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SCIENTIFIC OPINION

Scientific Opinion on the pest categorisation of Strawberry latent C virus[1]

EFSA Panel on Plant Health (PLH)[2,3]

European Food Safety Authority (EFSA), Parma, Italy

ABSTRACT

The Panel on Plant Health performed a pest categorisation of Strawberry latent C virus (SLCV) for the European Union (EU) territory. SLCV is defined only by symptoms in strawberry indicators. It has not been characterised, is not recognised as a valid species, and reliable detection assays are unavailable. SLCV is transmitted by vegetative multiplication of infected hosts and by *Chaetosiphon* aphid vectors. SLCV has been reported only from USA, Canada and Japan. It is listed in Annex IAI of Directive 2000/29/EC. It infects cultivated and wild strawberries, and there is no other information on its host range. SLCV is not expected to be affected by ecoclimatic conditions wherever its hosts are present, and has the potential to establish in large parts of the EU territory. SLCV can spread through the action of its widely distributed *C. fragaefolii* vector and through the movement of strawberry plants for planting. However, the existence of efficient and widely adopted certification systems for strawberry constitutes a very strong limitation to SLCV spread. Although latent in many strawberry varieties, SLCV can cause significant damage, in particular when in co-infection with other strawberry viruses. However, the importance and impact of SLCV have both essentially disappeared in North America, most probably as a result of modern practices including the systematic use of certified planting materials and the use of short crop cycles. Such practices are also widely used in the EU and have broadly reduced the impact of strawberry viruses. Overall, SLCV does not have the potential to be a quarantine pest or a regulated non-quarantine pest, because it does not fulfil the following pest categorisation criteria of the International Standards for Phytosanitary Measures (ISPM) No 11/21: clear identity of the pest (ISPM 11/21), presence in the PRA area (ISPM 21) and having a severe impact (ISPM 11).

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KEY WORDS

Strawberry latent C virus, *Nucleorhabdovirus*, *Chaetosiphon fragaefolii*, pest categorisation, quarantine pest, regulated non-quarantine pest

[1] On request from the European Commission, Question No EFSA-Q-2014-00285, adopted on 02 July 2014.

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[3] Acknowledgement: The Panel wishes to thank the members of the Working Group on Dir 2000/29 Viruses: Thierry Candresse, Stephan Winter, Wilhelm Jelkmann and Josef Špak for the preparatory work on this scientific opinion, and EFSA staff: Virág Kertész for the support provided to this scientific opinion.

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BACKGROUND AS PROVIDED BY THE EUROPEAN COMMISSION

The current European Union plant health regime is established by Council Directive 2000/29/EC 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, 10.7.2000, p. 1).

The Directive lays down, amongst others, the technical phytosanitary provisions to be met by plants and plant products 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, the list of harmful organisms whose introduction into or spread within the Union is prohibited and the control measures to be carried out at the outer border of the Union on arrival of plants and plant products.

The Commission is currently carrying out a revision of the regulatory status of organisms listed in the Annexes of Directive 2000/29/EC. This revision targets mainly organisms which are already locally present in the EU territory and that in many cases are regulated in the EU since a long time. Therefore it is considered to be appropriate to evaluate whether these organisms still deserve to remain regulated under Council Directive 2000/29/EC, or whether, if appropriate, they should be regulated in the context of the marketing of plant propagation material, or be deregulated. The revision of the regulatory status of these organisms is also in line with the outcome of the recent evaluation of the EU Plant Health Regime, which called for a modernisation of the system through more focus on prevention and better risk targeting (prioritisation).

In order to carry out this evaluation, a recent pest risk analysis is needed which takes into account the latest scientific and technical knowledge on these organisms, including data on their agronomic and environmental impact, as well as their present distribution in the EU territory. In this context, EFSA has already been asked to prepare risk assessments for some organisms listed in Annex IIAII. The current request concerns 23 additional organisms listed in Annex II, Part A, Section II as well as five organisms listed in Annex I, Part A, Section I, one listed in Annex I, Part A, Section II and nine organisms listed in Annex II, Part A, Section I of Council Directive 2000/29/EC. The organisms in question are the following:

Organisms listed in Annex II, Part A, Section II:

- *Ditylenchus destructor* Thome
- *Circulifer haematoceps*
- *Circulifer tenellus*
- *Helicoverpa armigera* (Hübner)
- *Radopholus similis* (Cobb) Thome (could be addressed together with the HAI organism *Radopholus citrophilus* Huettel Dickson and Kaplan)
- *Paysandisia archon* (Burmeister)
- *Clavibacter michiganensis* spp. *insidiosus* (McCulloch) Davis *et al.*
- *Erwinia amylovora* (Burr.) Winsl. *et al.* (also listed in Annex IIB)
- *Pseudomonas syringae* pv. *persicae* (Prunier *et al.*) Young *et al.*
- *Xanthomonas campestris* pv. *phaseoli* (Smith) Dye
- *Xanthomonas campestris* pv. *pruni* (Smith) Dye
- *Xylophilus ampelinus* (Panagopoulos) Willems *et al.*
- *Ceratocystis fimbriata* f. sp. *platani* Walter (also listed in Annex IIB)
- *Cryphonectria parasitica* (Murrill) Barr (also listed in Annex IIB)
- *Phoma tracheiphila* (Petri) Kanchaveli and Gikashvili
- *Verticillium albo-atrum* Reinke and Berthold
- *Verticillium dahliae* Klebahn
- *Beet leaf curl virus*
- *Citrus tristeza virus* (European isolates) (also listed in Annex IIB)
- Grapevine flavescence dorée MLO (also listed in Annex IIB)

- Potato stolbur mycoplasma
- *Spiroplasma citri* Saglio *et al.*
- *Tomato yellow leaf curl virus*

Organisms listed in Annex I, Part A, Section I:

- *Rhagoletis cingulata* (Loew)
- *Rhagoletis ribicola* Doane
- *Strawberry vein banding virus*
- Strawberry latent C virus
- Elm phloem necrosis mycoplasm

Organisms listed in Annex I, Part A, Section II:

- *Spodoptera littoralis* (Boisd.)

Organisms listed in Annex II, Part A, Section I:

- *Aculops fuchsiae* Keifer
- *Aonidiella citrina* Coquillet
- *Prunus necrotic ringspot virus*
- *Cherry leafroll virus*
- *Radopholus citrophilus* Huettel Dickson and Kaplan (could be addressed together with IIAII organism *Radopholus similis* (Cobb) Thome)
- *Scirtothrips dorsalis* Hendel
- *Atropellis* spp.
- *Eotetranychus lewisi* McGregor
- *Diaporthe vaccinii* Shaer.

TERMS OF REFERENCE AS PROVIDED BY THE EUROPEAN COMMISSION

EFSA is requested, pursuant to Article 29(1) and Article 22(5) of Regulation (EC) No 178/2002, to provide a pest risk assessment of *Ditylenchus destructor* Thome, *Circulifer haematoceps, Circulifer tenellus, Helicoverpa armigera* (Hübner), *Radopholus similis* (Cobb) Thome, *Paysandisia archon* (Burmeister), *Clavibacter michiganensis* spp. *insidiosus* (McCulloch) Davis *et al*, *Erwinia amylovora* (Burr.) Winsl. *et al, Pseudomonas syringae pv. persicae* (Prunier *et al.)* Young *et al. Xanthomonas campestris* pv. *phaseoli* (Smith) Dye, *Xanthomonas campestris* pv. *pruni* (Smith) Dye, *Xyîophilus ampelinus* (Panagopoulos) Willems *et al, Ceratocystis fimbriata* f. sp. *platani* Walter, *Cryphonectria parasitica* (Murrill) Barr, *Phoma tracheiphila* (Petri) Kanchaveli and Gikashvili, *Verticillium alboatrum* Reinke and Berthold, *Verticillium dahliae* Klebahn, *Beet leaf curl virus*, *Citrus tristeza virus* (European isolates), Grapevine flavescence dorée MLO, Potato stolbur mycoplasma, *Spiroplasma citri* Saglio *et al*, *Tomato yellow leaf curl virus*, *Rhagoletis cingulata* (Loew), *Rhagoletis ribicola* Doane, *Strawberry vein banding virus*, Strawberry latent C virus, Elm phloem necrosis mycoplasma, *Spodoptera littoralis* (Boisd.), *Aculops fuchsiae* Keifer, *Aonidiella citrina* Coquillet, *Prunus necrotic ringspot virus*, *Cherry leafroll virus*, *Radopholus citrophilus* Huettel Dickson and Kaplan (to address with the IIAII *Radopholus similis* (Cobb) Thome), *Scirtothrips dorsalis* Hendel, *Atropellis* spp., *Eotetranychus lewisi* McGregor *md Diaporthe vaccinii* Shaer., for the EU territory.

In line with the experience gained with the previous two batches of pest risk assessments of organisms listed in Annex II, Part A, Section II, requested to EFSA, and in order to further streamline the preparation of risk assessments for regulated pests, the work should be split in two stages, each with a specific output. EFSA is requested to prepare and deliver first a pest categorisation for each of these 38 regulated pests (step 1). Upon receipt and analysis of this output, the Commission will inform EFSA for which organisms it is necessary to complete the pest risk assessment, to identify risk reduction options and to provide an assessment of the effectiveness of current EU phytosanitary requirements (step 2). *Clavibacter michiganensis* spp. *michiganensis* (Smith) Davis *et al.* and *Xanthomonas campestris* pv. *vesicatoria* (Doidge) Dye, from the second batch of risk assessment requests for Annex IIAII organisms requested to EFSA (ARES(2012)880155), could be used as pilot cases for this approach, given that the working group for the preparation of their pest risk assessments has been constituted and it is currently dealing with the step 1 "pest categorisation". This proposed modification of previous request would allow a rapid delivery by EFSA by May 2014 of the first two outputs for step 1 "pest categorisation", that could be used as pilot case for this request and obtain a prompt feedback on its fitness for purpose from the risk manager's point of view.

As indicated in previous requests of risk assessments for regulated pests, in order to target its level of detail to the needs of the risk manager, and thereby to rationalise the resources used for their preparation and to speed up their delivery, for the preparation of the pest categorisations EFSA is requested, in order to define the potential for establishment, spread and impact in the risk assessment area, to concentrate in particular on the analysis of the present distribution of the organism in comparison with the distribution of the main hosts and on the analysis of the observed impacts of the organism in the risk assessment area.

ASSESSMENT

1. Introduction

1.1. Purpose

This document presents a pest categorisation prepared by the EFSA Scientific Panel on Plant Health (hereinafter referred to as the Panel) for the species Strawberry latent C virus (SLCV) in response to a request from the European Commission.

1.2. Scope

The pest risk assessment area is the territory of the European Union (hereinafter referred to as the EU) with 28 Member States (hereinafter referred to as EU MSs), restricted to the area of application of Council Directive 2000/29/EC, which excludes Ceuta and Melilla, the Canary Islands and the French overseas departments.

2. Methodology and data

2.1. Methodology

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

In accordance with the harmonised framework for pest risk assessment in the EU (EFSA PLH Panel, 2010), this work was initiated as result of the review or revision of phytosanitary policies and priorities. As explained in the background of the European Commission request, the objective of this mandate is to provide updated scientific advice to European risk managers to take into consideration when evaluating whether those organisms listed in the Annexes of Council Directive 2000/29/EC deserve to remain regulated under Council Directive 2000/29/EC, or whether they should be regulated in the context of the marketing of plant propagation material, or should be deregulated. Therefore, to facilitate the decision-making process, in the conclusions of the pest categorisation, the Panel addresses explicitly each criterion for a quarantine pest in accordance with ISPM 11 (FAO, 2013) but also for a regulated non-quarantine pest (RNQP) in accordance with ISPM 21 (FAO, 2004) and includes additional information required as per the specific terms of reference received by the European Commission. In addition, for each conclusion, the Panel provides a short description of its associated uncertainty.

Table 1 below presents the ISPM 11 (FAO, 2013) and ISPM 21 (FAO, 2004) pest categorisation criteria on which the Panel bases its conclusions. It should be noted that the Panel's conclusions are formulated respecting its remit and particularly with regards to the principle of separation between risk assessment and risk management (EFSA founding regulation[4]); 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, in agreement with EFSA guidance on a harmonised framework for pest risk assessment (EFSA PLH Panel, 2010).

[4] 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.

Table 1: ISPM 11 (FAO, 2013) and ISPM 21 (FAO, 2004) pest categorisation criteria under evaluation.

Pest categorisation criteria	ISPM 11 for being a potential quarantine pest	ISPM 21 for being a potential regulated non-quarantine pest
Identity of the pest	The identity of the pest should be clearly defined to ensure that the assessment is being performed on a distinct organism, and that biological and other information used in the assessment is relevant to the organism in question. If this is not possible because the causal agent of particular symptoms has not yet been fully identified, then it should have been shown to produce consistent symptoms and to be transmissible	The identity of the pest is clearly defined
Presence (ISPM 11) or absence (ISPM 21) in the PRA area	The pest should be **absent from all or a defined part of the PRA area**	The pest is **present** in the PRA area
Regulatory status	If the pest is present but not widely distributed in the PRA area, it should be under official control or expected to be under official control in the near future	The pest is under official control (or being considered for official control) in the PRA area with respect to the specified plants for planting
Potential for establishment and spread in the PRA area	The PRA area should have ecological/climatic conditions including those in protected conditions suitable for the establishment and spread of the pest and, where relevant, host species (or near relatives), alternate hosts and vectors should be present in the PRA area	–
Association of the pest with the plants for planting and the effect on their intended use	–	Plants for planting are a pathway for introduction and spread of this pest
Potential for consequences (including environmental consequences) in the PRA area	There should be clear indications that the pest is likely to have an unacceptable economic impact (including environmental impact) in the PRA area	–
Indication of impact(s) of the pest on the intended use of the plants for planting	–	The pest may cause severe economic impact on the intended use of the plants for planting
Conclusion	If it has been determined that the pest has the potential to be a quarantine pest, the PRA process should continue. If a pest does not fulfil all of the criteria for a quarantine pest, the PRA process for that pest may stop. In the absence of sufficient information, the uncertainties should be identified and the	If a pest does not fulfil all the criteria for an regulated non-quarantine pest, the PRA process may stop

Pest categorisation criteria	ISPM 11 for being a potential quarantine pest	ISPM 21 for being a potential regulated non-quarantine pest
	PRA process should continue	

In addition, in order to reply to the specific questions listed in the terms of reference, three issues are specifically discussed only for pests already present in the EU: the analysis of the present EU distribution of the organism in comparison with the EU distribution of the main hosts; the analysis of the observed impacts of the organism in the EU; and the pest control and cultural measures currently implemented in the EU.

The Panel will not indicate in its conclusions of the pest categorisation whether the pest risk assessment process should be continued, as it is clearly stated in the terms of reference that, at the end of the pest categorisation, the European Commission will indicate EFSA if further risk assessment work is required for the pest under scrutiny following its analysis of the Panel's scientific opinion.

2.2. Data

2.2.1. Literature search

A literature search on SLCV was conducted at the beginning of the mandate. The search was conducted for the scientific name of the pest together with the most frequently used common names on the ISI Web of Knowledge database. Further references and information were obtained from experts, from citations within the references as well as from grey literature.

2.2.2. Data collection

To complement the information concerning the current situation of the pest provided by the literature and online databases on pest distribution, damage and management, the PLH Panel sent a short questionnaire, on the current situation at country level based on the information available in the European and Mediterranean Plant Protection Organization Plant Quarantine Retrieval System (EPPO PQR), to the National Plant Protection Organisation (NPPO) contacts of all the EU MSs. A summary of the pest status based on EPPO PQR and MSs replies is presented in Table 2.

Information on the distribution of the main host plants was obtained from the EUROSTAT database.

3. Pest categorisation

3.1. Identity and biology of Strawberry latent C virus

3.1.1. Taxonomy

SLCV was probably first described by Harris and King (1942) from strawberry plants imported from the USA. It was better described and given the name SLCV by McGrew (1956) because no symptoms were observed in the strawberry varieties carrying it. SLCV is characterised by the specific differential symptomatology it causes in a range of strawberry indicators, distinguishing it from other strawberry-infecting viruses (McGrew, 1987). In particular, the absence of symptoms in non-sensitive indicators such as 'Alpine', 'UC-T', 'UC-4' or 'UC-6', but the observation of symptoms in susceptible indicators such as UC-5 or the 'East Malling' clone of *Fragaria vesca* ('EMC'), are considered diagnostic (Frazier, 1974; Martin and Tzanetakis, 2006, 2013). However, it is unclear whether this differential symptomatology always allows the unambiguous identification of SLCV, in particular in situations of mixed infection with other strawberry viruses, which might themselves induce symptoms in the SLCV non-sensitive indicators.

Besides the description of the symptoms it causes in strawberry indicators, SLCV has not been clearly identified or characterised. On the basis of electron microscope observation, it is suspected, with no direct proof, to be a plant-infecting *Rhabdovirus* with a nuclear tropism or *Nucleorhabdovirus*

(Yoshikawa et al., 1986). Mature particles of 68 × 190–380 nm with typical *Rhabdovirus* morphology were predominantly observed in the perinuclear space of cells from infected leaves, whereas immature particles and viroplasms were observed in the nuclei (Yoshikawa et al., 1986; Yoshikawa and Inouye, 1988). It should be stressed, however, that these observations were based on a limited number of SLCV sources and that the link between the *Rhabdovirus*-like particles observed and the symptoms caused by SLCV in indicator plants remains to be established.

As a consequence, the taxonomic status of SLCV remains highly uncertain and it is not currently recognised as a proper virus species by the International Committee for the Taxonomy of Viruses (King et al., 2012). In fact, there is a distinct possibility that SLCV might have been mistaken as a separate virus species, but it may only represent either a particular strain of a known strawberry virus or a complex of several strawberry viruses.

3.1.2. Biology of Strawberry latent C virus

There is very limited information on the biology of SLCV. It is a graft-transmissible agent (McGrew, 1956; Frazier, 1974) which, like other plant viruses, is transmitted through the vegetative multiplication of infected host plants. In addition, there is evidence that it is able to spread in the field (Fulton, 1960; Craig and Stultz, 1964) as a consequence of the activity of aphid vectors (Demaree and Marcus, 1951; Smith, 1952). Several *Chaetosiphon* species, including *C. fragaefolii* (Smith, 1952), *C. minor* and *C. thomasi* (Demaree and Marcus, 1951), have been reported to transmit SLCV. In the case of the last two species, there exists, however, conflicting data, since Rorie (1957) suggested that *C. minor* rarely, if at all, transmits SLCV and since some attempts to transmit SLCV with *C. jacobi* were not successful (unpublished results of N.W. Frazier; cited in McGrew, 1987).

The transmission parameter reported by Smith (1952), who found that *C. fragaefolii* requires more than one and fewer than six days to acquire SLCV and that infectivity of the aphids persisted for at least nine days, is comparable with those reported for *Strawberry crinkle virus* (SCV) (EFSA PLH Panel, 2014a) and is therefore compatible with the hypothesis that SLCV could be a *Nucleorhabdovirus*.

Besides the fact that it infects both strawberry and wild strawberry (*F. vesca*) (Frazier, 1974: Martin and Tzanetakis, 2006, 2013), there is no precise information on the host range of SLCV.

Thermotherapy alone or in combination with meristem tip culture has been shown to be at least partially effective for the elimination of SLCV and to allow the production of healthy plants from contaminated stocks (Bolton, 1967).

3.1.3. Intraspecific diversity

There is no clear information on the intraspecific variability of SLCV. Although some differences in the severity of the symptoms induced have been reported in the past, it is unclear whether these differences reflect true SLCV variability or whether they result from the presence of co-infecting viral agents in the SLCV sources compared (Converse, 1987; Martin and Tzanetakis, 2006).

3.1.4. Detection and identification of Strawberry latent C virus

Given that SLCV has not been characterised precisely, there is no currently available serological or molecular detection assay (Martin and Tzanetakis, 2006, 2013). SLCV can therefore be detected only by biological indexing (grafting) on a series of *F. vesca* indicators and by the observation of symptoms in susceptible indicators such as UC-5 or the 'East Malling' clone of *F. vesca* ('EMC'), accompanied by the absence of symptoms in non-sensitive indicators such as 'Alpine', 'UC-T, 'UC-4' or 'UC-6' (Frazier, 1974; Martin and Tzanetakis, 2006, 2013). However, it is unclear whether this differential indexing strategy always allows the unambiguous identification of SLCV, in particular in situations of mixed infection with other strawberry viruses.

3.2. Current distribution of Strawberry latent C virus

3.2.1. Global distribution of Strawberry latent C virus

SLCV has been reported only from north-eastern USA and Canada (Craig and Stultz, 1964; Bolton, 1967; Pisi, 1986), as well as from Japan. Indexing assays detected SLCV in the late 1970s in strawberry in Maryland, New Jersey, Iowa, Arkansas and Minnesota and failed to detect it in plants from North Carolina, Florida, Louisiana, California and Wisconsin (McGrew, 1987).

SLCV was reported to be one of the most common strawberry viruses in eastern Canada (Bolton, 1964); for example, the 'Premier' variety was fully infected with SLCV and a very high prevalence of SLCV (65–100 %) was also observed in the varieties 'Sparkle', 'Valentine' and 'Mackenzie' and in north-eastern USA. Remarkably, the SLCV status appears to have dramatically changed in the ensuing years, to the extent that Martin and Tzanetakis (2006) indicated 'there is not a reference isolate of SLCV available in North America to use for further characterization'. This very sharp decrease in prevalence has been accompanied by a parallel decrease in studies addressing this virus, with no original work published on SLCV since the early 1990s.

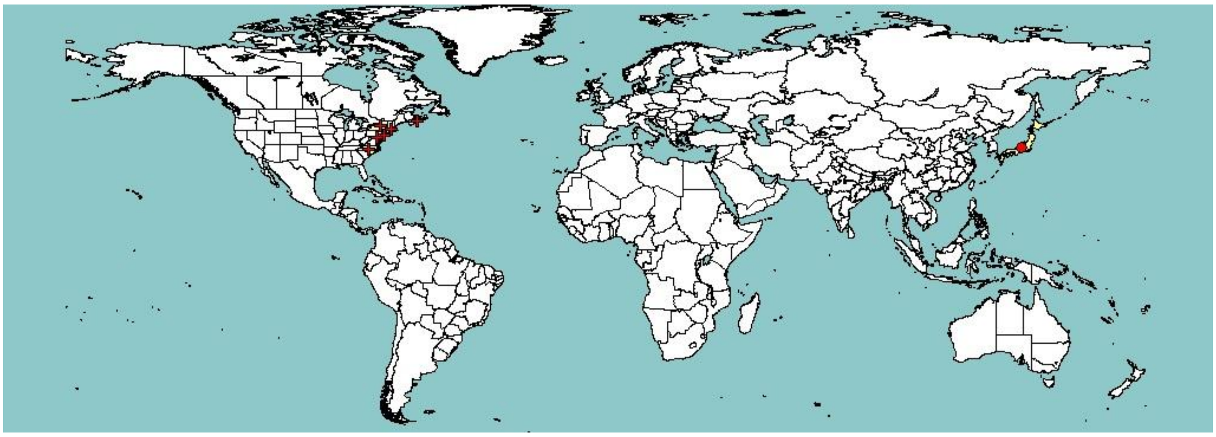

Figure 1: Global distribution map for Strawberry latent C virus (extracted from EPPO PQR, version 5.3.1, accessed in June 2014). Red circles represent pest presence as national records and red crosses represent pest presence as subnational records (note that this figure combines information from different dates, some of which could be out of date)

3.2.2. Distribution in the EU of Strawberry latent C virus

SLCV is not reported from the EU (Table 2). Limited indexing of cultivars from Germany, England, France, Poland and Italy has not detected SLCV (McGrew, 1987). However, given the absence of symptoms in many strawberry varieties and the absence of simple detection assays, any information on the geographical distribution of SLCV must be considered as carrying significant uncertainty.

There are no interception records for SLCV in the EUROPHYT database.

Table 2: Current distribution of Strawberry latent C virus in the risk assessment area, based on answers received from the 28 Member States, Iceland and Norway.

Member State	Strawberry latent C virus
Austria	**Absent**, no pest records
Belgium	**Absent**, no pest records
Bulgaria	**Absent**
Croatia	**Absent**, no pest records

Member State	Strawberry latent C virus
Cyprus	–
Czech Republic	–
Denmark	**Absent**, not known to occur
Estonia	No information is available
Finland	**Absent**, no pest records
France [(a)]	–
Germany	**Absent**, no pest records
Greece [(a)]	–
Hungary	**Absent**, no pest records
Ireland	**Absent**, no pest records
Italy	Never found; may be a strain of Srawberry crinkle virus
Latvia [(a)]	–
Lithuania [(a)]	–
Luxembourg [(a)]	–
Malta	**Absent**, no pest records
Netherlands	**Absent**, no pest records
Poland	**Absent**
Portugal	**Absent**, no pest records
Romania[(a)]	–
Slovakia	**Absent**, no pest records
Slovenia	**Absent**, no pest records
Spain	–
Sweden	**Absent**, not known to occur
United Kingdom	**Absent**
Iceland [(a)]	–
Norway [(a)]	–

(a): When no information was made available to EFSA, the pest status in the EPPO PQR (2012) was used.
–, No information available; EPPO PQR, European and Mediterranean Plant Protection Organization Plant Quarantine Data Retrieval system; NPPO, National Plant Protection Organisation.

3.2.3. Vectors and their distribution in the EU

C. fragaefolii is presumably of North American origin, but now occurs almost everywhere in the world where strawberries are cultivated (Blackman and Eastop, 2000). This wide distribution is confirmed, with some discrepancies, by several sources. According to CABI Crop Protection Compendium (CPC), it is present in Asia (Israel, Japan, the Philippines), North America (Canada, the USA), South America (Argentina, Bolivia), non-EU Europe (Macedonia, Serbia and Montenegro, Switzerland) and Oceania (Australia, New Zealand).

According to *Fauna Europaea*, it is present in the following non-EU European countries: Macedonia, Yugoslavia (Serbia, Kosovo, Vojvodina, Montenegro). Outside Europe it is present in the Afrotropical, Australian, East Palearctic, Nearctic and Neotropical regions, as well as in North Africa and the Near East. In addition, *C. fragaefolii* is reported to be present in 15 EU MSs (Table 3).

Table 3: Current distribution of the strawberry aphid *Chaetosiphon fragaefolii* in the risk assessment area, based on the Plantwise database, the CABI Crop Protection Compendium (CPC), the *Fauna Europaea* (data retrieved in January 2014) and Holman (2009).

Member State	Plantwise	CABI CPC	*Fauna Europaea*	Holman (2009)
Austria			Present	Present
Belgium	Present	Present, no further details	Present	
Bulgaria	Present	Widespread	Present	Present
Croatia				
Cyprus				
Czech Republic				Present
Denmark				
Estonia				
Finland				
France	Present	Present, no further details	Present	Present
Germany	Present	Widespread	Present	Present
Greece				
Hungary			Present	Present
Ireland			Present	Present
Italy	Present	Present, no further details	Present	Present
Latvia			Present	
Lithuania				
Luxembourg				
Malta				
Netherlands			Present	
Poland				
Portugal	Present	Restricted distribution	Present	Present
Romania			Present	
Slovakia				
Slovenia				
Spain	Present	Restricted distribution	Present	Present
Sweden				
United Kingdom	Present	Widespread	Present	Present
Iceland				
Norway			Present	Present

Much less information is available for the other potential vector species. *C. jacobi* is present in western USA (Blackman and Eastop, 2000), while *C. minor* is present in eastern North America, Venezuela, Japan, Korea and the Philippines (Blackman and Eastop, 2000).

3.3. Regulatory status

3.3.1. Legislation addressing Strawberry latent C virus (Directive 2000/29/EC)

SLCV is a regulated harmful organism in the EU and is listed in Council Directive 2000/29/EC in the following sections:

Table 4: Strawberry latent C virus in Council Directive 2000/29/EC.

Annex I, Part A	Harmful organisms whose introduction into, and spread within, all Member States shall be banned
Section I	Harmful organisms not known to occur in the community and relevant for the entire community
(d)	Viruses and virus-like organisms
5.	Viruses and virus-like organisms of … *Fragaria*…, such as:
(k)	Strawberry latent ‘C’ virus

3.3.2. Legislation addressing hosts of Strawberry latent C virus (Directive 2000/29/EC)

Table 5: Strawberry latent C virus host plants in 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	
18	Plants of [...] *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**
21.1.	Plants of *Fragaria* L. intended for planting, other than seeds, originating in countries where the relevant harmful organisms are known to occur The relevant harmful organisms are: Strawberry latent ‘C’ virus	Without prejudice to the provisions applicable to the plants listed in Annex III(A)(18), and Annex IV(A)(I)(19.2), official statement that: (a) the plants, other than those raised from seed, have been: — either officially certified under a certification scheme requiring them to bederived in direct line from material which has been maintained under appropriate conditions and subjected to official testing for at least the relevant harmful organisms using appropriate indicators or equivalent methods and has been found free, in these tests, from those harmful organisms, or — derived in direct line from material which is maintained under appropriate conditions and has been subjected, within the last three complete cycles of vegetation, at least once, to official testing for at least the relevant harmful organisms using appropriate indicators

		or equivalent methods and has been found free, in these tests, from those harmful organisms, (b) no symptoms of diseases caused by the relevant harmful organisms have been observed on plants at the place of production, or on susceptible plants in its immediate vicinity, since the beginning of the last complete cycle of vegetation.
Annex V	Plants, plant products and other objects which must be subject to a plant health inspection before being permitted to enter the Community	
Part A	Plants, plant products and other objects originating in the Community	
Section I	Plants, plant products and other objects which are potential carriers of harmful organisms of relevance for the entire Community and which must be accompanied by a plant passport	
2	Plants, plant products and other objects produced by producers whose production and sale is authorised to persons professionally engaged in plant production, other than those plants, plant products and other objects which are prepared and ready for sale to the final consumer, and for which it is ensured by the responsible official bodies of the Member States, that the production thereof is clearly separate from that of other products.	
2.1.	2.1. Plants intended for planting other than seeds of the genera [...] *Fragaria* L.,…;	

3.3.3. Legislation addressing the hosts in the Marketing directives

Fragaria, the host of SLCV, is regulated also under Marketing directives of the EU.

Table 6: Strawberry latent C virus host plants in EU Marketing Directives.

Plant propagation material	Marketing directive	Comment
Fragaria L.;	COUNCIL DIRECTIVE 2008/90/EC of 29 September 2008 on the marketing of fruit plant propagating material and fruit plants intended for fruit production (OJ L 267, 08/10/2008, p. 8–22)	Official inspections check if the material meets criteria for: Identity; Quality; Plant health; The rules also cover batch separation & marking, identification of varieties and labelling.

3.4. Elements to assess the potential for establishment and spread in the EU

3.4.1. Host range

Besides the fact that SLCV infects both strawberry and wild strawberry (*F. vesca*), there is no precise information on the host range of SLCV.

3.4.2. EU distribution of main host plants

Strawberry plants are widely grown both in the field and under protected cultivation in a wide range of EU MSs (Table 7). In addition, the wild strawberry (*F. vesca*), which is susceptible, has a widespread distribution in the EU (Table 7).

Table 7: Area of strawberry production in EU-28 in 2012 according to the Eurostat database (crops products—annual data [apro_cpp_crop] extracted on 23 January 2014), and the distribution of *Fragaria vesca* in the EU-28 according to *Flora Europaea*

Member State	Area of strawberry production (ha)	Strawberries under glass or high accessible cover (ha)	Presence of *Fragaria vesca*
Austria	1 300	0	+
Belgium	1 600	–	+
Bulgaria	700	0	+
Croatia	200	100	+ (a)
Cyprus	0	–	
Czech Republic	500	–	+
Denmark	1 100	–	+
Estonia	400	0	+
Finland	3 400	0	+
France	3 200	1 600	+
Germany	15 000	400	+
Greece	1 100	1 100	+
Hungary	600	–	+
Ireland	500	0	+
Italy	2 000(b)	2 700(b)	+
Latvia	300	0	+
Lithuania	1 000	0	+
Luxembourg	0	–	
Malta	0	–	+
Netherlands	1 800	300	+
Poland	50 600	100	+
Portugal	500	100	+
Romania	2 300	0	+
Slovakia	200	–	+
Slovenia	0	0	+ (a)
Spain	7 600	7 400	+
Sweden	2 200	0	+
United Kingdom	5 000	0	+
EU-28	103 000	–	

(a): Presence interpreted from the presence in Yugoslavia.
(b): Inconsistent figures as total strawberry area is lower than glasshouse area
–, No data available in Eurostat.

3.4.3. Analysis of the potential distribution of Strawberry latent C virus in the EU

As for other plant viruses, SLCV is not expected to be significantly affected by local ecoclimatic conditions as long as these are suitable for the development of its strawberry host plants. Given the wide distribution of strawberry crops and of wild strawberry (*F. vesca*) populations in Europe, it can be considered that SLCV has the potential to establish over large parts of the EU territory.

3.4.4. Spread capacity

SLCV has the potential to spread both through the activity of its aphid vectors and through the movement of strawberry plants for planting.

Assuming that SLCV is a *Nucleorhabdovirus* with transmission properties comparable (Smith, 1952; EFSA PLH Panel, 2014a) to those of SCV (a *Cytorhabdovirus*), the possibility that vector-mediated transmission could be blocked or could be efficient for only part of the year in areas where a threshold temperature is not reached (EFSA PLH Panel, 2014a) has to be considered. However, reports of SLCV natural spread in northern USA and Canada (Craig and Stultz, 1964) suggest that vector-mediated spread is unlikely to be affected by climatic conditions over vast parts of the EU territory.

The existence of efficient and widely adopted voluntary certification systems for strawberry constitutes a very strong limitation to the spread of SLCV and of other strawberry viruses through the plants for planting pathway (EFSA PLH Panel, 2013, 2014a, b). In this respect, the very sharp reduction in SLCV prevalence in North America over the past 50 years (Martin and Tzanetakis, 2006) appears to validate the prediction of McGrew (1987) that '*The production of cultivar clones free of SLCV and moderate care in isolation of seedling, selection, and nursery blocks from known sources, followed by continued replacement of certified fruiting-field stocks, should result in the disappearance of this disease*'.

3.5. Elements to assess the potential for consequences in the EU

3.5.1. Potential effects of Strawberry latent C virus

A wide range of effects have been attributed to SLCV, although it is difficult to rule out the possibility that some of the isolates analysed may have been in co-infections with other viruses (Martin and Tzanetakis, 2006). Several reports indicate that SLCV alone does not cause symptoms or causes only limited symptoms in modern strawberry cultivars (Martin and Tzanetakis, 2013). This observation has indeed contributed to the naming of SLCV.

However, some cultivars appear to express more or less severe symptoms. For example, SLCV alone had some effect on the yield of the 'Red coat' strawberry variety the first year after plantation (–8 %) and reduced fruit production considerably the second (–18 %) and third years after plantation (–24 %) (Bolton, 1974). It also decreased fruit size significantly (–18 %, –30 % and –55 % reduction in the proportion of fruits above 8 g in the first, second and third years after plantation, respectively). Moulton et al. (1958) observed strong differences in the number of runners per plot (reduced by 36–47 %) but much less in the yield (reduced by 3–9 %) between latent C-infected and virus-free 'Catskill' and 'Premier' plants. In the 'Jerseybelle' variety, SLCV alone reduced overall plant vigour by 29 %, as estimated by plant dry weight (Kender and Smith, 1964).

In addition, as is frequently observed for strawberry viruses, symptoms of SLCV are exacerbated in situations of co-infection owing to synergistic effects with other strawberry viruses. For example, in the 'Jerseybelle' variety, SLCV in co-infection with SCV and/or *Strawberry mottle virus* (SMoV) reduced plant dry weight by 36–55 % compared with 29 % when in single infection (Kender and Smith, 1964). Similarly, the combination of *Strawberry vein banding virus* (SVBV) and SLCV reduced yield by 25–36 % the first fruiting year in the 'Redcoat', 'Catskill' and 'Sparkle' varieties and by 63–81 % in the third year (Bolton, 1974).

Symptoms in sensitive clones of *F. vesca* include severe epinasty of young leaflets followed by moderate to severe dwarfing without epinasty, mottling or distortion (McGrew, 1987). Runner production is reduced and the plants often form a many-branched crown with severe to moderate reduction in petiole length (McGrew, 1970; cited in Pisi, 1986).

Overall, despite a significant damage potential, particularly when in co-infection with other strawberry viruses, it appears that the importance and impact of SLCV have almost completely disappeared in North America. This is most probably a consequence of modern strawberry cultural practices, including the systematic use of certified plants for planting and the use of short rotation cycles which limit the build-up of infected materials. Such strategies are also widely used in the EU and have widely contributed to the general reduction of the impact of strawberry-infecting viruses, as illustrated in a recent industry hearing and in EFSA opinions addressing such agents (EFSA, 2014; EFSA PLH Panel, 2013, 2014a, b).

There are no identified environmental consequences of SLCV infection.

3.5.2. Observed impact of Strawberry latent C virus in the EU

Given the absence of reports of SLCV from the EU, there is no observed impact of SLCV in the EU.

3.6. Uncertainty

The main uncertainty concerns the strong doubts about the precise identity of SLCV which, as indicated above, may not represent a separate virus species but may be either a strain of a known strawberry virus or a complex of strawberry viruses.

There are also important uncertainties when it comes to the biology of SLCV, because, in many cases, the isolates analysed in old literature reports may have been in co-infections with other viruses (Martin and Tzanetakis, 2006) or may have been misidentified.

The absence of reliable detection assays of symptoms in many strawberry varieties and of any recent research efforts introduce significant uncertainties when it comes to SLCV distribution.

Conclusions

The Panel summarises in the table below (Table 8) its conclusions on the key elements addressed in this scientific opinion in consideration of the pest categorisation criteria defined in ISPM 11 and ISPM 21 and of the additional questions formulated in the terms of reference.

Table 8: Panel's conclusions on the pest categorisation criteria defined in the International standards for Phytosanitary measures No 11 and No 21 and on the additional questions formulated in the terms of reference.

Criterion of pest categorisation	**Panel's conclusions against ISPM 11 criterion Yes/No**	**Panel's conclusions against ISPM 21 criterion Yes/No**	**List of main uncertainties**
Identity of the pest	*Is the identity of the pest clearly defined? Do clearly discriminative detection methods exist for the pest?* **No**, the pest does not satisfy this criterion. SLCV has not been characterised and its taxonomy remains highly uncertain. It is a graft-transmissible agent. No serological or molecular detection tests are available and it is unclear whether biological indexing allows reliable detection of SLCV, in particular under some mixed infection scenarios.		There are uncertainties regarding the identity of SLCV and the ability to detect it efficiently.
Absence (ISPM 11) or presence (ISPM 21) of the pest in the PRA area	*Is the pest absent from all or a defined part of the PRA area?* **Yes**, the pest satisfies this criterion. SLCV has not been reported to be present in the EU.	*Is the pest present in the PRA area?* **No**, the pest does not satisfy this criterion. SLCV has not been reported to be present in the EU.	There is uncertainty concerning the distribution because SLCV gives asymptomatic infection in a range of strawberry cultivar and because no simple detection assays are available.
Regulatory status	*In consideration that the pest under scrutiny is already regulated just mention in which annexes of 2000/29/EC and the marketing directives the pest and associated hosts are listed without further analysis. (the RM will have to consider the relevance of the regulation against official control)* SLCV is listed in Annex IA of Directive 2000/29EC.		–

Potential establishment and spread	*Does the PRA area have ecological conditions (including climate and those in protected conditions) suitable for the establishment and spread of the pest?* *And, where relevant, are host species (or near relatives), alternate hosts and vectors present in the PRA area?* **Yes**, the pest satisfies this criterion. Strawberry and wild strawberry are widely present in the EU and SLCV is unlikely to be affected by EU ecoclimatic conditions. The C. *fragaefolii* vector is widely present in the EU and SLCV can efficiently spread through the uncontrolled movement of infected plants for planting.	*Are plants for planting a pathway for introduction and spread of the pest?* **Yes**, the pest satisfies this criterion. SLCV is graft-transmissible and transmitted by vegetative propagation of infected host plants.	Uncertainties concern mainly the efficiency and the parameters of the aphid transmission process and the potential impact of EU ecoclimatic conditions on it.
Potential for consequences in the PRA area	*What are the potential for consequences in the PRA area?* *Provide a summary of impact in terms of yield and quality losses and environmental consequences.* The potential impact is significant, in particular in case of mixed infection with other strawberry viruses. However, modern practices including the use of certified planting materials and short cropping cycles strongly limit impact in practice and have, for example, completely abolished impact in north America. No SLCV environmental impact is identified.	*If applicable is there indication of impact(s) of the pest as a result of the intended use of the plants for planting?* The potential impact is significant, in particular in the case of mixed infection with other strawberry viruses. However modern practices including the use of certified planting materials and short cropping cycles strongly limit impact in practice and have, for example, completely abolished impact in north America. No SLCV environmental impact is identified.	Uncertainties mostly concern the impact of SLCV in the most recent strawberry varieties.
Conclusion on pest categorisation	**SLCV does not have the potential to be a quarantine pest** as it does not fulfil the ISPM 11 criteria for a clear identity of the pest and, given the current agricultural practices, for having an severe impact.	**SLCV does not have the potential to be a regulated non quarantine pest** as it does not fulfil the ISPM 21 criteria for a clear identity of the pest, and for presence in the PRA area.	Overall uncertainty on these criteria is limited.

REFERENCES

Blackman RL and Eastop VF, 2000. Aphids on the world's crops: an identification and information guide. 2nd edn. John Wiley & Sons, New York, USA, 324 pp.

Bolton AT, 1964. Virus diseases of strawberries in eastern Canada. Canadian Plant Disease Survey, 44, 83–90.

Bolton AT, 1967. The inactivation of veinbanding and latent C viruses in strawberries by heat treatment. Canadian Journal of Plant Science, 47, 375–380.

Bolton AT, 1974. Effects of three virus diseases and their combinations on fruit yield of strawberries. Canadian Journal of Plant Science, 54, 271–275.

Converse RH, 1987. Virus diseases of small fruits. United States Department of Agriculture, Agricultural Research Service, Washington, DC, USA, 277 pp.

Craig DL and Stultz HT, 1964. Aphid dissemination of strawberry viruses in Nova Scotia. Canadian Journal of Plant Science, 44, 235–239.

Demaree JP and Marcus CP, 1951. Virus diseases of strawberries in the United States with special reference to distribution, indexing and insect vectors in the East. Plant Disease Reporter, 35, 527–537.

EFSA (European Food Safety Authority), 2014. Technical Hearing with experts operating within the commercial cultivation and trade in strawberry and raspberry in the EU to assist evaluation of the risk of certain organism listed in Annex II, Part A, Section II of Council Directive 2000/29/EC. Supporting publication 2014: EN-546, 93 pp. Available online: www.efsa.europa.eu/publications

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. doi:10.2093/j.efsa.2010.1495

EFSA PLH Panel (EFSA Panel on Plant Health), 2013. Scientific opinion on the risk to plant health posed by Arabis mosaic virus, Raspberry ringspot virus, Strawberry latent ringspot virus and Tomato black ring virus to the EU territory with the identification and evaluation of risk reduction options. EFSA Journal 2013;11(10):3377, 22 pp. doi:10.2903/j.efsa.2013.3377

EFSA PLH Panel (EFSA Panel on Plant Health), 2014a. Scientific Opinion on the risk to plant health posed by Strawberry crinkle virus to the EU territory with the identification and evaluation of risk reduction options. EFSA Journal 2014;12(4):3630, 22 pp. doi:10.2903/j.efsa.2014.3630

EFSA PLH Panel (EFSA Panel on Plant Health), 2014b. Scientific Opinion on the risk to plant health posed by Strawberry mild yellow edge virus to the EU territory with the identification and evaluation of risk reduction options. EFSA Journal 2014;12(4):3629, 22 pp. doi:10.2903/j.efsa.2014.3629

EPPO (European and Mediterranean Plant Protection Organization) PQR (Plant Quarantine Data Retrieval System), 2012. EPPO database on quarantine pests. Available online: http://www.eppo.int

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

Frazier NW, 1974. 6 new strawberry indicator clones evaluated for the detection and diagnosis of 12 graft transmissible diseases. Plant Disease Reporter, 58, 28–31.

Fulton JP, 1960. Strawberry virus dissemination in Arkansas. Phytopathology, 50, 477–479.

Harris RV and King ME, 1942. Studies in strawberry diseases. V. The use of Fragaria vesca L. as an indicator of yellow-edge and crinkle. The Journal of Pomology and Horticultural Science, 19, 227–242.

Holman J, 2009. Host plant catalog of aphids: Palaearctic Region. Ed. Holman J. Springer, Ceské Budejovice, Czech Republic, 1140 pp.

Kender WJ and Smith CR, 1964. Effects of specific viruses, virus complexes, and nitrogen nutrition on the growth, mineral composition, and flowering of strawberry. Proceedings of the American Society for Horticultural Science, 84, 302–309.

King AMQ, Adams MJ, Carstens EB and Lefkowitz EJ, 2012. Virus taxonomy. Ninth report of the International Committee for the Taxonomy of Viruses. Eds King AMQ, Adams MJ, Carstens EB and Lefkowitz EJ. Elsevier, Oxford, UK, 23 pp.

McGrew JR, 1956. Analysis of viruses causing Demaree and Marcus type 1 and type 2 symptoms in Fragaria vesca. Plant Disease Reporter, 40, 173–175.

McGrew JR, 1987. Strawberry latent C. In: Virus diseases of small fruits. Ed. Converse RH. United States Department of Agriculture, Agricultural Research Service, Washington, DC, USA, 29–31.

Martin RR and Tzanetakis IE, 2006. Characterization and recent advances in detection of strawberry viruses. Plant Disease 90, 384–396.

Martin RR and Tzanetakis IE, 2013. High risk strawberry viruses by region in the United States and Canada: implications for certification, nurseries, and fruit production. Plant Disease, 97, 1358–1362.

Moulton JE, Fulton RH, Bell HK and Carlson RF, 1958. Comparison of virus-free stocks of strawberries with standard commercial plants. Michigan State University Agricultural Experiment Station Quarterly Bulletin, 40, 568–574.

Pisi A, 1986. Strawberry virus diseases. Bulletin OEPP, 16, 353–358.

Rorie FG, 1957. Resolution of certain strawberry viruses by the aphid vector *Capitophorus minor* Forbes. Plant Disease Reporter, 41, 683–689.

Smith HE, 1952. Aphid transmission of strawberry viruses from commercial plants to Fragaria vesca L. (East Mailing clone). Phytopathology, 42, 20.

Yoshikawa N and Inouye T, 1988. Strawberry viruses occurring in Japan. Acta Horticulturae, 236, 59–67.

Yoshikawa N, Inouye T, and Converse RH, 1986. Two types of Rhabdovirus in strawberry. Annals of the Phytopathological Society of Japan, 52, 437–444.

ABBREVIATIONS

EFSA:	European Food Safety Authority
EPPO:	European and Mediterranean Plant Protection Organization
EPPO-PQR:	European and Mediterranean Plant Protection Organization Plant Quarantine Retrieval System
EU:	European Union
FAO:	Food and Agriculture Organisation
ISPM:	International Standard for Phytosanitary Measures
MS(s):	Member State(s)
NPPO:	National Plant Protection Organisation
PLH Panel:	Plant Health Panel
RNQP:	Regulated Non Quarantine Pest
SLCV:	Strawberry latent C virus