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.

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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.

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

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

\(^3\) Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety, OJ L 31/1, 1.2.2002, p. 1-24.
1.1.2.1. Terms of Reference: Appendix 1

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

Annex IIA

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

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

(b) Bacteria

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

(c) Fungi

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

(d) Virus and virus-like organisms

- Beet curly top virus (non-EU isolates)
- Little cherry pathogen (non- EU isolates)
- Black raspberry latent virus
- Naturally spreading psorosis
- Blight and blight-like
- Palm lethal yellowing mycoplasma
- Cadang-Cadang viroid
- Satsuma dwarf virus
- Citrus tristeza virus (non-EU isolates)
- Tatter leaf virus
- Leprosis
- Witches’ broom (MLO)

Annex IIB

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

- Anthonomus grandis (Boh.)
- Ips cembrae Heer
- Cephalcia lariciphila (Klug)
- Ips duplicatus Sahlberg
- Dendrocoptes micas Kugelan
- Ips sexdentatus Börner
- Gilphinia hercyniae (Hartig)
- Ips typographus Heer
- Gonipterus scutellatus Gyll.
- Stenochetus mangiferae Fabricius
- Ips amitinus Eichhof
(b) Bacteria

*Curtobacterium flaccumfaciens pv. flaccumfaciens* (Hedges) Collins and Jones

(c) Fungi

*Glomerella gossypii* Edgerton

*Hypoxylon mammatum* (Wahl.) J. Miller

*Gremmeniella abietina* (Lag.) Morelet

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

Group of Tephritidae (non-EU) such as:

1) *Anastrepha fraterculus* (Wiedemann) 12) *Pardalaspis cyanescens* Bezzi

2) *Anastrepha ludens* (Loew) 13) *Pardalaspis quinaria* Bezzi

3) *Anastrepha obliqua* Macquart 14) *Pterandrus rosa* (Karsch)

4) *Anastrepha suspensa* (Loew) 15) *Rhacochlaena japonica* Ito

5) *Dacus ciliatus* Loew 16) *Rhagoletis completa* Cresson

6) *Dacus curcurbitae* Coquillett 17) *Rhagoletis fausta* (Osten-Sacken)

7) *Dacus dorsalis* Hendel 18) *Rhagoletis indifferens* Curran

8) *Dacus tryoni* (Froggatt) 19) *Rhagoletis mendax* Curran

9) *Dacus tsuneonis* Miyake 20) *Rhagoletis pomonella* Walsh

10) *Dacus zonatus* Saund.

11) *Epochra canadensis* (Loew)

(c) Viruses and virus-like organisms

Group of potato viruses and virus-like organisms such as:

1) Andean potato latent virus 4) Potato black ringspot virus

2) Andean potato mottle virus 5) Potato virus T

3) Arracacha virus B, oca strain 6) non-EU isolates of potato viruses A, M, S, V, X and Y (including Yo, Yh 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 8) Peach yellows mycoplasm

2) Cherry rasp leaf virus (American) 9) Plum line pattern virus (American)

3) Peach mosaic virus (American) 10) Raspberry leaf curl virus (American)

4) Peach phony rickettsia 11) Strawberry witches’ broom mycoplasma

5) Peach rosette mosaic virus 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.*

6) Peach rosette mycoplasm

7) Peach X-disease mycoplasm
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 zeas (Boddie)  
Hirschmanniella spp., other than Hirschmanniella gracilis (de Man) Luc and Goodey  
Liriomyza sativae Blanchard

(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 weinii (Murril) Kotlaba and Pouzar  
Melampsora farlowii (Arthur) Davis  

(c) Viruses and virus-like organisms

Tobacco ringspot virus  
Tomato ringspot virus  
Bean golden mosaic virus  
Cowpea mild mottle virus  
Lettuce infectious yellows virus  

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(d) Parasitic plants

*Araeuothobium* spp. (non-EU)

**Annex I AII**

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

*Meloidogyne fallax* Karssen

*Popillia japonica* Newman

(b) Bacteria

*Clavibacter michiganensis* (Smith) Davis et al.

ssp. *sepedonicus* (Spieckermann and Kotthoff) Davis et al.

*Ralstonia solanacearum* (Smith) Yabuuchi et al.

(c) Fungi

*Melampsora medusae* Thümen

*Synchytrium endobioticum* (Schilbersky) Percival

**Annex I B**

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

*Leptinotarsa decemlineata* Say

*bryoniae* (Kaltenbach)

(b) Viruses and virus-like organisms

Beet necrotic yellow vein virus

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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 an 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 an 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) |
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’ × *Poncirus trifoliata*), Troyer citrange (*C. sinensis* ‘Washington’ × *P. trifoliata*) and citrumelo (*P. trifoliata* × *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* × *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.

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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, Shikoku) | 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/
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 |                             |
3.2.2. Pest distribution 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)              | 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* Swingle, *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 community                                       |
| 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. |                                                                                                           |
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

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

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?  

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.

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 |
| 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