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Pest categorisation of *Satsuma dwarf virus*

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Abstract

The EFSA Panel on Plant Health performed a pest categorisation of *Satsuma dwarf virus* (SDV) for the EU territory. SDV is a well-known pathogen and the type species of the genus *Sadwavirus* in the family Secoviridae. SDV is now considered to include several other formerly distinct viruses which are therefore also covered in the present opinion. Citrus species and their relatives represent the main hosts of SDV and efficient diagnostic techniques are available. SDV is listed on some of its known hosts in Annex IIAI of Directive 2000/29/EC. It is transmitted by vegetative propagation of infected hosts and presumably through the soil, but the precise mechanism or vector(s) are still unknown. SDV is present in Asia and is not known to occur in the EU. Therefore, it does not meet this criterion to qualify as a Union regulated non-quarantine pest (RNPQ). Plants for planting represent the main pathway for the entry, but this pathway is closed by existing legislation for the main hosts (*Citrus*, *Fortunella* and *Poncirus*). SDV is, however, able to enter the EU on plants for plants of its unregulated rutaceous or non-rutaceous hosts. Should it be introduced, SDV has the potential to establish and subsequently spread with plants for planting and, possibly, through its poorly characterised natural spread mechanism(s). SDV is able to cause severe symptoms, quality and yield losses on a range of citrus crops. Overall, SDV meets all the criteria evaluated by EFSA to qualify as a Union quarantine pest. The main knowledge gaps and uncertainties concern (1) the potential significance of the unregulated rutaceous and non-rutaceous hosts for virus dissemination and epidemiology, (2) the origin and trade volume of the plants for planting of these host imported in the EU and (3) the efficiency of natural spread of SDV under EU conditions.

Keywords: *Satsuma dwarf virus*, SDV, Citrus, rutaceous, non-rutaceous hosts, Union quarantine pest

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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.

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

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

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

1.1.2.1. Terms of Reference: Appendix 1

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

Annex IIAI

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

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

(b) Bacteria

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

(c) Fungi

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

(d) Virus and virus-like organisms

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

Annex IIB

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

Anthonomus grandis (Boh.)
Cephalcia lariciphila (Klug)
Dendroctonus micans Kugelan
Gilphinia hercyniae (Hartig)
Gonipterus scutellatus Gyll.
Sternochetus mangiferae Fabricius
Ips amitinus Eichhof
Ips cembrae Heer
Ips duplicatus Sahlberg
Ips sexdentatus Börner
Ips typographus Heer

(b) Bacteria

Curtobacterium flaccumfaciens pv. flaccumfaciens (Hedges) Collins and Jones

(c) Fungi

Glomerella gossypii Edgerton

Gremmeniella abietina (Lag.) Morelet

Hypoxylon mammatum (Wahl.) J. Miller

1.1.2.2. Terms of Reference: Appendix 2

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

Annex IAI

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

Group of Cicadellidae (non-EU) known to be vector of Pierce's disease (caused by *Xylella fastidiosa*), such as:

1) *Carneocephala fulgida* Nottingham
2) *Draeculacephala minerva* Ball
3) *Graphocephala atropunctata* (Signoret)

Group of Tephritidae (non-EU) such as:

1) *Anastrepha fraterculus* (Wiedemann)
2) *Anastrepha ludens* (Loew)
3) *Anastrepha obliqua* Macquart
4) *Anastrepha suspensa* (Loew)
5) *Dacus ciliatus* Loew
6) *Dacus curcurbitae* Coquillet
7) *Dacus dorsalis* Hendel
8) *Dacus tryoni* (Froggatt)
9) *Dacus tsuneonis* Miyake
10) *Dacus zonatus* Saund.
11) *Epochra canadensis* (Loew)
12) *Pardalaspis cyanescens* Bezzi
13) *Pardalaspis quinaria* Bezzi
14) *Pterandrus rosa* (Karsch)
15) *Rhacochlaena japonica* Ito
16) *Rhagoletis completa* Cresson
17) *Rhagoletis fausta* (Osten-Sacken)
18) *Rhagoletis indifferens* Curran
19) *Rhagoletis mendax* Curran
20) *Rhagoletis pomonella* Walsh
21) *Rhagoletis suavis* (Loew)

(c) Viruses and virus-like organisms

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

1) Andean potato latent virus
2) Andean potato mottle virus
3) Arracacha virus B, oca strain
4) Potato black ringspot virus
5) Potato virus T
6) non-EU isolates of potato viruses A, M, S, V, X and Y (including Yo, Yn and Yc) and Potato leafroll virus

Group of viruses and virus-like organisms of Cydonia Mill., Fragaria L., Malus Mill., Prunus L., Pyrus L., Ribes L.,Rubus L. and Vitis L., such as:

1) Blueberry leaf mottle virus
2) Cherry rasp leaf virus (American)
3) Peach mosaic virus (American)
4) Peach phony rickettsia
5) Peach rosette mosaic virus
6) Peach rosette mycoplasm
7) Peach X-disease mycoplasm
8) Peach yellows mycoplasm
9) Plum line pattern virus (American)
10) Raspberry leaf curl virus (American)
11) Strawberry witches' broom mycoplasma
12) Non-EU viruses and virus-like organisms of *Cydonia Mill., Fragaria L., Malus Mill., Prunus L., Pyrus L., Ribes L., Rubus L.* and *Vitis L.*

Annex IIAI

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

Group of *Margarodes* (non-EU species) such as:

1) *Margarodes vitis* (Phillipi)

2) *Margarodes vredendalensis* de Klerk

3) *Margarodes prieskaensis* Jakubski

1.1.2.3. Terms of Reference: Appendix 3

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

Annex IAI

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

Acleris spp. (non-EU)
Amauromyza maculosa (Malloch)
Anomala orientalis Waterhouse
Arrhenodes minutus Drury
Choristoneura spp. (non-EU)
Conotrachelus nenuphar (Herbst)
Dendrolimus sibiricus Tschetverikov
Diabrotica 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

Satsuma dwarf virus (SDV) 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.

This pest categorisation covers SDV and several agents now considered as belonging to the SDV species, namely, *Citrus mosaic virus* (CiMV), *Navel orange infectious mottling virus* (NIMV), *Natsudaidai dwarf virus* (NDV) and *Hyuganatsu virus* (HV).

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A literature search on *Satsuma dwarf virus* and its strains, namely, *Citrus mosaic sadwavirus* (CiMV), *Navel orange infectious mottling virus* (NIMV), *Natsudaidai dwarf virus* (NDV) *and Hyuganatsu virus* (HV) was conducted at the beginning of the categorisation in the ISI Web of Science bibliographic database, using the scientific name of the pest as search term, as well as the names of the various viruses now considered as strains of SDV. 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 SDV, 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 pest 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, the pest is a virus species with clear taxonomy

Satsuma dwarf virus is the type species of the genus *Sadwavirus* in the family Secoviridae (Sanfaçon et al., 2009). Until the determination of its nucleotide sequence (Iwanami and Ieki, 1996; Iwanami et al., 1998), the virus was considered as a tentative member of *Nepovirus* genus in the Comoviridae family (Iwanami et al., 1999; Le Gall et al., 2007). Its bipartite, positive, single-stranded RNA (ssRNA) genome is encapsidated in polyhedral particles (Iwanami et al., 1999). Both RNAs of SDV have been sequenced (GenBank Accession numbers NC_003785.2 (RNA1) and NC_003786.2 (RNA2) (Iwanami et al., 1999). SDV is associated with a severe disease of satsuma orange (*Citrus unshiu;* Usugi and Saito, 1979). CiMV, NIMV, NDV (Tanaka and Yamada, 1972) and HV (Ito et al., 2004), which cause on specific citrus species the respective diseases after which they are named, were initially described as independent species but are now recognised as belonging to the SDV species (Le Gall et al., 2007).

3.1.2. Biology of the pest

Vegetative propagation of infected citrus hosts represents the main mode of transmission of SDV (Iwanami, 2010). Natural spread of SDV in citrus groves occurs and several observations suggest a soil-associated mode of transmission. These include (1) the spatial distribution of the diseased trees (in concentric rings), (2) the association of infected trees with other non-rutaceous hosts and (3) the fast infection of the trees replanted after roguing (Koizumi et al., 1988; Iwanami et al., 1999, 2010; Nakazono-Nagaoka et al., 2014). However, the precise transmission mechanism has not yet been elucidated and no biological vector is known so far. In the laboratory, SDV can be mechanically transmitted (by rubbing or knife slashing) to citrus and to some herbaceous hosts, although with difficulty (Usugi and Saito, 1979; Iwanami, 2010). However, mechanical transmission does not seem to occur in the field (Ushiyama & Ogaki, 1970 – cited in Koizumi et al., 1988). SDV is seed transmitted (8.6%) in *Phaseolus vulgaris* (kidney bean, cv. satisfaction) but not in *Citrus sulcata* or in white sesame (*Sesame indicum*) (Kishi, 1967-cited in Koizumi et al., 1988). Field observations do not suggest a pollen transmission mode.

The non-rutaceous woody hosts *Viburnum odoratissimum* var. *awabuki* (China laurestine) commonly used to form hedges in home gardens and as windbreak in citrus fields in Japan and *Daphniphyllum teijsmannii* are asymptomatic SDV hosts and possible virus reservoirs (Koizumi et al., 1988; Nakazono-Nagaoka et al., 2014).

3.1.3. Intraspecific diversity

Within the Secoviridae family, a pairwise aminoacid sequence identity of less than 75% for the CP or less than 80% for the protease-polymerase region (or the respective combined genes for the multipartite viruses) discriminates virus species. Additional criteria include the absence of reassortments between RNA1 and RNA2 (for viruses with bipartite genome), the absence of cross-protection, differences in antigenic reactions and distinct host ranges and vector specificities (Le Gall et al., 2007).

The SDV species contains a number of so-called SDV-related viruses (SDV-RV) (Iwanami et al., 2001) including CiMV, NIMV, NDV (Tanaka and Yamada, 1972) and HV (Ito et al., 2004), sharing over 75% amino acid sequence identity with SDV (Iwanami et al., 1999; Le Gall et al., 2007; Iwanami, 2010).

3.1.4. Detection and identification of the pest

Are detection and identification methods available for the pest? **YES**

As their names suggest, SDV and SDV-related viruses are associated with specific diseases of citrus. However, field symptoms are variable and may resemble those caused by other viruses such as severe strains of *Citrus tristeza virus* (CTV), (Koizumi et al., 1989; Zhou et al., 1996) or *Citrus infectious variegation virus* (CIVV) and *Citrus tatter leaf virus* (CTLV), (Roistacher, 2004). Therefore, symptoms observation does not represent a reliable diagnostic method. Graft transmission to specific indicator hosts, such as Natsudaidai, citron, sour lemon, Dweet tangor, mandarin or satsuma seedlings, may be used; however, there is the need to first eliminate any CTV isolate possibly present by graft inoculation of trifoliate orange seedlings (Roistacher, 2004), as CTV presence may otherwise interfere with the assay. Biological indexing includes also transmission to herbaceous hosts such as blackeye cowpea and satisfaction kidney bean (Tanaka and Kishi, 1963); however, white sesame is considered the most suitable herbaceous host (Kishi and Tanaka, 1964; Roistacher, 2004).

Currently, enzyme-linked immunosorbent assay (ELISA) or polymerase chain reaction (PCR) assays are commonly used for diagnosis of SDV. ELISA tests have been used for large-scale surveys of SDV in Japan (Kuhara et al., 1981). All SDV isolates can be detected by ELISA; however, most of NiMV and some SDV, CiMV, NDV isolates react poorly with SDV antisera. An immunochromatographic assay (ICA) has also been developed using an SDV antiserum, but does not detect NiMV (Kusano et al. 2007). Once the complete nucleotide sequences of the RNA 2 genome component of SDV, CiMV, NDV and NIMV became available (Iwanami et al., 1999), PCR protocols were developed (Shimizu et al., 2012). Multiplex PCR (Hyun et al., 2017) and a QuantiGene Plex-Luminex-based assay (Dang et al., 2016) were recently developed to detect SDV in combination with other citrus viruses and viroids.

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

Satsuma dwarf virus is reported from Japan, China, Korea, Iran and Turkey (see Table 2 and Figure 1) (EPPO, 2017). There is one report outside Asia, in Peru (IOCV website, 2017)[4]; however, this report is not confirmed in a later review on SDV written by the same author (Iwanami, 2010).

Table 2: Global distribution of *Satsuma dwarf virus* (extracted from EPPO Global Database, accessed 28 September 2017) with the addition of an unconfirmed report from Peru (IOCV web site, 2017)

Continent	Country	Status	References
Asia	China (Sichuan, Zhejiang)	Present, no details	
Asia	Korea (Korea Democratic People's Republic)	Present, no details	
Asia	Korea (Korea Republic)	Present, restricted distribution	
Asia	Iran	Present, no details	
Asia	Japan (Honshu, Kyushu, Shikolu)	Present, widespread	
S. America	Peru	Presence reported, but not confirmed	IOCV web site, 2017[4]
Non-EU Europe	Turkey	Present, restricted distribution	

[4] International Organization of Citrus Virologists, 2017. Available online: http://iocv.org/

Last updated: 2017-09-13

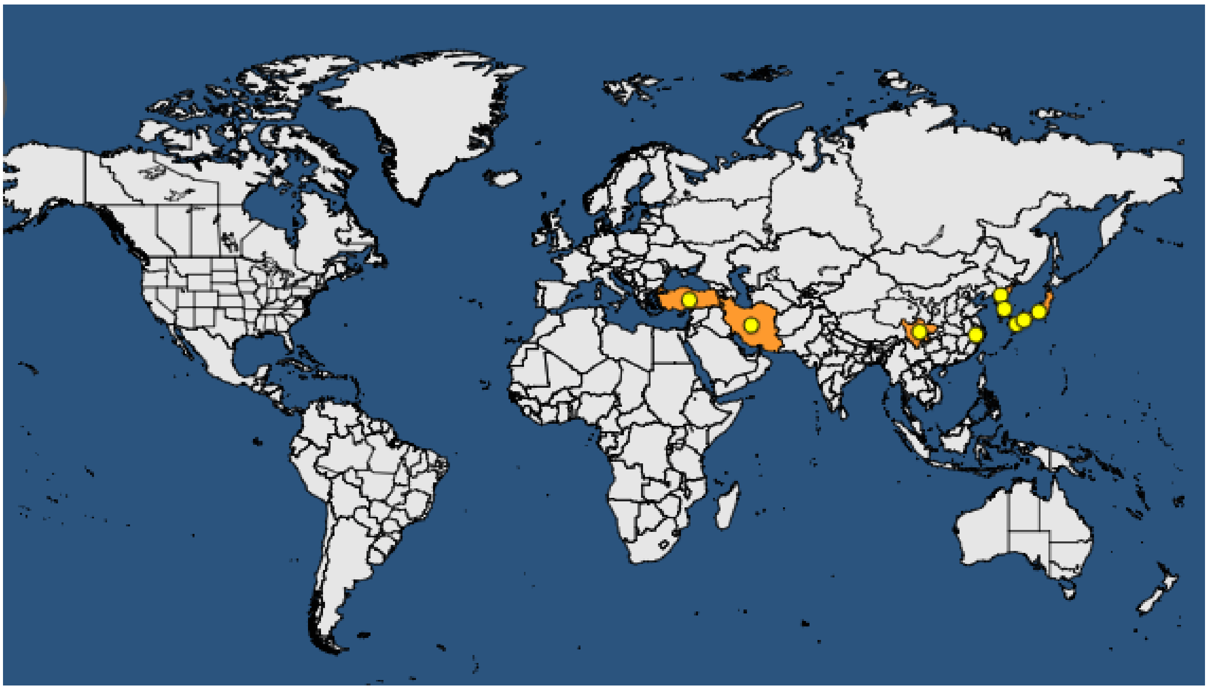

Figure 1: Global distribution of *Satsuma dwarf virus* (extracted from EPPO Global Database, accessed September 28, 2017)

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?

NO, SDV is not known to be present in the EU.

Satsuma dwarf virus is not known to occur in the EU and therefore does not fulfil this criterion to qualify as a Union RNQP.

3.3. Regulatory status

3.3.1. Council Directive 2000/29/EC

Satsuma dwarf virus is listed in Council Directive 2000/29/EC. Details are presented in Tables 3 and 4.

Table 3: *Satsuma dwarf 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
13.	Satsuma dwarf 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 *Satsuma dwarf virus* is regulated

Table 4: Regulated hosts and commodities that may involve *Satsuma dwarf virus* 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
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 **Part B**	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 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.....

3.4. Entry, establishment and spread in the EU

3.4.1. Host range

The natural host range of SDV includes almost all of the citrus and citrus relatives (Rutaceae family). Assays to investigate the host range of SDV showed that all the tested species (*Fortunella polyandra, Clymenia polyandra, Microcitrus australis, Eremocitrus glauca, Atalantia monophylla, Severinia buxifolia, Feroniella lucida, Swinglea glutinosa* and *Aegle melos*) were susceptible (Iwanami et al., 1993). Similarly, Miyakawa (1969) found 18 species of citrus plus seven hybrids and species in two related genera to be susceptible when they were bud-inoculated, indicating that SDV is able to infect a broad range of rutaceous species. Other citrus relatives (*Citrus hassaku*, *Citrus latifolia, Citrus medica, Citrus reticulata x C. paradisi* cv. Orlando) may also be symptomlessly infected (EPPO, 2017).

China laurestine (*V. odoratissimum* var. awabuki), a tree used as a windbreak in satsuma orchards in Japan, and *D. teijsmannii* Zoll. ex Kurz a wild woody plant are the only known non-rutaceous hosts. They have been found naturally (and symptomlessly) infected (Koizumi et al., 1988; Nakazono-Nagaoka et al., 2014) and may play a significant role in SDV epidemiology.

Experimentally, SDV can be mechanically transmitted to a wide range of dicotyledonous herbaceous species belonging to at least eight families (Tanaka and Kishi, 1963; Kishi and Tanaka, 1964; Tanaka & Nakanishi, 1972; Usugi and Saito, 1977 – cited in Usugi and Saito, 1979). These experimental herbaceous hosts of SDV are however unlikely to have relevance for its epidemiology.

Uncertainties exist about the potential significance of rutaceous hosts other than *Citrus, Fortunella* and *Poncirus* (especially those used as ornamentals) and of the non-rutaceous ones (*V. odoratissimum* var. awabuki, *D. teijsmannii*) for SDV dissemination and epidemiology.

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, SDV can enter via trade of non-regulated host plants

The most important pathway for entry is the trade of plants for planting. This pathway is closed for *Citrus*, *Fortunella* and *Poncirus* species and their hybrids by the existing Annex III legislation (see Section 3.3.2 and Table 4 above). As a consequence, the main entry pathway is the trade of plants for planting of non-regulated rutaceous (*Clymenia, Microcitrus, Eremocitrus, Atalantia, Severinia, Feroniella, Swinglea, Aegle,* see Section 3.4.1) and non-rutaceous hosts, *V. odoratissimum* var. awabuki (China laurestine) and *D. teijsmannii.* However, there are uncertainties on the origin and volume of the plants for planting imported in the EU for these non-regulated hosts.

Illegal entry of infected plants for planting of susceptible *Citrus*, *Fortunella* and *Poncirus* host species for commercial or for personal use may represent another low probability and/or high uncertainty pathway.

Between 1995 and 24 August 2017, there were no records of interception of SDV in the Europhyt database.

3.4.3. Establishment

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

YES, SDV does not have any ecoclimatic constraints other than those of its hosts and citrus species which are its major hosts, are widely grown in several EU southern MS

3.4.3.1. EU distribution of main host plants

Citrus spp. hosts of SDV are widely grown for citrus fruit production (oranges, mandarins, lemons, etc.) in eight MS in the Mediterranean part of the EU. In order of decreasing area of production, they are Spain, Italy, Greece, Portugal, Cyprus, Croatia, Malta and France (Table 5). In addition, plants of *Citrus*, *Fortunella* and *Poncirus* are grown as ornamentals, either in the open or under protected cultivation in a number of MS.

Table 5: 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]

Last update: 25.8.17.
n: not significant.

There are some uncertainties concerning the presence and distribution of other rutaceous hosts (species of *Clymenia, Microcitrus, Eremocitrus, Atalantia, Severinia, Feroniella, Swinglea, Aegle*) and of non-rutaceous hosts (*V. odoratissimum* var. awabuki, *D. teijsmannii*) in the EU territory.

3.4.3.2. Climatic conditions affecting establishment

There are no ecoclimatic constrains for SDV, except for those affecting its hosts. Therefore, SDV is expected to be able to establish in areas where its hosts are able to develop. Citrus cultivation occurs widely in the Mediterranean part of Europe (see EFSA PLH Panel, 2014), while ornamental rutaceous hosts may also grow in protected cultivation in more northern regions of the EU.

3.4.4. Spread

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

YES, with infected plants for planting of its hosts and, possibly, via soil transmission.

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

YES

3.4.4.1. Vectors and their distribution in the EU

The major means of SDV transmission is via the vegetative propagation of infected hosts. SDV spread in new areas and countries has been attributed to the use of uncertified planting materials (Roistacher, 2004). Subsequently, disease spreads slowly, possibly through soil. However, the mechanism(s) or the vector(s) have not been determined yet (see Section 3.1.2).

In Japan, from a single tree identified in 1933, the disease spread to 48 trees by 1953 and to 153 trees by 1965 (Izawa, 1966 cited in IOCV[4]). China laurestine very efficiently acquires SDV when planted in soil from SDV-infected fields, while its presence in citrus orchards markedly enhances virus spread (Koizumi et al., 1988).

Overall, should SDV be introduced in the EU, it is expected to spread through plants for planting. In the absence of precise information on the mechanism(s) of its slow natural spread, it is not possible to evaluate the efficiency of natural spread under EU conditions. Assuming that EU conditions are in this respect similar to those prevailing in Japan, a slow and relatively inefficient natural spread would be expected, but there are large uncertainties associated with this assessment.

3.5. Impacts

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

YES, SDV affects both the quality and yield of most of its citrus hosts

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

Satsuma mandarin trees infected with SDV show dwarfing and poor growth with characteristic boat-, or spoon-shaped leaves and shortened internodes, while the quality and yield of fruit decline significantly (Iwanami and Koizumi, 2000). Field infection rates as high as 31% have been reported in Turkey (Önelge and Çınar, 2010). The severity of symptoms is sometimes correlated with low temperature conditions (Kitajima et al., 1972). However, many citrus species may develop only transient symptoms (Miyakawa, 1969).

SDV-related viruses have been associated with a variety of symptoms: CiMV with dapples on rinds of satsuma mandarin fruits, NDV with mottling and curling of new leaves of *Citrus natsudaidai*, NIMV with chlorotic spots on navel oranges and HV with brown growth rings on Hyuganatsu (*Citrus tamurana*) (Ito et al., 2004).

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

Although there are no detailed reports on the yield losses associated with SDV, there is little uncertainty that introduction and spread of SDV would have an impact on EU citrus crops.

3.6. Availability and limits of mitigation measures

Are there measures available to prevent the entry into, establishment within or spread of the pest within the EU such that the risk becomes mitigated?

Yes, the plant for planting pathway is closed by legislation for *Citrus, Poncirus* and *Fortunella* but plants for planting of other rutaceous or non-rutaceous species, which are currently not regulated, could be targeted by an extension of the legislation

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 SDV spread through 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

- Transient symptoms developed in some citrus hosts
- Asymptomatic infection of the non-rutaceous hosts (*V. odoratissimum* var. awabuki, *D. teijsmannii*)
- Limited knowledge on the natural means of spread and, possibly, on the natural host range
- Systemic pathogen transmitted by vegetative multiplication practices.

3.6.2. Control methods

- Use of certified planting material
- Elimination of infected trees to reduce local inoculum

3.7. Uncertainty

- Uncertainties about the importance of the unregulated rutaceous (*Clymenia, Microcitrus, Eremocitrus, Atalantia, Severinia, Feroniella, Swinglea, Aegle*) and non-rutaceous (*V. odoratissimum* var. awabuki, *D. teijsmannii*) hosts for SDV dissemination and epidemiology.
- Uncertainties on the origin and trade volume of the plants for planting imported in the EU of the unregulated rutaceous and non-rutaceous hosts
- Uncertainties about the efficiency of natural spread of SDV under EU conditions

These uncertainties primarily affect two aspects of the present pest categorisation, the efficiency and extent to which SDV would be able to spread and the impact it would have should be introduced in the EU.

4. Conclusions

Satsuma dwarf virus meets all the criteria evaluated by EFSA to satisfy the definition of a Union quarantine pest and there is little uncertainty that, should it be introduced, it will have a negative impact on the EU citrus industry. It does not meet the criterion of being present in the EU to satisfy the definition of a Union RNQP (see Table 6).

Table 6: 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)	SDV is well characterised and reliable diagnostic techniques are available	SDV is well characterised and reliable diagnostic techniques are available	No uncertainty
Absence/presence of the pest in the EU territory (Section 3.2)	SDV is not known to be present in the EU	SDV is not known to be present in the EU and therefore does not meet this criterion to qualify as a Union RNQP	No uncertainty
Regulatory status (Section 3.3)	SDV is currently regulated on *Citrus, Fortunella* and *Poncirus* plants for planting	SDV is currently regulated on *Citrus, Fortunella* and *Poncirus* plants for planting	No uncertainty
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	SDV is able to enter, become established and spread within the EU. However, the main pathway (plants for planting of *Citrus, Fortunella* and *Poncirus*) is closed by existing legislation. Entry is therefore only possible with plants for planting of other rutaceous or non-rutaceous hosts, or on illegally imported regulated hosts	Plants for planting constitute the main means of spread over long distances	• Uncertainty about the importance of other rutaceous and non-rutaceous hosts for SDV dissemination and epidemiology • Uncertainties on the origin and trade volume of plants for planting imported in the EU of unregulated host species • Uncertainty about the efficiency of natural spread of SDV under EU conditions
Potential for consequences in the EU territory (Section 3.5)	Introduction and spread of SDV would have a negative impact on the EU citrus industry	Because of the negative impact of SDV, its presence on plants for planting of host species would have a negative impact on their intended use	Very limited uncertainty
Available measures (Section 3.6)	Use of certified planting material and elimination of infected trees to reduce local inoculum	Certification of planting material of susceptible hosts is by far the most efficient control method	Uncertainty about the importance of the unregulated rutaceous and non-rutaceous hosts for SDV dissemination and epidemiology
Conclusion on pest categorisation (Section 4)	SDV meets all the criteria evaluated by EFSA to qualify as a Union quarantine pest.	SDV does not meet the criterion of being present in the EU to satisfy the definition of a Union RNQP	
Aspects of assessment to focus on/scenarios to address in future if appropriate	The main knowledge gaps or uncertainties identified concern: • the importance of the unregulated rutaceous and of the non-rutaceous hosts for SDV dissemination and epidemiology. • the efficiency of natural spread of SDV under EU conditions • the origin and trade volume of the plants for planting imported in the EU of the unregulated rutaceous hosts and of the non-rutaceous ones		

References

Dang T, Ramirez B, Osman F, Bodaghi S and Vidalakis G, 2016. QuantiGene Plex: A non-PCR, high throughput, multiplex detection assay for citrus pathogens. Abstract of the 20th Conference of the International Organization of Citrus Virologists, Chongqing, China, iocv_journalcitruspathology_32500. Page 5.

EFSA PLH Panel (EFSA Panel on Plant Health), 2010. PLH Guidance on a harmonised framework for pest risk assessment and the identification and evaluation of pest risk management options by EFSA. EFSA Journal 2010;8(2):1495, 66 pp. https://doi.org/10.2903/j.efsa.2010.1495

EFSA PLH Panel (EFSA Panel on Plant Health), 2014. Scientific Opinion on the pest categorisation of Citrus tristeza virus. EFSA Journal 2014;12(12):3923, 32 pp. https://doi.org/10.2903/j.efsa.2014.3923

EPPO (European and Mediterranean Plant Protection Organization), 2017. EPPO Global Database. Available online: https://gd.eppo.int [Accessed: 28 September 2017]

FAO (Food and Agriculture Organization of the United Nations), 2004. ISPM (International Standards for Phytosanitary Measures) 21—Pest risk analysis of regulated non-quarantine pests. FAO, Rome, 30 pp. Available online: https://www.ippc.int/sites/default/files/documents//1323945746_ISPM_21_2004_En_2011-11-29_Refor.pdf

FAO (Food and Agriculture Organization of the United Nations), 2013. ISPM (International Standards for Phytosanitary Measures) 11—Pest risk analysis for quarantine pests. FAO, Rome, 36 pp. Available online: https://www.ippc.int/sites/default/files/documents/20140512/ispm_11_2013_en_2014-04-30_201405121523-494.65%20KB.pdf

Hyun JW, Hwang RY and Jung KE, 2017. Development of multiplex PCR for simultaneous detection of citrus viruses and the incidence of citrus viral diseases in late-maturity citrus trees in Jeju Island. The Plant Pathology Journal, 33, 307.

Ito T, Iwanami T, Ieki H, Shimomura K, Shimizu S and Ito T, 2004. A new virus related to *Satsuma dwarf virus*: nucleotide sequence of the 3′-terminal regions of Hyuganatsu virus RNAs 1 and 2. Archives of virology, 149, 1459–1465.

Iwanami T, 2010. Properties and control of *Satsuma dwarf virus*. Japan Agricultural Research Quarterly: JARQ, 44, 1–6.

Iwanami T, Omura M and Ieki H, 1993. Susceptibility of several citrus relatives to *Satsuma dwarf virus*. In: Moreno P, da Graca JV and Timmer LW (eds.). *Proc. 12th IOCV*, IOCV, Riverside, CA. pp. 352–356.

Iwanami T and Ieki H, 1996. Nucleotide sequence of the 3′-termimal region of RNA1 of *Satsuma dwarf virus*. Japanese Journal of Phytopathology, 62, 4–10.

Iwanami T, Kondo Y, Makita Y, Azeyanagi C and Ieki H, 1998. The nucleotide sequence of the coat protein genes of *Satsuma dwarf virus* and navel infectious mottling virus. Archives of Virology, 143, 405–412.

Iwanami T, Kondo Y and Karasev AV, 1999. Nucleotide sequences and taxonomy of *Satsuma dwarf virus*. Journal of General Virology, 80, 793–797.

Iwanami T and Koizumi M, 2000. Satsuma dwarf virus group. In: Timmer LV, Gansey SM and Graham JH (eds.). *Compendium of Citrus Diseases*, 2nd edition. APS, St. Paul, MN. pp. 59.

Iwanami T, Kondo Y, Kobayashi M, Han SS and Karasev AV, 2001. Sequence diversity and interrelationships among isolates of Satsuma dwarf-related viruses. Archives of Virology, 146, 807–813.

Izawa H, 1966. Investigation on withering disease of *Citrus unshiu* Marc. (in Gamagori district, Aichi Prefecture). Bulletin of Aichi Horticultural Experiment Station B, 5, 1–9.

Kishi K and Tanaka S, 1964. Studies on the indicator plants for citrus viruses. II. Mechanical transmission of the virus, causing satsuma dwarf, to sesame (*Sesamum indicum* L.) Ann. Phytopathologicial Society of Japan, 29, 142–148.

Kishi K, 1967. Studies on indicator plants for citrus viruses. IV On the properties of the sap transmissible virus associated with satsuma dwarf and some other virus-like disease. Bull Hortic Res Stn Min Agric Forest Hiratsuka Ser A, 6, 155–131.

Kitajima H, Tanaka H, Yamada S and Kishi K, 1972. Influence of temperature on the development of leaf symptoms of satsuma dwarf disease. IOCV Proceedings. pp. 76–79.

Koizumi M, Kano T, Ieki H and Mae H, 1988. China laurestine: a symptomless carrier of *Satsuma dwarf virus* which accelerates natural transmission in fields. In: Timmer LW, Garnsey SM and Navarro L (eds.). *Proc. 10th IOCV*. IOCV, Riverside, CA. pp. 348–352.

Koizumi M, Ieki H, Kano T, Kashiwazaki S, Tsuchizaki T, Kuhara S, Tanaka A and Yamaguchi A, 1989. Etiological factors in dwarfing of Kusumoto Wase, an early variety of satsuma mandarin. Bulletin of Aichi Horticultural Experiment Station B, 16, 67–91.

Kuhara S, Koizumi S, Yamada S and Yamaguchi A, 1981. A nation-wide campaign for certification of early satsuma 'Miyamoto Wase' for citrus mosaic by ELISA. In Proc. Intl. Soc. Citriculture, 1981. ISC Japan, Okitsu, Shimizu, Shizuoka, 1, 441–444.

Kusano N, Hirashima K, Kuwahara M, Narahara K, Imamura T, Mimori T, Nakahira K and Torii K, 2007. Immunochromatographic assay for simple and rapid detection of Satsuma dwarf virus and related viruses using monoclonal antibodies. Journal of General Plant Pathology, 73, 66–71.

Le Gall O, Sanfaçon H, Ikegami M, Jones T, Karasev A, Lehto K, Wellink J, Wetzel T and Yoshikawa N, 2007. Cheravirus and Sadwavirus: two unassigned genera of plant positive-sense sinle-stranded RNA viruses formerly considered atypical members of the genus Nepovirus (family Comoviridae). Archives of Virology, 152, 1767–1774.

Miyakawa T, 1969. Susceptibility of *Citrus* spp. and the other related plants to the *Satsuma Dwarf Virus* (SDV). Japanese Journal of Phytopathology, 35, 224–233.

Nakazono-Nagaoka E, Takemoto S, Fujikawa T, Nakajima K, Uenishi H and Iwanami T, 2014. Natural Satsuma dwarf virus infection of two woody plants, Daphniphyllum teijsmannii Zoll. ex Kurz. and Viburnum odoratissimum Ker-Gaul. var. awabuki (K. Koch) Zabel near Citrus Fields. Japan Agricultural Research Quarterly: JARQ, 48, 419–424.

Önelge N and Çınar A, 2010. Virus and virus-like diseases in turkey citriculture. In: *Proc. 20 th Conf. IOCV*. IOCV, Riverside, CA. pp. 233–236.

Roistacher CN, 2004. Diagnosis and management of virus and virus like diseases of citrus. *In Diseases of Fruits and Vegetables* Volume I. Springer, Netherlands. pp. 109–189.

Sanfaçon H, Wellink J, Le Gall O, Karasev A, Van der Vlugt R and Wetzel T, 2009. Secoviridae: a proposed family of plant viruses within the order Picornavirales that combines the families Sequiviridae and Comoviridae, the unassigned genera Cheravirus and Sadwavirus, and the proposed *genus Torradovirus*. Archives of Virology, 154, 899–907.

Shimizu S, 2012. A broad spectrum, one-step RT-PCR to detect Satsuma dwarf virus variants using universal primers targeting both segmented RNAs 1 and 2 (vol 77, pg 326, 2011). Journal of General Plant Pathology, 78, 145–145.

Tanaka S and Kishi K, 1963. Studies on indicator plants for citrus viruses. Mechanical inoculation on leguminous plants with sap from satsuma dwarf tree. Annals of the Phytopathological Society of Japan, 28, 262–269.

Tanaka H and Yamada S, 1972. Evidence for a relationship among the viruses of satsuma dwarf, citrus mosaic, navel infectious-mottling, Natsudaidai dwarf, citrus variegation and citrus crinkly leaf. In: *Proc. 5 th Conf. IOCV*. Univ. Fla. Press, Gainesville, FL. pp. 71–76.

Ushiyama K and Ogaki C, 1970. Studies on Satsuma dwarf virus disease. I. A survey in the Kana-gawa prefecture. Bulletin of the Horticultural Branch (Section). Kanagawa Agricultural Experiment Station, 18, 57–65.

Usugi T and Saito Y, 1977. Some properties of satsuma dwarf virus. Annual Phytopathology Society Japan, 43, 137–144.

Usugi T and Saito Y, 1979. Satsuma dwarf virus. CMI/AAB Descriptions of Plant Viruses, No. 208, 2–1.

Zhou C, Zhou X and Jiang Y, 1996. Boat-shaped leaf symptoms of satsuma mandarin associated with citrus tristeza virus (CTV). In: *Proc 13th conf. IOCV*. IOCV, Riverside. pp. 154–157.

Abbreviations

CiMV	*Citrus mosaic virus*
CIVV	*Citrus infectious variegation 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
HV	*Hyuganatsu virus*
ICA	immunochromatographic assay
IPPC	International Plant Protection Convention
PCR	polymerase chain reaction
PLH	EFSA Panel on Plant Health
NDV	*Natsudaidai dwarf virus*
NIMV	*Navel orange infectious mottling virus*
RNQP	regulated non-quarantine pest
SDV	*Satsuma dwarf virus*
ssRNA	single-stranded RNA
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference