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Pest categorisation of *Haplaxius crudus*

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Abstract

The EFSA Panel on Plant Health performed a pest categorisation of the planthopper *Haplaxius crudu*s (Hemiptera: Cixiidae) for the EU. This species occurs from south-eastern USA to Northern Brazil and on many Caribbean islands. Adults oviposit on grasses, mostly Poaceae and Cyperaceae in the vicinity of palms (Arecaceae). The pest can also be found on plants of the families Arecaceae, Heliconiaceae, Pandanaceae and Verbenaceae. Preimaginal development takes place on the roots of grasses, where nymphs feed. Upon emergence, adults move to palms for feeding and return to grasses for oviposition. *H. crudus* is regulated in Annex IIA of Commission Implementing Regulation 2019/2072 as *Myndus crudus*, a junior synonym. This species is a competent vector of *Candidatus* Phytoplasma palmae, the causal agent of coconut lethal yellowing, a disease also regulated in Annex IIA of the same regulation. Within this regulation, potential entry pathways for *H. crudus*, such as Arecaceae and Poaceae plants for planting with foliage and soil/growing medium, and soil/growing media by themselves can be considered as closed. However, plants for planting of the families Cyperaceae, Heliconiaceae, Pandanaceae and Verbenaceae are not specifically regulated. Should *H. crudus* arrive in the EU, climatic conditions and availability of susceptible hosts in a small area in southern EU (e.g. eastern Cyprus and south-western Spain) may provide conditions for limited establishment, and further spread to neighbouring areas in the Mediterranean basin during summer months. Economic impact is anticipated only if *Candidatus* Phytoplasma palmae is also introduced into the EU. Phytosanitary measures are available to reduce the likelihood of entry. *H. crudus* satisfies the criteria that are within the remit of EFSA to assess for this species to be regarded as a potential Union quarantine pest. This species does not meet the criteria of being present in the EU and plants for planting being the main pathway for spread for it to be regarded as a potential non-quarantine pest.

Keywords: American palm cixiid, coconut lethal yellowing, phytoplasma, plant health, plant pest, quarantine, vector

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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.

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[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 & 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
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 (Kaltenbach)

(b) Viruses and virus-like organisms

Beet necrotic yellow vein virus

1.2. Interpretation of the Terms of Reference

Myndus crudus Van Duzee 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 (RNQP) for the area of the EU excluding Ceuta, Melilla and the outermost regions of Member States (MS) 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].

A taxonomic revision now considers *Myndus crudus* Van Duzee, 1907 a junior synonym of *Haplaxius crudus* (Bourgoin, 2019), which is the current preferred scientific name. Therefore, in this categorisation the insect under scrutiny will be referred to as *Haplaxius crudus* (Van Duzee).

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A literature search on *H. crudus* 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

[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.

papers were reviewed, and further references and information were obtained from experts, as well as from citations within the references and grey literature.

2.1.2. Database search

Pest information, on host(s) and distribution, was retrieved from the European and Mediterranean Plant Protection Organization (EPPO) Global Database (EPPO, 2020) 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 MS and the phytosanitary measures taken to eradicate or avoid their spread.

2.2. Methodologies

The Panel performed the pest categorisation for *Haplaxius crudus* 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 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 terms of reference received by the European Commission. In addition, for each conclusion, the Panel provides a short description of its associated uncertainty.

Table 1 presents the Regulation (EU) 2016/2031 pest categorisation criteria on which the Panel bases its conclusions. All relevant criteria have to be met for the pest to potentially qualify either as a quarantine pest 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 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?

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
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 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?
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 well established.

Haplaxius crudus (Van Duzee, 1907) (Hemiptera: Fulguromorpha: Cixiidae) is a planthopper originally described by Van Duzee in 1907 as *Myndus crudus* from specimens collected in Jamaica in 1906 (Bourgoin, 2019). In 1946, Caldwell designated the North American species within the genus *Myndus* as members of the genus *Haplaxius* Fowler, 1904, thus creating the binomial *Haplaxius crudus,* which remains the preferred name for this cixiid (Tsai, 2005). As well as *Myndus crudus* Van Duzee, 1907, other junior synonyms include *Haplaxius cocois* (Fennah, 1945); *Haplaxius pallidus* Caldwell, 1946; *Paramyndus cocois* Fennah, 1945, and *Paramyndus crudus* Van Duzee, 1907; (University of Delaware, 2020). The EPPO code[6] (Griessinger and Roy, 2015; EPPO, 2019) for this species is MYNDCR (EPPO, 2020). It is also known as the American palm cixiid and the pallid cane leafhopper.

3.1.2. Biology of the pest

The planthopper *H. crudus* (Figure 1) is most probably native to the American tropics and its relevance is directly related to its role as competent vector of *Candidatus* Phytoplasma palmae, the causal agent of the coconut lethal yellowing (EFSA PLH Panel, 2017). The immature stages are subterranean and occur in the field in the thatch layer and on the roots of different grasses (mostly Poacaeae and Cyperaceae, see Appendix A) in both cultivated and natural habitats. Mature adults fly to palms to feed and mate and return to the grasses for oviposition (CABI, 2020). Eggs (whitish; 0.54 $\times$ 0.17 mm) are laid singly or in rows of up to five on the lower fronds of grasses, near to the root collar or on moist soil adjacent to roots or grass stolons (Reinert, 1977). After hatching, the nymphs move down to the soil surface and develop in the root zone of grasses, often beneath small clumps of leaf litter and other organic matter at soil depths of 3 cm (Howard and Gallo, 2019). Moist sites and longer grasses are preferred over drier sites and short-cut grasses (Howard and Gallo, 2019). Organic mulching also encourages nymph development (Howard and Gallo, 2019). Nymphs (5 instars) secrete a cottony wax material from their abdominal glands producing a sort of nest (1 cm in diameter), where they live in groups of 10–20 specimens protected from moisture, disease and predation. If disturbed, nymphs can jump approximately 5–10 cm (Tsai and Kirsch, 1978; Howard and Gallo, 2019).

Mature adults, which are active at night and during the day, remain at the bases of the host grasses for a few hours before flying to palm foliage to feed from the phloem with their piercing-sucking mouthparts (Kramer, 1979; Howard and Gallo, 2019). Mating also occurs on palm foliage. After mating, they return to grasses, where further mating may take place and where females oviposit. *H. crudus* reproduces throughout the year and the annual number of generations depends on temperature (Smith et al., 1997). Parthenogenic reproduction has not been observed (Tsai and Kirsch, 1978).

[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).

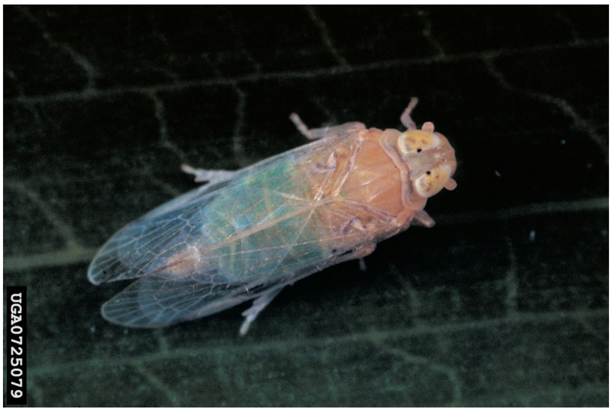

Figure 1: Adult *Haplaxius crudus*. (J.D. de Filippis, University of Florida, Bugwood.org)

H. crudus is a warmth loving insect. Tsai and Kirsch (1978) examined development of *H. crudus* on the grass *Stenotaphrum secundatum* at 15, 24 and 30°C. Nymphs reared at 15°C failed to moult to adults. At 24°C, the mean time taken from oviposition to adult was 80.8 days whilst at 30°C complete development took 52.6 days. At 24°C, adults live for approximately 7 or 8 days. Adult longevity was much longer on Arecaceae, with up to 50 days in Christmas palm (*Veitchia merrillii*) and 37 days on coconut palm (*Cocos nucifera*) (Tsai and Kirsch, 1978).

3.1.3. Intraspecific diversity

There is no evidence of intraspecific diversity within *H. crudus.*

3.1.4. Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, detection and identification methods to species level for *H. crudus* exist

Detection

According to CABI (2020), *H. crudus* does not appear to cause visible damage to its host plants in the adult or nymphal stage, which could facilitate the location of their feeding and breeding places. Since no pheromones have been discovered for this species, different monitoring systems have been used. These include the use of adhesive applied to palm fronds, sweep net sampling, and sticky traps (CABI, 2020).

Identification

According to Redford et al. (2010), as *H. crudus* is the only species within the Cixiidae family occurring on palm foliage in Florida and the Caribbean, the typical features of this family support the identification of this planthopper. These include the occurrence of a barrel-like basal segment (scape) bearing a seta-like flagellum on the antennae, clusters of tibial spines, and three parallel elevated ridges (carinae) along the prothorax.

According to CABI (2020), the head and thorax of the adults vary in colour from straw-coloured to pale-brown, the forewings are hyaline with pale or light-brown veins. Abdomen is pale green (Figure 1). Adults measure 4.2–5.1 mm long, with females tending to be larger than males. Characters of the male genitalia are essential for species-specific identification (Kramer, 1979).

The egg and pre-imaginal stages of *H. crudus* have been described by Wilson and Tsai (1982), who provide a key to the five nymphal stages. Kramer (1979) provides a key to males of species of *Haplaxius* occurring in the USA, Mexico and the Neotropics.

Nymphs of *H. crudus* are tan to grey in colour, with a reddish blush on the front of the head and rostrum. The legs are also reddish, grading to bright red distally. The foretibia are flattened. Nymphs produce wax threads, which coat their excrement and isolates the nymphs from them (Wilson and Tsai, 1982; Howard, 1987; Howard and Gallo, 2019). The eyes of the nymphs are maroon and do not change colour with light intensity (Howard and Gallo, 2019).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

H. crudus is native to the Caribbean and south Florida, throughout Central America and into northern South America (Bartlett et al., 2014). Hill et al. (2018) reported *H. crudus* from Ocean Springs, coastal Mississippi, where the climate is humid and sub-tropical. Howard and Wilson (2001) suggested that reports of small, transient, populations in southern Texas (Lower Rio Grande Valley) are seasonal migrants from more southerly areas (i.e. Mexico). The current known distribution of *H. crudus* is shown in Figure 2 and in Table 2.

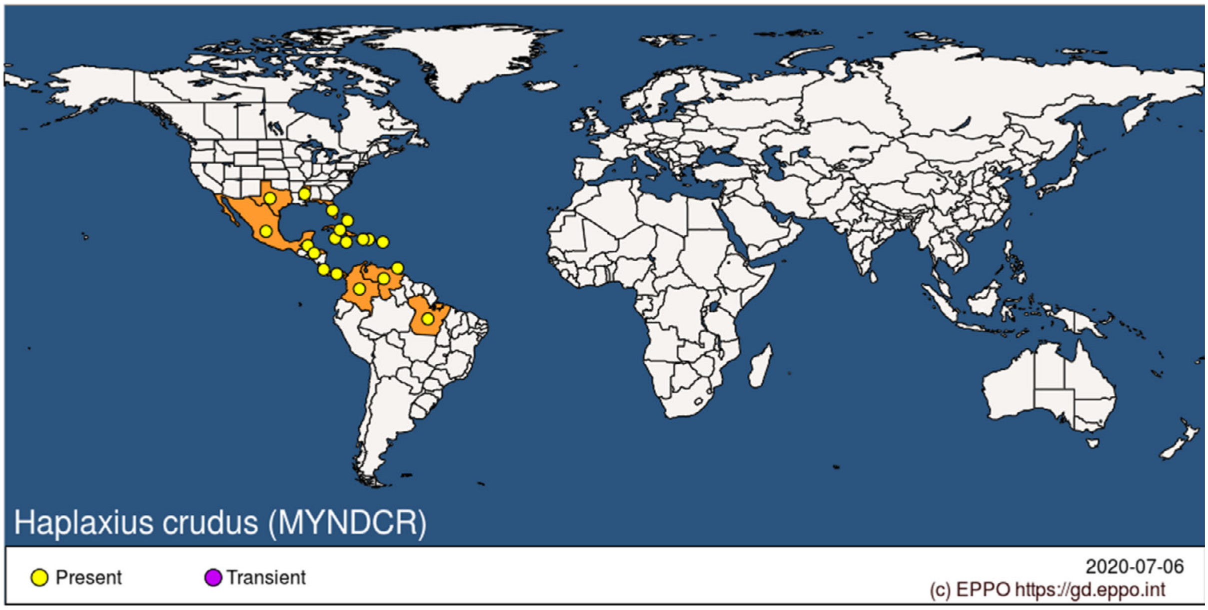

Figure 2: Global distribution map for *Haplaxius crudus* (extracted from the EPPO Global Database accessed on 6/7/2020)

Table 2: Distribution of *Haplaxius crudus* (Source: EPPO Global Database, 2020, other sources are indicated in the table

Continent	Country	Sub-national area e.g. State	Status
America	Bahamas		Present (CABI 2020)
	Belize		Present (CABI 2020)
	Brazil		Present, restricted distribution
		Pará	Present, no details (da Silva et al., 2019)
	Cayman Islands		Present, no details (University of Delaware, 2020)
	Colombia		
	Costa Rica		Present (CABI 2020)
	Cuba		Present, widespread (CABI 2020)
	Dominican Republic		Present, no details
	Haiti		Present (CABI 2020)
	Honduras		Present, no details
	Jamaica		Present, widespread (CABI 2020)
	Mexico		Present, no details (University of Delaware)

Continent	Country	Sub-national area e.g. State	Status
		Baja California Sur, Morelos, Quintana Roo, Veracruz, Yucatán	Present (Kramer, 1979; Howard et al., 1984; Pérez-Hernández et al., 2004)
	Panama		CABI (2020)
	Puerto Rico		CABI (2020)
	Trinidad and Tobago		Present, no details
	United States of America	Florida, Mississippi, Texas,	Present, restricted distribution
			Present, no details
	Venezuela		Kramer (1979)

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, *H. crudus* is not known to occur in the EU.

H. crudus is not known to occur in the EU. The NPPO of the Netherlands confirmed to EPPO in April 2018 that *H. crudus* was absent from its territory on the basis of surveys for harmful pests. Slovenia (July 2017) declared to EPPO that *H. crudus* was absent from its territory on the basis that there are no records of it in the country (EPPO, 2020).

3.3. Regulatory status

3.3.1. Commission Implementing Regulation 2019/2072

H. crudus is listed in Commission Implementing Regulation 2019/2072 as *Myndus crudus*. Details are presented in Tables 3 and 4.

Table 3: *Haplaxius (Myndus) crudus* 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
41.	*Myndus crudus* Van Duzee [MYNDCR]

3.3.2. Legislation addressing the hosts of *Haplaxius crudus*

Table 4: Regulated hosts and commodities that may involve *Haplaxius (Myndus) crudus* in Annexes 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
14.	Plants for planting of the family *Poaceae*, other than plants of ornamental perennial grasses of the subfamilies *Bambusoideae* and *Panicoideae* and of the genera *Buchloe*, *Bouteloua* Lag., *Calamagrostis*, *Cortaderia* Stapf., *Glyceria* R. Br., *Hakonechloa* Mak. ex Honda, *Hystrix*, *Molinia*, *Phalaris* L., *Shibataea*, *Spartina* Schreb., *Stipa* L. and *Uniola* L., other than seeds	ex 0602 90 50 ex 0602 90 91 ex 0602 90 99	Third countries other than: Albania, Algeria, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canary Islands, Egypt, Faeroe Islands, Georgia, Iceland, Israel, Jordan, Lebanon, Libya, Liechtenstein, Moldova, Monaco, Montenegro, Morocco, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny federalny okrug), Northwestern Federal District (Severo-Zapadny federalny okrug), Southern Federal District (Yuzhny federalny okrug), North Caucasian Federal District (Severo-Kavkazsky federalny okrug) and Volga Federal District (Privolzhsky federalny okrug)), San Marino, Serbia, Switzerland, Syria, Tunisia, Turkey and Ukraine

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
6.	Plants for planting, of the family *Poaceae* of ornamental perennial grasses of the subfamilies *Bambusoideae*, *Panicoideae* and of the genera *Buchloe* Lag., *Bouteloua* Lag., *Calamagrostis* Adan., *Cortaderia* Stapf, *Glyceria* R. Br., *Hakonechloa* Mak. ex Honda, *Hystrix* L., *Molinia* Schnrak, *Phalaris* L., *Shibataea* Mak. Ex Nakai, *Spartina* Schreb., *Stipa* L. and *Uniola* L., other than seeds	ex 0602 90 50 ex 0602 90 91 ex 0602 90 99	Third countries other than Albania, Algeria, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canary Islands, Egypt, Faeroe Islands, Georgia, Iceland, Israel, Jordan, Lebanon, Libya, Liechtenstein, Moldova, Monaco, Montenegro, Morocco, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny federalny okrug), Northwestern Federal District (Severo- Zapadny federalny okrug), Southern Federal District (Yuzhny federalny okrug), North Caucasian Federal District (Severo-Kavkazsky federalny okrug) and Volga Federal District (Privolzhsky federalny okrug)), San Marino, Serbia, Switzerland, Syria, Tunisia, Turkey, and Ukraine	Official statement that the plants: (a) have been grown in nurseries; (b) are free from plants debris, flowers and fruits; (c) have been inspected and prior to export; (d) are found to be free from symptoms of harmful bacteria, viruses and virus- like organisms; and (e) are found to be free from signs or symptoms of harmful nematodes, insects, mites and fungi, or have been subjected to appropriate treatment to eliminate such organisms. EN L 319/98 Official Journal of the European Union 10.12.2019

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 codes	Origin	Special requirement
55.	Plants for planting of *Palmae* other than seeds	ex 0602 10 90 ex 0602 20 20 ex 0602 20 80 ex 0602 90 41 ex 0602 90 45 ex 0602 90 46 ex 0602 90 47 ex 0602 90 48 ex 0602 90 50 ex 0602 90 70 ex 0602 90 99	Third countries other than Albania, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canary Islands, Faeroe Islands, Georgia, Iceland, Liechtenstein, Moldova, Monaco, Montenegro, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny federalny okrug), Northwestern Federal District (Severo-Zapadny federalny okrug), Southern Federal District (Yuzhny federalny okrug), North Caucasian Federal District (Severo-Kavkazsky federalny okrug) and Volga Federal District (Privolzhsky federalny okrug))., San Marino, Serbia, Switzerland, Turkey and Ukraine	Official statement that: (a) either the plants originate in an area known to be free from Palm lethal yellowing phytoplasmas and Coconut cadang-cadang viroid, and no symptoms have been observed at the place of production or in its immediate vicinity since the beginning of the last complete cycle of vegetation, or (b) no symptoms of Palm lethal yellowing phytoplasmas and Coconut cadang-cadang viroid have been observed on the plants since the beginning of the last complete cycle of vegetation, and plants at the place of production which have shown symptoms giving rise to the suspicion of contamination by the pests have been rogued out at that place and the plants have undergone appropriate treatment to rid them of *Myndus crudus* Van Duzee, EN L 319/130 Official Journal of the European Union 10.12.2019

Based on Annex VI, 14, the following subfamilies of Poaceae are prohibited from third countries which include countries where *H. crudus* occurs: Anomochlooideae, Aristidoideae, Arundinoideae, Chloridoideae, Danthonioideae, Micrairoideae, Oryzoideae (=Ehrhartoideae), Pharoideae, Pooideae, Puelioideae.

Ornamental perennial grasses in Bambusoideae and Panicoideae are permitted from third countries given they comply with conditions in Annex VII, 6.

Additionaly, Palmae hosts are regulated for another pest species, the red palm weevil, *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae), and are listed in:

- Annex IV, Part D, RNQPs concerning propagating material of ornamental plants and other plants for planting intended for ornamental purposes
- Annex V, Part C, Measures to prevent the presence of RNQPs on propagating material of ornamental plants and plants for planting intended for ornamental purposes
- Annex X, List of plants, plant products and other objects, whose introduction into, or moved within protected zones and corresponding special requirements for protected zones
- Annex XIV, List of plants, plant products and other objects for which a plant passport with the designation 'PZ' is required for introduction into, and movement within certain protected zones.

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

H. crudus is known to vector Coconut lethal yellowing phytoplasma (EPPO code PHYP56) (EFSA PLH Panel, 2017). Additionally, *H. crudus* has been referred to as a potential vector of the unidentified phytoplasma causing Texas phoenix palm disease/decline also referred to as lethal bronzing (no EPPO code) (Harrison et al., 2009; Halbert et al., 2018); and the virus causing coconut foliar decay (EPPO code CFDV00) (CABI, 2020). However, there is no strong evidence supporting this.

From these diseases, the coconut lethal yellowing phytoplasma is listed in Commission Implementing Regulation 2019/2072. Details are presented in Table 5.

Table 5: Legislation in Commission Implementing Regulation 2019/2072 addressing the organisms vectored by *Haplaxius crudus*

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
F.	Viruses, viroids and phytoplasmas
	Palm lethal yellowing phytoplasma [PHYP56]

3.4. Entry, establishment and spread in the EU

3.4.1. Host range

True hosts, i.e. those on which *H. crudus* can complete its life cycle (see Appendix A), are mostly grasses, either wild or cultivated as turf or forage, mostly in the family Poaceae (81.8%), but also in Cyperaceae (7.4%) and Verbenaceae (3.7%). Adults may additionally feed on other plants (feeding hosts), mostly Arecaceae (93.3%) grown in association with those grasses. Adults have been also observed on dicotyledonous shrubs but such cases are rare and they may correspond to vagrants from nearby palms (CABI 2020). Consequently, present regulations are not comprehensive of the host range of *H. crudus*, as plants for planting of the families Cyperaceae, Heliconiaceae, Pandanaceae, and Verbenaceae other than seeds from third countries (where *H. crudus* occurs) are not specifically regulated.

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, *H. crudus* could enter into the EU. The main pathways would be plants for planting of the families Arecaceae, Heliconiaceae, Pandanaceae, Poaceae and Cyperaceae, as well as Verbenaceae (excluding true seeds) and soil imported from countries where *H. crudus* occurs. These pathways can be considered as partially closed with current regulations in place.

According to EPPO (2020), *H. crudus* is less likely to be carried by palms and palm-like species (i.e. Pandanaceae), which are the adult feeding hosts and which are infested by mobile adults only. Adults would be expected to hop off such plants when disturbed by moving the plants. *H. crudus* is more likely to move in international trade as nymphs on roots of breeding hosts (i.e. grasses) or in the soil accompanying palm plants for planting.

A search of Europhyt interceptions database did not reveal any interception of *H. crudus* (accessed 14 May 2020). Adults of this planthopper, though, have been intercepted twice at USA ports of entry on cut flowers, once from Australia and another time from Costa Rica (CABI, 2020). There is some uncertainty regarding the interception reported to be from Australia because neither EPPO (2020) nor CABI (2020) list Australia as a country where *H. crudus* occurs.

Potential entry pathways are shown in Table 6.

Table 6: Potential pathways for *Haplaxius crudus* and existing mitigations (if any)

Pathways	Life stage	Relevant mitigations [e.g. prohibitions (Annex VI) or special requirements (Annex VII) within Implementing Regulation 2019/2072]
Plants for planting with foliage and growing medium	Eggs and nymphs on roots/soil Adults on foliage	**Annex VI (14)**. Bans the introduction of plants for planting of the family Poaceae from third countries (with some exceptions, see Table 4). **Annex VII (6)**. Requires official statement that Poaceae plants for planting excluded in **Annex VI (14.)** (a) have been grown in nurseries (...) and (e) are found to be free from signs or symptoms of harmful (...) insects (...) or have been subjected to appropriate treatment to eliminate such organisms. **Annex VII (55.)** Requires official statement that plants for planting of the family Arecaceae from third countries (with some exceptions but including all countries where *H. crudus* occurs, see Table 4): (a) either the plants originate in an area known to be free from Palm lethal yellowing phytoplasmas (...) and no symptoms have been observed at the place of production or in its immediate vicinity since the beginning of the last complete cycle of vegetation, or (b) (...) plants have undergone appropriate treatment to rid them of *Haplaxius crudus*. **Annex VII (1.)**. The growing medium attached to or associated with plants, intended to sustain the vitality of the host plants are mostly covered by the CN codes listed in Annex VII of Regulation 2019/2072 and require a general freedom from symptoms of quarantine pests.
Soil & growing media	Immature stages	**Annex VI (19. and 20.)** bans the introduction of soil and growing media as such into the Union from third countries other than Switzerland
Soil on machinery	Immature stages	**Annex VII (2.)** Official statement that machinery or vehicles are cleaned and free from soil and plant debris.

The plants for planting with foliage and growing medium pathway can be considered as partially closed because plants for planting of Poaceae and Arecaceae from countries where *H. crudus* occurs are either prohibited (Annex VI) or subjected to official statement ensuring freedom from this planthopper (Annex VII). Although plants for planting with foliage and growing medium of the families Cyperaceae, Heliconiaceae, Pandanaceae and Verbenaceae require a phytosanitary certificate and, therefore, should be free from quarantine pests, they are not specifically regulated in relation to *H. crudus*.

The soil/growing media pathway can be considered as closed because soil can only enter the EU from Switzerland (Annex VI). *H. crudus* is not known to occur in Switzerland.

Live plants from the countries where the pest occurs are imported into the EU. However, the exact identity of these plants cannot be ascertained using specific CN codes (see Appendix B). In the EFSA Scientific Opinion on pest categorisation of Palm lethal yellowing phytoplasmas (EFSA PLH Panel, 2017), where the main pathway for entry identified was palm plants for planting, imports of coconut plants from the Caribbean between 2000 and 2011 was documented.

3.4.3. Establishment

Is the pest able to become established in the EU territory? (Yes or No)

Yes, a relatively very small area of the EU might provide suitable conditions for establishment of *H. crudus,* which is primarily a tropical and semi-tropical pest. Some host palms and grasses are widely available in the southern EU. However, establishment will be confined to areas that do not suffer frosts and which accumulate sufficient thermal energy to facilitate continuous development. Parts of Cyprus and Andalusia have been identified as areas where biotic and abiotic conditions may enable establishment.

3.4.3.1. EU distribution of main host plants

In many places in southern Europe around the Mediterranean, palms (Arecaceae) are an essential component of the urban landscape. They are planted in large numbers along streets, in public parks, hotel grounds and private gardens providing important ecosystem services (MacLeod and Hussein, 2017). When describing the relative abundance of palms in the EuroMed region Rochat et al. (2014) categorised palms into three groups:

- Group 1 are species that are highly abundant and widespread in the EuroMed area,
- Group 2 are species that are widespread and locally abundant, but the total number are much less than species of group 1,
- Group 3 are rare species compared to those in Groups 1 or 2; they are scattered in the environment within the EuroMed.

Table 7 places *H. crudus* palm hosts into the groups described by Rochat et al. (2014) and lists those palm hosts that are absent outdoors or only grow indoors/within protection in Europe.

Table 7: Relative abundance of *Haplaxius crudus* palm hosts in the Euro-Med area

Group	Relative abundance	Host
1	Very abundant & widely distributed	*Phoenix canariensis*
		Phoenix dactylifera
2	Locally abundant	*Trachycarpus fortunei*
		Washingtonia robusta
3	Rare	*Sabal palmetto*
–	Absent outdoors (indoor/protected ornamental)	*Pritchardia pacifica*
		Adonidia (=Veitchia) merrillii
		Dypsis lutescens
		Pritchardia thurstonii
–	Absent	*Cocos nucifera*
		Roystonea regia

According to EFSA PLH Panel (2017), the only native palm species that grow on the European mainland are the European fan palm (*Chamaerops humilis*, with a distribution mainly in coastal areas of the western half of the Mediterranean basin) and the Cretan date palm (*Phoenix theophrasti,* endemic to Crete (Greece) and a few east Aegean islands) (Vamvoukakis, 1988). Many other palm species, including among others *C. humilis,* the Canary Islands date palm (*Phoenix canariensis*) the date palm (*Phoenix dactylifera*), *Trachycarpus fortunei*, *Washingtonia filifera*, and *W. robusta*, are widely used as ornamentals for landscaping in southern Europe (Cohen, 2017). Some of these species are also grown in the EU under protected cultivation conditions for ornamental purposes. Spain produces about 2 million palm trees annually with *P. canariensis* (1.2 million plants) being the predominant species, followed by other species such as *P. dactylifera*, *Phoenix reclinata*, *W. filifera*, *W. robusta*, *C. humilis* and *T. fortunei* (Armengol et al., 2005). There is also a significant ornamental palm production in nurseries in the Marche region of Italy (Nardi et al., 2009).

3.4.3.2. Climatic conditions affecting establishment

Smith et al. (1997) are not sure that *H. crudus* would survive in southern Europe. Climatic mapping is the principal method for identifying areas that could provide suitable conditions for the establishment of a pest taking key abiotic factors into account (Baker et al., 2000). As noted in Section 3.1.2 above, *H. crudus* is a warmth loving insect. *H. crudus* is not cold hardy, and nymphs reared at 15°C failed to develop into adults (Tsai and Kirsch, 1978). In Brazil, Bastos et al. (2019) reported that the abundance of *H. crudus* was positively correlated with temperature between 25 and 28°C and negatively correlated with rainfall. The pest was most abundant in months when monthly rainfall was below 200 mm and average monthly temperatures were above 25°C. Kramer (1979) reports that in the Americas the northern limit of *H. crudus* is determined by the distribution of its tropical palm hosts. Given that no life stages undergo a winter diapause *H. crudus* is limited to areas with mild winters (Purcell, 1985). Together, these factors suggest that maps showing the number of frost days per year and accumulated temperature could be examined when considering whether

H. crudus could establish in the EU. Figure 3 shows the mean number of frost days per year in North America and indicates three locations in the USA where *H. crudus* may be at the margin of its distribution. In Florida *H. crudus* is reported as far north as Gainesville (Halbert et al., 2014) (marked A in Figure 3). *H. crudus* is also reported from Ocean Springs, Jackson County, Mississippi (Hill et al., 2018) (B in Figure 3) and the Lower Rio Grande Valley, Texas (Meyerdirk and Hart (1982)) (C in Figure 3). These locations have up to 10 days of frost per year and have over 3,000 accumulated degree days above a threshold of 10°C (Baker et al., 2000) (Figure 4).

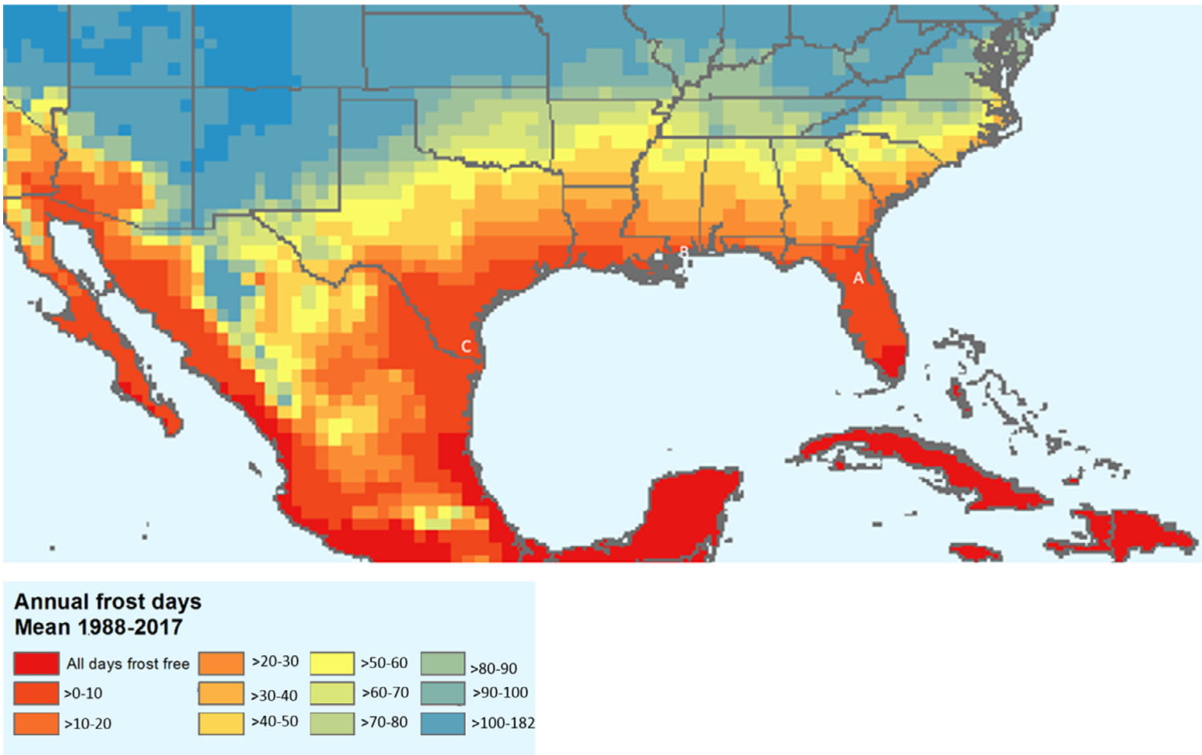

Figure 3: Mean annual number of frost days in North America and the northern Caribbean (1988–2017). Map created from data for the 30-year period 1988–2017, sourced from the Climatic Research Unit high resolution gridded data set CRU TS v. 4.03 at 0.5° resolution (https://crudata.uea.ac.uk/cru/data/hrg/)

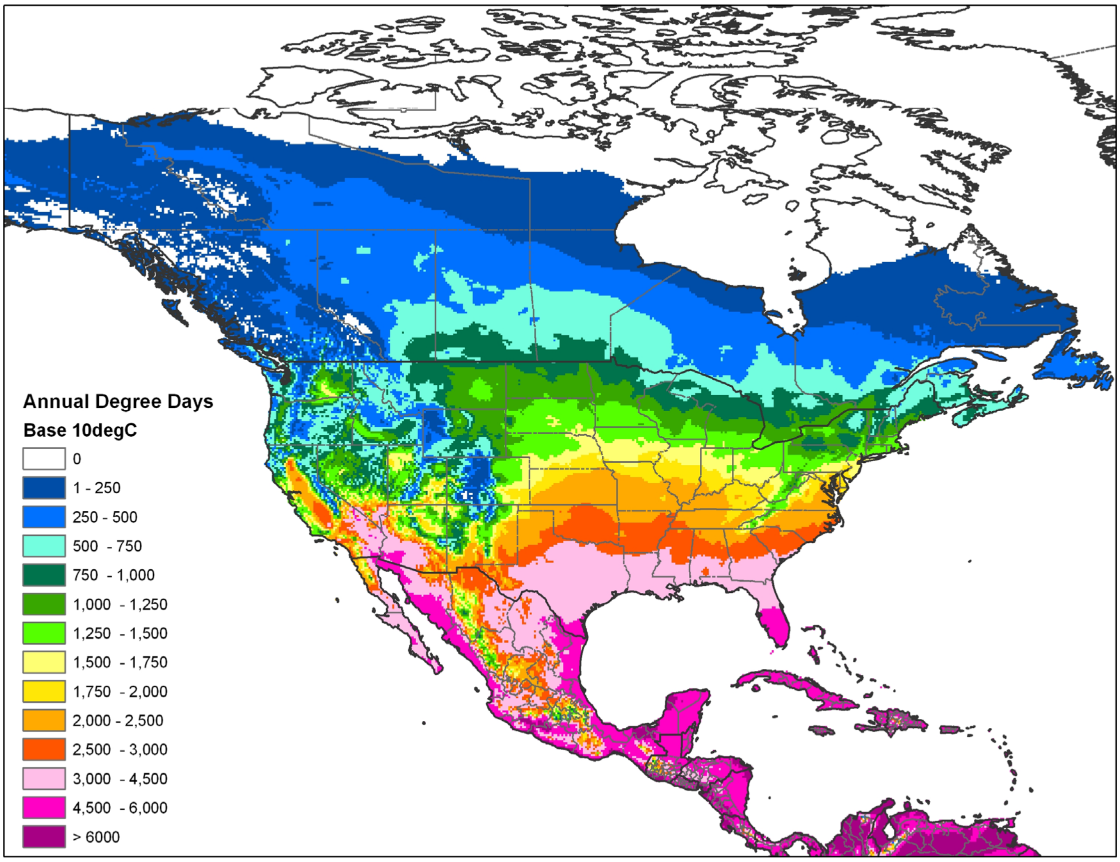

Figure 4: Accumulated degree days above 10°C in North America (from Baker, 2002; part of the original figure)

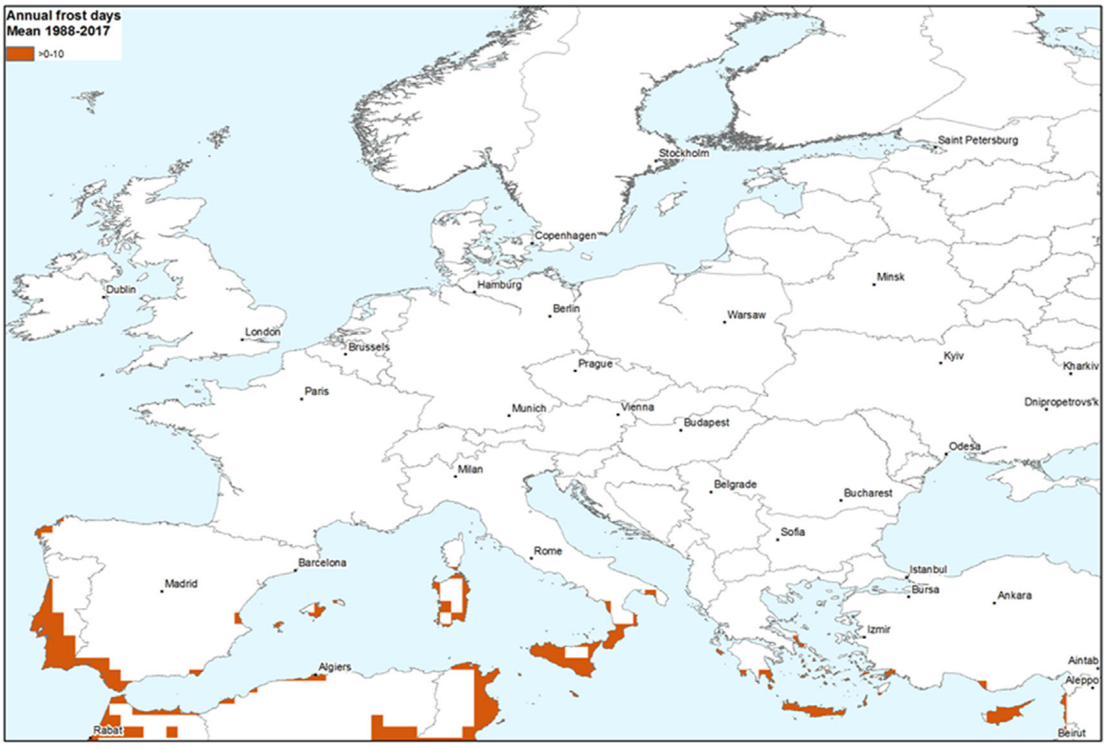

Figure 5: Areas of Europe with up to 10 frost days per year. Map created from data for the 30-year period 1988–2017, sourced from the Climatic Research Unit high resolution gridded data set CRU TS v. 4.03 at 0.5° resolution (https://crudata.uea.ac.uk/cru/data/hrg/)

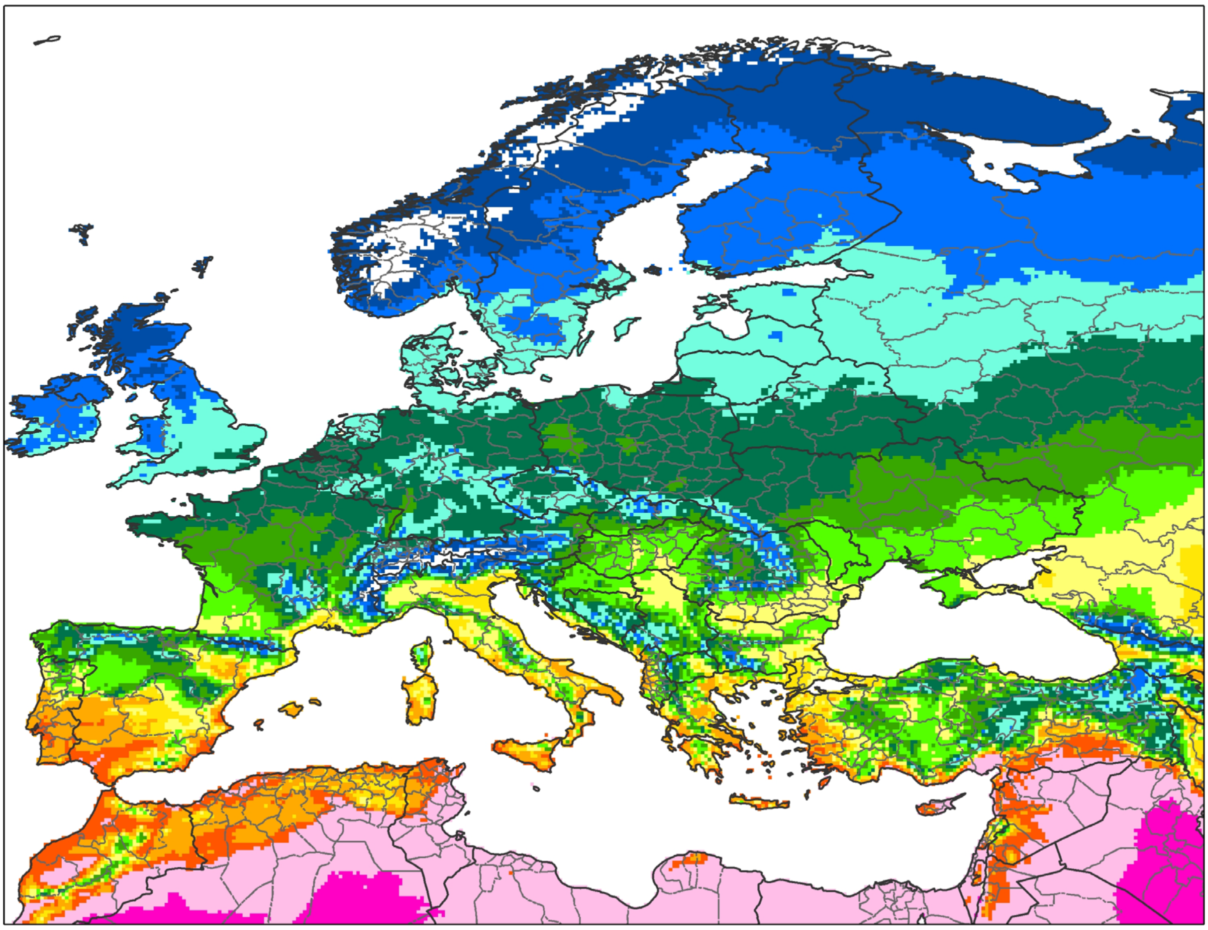

Figure 6: Accumulated degree days above threshold of 10°C (from Baker, 2002; part of the original figure) (Same colour scale as Figure 3)

Regions of Europe with up to 10 days of frost per year are shown in Figure 5. Figure 6 shows accumulated degree days above a threshold of 10°C. Parts of Cyprus and south-western Spain, in the Autonomous Community of Andalusia, around the Guadalquivir River south of Seville, accumulate over 3000 degree-days annually. Where host grasses and palms coincide with these areas, establishment of *H. crudus* may be possible.

3.4.4. Spread

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

Yes, *H. crudus* could spread within the EU following establishment. Adults can fly and immature stages could be inadvertently moved with plants for planting.

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

Both natural spread (i.e. flying adults) and human-assisted dispersal (i.e. immature stages attached to the roots of the host plant) could contribute to the spread of this planthopper. Therefore, the latter cannot be considered as the main pathway for spread.

According to CABI (2020), adults, either actively flying or passively carried by wind currents, can disperse. In addition, human-assisted dispersal of infested plants for planting (i.e. immature stages on roots/in soil) could also contribute to the spread of this insect. CABI (2020) notes that *H. crudus* not only prefers tropical climates but also tolerates Cs climates (Mediterranean climates as in Köppen–

Geiger system (Kottek et al., 2006)). Therefore, it is possible that in summer *H. crudus* could spread from areas where it is established all year round to other areas where Cs climates occur.

3.5. Impacts

> *Would the pests' introduction have an economic or environmental impact on the EU territory?*
>
> **Yes**, should the causal agent of the coconut lethal yellowing be introduced into the EU, the introduction of *H. crudus* would most probably have an economic and an environmental impact on the EU territory.
>
> *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?*[7]
>
> **Yes**, should the causal agent of the coconut lethal yellowing be introduced into the EU, the presence of *H. crudus* on plants for planting would most likely have an economic impact on their intended use.

H. crudus does not cause visible damage to its host plants (Tsai and Kirsch, 1978; Smith et al., 1997). However, it is a vector of lethal yellowing diseases in palms. *H. crudus* is the confirmed primary vector of the 16SrIV-A '*Candidatus* Phytoplasma palmae' strain, which causes coconut lethal yellowing in coconut palms in Florida (EFSA PLH Panel, 2017; Howard and Gallo, 2019). The phytoplasma is transmitted in a persistent (circulative-propagative) manner. Additionally, *H. crudus* has been referred to as a potential vector of the causal agents of Texas phoenix palm disease and coconut foliar decay (CABI, 2020). However, there is no strong evidence supporting this.

Palm lethal yellowing phytoplasmas are a serious economic threat for coconut cultivation. A number of other palm species are susceptible to lethal yellowing but the pathogen does not seem to be widespread or severe in these other palm species. For some species grown in the EU, such as the date palm (*P. dactylifera*) and the Canary Island date palm (*P. canariensis*), susceptibility has been observed and some symptoms and damage could be expected should the pathogen be introduced. Information is lacking for other species, in particular the two EU native palms (*Chamaerops humilis* and *Phoenix theophrasti*). The Palm lethal yellowing phytoplasmas could potentially have severe economic and environmental impacts in a limited area of the EU, but this judgement is highly uncertain (see pest categorisation for lethal yellowing EFSA PLH Panel, 2017).

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 Section 3.3) can mitigate the risk of entry. The pathways identified (plants for planting excluding seeds of the families Arecaceae, Cyperaceae, Heliconiaceae, Verbenaceae and Poaceae, and soil; see Section 3.4.2) are partially regulated and can be considered as partly closed (i.e. Arecaceae and Poaceae). However, plants for planting excluding seeds the families Cyperaceae, Heliconiaceae, Pandanaceae and Verbenaceae are not specifically regulated.
>
> *RNQPs: Are there measures available to prevent pest presence on plants for planting such that the risk becomes mitigated?*
>
> **Yes**, sourcing of plants from PFA would reduce the risk of the pest being present on plants for planting.

3.6.1. Identification of additional measures

Phytosanitary measures are currently applied to plants for planting and soil (see Section 3.3). Therefore, the entry pathways can be considered as partially closed (i.e. soil and Poaceae and Arecaceae plants for planting). Extending these measures to plants for planting of the families Cyperaceae, Heliconiaceae, Pandanaceae and Verbenaceae would further reduce the risk of entry of *H. crudus* into the EU.

3.6.1.1. Additional control measures

A number of hosts are currently prohibited for import (see Table 4). The prohibition could be extended to all hosts (e.g. plants for planting with foliage and soil/growing medium of the families

[7] See section 2.2 on what falls outside EFSA's remit.

Cyperaceae, Heliconiaceae, Pandanaceae and Verbenaceae) from countries where *H. crudus* occurs (i.e. extension of regulations in Annex VI. 14). If prohibition is not going to be extended, then potential additional control measures are listed in Table 8.

Table 8: Selected control measures (a full list is available in EFSA PLH Panel et al., 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)
Heat and cold treatments	As a tropical pest it is expected that *H. crudus* would be sensitive to cold treatment. Controlled temperature treatments aimed to kill or inactivate pests without causing any unacceptable prejudice to the treated material itself. The measures addressed in this information sheet are: autoclaving; steam; hot water; hot air; cold treatment	Entry, spread
Controlled atmosphere	Treatment of plants by storage in a modified atmosphere (including modified humidity, O_2, CO_2, temperature, pressure).	Entry, spread
Chemical treatments on consignments or during processing	Use of chemical compounds that may be applied to plants or to plant products after harvest, during process or packaging operations and storage. The treatments addressed in this information sheet are: a) fumigation; b) spraying/dipping pesticides; c) surface disinfectants; d) process additives; e) protective compounds	Entry, spread

3.6.1.2. Additional supporting measures

Potential additional supporting measures are listed in Table 9.

Table 9: 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)
Phytosanitary certificate and plant passport	Extension of the official statement required for Arecaceae in Annex VII.55 (I.e. plants for planting have undergone appropriate treatment to rid them of *Haplaxius crudus*) to the families Cyperaceae, Heliconiaceae, Pandanaceae and Verbenaceae.	Entry

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

- Immature stages can remain hidden on the roots of/in the soil attached to host plants, hampering their detection by external visual inspection.
- Adults could be present as hitchhikers on non-host plants.
- Adults can actively fly.

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

- Immature stages can remain hidden on the roots of/in the soil attached to host plants, hampering their detection by external visual inspection.

3.7. Uncertainty

There are no uncertainties affecting the conclusions of this categorisation. However, it should be taken into account that establishment, if possible at all, is likely only in small areas of the southern EU.

4. Conclusions

H. crudus satisfies the criteria that are within the remit of EFSA to assess for this species to be regarded as a potential Union quarantine pest. This species does not meet the criteria of being present in the EU and plants for planting being the main pathway for spread for it to be regarded as a potential non-quarantine pest. Pest categorisation conclusions are presented in Table 10.

Table 10: 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 *H. crudus* is established	The identity of *H. crudus* is established	
Absence/ presence of the pest in the EU territory (Section 3.2)	*H. crudus* is not known to occur in the EU territory	*H. crudus* is not known to occur in the EU territory. Therefore, it doesn't meet the criterion of being present in the EU to qualify for RNQP is not met	
Regulatory status (Section 3.3)	*H. crudus* is not known to occur in the EU	*H. crudus* is currently regulated as a quarantine pest. There are no grounds to consider the revoking of this status	
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	*H. crudus* could enter into, establish in, and spread within the EU territory.Main pathways are: • plants for planting of the families Arecaceae, Cyperaceae, Heliconiaceae, Poaceae, and, Pandanaceae with growing medium, and • Soil and growing medium as such or attached to machinery These pathways can be considered as partially closed by present legislation, as plants for planting of the families Cyperaceae, Heliconiaceae, Pandanaceae and Verbenaceae other than seeds are not specifically regulated for import into the EU	*H. crudus* could spread within the EU territory. Adults can fly and nymphs could spread with plants for planting. The latter, though, cannot be considered as the main pathway	Establishment of *H. crudus* in the EU is uncertain and would be most likely restricted to small areas in southern EU
Potential for consequences in the EU territory (Section 3.5)	Should the causal agent of the coconut lethal yellowing be introduced into the EU, the introduction of *H. crudus* into the EU territory would most likely have an economic and/or environmental impact	Should the causal agent of the coconut lethal yellowing be introduced into the EU, the presence of *H. crudus* on plants for planting would most likely have an economic impact on their intended use	

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 to prevent the entry, establishment and spread of *H. crudus* within the EU territory, like sourcing plants for planting from PFA	There are measures to prevent the presence of *H. crudus* in plants for planting, like sourcing plants for planting from PFA	
Conclusion on pest categorisation (Section 4)	*H. crudus* fulfils all criteria assessed by EFSA above for consideration as a quarantine pest	Neither the criterion of plants for planting being the main means of spread for consideration as a RNQP, nor that of the pest being present in the EU territory are met. Therefore, *H. crudus* does not fulfil the criteria for consideration as a potential RNQP	
Aspects of assessment to focus on/ scenarios to address in future if appropriate			

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Abbreviations

DG SANTÉ	Directorate General for Health and Food Safety
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
RNQP	regulated non-quarantine pest
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 – Host plants for *Haplaxius crudus*

True hosts of *Haplaxius crudus*, where life cycle is complete (= nymphal hosts)

Family	Host	Common name	Reference
Cyperaceae	*Cyperus* sp.	flatsedge	CABI (2020)
	Cyperus esculentus	yellow nutsedge	CABI (2020)
	Fimbristylis cymosa	tropical fimbry	CABI (2020)
Poaceae	*Andropogon bicornis*	West Indian foxtail grass	CABI (2020)
	Andropogon virginicus	broomsedge	CABI (2020)
	Cenchrus ciliaris	Buffel grass	CABI (2020)
	Chloris barbata	purpletop chloris	CABI (2020)
	Cynodon dactylon	Bermuda grass	CABI (2020)/EPPO (2020)
	Digitaria eriantha	pangola grass	CABI (2020)
	Distichlis spicata		CABI (2020)
	Eragrostis curvula	weeping lovegrass	CABI (2020)
	Eremochloa ophiuroides	centipedegrass	CABI (2020)
	Eustachys petraea		CABI (2020)
	Megathyrsus maximus	Guinea grass	CABI (2020)
	Panicum bartowense		CABI (2020)
	Saccharum officinarum	sugarcane	CABI (2020)
	Setaria	foxtailmillet	CABI (2020)
	Setaria viridis	green foxtail	CABI (2020)
	Stenotaphrum secundatum	buffalo grass	CABI (2020)/EPPO GD (2020)
	Zoysia		CABI (2020)
	Paspalum notatum	bahiagrass	CABI (2020)/EPPO (2020)
Verbenaceae	*Verbena scabra*	sandpaper vervain	CABI (2020)

Additional adult feeding hosts of *H. crudus* (i.e. life cycle cannot be completed on these hosts).

Family	Host	Common name	Reference
Arecaceae	*Cocos nucifera*	coconut	CABI (2020)/EPPO (2020)
	Phoenix canariensis	Canary Island date palm	CABI (2020)/EPPO (2020)
	Phoenix dactylifera	date-palm	CABI (2020)
	Pritchardia		CABI (2020)
	Pritchardia pacifica		CABI (2020)
	Pritchardia thurstonii	Thurston palm	CABI (2020)
	Sabal palmetto	cabbage palmetto	CABI (2020)
	Trachycarpus fortunei	Chinese windmill palm	CABI (2020)
	Veitchia merrillii	Christmas palm	CABI (2020)
	Washingtonia	Washington-palm	CABI (2020)
	Washingtonia robusta	Mexican washington-palm	CABI (2020)
	Dypsis lutescens		CABI (2020)
	Roystonea regia	Cuban royal palm	CABI (2020)
Heliconiaceae	*Heliconia bihai*	Macaw flower	CABI (2020)
Pandanaceae	*Pandanus utilis*		CABI (2020)

Appendix B – Trade of potential host plants with countries where the pest occurs

	Live outdoor plants, incl. their roots (excl. bulbs, tubers, tuberous roots, corms, crowns and rhizomes, incl. chicory plants and roots, unrooted cuttings, slips, rhododendrons, azaleas, roses, mushroom spawn, pineapple plants, vegetable and strawberry plants, trees, shrubs and bushes)					Live indoor plants and cacti (excl. rooted cuttings, young plants and flowering plants with buds or flowers)				
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2015**	**2016**	**2017**	**2018**	**2019**
BAHAMAS										
BRAZIL	1	900	0	2,838	2,510	537	644	13	329	6
BELIZE				24						
CAYMAN ISLANDS										
COLOMBIA		3	11	0	2	11	3	9	3	2
COSTA RICA	3,584	3,707	1,616	3,061	2,467	73,726	140,448	175,417	189,571	216,029
CUBA				0				0		
DOMINICAN REPUBLIC	0		3	7		41	484	142	514	5706
HAITI										
HONDURAS		215		342	858	21,269	16,223	21,443	14,477	19,678
JAMAICA				0						
MEXICO	1,440	520	964	416	237	712	648	331	230	1,210
PANAMA				0				0		3
TRINIDAD AND TOBAGO			0	0						
UNITED STATES	3,153	2,224	2,478	1,888	2,394	2,858	2,101	1,667	2,470	2,990
VENEZUELA										

Source: Eurostat (EASY COMEXT) trade data, accessed 15/06/2020.