2019/2072

D. citri is listed in Annex II of Commission Implementing Regulation (EU) 2019/2072, the implementing act of Regulation (EU) 2016/2031. Details are presented in Table 2.

Table 2: *Diaphorina citri* in Commission Implementing Regulation 2019/2072

Annex II	**List of Union quarantine pests and their respective codes**
Part A	Pests not known to occur in the Union territory
	Quarantine pests and their codes assigned by EPPO
C	Insects and mites
28	*Diaphorina citri* Kuwayana [DIAACI]

3.3.2. Legislation addressing the hosts of *Diaphorina citri*

Legislation addressing the hosts of *D. citri* is detailed in Tables 3 and 4.

Table 3: Regulated hosts and commodities that may involve *Diaphorina citri* in Annex VI of Commission Implementing Regulation 2019/2072

Annex VI	**List of plants, plant products and other objects whose introduction into the Union from certain third countries is prohibited**		
	Description	**CN Code**	**Third country, group of third countries or specific area of third country**
11.	Plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruits and seeds	ex 0602 10 90 ex 0602 20 20 0602 20 30 ex 0602 20 80 ex 0602 90 45 ex 0602 90 46 ex 0602 90 47 ex 0602 90 50 ex 0602 90 70 ex 0602 90 91 ex 0602 90 99 ex 0604 20 90 ex 1404 90 00	All third countries

Table 4: Regulated hosts and commodities that may involve *Diaphorina citri* in Annex VII of Commission Implementing Regulation 2019/2072

Annex VII	**List of plants, plant products and other objects, originating from third countries and the corresponding special requirements for their introduction into the Union territory**			
	Plants, plant products and other objects	**CN Code**	**Origin**	**Special requirements**
53.	Plants of *Aegle* Corrêa, *Aeglopsis* Swingle, *Afraegle* Engl., *Amyris* P. Browne, *Atalantia* Corrêa, *Balsamocitrus* Stapf, *Choisya* Kunth, *Citropsis* Swingle & Kellerman, *Clausena* Burm. f., *Eremocitrus* Swingle, *Esenbeckia* Kunth., *Glycosmis* Corrêa, *Limonia* L., *Merrillia* Swingle, *Microcitrus* Swingle, *Murraya* J. Koenig ex L., *Naringi* Adans., *Pamburus* Swingle, *Severinia* Ten., *Swinglea* Merr., *Tetradium* Lour., *Toddalia* Juss., *Triphasia* Lour., *Vepris* Comm., *Zanthoxylum* L., other than fruit and seed	ex 0602 10 90 ex 0602 20 20 ex 0602 20 30 ex 0602 20 80 ex 0602 90 41 ex 0602 90 45 ex 0602 90 46 ex 0602 90 47 ex 0602 90 48 ex 0602 90 50 ex 0602 90 70 ex 0602 90 91 ex 0602 90 99 ex 0603 19 70 ex 0604 20 90 ex 1404 90 00	Third countries	Official statement that the plants originate: in a country in which *Diaphorina citri* Kuway is known not to occur, or in an area free from *Diaphorina citri* Kuway, established by the national plant protection organisation in accordance with the relevant International Standards for Phytosanitary Measures, and which is mentioned on the phytosanitary certificate referred to in Article 71 of Regulation (EU) No 2016/2031, under the rubric 'Additional declaration'

3.3.3. Legislation addressing the organisms vectored by *Diaphorina citri* (Commission Implementing Regulation 2019/2072)

Requirements against the pathogens listed in Table 5 are shown in Table 6 below.

Table 5: The organisms vectored by *Diaphorina citri* in Commission Implementing Regulation 2019/2072

Annex II	**List of Union quarantine pests and their respective codes**
Part A	Pests not known to occur in the Union territory
	Quarantine pests and their codes assigned by EPPO
A	Bacteria
1.	*Candidatus* Liberibacter africanus [LIBEAF]
2.	*Candidatus* Liberibacter americanus [LIBEAM]
3.	*Candidatus* Liberibacter asiaticus [LIBEAS]

Table 6: Special requirements in Annex VII of Commission Implementing Regulation 2019/2072 to protect against pathogens vectored by *Diaphorina citri*

Annex VII	**List of plants, plant products and other objects, originating from third countries and the corresponding special requirements for their introduction into the Union territory**			
	Plants, plant products and other objects	**CN Code**	**Origin**	**Special requirements**
51.	Plants of *Aegle* Corrêa, *Aeglopsis* Swingle, *Afraegle* Engl, *Atalantia* Corrêa, *Balsamocitrus* Stapf, *Burkillanthus* Swingle, *Calodendrum* Thunb., *Choisya* Kunth, *Clausena* Burm. f., *Limonia* L., *Microcitrus* Swingle., *Murraya* J. Koenig ex L., *Pamburus* Swingle, *Severinia* Ten., *Swinglea* Merr., *Triphasia* Lour. and *Vepris* Comm., other than fruit (but including seeds); and seeds of *Citrus* L., *Fortunella* Swingle and *Poncirus* Raf., and their hybrids	ex 0602 10 90 ex 0602 20 20 ex 0602 20 30 ex 0602 20 80 ex 0602 90 41 ex 0602 90 45 ex 0602 90 46 ex 0602 90 47 ex 0602 90 48 ex 0602 90 50 ex 0602 90 70 ex 0602 90 91 ex 0602 90 99 ex 0603 19 70 ex 0604 20 90 ex 1209 30 00 ex 1209 99 10 ex 1209 99 91 ex 1209 99 99 ex 1404 90 00	Third countries	Official statement that the plants originate in a country recognised as being free from *Candidatus* Liberibacter africanus, *Candidatus* Liberibacter americanus and *Candidatus* Liberibacter asiaticus, causal agents of Huanglongbing disease of citrus/citrus greening, in accordance with relevant International Standards for Phytosanitary Measures, provided that this freedom status has been communicated in writing to the Commission by the national plant protection organisation of the third country concerned

