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Pest categorisation of Cadang-Cadang viroid

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Abstract

The EFSA Panel on Plant Health performed a pest categorisation of Cadang-Cadang viroid for the European Union (EU) territory. *Coconut cadang-cadang viroid* (CCCVd) is a well-known viroid for which efficient molecular detection assays are available. It is transmitted by vegetative multiplication of infected hosts, by seed and pollen and, possibly, by the action of unknown vector(s). CCCVd is reported from a few countries in Asia and is not known to occur in the EU. It therefore does not meet one of the criteria for being a Union regulated non-quarantine pest. The host range of CCCVd is restricted to Arecaceae species (palms), in particular coconut and it is listed on all known hosts in Annex IIAI of Directive 2000/29/EC. CCCVd is expected to be able to enter in the EU and to be able to establish in the open in the southernmost regions of the EU and elsewhere under protected cultivation. It has the potential to subsequently spread via plants for planting and possibly other mechanisms. CCCVd is able to cause severe symptoms in some Arecaceae species while others seem less affected. The potential impact of CCCVd if introduced in the EU is very difficult to assess. Given that the spread potential is, as for other viroids, likely to be limited, the potential impact is estimated to be limited in extent but this judgement is affected by large uncertainties. Overall, CCCVd meets all the criteria evaluated by EFSA to qualify as Union quarantine pest. The main knowledge gaps concern (1) the relationships between CCCVd-related RNAs and CCCVd, (2) the origin and volume of the trade in palm seeds and plants for planting imported in the EU (3) the efficiency of natural spread under EU conditions and (4) host status and susceptibility of many palm species grown in the EU.

Keywords: cadang-cadang viroid, cadang-cadang disease, orange spotting disease, CCCVd, palm, coconut, Arecaceae

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

Following the evaluation of the plant health regime, the new basic plant health law, Regulation (EU) 2016/2031[2] on protective measures against pests of plants, was adopted on 26 October 2016 and will apply from 14 December 2019 onwards, repealing Directive 2000/29/EC. In line with the principles of the above mentioned legislation and the follow-up work of the secondary legislation for the listing of EU regulated pests, EFSA is requested to provide pest categorizations of the harmful organisms included in the annexes of Directive 2000/29/EC, in the cases where recent pest risk assessment/pest categorisation is not available.

1.1.2. Terms of Reference

EFSA is requested, pursuant to Article 22(5.b) and Article 29(1) of Regulation (EC) No 178/2002[3], to provide scientific opinion in the field of plant health.

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

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

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

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

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

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

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

1.1.2.1. Terms of Reference: Appendix 1

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

Annex IIAI

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

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

(b) Bacteria

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

(c) Fungi

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

(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)

<u>Annex IAII</u>

(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

<u>Annex I B</u>

(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

Cadang-Cadang viroid 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 Union regulated non-quarantine pest (RNQP) for the area of the European Union (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.

This pest categorisation covers *Coconut cadang-cadang viroid* (CCCVd). RNAs that hybridise with probes representing part or all of the genome of CCCVd sequence (so called 'CCCVd-related RNAs') have been reported to occur in a number of palm species and other monocotyledons in the Pacific region and South-East Asia (Randles et al., 1980; Hanold and Randles, 1991b). However, there has generally been no unambiguous demonstration that these RNAs represent infectious CCCVd molecules. Although there are uncertainties, reports of the presence of CCCVd-related RNAs are therefore not considered in the present opinion as an indication of the presence of CCCVd.

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A literature search on Cadang-Cadang viroid was conducted at the beginning of the categorisation. Further references and information were obtained from citations within the references and from the grey literature.

2.1.2. Database search

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

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

The Europhyt database was consulted for pest-specific notifications on interceptions and outbreaks. Europhyt is a web-based network launched by the European Commission Directorate General for Health and Consumers (DG SANCO), and is a subproject of PHYSAN (Phyto-Sanitary Controls) specifically concerned with plant health information. The Europhyt database manages notifications of interceptions of plants or plant products that do not comply with EU legislation, as well as notifications of plant pests detected in the territory of the MSs and the phytosanitary measures taken to eradicate or avoid their spread.

2.2. Methodologies

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

In accordance with the guidance on a harmonised framework for pest risk assessment in the EU (EFSA PLH Panel, 2010), this work was initiated following an evaluation of the EU's plant health regime. Therefore, to facilitate the decision-making process, in the conclusions of the pest categorisation, the Panel addresses explicitly each criterion for a Union 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 as per the specific terms of reference received by the European Commission. In addition, for each conclusion, the Panel provides a short description of its associated uncertainty.

Table 1 presents the Regulation (EU) 2016/2031 pest categorisation criteria on which the Panel bases its conclusions. All relevant criteria have to be met for the pest to potentially qualify either as a quarantine pest or as a RNQP. If one of the criteria is not met, the pest will not qualify. Note that a pest that does not qualify as a quarantine pest may still qualify as a RNQP which needs to be addressed in the opinion. For the pests regulated in the protected zones only, the scope of the categorisation is the territory of the protected zone, thus the criteria refer to the protected zone instead of the EU territory.

