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SCIENTIFIC OPINION

Scientific Opinion on the risk to plant health posed by *Strawberry mild yellow edge virus* to the EU territory with the identification and evaluation of risk reduction options[1]

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

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ABSTRACT

The Panel on Plant Health assessed the risk to plant health of *Strawberry mild yellow edge virus* (SMYEV) 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 very likely with low uncertainty. The probability of local spread by natural means is moderately likely to likely, with medium 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 inefficient visual inspection as well as the exceptions or derogations offered to some countries in which SMYEV 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 mild yellow edge virus, Potexvirus, Chaetosiphon fragaefolii, risk assessment, risk reduction options

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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 mild yellow edge virus* (SMYEV) 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 Panel on Plant Health, 2010) of the 'Guidance on evaluation of risk reduction options' (EFSA PLH Panel, 2012). As SMYEV 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 mild yellow edge virus*, for the EU territory, this virus is currently established in the risk assessment area and in other strawberry-growing regions of the world. SMYEV has an efficient 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 SMYEV. 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:

<u>Entry</u>

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. SMYEV is present outside Europe and confirmed in many countries. Wherever strawberries are grown, its presence can be assumed. 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. Yet, the presence of SMYEV can be overlooked, as evidenced by recent outbreaks in Canada and the USA. Based on these factors, the association with the pathway at origin is estimated as unlikely to moderately likely. SMYEV 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.

<u>Establishment</u>

The probability of establishment was rated as **very likely** with low uncertainty. SMYEV 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 the establishment of SMYEV 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 SMYEV 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 to likely**. Susceptible host plants and an efficient aphid vector are already present in many EU Member States. The associated uncertainty is medium, as there is limited knowledge on the efficiency of vector-mediated spread and on the size of vector populations. 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. SMYEV does not cause significant damage or losses in most of the currently used strawberry varieties and consequences are considered marginal by the industry (EFSA, 2014), with the possible exception of cases of mixed infections. The actual impact of the disease is 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. Serious impact is, however, observed when SMYEV occurs in mixed infection with other strawberry viruses, causing strawberry decline. There are no identified environmental consequences. The associated uncertainty is medium, as there is limited precise recent information available on the actual damages caused by SMYEV.

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 SMYEV 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 SMYEV 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 SMYEV 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 low effectiveness of visual inspections for the detection of SMYEV infections.

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 SMYEV 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 mild yellow edge virus* (hereinafter referred to as SMYEV) 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 SMYEV 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 SMYEV 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 SMYEV 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 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.

[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.

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

Strawberry mild yellow edge (SMYE) disease was first described in California in 1922 (Converse, 1987; Jelkmann et al., 1990) and later recognized as a widespread and common disease in strawberry plants (Martin and Tzanetakis, 2006). The identification of the disease was initially based on the development of symptoms in artificially inoculated indicator *Fragaria* spp. plants (Harris and King, 1942; Frazier, 1975).

Initial efforts at the characterization of the causal agent of SMYE led to conflicting results and to significant confusion. However, a *Potexvirus* initially described as Strawberry mild yellow edge-associated virus (Jelkmann et al., 1990, 1992) and later renamed *Strawberry mild yellow edge virus* (Lamprecht and Jelkmann, 1997) has been consistently found associated with all sources of the SMYE disease investigated (Jelkmann et al., 1990; Hepp and Martin, 1992; Kaden-Kreuziger et al., 1995; Quail et al., 1995). It has now been conclusively proven to be the sole agent responsible for SMYE, by the reproduction of the disease in susceptible indicator plants by inoculation of an infectious cDNA clone of SMYEV (Lamprecht and Jelkmann, 1997, 1998).

A lot of the initial confusion on the identity of the causal agent of SMYE involved hypotheses or results suggesting that it likely belonged to the *Luteovirus* group. Among the hints pointing at such an etiology are the persistent aphid transmission of the disease and its yellowing-type symptomatology. The hypothesis of a luteovirus etiology was later reinforced by various findings, including the observation of spherical, luteovirus-like particles in thin sections of infected plants (Yoshikawa et al., 1984), the partial purification of such spherical particles (Martin and Converse, 1985) and the observation of a serological relationship between these particles and *Beet western yellows virus* (Spiegel et al., 1986). The detection, in infected plants, of double-stranded RNAs (dsRNA) with molecular weights similar to those of the luteoviruses *Barley yellow dwarf virus* and *Beet western yellows virus* was also reported (Spiegel, 1987).

In retrospect, most of these results can probably be explained by either the observation of the SMYEV *Potexvirus* itself (viral dsRNAs) or by the presence, in some strawberry plants, of asymptomatic and then unknown spherical viruses such as *Fragaria chiloensis cryptic virus* (Tzanetakis et al., 2008).

Following the discovery of SMYEV and the conclusive demonstration of its role in the disease, the possibility that the simultaneous presence of a luteovirus might be responsible for the unusual transmission biology was entertained (Hepp and Martin, 1992). However, this hypothesis could not be confirmed by Rojas et al. (2013) in more recent experiments involving the high-throughput sequencing of purified nucleic acid molecules from affected plants.

The current understanding of the SMYE disease is therefore that it is caused by a single *Potexvirus*, SMYEV, with an unusual transmission biology. As a consequence, in preparing the assessment that follows, the Panel used either information on the SMYE disease itself or on the SMYEV potexvirus.

3.1.1.1. Taxonomy, detection and identification

SMYEV is a well-characterized member of the *Potexvirus* genus (Jelkmann et al., 1990, 1992; Lamprecht and Jelkmann, 1997). In particular, its genome has been completely sequenced and an infectious cDNA clone obtained (Jelkmann et al., 1992; Lamprecht and Jelkmann, 1997). The diversity of SMYEV has been investigated (Thompson and Jelkmann, 2001; Thompson and Jelkmann, 2004). Significant diversity was observed (up to ~15 % divergence in the 3' region of the genome) and some unusual genomic features appear to be conserved, including a non-AUG initiation codon for open reading frame 2, which encodes the triple gene block protein 1, and overlapping TGB3 and coat protein (CP) genes, features unique in the *Potexvirus* genus. However, there is no indication that the known molecular variability of SMYEV might be associated with phenotypic variability or differences in virulence.

Despite SMYEV variability, efficient detection assays are available. SMYEV can be readily detected, using either enzyme-linked immunoassay (ELISA)-based serological methods (Conci et al., 2009; Jelkmann et al., 1990; Kaden-Kreuziger et al., 1995) or polymerase chain reaction (PCR)-based molecular detection assays (Thompson et al., 2003; Cai et al., 2009). SMYEV can also be detected by biological indexing in susceptible indicator plants (Harris and King, 1942; Frazier, 1975), a technique that was historically used to differentiate the SMYE disease from other diseases such as the pseudo mild yellow edge disease, which is now known to be associated with a *Carlavirus* (Yoshikawa and Inoyue, 1986).

SMYEV can be eliminated from infected plants using either meristem tip culture (Miller and Belkengren, 1963), a combination of thermotherapy and meristem tip culture (Converse and Tanne, 1984) or cryotherapy (Cai et al., 2008).

3.1.1.2. Host range

SMYEV has a restricted host range since *Fragaria* species are its only known natural hosts (Martin et al., 1989). Successful inoculation by graft transmission has demonstrated *Rubus rosifolius* and *Potentilla reptans* to be experimental hosts (Yohalem et al., 2009). Mechanical inoculation experiments have shown that the virus is able to replicate and cause local lesions in *Chenopodium quinoa*, *C. murale* and *C. foetidum* but that it is unable to spread in these local lesion hosts (Lamprecht and Jelkmann, 1997, 1998).

3.1.1.3. Diseases and symptomatology

SMYEV is the causal agent of the SMYE disease of strawberry (Lamprecht and Jelkmann, 1997). Although there are few data on the precise evaluation of the impact of the disease, it is clear that there is a great deal of variability in the level of damage observed, probably as a consequence of both viral variability and differences in varietal susceptibility (Potter, 1940; Martin and Tzanetakis, 2006). In addition, it should be stressed that the precise sanitary status of plants used in old publications is frequently unclear, making their interpretation difficult.

Besides the leaf marginal yellowing symptoms, which have given its name to the disease, reduction in fruit yield of between 0 % to about 30 % has been reported (Converse, 1987; Martin and Tzanetakis, 2006). In some varieties, a strong reduction in the number of runners and the number of young plants produced per infected mother plant has also been reported (Aerts, 1976, 1980). Susceptible varieties also develop dwarfing and leaf distortions (Martin and Tzanetakis, 2006).

Many varieties do not, however, express clear symptoms or damage (Barritt and Loo, 1973; Martin and Tzanetakis, 2006; Martin et al., 2013) and many, if not most, cultivars grown today are considered tolerant to SMYEV (Martin and Tzanetakis, 2006). However, symptoms may be greatly exacerbated in cases of mixed infection with other viruses, in particular *Strawberry crinkle virus* (SCV), *Strawberry mottle virus* (SMoV) or *Strawberry pallidosis virus* (SPaV). Disease symptoms can then be particularly severe, impacting plant vigour and yield (Barritt and Loo, 1973; Martin and Tzanetakis, 2006; Martin et al., 2013).

3.1.1.4. Vector species and transmission

Potexviruses are not usually vector borne, but SMYEV is transmitted by the strawberry aphid *Chaetosiphon fragaefolii* (Cockerell) (Homoptera: Aphididae) (Massee, 1935; Converse, 1979; Krczal, 1979). All stages of *C. fragaefolii* (larvae, apterous and alate adults) efficiently transmit SMYEV (Krczal, 1980). Although it is not straightforward to reconcile the precise details from the literature, the transmission parameters for SMYEV most closely resemble those of persistently transmitted viruses, with a relatively long acquisition period of a few hours to a couple of days (Engelbrecht, 1967; Krczal, 1980) and a long retention period of several days, during which the aphids remain viruliferous and can transmit the virus to healthy plants (Engelbrecht, 1967).

Transmission by *C. fragaefolii* is an efficient process with up to 16 % experimental transmission observed using a single aphid per plant (Krczal, 1980). In the field, after two experimental years, plants grown initially from healthy seeds were found to be 50 % infected with SMYEV (Miller, 1965). In another experiment, Shanks (1965) observed rapid short-distance spread (3.7 m) during a growing season, presumably as a consequence of apterous aphids movement. Indicator plants positioned 11 m from source plants showed 6 % infection after a single growing season, but no spread was detected further away.

In addition to *C. fragaefolii*, there is evidence that some other species within the *Chaetosiphon* genus might also be able to vector SMYEV. These include *C. minor* (Frazier, 1975) and the dark strawberry aphid, *C. jacobi* (Blackman and Eastop, 2000). As for other potexviruses, SMYEV is also transmissible mechanically through the wounding of plants (Lamprecht and Jelkmann, 1997, 1998) and by grafting (Martin et al., 1989). However, experimental mechanical transmission of viruses to strawberry plants is notoriously difficult (Converse, 1987), so that this process is not expected to make a significant contribution to SMYEV spread under field conditions. SMYEV is transmitted by vegetative propagation of infected hosts, resulting in the production of infected daughter plants. SMYEV is not reported to be seed or pollen transmitted.

3.1.2. Current distribution

3.1.2.1. Global distribution of SMYEV

SMYEV is reported from all five continents (Figure 1). In the USA, SMYEV was detected in all production areas at rates varying between 4 and 68 % (11.5 % California, 53 % Pacific North-west, 4 % Midwest, 39 % South-east, 68 % Northeast) (Martin and Tzanetakis, 2013) In recent years, the virus has also been reported in Korea (Cho et al., 2011), Argentina (Conci et al., 2009) and Mexico (Silva-Rosales et al., 2013).

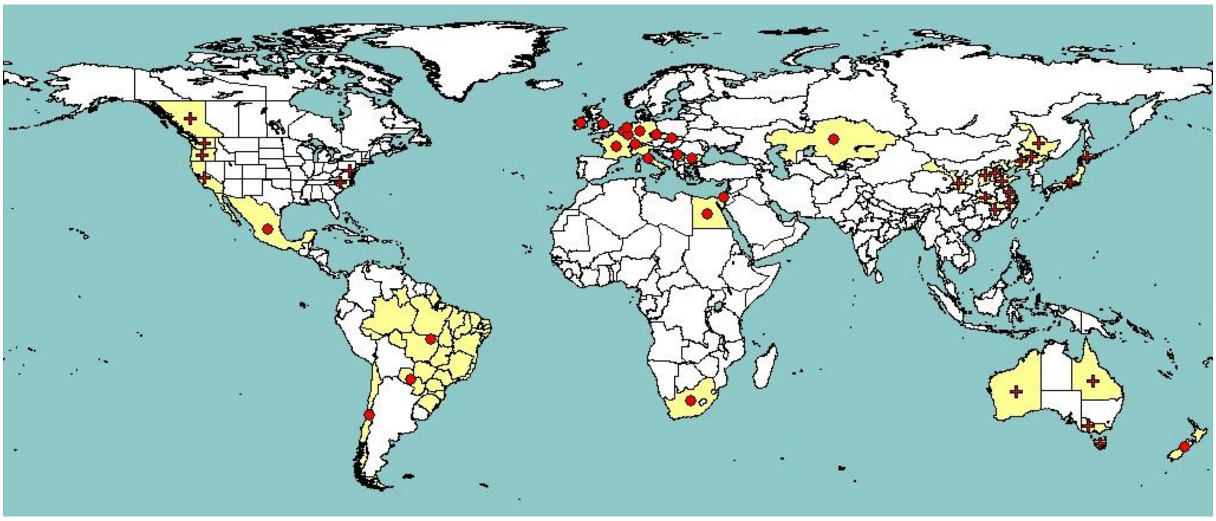

Figure 1: Global distribution map for *Strawberry mild yellow edge virus* (extracted from EPPO PQR, version 5.0 accessed in November 2013). Red circles represent pest presence as national records and red crosses represent pest presence as subnational records (note that this figure combines information from different dates, some of which could be out of date).

3.1.2.2. Distribution of SMYEV in the risk assessment area

As indicated by the answers to a questionnaire sent by EFSA to Member States, the presence of SMYEV is reported in 12 countries (Belgium, Bulgaria, Czech Republic, France, Germany, Hungary, Ireland, Italy, Luxembourg, Netherlands, Romania and the United Kingdom) (Table 1). Given that it does not necessarily induce remarkable symptoms in many recent strawberry varieties, SMYEV is likely to be present in a number of other Member States. Data on the presence or absence of the organism is not available in Croatia, Latvia and Spain. The virus is reported as absent in Iceland and Norway.

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

Member State	***Strawberry mild yellow edge virus***
Austria	**Absent**, no pest records
Belgium	**Present**, at low prevalence. 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 found on strawberry in the provinces of Antwerp (three locations, 2012), Limburg (two locations, 2012), East-Flanders (one location in 2011 and in 2012, also positive for SLRV in 2012) and West Flanders (two locations in 2011, both negative for SMYEV in 2012 but one positive for SLRV in 2012). The pest was also found in co-infections with SCV on strawberry at three locations (provinces East-Flanders (2012), Limburg (2011) and Liège (2011)). Besides the survey in the production companies, a collection of old strawberry varieties brought together in the framework of another project was tested. Here, five samples tested positive for SMYEV and two samples were co-infected with SCV and SMYEV.
Bulgaria	**Present**, no details
Croatia	– (no data at NPPO)
Cyprus	**Absent**, not surveyed
Czech Republic	**Present**, restricted distribution

Member State	*Strawberry mild yellow edge virus*
Denmark	**Absent**, no pest records
Estonia	**Absent**, no pest records
Finland	**Absent**, no pest records
France	**Present**, restricted distribution
Germany	**Present**, few occurrences
Greece[(a)]	**Absent**, not known to occur
Hungary	**Present**, restricted distribution
Ireland	**Present**, restricted distribution
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)]	**Present**, no details
Malta	**Absent**, not known to occur
Netherlands	**Present**, restricted distribution
Poland	**Absent**, pest no longer present
Portugal	**Absent**, not known to occur
Romania	**Present**, restricted distribution
Slovakia	**Absent**
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, few occurrences **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 (2012) 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 inside 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 and the Fauna europaea (data retrieved in January 2014)

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

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

3.1.3. Regulatory status in the risk assessment area

3.1.3.1. Legislation directly addressing the pathogen

SMYEV 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**
13. Strawberry mild yellow edge 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 mild yellow edge 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 mild yellow edge 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 SMYEV 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 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.

[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.

- 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

SMYEV 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).

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 SMYEV vector, the strawberry aphid *C. fragaefolii*, is reported to be widely distributed in the risk assessment area (Table 2), although knowledge about its precise distribution is rather limited.

3.1.4.3. Suitability of the environment

SMYEV 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 SMYEV differ substantially from those of its *Fragaria* host plants, which are generally well adapted to EU conditions.

3.1.5. Potential for consequences in the risk assessment area

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

3.1.6. Conclusion on pest categorisation

SMYEV 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 efficient local spread of SMYEV. 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 SMYEV 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 SMYEV suggest that the current impact of SMYEV is limited and 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 fulfil the terms of reference of this assessment, a detailed risk assessment is required.

3.2. Probability of entry

SMYEV is present in at least 12 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 SMYEV 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 SMYEV 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 only a single report on interception of SMYEV 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

SMYEV 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 or, very inefficiently, by mechanical 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.

Therefore, the Panel 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

SMYEV has a restricted host range and to date has been found in nature only in wild and cultivated *Fragaria* spp. plants. SMYEV is widely distributed and found in many countries inside and outside Europe, predominantly in cultivated strawberry plants, but also in wild *F. chiloensis* grown far distant from any cultivation (Hepp and Martin, 1992; Rojas et al., 2010, 2013). However, besides reports on the occurrence of SMYEV, there is little quantitative data on the prevalence of SMYEV. A systematic survey conducted in the USA found an incidence of SMYEV in cultivated strawberry of between 4 and 68 % (Martin and Tzanetakis, 2013). Depending on virus isolate and cultivar, SMYEV symptoms may vary, but most cultivars grown commercially are tolerant to infection with only mild or no symptoms when the virus occurs in single infections (Martin and Tzanetakis, 2013). Because of this limited symptomatology and the fact that systematic surveys are rarely performed, it can be assumed that SMYEV has a more widespread occurrence than currently recorded.

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. Still, recent reports on severe decline diseases of strawberry in the USA and Canada (Martin et al., 2013; Martin and Tzanetakis, 2013) provide evidence that mixed infections involving SMYEV in plants for planting can be overlooked, even in certification systems, resulting in serious disease outbreaks.

In conclusion, considering the restricted movement of strawberry planting materials into the EU, the near 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 SMYEV 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 SMYEV 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, SMYEV 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, unlikely to have significant effectiveness (see above evaluation of visual inspection). 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 near 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 SMYEV of surviving existing pest management procedure is moderately likely with moderate to high uncertainty.

3.2.2.4. Probability of transfer to a suitable host

SMYEV entering with infected propagation material, is in a conducive 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 SMYEV to susceptible hosts and subsequent spread is efficient when *Chaetosiphon* aphid vectors are present. Thus, transfer of SMYEV 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	SMYEV is present outside Europe and confirmed in many countries. Wherever strawberries are grown, its presence can be assumed. 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 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. SMYEV 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

SMYEV 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*. While SMYEV has so far only been reported on *Fragaria*, several potential other host plants also exist. In particular, *P. reptans*, a common weed is experimentally susceptible to SMYEV and once infected could serve as a virus reservoir, maintaining the virus in the environment (Yohalem et al., 2009). With *C. fragaefolii* aphids serving as efficient virus vectors also present in many European countries all preconditions are met to support establishment of SMYEV in Europe.

3.3.2. Suitability of the environment

As for other plant viruses, biological functions of SMYEV 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 SMYEV 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

SMYEV infection is often associated with inconspicuous or mild symptoms (particularly in the currently used strawberry varieties) and the virus may remain undetected when plants are inspected for symptoms. Hence, virus-infected plants are unlikely to be identified unless appropriate detection methods are used. The existence of aphid-mediated transmission, which is unusual for Potexviruses, provides an efficient means for virus dissemination.

3.3.5. Conclusions on the probability of establishment

Rating	Justification
Very likely	SMYEV 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 SMYEV establishment wherever these conditions are suitable for SMYEV primary hosts,

Rating	Justification
	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	SMYEV 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

Under experimental conditions, SMYEV can be mechanically transmitted to a number of indicator host plants. However, mechanical inoculation of strawberry plants is notoriously difficult, so that, under field conditions, mechanical SMYEV transmission through wounding of plants (inflicted by machinery for weeding, etc.), albeit possible, is likely to be negligible. On the other hand, SMYEV is transmitted by *Chaetosiphon* spp. aphids, the most prominent one being *C. fragaefolii*. This aphid is present in many EU Member States and reported to be an efficient vector (Miller, 1965; Shanks, 1965; Krczal, 1980) and thus aphid transmission represents the most important route of natural spread. The probability of local spread by natural means is, therefore, evaluated by the Panel to be moderately likely to likely with medium uncertainty, mostly associated with uncertainties of the size of the vector populations and on the efficiency of spread.

3.4.2. Long distance spread by human assistance

Similar to other viruses, SMYEV 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 mode of transmission, SMYEV can also be transmitted by viruliferous aphids associated with plant consignments, provided that susceptible plants become available within the retention period of the virus in 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 SMYEV 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 SMYEV 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 efficient aphid vector, it is unlikely that this virus can be contained.

3.4.4. Conclusions on the probability of spread

Rating	Justification
Moderately likely to likely for local spread by natural means	Susceptible host plants and an efficient aphid vector are present in many EU Member States.
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
Medium for local spread by natural means	Limited knowledge on efficiency of vector-mediated spread and on size of vector populations. 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 incidence.

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 and is an efficient vector. Favourable environmental conditions for the virus and its vector exist widely in the EU, as indicated by the broad distribution of the virus. 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

SMYEV alone is not particularly damaging to most strawberry cultivars (Converse, 1987; Martin and Tzanetakis, 2006), but susceptible cultivars may show marginal chlorosis, leaf distortion, stunting and yield reduction (Martin and Tzanetakis, 2006). Field trials conducted by several research groups, summarized by Converse (1987), revealed that neither vigor nor fruit yield was significantly reduced by SMYEV. However, in susceptible cultivars, such as the variety 'Gorella', a 30 % reduction in fruits per plant was recorded. In addition, in susceptible varieties, a strong reduction in the number of runners and in the number of young plants produced per infected mother plant has also been reported (Aerts, 1976, 1980). Symptoms in strawberry are thus dependent on cultivar/variety considered and, potentially, on virus viability and on environmental conditions (Martin and Tzanetakis, 2006).

However, most modern cultivars grown commercially are tolerant to virus infection and show only very mild, if any, symptoms (Martin and Tzanetakis, 2006).

SMYEV, however, shows synergistic interactions with other viruses, resulting in very severe decline symptoms. This is particularly the case with SmoV (Martin and Tzanetakis, 2013) and SCV, but also with other viruses infecting strawberry such as SPaV. Mixed infections involving SMYEV result in severe loss of plant vigor, yield, and fruit quality. The recent outbreak of severe strawberry decline reported from Canada and USA (Martin and Tzanetakis, 2013) involved a mixed infection of SMYEV and SMoV. The disease was expressed as discoloration, chlorosis, reddening, stunting of root system and leaves. The plants progressively weakened, little or no fruits were produced and severe decline resulted in plant death. Similarly, mixed infections of SMYEV and SCV are known as ‘xanthosis’, yellows or yellow-edge (Converse, 1987). Symptom severity frequently varies with the number of the viruses contributing to the disease complex.

In current production systems, involving the use of certified, virus-free planting material and rapid crop turnover with annual or bi-annual crop cycles, the prevalence of virus-infected plants is generally low and inoculum build-up limited. Overall, damage by SMYEV in largely tolerant cultivars 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 SMYEV 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

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

3.6.3. Conclusions on the assessment of consequences

Rating	Justification
Minimal to minor	SMYEV does not cause important damage or losses in most of the currently used strawberry varieties and impact is 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 voluntary 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. Serious impact is, however, observed when SMYEV occurs in mixed infection with other strawberry viruses, causing strawberry decline. 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 SMYEV.

4. Identification and evaluation of risk reduction options

The structure of this section is as follows. Phytosanitary measures to prevent the entry of SMYEV 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 SMYEV and the consequences of deregulation are finally presented in Section 4.6.

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. Given that most of the currently used cultivars are generally tolerant to SMYEV (Martin and Tzanetakis, 2006) and given the existence of an efficient aphid vector, visual inspection of symptoms is not considered adequate.

Effectiveness: low.

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

Uncertainty: low.

(ii) Specified testing at the place of production

The presence of SMYEV 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 SMYEV persistent mode of transmission indicate that insecticides might be at least partially effective in reducing virus spread. However, there is no precise information in the literature to support this analysis.

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

Most commercial strawberry varieties have tolerance to SMYEV while resistance to SMYEV is not known (Martin and Tzanetakis, 2006).

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 SMYEV 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 SMYEV, 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 SMYEV 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, SMYEV 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 SMYEV 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.

(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 SMYEV 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.

[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

Because SMYEV 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 SMYEV-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 SMYEV of 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

Most of the currently used strawberry varieties express few or no symptoms in SMYEV single infections and are considered tolerant (Martin and Tzanetakis, 2006). Thus, visual inspection is not effective to identify consignments containing SMYEV-infected plants.

Effectiveness: low.

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

Uncertainty: low.

(ii) Specified testing of the consignment

The presence of SMYEV 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 SMYEV 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, SMYEV 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 SMYEV infections as well as the fact that most current strawberry varieties appear to be tolerant, resulting in largely asymptomatic infections, 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 that SMYEV-infected plants do not develop obvious symptoms, 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: effectiveness high if, throughout the quarantine process, plants are routinely tested for the presence of SMYEV.

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 SMYEV 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 SMYEV, 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

SMYEV 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 SMYEV 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 SMYEV 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 SMYEV, the enforcement of a strawberry-free period might be considered as an additional interesting component of an eradication effort. SMYEV 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 SMYEV, it should be stressed that the combination of the use of largely tolerant commercial cultivars, 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 SMYEV-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 SMYEV 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 SMYEV 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	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	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 SMYEV presence)	Low (large number of plants) High (limited number of plants)	Low
		Internal surveillance at the places of production or distribution in the	Low to moderate	Moderate	Low

Level of action of option	Category of options	Type of measure	Effectiveness	Technical feasibility	Uncertainty
		PRA area			
		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 …)	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 SMYEV are present in Annexes II and IV of Council Directive 2000/29/EC (see Section 3.1.3). In Annex IIAII, SMYEV 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 SMYEV, or that no symptoms of the SMYE 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 SMYEV 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 SMYEV 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 SMYEV 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:

- SMYEV is reported in many countries outside the EU and, particularly, 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 SMYEV (*Fragaria* spp.) but the virus may have a few other natural hosts.

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

Overall, given the restricted host range of SMYEV 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 SMYEV 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 low effectiveness of visual inspections for the detection of SMYEV.

4.6.2. Consequences of removing the pest from Annex IIAII

If the current legislation aimed at preventing the introduction and spread of SMYEV 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 SMYEV listing from Annex IIAII, the Panel considered that:

- SMYEV 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 SMYEV is made by certification schemes adopted by a well-developed nursery industry to improve the phytosanitary status of *Fragaria* plant material for planting. SMYEV is among the pathogens addressed by the certification protocols.
- Most currently used strawberry varieties appear to be tolerant and to express few or no symptoms in case of single infection by SMYEV.
- Further protection against the consequences of SMYEV 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 SMYEV 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 strong potential impact of SMYEV in cases of mixed infection with other agents such as SCV or SMoV, it can be assumed that even if the current IIAII regulation was lifted, the industry would continue to include SMYEV 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 SMYEV 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.

If, on the other hand, the current legislation was removed and the industry simultaneously ceased or reduced its non mandatory certification activity or excluded SMYEV and other viruses such as SCV 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 mild yellow edge virus*, for the EU territory, this virus is currently established in the risk assessment area and in other strawberry-growing regions of the world. SMYEV has an efficient aphid vector, the strawberry aphid (*C. fragaefolii*), which occurs widely in the risk assessment area and which has the potential to contribute to the local spread of SMYEV. 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. SMYEV is present outside Europe and confirmed in many countries. Wherever strawberries are grown, its presence can be assumed. 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. Yet, the presence of SMYEV can be overlooked, as evidenced by recent outbreaks in Canada and the USA. Based on these factors, the association with the pathway at origin is estimated as unlikely to moderately likely. SMYEV 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. SMYEV 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 the establishment of SMYEV 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 SMYEV 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 to likely**. Susceptible host plants and an efficient aphid vector are already present in many EU Member States. The associated uncertainty is medium, as there is limited knowledge on the efficiency of vector-mediated spread and on the size of vector populations. 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. SMYEV does not cause significant damage or losses in most of the currently used strawberry varieties and consequences are considered marginal by the industry (EFSA, 2014), with the possible exception of cases of mixed infections. The actual impact of the disease is 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. Serious impact is, however, observed when SMYEV occurs in mixed infection with other strawberry viruses, causing strawberry decline. There are no identified environmental consequences. The associated uncertainty is medium, as there is limited precise recent information available on the actual damages caused by SMYEV.

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 SMYEV 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 SMYEV 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 SMYEV 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 low effectiveness of visual inspections for the detection of SMYEV infections.

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 SMYEV 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

Appendix A. 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 recognises 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

Rating for spread	Descriptors
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.