3.4. Entry, establishment and spread in the EU

3.4.1. Host range

The hosts of *D. citri* are all members of Rutaceae, the citrus family. Commercial fruit hosts that are regarded as major hosts by EPPO (EPPO, online) include *Citrus limon* (lemons), *C. aurantium* (sour orange), *C. paradisi* (grapefruit), *C. aurantiifolia* (limes), *C. maxima* (pomelo) and *C. reticulata* (mandarin/clementine). Lemons are usually the most 'susceptible'. *Murraya koenigii*, the curry tree, and *M. paniculata*, the orange jasmine, an ornamental rutaceous plant used for hedges, are also preferred hosts. A broad host range within the rutaceous subfamily Aurantioideae is reported (Halbert and Manjunath, 2004; Yang et al., 2006; EPPO, online). At least 10 genera, in addition to *Citrus*, are known host plants (Grafton-Cardwell et al., 2013). Oviposition and development on commonly grown citrus cultivars and related *M. paniculata* are similar and increases are influenced mainly by flush production (Tsai and Liu, 2000; Nava et al., 2007). However, various investigations have focused on identification of citrus and citrus-related genotypes that display resistance to colonisation and/or subsequent development by *D. citri* (Nehru et al., 2004; Nava et al., 2007; Tsagkarakis and Rogers, 2010). Different commercial varieties of sweet orange were compared by Alves et al. (2014) in terms of *D. citri* survival rates, development duration and various other biological parameters. The results obtained for the biological parameters and the life table indicate that Valencia and orange jasmine were the most suitable hosts whereas Hamlin was least suitable for the development of *D. citri* (Alves et al., 2014).

Appendix B provides a more comprehensive list of reported hosts.

3.4.2. Entry

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

Yes, *D. citri* has been intercepted on *Murraya* spp. being imported into the EU on several occasions.

Burckhardt and Martinez (1989) report *D. citri* being intercepted in France on citrus fruit (lime) from Honduras. It is not reported whether the fruit was free from leaves.

Table 7: Potential pathways for *Diaphorina citri* and existing mitigations

Pathways	Life stage	Relevant mitigations [e.g. prohibitions (Annex VI) or special requirements (Annex VII) within Implementing Regulation 2019/2072]
Plants for planting with leaves or buds	Egg, nymph, adult	Annex VI of Regulation 2016/2031 prohibits the introduction in the EU of plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruits and seeds from third countries Annex VII of Regulation 2016/2031 regulates the introduction of plants and plants for planting into the Union from third countries where the pest is present
Fresh leaves for consumption of *Murraya koenigii* and *Citrus hystrix*	Egg, nymph, adult	Annex XI of Regulation 2016/2031 regulates plants, plant products and other objects subject to phytosanitary certificates for their introduction into the Union territory
Cut flowers/cut branches/ foliage of *Murraya paniculata* and *Citrus hystrix*	Egg, nymph, adult	Annex XI of Regulation 2016/2031 regulates plants, plant products and other objects subject to phytosanitary certificates for their introduction into the Union territory
Fruit of *Citrus* spp. (hitch-hiker behaviour)	Adult	Annex VII of Regulation 2016/2031 regulates the introduction of Fruits of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids into the Union from third countries

Citrus material (budwood, grafted trees, rootstock seedlings) from infested areas can carry eggs and nymphs over longer distances. Such 4th or 5th-instar nymphs, as well as the adults developing from these nymphs, are capable of transmitting the greening agent to citrus facilitating entry of the quarantine listed pathogens. The rutaceous plant *M. paniculata*, frequently used as an ornamental bush or hedge, is one of the best hosts of *D. citri*. This plant can carry eggs or nymphs of *D. citri,* and therefore, its introduction into disease and vector-free regions presents a plant health risk. Europhyt data do not provide any evidence that citrus fruit provides a pathway for *D. citri* into the EU. Nevertheless, findings of adults in bulk loads of oranges being transported within the USA for processing indicates that *D. citri* can be moved with fruit even when there is minimal foliage, suggesting that commercial distribution of fruit could also facilitate spread of the vector and disease (Halbert et al., 2010; McRoberts et al., 2019).

Up until May 2020, there were 21 records of interception of *D. citri* in the Europhyt database. All 21 interceptions were on *Murraya* spp. (19 on *M. koenigii*, one on *M. paniculata* and one on an unidentified *Murraya* species). Prior to 2012, there were no interceptions recorded in the EUROPHYT interceptions database or on TRACES.

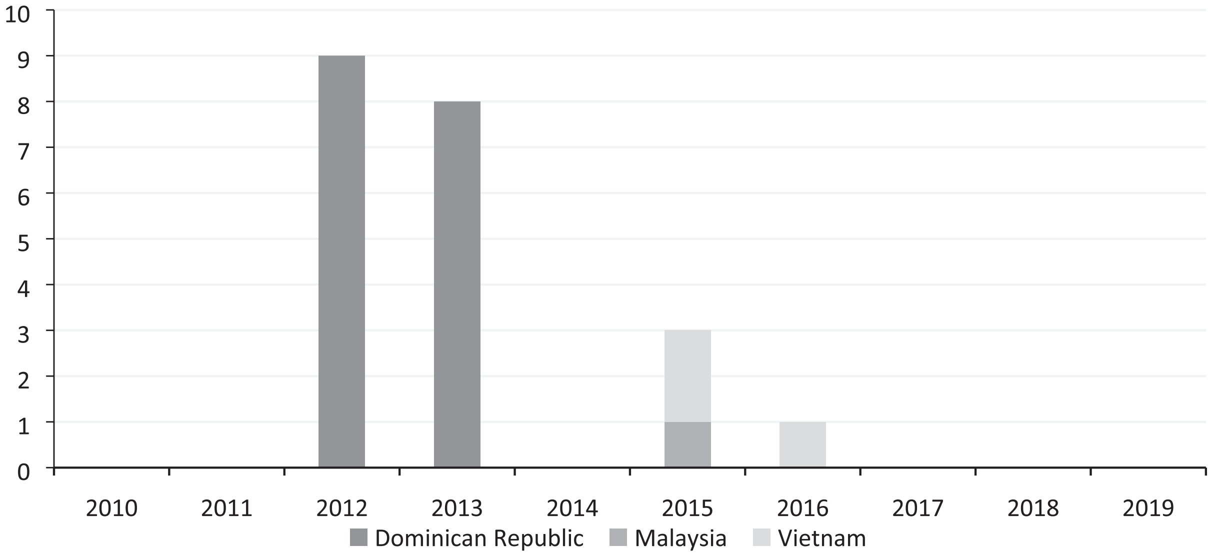

Figure 2: Interceptions of *Diaphorina citri* notified to EUROPHYT and country and origin (n = 21)

Figure 2 indicates that the majority of interceptions occurred on material from the Dominican Republic in 2012 and 2013. However, there are limits regarding how interception data can be interpreted. This is because the number of consignments imported into the EU potentially carrying *D. citri* and the total number of consignments examined is not centrally compiled or linked with interception data, preventing a more meaningful analysis. Reports of interception should therefore be interpreted with caution (MacLeod, 2015). Recording inspection and sampling effort with the number of consignments entering the EU would provide information that could greatly help the interpretation of interception data. Moreover, it would better inform risk reduction decision-making and would allow the efficacy of the risk reduction options affecting entry to be measured (MacLeod et al., 2005; MacLeod, 2015).

Citrus fruit from countries where the pest occurs is imported into the EU (see Appendix C). Europhyt contains no records of interceptions of *D. citri* on any Citrus fruit. The only interception on fruit is from 1989 (Burckhardt and Martinez), prior to the establishment of Europhyt in 1995.

Despite the regulatory prohibition of imports, intended to reduce the likelihood of entry, there have been reports of illegal imports of *Citrus* spp. and *Murraya* spp. plants which constitute a pathway of entry for high-risk material (ANSES, 2019).

There are uncertainties relating to the precise quantification of flows of certain plant products, especially foliage of *M. koenigii, M. paniculata* and *Citrus hystrix* for example, as well as certain aspects of biology such as the survival of insects during transport (ANSES, 2019).

3.4.3. Establishment

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

Yes, climatic conditions around the Mediterranean basin, especially in the regions with commercial citrus production are likely to be conducive for the establishment of *D. citri*.

3.4.3.1. EU distribution of main host plants

Citrus hosts occur widely in the EU with commercial citrus fruit production concentrated around the Mediterranean (Figure 3).

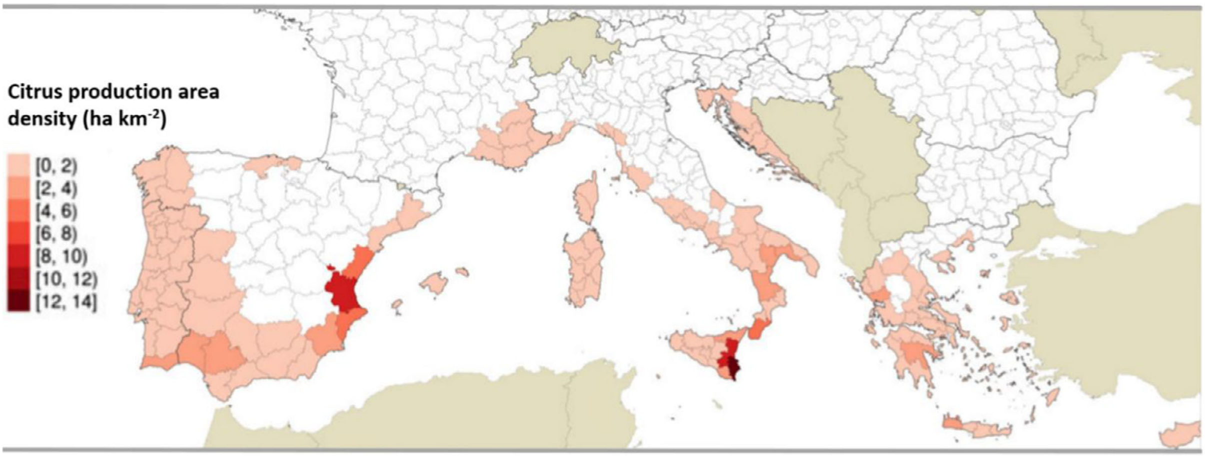

Figure 3: Citrus production areas in the EU at NUTS3 (Nomenclature of Territorial Units for Statistics 3) (Source: EFSA PLH Panel, 2016)

There is over half a million hectares dedicated to citrus fruit production in the EU each year, over half of which occurs in Spain (Table 8).

Table 8: EU 28 crop production (2015–2019) of citrus fruits (in 1,000 ha). Source Eurostat, data extracted on 18/6/2020

EU Member State	2015	2016	2017	2018	2019
Spain	298.72	295.33	294.26	297.62	296.08
Italy	149.10	147.65	135.36	134.64	135.10
Greece	50.94	45.86	43.47	46.26	46.26
Portugal	20.21	20.36	20.51	21.07	21.07
France	4.21	4.22	4.27	4.39	4.46
Cyprus	2.84	3.41	2.92	3.00	3.11
Croatia	2.21	2.19	2.06	1.97	2.19
European Union	528.23	519.01	502.84	508.94	508.27

Source: Eurostat [apro_cpsh1] Crop production in EU standard humidity, Crop code T0000.

3.4.3.2. Climatic conditions affecting establishment

D. citri occurs in tropical and subtropical citrus growing regions in Asia, Africa and the Americas. Surveys in citrus during 2014 and 2015 found *D. citri* in East Africa for the first time (Shimwela et al., 2016). Having found *D. citri* in Tanzania, Shimwela et al. (2016) used correlative modelling to identify areas elsewhere in Africa and Europe where climate may be suitable for establishment of *D. citri.* Using MaxEnt Shimwela et al. (2016) concluded that some of the citrus growing areas in Europe (including the EU) would be suitable for establishment of *D. citri*. Areas most suitable included Portugal, coastal Spain (south and east), Sardinia, southern Italy and Sicily, coastal Greece and Cyprus.

Gutierrez and Ponti (2013) developed a weather-driven physiologically based demographic model combining citrus yields, the relative density of *D. citri* and its parasitoid *Tamarixia radiata* (Waterstone) (Hymenoptera: Eulophidae) together with the potential severity of citrus greening disease to predict the potential geographic distribution, phenology and relative abundance of *D. citri* and HLB in North America and around the Mediterranean Basin. Using a lower temperature threshold of 12.85°C for *D. citri* development, which they derived from existing literature, and with 206.1 DD required for egg to adult development, Gutierrez and Ponti (2013) identified regions within EU countries including Portugal, Spain, Italy, Greece, Cyprus and small areas of southern France as suitable for *D. citri* (see map in Figure 6c of Gutierrez and Ponti (2013)).

Narouei-Khandan et al. (2016) also used correlative species distribution modelling to identify areas of the world where *D. citri* could establish and found some citrus growing regions of the EU would be suitable.

Drawing on the literature referenced above, a pest risk analyses by ANSES (2019) highlight that southern Portugal, eastern Spain, Corsica, southern Italy, Greece, Croatia, Cyprus and Malta are favourable for establishment of *D. citri*.

Using models to map the potential thermal niche of *D. citri*, Taylor et al. (2019) also identified that within Europe, the Iberian Peninsula was the most suitable region for establishment of *D. citri.*

3.4.4. Spread

Is the pest able to spread within the EU territory following establishment? How?

Yes. *D. citri* is liable to be locally spread by natural dispersal. Movement of infested material (either fruit, cut branches, plants and plants for planting and reused fruit boxes) would be the main means of spread, especially if moved with leaves or leaf buds. Longer distance dispersal is also possible via the same means and via wind or air currents.

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

No, plants for planting would not be the main means of spread (see text above).

D. citri can disperse by itself. Several papers refer to adults moving hundreds of meters. Surveys conducted by Boina et al. (2009) indicate that frequent movement of adult *D. citri* occurs between orchards. Indeed, an immunomarking technique was adapted for tracking the movement of *D. citri* in Florida by marking psyllids in situ and then tracking their undisturbed movement behaviour over time. *D. citri* was capable of moving 100 m within 3 days, with abandoned citrus groves serving as a source of infestation for nearby managed citrus (Boina et al., 2009). Subsequent investigations showed that *D. citri* was capable of dispersing 400 m within 4 days and that 2–14% of the psyllids moving from abandoned into managed groves carried the Las pathogen (Tiwari et al., 2010). Asian citrus psyllid may be induced to disperse when conditions are unfavourable (e.g. lack of young flush, intraspecific competition, insecticidal applications) (Croxton 2015; Lewis-Rosenblum et al. 2015; Tomaseto et al., 2016; Johnston et al., 2019). Influence of abiotic factors (i.e. temperature, barometric pressure, wind and humidity) was also highlighted (Johnston et al., 2019). Dispersal $\geq$ 2 km has been demonstrated both indirectly, e.g. by detection of symptomatic trees in an orchard far from disease-affected areas (Bassanezi et al., 2010, 2013b; Gottwald et al., 2007, 2010; Martini et al., 2013), and using a flight mill (Arakawa and Mivamolo, 2007; Martini et al., 2014), and directly, from the spatial distribution of milk protein-labelled insects (Lewis-Rosenblum et al., 2015). Long-distance dispersal by the insect is probably associated with short sequential flights or air movements since the musculature in relation to wing size is considered weak in *D. citri* (Sakamaki 2005), making active long-distance single flights difficult. In addition, long-range dispersal of psyllids might be facilitated by wind.

Gottwald et al. (2007) investigated HLB infection data and hypothesised that wind-assisted *D. citri* dispersal in Florida ranges from 90 to 145 km. In addition, Sakamaki (2005) suggested that *D. citri* could have dispersed up to 470 km, throughout the Okinawan islands, mediated by lower jet airstreams (Lewis-Rosenblum et al., 2015).

In California, the hotspots of *D. citri* abundance were strongly associated with certain urbanised regions and suggest more frequent introduction events in these areas, perhaps due to the transportation of plant material, equipment and fruit via road networks. In addition to the transportation-mediated introduction events of invasive insects, urbanisation may also be correlated with the amount of suitable habitat available for establishment and spread. Subsequent spread of *D. citri* was likely the result of natural dispersal of the psyllid throughout areas with a high density of residential citrus trees, coupled with some continuing longer distance movement via unregulated or illegal movement of plant material (Bayles et al., 2017).

Long-distance dispersal is thought to be a combination of both natural adult psyllid movement and human-mediated transportation events (Bayles et al., 2017). Indeed, commercial distribution of fruit could also facilitate spread of the insect and disease over greater distances (Halbert et al., 2010; McRoberts et al., 2019). However, EPPO (2020) state that cleaned fruits that have been washed and are without leaves at the end of the packing process are not considered to pose a risk. The pest is liable to be carried on leafy plant material of host species and live plants are considered the most important pathways for this pest (ANSES, 2019).

3.5. Impacts

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

Yes, should *D. citri* enter and establish in the EU, economic impacts on citrus would be expected.

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?[8]

Yes, the presence of the pest on plants for planting has an economic impact on its intended use.

D. citri is an important pest of citrus in several countries, due primarily to its role as a vector of bacterial pathogens which are recognised as the putative causal agents of Huanglongbing (HLB), also known as yellow dragon disease or citrus greening. The disease of citrus is associated with three *Candidatus* Liberibacter spp.; *Candidatus* Liberibacter asiaticus (Las), *Candidatus* Liberibacter africanus (Laf) and *Candidatus* Liberibacter americanus (Lam) (Lallemand et al., 1986; Bové, 2006; EFSA, 2019) (for more information, see Section 3.1.2. and EFSA (2019)). The other psyllid species, responsible for the same bacteria transmission is *Trioza erytreae*, which occurs in the EU in Spain and Portugal, including Madeira and the Canary Islands (EPPO Reporting Service, 2016; Siverio et al., 2017). None of the three bacteria have been found in the EU (ANSES, 2019; EFSA, 2019).

The most widely distributed HLB pathogen is Las which is present in Asia, North America, South America and Africa. Laf is restricted to parts of Africa and the Middle East and Lam is restricted to certain regions of Brazil. The current global distribution of both the bacteria and vector are thought to be determined largely by the human movement of plant material (Gottwald et al., 2010).

In their current area of distribution, the three bacterial species have negative impacts on yields (premature fruit drop), harvest quality (decline in the quality of fruit juices) and trees (degraded physiology, premature death) (ANSES, 2019).

In addition, *D. citri* typically causes defoliation and twig dieback. Serious damage to growing points can occur, which can lead to dwarfing as well as lack of juice and taste in fruit. Heavy *D. citri* populations can cause blossom and fruitlet drop (EPPO, 2020).

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, the existing measures (see sections 3.3 and 3.4.2) can mitigate the risks of entry, establishment, and spread within the EU. As a pest listed in Annex IIA, its introduction and spread in the EU is banned irrespective of what it may be found on. Despite the regulatory prohibition of imports, intended to prevent entry, there have been reports of illegal imports of *Citrus* spp. and *Murraya* spp. plants which constitute a pathway of entry for high-risk material (ANSES, 2019).

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

Yes, measures would be available to prevent pest spread via plants for planting if *D. citri* established in the EU. Measures could include growing plants under protection and applying chemical treatments.

3.6.1. Identification of additional measures

3.6.1.1. Additional control measures

Potential additional control measures are listed in Table 9.

[8] See Section 2.1 on what falls outside EFSA's remit.

Table 9: Selected control measures (a full list is available in EFSA PLH Panel, 2018) for pest entry/establishment/spread/impact in relation to currently unregulated hosts and pathways. Control measures are measures that have a direct effect on pest abundance

Information sheet title (with hyperlink to information sheet if available)	Control measure summary	Risk component (entry/ establishment/ spread/impact)
Growing plants in isolation	Plants could be grown in dedicated screenhouses (Ferrarezi et al., 2019)	Entry, Spread, Impact
Chemical treatments on consignments or during processing	Chemical control is the primary management strategy currently employed (Qureshi et al, 2014, Boina and Bloomquist, 2015). Foliar systemic insecticides (e.g. imidacloprid, fenpropathrin, chlorpyrifos and dimethoate) are considered to be effective in reducing citrus psyllid populations on plants during production, process or packaging operations. However, decreases in susceptibility of *D. citri* to several insecticides have been reported recently (Chen et al., 2020) Systemic soil-applied insecticides provide a longer period (months) of protection compared with foliar insecticides (weeks). Systemic insecticides are especially important for young trees that flush nearly continuously and thus require constant protection	Entry
Conditions of transport	Specific requirements for mode and timing of transport of commodities to prevent escape of the pest and/or contamination a) physical protection of consignment	Entry
Chemical treatments on crops including reproductive material	Foliar systemic insecticides (e.g. imidacloprid, fenpropathrin, chlorpyrifos and dimethoate) are considered to be effective in reducing citrus psyllid populations on plants during production operations (Boina and Bloomquist, 2015). However, decreases in susceptibility of *D. citri* to several insecticides have been reported recently (Chen et al., 2020) Systemic soil-applied insecticides provide a longer period (months) of protection compared with foliar insecticides (weeks). Systemic insecticides are especially important for young trees that flush nearly continuously and thus require constant protection (Boina and Bloomquist, 2015)	Establishment, Spread and Impact
Use of resistant and tolerant plant species/varieties	HLB tolerance has been observed in trifoliate orange, *Poncirus trifoliata* (L.) Raf., some of its hybrids and some citrus-related genera (Albrecht and Bowman, 2012; Ramadugu et al., 2016). Interestingly, *D. citri* is known to avoid colonising *P. trifoliata* (Westbrook et al., 2011; Hall et al., 2015). This is a result of both antixenotic and antibiotic mechanisms of resistance occurring in this plant genotype (Richardson and Hall, 2013; Andrade et al., 2016). On the other hand, citrange Carrizo was proven to be a highly susceptible rootstock to *D. citri* (Urbaneja-Bernat et al., 2020)	Establishment, Spread and Impact
Biological control and behavioural manipulation	Other pest control techniques not covered by 1.03 and 1.13 a) biological control Several fungal entomopathogens are reported to infect *D. citri*, especially under conditions of high humidity. These include *Isaria* (*Paecilomyces*) *fumosorosea* (Wize) A.H.S. Brown and G. Smith, *Lecanicillium lecanii* R. Zare & W Gams, *Beauveria bassiana* (Bals.) Vuill. and *Hirsutella citriformis* Speare (Grafton-Cardwell et al., 2013) The ectoparasitoid *Tamarixia radiata* (Waterston) (Eulophidae) and the endoparasitoid *Diaphorencyrtus aligarhensis* (Shafee, Alam and Argarwal) (Encyrtidae) are generally accepted as the only currently known primary parasitoids of *D. citri* (Grafton-Cardwell et al., 2013). Besides, predators of *D. citri* are reported among lady beetles, lacewings, syrphids and spiders. However, the relative importance of each group is less certain due in part to the difficulty of evaluating their individual contributions to mortality (Grafton-Cardwell et al., 2013)	Establishment, Spread and Impact

Information sheet title (with hyperlink to information sheet if available)	Control measure summary	Risk component (entry/establishment/spread/impact)
	b) behavioural control The strategy known as stimulodeterrent diversion or push–pull strategy has been investigated and in some cases field validated (Yan et al., 2015; Chow et al., 2019). *D. citri* repellents based on plant volatiles or plant-derived essential oils have been suggested (Cen et al., 2005; Zaka et al., 2010). Physical repellents, such as clay particle film, have also shown utility for possibly reducing transmission-related behaviours (Hall et al., 2007)	

3.6.1.2. Additional supporting measures

Potential additional supporting measures are listed in Table 10.

Table 10: Selected supporting measures (a full list is available in EFSA PLH Panel, 2018) in relation to currently unregulated hosts and pathways. Supporting measures are organisational measures or procedures supporting the choice of appropriate risk reduction options that do not directly affect pest abundance

Information sheet title (with hyperlink to information sheet if available)	Supporting measure summary	Risk component (entry/establishment/spread/impact)
Inspection and trapping	Research challenges for areas of recent invasion of *D. citri* include improved monitoring methods to detect psyllids at low levels in order to conduct more effective suppression programmes Yellow sticky traps (wavelength 550 nm) attract *D. citri,* as well as other psyllid pest species (Hall, 2009; Sétamou et al., 2014). A combination of a yellow sticky trap and a host plant is more attractive than a yellow sticky trap or a host plant alone (Godfrey et al., 2013; Sétamou et al., 2014; Uechi et al., 2014). Tap and suction sampling methods are used to monitor *D. citri* (Hall and Hentz, 2010; Monzo et al., 2015)	Establishment, spread
Laboratory testing	Molecular techniques are available for *D. citri* diagnosis (Fujiwara et al., 2017)	Entry, spread
Delimitation of Buffer zones	As an organism that would spread locally, buffer zones could be used to inhibit spread if the pest was to establish in the EU	Spread
Surveillance	Surveillance to guarantee that plants and produce originate from a pest-free area could be an option	Entry

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

- The psyllid is prolific, short-lived, tolerant to temperature extremes, and vagile.
- Young trees or alternative hosts that flush frequently provide a constant safe haven for the immature stages.

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

- Adults are mobile and move easily between plants
- Eggs are difficult to detect
- Some evidence of resistance to chemicals developing

3.7. Uncertainty

There are no uncertainties affecting the pest categorisation conclusions.

4. Conclusions

D. citri meets the criteria assessed by EFSA for consideration as a potential Union quarantine pest (it is absent from the EU, potential pathways exist, and its establishment would cause an economic impact). The criterion of the pest being present in the EU, which is a prerequisite for RNQP and PZ QP status, is not met.

Table 11: 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 pests (Section 3.1)	The identity of *D. citri* is well established. An EPPO protocol provides appropriate diagnostic approaches. Molecular identification methods are available	The identity of *D. citri* is well established	
Absence/ presence of the pest in the EU territory (Section 3.2)	The pest is not known to occur in the EU. Therefore, the criterion of absence for Union quarantine pest status is satisfied	The pest is not known to occur in the EU. Therefore, the criterion of widespread distribution within the EU for RNQP status is not satisfied	
Regulatory status (Section 3.3)	The pest is listed in Commission Implementing Regulation (EU) 2019/2072, Annex II, Part A, list of Union quarantine pests and their respective codes of pests not known to occur in the Union territory	There are no grounds to consider its status as a quarantine pest may be revoked	
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	Climatic conditions around the Mediterranean basin, especially in the regions with commercial citrus production are likely to be conducive for the establishment of *D. citri* The main pathways are: • plants for planting with foliage, • fresh leaves for consumption • cut branches with foliage	*D. citri* has only moderate dispersal potential by itself but can spread longer distances as a hitchhiker on fruit and in recycled fruit boxes. Wind-assisted dispersal can be important. Movement of plants for planting would not be the main means of spread	The significance of fruit as a pathway for entry is uncertain
Potential for consequences in the EU territory (Section 3.5)	Should *D. citri* enter and establish in the EU, economic impacts on its main hosts (*Citrus* spp.) would be expected in relation to both direct and mainly indirect effects due to HLB potential transmission	The presence of the pest on plants for planting has an economic impact on its intended use	
Available measures (Section 3.6)	There are measures available to prevent the likelihood of entry into the EU (e.g. prohibition of plant for planting; source plants for planting of Citrus and other hosts, from pest-free areas)	There are measures available to prevent pest presence on plants for planting (e.g. source plants from PFA)	
Conclusion on pest categorisation (Section 4)	*D. citri* satisfies all the criteria assessed by EFSA for it to be regarded as a Union quarantine pest	*D. citri* does not meet the criteria of occurring in the EU, nor plants for planting being the principal means of spread, for it to be regarded as a potential Union regulated non-quarantine pest	

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
Aspects of assessment to focus on/ scenarios to address in future if appropriate			

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Abbreviations

EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization
IPPC	International Plant Protection Convention

ISPM	International Standards for Phytosanitary Measures
MS	Member State
PLH	EFSA Panel on Plant Health
PZ	Protected Zone
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference

Glossary

Containment (of a pest)	Application of phytosanitary measures in and around an infested area to prevent spread of a pest (FAO, 1995, 2017)
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO, 1995, 2017)
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO, 2017)
Eradication (of a pest)	Application of phytosanitary measures to eliminate a pest from an area (FAO, 2017)
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2017)
Greenhouse	A walk-in, static, closed place of crop production with a usually translucent outer shell, which allows controlled exchange of material and energy with the surroundings and prevents release of plant protection products (PPPs) into the environment
Impact (of a pest)	The impact of the pest on the crop output and quality and on the environment in the occupied spatial units
Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO, 2017)
Measures	Control (of a pest) is defined in ISPM 5 (FAO 2017) as 'Suppression, containment or eradication of a pest population' (FAO, 1995). Control measures are measures that have a direct effect on pest abundance. Supporting measures are organisational measures or procedures supporting the choice of appropriate Risk Reduction Options that do not directly affect pest abundance
Pathway	Any means that allows the entry or spread of a pest (FAO, 2017)
Phytosanitary measures	Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO, 2017)
Protected zones (PZ)	A Protected zone is an area recognised at EU level to be free from a harmful organism, which is established in one or more other parts of the Union
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO, 2017)
Regulated non-quarantine pest	A non-quarantine pest whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing contracting party (FAO, 2017)
Risk reduction option (RRO)	A measure acting on pest introduction and/or pest spread and/or the magnitude of the biological impact of the pest should the pest be present. A RRO may become a phytosanitary measure, action or procedure according to the decision of the risk manager
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO, 2017)

Appendix A – Worldwide distribution of *Diaphorina citri*

Continent	Country	Subnational e.g. state	Status
Africa	Ethiopia		Present, restricted distribution
	Kenya		Present, restricted distribution
	Mauritius		Present, no details
	Nigeria		Present, no details
	Reunion		Present, no details
	Tanzania		Present, restricted distribution
America	Antigua and Barbuda		Present, no details
	Argentina		Present, restricted distribution
	Bahamas		Present, no details
	Barbados		Present, restricted distribution
	Belize		Present, no details
	Brazil		Present, widespread
	Brazil	Amazonas	Present, no details
	Brazil	Bahia	Present, no details
	Brazil	Ceara	Present, no details
	Brazil	Para	Present, no details
	Brazil	Pernambuco	Present, no details
	Brazil	Rio de Janeiro	Present, no details
	Brazil	Santa Catarina	Present, no details
	Brazil	Sao Paulo	Present, no details
	Cayman Islands		Present, no details
	Colombia		Present, widespread
	Costa Rica		Present, no details
	Cuba		Present, no details
	Dominica		Present, no details
	Dominican Republic		Present, no details
	Guadeloupe		Present, restricted distribution
	Haiti		Present, no details
	Jamaica		Present, no details
	Martinique		Present, no details
	Mexico		Present, restricted distribution
	Paraguay		Present, restricted distribution
	Puerto Rico		Present, no details
	Saint Lucia		Present, no details
	St Vincent and the Grenadines		Present, no details
	United States of America		Present, restricted distribution
	United States of America	Alabama	Present, few occurrences
	United States of America	Arizona	Present, restricted distribution
	United States of America	California	Present, few occurrences
	United States of America	Florida	Present, restricted distribution
	United States of America	Georgia	Present, few occurrences
	United States of America	Hawaii	Present, no details
	United States of America	Louisiana	Present, few occurrences
	United States of America	Mississippi	Present, few occurrences
	United States of America	South Carolina	Present, few occurrences
	United States of America	Texas	Present, no details
	Uruguay		Present, few occurrences
	Venezuela		Present, restricted distribution

Continent	Country	Subnational e.g. state	Status
	Virgin Islands (US)		Present, no details
Asia	Afghanistan		Present, no details
	Bangladesh		Present, no details
	Bhutan		Present, no details
	Cambodia		Present, no details
	China		Present, no details
	China	Aomen (Macau)	Present, no details
	China	Fujian	Present, no details
	China	Guangdong	Present, no details
	China	Guangxi	Present, restricted distribution
	China	Guizhou	Present, no details
	China	Hainan	Present, no details
	China	Henan	Present, no details
	China	Hunan	Present, no details
	China	Jiangxi	Present, no details
	China	Sichuan	Present, no details
	China	Xianggang (Hong Kong)	Present, widespread
	China	Yunnan	Present, no details
	China	Zhejiang	Present, no details
	East Timor		Present, no details
	India		Present, widespread
	India	Andhra Pradesh	Present, no details
	India	Arunachal Pradesh	Present, no details
	India	Assam	Present, no details
	India	Bihar	Present, no details
	India	Delhi	Present, no details
	India	Gujarat	Present, no details
	India	Haryana	Present, no details
	India	Himachal Pradesh	Present, no details
	India	Jammu & Kashmir	Present, no details
	India	Karnataka	Present, no details
	India	Kerala	Present, no details
	India	Lakshadweep	Present, no details
	India	Madhya Pradesh	Present, no details
	India	Maharashtra	Present, no details
	India	Manipur	Present, no details
	India	Meghalaya	Present, no details
	India	Punjab	Present, no details
	India	Rajasthan	Present, no details
	India	Sikkim	Present, no details
	India	Tamil Nadu	Present, no details
	India	Tripura	Present, no details
	India	Uttar Pradesh	Present, no details
	India	West Bengal	Present, no details
	Indonesia		Present, no details
	Indonesia	Java	Present, no details
	Indonesia	Maluku	Present, no details
	Indonesia	Nusa Tenggara	Present, no details
	Indonesia	Sumatra	Present, no details
	Iran		Present, restricted distribution

Continent	Country	Subnational e.g. state	Status
	Japan		Present, restricted distribution
	Japan	Kyushu	Present, few occurrences
	Japan	Ryukyu Archipelago	Present, no details
	Lao		Present, no details
	Malaysia		Present, few occurrences
	Malaysia	Sabah	Present, no details
	Malaysia	West	Present, no details
	Maldives		Present, no details
	Myanmar		Present, no details
	Nepal		Present, no details
	Oman		Present, restricted distribution
	Pakistan		Present, widespread
	Philippines		Present, no details
	Saudi Arabia		Present, no details
	Singapore		Present, restricted distribution
	Sri Lanka		Present, no details
	Taiwan		Present, restricted distribution
	Thailand		Present, no details
	United Arab Emirates		Present, no details
	Viet Nam		Present, restricted distribution
	Yemen		Present, no details
Oceania	American Samoa		Present, no details
	Guam		Present, no details
	Northern Mariana Islands		Present, no details
	Papua New Guinea		Present, restricted distribution

Appendix B – Host plants

Host plants of *Diaphorina citri* and their status as recognised in the EPPO global database (EPPO, online) and CABI Crop Protection Compendium (CABI, 2020; accessed 9 June 2020), and in other sources as cited by ANSES (2019).

Class/Family	Plant name	EPPO status	CABI status	Other sources as cited by ANSES (2019)
Rutaceae	*Aegle marmelos*	Minor		
Rutaceae	*Aeglopsis chevalieri*			ANSES (2019)
Rutaceae	*Afraegle gabonensis*			Halbert and Manjunath (2004)
Rutaceae	*Afraegle paniculata*	Minor		
Fabaceae	*Archidendron lucidum*	Incidental		
Rutaceae	*Atalantia*	Incidental		
Rutaceae	*Atalantia buxifolia*	Minor		
Rutaceae	*Atalantia missions*			Tirtawidjaja (1981)
Rutaceae	*Atalantia monophylla*			Halbert and Manjunath (2004)
Rutaceae	*Balsamocitrus dawei*	Minor		
Rutaceae	*Casimiroa edulis*	Incidental		
Rutaceae	*Choisya arizonica*			Sétamou et al. (2016)
Rutaceae	*Choisya ternata*			Sétamou et al. (2016)
Rutaceae	*Citroncirus*	Minor		
Rutaceae	*Citroncitrus cleopatra*			Westbrook et al. (2011)
Rutaceae	*Citroncitrus webberi*			Folimonova et al. (2009)
Rutaceae	*Citropsis gilletiana*			Halbert and Manjunath (2004)
Rutaceae	*Citropsis schweinfurthii*			Chavan and Summanwar (1993)
Rutaceae	*Citrus*	Minor	Main	
Rutaceae	*Citrus amblycarpa*	Minor		
Rutaceae	*Citrus aurantiifolia*	Minor	Main	
Rutaceae	*Citrus x aurantiifolia*			Aubert (1987)
Rutaceae	*Citrus aurantium*	Major		
Rutaceae	*Citrus australasica*	Minor		
Rutaceae	*Citrus australis*	Minor		
Rutaceae	*Citrus grandis*			Aubert (1987)
Rutaceae	*Citrus halimii*	Minor		
Rutaceae	*Citrus hassaku*	Minor		
Rutaceae	*Citrus hystrix*	Minor		
Rutaceae	*Citrus indica*			Folimonova et al. (2009)
Rutaceae	*Citrus inodora*	Minor		
Rutaceae	*Citrus jambhiri*	Minor		
Rutaceae	*Citrus x jambhiri*			Tsai and Liu (2000)
Rutaceae	*Citrus latifolia*		Other	
Rutaceae	*Citrus latipes*	Minor		
Rutaceae	*Citrus leiocarpa*			Westbrook et al. (2011)
Rutaceae	*Citrus limettioides*	Minor		
Rutaceae	*Citrus limon*	Major	Main	
Rutaceae	*Citrus x limon*			Halbert and Núñez (2004)
Rutaceae	*Citrus limonia*			Nava et al. (2007)
Rutaceae	*Citrus longispina*			Westbrook et al. (2011)
Rutaceae	*Citrus macrophylla*	Major		
Rutaceae	*Citrus madurensis*			Aubert (1990)
Rutaceae	*Citrus maxima*	Major		

Class/Family	Plant name	EPPO status	CABI status	Other sources as cited by ANSES (2019)
Rutaceae	*Citrus medica*	Minor		
Rutaceae	*Citrus meyeri*			Halbert and Manjunath (2004)
Rutaceae	*Citrus microcarpa*			Manjunath et al. (2008)
Rutaceae	*Citrus nobilis*			Aubert (1987)
Rutaceae	*Citrus obovoidea*			Halbert and Manjunath (2004)
Rutaceae	*Citrus paradisi*	Major		
Rutaceae	*Citrus reshni*	Minor		
Rutaceae	*Citrus reticulata*	Major		
Rutaceae	*Citrus sinensis*	Minor		
Rutaceae	*Citrus suhuiensis*			ANSES (2019)
Rutaceae	*Citrus sunki*	Minor		
Rutaceae	*Citrus taiwanica*	Minor		
Rutaceae	*Citrus volkameriana*	Minor		
Rutaceae	*Citrus webberi*	Minor		
Rutaceae	*Citrus x limonia*	Minor		
Rutaceae	*Citrus x nobilis*	Minor		
Rutaceae	*Clausena anisum-olens*	Minor		
Rutaceae	*Clausena excavata*	Minor		
Rutaceae	*Clausena harmandiana*	Minor		
Rutaceae	*Clausena indica*	Incidental		
Rutaceae	*Clausena lansium*	Minor		
Boraginaceae	*Cordia myxa*	Unclassified	Other	
Rutaceae	*Eremocitrus glauca*	Minor		
Moraceae	*Ficus carica*	Incidental		
Rutaceae	*Fortunella*	Minor		
Rutaceae	*Fortunella crassifolia*			Halbert and Manjunath (2004)
Rutaceae	*Fortunella japonica*	Minor		
Rutaceae	*Fortunella margarita*			Halbert and Manjunath (2004)
Rutaceae	*Fortunella polyandra*			Halbert and Manjunath (2004)
Rutaceae	*Fortunella sp.*	Minor		
Rutaceae	*Glycosmis pentaphylla*	Incidental		
Rutaceae	*Helietta apiculata*			Pimpinato et al. (2017)
Rutaceae	*Helietta parvifolia*			Sétamou et al. (2016)
Rutaceae	*Limonia acidissima*	Minor		
Rutaceae	*Merrillia caloxylon*	Incidental		
Rutaceae	*Microcitrus australasica*			Aubert (1987)
Rutaceae	*Microcitrus australis*			Halbert and Manjunath (2004)
Rutaceae	*Microcitrus inodora*			Westbrook et al. (2011)
Rutaceae	*Microcitrus papuana*			Halbert and Manjunath (2004)
Rutaceae	*Murraya koenigii*	Minor	Main	
Rutaceae	*Murraya paniculata*	Major		
Rutaceae	*Naringi crenulata*			Halbert and Manjunath (2004)
Rutaceae	*Pamburus missionis*			Halbert and Manjunath (2004)
Rutaceae	*Poncirus trifoliata*	Minor		
Rutaceae	*Rutaceae*	Minor		
Rutaceae	*Severinia (= Atalantia) buxifolia*			ANSES (2019)
Rutaceae	*Swinglea glutinosa*	Incidental		
Rutaceae	*Toddalia asiatica*	Incidental		
Rutaceae	*Triphasia trifolia*	Minor		

Class/Family	Plant name	EPPO status	CABI status	Other sources as cited by ANSES (2019)
Rutaceae	*Vepris lanceolata*	Incidental		
Rutaceae	*x Citrofortunella microcarpa*	Minor		
Rutaceae	*x Citrofortunella sp.*	Minor		
Rutaceae	*Zanthoxylum ailanthoides*	Incidental		
Rutaceae	*Zanthoxylum fagara**			Halbert and Manjunath (2004)
Moraceae	*Artocarpus heterophyllus***			Shivankar et al. (2000)

*: Host plants cited but not confirmed by Halbert and Manjunath (2004).
**: Host plant cited by Shivankar et al. 2000 but not confirmed by Pena et al. (2006).

Appendix C – Trade of citrus fruit, fresh or dried (CN 0805) with countries where the pest is present

PARTNER/PERIOD	2015	2016	2017	2018	2019
UNITED ARAB EMIRATES	121	49	316	47	16
AFGHANISTAN		0			7
ANTIGUA AND BARBUDA					1,760
ARGENTINA	1,710,295	2,514,690	1,995,206	2,324,659	166,8427
BARBADOS				0	
BANGLADESH	2,147	2,576	2,469	2,283	2,244
BAHAMAS			0		
BELIZE	411	3,344	2,543	821	8,166
BRAZIL	974,595	104,9765	110,7794	106,5009	974,416
CHINA (PEOPLE'S REPUBLIC OF)	844,156	848,070	110,5733	104,2660	113,7794
COLOMBIA	47,360	45,474	80,213	124,575	137,242
COSTA RICA	6,860	4,700	921	2,701	411
CUBA	2,953	7,166	3,864	4,438	3,422
DOMINICA	1,427	866	193	58	76
DOMINICAN REPUBLIC	12,317	12,155	11,204	10,633	7,355
HAITI	135	207	177	72	31
INDONESIA (ID+TP from 77, excl. TP -> 2001)	22	567	556	779	837
INDIA	3	327	523	821	118
JAMAICA	17,488	15,271	11,559	5,439	3,175
IRAN, ISLAMIC REPUBLIC OF	1,623	2,214	1,483	1,894	2,433
JAPAN	358	353	417	273	319
KENYA			0	9	
CAMBODIA (ex KAMPUCHEA)			0	0	3
LAO PEOPLE'S DEMOCRATIC REPUBLIC (LAOS)	37	52	2		
SRI LANKA (ex CEYLAN)	8	1	81	136	12
MAURITIUS		214	0	14	
MALDIVES			0		
MEXICO	663,492	723,219	703,129	710,277	529,586
MALAYSIA	441	23	39	107	8
NEPAL			1,170	0	60
OMAN	15		0	0	
PAPUA NEW GUINEA			0		
PHILIPPINES		94	0	10	8
PAKISTAN		209	1,494	422	1
PARAGUAY	0		0	0	6
SAUDI ARABIA	240		0	0	693
SINGAPORE			0	0	
THAILAND	705	836	1,756	670	814
TANZANIA, UNITED REPUBLIC OF	55	180	190	144	36
TAIWAN	0	157	0	0	
UNITED STATES	417,696	325,952	244,553	191,863	188,320
URUGUAY	536,168	418,462	383,635	386,679	420,329
ST VINCENT AND THE GRENADINES			13	14	
VENEZUELA	1,927	744	2216	681	
VIETNAM (excl. NORTH -> 1976)	18,808	28,649	46,952	70,934	73,964