It should be noted that the Panel's conclusions are formulated respecting its remit and particularly with regards to the principle of separation between risk assessment and risk management (EFSA founding regulation (EU) No 178/2002); therefore, instead of determining whether the pest is likely to have an unacceptable impact, the Panel will present a summary of the observed pest impacts. Economic impacts are expressed in terms of yield and quality losses and not in monetary terms, while addressing social impacts is outside the remit of the Panel, in agreement with EFSA guidance on a harmonised framework for pest risk assessment (EFSA PLH Panel, 2010).

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

Criterion of pest categorisation	Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Criterion in Regulation (EU) 2016/2031 regarding protected zone quarantine pest (articles 32-35)	Criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest
Identity of the pest (Section 3.1)	Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible?	Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible?	Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible?
Absence/presence of the pest in the EU territory (Section 3.2)	Is the pest present in the EU territory? If present, is the pest widely distributed within the EU? Describe the pest distribution briefly!	Is the pest present in the EU territory? If not, it cannot be a protected zone quarantine organism.	Is the pest present in the EU territory? If not, it cannot be a regulated non-quarantine pest. (A regulated non-quarantine pest must be present in the risk assessment area).
Regulatory status (Section 3.3)	If the pest is present in the EU but not widely distributed in the risk assessment area, it should be under official control or expected to be under official control in the near future.	The protected zone system aligns with the pest free area system under the International Plant Protection Convention (IPPC). The pest satisfies the IPPC definition of a quarantine pest that is not present in the risk assessment area (i.e. protected zone).	Is the pest regulated as a quarantine pest? If currently regulated as a quarantine pest, are there grounds to consider its status could be revoked?
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	Is the pest able to enter into, become established in, and spread within, the EU territory? If yes, briefly list the pathways!	Is the pest able to enter into, become established in, and spread within, the protected zone areas? Is entry by natural spread from EU areas where the pest is present possible?	Is spread mainly via specific plants for planting, rather than via natural spread or via movement of plant products or other objects? Clearly state if plants for planting is the main pathway!
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 regulated non-quarantine pest 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?

Yes

Coconut cadang-cadang viroid (CCCVd) is a well characterised viroid and the type member of the genus *Cocadviroid* within the family Pospiviroidae. It is the smallest known viroid and the smallest known infectious pathogen (Flores et al., 2003; CABI, 2015). The genome of some isolates has been sequenced (see for example GenBank Accession numbers J02049, J02050).

CCCVd is the causal agent of the homonymous lethal disease ('cadang-cadang' or 'yellow mottling' disease) of coconut (*Cocos nucifera*) palm. A different disease phenotype characterised by a distinct brooming symptom has also been attributed to CCCVd variants (Rodriguez and Randles, 1993).

CCCVd is unique in that it can develop in infected plants as a mixture of molecular forms differing by either the addition of a single nucleotide or short repeated sequences (Haseloff et al., 1982).

3.1.2. Biology of the pest

CCCVd is seed-transmitted at a low rate of about 1 out of 300 in naturally infected palms (Anon., 1982 – cited by Randles and Imperial, 1984; Pacumbaba et al., 1994). It can also be transmitted at a low rate through pollen to progeny seeds and plants (Pacumbaba et al., 1994; Manalo et al., 2000 - cited by Randles and Rodriguez, 2003). Transmission at a low rate by mechanical means (e.g. via contaminated tools) cannot be excluded (Randles et al., 1977; Randles and Rodriguez, 2003). Some coleopterans have been suspected but never confirmed as possible vectors (Zelazny and Pacumbaba, 1982). In addition, as for other virus and virus-like pathogens, CCCVd is transmitted by vegetative propagation.

In the Philippines, CCCVd epidemics occur in different times and places; however, disease boundaries expand at a low rate of about 0.5 km per year with no specific pattern of disease increase. At a localised scale, infected palms have a scattered distribution but the spread of the disease over large areas appeared somehow clustered (Randles and Rodriguez, 2003). Disease incidence is negligible in palms of pre-bearing age (up to 10 years old), and later on it is positively correlated with the age of palm plantations up to 40 years (Pacumbaba et al., 1994) but negatively correlated with the altitude (Zelazny, 1980). Overall, epidemiological observations suggest that the principal mode of natural spread may be still unknown (Pacumbaba et al., 1994).

3.1.3. Intraspecific diversity

Viroids occur in nature as complex populations of closely related sequence variants. An arbitrary cut-off figure of 90% nucleotide sequence identity is used to demarcate different viroid species from variants of the same species (Flores et al., 2005). Specific sequence variants of CCCVd (sharing more than 90% homology with the basic form of the viroid) have been identified and are associated with different disease phenotypes in coconut and oil palm (Rodriguez and Randles, 1993; Wu et al., 2013). The lamina-depleting 'brooming' disease of coconut is associated with the presence of specific point mutations (GenBank Accession Number J02049) in the pathogenicity and the central conserved domains (Rodriguez and Randles, 1993). Recently, a variant of CCCVd (GeneBank Accession Number HQ608513) with mutations in the same domains was recovered from 'orange spotting' (OS) affected African oil palms (*Elaeis guineensis*) in Malaysia (Wu et al., 2013). However, different variants of CCCVd have also been described from oil palms in Malaysia (GenBank Accession numbers DQ097183–DQ097185) with no OS symptoms (Vadamalai et al., 2006), so that the association of CCCVd with this disease remains in doubt.

In addition, the different length forms of the viroid produced disease progression have been associated with the development of the symptoms in the infected coconut plants (Hanold and Randles, 1991a).

In palms or other tropical monocotyledon plants, RNAs that hybridise with probes representing part or all of the basic 246 nt CCCVd sequence occur (CCCVd-related or CCCVd-like RNAs; Randles et al., 1980; Hanold and Randles, 1991b). However, no sequence information or pathogenicity data is available for those CCCVd-like RNAs so that their relationship with CCCVd remains uncertain. Although there are uncertainties, reports of the presence of CCCVd-related RNAs are therefore not considered in the present opinion as an indication of the presence of CCCVd.

3.1.4. Detection and identification of the pest

Are detection and identification methods available for the pest?
Yes, efficient molecular assays are available for CCCVd detection.

CCCVd can be identified by analysing leaf tips using polyacrylamide gel electrophoresis (PAGE) followed by silver staining, dot-blot or gel electroblot hybridisation (Hanold and Randles, 1991a; Imperial et al., 1985; Mohamed & Imperial, 1984) or RT-PCRs (Rodriguez and Randles, 1993). Improved extraction and RT-PCR protocols are available for the sensitive detection of CCCVd and its variants and its reliable discrimination from other viroids such as *Coconut tinangaja viroid* (CTiVd) that produces similar symptoms (Hodgson et al., 1998; Vadamalai et al., 2006; Roslan et al., 2016). In addition, a ribonuclease protection assay (RPA) (Vadamalai et al., 2009) and a reverse transcription loop-mediated isothermal amplification (RT-LAMP) (Thanarajoo et al., 2014) may also efficiently detect low amounts of CCCVd-related RNAs.

Symptoms are not reliable for the detection of CCCVd as they appear years after the initial infection (up to 6 years in the field) and they may resemble those caused by CTiVd ('tinangaja disease') or physiological changes due to other biotic (insect, microbes) or abiotic stresses. In addition, CCCVd mutants or variants may be associated with distinct disease phenotypes (see Section 3.3.1).

Detection results obtained using molecular hybridisation assays should be considered with caution because of the presence in some palms or other tropical monocotyledons of RNAs that hybridise with probes representing part or all of the CCCVd genome but that has never been proven to be bona fide CCCVd (Randles et al., 1980; Hanold and Randles, 1991b). These so-called 'CCCVd-related RNAs' have been suspected, but never demonstrated, to be associated with CCCVd infection and/or with the OS disorder of African oil palm (Hanold and Randles, 1991b; Hanold and Randles, 2003).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

CCCVd is widely present in the central Philippines. There are a few additional reports in Asia and Oceania (Table 2). CCCVd has also been recently identified from African oil palms in Malaysia (Vadamalai et al., 2006; Wu et al., 2013; Thanarajoo et al., 2014) and, with some uncertainties,[4] in coconut palm in Sri Lanka (Vadamalai et al., 2009).

[4] Uncertainties come from the fact that detection was by an RPA assay and that no sequence information is available for the isolates involved.

Table 2: Global distribution *Coconut cadang-cadang viroid* extracted from the EPPO Global Database (accessed 10/03/2017) and completed from other sources. Reports of CCCVd-related RNAs were not considered

Continent	Country	Status – EPPO GD	Other sources
Asia	Malaysia	Absent, unreliable record	Present (Vadamalai et al., 2006; Wu et al., 2013; Thanarajoo et al., 2014)
Asia	Philippines	Present, restricted distribution	Present, widespread (Randles and Imperial, 1984; Randles and Rodriguez, 2003; CABI, 2015)
Asia	Sri Lanka	Absent, unreliable record	Present (Vadamalai et al., 2009)[2]
Oceania	Guam	Absent, unreliable record	
Oceania	Solomon islands	Absent, unreliable record	

3.2.2. Pest distribution in the EU

Is the pest present in the EU territory?

No, CCCVd is not known to occur in the EU.

CCCVd is not known to occur in the EU and as a consequence does not meet one of the criteria to qualify as a Union RNQP.

3.3. Regulatory status

3.3.1. Council Directive 2000/29/EC

Cadang-Cadang viroid is listed in Council Directive 2000/29/EC. Details are presented in Tables 3 and 4.

Table 3: Cadang-Cadang viroid in Council Directive 2000/29/EC

Annex II, Part A	**Harmful organisms whose introduction into, and spread within, all Member States shall be banned if they are present on certain plants or plant products**	
Section I	Harmful organisms not known to occur in the community and relevant for the entire community	
(d)	Virus and virus-like organisms	
	Species	**Subject of contamination**
4.	Cadang-Cadang viroid	Plants of *Palmae*, intended for planting, other than seeds, originating in non-European countries

3.3.2. Legislation addressing plants and plant parts on which on which Cadang-Cadang viroid is regulated

Table 4: Regulated hosts and commodities that may involve Cadang-Cadang viroid in Annexes III, IV and V of Council Directive 2000/29/EC

Annex III, Part A	**Plants, plant products and other objects the introduction of which shall be prohibited in all Member States**	
	Description	**Country of origin**
17.	Plants of *Phoenix* spp. other than fruit and seeds	Algeria, Morocco
Annex IV, Part A	Special requirements which must be laid down by all Member States for the introduction and movement of plants, plant products and other objects into and within all Member States	
Section I	Plants, plant products and other objects originating outside the community	

	Plants, plant products and other objects	Special requirements
37.	Plants of *Palmae* intended for planting other than seeds, originating in non-European countries	Without prejudice to the prohibitions applicable to the plants listed in Annex III(A)(17), where appropriate, official statement that: a) either the plants originate in an area known to be free from Palm lethal yellowing mycoplasm and 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 mycoplasm and 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 organisms have been rogued out at that place and the plants have undergone appropriate treatment to rid them of *Myndus crudus* Van Duzee; c) in the case of plants in tissue culture, the plants were derived from plants which have met the requirements laid down in (a) or (b)
Annex V	Plants, plant products and other objects which must be subject to a plant health inspection (at the place of production if originating in the community, before being moved within the community – in the country of origin or the consignor country, if originating outside the community) before being permitted to enter the community	
Part A	Plants, plant products and other objects originating in the Community	
I.	Plants, plant products and other objects which are potential carriers of harmful organisms of relevance for the entire Community and which must be accompanied by a plant passport	
2.3.1	Plants of *Palmae,* intended for planting, having a diameter of the stem at the base of over 5 cm and belonging to the following genera: *Brahea* Mart., *Butia* Becc., *Chamaerops* L., *Jubaea* Kunth, *Livistona* R. Br., *Phoenix* L., *Sabal* Adans., *Syagrus* Mart., *Trachycarpus* H. Wendl., *Trithrinax* Mart., *Washingtonia* Raf	
Part B	Plants, plant products and other objects originating in territories, other than those territories referred to in part a	
I.	Plants, plant products and other objects which are potential carriers of harmful organisms of relevance for the entire Community	
2.	Parts of plants, other than fruits and seeds, of: – *Castanea* Mill., *Dendranthema* (DC.) Des Moul., *Dianthus* L., *Gypsophila* L., *Pelargonium* l'Herit. ex Ait, *Phoenix* spp., *Populous* L., *Quercus* L., *Solidago* L. and cut flowers of Orchidaceae	

3.3.3. Emergency measures for *Rhynchophorus ferrugineus* (Olivier) (red palm weevil)

Owning the compatibility of hosts, the emergency measures currently in place to prevent the introduction and spread in the EU of the harmful organism *Rhynchophorus. ferrugineus* (Olivier) (Commission Decision 2007/365/EC[5]) should be also considered.

Commission Decision 2007/365/EC sets forth rules to prevent to introduction and spread in the European Community of the harmful organism *R. ferrugineus* that was amended in 2010. The emergency measures among others include to susceptible plants specific requirements for the imports into the EU and for the internal movements within the EU applicable.

[5] Commission Decision 2007/365/EC on emergency measures to prevent the introduction into and the spread within the Community of *Rhynchophorus ferrugineus* (Olivier).

- **Specific requirements for the imports into the EU**

  Susceptible plants originating in third countries shall be accompanied by a phytosanitary certificate, which states under the heading 'Additional declaration', that the susceptible plants:

  (a) have been growing throughout their life in a country free of Red Palm Weevil; or
  (b) have been growing throughout their life in a pest-free area; or
  (c) have, during a period of at least 1 year prior to export, been growing in a place of production:

    (i) which is registered and supervised by the national plant protection organisation in the country of origin, and
    (ii) where the plants were placed in a site with complete physical protection against the introduction of the specified organism or an application of appropriate preventive treatments takes place, and
    (iii) where, during official inspections carried out at least every three months and immediately prior to export, no signs of the specified organism have been observed.

- **Specific requirements for the internal movements within the EU**

  Susceptible plants, either originating in the Community or imported into the Community, may be moved within the Community only if they are accompanied by a plant passport and have been growing:

  (a) throughout their life in a Member State or third country free of Red Palm Weevil; or
  (b) throughout their life in a place of production in a pest-free area; or
  (c) in a nursery in a Member State during a period of 2 years prior to the movement, during which:

    (i) the susceptible plants were placed in a site with complete physical protection against the introduction of the specified organism or an application of appropriate preventive treatments takes place, and
    (ii) no signs of the specified organism have been observed in official inspections carried out at least every 3 months; or

  (d) if imported, have been growing since their introduction into the Community in a place of production in a Member State during a period of at least 1 year prior to the movement during which:

    (i) (the susceptible plants were placed in a site with complete physical protection against the introduction of the specified organism, and
    (ii) no signs of the specified organism have been observed in official inspections carried out at least every 3 months (European Commission, 2011)

However, it should be noted that due to the unreliability of symptoms for CCCVd detection (see Section 3.1.4) it is unlikely these emergency measures will completely close all pathways for entry of CCCVd in the EU.

In addition, on May 2017, the Standing Committee on Plants, Animals, Food and Feed – section 'Plant Health' (PAFF Committee) exchanged views on the draft Commission Implementing Decision repealing Decision 2007/365/EC so that there exist some doubts about the long term status of these emergency measures.

However, it should be noted that due to the unreliability of symptoms for CCCVd detection (see Section 3.1.4), it is unlikely these emergency measures will completely close all pathways for entry of CCCVd in the EU.

In addition, on May 2017, the Standing Committee on Plants, Animals, Food and Feed – section 'Plant Health' (PAFF Committee) exchanged views on the draft Commission Implementing Decision repealing Decision 2007/365/EC so that there exist some doubts about the long term status of these emergency measures.

3.4. Entry, establishment and spread in the EU

3.4.1. Host range

All hosts of CCCVd belong to the Arecaceae family (owing to historical usage, the family is also referred to as Palmae as in directive 2000/29/EC),[6] a large family of ca. 181 genera and 2,600 perennial species of trees and shrubs (Christenhusz and Byng, 2016). There is only one report of a Poaceae species (*Chloris*) as a host of CCCVd (CABI, 2015) but the Panel was unable to identify the source of this information and to verify it.

Cocos nucifera (coconut palm) is the main host of CCCVd, with all commercial varieties cultivated in the Philippines being susceptible. A wide number of Arecaceae species such as *Aiphanes horrida, Aiphanes minima, Allagoptera arenaria, Arenga pinnata, Borassus flabellifer, Caryota mitis, Caryota urens, Corypha umbraculifera, Corphya utan, Dictyosperma album, Elaeis guineensis, Gaussia attenuata, Howea belmoreana, Howea forsteriana, Latania lontaroides, Livistona australis, Livistona rotundifolia, Metroxylon sagu, Neodypsis decaryi, Neodypsis leptocheilos, Ravenea rivularis, Syagrus schizophylla, Trachycarpus fortunei* are natural hosts of CCCVd (EPPO GD; CABI, 2015; Wu et al., 2013). Experimental hosts identified after artificial inoculation include *Adonidia merrillii*, *Areca catechu*, *Chrysalidocarpus lutescens*, *Corypha elata, Dypsis lutescens, Oreodoxa regia, Phoenix dactylifera, Ptychosperma macarthurii, Roystonea regia* (EPPO GD; Imperial et al., 1985; Hanold and Randles, 1991a; Randles and Rodriguez, 2003) and possibly *Maranta* species (the later cited in CABI, 2015, but the Panel was unable to verify this information provided without indication on the original source).

CCCVd-related RNAs have been detected in *Elaeis guineensis* and *Corypha elata* in the Philippines (Randles et al., 1980), as well as in members of Arecaceae, Pandanaceae, Zingiberaceae, Marantaceae and Commelinaceae in some south-west Pacific regions (Hanold and Randles, 1991b). But as stated elsewhere, the relationships between CCCVd-related RNAs and CCCVd have never been satisfactorily clarified.

CCCVd is regulated in all of its Arecaceae hosts (*Palmae* species, see paragraph 3.3.1). However, there is some uncertainty concerning the report of *Chloris* as a host (CABI, 2015; see above).

3.4.2. Entry

Is the pest able to enter into the EU territory?
YES, CCCVd could potentially enter EU via palm seeds or live plants imported as ornamentals.

The main pathway for entry identified by the Panel is the trade of palm seeds or of plants for planting of susceptible Arecaceae species. Within the EU, many nurseries commercialise young palms for ornamental use and it is likely that those are either imported as small plants or grown in the EU from imported seeds. According to the ISEFOR database,[7] between the year 2000 and 2011 among several Arecaceae species, coconut plants were imported from Philippines (30 plants), Malaysia (1393 plants) and Sri Lanka (92 plants). Therefore, CCCVd is able to enter EU with at least coconut plants and the same applies to other susceptible palm species imported from those infected countries.

3.4.3. Establishment

3.4.3.1. EU distribution of main host plants

Is the pest able to become established in the EU territory?
YES, Several Arecaceae species are produced and are widely used as ornamentals for landscaping in southern Europe.

In general, viroids have no other environmental constrains than those of their hosts. Palms, the hosts of CCCVd, are distributed in the tropical regions of the world with a few species adapted either to somewhat temperate or dry and arid conditions (Eiserhardt et al., 2011). The only palm species that grow naturally 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

[6] http://www.bgbm.org/IAPT/Nomenclature/Code/SaintLouis/0022Ch3Sec2a018.htm

[7] Database developed within the FP7 Project 'Increasing Sustainability of European Forests: Modelling for Security Against Invasive Pests and Pathogens under Climate Change'.

date palm (*Phoenix theophrasti,* endemic to Crete (Greece) and a few east Aegean islands) (Vamvoukakis, 1988). Many other palm species and mainly *Chamaerops* species*,* Canary palm *(Phoenix canariensis)* and date palm (*Phoenix dactylifera*) as well as *Washingtonia robusta* and *Washingtonia filinera* are widely used as ornamentals for landscaping in southern Europe (Cohen, 2017). The only known palm commercial cultivation for non-ornamental purposes in Europe is that of date palm (*P. dactylifera*) in Elche, Spain (38°17′N) (Ferry et al., 2002) an area in the extreme northern latitude for its distribution (Abdelouahhab and Arias-Jimenez, 1999).

Several palm species are widely grown in the EU under protected cultivation conditions for ornamental purposes. Spain produces about 2 million palm trees annually with *Phoenix canariensis* (1.2 million plants) being the predominant species, followed by other species such as *P. dactylifera*, *Phoenix reclinata*, *W. filifera*, *W. robusta*, *Chamaerops humilis* and *Trachycarpus 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). In addition, the species *Trachycarpus fortune* is an ornamental species that is sometime grown in the open up to more northern latitudes (e.g. southern Switzerland) Gian das.

Therefore, CCCVd is able to establish in the EU as there are some hosts grown in unprotected cultivation in southern Europe while many of them are grown in protected cultivation in more northern regions of the EU. However, there are some uncertainties concerning the sensitivity of the European native palm species (European fan palm and Cretan date palm) to CCCVd. The same applies to several other palm species grown for ornamental purposes in the EU.

3.4.4. Spread

3.4.4.1. Vectors and their distribution in the EU (if applicable)

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

Yes. However, the spread is likely to be limited and with large uncertainties as the principal mode of spread may still be unknown.

How: Through production and trade of plants for planting. Also through pollen and seeds of susceptible Arecaceae species.

CCCVd systematically invades its hosts (see Section 3.1.2) and therefore can be transmitted through vegetative propagation practiced either by offshoot or tissue culture applied for some palm species e.g. date palm (Abdelouahhab and Arias-Jimenez, 1999). On the other hand, low rates of pollen and seed transmission of CCCVd, can be also responsible for pathogen movement (Hanold and Randles, 1991a; Pacumbaba et al., 1994) but this mechanism is expected to be significant only for species able to reproduce naturally under conditions prevailing in the EU. This applies in particular to the European fan palm and the Cretan date palm.

In the infected areas in the Philippines, the extend and the patterns of natural spread cannot be fully explained by vegetative and pollen or seed transmission suggesting that the main mean of spread is still unknown (Pacumbaba et al., 1994). Therefore, additional mechanisms of spread cannot be excluded, but the uncertainties on this specific aspect are obviously very large.

3.5. Potential or observed impacts in the EU

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

YES.

3.5.1. Potential pest impacts

3.5.1.1. Direct impacts of the pest

Coconut palms are severely affected by CCCVd. The disease is characterised by a slow progression of symptoms, closely associated with the progress of the infection and the presence of the different molecular forms of the viroid (Mohamed et al., 1982). It results eventually in the death of the diseased coconut trees (Randles and Rodriguez, 2003). First symptoms appear 1–2 years after the first detection of the viroid; nuts become rounded and scarified with an increasing incidence, while only at a later stage chlorotic (or water-soaked) spots appear on the leaves, inflorescences are stunted with tip necrosis and show loss of some male florets. As disease progresses, symptoms become more severe, there is a decline in fruit production as fewer nuts, spathe and inflorescences are produced, leaf spot numbers increase and coalesce while plant appear chlorotic, stunted, with a progressive decline, and eventually die. Susceptibility to the viroid decreases with the age of the plant (Velasco, 1997).

CCCVd is considered to be a serious economic threat for coconut, causing their premature decline and death (Hanold and Randles, 1991a). It was estimated that in the Philippines about 40 million palms have died from cadang-cadang with a loss of about US$100 per infected palm due to lost production and delay in replacement (Randles and Rodriguez, 2003). The impact of the coconut lamina-depleting 'brooming' disease associated with the presence of single mutations (Rodriguez and Randles, 1993; Rodriguez and Randles, 1993) and the orange spotting disease, possibly associated with the occurrence of CCCVd variants in African oil palm in Malaysia (Vadamalai et al., 2006), is not yet estimated.

Most species in the Arecaceae family that have been successfully inoculated with CCCVd, for example betel nut (*Areca catechu*) and palmera (*Chrysalidocarpus lutescens*), develop severe yellow leaf spotting. Other species such as buri palm (*Corypha elata*), oil palm (*Elaeis guineensis*), royal palm (*Oreodoxa regia*) and Manila palm (*Adonidia merrillii*) were also stunted (Imperial et al., 1985).

3.5.2. Observed pest impacts in the EU

CCCVd is not present in the EU; therefore, no impact is observed. For some species grown in the EU, such as the date palm (*P. dactylifera*), susceptibility has been experimentally demonstrated and some symptoms and damage could be expected should CCCVd be introduced. For other species grown it the EU, and in particular for the two species growing spontaneously in the EU (European fan palm and Cretan date palm), no information on susceptibility is available so that impact, if any, remains highly uncertain.

None of the known hosts of CCCVd represents an important EU agricultural rop; however, a few of them are of high ornamental, landscape or cultural importance in the Mediterranean countries of the EU. A large number of those ornamental palms are produced in EU countries such as Spain and Italy (see Section 3.4.3.1) to be traded to the European markets, therefore they can be of considerable economic importance. On the other hand, three major heritage palm groves exist in the Mediterranean European countries, in Elche in Spain, Bordighera in Italy and Crete in Greece. The major one is that of Elche (Spain) that is made up of about 180,000 adult date palms, in an area of almost 400 ha. The total date fruit production in Elche is estimated to be 5,000 tonnes per year, of which only about 100 tonnes are sold for human consumption (Ferry et al. 1997 – cited in Ferry et al., 2002). However, the grove of date palm in Elche (Valencia) trees known as 'Palmeral of Elche' was designated in 2000 as a World Heritage Site (http://whc.unesco.org/en/list/930). There are also a couple of additional historical groves in the same area of Spain, in Orihuela and Alicante, but they are not as large as the one in Elche (Suárez, 2010; Jacas et al., 2011). In Bordighera, in Italy, date palms have been cultivated since at least the 16th century for religious purposes, and even though their number has significantly dropped since the last century, they remain of high landscape significance. Other threatened native species may include the Cretan date palm (*Phoenix theophrasti*) that is present only in Crete (Greece) and a few east Aegean islands (Vamvoukakis, 1988) and is a species with a near threatened status *(2006 IUCN Red List of Threatened Species*).

Overall, while several species grown in Europe and of commercial or cultural importance are known to be susceptible to CCCVd, information is lacking for other species, in particular the two European native palms. In addition, there are important uncertainties about how efficiently CCCVd would be able to spread in European palms. The potential impact of CCCVd if introduced in the EU is therefore very difficult to assess. Given that the spread potential is, as for other viroids, likely to be limited, the potential impact is estimated to be limited in extent but this judgement is affected by large uncertainties.

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 for entry: tightening of regulations to include seeds and to rely on CCCVd testing rather than on the unreliable observation of symptoms.

Cadang-Cadang viroid is listed in Council Directive 2000/29/EC and it is regulated in all of its hosts[8] (see Section 3.4.1). The present legislation imposes several conditions on imported plants for planting

[8] Chloris has been reported as a host but this assessment is associated with significant uncertainties.

of Arecaceae (*Palmae*) species. Specifically, these may be imported on the condition that 'no symptoms of Cadang-Cadang viroid have been observed on the plants since the beginning of the last complete cycle of vegetation and that plants at the place of production which have shown symptoms giving rise to the suspicion of contamination by the organisms have been rogued out at that place' (Council Directive 2000/29/EC, Annex IV, Part A, Section I, 37b). In addition, the import into and movement within the EU of many palm species is subjected to specific requirements and inspections according to the emergency measures set with the Commission Decision 2007/365/EC for *R. ferrugineus* (see Section 3.4.1). In the field, symptoms of CCCVd may have an incubation period of up to 6 years and roguing is not effective in controlling the spread of the viroid (Randles and Rodriguez, 2003). Therefore, due to its reliance on the short-term observation of symptoms, the current plant health legislation is not considered fully efficient. Accordingly, the emergency measures for *R. ferrugineus* may only slightly improve the efficiency of the current legislation as CCCVd incubation period is longer than the surveillance period put in place. On the other hand, the current legislation does not take into account seeds, despite the fact that CCCVd is known to be seed-transmitted (Anon., 1982 – cited by Randles and Imperial, 1984; Pacumbaba et al., 1994). In addition, there are also uncertainties about whether imported coconuts would be considered as seeds or as fruits.

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

- Existence of a long asymptomatic phase of up to 6 years in the field
- Symptoms, especially the early ones, resemble those caused by abiotic stress or other pests
- Seed and pollen transmission
- Imperfect knowledge on the natural means of spread
- Systemic pathogen transmitted by vegetative multiplication practices
- No clear ecoclimatic limitations besides those applying to the host
- The ambiguous status of CCCVd-related molecules affecting the host range and geographic distribution of CCCVd
- Unavailability of genetic resistance and efficient control strategies.

3.6.2. Control methods

Exclusion in the only method considered to be effective in controlling the spread of CCCVd. In the Philippines, the spread of Cadang-Cadang disease is managed by regulating movement of coconut products across internal quarantine boundaries (Carpio, 2011; -cited by Geering and Randles, 2012). Control by eradication has been unsuccessful, while replanting does not significantly affect disease spread, but only allow to maintain production in affected areas (Randles, 1987).

No genetic resistance or tolerance is available in *C. nucifera*; all 93 tested coconut populations were susceptible to inoculation (Orolfo et al., 2000); however, some field resistance to natural infection may be available in some population (Randles and Rodriguez, 2003).

3.7. Uncertainty

The Panel identified four mains sources of uncertainty in the present opinion:

- Uncertainties on the relationships between CCCVd-related RNAs and CCCVd and therefore on host range and geographic distribution of CCCVd.
- Uncertainties on the origin and volume of the trade in palm seeds and plants for planting imported in the EU.
- Uncertainties about the efficiency of spread under EU conditions.
- Lack of information on host status and susceptibility of many palm species grown in the EU and, in particular on susceptibility of the two species growing spontaneously in the EU.

These uncertainties primarily affect two aspects of the present Pest Categorisation, the efficiency and extent to which CCCVd would be able to spread and the impact it would have if introduced in the EU.

4. Conclusions

CCCVd meets the criteria required to satisfy the definition of a Union quarantine pest (Table 5).

Table 5: The Panel's conclusions on the pest categorisation criteria defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest	Key uncertainties
Identity of the pest (Section 3.1)	The identity of the pest is well established; it can be identified with reliable and sensitive molecular diagnostic techniques	The identity of the pest is well established; it can be identified with reliable and sensitive molecular diagnostic techniques	Uncertainties concerning the relationship of CCCVd-related RNAs with CCCVd
Absence/presence of the pest in the EU territory (Section 3.2)	CCCVd is **not known to occur** in the EU territory	CCCVd is not known to occur in the EU territory, therefore does not qualify as a Union RNQP	Although not documented, some CCCVd isolates might be present in the EU
Regulatory status (Section 3.3)	CCCVd is currently regulated on *Palmae* (Arecaceae) plants for planting by 2000/29/EC. Emergency measures set with the Commission Decision 2007/365/EC for *R. ferrugineus* and many palm species may improve the efficiency of 2000/29/EC	CCCVd is currently regulated on *Palmae* (Arecaceae) plants for planting by 2000/29/EC. Emergency measures set with the Commission Decision 2007/365/EC for *R. ferrugineus* and many palm species may improve the efficiency of 2000/29/EC	No uncertainties
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	CCCVd could potentially enter, establish and spread in the EU. At least plants for planting and seeds of Arecaceae species represent possible pathways for the pest to enter and spread in the EU	Plants for planting and seeds of Arecaceae species represent the main entry pathways and the main means of CCCVd spread over long distance	Uncertainties on the origin and volume of the trade in palm seeds and plants for planting imported in the EU Uncertainties about the efficiency of spread under EU conditions Lack of information on host status of many palm species grown in the EU and, in particular on susceptibility of the two species growing spontaneously in the EU
Potential for consequences in the EU territory (Section 3.5)	The potential impact of CCCVd if introduced in the EU is very difficult to assess. Given that the spread potential is, as for other viroids, likely to be limited, the potential impact is estimated to be limited in extent but this judgement is affected by large uncertainties.	Because of the limited spread potential of viroids the expected impact, is expected to be limited, but large uncertainties affect this assessment	Lack of information on host status and susceptibility of many palm species grown in the EU and, in particular on susceptibility of the two species growing spontaneously in the EU
Available measures (Section 3.6)	Exclusion in the only method considered to be effective in controlling the spread of the pest.	There are no efficient methods (e.g roguing, natural resistance or tolerance) for controlling CCCVd spread after its introduction in an area. Replanting is used only to maintain production in affected areas	The ambiguous status of CCCVd-related molecules affects the host range and geographic distribution of CCCVd therefore hinders the efficiency of the measures

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
Conclusion on pest categorisation (Section 4)	CCCVd meets all the criteria evaluated by EFSA to qualify as a Union quarantine pest	CCCVd does not meet the presence on the territory criterion and therefore does not qualify as a Union RNQP	
Aspects of assessment to focus on/scenarios to address in future if appropriate	The main knowledge gaps concern (1) the relationships between CCCVd-related RNAs and CCCVd, (2) the origin and volume of the trade in palm seeds and plants for planting imported in the EU (3) the efficiency of natural spread under EU conditions and (4) host status and susceptibility of many palm species grown in the EU. Given that the present categorisation has explored most if not all of the available data on these points, a more complete assessment is unlikely to provide much clearer conclusions		

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Abbreviations

CCCVd	Coconut Cadang-Cadang viroid
CTiVd	*Coconut tinangaja viroid*
EPPO	European and Mediterranean Plant Protection Organization
EU MS	European Union Member State
FAO	Food and Agriculture Organization
IPPC	International Plant Protection Convention
OS	orange spotting
PAGE	polyacrylamide gel electrophoresis
PLH	EFSA Panel on Plant Health
RA	risk assessment
RNQP	regulated non-quarantine pest
RPA	ribonuclease protection assay
RT-LAMP	reverse transcription loop-mediated isothermal amplification
RT-PCR	reverse transcription polymerase chain reaction
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference