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SCIENTIFIC OPINION

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[1]

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

European Food Safety Authority (EFSA), Parma, Italy

ABSTRACT

The Panel on Plant Health assessed the risk to plant health of *Strawberry crinkle virus* (SCV) for the European Union (EU) territory, and evaluated the current EU legislation and possible risk reduction options. This virus is widely distributed both within and outside Europe and the same applies to its main vector, the strawberry aphid, *Chaetosiphon fragaefolii.* At-risk hosts (*Fragaria* spp.) occur widely in Europe. Plants for planting were identified as the most significant entry pathway and the probability of entry is rated as unlikely to moderately likely with high uncertainty. The probability of establishment is rated as very likely with low uncertainty. The probability of local spread by natural means is moderately likely, with high uncertainty, whereas that of human-assisted long-distance spread is unlikely, with medium uncertainty. The potential consequences are rated as minimal to minor with medium uncertainty. Prohibition and restricting import or intra-EU trade to certified materials or to materials originating from pest-free areas or pest-free places of production are the options with highest effectiveness against the risks of introduction or against the risks of further spread. Prohibition and certification are also among the options of high or very high feasibility. In addition, it should be noted that the combination of options (cultural practices, certification, exclusion conditions, tolerant varieties) has an overall high to very high level of effectiveness and feasibility. The current legislation has few weaknesses: the reliance on visual inspection, as well as the exceptions or derogations offered to some countries in which SCV is present. If the current legislation were removed, no major consequences would be expected unless the industry simultaneously ceased its widely adopted certification activity, which seems unlikely given the potential consequences.

KEY WORDS

Strawberry crinkle virus, Cytorhabdovirus, Chaetosiphon fragaefolii, risk assessment, risk reduction options

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[2] Panel members: Richard Baker, Claude Bragard, Thierry Candresse, Gianni Gilioli, Jean-Claude Grégoire, Imre Holb, Michael John Jeger, Olia Evtimova Karadjova, Christer Magnusson, David Makowski, Charles Manceau, Maria Navajas, Trond Rafoss, Vittorio Rossi, Jan Schans, Gritta Schrader, Gregor Urek, Johan Coert van Lenteren, Irene Vloutoglou, Stephan Winter and Wopke van der Werf. Correspondence: alpha@efsa.europa.eu

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SUMMARY

Following a request from the European Commission (EC), the EFSA Panel on Plant Health (PLH) was asked to deliver a scientific opinion on the pest risk of *Strawberry crinkle virus (SCV)* for the European Union (EU) territory and to identify risk reduction options and evaluate their effectiveness in reducing the risk to plant health posed by the organism. In particular, the Panel was asked to provide an opinion on the effectiveness of the current EU requirements against this organism, which are laid down in Council Directive 2000/29/EC, in reducing the risk of introduction of the pest into, and its spread within, the EU territory.

The Panel conducted the pest risk assessment following the general principles of the 'Guidance on a harmonised framework for pest risk assessment and the identification and evaluation of pest risk management options' (EFSA PLH Panel, 2010) and of the 'Guidance on evaluation of risk reduction options' (EFSA PLH Panel, 2012). As SCV is already present in some EU Member States and has been regulated by the EU for many years, the Panel conducted the pest risk assessment taking into account the current EU plant health legislation.

After consideration of the evidence, the Panel reached the following conclusions:

With regard to the assessment of the risk to plant health of *Strawberry crinkle virus*, for the EU territory, this virus is currently established in the risk assessment area and in other strawberry-growing regions of the world. SCV has an aphid vector, the strawberry aphid (*Chaetosiphon fragaefolii*), which occurs widely in the risk assessment area and which has the potential to contribute to the local spread of SCV at least during the hottest period of the year in a large part of the risk assessment area. The major crops at risk, *Fragaria* spp., are cultivated throughout the EU.

Under the current phytosanitary measures, the conclusions of the pest risk assessment conducted by the Panel are as follows:

Entry

The Panel identified two pathways, plants for planting of *Fragaria* spp. (excluding seeds and pollen) and plant parts of host plants. Only the first pathway, considered as most significant, was evaluated in detail. The probability of entry - based on the most restrictive step of the entry process – was rated as **unlikely to moderately likely** with the associated uncertainty rated as high. SCV is present outside Europe and confirmed from many countries. Given that it does not always induce remarkable foliar symptoms, SCV presence could potentially be overlooked in some countries. The pathway of entry for strawberry, however, is regulated and exceptions or derogations exist for only a few countries. It can be assumed that strawberry planting material from most countries with an import exception/derogation is produced within certification schemes to ensure high product quality and virus freedom. Certification systems may not however be 100 % effective, as illustrated by recent outbreaks of strawberry decline in the US and Canada. Based on these factors, the association with the pathway at origin is estimated as unlikely to moderately likely. SCV in its hosts is very likely to survive transport and storage while the existing management procedures are expected to have only limited effects on the virus so that the survival of management procedures is rated as moderately likely. The probability of transfer to a suitable host is rated as very likely since, in the plants for planting pathway, the virus is present in a susceptible host that will be planted and grown for one or several seasons. The main uncertainties concern (1) the estimation of the exact quantities of plants for planting imported into Europe; (2) the distribution of the virus outside the EU and its association with imported plants; and (3) the efficiency of inspections of strawberry planting material consignments.

Establishment

The probability of establishment was rated as **very likely** with low uncertainty. SCV is already established in many EU Member States and the same applies to its main vector, *C. fragaefolii*. EU

ecoclimatic conditions are not expected to significantly affect SCV establishment wherever these conditions are suitable for its primary hosts, cultivated and wild strawberries. Currently used cultural practices and control measures are unlikely to significantly impede establishment. The associated uncertainty is low, as the presence of SCV in many EU Member States is confirmed and all environmental and biological preconditions for the virus to establish are met.

Spread

Local spread by natural means was rated as **moderately likely**. Susceptible host plants and an aphid vector are present in many EU Member States. Vector-mediated transmission is however not as efficient as for other strawberry viruses such as *Strawberry mild yellow edge virus* (SMYEV). Aphid-mediated transmission is unlikely to be completely inhibited by climatic factors in a wide range of EU Member States. It may be impacted in some areas by the effect of low temperatures on the duration of the virus latency period. The associated uncertainty is high, as there is limited knowledge on the size of vector populations. There is also no information on the potential impact of fluctuating temperatures (closer to real life conditions) on the length of the latency period of SCV in its vectors and thus on the extent to which climatic conditions may affect aphid-mediated transmission. Furthermore, there is lack of information on potential reservoirs in the uncultivated environment. Long-distance spread via human-assisted means is **unlikely,** since non-mandatory certification schemes in place efficiently prevent the dissemination of virus-infected planting material. The level of uncertainty is medium because of the lack of data on volumes of intra-EU trade of plants for planting and on virus incidence.

Consequences

Consequences were assessed as **minimal to minor** with medium uncertainty. SCV may cause significant losses in strawberry production but consequences are considered marginal by the industry (EFSA, 2014), with the possible exception of cases of mixed infections. The actual consequences of the disease are limited by several factors including (1) the existence of efficient and widely adopted certification systems for strawberry plants; and (2) the use of short cropping cycles in modern strawberry cultivation, limiting the incidence of infected plants and of virus spread by vectors. There are no identified environmental consequences. The associated uncertainty is medium, as there is limited precise recent information available on the actual damage caused by SCV.

With regard to risk reduction options, the Panel identified risk reduction options and evaluated their effectiveness and feasibility in reducing the risk of introduction, spread and the magnitude of consequences. It then evaluated the current phytosanitary measures against the introduction and spread of SCV listed in Council Directive 2000/29/EC, and explored the possible consequences if these measures were to be removed.

None of the risk reduction options explored was considered to have a very high effectiveness in reducing the risk of introduction. However, prohibition, certifications schemes or limiting imports to planting materials produced in pest free areas (PFAs) or pest-free production sites (PFPSs) provided that appropriate tests are used, were rated as having a high effectiveness. Their technical feasibility was rated as low to moderate (PFAs), moderate (PFPSs), high (prohibition) or very high (certification). The associated uncertainty was rated as low (certification) or medium (PFAs, PFPSs, prohibition). Concerning containment, no option was evaluated as having very high effectiveness and three options (certification, PFAs, PFPSs) were identified as being the most effective. In addition, it should be noted that the combination of options (cultural practices, use of tolerant varieties, certification, use of exclusion conditions) has an overall high to very high level of effectiveness in limiting consequences as well as a very high feasibility.

Given the restricted host range of SCV and the limited volume of imports of plants for planting, the current legislation appears to have few weaknesses. The Annex IIIA legislation is, however, analyzed as being considerably weakened by import exceptions or derogations offered to countries where SCV is reportedly present and, as in the case of the USA, sometimes widespread. Similarly, the Annex IVA

requirements are analyzed as being of little value given the limitations of visual inspections for the detection of SCV.

If the current regulation were to be removed, no major consequences are expected. This is largely owing to the important level of protection afforded to the industry by the efficient and widely used certification scheme for *Fragaria* spp., which is regarded by the Panel as reducing the risk of introduction, the risk of spread and the magnitude of consequences in a very significant way. The weaknesses identified in the current legislation (Annexes IIIA and IVA) also limit the consequences predicted if these measures were to be removed.

If, however, the current legislation were removed and the industry simultaneously ceased or reduced its non-mandatory certification activity, or excluded SCV from the list of organisms addressed, a return to a high prevalence of this virus in *Fragaria* would be expected.

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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.l).

The Directive lays down, amongst other things, 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.

Arabic mosaic virus, Tomato black ring virus, Rasberry ringspot virus, Strawberry latent ringspot virus, Strawberry crinkle virus, Strawberry mild yellow edge virus, *Daktulosphaira vitifoliae* (Fitch), *Eutetranychus orientalis* Klein, *Parasaissetia nigra* (Nietner), *Clavibacter michiganensis* spp. *michiganensis* (Smith) Davis *et al.*, *Xanthomonas campestris* pv. *vesicatoria* (Doidge) Dye, *Didymella ligulicola* (Baker, Dimock and Davis) v. Arx, and *Phytophthora fragariae* Hickmann var. *fragariae* are regulated harmful organisms in the EU. They are all listed in Annex II, Part A, Section II of Council Directive 2000/29/EC, which means that they are organisms known to occur in the EU and whose further introduction into and spread within the EU is banned if they are found present on certain plants or plant products.

Given the fact that these organisms are already locally present in the EU territory and that they are regulated in the EU for a long time, 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. In order to carry out this evaluation a pest risk analysis is needed which takes into account the latest scientific and technical knowledge of these organisms, including data on their agronomic and environmental impact, as well as their present distribution in the EU territory.

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).

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 Arabic mosaic virus, Tomato black ring virus, Rasberry ringspot virus, Strawberry latent ringspot virus, Strawberry crinkle virus, Strawberry mild yellow edge virus, *Daktulosphaira vitifoliae* (Fitch), *Eutetranychus orientalis* Klein, *Parasaissetia nigra* (Nietner), *Clavibacter michiganensis* spp. *michiganensis* (Smith) Davis *et al.*, *Xanthomonas campestris* pv. *vesicatoria* (Doidge) Dye, *Didymella ligulicola* (Baker, Dimock and Davis) v. Arx, and *Phytophthora fragariae* Hickmann var. *fragariae*, for the EU territory.

For each organism EFSA is asked to identify risk management options and to evaluate their effectiveness in reducing the risk to plant health posed by the organism. EFSA is also requested to provide an opinion on the effectiveness of the present EU requirements against those organisms, which are laid down in Council Directive 2000/29/EC, in reducing the risk of introduction of these pests into, and their spread within, the EU territory.

Even though a full risk assessment is requested for each organism, in order to target its level of detail to the needs of the risk manager, and thereby to rationalise the resources used for its preparation and to speed up its delivery, EFSA is requested to concentrate in particular on the analysis of the present spread of the organism in comparison with the endangered area, the analysis of the observed and potential impacts of the organism as well as the availability of effective and sustainable control methods.

ASSESSMENT

1. Introduction

1.1. Purpose

This document presents a pest risk assessment prepared by the Panel on Plant Health (PLH; hereinafter referred to as the Panel) for *Strawberry crinkle virus* (hereinafter referred to as SCV) in response to a request from the European Commission (EC). The scientific opinion includes the identification and evaluation of risk reduction options in terms of their effectiveness and technical feasibility in reducing the risk posed by the viruses mentioned above.

1.2. Scope

The scope of the opinion is to assess the risks posed by SCV to the risk assessment area and to identify and evaluate risk reduction options.

The Panel prepared its opinion taking into account the current European Union (EU) legislation and the existing industry certification systems for *Fragaria*.

The pest risk assessment area is the territory of the European Community (EU-28).

2. Methodology and data

For the purpose of this opinion, *Fragaria* should be understood as comprising all species of the plant genera. In some instances, the term strawberry is used when referring to *Fragaria* × *ananassa*.

2.1. Methodology

2.1.1. The guidance documents

The risk assessment was conducted in line with the principles described in the 'Guidance on a harmonised framework for pest risk assessment and the identification and evaluation of pest risk management options' (EFSA PLH Panel, 2010) and in the 'Guidance of the Scientific Committee on Transparency in the Scientific Aspects of Risk Assessments carried out by EFSA' (EFSA, 2009).

The detailed questions in the EFSA-adapted EPPO risk assessment scheme, presented in the former guidance document mentioned above, have been used as a checklist to ensure that all elements are included. However, as the terms of reference require the opinion to '*concentrate in particular on the analysis of the present spread of the organism in comparison with the endangered area, the analysis of the observed and potential impacts of the organism as well as the availability of effective and sustainable control methods*', the opinion provides only a limited assessment of entry and establishment.

The evaluation of risk reduction options was conducted in line with the principles described in the 'Guidance on a harmonised framework for pest risk assessment and the identification and evaluation of pest risk management options' (EFSA Panel on Plant Health, 2010), as well as with those in 'Guidance on methodology for evaluation of the effectiveness of options to reduce the risk of introduction and spread of organisms harmful to plant health in the EU territory' (EFSA PLH Panel, 2012).

In order to follow the principle of transparency, as described under Section 3.1 of the guidance document on the harmonised framework for pest risk assessment (EFSA Panel on Plant Health, 2010)—'*Transparency requires that the scoring system to be used is described in advance. This includes the number of ratings, the description of each rating … the Panel recognises the need for*

further development …'—the Plant Health Panel developed rating descriptors to provide clear justification when a rating is given, which are presented in Appendix A of this opinion.

2.1.2. Methods used for conducting the risk assessment

The pest categorization assesses all those characteristics of the pest observed outside the risk assessment area and useful to the completion of the pest risk assessment. The level of detail provided is therefore in accordance with the relevance of the information in assessing the risk of entry, establishment, spread and consequences of the pest in the risk assessment area. This should reduce repetitions and redundancies in the document.

Since SCV is already present in the EU territory and has been regulated for a long time (Annex IIAII of Council Directive 2000/29/EC[4]), the assessment of the probability of entry (Section 3.2) focuses on the potential for further entry of the organism into the risk assessment area, whereas the assessment of the probability of spread (Section 3.4) is conducted with regard to further spread of the organism within and between the EU Member States. The Panel took into account the existing legislation when conducting the pest risk assessment.

The conclusions for entry, establishment, spread and consequences are presented separately and the descriptors used to assign qualitative ratings are provided in Appendix A.

2.1.3. Methods used for evaluating the risk reduction options

The Panel identified potential risk reduction options and evaluated them with respect to their effectiveness and technical feasibility, i.e. consideration of technical aspects that influence their practical application. The sustainability of the options is considered based on the definition of 'sustainable agriculture' such as 'capable of being continued with minimal long-term effect on the environment/capable of being maintained at a steady level without exhausting natural resources or causing severe ecological damage'.[5] The evaluation of the efficiency of risk reduction options in terms of the potential cost-effectiveness of measures and their implementation is not within the scope of the Panel's evaluation.

The descriptors used to assign qualitative ratings for the evaluation of the effectiveness and technical feasibility of risk reduction options are provided in Appendix A.

2.1.4. Level of uncertainty

For the risk assessment conclusions on entry, establishment, spread and consequences and for the evaluation of the effectiveness of the risk reduction options, the levels of uncertainty have been rated separately.

The descriptors used to assign qualitative ratings to the level of uncertainty are provided in Appendix A.

2.2. Data

2.2.1. Literature search

An extensive literature search was performed on SCV at the beginning of the mandate, using the scientific name and the most often used synonyms and common names as key words. The literature search followed the first three steps (preparation of protocols and questions, search, selection of

[4] 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.

[5] Dictionary.com, "sustainable", in Collins English Dictionary—Complete and Unabridged 10th Edition. Source location: HarperCollins Publishers. http://dictionary.reference.com/browse/sustainable. Available online: http://dictionary.reference.com. Accessed 2 March 2013.

studies) of the EFSA guidance on systematic review methodologies (EFSA, 2010). Further references and information were obtained from experts and from citations within the references found.

2.2.2. Data collection

In seeking data and information concerning the current situation of the pathogen, its distribution, the damage caused to plants, as well as the management of the disease, the PLH Panel undertook the following actions:

1. The National Plant Protection Organization (NPPO) contacts of all the EU Member States were requested to confirm or update the current status of the organisms in their territory (contacted on 24 January 2013, with answers received until 21 March 2013). The NPPOs' replies are provided in Section 3.1.2.2.

2. A hearing of technical experts from the small fruit sector was organised in order to obtain data and information on the production, trade, propagation, certification and disease management in Europe of strawberry and raspberry plant propagation material. The meeting took place in Parma on 22 May 2013, and a technical report of the data and information received from the industry experts was prepared and published (EFSA, 2014).

3. For the evaluation of the probability of entry, the Europhyt database was consulted, searching for pest-specific notifications on interceptions. 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.

3. Pest risk assessment

3.1. Pest categorisation

3.1.1. Identity and biology of the pest

3.1.1.1. Taxonomy, detection and identification

SCV is the causal agent of the strawberry crinkle disease. It is a well characterized viral agent belonging to the genus *Cytorhabdovirus* in the *Rhabdoviridae* family. *Rhabdoviridae* are single-stranded RNA viruses with a negative genome polarity. Members of this family have been shown to infect vertebrates, insects or plants. SCV belongs to the genus *Cytorhabdovirus*, one of the two genera of plant-adapted rhabdoviruses which replicate in the cytoplasm of their host plants and in their insect vectors (Dietzgen et al., 2006). The genome of SCV has been completely sequenced (Schoen et al., 2001) and shown to be a single-stranded RNA of 14.5 kilobases encoding seven open reading frames in negative polarity. Bullet-shaped particles typical for rhabdoviruses have been observed by electron microscopy in cells of infected *Fragaria* spp. indicator plants (Richardson et al., 1972; Converse and Schaper, 1988; Jelkmann et al., 1988) or of viruliferous aphid vectors (Richardson et al., 1972). A diversity study (Klerks et al., 2004) revealed the existence of two clades of SCV isolates differing by 11 % nucleotide divergence in a small region of the viral polymerase. However, these sequence groups were not correlated to symptomatology or geographical origin of the isolates (Klerks et al., 2004).

Despite sequence variability of SCV isolates, robust assays are available for SCV detection. Antisera are not considered to provide sufficient sensitivity and specificity for detection of SCV (Schoen and Leone, 1995) but reverse transcription polymerase chain reaction (RT-PCR) (Posthuma et al., 2002; Klerks et al., 2004; Thompson and Jelkmann, 2004; Martin and Tzanetakis, 2013), real-time PCR (Botti and Cardoni, 2009) or TaqMan assays (Mumford et al., 2004) allow sensitive detection of SCV in strawberry and in aphid vectors. Sampling at proper times (i.e. avoiding the summer period, during which viral titers generally tend to be lower) and the use of appropriate buffers, reagents and protocols

to avoid the problems associated with inhibitory substances present in *Fragaria* spp. plants are crucial for reliable virus testing (Thompson et al., 2003). SCV can also be detected by index grafting and symptom assessment in susceptible indicator plants (King and Harris, 1942; Miller, 1951).

SCV can be eliminated from infected plants using either meristem tip culture (Miller and Belkengren, 1962, 1963) or combinations of chemotherapy, thermotherapy and meristem tip culture (Converse, 1987; Kondakova and Schuster, 1991).

3.1.1.2. Host range

SCV has a restricted host range and *Fragaria* spp. are the only known natural hosts (Posthuma et al., 2000), including wild *Fragaria* species such as *F. cuneifolia*, *F. chiloensis* (Zeller, 1934) and *F. vesca* (Harris and King, 1942; Miller, 1951). By approach grafting, it was possible to transmit SCV to *P. reptans* in which SCV could replicate albeit in latent infections (Yohalem et al., 2009), indicating that *P. reptans* constitutes a potential virus reservoir in nature. Similarly, when introduced by experimental injection into *Macrosiphum euphorbiae* or other aphid species, SCV was transferred, after a suitable latent period, to solanaceous hosts (Sylvester et al., 1987; Posthuma et al., 2000). This suggests that host preference of the insect determines, at least in part, the host range of the virus. Once transmitted to an experimental host, the virus could be propagated and transmitted by mechanical inoculation to further host plant species. The experimental host range of SCV includes *Physalis floridana*, *P. pubescens*, *P. ixocarpa* and some *Nicotiana* species such as *Nicotiana occidentalis*, *N. glutinosa*, *N. clevelandi* and *N. edwardsonii* (Sylvester et al., 1987; Sylvester and Richardson, 1990; Posthuma et al., 2000).

Like other plant-adapted rhabdoviruses, SCV also replicates in its insect vectors, *Chaetosiphon fragaefolii* Cockerell and *C. jacobi* Hille Ris Lamberts (Posthuma et al., 2000). When purified virion preparations were injected into non-vector aphid species, such as *Hyperomyzus lactucae* (L.), *Macrosiphon euphorbiae* Thomas, *Myzus ornatus* Laing, *Megoura viciae* Buckton and *Acyrthosiphon pisum* (Harris) (Sylvester and Richardson, 1981; Posthuma et al., 2000), virus replication was also observed.

3.1.1.3. Diseases and symptomatology

SCV is the causal agent of the crinkle disease of strawberry plants (Posthuma et al., 2000). Although there is very little recent information on the impact of the disease on strawberry production, SCV is considered as one of the four most economically important viruses in the main strawberry production areas of the world (Martin and Tzanetakis, 2006). There exists a great deal of variability in the level of damage caused by SCV, probably as a consequence of both viral variability and of differences in varietal susceptibility (Posthuma et al., 2000; Klerks et al., 2004; Botti and Cardoni, 2009). While some strawberry cultivars showed tolerance to SCV infections (Sylvester et al., 1976), there are no reports of resistance. Assessment of symptoms and impact of SCV in earlier publications is, however, complicated by the fact that the sanitary status of the plants used is frequently unclear, with the possible presence of other viruses in addition to SCV.

Foliar symptoms of SCV in sensitive cultivars are small, scattered, chlorotic or necrotic spots associated with veins and vein clearing. Leaflets are distorted and crinkled and unequal in size and shape (Anon, 1950; Converse, 1987). Symptoms are best visible in cooler seasons (autumn, winter and spring) and much less conspicuous during summer. Yield can be considerably reduced compared with healthy plants (Anon, 1950; Converse, 1987). In some varieties, such as Senga Sengana, Framura and Fratina, no clear foliar symptoms were observed but yield was nevertheless affected (Graichen et al., 1985).

Yield reduction can be very severe. For example, yield reduction in the varieties Moutot and Jukunda was 25-32 % the first year of plantation, 41-48 % the second and 61-64 % the third year (Babovic, 1971, 1976). In addition, fruit dry matter was reduced by 17 %, sugars reduced by 12–18 % and total acids increased by 14–15% (Babovic, 1969, 1976). Similarly, Graichen et al. (1985) reported yield

reductions of 12–28 % in the first year of plantation in the varieties Elvira, Gorella, Senga Sengana, Framura and Fratina, while the number of runners was reduced by up to 56 %.

SCV often occurs with other viruses in mixed infection, resulting in synergistic interactions, in particular with *Strawberry mottle virus* (SMoV), *Strawberry mild yellow edge virus* (SMYEV) or *Strawberry pallidosis virus* (SPaV). The resulting strawberry decline disease can then be particularly severe, impacting plant vigor and yield and frequently resulting in the death of some plants (Barritt and Loo, 1973; Martin and Tzanetakis, 2006; Martin, 2013).

3.1.1.4. Vector species and transmission

SCV is transmitted by the strawberry aphid *Chaetosiphon fragaefolii* (Cockerell) (Homoptera: Aphididae) (Vaughan, 1933; Engelbrecht, 1967; Krczal, 1980). All stages of *C. fragaefolii* (larvae, apterous and alatae adults) efficiently transmit SCV (Krczal, 1980). Although there is some variability in the transmission parameters reported in the literature, the mode of SCV transmission is circulative with virus replication in the insect vector. The virus/vector interaction is characterized by a relatively long acquisition period of a few hours (eight hours reported by Engelbrecht, 1967) and an exceptionally long latent period during which the virus translocates and replicates in the aphid vector. Significant differences in the length of this latent period, during which the aphid is unable to transmit the virus, are found in the literature ranging from 9–10 days (Prentice and Woollcombe, 1951, cited in Engelbrecht, 1967) to up to 59 days in *C. jacobi* (Frazier, 1968). This may be explained by the observation that the latent period increases at lower temperatures (Krczal and Merbecks, 1988). These authors showed that at 10 °C constant temperature, the latent period of SCV increased dramatically and was longer than the average aphidlife span, so that the aphids died before they could become viruliferous. It has been suggested that this may explain the limited impact of SCV in some of the cooler strawberry production areas (Martin and Tzanetakis, 2006). This hypothesis is however difficult to reconcile with recent reports of high SCV prevalence in other cool regions such as the US Pacific north-west (Martin et al., 2013).

Transmission of SCV by *C. fragaefolii* does not seem to be as efficient as the transmission of some other strawberry viruses such as SMYEV. Krczal (1980) did not observe any experimental transmission using 1 or 5 aphids per plant and needed to use 10 or more aphids per plant to observe limited rates of transmission (between 3 % and 28 %, using 10, 15 or 20 aphids per plant).

In addition to *C. fragaefolii*, the dark strawberry aphid, *C. jacobi*, is also able to transmit SCV, with similar transmission parameters ((Frazier, 1968; Getz et al., 1982). In contrast, a report that SCV could be transmitted by the strawberry root aphid, *Cerosipha forbesi* (Babovic, 1965) has never been confirmed and transmission by this aphid is therefore considered unlikely (Sylvester and Richardson, 1990).

Experimental mechanical transmission of viruses to strawberry plants is notoriously difficult (Converse, 1987). SCV could not be transmitted from strawberry to experimental herbaceous hosts by mechanical inoculation (Posthuma et al., 2000). However, SCV can be experimentally transmitted by mechanical inoculation between some experimental solanaceous hosts (Hunter et al., 1990; Klerks et al., 2004).

SCV can be transmitted by grafting to indicator plants, a routine indexing method used for virus detection in strawberry plants (Harris and King, 1942). However, this process is not likely to be relevant for SCV spread under field conditions. SCV is transmitted by vegetative propagation of infected hosts, resulting in the production of infected daughter plants. SCV is not reported to be transmitted by seed or pollen.

3.1.2. Current distribution

3.1.2.1. Global distribution of SCV

SCV is reported from all five continents (Figure 1). In the USA, SCV was detected in all production areas, except for the north-eastern region, at rates of between 1.6 % (south-east) and 36.6 % (Pacific north-west) (Martin and Tzanetakis, 2013).

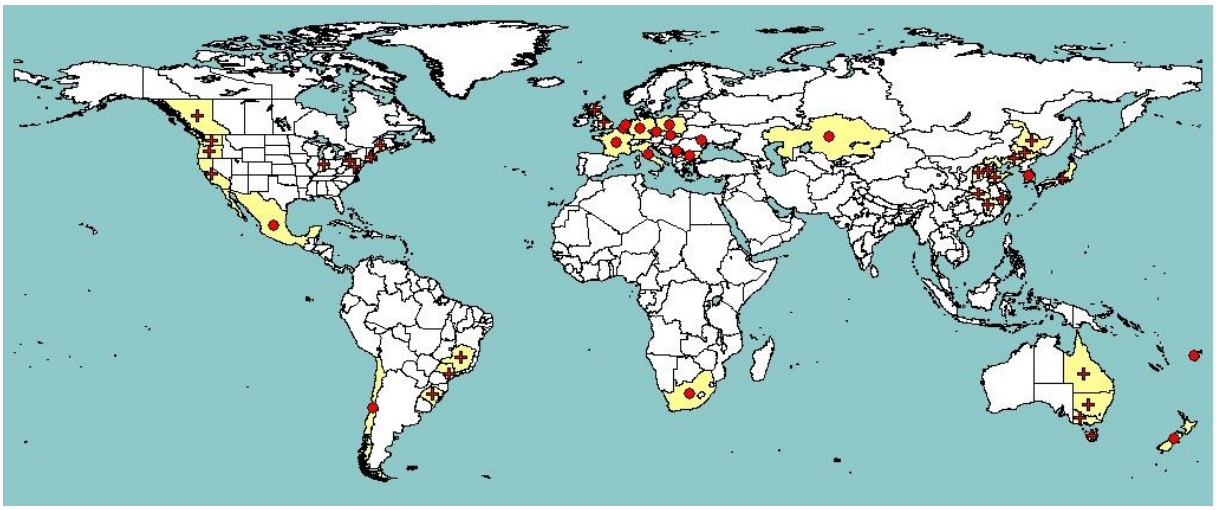

Figure 1: Global distribution map for *Strawberry crinkle virus* (extracted from EPPO PQR, version 5.3.1. accessed on 21 March 2014). Red circles represent pest presence as national records and red crosses represent pest presence as subnational records (note that this figure combines information from different dates, some of which could be out of date).

3.1.2.2. Distribution of SCV in the risk assessment area

As indicated by the answers to a questionnaire sent by EFSA to Member States, the presence of SCV is reported in 11 countries (Belgium, Bulgaria, Czech Republic, France, Germany, Ireland, Italy, Netherlands, Poland, Slovakia and the United Kingdom) (Table 1). Given that it does not always induce remarkable foliar symptoms, SCV could potentially also be present in some other Member States. Data on the presence or absence of SCV are not available in Croatia, Latvia, Luxembourg and Spain. The virus is reported as absent in Iceland and Norway.

Table 1: Current distribution of *Strawberry crinkle virus* in the risk assessment area, based on answers received from the 28 Member States, Iceland and Norway

Member State	***Strawberry crinkle virus***
Austria	**Absent**, no pest records
Belgium	Old NPPO status in PQR5 is '**present**, no details'. A survey was carried out in 2011 and 2012 during an NPPO research project (QUARANSTAT) in the production of strawberry and soft fruit (*Rubus idaeus*, *R. fruticosus*, *Ribes rubrum*, *R. uva-crispa*, *Vaccinium myrtillus*). In total, 818 samples were analysed throughout Belgium. The pest was detected on strawberry at three locations (in the provinces East-Flanders (2012), Limburg (2011) and Liège (2011)) and always in co-infection with SMYEV. Besides the survey in the production companies, a collection of old strawberry varieties brought together in the framework of another project was tested. Here, 19 samples positive for SCV and 2 samples co-infected with SCV and SMYEV were detected.
Bulgaria	**Present**, widespread
Croatia	– (no data at NPPO)
Cyprus	**Absent**, based on surveys
Czech Republic	**Present**, few occurrences
Denmark	**Absent**, no pest records

Member State	*Strawberry crinkle virus*
Estonia	**Absent**, no pest records
Finland	**Absent**, no pest records
France	**Present**, no details
Germany	**Present**, few occurrences
Greece [(a)]	**Absent**, not known to occur
Hungary	**Absent**, no pest records
Ireland	**Present**, at low prevalence
Italy	**Present**, widespread (in some areas only found on old strawberry cultivar for non-professional use out of the certification programme)
Latvia [(b)]	–
Lithuania	**Absent**, no pest records
Luxembourg [(b)]	–
Malta	**Absent**, not known to occur
Netherlands	**Present**, restricted distribution
Poland	**Present**, few occurrences
Portugal	**Absent**, not known to occur
Romania	– (no data at NPPO)
Slovakia	**Present**, restricted distribution
Slovenia	**Absent**, no pest records
Spain [(b)]	–
Sweden	**Absent**, not known to occur; no pest records
United Kingdom [(c)]	**England, Wales and Northern Ireland:** Present, widespread **Scotland:** Present, unknown distribution **Channel Islands and IOM:** Absent, pest no longer present
Iceland	**Absent**, no records
Norway	**Absent**, no pest records [(d)]

(a): Based on the records kept in the archives of the Department of Entomology and Agricultural Zoology, the Laboratory of Bacteriology, the Laboratory of Mycology, the Laboratory of Virology of the Benaki Phytopathological Institute. The archives refer to the results of the laboratory examination of diseased plant specimens sent to the Institute by the Extension Services of the Hellenic Ministry of Rural Development and Food, Agricultural Cooperatives, farmers, agronomists, private companies, etc., and also on other national records. No systematic survey data are available.
(b): When no information was made available to EFSA, the pest status in the EPPO PQR (2014) was used.
(c): Unless otherwise stated, the UK includes England, Scotland, Wales, Northern Ireland, the Channel Islands and the Isle of Man. The Channel Islands refers to the states of Guernsey and Jersey.
(d): The virus is under official control and is included in the testing program of the nuclear stock program for strawberry in Norway.
–: No information available;
EPPO PQR: European and Mediterranean Plant Protection Organization Plant Quarantine Data Retrieval System; IOM: Isle of Man; NPPO: National Plant Protection Organisation.

3.1.2.3. Distribution of vectors in and outside the risk assessment area

C. fragaefolii is presumably of North American origin, but now occurs 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 CPC, it is present in Asia (Israel, Japan, the Philippines), North America (Canada, 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, Voivodina, Montenegro). Outside Europe it is present in the Afro-tropical, the Australian, the East Palearctic, the Nearctic and the Neotropical regions, as well as in North Africa and the Near East. In addition, *C. fragaefolii* is reported to be present in 15 EU Member States (Table 2).

Table 2: Current distribution of the strawberry aphid *Chaetosiphon fragaefolii* in the risk assessment area, based on the Plantwise database, the CABI Crop Protection Compendium, 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 vector species, *C. jacobi*, which is reported from the western USA (Blackman and Eastop, 2000).

3.1.3. Regulatory status in the risk assessment area

3.1.3.1. Legislation directly addressing the pathogen

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

> 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 II—Harmful organisms known to occur in the Community and relevant for the entire Community
> >
> > (d) Viruses and virus-like organisms

Species	Subject of contamination
11. Strawberry crinkle virus	Plants of *Fragaria* L., intended for planting, other than seeds

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

Plant products and other objects	**Special requirements**
19.2. Plants of … *Fragaria* L., … intended for planting, other than seeds, originating in countries where the relevant harmful organisms are known to occur on the genera concerned The relevant harmful organisms are — on *Fragaria* L.: — Strawberry crinkle virus	Without prejudice to the provisions applicable to the plants where appropriate listed in Annex III(A)(9) and (18), and Annex IV(A)(I)(15) and (17), official statement that no symptoms of diseases caused by the relevant harmful organisms have been observed on the plants at the place of production since the beginning of the last complete cycle of vegetation

Section II—Plants, plant products and other objects originating in the Community

Plant products and other objects	**Special requirements**
12. Plants of *Fragaria* L., … intended for planting, other than seeds	Official statement that: (a) the plants originate in areas known to be free from the relevant harmful organisms; or (b) no symptoms of diseases caused by the relevant harmful organisms have been observed on plants at the place of production since the beginning of the last complete cycle of vegetation. The relevant harmful organisms are: — on *Fragaria* L.: — Strawberry crinkle virus

3.1.3.2. Legislation addressing hosts of the pathogens

In addition, other legislation, though targeted at other pests or hosts, may have an indirect effect in limiting the risk of further entry of SCV into the risk assessment area, and are listed below.

- 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, originating from 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
  – 21.1–3. Plants of *Fragaria* L. intended for planting, other than seeds, originating from places of production recognised as being free from Strawberry latent 'C' virus, Strawberry vein banding virus, Strawberry witches' broom mycoplasm, *Aphelenchoides besseyi* Christie, *Anthonomus bisignifer* (Schenkling);

  – Herbaceous perennial plants, intended for planting, other than seeds, of the *Rosaceae* (except *Fragaria* L.), originating in third countries, other than European and Mediterranean countries, free from fruits, grown in nurseries and free from harmful organisms.

- 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
    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
        - 2.1. Plants intended for planting other than seeds of the genera *Fragaria* L.,…;

In addition to Council Directive 2000/29/EC, *Fragaria* plants for planting are further regulated:

- under Council Directive 2008/90/EC6 on the marketing of fruit plant propagating material: *Fragaria* L.

- under Commission Decisions 2011/74/EC amending Commission Decision 2003/248/EC7[7] and Commission Decision 2011/75/EC amending Commission Decision 2003/249/EC8[8]. These legislations provide temporary derogations from the import prohibition specified in Annex III, point 18, for *Fragaria* plants for planting other than seeds originating in Argentina and Chile, respectively. These derogations concern not only *P. fragariae* but cover all harmful organisms, in particular those listed in Annex I and II of 2000/29/EC. Detailed requirements for these imports of *Fragaria* plants for planting are specified in Annex I of Commission Decisions 2003/248/EC and 2003/249/EC, and they are far more stringent than the requirements of 2000/29/EC, Annex IV, Part A, Section I (19.2), e.g.:

    - Import of these plants is allowed only from 1 June to 30 September.

    - The plants shall have been produced exclusively from mother plants, which were imported from a Member State and certified under an approved certification scheme of a Member State.

    - The land on which the plants are produced must meet specific conditions.

    - The plants must be officially inspected by the respective Plant Protection Services of Argentina and Chile, at least three times during the growing season and again prior to export for the presence of the harmful organisms.

3.1.4. Potential for establishment and spread in the risk assessment area

3.1.4.1. Availability of suitable hosts in the risk assessment area

SCV has a restricted natural host range, limited to *Fragaria* spp. However, strawberry plants are widely grown both in the field and under protected cultivation in a wide range of EU Member States (Table 3). In addition, the wild strawberry (*Fragaria vesca*), which is susceptible, has a large distribution in the EU and, similarly, the experimental host *P. reptans* is widely distributed in the EU (Table 3).

[6] 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 267/8, 8.10.2008, p. 8–22.

[7] Commission Decision of 2 February 2011 amending Decision 2003/248/EC as regards the extension of the duration of temporary derogations from certain provisions of Council Directive 2000/29/EC in respect of plants of strawberry (*Fragaria* L.), intended for planting, other than seeds, originating in Argentina. OJ L 29, 3.2.2011, p. 32.

[8] Commission Decision of 2 February amending Decision 2003/249/EC as regards the extension of the duration of temporary derogations from certain provisions of Council Directive 2000/29/EC in respect of plants of strawberry *(Fragaria* L.), intended for planting, other than seeds, originating in Chile. OJ L 29, 3.2.2011, p. 33.

Table 3: Area of strawberry production in Europe 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* and *Potentilla reptans* in 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*	Presence of *Potentilla reptans*
Austria	1 300	0	+	+
Belgium	1 600	–	+	+
Bulgaria	700	0	+	+
Croatia	200	100	+ (a)	+ (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	2,700	+	+
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)	+ (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.
–: No data available in Eurostat.

3.1.4.2. Availability of suitable vectors in the risk assessment area

The best-known SCV vector, the strawberry aphid *C. fragaefolii*, is reported to be widely distributed in the risk assessment area (Table 2), although knowledge about its prevalence is rather limited.

3.1.4.3. Suitability of the environment

SCV and its main vector, *C. fragaefolii*, occur in, or have been reported in the past from, many countries of the risk assessment area, indicating that they are generally well adapted to the diverse ecoclimatic conditions found in Europe. There is no indication that the ecoclimatic requirements of SCV differ substantially from those of its *Fragaria* host plants, which are generally well adapted to EU conditions.

As indicated above in Section 3.1.1.4, results from Krczal and Merbecks (1988) suggest the existence of a minimal temperature below which the SCV latency period may become too long as compared with the aphid lifespan, so that the aphids never become viruliferous. This would effectively block vector-mediated transmission in areas where this minimal temperature is not reached. It would also limit vector-mediated transmission to parts of the year when this climatic condition is reached. Such a

scenario could explain, at least in part, the reported absence of SCV in the northernmost part of Europe (Sweden, Lithuania, Finland, Estonia, Denmark, Iceland, Norway; see Table 1 above). However, if set at about 10 °C constant temperature (Krczal and Merbecks, 1988), this criterion is clearly met during at least some periods of the year over a large part of Europe, so that aphid-mediated transmission is unlikely to be completely inhibited by climatic factors in a wide range of EU Member States. There is, however, no information on the potential impact on SCV transmission of more variable climatic regimes that would be closer to real-life conditions.

3.1.5. Potential for consequences in the risk assessment area

Although there appears to be variability in damage, SCV has been reported to cause significant yield reduction in many strawberry varieties. In addition, when present in mixed infection with other viruses, in particular SMoV and SMYEV, SCV can cause very serious disease.

3.1.6. Conclusion on pest categorisation

SCV is currently established in the risk assessment area. Its main aphid vector, the strawberry aphid, *C. fragaefolii*, also occurs widely in the risk assessment area. It has the potential to contribute to the local spread of SCV, at least during the hottest period of the year, in a large part of the risk assessment area. The only crops at risk, *Fragaria* spp., are cultivated throughout the EU and virus infection in those hosts is potentially damaging. It should be stressed that much of the literature on SCV and its vectors is rather old, with only limited information published in more recent years. As a consequence, many of the aspects analysed in the present opinion carry significant uncertainty. The almost complete lack of recently published data on the prevalence or impact of SCV suggests that its current impact is limited and/or that specific diagnostic procedures for this agent are not routinely used. To determine the extent to which this pest poses a threat to European crops and to fulfill the terms of reference of this assessment, a detailed risk assessment is required.

3.2. Probability of entry

SCV is present in at least 11 Member States (Table 1). The assessment of the probability of entry considers the potential for further entry from third countries.

3.2.1. Identification of pathways

The Panel identified the following pathways for entry of SCV from infested areas into the risk assessment area:

1. Plants for planting comprising vegetative plant propagation material (excluding seeds and pollen because there is no evidence of SCV transmission via these mechanisms).

2. Plant parts of host plants (not intended for planting).

3.2.1.2. Selection of the most important pathways

The selection of the most important pathway(s) for further assessment is based on the EFSA Guidance on a harmonised framework for pest risk assessment and the identification and evaluation of pest risk management options (EFSA Panel on Plant Health, 2010), which states that the most relevant pathways should be selected using expert judgement.

There is no report on interception of SCV in the Europhyt database; therefore, the assessment of the significance of the identified pathways was based on information on the biology of the pest, its vector and host plants available from literature.

1. Plants for planting

SCV establishment is greatly facilitated when entry is associated with strawberry plants for planting and, as a consequence, plant material for propagation purposes is considered to be the most significant

entry pathway, and is analysed in detail below. Strawberries are vegetatively propagated plants. There is a considerable movement of high volumes of planting material within Europe, but planting material from third countries also arrives, in much smaller volumes (EFSA, 2014).

2. Plant parts of host plants (not intended for planting)

Plant parts of host plants (not intended for planting) can present a pathway since fruit body and associated green sepals from systemically infected plants carry the virus. Despite the considerable volume of strawberry fruit imports from third countries, this entry pathway can be considered of lesser importance because successful establishment following entry would require transfer of the virus to a suitable host by vector transmission. The concomitant presence, in close vicinity, of a virus source, of vectors and of susceptible host plants makes this an unlikely event.

Viruliferous aphids may also be present in consignments of plant parts of host plants (not intended for planting) and may contribute to virus entry since viral replication in the aphid vectors ensures life-long retention of the virus (Posthuma et al., 2000). As the intended use of strawberry fruits is for fresh market consumption, it is unlikely that such plant parts and the aphids they may harbour will be brought in close contact with susceptible host plants.

Overall, the Panel therefore considered the plant parts of host plants pathway as minor and did not analyse it in detail.

3.2.2. Detailed analysis of pathway 1: plants for planting

3.2.2.1. Probability of association with the pathway at origin

SCV has a restricted host range and is found in nature only in wild and cultivated *Fragaria* spp. plants. The virus is widely distributed and found in many countries inside and outside Europe, predominantly in cultivated strawberry but also in wild *F. chiloensis* grown far distant from any cultivation (Rojas et al., 2013). However, besides reports on the occurrence of SCV, there are no quantitative data on the prevalence of the virus in the countries were it was reported, with the exception of a systematic survey conducted in North America (Martin et al., 2013). In this survey, SCV was found in all US production areas, except the north-east, at rates of between 1.6 % (south-east) and 36.6 % (Pacific north-west).

Depending on strawberry cultivar and other parameters, SCV foliar symptoms may be more or less conspicuous and there are reports of tolerant varieties which react to infection with only mild or no symptoms (Graichen et al., 1985; Posthuma et al., 2000). However, SCV shows strong synergistic interactions with SMoV and other viruses in mixed infections and those disease complexes result in more severe symptoms (Converse, 1987).

Fragaria planting material is produced under strict certification schemes in Europe (EFSA, 2014) and most of the planting material is produced in Europe. Restrictions apply to imports of planting material from most third countries and it can be assumed that in those countries with EU import exceptions or derogations *Fragaria* plants for planting are produced with similar standards. However, recent reports on outbreaks of severe decline disease of strawberry in the USA and Canada, associated with a mixed infection of SMYEV and SMoV (Martin et al., 2013; Martin and Tzanetakis, 2013), provide a reminder that detrimental viral infections can be overlooked in plants for planting, even in certification systems.

In conclusion, considering the restricted movement of strawberry planting materials into the EU, the absence of interception reports and the certification systems under which plants for planting are generally produced both within and outside Europe, the Panel assessed the probability of the association of SCV with the pathway at origin as unlikely to moderately likely. This evaluation is associated with a high uncertainty given the near absence of relevant data (trade volumes and trade partners, prevalence of SCV in countries exporting to the EU, frequency of testing of imported materials, etc.).

3.2.2.2. Probability of survival during transport or storage

When present in plants for planting, SCV will survive transport and storage as long as the host remains alive. Storage of planting material at low temperatures prior to planting does not affect virus infections in strawberry. Overall, the probability of the viruses surviving transport and storage is considered as very likely, with low uncertainty.

3.2.2.3. Probability of surviving existing pest management procedures

Existing management procedures are defined by the requirements in Annexes II, III, IV and V of the Directive 2000/29/EC (see also Section 3.1.3). Concerning Annex IIIA, the requirements are based solely on visual inspection of the plants at the site of production and, therefore, may not have complete effectiveness (see below evaluation of visual inspection as a Risk Reduction Option). Concerning the requirements of Annex IIAII, it is unclear whether Member States rely only on visual inspection or also apply some amount of testing. The total absence of interception reports for a widely distributed virus suggests, however, a significant reliance on visual inspection only. As a consequence, the Panel concludes that the probability of SCV surviving existing pest management procedures is moderately likely with moderate to high uncertainty.

3.2.2.4. Probability of transfer to a suitable host

SCV entering with infected propagation material is in a susceptible host that will be planted and cultivated for one or more cropping seasons, serving as virus source for further spread and transfer to other potential host plants. Because strawberries are plantation crops, susceptible host plants are in close vicinity. Transfer of SCV to susceptible hosts and subsequent spread occurs when *Chaetosiphon* aphid vectors are present. Thus, transfer of SCV to a suitable host is very likely to occur, with low uncertainty.

3.2.3. Conclusions on the probability of entry

The probability of entry was estimated based on the most restrictive step of the entry process, with an association with the pathway at origin estimated as unlikely to moderately likely.

Rating	Justification
Unlikely to moderately likely	SCV is present outside Europe and confirmed from many countries. Given that it does not always induce remarkable foliar symptoms, SCV presence could potentially be overlooked in some countries. The pathway of entry for strawberry however, is regulated and derogations exist for only a few countries. It can be assumed that strawberry planting material from most countries with an import derogation is produced within certification schemes to ensure high product quality and virus freedom. Certification systems may not, however, be 100 % effective, as illustrated by recent outbreaks of strawberry decline in the USA and Canada. SCV in its host is very likely to survive transport and storage while the existing management procedures are expected to have only limited effects on the virus and thus the survival of management procedures is rated as moderately likely. The probability of transfer to a suitable host is rated as very likely since the virus is present in a susceptible host that will be planted and grown for one or several seasons.

3.2.4. Uncertainties on the probability of entry

Rating	Justification
High	The main uncertainties concern: 1. the estimation of the exact quantities of plants for planting imported into Europe; 2. the distribution of the virus outside the EU and its association with imported plants; 3. the efficiency of inspections of strawberry planting material consignments.

3.3. Probability of establishment

3.3.1. Availability of suitable hosts, alternate hosts and vectors in the risk assessment area

SCV is reported from a number of EU Member States and thus already established. The virus has a narrow host range restricted to cultivated and wild members of the genus *Fragaria*. *P. reptans*, a common weed, was found susceptible to SCV under experimental conditions and could potentially serve as virus reservoir (Yohalem et al., 2009). With *C. fragaefolii* aphids vectors also present in many European countries all preconditions are met to support establishment of SCV in Europe.

3.3.2. Suitability of the environment

As for other plant viruses, biological functions of SCV are not significantly different from those of its hosts, which are widely cultivated, or present in the wild, in the EU. Thus, the entire area is considered to have suitable environmental conditions for SCV establishment as long as local conditions are suitable for the development of *Fragaria* plants.

3.3.3. Cultural practices and control measures

The currently used cultural practices for strawberry, in particular the short production cycles with frequent removal and renewal of the entire crop, limit establishment of viruses and inoculum build-up.

3.3.4. Other characteristics of the pest affecting the probability of establishment

SCV infections may not result in clear foliar symptoms in some strawberry cultivars and thus the virus may remain undetected when plants are inspected for symptoms.

3.3.5. Conclusions on the probability of establishment

Rating	Justification
Very likely	SCV is already established in many EU Member States and the same applies to its main vector, *C. fragaefolii*. EU ecoclimatic conditions are not expected to significantly affect SCV establishment wherever these conditions are suitable for its primary hosts, cultivated and wild strawberries. Currently used cultural practices and control measures are unlikely to significantly impede establishment.

3.3.6. Uncertainties on the probability of establishment

Rating	Justification
Low	SCV presence in many EU Member States is confirmed and all environmental and biological preconditions for the virus to establish are met.

3.4. Probability of spread

3.4.1. Local spread by natural means

Several aspects specific to the virus and its relationship with its vector(s) determine spread under natural conditions. SCV is exclusively transmitted by *Chaetosiphon* aphids, in a persistent circular mode. The most prominent vector, *C. fragaefolii*, is present in many EU Member States. While a vector for both SCV and SMYEV, it transmits SCV less efficiently (Krczal, 1980; Krczal and Merbecks, 1988). SCV needs longer acquisition access periods than SMYEV and it has a long latency period in the vector. The latter is affected by temperature and the time needed for the aphid to become viruliferous increases with decreasing temperatures (Krczal and Merbecks, 1988).

The results of Krczal and Merbeks (1988) suggest that vector-mediated transmission could be blocked or could be efficient only part of the year in areas where a threshold temperature is not reached. However, if set at about 10 °C constant temperature (Krczal and Merbecks, 1988), this criterion is clearly met during at least some periods of the year over a large part of Europe, so that aphid-mediated transmission is unlikely to be completely inhibited by climatic factors in a wide range of EU Member States. The probability of local spread by natural means is, therefore, evaluated by the Panel to be moderately likely with high uncertainty associated with lack of information on the exact parameters governing the efficiency of SCV transmission (Martin, 2013).

3.4.2. Long distance spread by human assistance

Similar to other viruses, SCV invades all parts of its host plants and vegetative propagation of infected plants generates infected progeny plants. The trade in infected strawberry planting material therefore provides the most effective way to disseminate the virus over long distances. Because of its persistent and replicative mode of transmission, SCV can be also be transmitted by viruliferous aphids associated with plant consignments, provided that susceptible plants become available to the vectors.

The movement of infected strawberry planting material is limited by widely adopted certification systems (EFSA, 2014). As a consequence, the probability of long-distance spread through human assistance is evaluated as unlikely, with medium uncertainty, mostly related to the absence of data on intracommunity trade volumes and of quantitative data on SCV incidence.

3.4.3. Containment of the pest within the risk assessment area

Comprehensive certification programmes that include the use of virus-free planting materials very efficiently minimize the risk of dissemination of SCV through vegetative propagation and trade in infected planting materials. However, because of the already widespread presence of the virus, the widespread presence of susceptible host plants in the environment and the existence of an aphid vector, it is unlikely that this virus can be contained.

3.4.4. Conclusions on the probability of spread

Rating	Justification
Moderately likely for local	Susceptible host plants and an aphid vector are present in many EU Member States. Vector-mediated transmission is, however, not as efficient as for other

Rating	Justification
spread by natural means	strawberry viruses such as SMYEV. Aphid-mediated transmission is unlikely to be completely inhibited by climatic factors in a wide range of EU Member States. It may be affected in some areas by the effect of low temperatures on the duration of the virus latency period.
Unlikely for long-distance spread through human-assisted means	Non-mandatory certification schemes in place efficiently prevent dissemination of virus infected planting materials.

3.4.5. Uncertainties on the probability of spread

Rating	Justification
High for local spread by natural means	Limited knowledge on size of vector populations. No information on the potential impact of fluctuating temperatures (closer to real life conditions) on the length of the latency period of SCV in its vectors and thus on the extent to which climatic conditions may affect aphid-mediated transmission. Lack of information on potential reservoirs in the uncultivated environment.
Medium for long-distance spread through human-assisted means	Lack of data on volumes of intra-EU trade of plants for planting and on virus prevalence.

3.5. Conclusion regarding the endangered area

In Europe, susceptible host plant species, wild and cultivated *Fragaria* spp. and other putative wild hosts plants are widely available. *C. fragaefolii*, the main vector, is also widely distributed. Favourable environmental conditions for the virus and its vector exist widely in the EU. Despite this, climatic conditions may reduce or abolish transmission in the wild in the northernmost European countries, through an effect on the virus latency period. Therefore, the entire EU territory is considered as the endangered area.

3.6. Assessment of consequences

3.6.1. Direct pest effects

3.6.1.1. Negative effects on crop yield and/or quality to cultivated plants

SCV is considered one of the most damaging viruses of strawberry plants (Converse, 1987). In most cultivars SCV infection reduces plant vigor, runner production and fruit yield. SCV impact is further increased in the event of mixed infection with other viruses such as SMYEV, SMoV or SPaV (Martin and Tzanetakis, 2013). These virus complexes cause more severe symptoms and the degenerative diseases generally described as 'decline' (Converse, 1987).

However, in current production systems, involving the use of certified, virus-free planting material and rapid crop turnover with annual or bi-annual crop cycles, incidence of virus-infected plants is generally low and inoculum build-up limited. Overall, damage by SCV is therefore very limited as indicated at the hearing of industry representatives (EFSA, 2014). As a consequence, the Panel concludes that the direct effects of SCV in strawberries can be considered as minimal to minor, with moderate uncertainty associated with the limited amount of precise recent information available.

3.6.2. Environmental consequences

SCV has a very limited host range. Besides cultivated strawberries, it can infect only wild strawberry (*F. vesca*) and potentially a few additional rosaceous wild hosts such as *P. reptans*. No significant impact from SCV infections on wild plants and plant communities is currently known. As a consequence, no significant environmental consequences are expected.

3.6.3. Conclusions on the assessment of consequences

Rating	Justification
Minimal to minor	SCV may cause significant losses in strawberry plants, but consequences are considered marginal by the industry (EFSA, 2014). With the possible exception of cases of mixed infection, the actual impact of the disease is limited by several factors including: • the existence of efficient and widely adopted certification systems for strawberry; • the use of short cropping cycles in modern strawberry cultivation, limiting the incidence of infected plants and of virus spread by vectors. There are no identified environmental consequences.

3.6.4. Uncertainties on the assessment of consequences

Rating	Justification
Medium	Limited precise recent information available on the actual damages caused by SCV.

4. Identification and evaluation of risk reduction options and of the current phytosanitary measures

The structure of this section is as follows. Phytosanitary measures to prevent the entry of SCV from third countries into the EU are addressed in Section 4.1. Measures to prevent establishment and spread within the EU or those to reduce the impact of the pathogen are outlined in Section 4.2. The analysis of combinations of options is presented in Section 4.3, that of prohibition in Section 4.4 and the conclusions on the analysis of risk reduction options are presented in Section 4.5. The current regulations to prevent the introduction and spread of SCV and the consequences of deregulation are finally presented in Section 4.6.

The effectiveness and feasibility of risk reduction options and the associated uncertainties are essentially determined by the biology of the pest and by the crop(s) under consideration. In this respect, risk reduction options against SCV are analysed by the Panel as being, to a very large extent, similar in effectiveness and feasibility to those analysed for SMYEV (EFSA PLH Panel, 2014).

This is because these two viruses share many important biological traits including:

- a natural host range limited to *Fragaria* spp., with only a few potential (experimental) alternative hosts, including *P. reptans*;
- transmission in the persistent mode by the same *Chaetosiphon* aphid species, one of which, *C. fragaefolii*, is widely distributed in Europe;
- the availability of efficient PCR-based detection assays;
- the absence of resistant strawberry varieties but the existence of tolerant varieties, which complicates virus detection by the visual observation of symptoms alone;
- a wide distribution of the two viruses, both within and outside Europe, and an identical regulatory status.

As a consequence, the reasoning when analysing risk reduction options against SCV and their effectiveness, feasibility and uncertainty ratings are in most cases very similar to the reasoning developed in the case of SMYEV, with few limited exceptions.

4.1. Options before entry

4.1.1. Options at the place of production

4.1.1.1. Detection of the pest at the place of production by inspection or testing

(i) Visual inspection at the place of production

Currently, the production scheme of strawberry plants for planting includes visual inspection for viral disease symptoms as well as screening mother plants for the presence of viruses. International Standards for Phytosanitary Measures (ISPM) 31 (IPPC, 2009) provides guidance on appropriate sampling methodologies for inspection or testing of consignments. However, while nuclear stocks generally are tested for virus presence using molecular, serological or indicator grafting assays, inspection for viruses in multiplication stages close to commercialisation is by visual inspection only. Even though SCV appears to cause foliar symptoms in a wider range of varieties than SMYEV, there exists a great deal of variability in the level of damage caused by SCV, probably as a consequence of both viral variability and differences in varietal susceptibility (Posthuma et al., 2000; Klerks et al., 2004; Botti and Cardoni, 2009). Some strawberry cultivars have also been reported to show tolerance to SCV infections (Sylvester et al., 1976). Overall, visual inspection of symptoms is, therefore, not considered as fully effective for the detection of SCV.

Effectiveness: low to moderate.

Technical feasibility: high because visual inspection is simple and common practice.

Uncertainty: low to medium.

(ii) Specified testing at the place of production

The presence of SCV can be tested using appropriate techniques such as ELISA and PCR. The latter method is more sensitive and can detect the virus at low concentrations even in asymptomatic hosts. Tests could be performed on all plants in the case of a limited number of plants. When large numbers of plants are to be tested, appropriate sampling protocols exist to guide virus indexing (ISPM 31—IPPC, 2009) (Martin and Tzanetakis, 2013).

Effectiveness: high if the entire nursery propagation stock is tested. However, with large numbers of plants, only a limited number of individuals can be sampled and tested, although this limitation can be partially overcome by repeated sampling and testing performed to continuously monitor plant production over time. The overall effectiveness is therefore rated as moderate.

Technical feasibility: high for testing a limited number of plants, but decreasing to low for large volumes of plants.

Uncertainty: low.

4.1.1.2. Prevention of infestation of the commodity at the place of production

(i) Specified treatment of the crop

There is currently no treatment with curative effects on a virus infected crop. Preventive measures, to reduce virus spread by controlling insect vectors are, however, widely available. Chemical control can be used to decrease insect vector populations and, subsequently, reduce viral spread. Although chemical control is highly effective to regulate insect population build-up, generally virus spread cannot be entirely stopped. The tight association of *C. fragaefolii* with strawberry and SCV persistent mode of transmission indicate that insecticides might be at least partially effective in reducing virus spread.

Effectiveness: moderate because it is almost impossible to eliminate all viruliferous aphids year-round by treatment with the available insecticides.

Technical feasibility: very high.

Uncertainty: high because of a lack of precise data on the efficiency and sustainability of this measure and on possible ecological problems.

(ii) Consignment should be composed of specified cultivars

There are no reports of strawberry varieties with resistance to SCV.

Effectiveness: very low because of the unavailability of resistant varieties.

Technical feasibility: very low because of the unavailability of resistant varieties.

Uncertainty: low.

(iii) Specified growing conditions of the crop—growing host plants under exclusion conditions

Growing strawberry plants under exclusion conditions (protected cultivation) may be effective for the management of SCV and its aphid vectors. Enclosures provide opportunities for pest exclusion which are not available in open field cultivation (ISPM 36—IPPC, 2012). Given the extremely narrow host range of SCV, the inclusion of strawberry-free periods in the production scheme of a facility, as an effort to break the viral cycle, might be considered as an additional interesting measure. Plants intended for production under protected cultivation should be virus free or originate from a pest-free production area or site. The Panel concludes that growing plants under exclusion conditions could be highly effective, but may be technically challenging in large-scale production settings.

Effectiveness: high.

Technical feasibility: moderate to high.

Uncertainty: low.

(iv) Specified age of plant, growth stage or time of year of harvest

All strawberry growth stages can sustain SCV infection and might be a source of the virus.

Effectiveness: very low.

Technical feasibility: very low.

Uncertainty: low.

(v) Certification scheme

The selection of healthy propagation material is a useful strategy and common practice and part of certification schemes to ensure high-quality, virus-free planting material. Voluntary or compulsory (official) certification of virus-free plants is an essential part of the nursery supply chain, employing a constant programme of indexing to guarantee substantial freedom from virus (Jarvis, 1993). ISPM 7 (IPPC, 2011) lists requirements and describes components of a phytosanitary certification system to be established by national plant protection organisations.

Certification schemes exist for the production of strawberry plants for planting and those are usually based on the same principles (Commission Communication 2010/C 341/04[9]; EPPO schemes, available online: http://archives.eppo.int/EPPOStandards/certification.htm). For strawberry, SCV is on the list of the viruses addressed by virus-free certification schemes (EPPO schemes, online).

Effectiveness: high.

Technical feasibility: very high as this strategy is already widely used.

Uncertainty: low.

4.1.1.3. Establishment and maintenance of pest freedom of a crop, place of production or area

(i) Pest-free place of production

A pest-free production site is a place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period (ISPM 10—IPPC, 1999). Requirements for the establishment and maintenance of a pest-free production site as an approved phytosanitary measure by the NPPO include:

- systems to establish pest freedom;
- systems to maintain pest freedom;
- verification that pest freedom has been attained or maintained;
- product identity and phytosanitary security of the consignment.

Where necessary, a pest-free place of production also includes the establishment and maintenance of an appropriate buffer zone. Pre-plant site preparation, combined with the use of healthy planting material, is critically important. All infected host plants that might act as virus reservoirs must be removed on the production site and in its vicinity.

Effectiveness: high in preventing the introduction or spread of SCV in the case of regularly organised surveillance involving testing.

Technical feasibility: moderate given the ability of the aphid vectors to disperse over substantial distances.

Uncertainty: medium because of the limited accuracy of surveys.

[9] Commission Communication — EU best practice guidelines for voluntary certification schemes for agricultural products and foodstuffs (2010/C 341/04) available online: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:341:0005:0011:en:PDF

(ii) Pest-free area

A pest-free area is an area, in which a specific pest does not occur and for which this status is demonstrated by scientific evidence. Delimitation of the area should be relevant to the biology of the pest. In principle, the pest-free area should be established by using the criteria for establishing freedom from pests as set out in ISPM 4 (IPPC, 1995) 'Requirements for the Establishment of Pest-Free Areas.'

In the production areas where SCV and its aphid vectors have not been recorded, and where surveillance is carried out to confirm pest-free status, a pest-free area could be declared.

Because SCV and its main aphid vector are present in a wide range of countries, it could prove difficult to establish and maintain pest-free areas. It should be stressed that the establishment of SCV-free areas is likely to be contingent on the absence of vector populations.

Effectiveness: high in the case of regularly organised surveillance.

Technical feasibility: low to moderate because of the wide distribution of SCV and its vectors.

Uncertainty: moderate.

4.1.2. Options after harvest, at pre-clearance or during transport

4.1.2.1. Detection of the pest in consignments by inspection or testing

(i) Visual inspection of the consignment

SCV appears to cause foliar symptoms in a range of varieties, and therefore, visual inspection is analysed as being somewhat more efficient than in the case of SMYEV. However, symptoms vary in intensity (Posthuma et al., 2000; Klerks et al., 2004; Botti and Cardoni, 2009) and there and some strawberry cultivars that showed tolerance to SCV (Sylvester et al., 1976). Thus, visual inspection is not considered fully effective to identify consignments containing SCV-infected plants.

Effectiveness: low to moderate.

Technical feasibility: high because visual inspection is common practice for import control.

Uncertainty: low to medium.

(ii) Specified testing of the consignment

The presence of SCV can be tested by using appropriate techniques such as ELISA or PCR. The latter method is more sensitive and can detect the virus at low concentrations, even in asymptomatic hosts. Tests could be performed on all plants in the case of a consignment composed of a limited number of plants. However, in the case of large numbers of plants, only random samples can be tested, reducing effectiveness.

Effectiveness: high when testing all imported plants but reduced if random samples need to be tested; therefore, the overall effectiveness is rated as moderate.

Technical feasibility: high for testing a limited number of plants, but decreasing to low for large volumes of imported planting material.

Uncertainty: low.

4.1.2.2. Removal of the pest from the consignment by treatment or other phytosanitary procedures

(i) Specified treatment

The conditions of preparation of the consignment and specified treatment of the consignment to reduce pest prevalence in the consignment are specified in ISPM 11 (IPPC, 2013). Options to eliminate SCV from strawberry plants are not available because this virus remains biologically active throughout the life of the infected host. Insecticide treatments can eliminate viruliferous aphid vectors from an infested consignment and reduce the risk of virus transmission and spread.

Effectiveness: low because no effective treatments exist against viruses.

Technical feasibility: low because no effective treatments exist against viruses.

Uncertainty: low.

(ii) Removal of parts of plants from the consignment

Like most plant viruses, SCV systemically invades all parts of the infected plant. Removal of specific parts from an infected plant will not affect virus presence.

Effectiveness: very low.

Technical feasibility: very low.

Uncertainty: low.

(iii) Specific handling/packing methods of the consignment

The systemic nature of SCV infections, as well as the fact that resistant strawberry varieties are not available, essentially render this option ineffective.

Effectiveness: very low.

Technical feasibility: very low.

Uncertainty: low.

4.2. Options after entry

(i) Post-entry quarantine

Post-entry quarantine can be very effective to ensure absence of harmful organisms. EU Member States may impose a post-entry quarantine when particular consignments are suspected of harbouring harmful organisms. Quarantine controls can be applied over a period of time to demonstrate disease freedom, cultivating plants in strict isolation and administering inspections and/or tests. Given the tolerance of some strawberry cultivars (Sylvester et al., 1976), this control measure needs to be accompanied by appropriate testing measures. Under such conditions, effectiveness and feasibility are high or very high when small numbers of plants such as nuclear stocks are to be tested. However, the feasibility is considered low when high numbers of plants are to be tested.

Effectiveness: high if, throughout the quarantine process, plants are routinely tested for the presence of SCV.

Technical feasibility: low when considering large number of plants but high if applied to a limited number of plants, such as nuclear stocks used for vegetative propagation.

Uncertainty: low because the techniques and procedures involved are well known.

(ii) Restrictions in the period of entry, distribution in the PRA area and end uses

Given that SCV is already widely present in the PRA area, these measures are not expected to have significant effects. When imported plants for planting are to be used for production only, and not for

further multiplication, this may prevent further human-assisted spread of SCV, but would have no impact on vector-mediated spread.

Effectiveness: low to very low.

Technical feasibility: moderate to high.

Uncertainty: low.

(iii) Internal surveillance at the places of production (e.g. field inspections) or distribution (e.g. markets) in the PRA area

SCV and its main aphid vector are established in large parts of the risk assessment area. Information on the proportion of the affected area within each Member State is, however, generally not available. Inspections and surveillance can be effective in reducing further spread of the virus provided that they are followed by removal of infected plants and that the area from which the virus is absent is documented. ISPM 6 (IPPC, 1997) provides guidelines for general and specific surveys. Because inspection is always necessary to confirm pest freedom, it is an integral part of several other options such as establishment of pest-free areas (ISPM 4—IPPC, 1995) and places of production (ISPM 10—IPPC, 1999).

Effectiveness: low to moderate given that SCV is already present in many Member States.

Technical feasibility: moderate given that testing of plants is needed for this measure to have any effectiveness.

Uncertainty: low

(iv) Eradication

Eradication of SCV from open fields and from protected cultivations would necessitate removal of all infected plants from plantations. An eradication programme should include action against vectors to prevent spread and post-eradication surveys to verify absence of the disease. Given the restricted host range of SCV, the enforcement of a strawberry-free period might be considered as an additional interesting component of an eradication effort. SCV is largely distributed in the EU and, while it would likely be impossible to eradicate the virus from the environment, eliminating all infected strawberry plants would be an effective method of maintaining virus freedom of the plantation, provided there is no recontamination from the environment or from the use of contaminated planting material.

Effectiveness: moderate to high when strawberry plants are grown in protected cultivation and low to moderate in open field cultivation because of the difficulty of controlling recontamination through the activity of aphid vectors.

Technical feasibility: low to moderate.

Uncertainty: medium.

(v) Containment

A range of risk reduction options applied before entry (at the place of production, or after harvest at pre-clearance, or during transport) can be used following introduction of a pest in order to prevent further spread. These options are already discussed and rated in Section 4.1 above and the ratings are considered by the Panel to be similar when it comes to their effectiveness and feasibility in a containment context.

4.3. Options in combination

Some of the options analysed above are frequently used in combination. In particular, visual inspection, testing, treatments targeting the vectors and the use of exclusion conditions are generally intrinsic components of a well designed certification scheme.

In the specific case of SCV, it should be stressed that the combination of the use of partially effective cultural practices (short cropping cycles, protected cultivation) and of certified planting material has an overall high to very high level of effectiveness and feasibility, with low uncertainty (EFSA, 2014).

4.4. Prohibition

The prohibition of importation of all SCV-infected plants from third countries into the risk assessment area is a possible measure to reduce the risk of further entry of the pathogen. However, there is no indication that isolates of SCV outside of the EU might have different biological properties than those already present within the EU, potentially weakening the justification for a prohibition measure. Given that the only known natural hosts of SCV are *Fragaria* spp., it can be considered that this measure is already effectively in place for all countries, excluding those benefiting from an import exception or derogation in Annex IIIA of Council Directive 2000/29/EC or in Commission Decisions 2011/74/EC amending Commission Decision 2003/248/EC7 and 2011/75/EC amending Commission Decision 2003/249/EC.

Effectiveness: high in preventing further entry if the current measure was extended to all countries.

Technical feasibility: high since this measure is already in place for a range of countries.

Uncertainty: medium given the uncertainties about the possible existence of other natural hosts.

4.5. Conclusions on the analysis of risk reduction options

The evaluation ratings and the related uncertainty ratings for risk reduction options that have at least moderate effectiveness and technical feasibility are summarised in Table 4 below.

Table 4: Summary of the ratings provided by the Panel concerning risk reduction options identified and evaluated in Section 4.

Level of action of option	Category of options	Type of measure	Effectiveness	Technical feasibility	Uncertainty
Options before entry	Options at the place of production	Visual inspection at the place of production	Low to moderate	High	Low to medium
		Specified testing at the place of production	Moderate (overall) High (when testing entire nursery propagation stock)	High (limited number of plants) Low (large volumes of plants)	Low
		Specified treatment of the crop (against vectors)	Moderate	Very high	High
		Growing host plants under exclusion conditions	High	Moderate to high	Low
		Certification scheme	High	Very high	Low
		Pest-free place of production	High	Moderate	Medium
		Pest-free area	High	Low to moderate	Medium
	Options after harvest, at pre-clearance or during transport	Visual inspection of the consignment	Low to moderate	High	Low to medium
		Specified testing of the consignment	Moderate (overall) High (when testing all imported plants)	High (limited number of plants) Low (large volumes of plants)	Low
Options after entry		Post-entry quarantine	High (if plants are routinely tested for SCV presence)	Low (large number of plants) High (limited number of plants)	Low
		Internal surveillance at the places of production or distribution in the PRA area	Low to moderate	Moderate	Low

Level of action of option	Category of options	Type of measure	Effectiveness	Technical feasibility	Uncertainty
		Eradication	Moderate to high (in protected cultivation) Low to moderate (in open field)	Low to moderate	Medium
		Containment	The risk reduction options applied before entry at the place of production or after harvest, at pre-clearance or during transport can be used for containment. These options are already discussed and rated in this table above and the ratings are considered by the Panel to be similar when it comes to their effectiveness and feasibility in a containment context.		
		Combination of options (use of certified planting material, short cropping cycles, protected cultivation, visual inspection, possibly treatments targeting the vectors, etc)	High to very high	High to very high	Low
		Prohibition	High	High	Medium

4.6. Analysis of the current phytosanitary measures

4.6.1. Effectiveness of the current legislation

Phytosanitary measures to prevent the introduction and spread of SCV are present in Annexes II and IV of Council Directive 2000/29/EC (see Section 3.1.3). In Annex IIAII, SCV is listed as a harmful organism known to occur in the Community and relevant to the entire Community. Its introduction into, and spread within, all Member States is effectively banned if it is present on plants of *Fragaria* intended for planting, other than seeds. Annexes IVAI and IVAII describe the special requirements which must be followed by all Member States for the introduction and movement of plants, plant products and other objects into and within all Member States. They require that an official statement is made that *Fragaria* materials originate in areas known to be free from SCV, or that no symptoms of the strawberry crinkle disease have been observed on plants at the place of production since the beginning of the last complete cycle of vegetation.

In addition, Annex V, which lists plants, plant products and other objects which must be subject to a plant health inspection before being moved within the Community or permitted to enter the Community, mandates that plants intended for planting, other than seeds of the genus *Fragaria*, must be accompanied by a plant passport. Such a passport would need to include information on the absence of SCV given its listing in Annex IIAII.

Finally, Annex IIIA, independently of Annex IIAII, lists plants, plant products and other objects, the introduction of which is prohibited in all Member States. Among the listed plants are plants of *Fragaria* L., intended for planting, other than seeds and originating from non-European countries other than Mediterranean countries, Australia, New Zealand, Canada and the continental states of the USA. In addition, derogations for Argentina and Chile from the import prohibition of Annex IIIA are provided by Commission Decision 2003/248/EC (amended by Commission Decision 2011/74/EC) and Commission Decision 2003/249/EC (amended by Commission Decision 2011/75/EC). These derogations are not specifically formulated for SCV but cover all harmful organisms, in particular those listed in the Annexes of Commission Decision 2000/29/EC. The special requirements of these derogations are far more stringent than those of Annex IVA, nonetheless, partly rely on visual inspection of plants.

The Panel's opinion on the effectiveness of the present EU requirements in reducing the risk of introduction of SCV into, and spread within, the EU territory is based on the analysis of Annexes IIAII, III, IV and V. In reaching its conclusions, the Panel considered the following elements:

- SCV is reported in many countries outside the EU and, in particular, in at least some of the countries benefiting from an import exception or derogation in Annex IIIA or in Commission Decision 2011/74/EC amending Commission Decision 2003/248/EC7 and Commission Decision 2011/75/EC amending Commission Decision 2003/249/EC. The protective value of the Annex III regulation is therefore viewed as limited.

- Imports of *Fragaria* spp. plants for planting from third countries are limited (EFSA, 2014).

- The legislation covers the only known natural hosts of SCV (*Fragaria* spp.) but the virus may have a few other natural hosts.

- In the current situation, a relevant contribution to reducing the risks of SCV is made by certification schemes adopted by a well-developed nursery industry to improve the phytosanitary status of *Fragaria* plant material for planting. SCV is among the pathogens addressed by the certification protocols.

Overall, given the restricted host range of SCV and the minor significance of the plant parts of host plants pathway, the current legislation appears to have few weaknesses. As explained above, the

Annex III legislation is, however, seen by the Panel as being considerably weakened by import exceptions or derogations offered to countries in which SCV is present and, as in the case of the USA, sometimes widespread. Similarly, the Annex IVA requirements are analyzed as being of limited value given the limitations of visual inspections for the detection of SCV.

4.6.2. Consequences of removing the pest from Annex IIAII

If the current legislation aimed at preventing the introduction and spread of SCV were to be removed, the ban on the introduction into and movement within the EU of this virus in plants for planting of *Fragaria* would be withdrawn. Such deregulation may have a benefit for exporters outside and within the EU (for intra-EU trade) because trade would be less restricted.

In its analysis of the consequences of removing SCV listing from Annex IIAII, the Panel considered that:

- SCV is already present and widely distributed within the EU.
- Imports of *Fragaria* spp. plants for planting into the EU are limited.
- The protection afforded by Annexes IIIA and IVA are considered to be limited (see previous section).
- In the current situation, a relevant contribution to reducing the risks of SCV is made by certification schemes adopted by a well-developed nursery industry to improve the phytosanitary status of *Fragaria* plant material for planting. SCV is among the pathogens addressed by the certification protocols.
- Further protection against the consequences of SCV is provided by new crop production practices that are more and more widely used (short production cycles, protected cultivation, etc.).

In reaching its conclusions, the Panel considered that revoking the IIAII regulation would have consequences for other elements of the Council Directive 2000/29/EC, particularly on the specific requirements laid down in Annexes IV and V, and that the mandatory requirements for official statements on pest freedom of production areas, plant inspection activities and freedom from symptoms in traded plants would therefore be correspondingly relaxed.

Fragaria plants are covered by several regulations specified in Annexes of the Council Directive 2000/29/EC. Those listings concern other pathogens, viruses and virus-like organisms listed in Annexes IAI (non-European viruses and virus-like organisms) and IIAII. Revoking of the SCV regulation would not affect these other regulations, and therefore does not mean that strawberry planting materials would arrive and move within the EU without being indexed for pathogens.

Plants for planting of *Fragaria* are produced following comprehensive certification schemes for propagation materials voluntarily applied by the industry. These are also specified in an EPPO certification scheme (EPPO, 2008). The EPPO standards also recommend laboratory testing (ELISA, PCR) in addition to regular visual monitoring of the general status of the plants with respect to pests, diseases or unknown symptoms. It is likely that the industry adheres to these standards partly to comply with Council Directive 2000/29/EC and partly to ensure product quality. Given the potential impact of SCV and its even stronger impact in case of mixed infection with other agents such as SMYEV or SMoV, it can be assumed that even if the current IIAII regulation was lifted, the industry would continue to include SCV in the present non-mandatory certification schemes.

If the current regulation were to be removed, no major consequences or changes in the potential impact of SCV would be expected. This is largely owing to the important level of protection afforded

to the industry by the efficient and widely used strawberry certification scheme, which is regarded by the Panel as reducing the risks of introduction, spread and consequences in a very significant fashion. The weaknesses identified in the current legislation (Annexes IIIA and IVA) also limit the consequences predicted if these measures were to be removed.

If, on the other hand, the current legislation was removed and the industry simultaneously ceased or reduced its non-mandatory certification activity or excluded SCV and other viruses such as SMYEV or SMoV from the list of organisms addressed, a return to a high prevalence of these viruses might be expected, with ensuing damage.

CONCLUSIONS

After consideration of the evidence, the Panel reached the following conclusions:

With regard to the assessment of the risk to plant health of *Strawberry crinkle virus*, for the EU territory, this virus is currently established in the risk assessment area and in other strawberry-growing regions of the world. SCV has an aphid vector, the strawberry aphid (*Chaetosiphon fragaefolii*), which occurs widely in the risk assessment area and which has the potential to contribute to the local spread of SCV at least during the hottest period of the year in a large part of the risk assessment area. The major crops at risk, *Fragaria* spp., are cultivated throughout the EU.

Under the current phytosanitary measures, the conclusions of the pest risk assessment conducted by the Panel are as follows:

Entry

The Panel identified two pathways, plants for planting of *Fragaria* spp. (excluding seeds and pollen) and plant parts of host plants. Only the first pathway, considered as most significant, was evaluated in detail. The probability of entry - based on the most restrictive step of the entry process – was rated as **unlikely to moderately likely** with the associated uncertainty rated as high. SCV is present outside Europe and confirmed from many countries. Given that it does not always induce remarkable foliar symptoms, SCV presence could potentially be overlooked in some countries. The pathway of entry for strawberry, however, is regulated and exceptions or derogations exist for only a few countries. It can be assumed that strawberry planting material from most countries with an import exception/derogation is produced within certification schemes to ensure high product quality and virus freedom. Certification systems may not however be 100 % effective, as illustrated by recent outbreaks of strawberry decline in the US and Canada. Based on these factors, the association with the pathway at origin is estimated as unlikely to moderately likely. SCV in its hosts is very likely to survive transport and storage while the existing management procedures are expected to have only limited effects on the virus so that the survival of management procedures is rated as moderately likely. The probability of transfer to a suitable host is rated as very likely since, in the plants for planting pathway, the virus is present in a susceptible host that will be planted and grown for one or several seasons. The main uncertainties concern (1) the estimation of the exact quantities of plants for planting imported into Europe; (2) the distribution of the virus outside the EU and its association with imported plants; and (3) the efficiency of inspections of strawberry planting material consignments.

Establishment

The probability of establishment was rated as **very likely** with low uncertainty. SCV is already established in many EU Member States and the same applies to its main vector, *C. fragaefolii*. EU ecoclimatic conditions are not expected to significantly affect SCV establishment wherever these conditions are suitable for its primary hosts, cultivated and wild strawberries. Currently used cultural practices and control measures are unlikely to significantly impede establishment. The associated uncertainty is low, as the presence of SCV in many EU Member States is confirmed and all environmental and biological preconditions for the virus to establish are met.

Spread

Local spread by natural means was rated as **moderately likely**. Susceptible host plants and an aphid vector are present in many EU Member States. Vector-mediated transmission is however not as efficient as for other strawberry viruses such as *Strawberry mild yellow edge virus* (SMYEV). Aphid-mediated transmission is unlikely to be completely inhibited by climatic factors in a wide range of EU Member States. It may be impacted in some areas by the effect of low temperatures on the duration of the virus latency period. The associated uncertainty is high, as there is limited knowledge on the size of vector populations. There is also no information on the potential impact of fluctuating temperatures (closer to real life conditions) on the length of the latency period of SCV in its vectors and thus on the extent to which climatic conditions may affect aphid-mediated transmission. Furthermore, there is lack of information on potential reservoirs in the uncultivated environment. Long-distance spread via human-assisted means is **unlikely,** since non-mandatory certification schemes in place efficiently prevent the dissemination of virus-infected planting material. The level of uncertainty is medium because of the lack of data on volumes of intra-EU trade of plants for planting and on virus incidence.

Consequences

Consequences were assessed as **minimal to minor** with medium uncertainty. SCV may cause significant losses in strawberry production but consequences are considered marginal by the industry (EFSA, 2014), with the possible exception of cases of mixed infections. The actual consequences of the disease are limited by several factors including (1) the existence of efficient and widely adopted certification systems for strawberry plants; and (2) the use of short cropping cycles in modern strawberry cultivation, limiting the incidence of infected plants and of virus spread by vectors. There are no identified environmental consequences. The associated uncertainty is medium, as there is limited precise recent information available on the actual damage caused by SCV.

With regard to risk reduction options, the Panel identified risk reduction options and evaluated their effectiveness and feasibility in reducing the risk of introduction, spread and the magnitude of consequences. It then evaluated the current phytosanitary measures against the introduction and spread of SCV listed in Council Directive 2000/29/EC, and explored the possible consequences if these measures were to be removed.

None of the risk reduction options explored was considered to have a very high effectiveness in reducing the risk of introduction. However, prohibition, certifications schemes or limiting imports to planting materials produced in pest free areas (PFAs) or pest-free production sites (PFPSs) provided that appropriate tests are used, were rated as having a high effectiveness. Their technical feasibility was rated as low to moderate (PFAs), moderate (PFPSs), high (prohibition) or very high (certification). The associated uncertainty was rated as low (certification) or medium (PFAs, PFPSs, prohibition). Concerning containment, no option was evaluated as having very high effectiveness and three options (certification, PFAs, PFPSs) were identified as being the most effective. In addition, it should be noted that the combination of options (cultural practices, use of tolerant varieties, certification, use of exclusion conditions) has an overall high to very high level of effectiveness in limiting consequences as well as a very high feasibility.

Given the restricted host range of SCV and the limited volume of imports of plants for planting, the current legislation appears to have few weaknesses. The Annex IIIA legislation is, however, analyzed as being considerably weakened by import exceptions or derogations offered to countries where SCV is reportedly present and, as in the case of the USA, sometimes widespread. Similarly, the Annex IVA requirements are analyzed as being of little value given the limitations of visual inspections for the detection of SCV.

If the current regulation were to be removed, no major consequences are expected. This is largely owing to the important level of protection afforded to the industry by the efficient and widely used certification scheme for *Fragaria* spp., which is regarded by the Panel as reducing the risk of

introduction, the risk of spread and the magnitude of consequences in a very significant way. The weaknesses identified in the current legislation (Annexes IIIA and IVA) also limit the consequences predicted if these measures were to be removed.

If, however, the current legislation were removed and the industry simultaneously ceased or reduced its non-mandatory certification activity, or excluded SCV from the list of organisms addressed, a return to a high prevalence of this virus in *Fragaria* would be expected.

DOCUMENTATION PROVIDED TO EFSA

Request (see Background and Terms of Reference) to provide a scientific opinion on the risks to plant health of *Arabis mosaic virus*, *Tomato black ring virus*, *Raspberry ringspot virus*, *Strawberry latent ringspot virus*, *Strawberry crinkle virus*, *Strawberry mild yellow edge virus*, *Daktulosphaira vitifoliae* (Fitch), *Eutetranychus orientalis* Klein, *Parasaissetia nigra* (Nietner), *Clavibacter michiganensis* spp. *michiganensis* (Smith) Davis et al., *Xanthomonas campestris* pv. *vesicatoria* (Doidge) Dye, *Didymella ligulicola* (Baker, Dimock and Davis) v. Arx, and *Phytophthora fragariae* Hickmann var. *fragariae*, for the EU territory; SANCO.E2 GC/ap (2012) 1011925, 19 July 2012. Submitted by the European Commission, DG SANCO (Directorate General for Health and Consumers).

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APPENDIX - RATINGS AND DESCRIPTORS

In order to follow the principle of transparency as described under Paragraph 3.1 of the Guidance document on the harmonised framework for risk assessment (EFSA PLH Panel, 2010)—'Transparency requires that the scoring system to be used is described in advance. This includes the number of ratings, the description of each rating … the Panel recognizes the need for further development'—the Plant Health Panel has developed specifically for this opinion rating descriptors to provide clear justification when a rating is given.

1. Ratings used in the conclusion of the pest risk assessment

In this opinion of EFSA's Plant Health Panel for the risk assessment of *Strawberry mild yellow edge virus* and the evaluation of the effectiveness of the risk reduction options, a rating system of five levels with their corresponding descriptors has been used to formulate separately the conclusions on entry, establishment, spread and consequences as described in the following tables.

1.1. Rating of probability of entry

Rating for entry	Descriptors
Very unlikely	The likelihood of entry would be very low because the pest: 1. is not or is only very rarely associated with the pathway at the origin; 2. cannot survive during transport or storage; 3. cannot survive the current pest management procedures existing in the risk assessment area; 4. cannot transfer to a suitable host in the risk assessment area
Unlikely	The likelihood of entry would be low because the pest: 1. is rarely associated with the pathway at the origin; 2. can survive at a very low rate during transport or storage; 3. is strongly limited by the current pest management procedures existing in the risk assessment area; 4. has effective limitations for transfer to a suitable host in the risk assessment area
Moderately likely	The likelihood of entry would be moderate because the pest: 1. is occasionally associated with the pathway at the origin; 2. can survive at a low rate during transport or storage; 3. is limited by the current pest management procedures existing in the risk assessment area; 4. has some limitations for transfer to a suitable host in the risk assessment area
Likely	The likelihood of entry would be high because the pest: 1. is frequently associated with the pathway at the origin; 2. can survive during transport or storage; 3. is unlikely to be limited by the current pest management procedures existing in the risk assessment area; 4. has very few limitations for transfer to a suitable host in the risk assessment area
Very likely	The likelihood of entry would be very high because the pest: 1. is always or almost always associated with the pathway at the origin; 2. always survives during transport or storage; 3. is not limited by the current pest management procedures existing in the risk assessment area; and/or 4. has no limitations for transfer to a suitable host in the risk assessment area

1.2. Rating of probability of establishment

Rating for establishment	Descriptors
Very unlikely	The likelihood of establishment would be very low because of the absence or very limited availability of host plants; the unsuitable environmental conditions; and the occurrence of other considerable obstacles preventing establishment
Unlikely	The likelihood of establishment would be low because of the limited availability of host plants; the unsuitable environmental conditions over the majority of the risk assessment area; and the occurrence of other obstacles preventing establishment.
Moderately likely	The likelihood of establishment would be moderate because hosts plants are abundant in few areas of the risk assessment area; environmental conditions are suitable in few areas of the risk assessment area; and no obstacles to establishment occur.
Likely	The likelihood of establishment would be high because hosts plants are widely distributed in some areas of the risk assessment area; environmental conditions are suitable in some areas of the risk assessment area; and no obstacles to establishment occur. Alternatively, the pest has already established in some areas of the risk assessment area.
Very likely	The likelihood of establishment would be very high because hosts plants are widely distributed; environmental conditions are suitable over the majority of the risk assessment area; and no obstacles to establishment occur. Alternatively, the pest has already established in the risk assessment area.

1.3. Rating of probability of spread

Rating for spread	Descriptors
Very unlikely	The likelihood of spread would be very low because: 1. the pest has only one specific way to spread (e.g. a specific vector, specific assisting virus…) which is not present in the risk assessment area; 2. highly effective barriers to spread exist; 3. the hosts are not or very rarely present in the area of possible spread
Unlikely	The likelihood of spread would be low because: 1. the pest has one to few specific ways to spread (e.g. specific vectors, specific assisting virus) and the occurrence of the pest in the risk assessment area is rare; 2. effective barriers to spread exist; 3. the hosts are occasionally present
Moderately likely	The likelihood of spread would be moderate because: 1. the pest has few specific ways to spread (e.g. specific vectors, specific assisting virus) and the occurrence of the pest in the risk assessment area is limited; 2. partially effective barriers to spread exist; 3. the hosts are abundant in few parts of the risk assessment area.
Likely	The likelihood of spread would be high because: 1. the pest has some non-specific ways to spread (mechanical transmission…), which occur in the risk assessment area; 2. no effective barriers to spread exist; 3. the hosts are widely present in some parts of the risk assessment area
Very likely	The likelihood of spread would be very high because: 1. the pest has multiple non-specific ways to spread (mechanical transmission…), which all occur in the risk assessment area; 2. no effective barriers to spread exist; 3. the hosts are widely present in the whole risk assessment area

1.4. Rating of magnitude of the potential consequences

Rating of potential consequences	Descriptors
Minimal	Differences in crop production (saleable fruits, tubers, plants for planting, seed, etc.) are within normal day-to-day variation; no additional control measures are required
Minor	Crop production (saleable fruits, tubers, plants for planting, seed, etc.) is rarely reduced or at a limited level; additional control measures are rarely necessary
Moderate	Crop production (saleable fruits, tubers, plants for planting, seed, etc.) is occasionally reduced to a limited extent; additional control measures are occasionally necessary
Major	Crop production (saleable fruits, tubers, plants for planting, seed, etc.) is frequently reduced to a significant extent; additional control measures are frequently necessary
Massive	Crop production (saleable fruits, tubers, plants for planting, seed, etc.) is always or almost always reduced to a very significant extent (severe crop losses that compromise the harvest); additional control measures are always necessary

2. Ratings used for the evaluation of the risk reduction options

The Panel developed the following ratings with their corresponding descriptors for evaluating the effectiveness of the risk reduction options to reduce the level of risk.

2.1 Rating of the effectiveness of risk reduction options

Rating	Descriptors
Negligible	The risk reduction option has no practical effect in reducing the probability of entry, establishment or spread, or the magnitude of potential consequences.
Low	The risk reduction option reduces, to a limited extent, the probability of entry, establishment or spread, or the magnitude of potential consequences.
Moderate	The risk reduction option reduces, to a substantial extent, the probability of entry, establishment or spread, or the magnitude of potential consequences.
High	The risk reduction option reduces the probability of entry, establishment or spread, or the magnitude of potential consequences, by a major extent.
Very high	The risk reduction option essentially eliminates the probability of entry, establishment or spread, or any potential consequences.

2.2 Rating of the technical feasibility of risk reduction options

Rating	Descriptors
Negligible	The risk reduction option is not in use in the risk assessment area, and the many technical difficulties involved (e.g. changing or abandoning the current practices, implementing new practices and or measures) make their implementation in practice impossible.
Low	The risk reduction option is not in use in the risk assessment area, but the many technical difficulties involved (e.g. changing or abandoning the current practices, implementing new practices and or measures) make its implementation in practice very difficult.

Moderate	The risk reduction option is not in use in the risk assessment area, but it can be implemented (e.g. changing or abandoning the current practices, implementing new practices and or measures) with some technical difficulties
High	The risk reduction option is not in use in the risk assessment area, but it can be implemented in practice (e.g. changing or abandoning the current practices, implementing new practices and or measures) with limited technical difficulties.
Very high	The risk reduction option is already in use in the risk assessment area or can be easily implemented with no technical difficulties.

3. Ratings used for describing the level of uncertainty

For the risk assessment chapter—entry, establishment, spread and consequences—as well as for the evaluation of the effectiveness of the risk reduction options, the level of uncertainty has been rated separately in coherence with the descriptors that have been defined specifically by the Panel in this opinion.

Rating	**Descriptors**
Low	No or little information or no or a small amount of data is missing, incomplete, inconsistent or conflicting. No subjective judgement is introduced. No unpublished data are used.
Medium	Some information is missing or some data are missing, incomplete, inconsistent or conflicting. Subjective judgement is introduced with supporting evidence. Unpublished data are sometimes used.
High	Most information is missing or most data are missing, incomplete, inconsistent or conflicting. Subjective judgement may be introduced without supporting evidence. Unpublished data are frequently used.