SCIENTIFIC OPINION

EFSA Journal

ADOPTED: 28 September 2017

doi: 10.2903/j.efsa.2017.5033

Pest categorisation of Tatter leaf virus

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Abstract

The EFSA Panel on Plant Health performed a pest categorisation of Citrus tatter leaf virus (CTLV) for the EU territory. This virus is the causal agent of tatter leaf and graft incompatibility in trifoliate orange (*Poncirus trifoliata*) and its hybrids. CTLV is now recognised as a synonym of *Apple stem grooving virus* (ASGV), the type *Capillovirus* species, for which efficient diagnostics are available. There are no known ASGV vectors. The virus is reported in citrus from many countries. In the EU, while ASGV is widely present on apple and pear, it has never been reported on citrus. Since the citrus plants for planting pathway is closed by existing legislation, the main pathway for entry is plants for planting of other host species. In the EU, the high prevalence of ASGV in non-citrus hosts, but its absence in citrus ones suggests that interspecific host transfers are rare. However, there are high uncertainties on the importance and specifics of such host change events. No limits to the establishment of ASGV are identified and spread is likely through the vegetative propagation and trade of infected hosts. Infection of sensitive citrus rootstocks leads to stunted growth and decline of the entire plant a few years after grafting. The rootstocks that are now widely used to prevent citrus tristeza decline are the most affected. Among the criteria evaluated by EFSA for an organism to qualify as a Union quarantine pest, ASGV does not meet the criterion of being absent from or under official control in the EU territory. ASGV satisfies all the criteria evaluated by EFSA to qualify as a Union regulated non-quarantine pest. The main uncertainties concern the possible unreported presence of ASGV in citrus in the EU, the existence and efficiency of interspecific host transfers and the existence of ASGV natural spread.

Keywords: Apple stem grooving virus, ASGV, Citrus tatter leaf virus, CTLV, rootstock, incompatibility, citrus, apple

Requestor: European Commission

Question number: EFSA-Q-2017-00314

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Suggested citation: EFSA PLH Panel (EFSA Panel on Plant Health), Jeger M, Bragard C, Caffier D, Dehnen-Schmutz K, Gilioli G, Gregoire J-C, Jaques Miret JA, MacLeod A, Navajas Navarro M, Niere B, Parnell S, Potting R, Rafoss T, Rossi V, Urek G, Van Bruggen A, Van der Werf W, West J, Chatzivassiliou E, Winter S, Catara A, Duran-Vila N, Hollo G and Candresse T, 2017. Scientific Opinion on the pest categorisation of Tatter leaf virus. EFSA Journal 2017;15(10):5033, 22 pp. https://doi.org/10.2903/j.efsa.2017.5033

ISSN: 1831-4732

Table of contents

1. Introduction

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

1.1.1. Background

Council Directive 2000/29/EC[1] on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community establishes the present European Union plant health regime. The Directive lays down the phytosanitary provisions and the control checks to be carried out at the place of origin on plants and plant products destined for the Union or to be moved within the Union. In the Directive's 2000/29/EC annexes, the list of harmful organisms (pests) whose introduction into or spread within the Union is prohibited, is detailed together with specific requirements for import or internal movement.

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

1.1.2. Terms of Reference

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

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

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

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

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

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

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

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

1.1.2.1. Terms of Reference: Appendix 1

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

Annex IIAI

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

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

(b) Bacteria

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

(c) Fungi

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

Tatter leaf virus (Citrus tatter leaf virus (CTLV)) 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 European Union (EU) excluding Ceuta, Melilla and the outermost regions of Member States (MSs) referred to in Article 355(1) of the Treaty on the Functioning of the European Union (TFEU), other than Madeira and the Azores.

Initially considered as a distinct virus, CTLV has been demonstrated to be a synonym for *Apple stem grooving virus* (ASGV), a well-characterised *Capillovirus*. There is no evidence from either CTLV genome sequence or its biology that would support its distinction from ASGV. In the present opinion, the PLH Panel therefore selected to follow the current taxonomy and to refer to CTLV under its approved ASGV name.

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A literature search on Tatter leaf virus was conducted at the beginning of the categorisation in the ISI Web of Science bibliographic database, using the scientific name of the pest and its synonym and the name of the disease in citrus as search term. Relevant papers were reviewed, and further references and information were obtained from experts, from citations within the references and grey literature.

2.1.2. Database search

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

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

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

2.2. Methodologies

The Panel performed the pest categorisation for Tatter leaf virus, 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 ToR received by the European Commission. In addition, for each conclusion, the Panel provides a short description of its associated uncertainty.

Table 1 presents the Regulation (EU) 2016/2031 pest categorisation criteria on which the Panel bases its conclusions. All relevant criteria have to be met for the pest to potentially qualify either as a quarantine pest or as 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 regard to the principle of separation between risk assessment and risk management (EFSA founding regulation (EU) No 178/2002); therefore, instead of determining whether the pest is likely to have an unacceptable impact, the Panel will present a summary of the observed pest impacts. Economic impacts are expressed in terms of yield and quality losses and not in monetary terms, while addressing social impacts is outside the remit of the Panel, in agreement with EFSA guidance on a harmonised framework for pest risk assessment (EFSA PLH Panel, 2010).

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)

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
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 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, or has it been shown to produce consistent symptoms and to be transmissible? (Yes or No)
YES

Citrus tatter leaf virus was initially the name given to a virus causing leaf malformation in *Citrus excelsa* and severe indentations and a brown line and crease at the bud union on trifoliate orange, citranges and citrumelo used as rootstocks (Calavan et al., 1963). These symptoms are often followed by stunted growth and plant decline. When the positive sense, single-stranded RNA genome of CTLV (ca. 6500 nucleotides, Tatineni et al., 2009; Yoshikawa et al., 1996; Yoshikawa, 2000) was sequenced, it was realised that it showed very high sequence identity with ASGV, the type species of the genus *Capillovirus*, in the family Betaflexiviridae. As a consequence, CTLV isolates from citrus and ASGV isolates from other hosts are today regarded as all belonging to a single species, ASGV (ICTV Master species list).[4]

This conclusion is also supported by the observation that an ASGV isolate from a non-citrus host could infect Etrog citron and induce symptoms similar to those CTLV infection (Iwanami et al., 1991).

While the CTLV name was used in the past, neither genome sequence nor biological properties allow to draw a solid distinction between CTLV and ASGV.

In conclusion, the taxonomic status of CTLV is today firmly established as a synonym of ASGV, a well-characterised *Capillovirus* species. In the present opinion, the PLH Panel selected to follow the current taxonomy and therefore to refer to CTLV throughout the present opinion under its approved ASGV name.

3.1.2. Biology of the pest

ASGV infections in rootstocks of trifoliate orange and its hybrids (e.g. rusk citrange (*Citrus sinensis* 'Ruby' x *Poncirus trifoliata*), Troyer citrange (*C. sinensis* 'Washington' x *P. trifoliata*) and citrumelo (*P. trifoliata* x *Citrus paradisi*)) result in a severe bud-union incompatibility with severe symptoms on leaves and stunted plant growth followed by decline and plant death often only observed 5–6 years after planting (Broadbent et al., 1994; Da Graca and Skaria, 1996). In addition, leaf symptoms are observed in *C. excelsa* (*Citrus micrantha* x *Citrus medica*). Infections generally remain symptomless in other citrus species and their relatives.

ASGV is a mechanically transmitted virus and from citron to citron (*C. medica*), it can be transmitted by rub inoculation of sap from virus-infected plants, through blades of pruning knives and wounds introduced by stem slashing and leaf abrasion (Roistacher et al., 1980; Timmer et al., 1988). Mechanical transmission from or to other citrus hosts is more difficult to achieve. The virus systemically invades its hosts, and therefore, all tissues and plant organs become infected and the virus can be transmitted by all vegetative propagation techniques.

There is no known vector for capilloviruses and likewise for ASGV. Seed transmission of ASGV was reported for Eureka lemon (*Citrus limon* cv. 'Eureka') at a rate of 1.4%, while seeds from ASGV-infected plants of Clementine mandarin, Meiwa kumquat and Meyer lemons did not develop into infected seedlings (Tanner et al., 2011). Seed transmission may exist for other citrus cultivars, but this has not yet been investigated.

3.1.3. Intraspecific diversity

Comparisons of partial or complete genomic sequences demonstrate the existence of genetic diversity in the ASGV species. In an analysis performed by the Panel, ASGV isolates tend to form two separate clades, broadly corresponding, respectively, to isolates from citrus and from rosaceous hosts. Some citrus isolate sequences (such as KC588948 from China) cluster however in the rosaceous isolates clade, so that there is not firm link between ASGV isolates and the ability to infect particular hosts.

[4] https://talk.ictvonline.org/files/master-species-lists/m/msl

3.1.4. Detection and identification of the pest

Are detection and identification methods available for the pest?

YES

Detection of ASGV in citrus was historically achieved by biological indexing on Rusk or Troyer citranges, by serology or by electron microscopy (Broadbent and Dephoff, 1992; Broadbent et al., 1994). ASGV detection is today largely based on enzyme-linked immunosorbent assay (ELISA) or reverse transcription polymerase chain reaction (RT-PCR) assays (Hailstones et al., 2000; Roy et al., 2005; Liu et al., 2009). Recently, a real-time RT-qPCR assay was developed that shows high sensitivity and was reported to specifically identify citrus isolates of ASGV (Cowell et al., 2017). However, given that the authors used only a single non-citrus ASGV control, it is unclear whether this assay specificity would still be valid by using a larger panel of ASGV isolates.

In summary, robust detection and identification methods exist for ASGV.

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

Tatter leaf has been reported in citrus from the USA, Japan, China, Taiwan, Korea, India, Brazil, Taiwan, Thailand, the Philippines, Australia and South Africa (Table 2 and Figure 1) and was associated with serious bud-union incompatibility in trees on trifoliate and trifoliate hybrid rootstocks in Japan (Miyakawa and Tsuji, 1988), China (Zhang et al., 1988; Ke and Wu, 1991), South Africa (Marais and Lee, 1987) and Texas (Herron and Skaria, 2000).

Table 2: Global distribution of Tatter leaf of citrus (extracted from EPPO Global Database, accessed 28 September 2017) and complemented using recent references in the scientific literature

Continent	Country	Status	References
Africa	South Africa	Present, restricted distribution	
Africa	Swaziland	Absent, unreliable record	
Americas	United States of America (California, Florida, Texas)	Present, restricted distribution	
Americas	Brazil	Present, no details	IOCV website[(a)]
Asia	China (Fujian, Guangdong, Guangxi, Hunan, Zhejiang)	Present, no details	
Asia	India	Present	Bhardwaj et al. (2014)
Asia	Japan (Honshu, Shikolu)	Present, no details	
Asia	Korea Republic	Present, no details	
Asia	Taiwan	Present, few occurrences	
Asia	Philippines, Thailand	Present, no details	IOCV website[(a)]
Oceania	Australia (New South Wales)	Present, restricted distribution	
Oceania	Australia (Queensland)	Present, few occurrences)	

(a): International Organization of Citrus Virologists, 2017. Available online: http://iocv.org/

Last updated: 2017-9-13

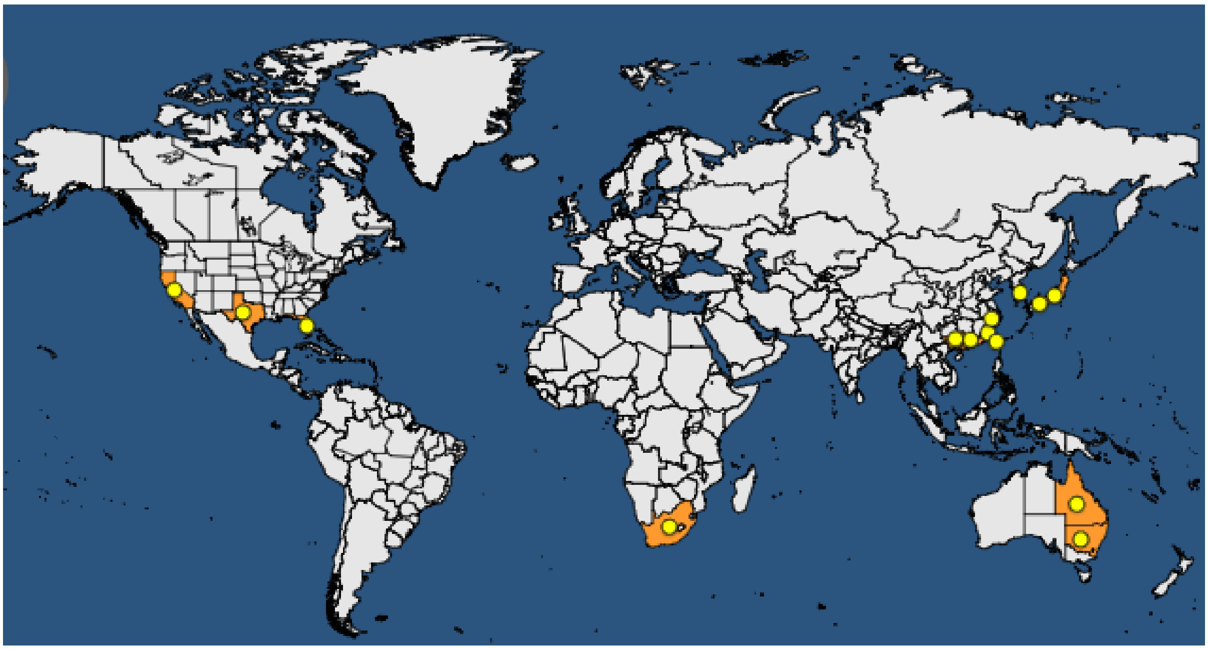

Figure 1: Global distribution of Tatter leaf of citrus (extracted from EPPO Global Database, accessed September 28, 2017)

The global distribution of ASGV is much wider than the one reported for its citrus isolates because of ASGV presence in wider range of hosts, in particular apple and pear in which it is an extremely frequent and latent virus (Massart et al., 2011). The current distribution comprises all five continents, Asia, Africa, the Americas, Oceania and Europe (see Table 3).

Table 3: Global distribution of *Apple stem grooving virus* (extracted from EPPO Global Database, accessed 28 September 2017) and complemented using recent references in the scientific literature

Continent	Country	Status	References
Africa	Egypt, Ethiopia, Morocco, South Africa	Present, no details	
Africa	Nigeria		Song et al. (2016)
Americas	Brazil, Canada, Netherlands Antilles, USA	Present, no details	
Asia	China, India, Israel, Korea Dem. People Rep, Korea Republic, Lebanon, Pakistan, Taiwan	Present, no details	
Oceania	Australia, New Zealand	Present, no details	
Europe (EU countries)	Austria, Belgium, Croatia, Cyprus, Czech Republic, Denmark, Estonia, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom	Present, no details	
Europe (non-EU countries)	Bosnia and Herzegovina, Georgia, Norway, Russia, Serbia, Switzerland, Turkey, Ukraine,	Present, no details	

Last updated: 2017-3-17

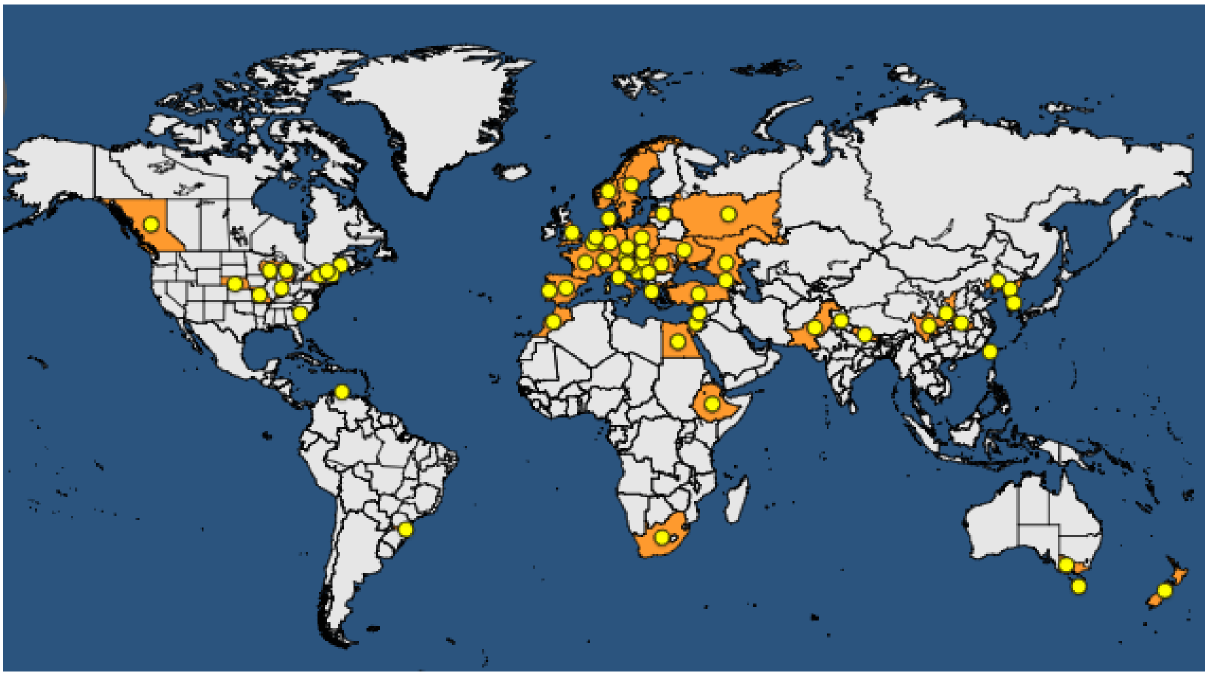

Figure 2: Global distribution of *Apple stem grooving virus* (extracted from EPPO Global Database, accessed September 28 2017)

3.2.2. Pest distribution in the EU

Is the pest present in the EU territory? If present, is the pest widely distributed within the EU?   **Yes**, ASGV is widely present in non-citrus hosts in the EU territory. However, it has never been reported from citrus in the EU.

ASGV is a very frequent virus of apple and pear (Massart et al., 2011) in which it remains as a latent infection. While widely present in these hosts in the EU (see Table 3 and Figure 2), it has never been reported from citrus in any EU MS.

3.3. Regulatory status

3.3.1. Council Directive 2000/29/EC

Tatter leaf virus is listed in Council Directive 2000/29/EC. Details are presented in Tables 4 and 5.

Table 4: Tatter leaf virus 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
14.	Tatter leaf virus	Plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruit and seeds

3.3.2. Legislation addressing plants and plant parts on which Tatter leaf virus and ASGV are regulated

Table 5: Regulated hosts and commodities that may involve Tatter leaf/ASGV in Annexes III, IV and V of Council Directive 2000/29/EC

Annex III, Part A	**Plants, plant products and other objects the introduction of which shall be prohibited in all member states**
Description	**Country of origin**
16. Plants of *Citrus* L., *Fortunella* Swinlge, *Poncirus* Raf., and their hybrids, other than fruit and seeds	Third countries
9. Plants of Chaenomeles Ldl., *Cydonia* Mill., *Crateagus* L., *Malus* Mill., *Prunus* L., *Pyrus* L., and *Rosa* L., intended for planting, other than dormant plants free from leaves, flowers and fruit	Non-European countries
18. Plants of *Cydonia* Mill., *Malus* Mill., *Prunus* L. and *Pyrus* L. and their hybrids, and *Fragaria* L., intended for planting, other than seeds	Without prejudice to the prohibitions applicable to the plants listed in Annex III A (9), where appropriate, non-European countries, other than Mediterranean countries, Australia, New Zealand, Canada, the continental states of the USA
Annex IV, Part A	**Special requirements which must be laid down by all member states for the introduction and movement of plants, plant products and other objects into and within all member states**
Section I	**Plants, plant products and other objects originating outside the community**
Plants, plant products and other objects	**Special requirements**
16.1 Fruits of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, originating in third countries	The fruits shall be free from peduncles and leaves and the packaging shall bear an appropriate origin mark.
Section II	**Plants, plant products and other objects originating in the community**
Plants, plant products and other objects	**Special requirements**
30.1 Fruits of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids	The packaging shall bear an appropriate origin mark
Annex V	Plants, plant products and other objects which must be subject to a plant health inspection (at the place of production if originating in the community, before being moved within the community — in the country of origin or the consignor country, if originating outside the community) before being permitted to enter the community
Part A	Plants, plant products and other objects originating in the communityI.Plants, plant products and other objects which are potential carriers of harmful organisms of relevance for the entire Community and which must be accompanied by a plant passport
	1.1 Plants, intended for planting, other than seeds, of ..... *Cydonia* Mill., ..., *Malus* Mill...., *Pyrus* L... 1.4 Plants of *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, *Casimiroa* La Llave, *Clausena* Burm. f., *Vepris* Comm., *Zanthoxylum* L. and *Vitis* L., other than fruit and seeds.. 1.5 Without prejudice to point 1.6, plants of *Citrus L.* and their hybrids other than fruit and seeds. 1.6 Fruits of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf. and their hybrids with leaves and peduncles.

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
	1. Plants, intended for planting, other than seeds but including seeds of *Citrus* L., *Fortunella* Swingle and *Poncirus* Raf., and their hybrids. . ... 3. Fruits of: - *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, *Momordica* L. and *Solanum melongena* L.

3.4. Entry, establishment and spread in the EU

3.4.1. Host range

The main crop hosts of ASGV are apple, European pear, Japanese pear, Japanese apricot, citrus and lily (Yoshikawa, 2000) as well as kiwifruit (Blouin et al., 2013). The host range of ASGV is wide, comprising more than 40 species in 17 plant families (Nishio et al., 1982; Yoshikawa, 2000). Among the many herbaceous hosts, *Vicia faba*, *Pisum sativum*, *Glycine max*, *Solanum lycopersicum* and *Vigna unguiculata* are important vegetable crops. The citrus hosts of ASGV cover a broad range of citrus species, including *Citrus reticulata*, *Citrofortunella microcarpa*, *Citroncirus webberi*, *C. limon*, *C. paradisi*, *C. sinensis*, *Poncirus trifoliata*, citrange and citrumelo hybrids and *Fortunella japonica* (EPPO, 2017). There are no indications that the host range of ASGV isolates from citrus might differ from that of ASGV isolates from non-citrus hosts. It is likely that other ASGV hosts exist and are yet to be identified.

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, through plants for planting and ASGV can enter with infected non-citrus hosts plants

Considering citrus hosts, the most important pathway for entry of ASGV is the trade of plants for planting of *Citrus*, *Fortunella* and *Poncirus* species and their hybrids, which is closed by the existing Annex III legislation (see Section 3.3.2 and Table 4 above). ASGV is seed transmitted at a low rate in some of its citrus hosts (Tanner et al., 2011). Citrus seeds are regulated in Annex V of Directive 2000/29/EC, which specifies that they must be submitted to a general plant health inspection. However, such inspection may be inefficient at detecting the presence of ASGV since some of its citrus hosts do not show any symptoms. Seeds of citrus may constitute a potential entry pathway.

In addition, ASGV can also enter with plants for planting of its non-citrus hosts which are either not regulated or regulated by less restrictive legislation.

Between 1995 and the 24th of August 2017, there are no interception records for CTLV or ASGV in the Europhyt database.

3.4.3. Establishment

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

YES, hosts are widely present in the EU and eco-climatic conditions are not expected to affect ASGV establishment

As for other viruses, ASGV is able to develop in its hosts wherever conditions suitable for the host are available. Eco-climatic conditions are not expected to affect ASGV establishment in regions where its hosts are grown.

3.4.3.1. EU distribution of main host plants

The main *Citrus* sp. hosts of ASGV are commercially grown for citrus fruit production (oranges, mandarins, lemons…) in eight EU MS, Spain, Italy, Greece, Portugal, Cyprus, Croatia, Malta and France. In addition, plants of *Citrus, Fortunella* and *Poncirus* are grown as ornamentals, either in the open or under protected cultivation in a number of MSs (Table 6).

Table 6: Area (cultivation/harvested/production) of citrus production (in 1,000 ha) in Europe according to the Eurostat database (Crop statistics apro_acs_a extracted on 31 August 2017)

GEO/TIME	2012	2013	2014	2015	2016
Spain	310.50	306.31	302.46	298.72	295.33
Italy	146.79	163.59	140.16	149.10	141.22
Greece	50.61	49.88	49.54	46.92	44.72
Portugal	19.85	19.82	19.80	20.21	20.21
France	3.89	4.34	4.16	4.21	4.70
Cyprus	3.21	2.63	2.69	2.84	3.29
Croatia	1.88	2.17	2.17	2.21	2.18
Malta	0.00[(n)]	0.00[(n)]	0.00[(n)]	0.00[(n)]	0.00[(n)]

n: not significant.

In addition, other hosts of ASGV, in particular apple and pear are also very widely grown throughout the EU.

3.4.4. Spread

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

YES. There are no known vectors for ASGV but the virus can spread through vegetative propagation and trade of 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?

YES

Under experimental conditions, ASGV can be transmitted mechanically to citron. ASGV can also be transmitted from citrus or from other hosts to herbaceous hosts, although frequently with difficulty (Roistacher et al., 1980; Massart et al., 2011). Thus, theoretically there is no host boundary to limit virus spread from and to citrus. The fact that ASGV is very frequent in apple and pear in the EU but has never been observed in citrus (see Section 3.2.2) indicates that strong limitations exist to transfer from infected non-citrus hosts to citrus hosts. However, the only incomplete association of the two main ASGV clades with different host groups (see Section 3.1.3) suggest that interspecific host transfers may occur, even if very rarely. The frequency and mechanism(s) involved in these interspecific transfers are currently unknown, further adding to uncertainties.

There is no known vector of ASGV and there is no evidence of its natural spread in apple or pear orchards (Massart et al., 2011). The contribution to field spread of ASGV, if any, of mechanical transmission through contaminated pruning tools has not been studied but would appear to be at best extremely limited.

Similarly, the Panel was unable to identify evidence for natural spread of ASGV in citrus groves. Spread of ASGV may, however, occur in some citrus hosts at a low level, through seed transmission (Massart et al., 2011; Tanner et al., 2011).

The main mechanism for spread is therefore the vegetative multiplication of infected hosts and the trade of plants for planting.

3.5. Impacts

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

YES. Citrange and citrumelo hybrids are very important rootstocks (because of their wide use to prevent CTV-induced decline in grafted trees). In those rootstocks, ASGV infections result in graft incompatibility and subsequent decline of the trees

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?[5]

YES

Serious tatter leaf damage to commercial groves has been reported in grafted citrus combinations, for example, in Southern China and Japan (Miyakawa and Ito, 2000; Liu et al., 2011).

The EU citriculture is increasingly replacing sour orange rootstocks that are highly susceptible to Citrus tristeza virus (CTV) with citrange and citrumelo rootstocks that do not respond the CTV-induced decline but are highly susceptible to ASGV (Calavan et al., 1963). The establishment and spread of ASGV in the EU would therefore compromise the efficient control of CTV currently achieved through rootstocks replacement. Such a scenario would have clear negative consequences.

Since ASGV can infect most citrus cultivars resulting in latent infections, its dissemination through plants for planting would have a clear negative impact on the intended use of these plants.

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?

NO. The citrus plants for planting pathway is already closed by existing legislation. Closing this pathway for other hosts (apple, pear, etc.) would have very limited influence given the already high prevalence of ASGV in these hosts in the EU

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

YES. Existing citrus certification systems constitute a strong limitation to ASGV spread through citrus plants for planting

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

- Latency of symptoms and uneven distribution of the virus in plants limit efficient diagnosis
- Existence of asymptomatic ASGV infections in a number of hosts
- Wide prevalence of ASGV in apple and pear in the EU.

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

- Latency in symptoms and uneven distribution of the virus in plants are a limiting factor for an efficient diagnostic
- Difficulty to eliminate the virus by shoot tip grafting unless thermotherapy is associated.
- Existence of asymptomatic infections in a number of citrus hosts.

3.6.3. Control methods

- Use of certified citrus propagation and planting materials
- Use of alternative rootstocks on which ASGV infection does not lead to tree decline. However, the use of such rootstocks faces other agronomical constraints, currently limiting the applicability of this strategy.

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

3.7. Uncertainties

- Uncertainty about the presence of ASGV in citrus the EU, in particular in old citrus orchards or germplasm collections.
- Uncertainty about the existence of ASGV hosts not currently identified.
- Uncertainty about the existence and efficiency of interspecific host transfers and the ability of ASGV infecting non-citrus hosts to be transferred to citrus hosts.
- Uncertainty about the existence of ASGV natural spread.

4. Conclusions

The synonymy of CTLV with ASGV has been clearly established. Among the criteria evaluated by EFSA for an organism to qualify as a Union quarantine pest, ASGV does not meet the criterion of being absent from or under official control in the EU territory. ASGV satisfies all the criteria evaluated by EFSA to qualify as a Union RNQP (Table 7).

Table 7: 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 synonymy of CTLV with *Apple stem grooving virus* (ASGV) has been clearly established	The synonymy of CTLV with *Apple stem grooving virus* (ASGV) has been clearly established	No uncertainty
Absence/presence of the pest in the EU territory (Section 3.2)	ASGV is widely distributed in the EU in non-citrus hosts. It is however not known to be present in citrus hosts	ASGV is widely distributed in the EU in non-citrus hosts. It is, however, not known to be present in citrus hosts	Uncertainty of ASGV absence on citrus in EU because of symptomless infections and absence of systematic monitoring
Regulatory status (Section 3.3)	ASGV is only regulated (as CTLV) on citrus and not known to occur in these hosts in the EU. However, it is widely present and not under official control in several other hosts	ASGV is only regulated (as CTLV) on citrus and not known to occur in these hosts in the EU. However, it is widely present and not under official control in several other hosts	No uncertainty
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	ASGV is able to enter, establish and spread in the EU. The citrus plants for planting pathway is closed by legislation, but ASGV can enter on plants for planting of other host species or, potentially, on seed of its citrus hosts in which it may be transmitted at a low rate	Plants for planting are the main pathway for spread	Uncertainty about the existence and efficiency of interspecific host transfers and the ability of ASGV infecting non-citrus hosts to be transferred to citrus hosts Uncertainty about the existence of ASGV natural spread mechanism(s)
Potential for consequences in the EU territory (Section 3.5)	The establishment and spread of ASGV in citrus in the EU would compromise the efficient control of CTV currently achieved through rootstocks replacement	The presence of ASGV on citrus plants for planting severely affects their intended use	Very limited uncertainty
Available measures (Section 3.6)	The citrus plants for planting pathway is closed by legislation	Certification of citrus plants for planting is the most efficient strategy to limit spread and impact ASGV in citrus	No uncertainty
Conclusion on pest categorisation (Section 4)	Among the criteria evaluated by EFSA for an organism to qualify as a Union quarantine pest, ASGV does not meet the criterion of being absent from or under official control in the EU territory	ASGV satisfies all the criteria evaluated by EFSA to qualify as a Union RNQP	
Aspects of assessment to focus on/scenarios to address in future if appropriate	The main uncertainties concern • the presence of ASGV in citrus in the EU, particularly in old orchards or germplasm collections • the existence and efficiency of interspecific host transfers and the ability of ASGV infecting non-citrus hosts to be transferred to citrus hosts • the existence of ASGV natural spread		

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Abbreviations

ASGV	Apple stem grooving virus
CTLV	Citrus tatter leaf virus
CTV	*Citrus tristeza virus*
ELISA	enzyme-linked immunosorbent assay
EPPO	European and Mediterranean Plant Protection Organization
EU MS	European Union Member State
FAO	Food and Agriculture Organization
IPPC	International Plant Protection Convention
PLH	EFSA Panel on Plant Health
RNQP	regulated non-quarantine pest
RT-PCR	reverse transcription polymerase chain reaction
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference