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Pest categorisation of Apium virus Y

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Abstract

Following a request from the EU Commission, the EFSA Panel on Plant Health conducted a pest categorisation of Apium virus Y (ApVY) for the EU territory. The identity of the ApVY, a member of the genus *Potyvirus* (family *Potyviridae*), is well established and reliable detection methods are available. The pathogen is not included in EU Commission Implementing Regulation 2019/2072. ApVY, considered endemic in Australia, was reported also in New Zealand and USA. In the EU, the virus was identified in Germany and Slovenia. No information on adoption of official control measures is available. In natural conditions, ApVY infects plant species of the family Apiaceae (i.e. celery, coriander, dill, parsley, bishop's weed) in which it generally induces leaf symptoms and/or stunting. In some hosts (i.e. parsley and poison hemlock), ApVY may be asymptomatic. The virus is transmitted in a non-persistent manner by the aphid *Myzus persicae* which is widespread in the EU. Although ApVY transmission through seeds has been experimentally excluded for some hosts (i.e. poison hemlock and celery), uncertainty exists for the other hosts because seed transmission is not uncommon for potyvirids. Plants for planting, including seeds for sowing, were identified as potential pathways for entry of ApVY into the EU. Cultivated and wild hosts of ApVY are distributed across the EU. Economic impact on the production of the cultivated hosts is expected if further entry and spread in the EU occur. Phytosanitary measures are available to prevent further entry and spread of the virus. Currently, ApVY does not fulfil the criterion of being absent or present with restricted distribution and under official control to be regarded as a potential Union quarantine, unless official control is implemented. This conclusion is associated with high uncertainty regarding the current virus distribution in the EU.

Keywords: Apiaceae, ApVY, *Myzus persicae*, pest risk, plant health, plant pest, *Potyvirus*, *Potyviridae*, quarantine

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1. Introduction

1.1. Background and Terms of Reference as provided by the requestor

1.1.1. Background

The new Plant Health Regulation (EU) 2016/2031, on the protective measures against pests of plants, is applying from 14 December 2019. Conditions are laid down in this legislation in order for pests to qualify for listing as Union quarantine pests, protected zone quarantine pests or Union regulated non-quarantine pests. The lists of the EU regulated pests together with the associated import or internal movement requirements of commodities are included in Commission Implementing Regulation (EU) 2019/2072. Additionally, as stipulated in the Commission Implementing Regulation 2018/2019, certain commodities are provisionally prohibited to enter in the EU (high risk plants, HRP). EFSA is performing the risk assessment of the dossiers submitted by exporting to the EU countries of the HRP commodities, as stipulated in Commission Implementing Regulation 2018/2018. Furthermore, EFSA has evaluated a number of requests from exporting to the EU countries for derogations from specific EU import requirements.

In line with the principles of the new plant health law, the European Commission with the Member States are discussing monthly the reports of the interceptions and the outbreaks of pests notified by the Member States. Notifications of an imminent danger from pests that may fulfil the conditions for inclusion in the list of the Union quarantine pest are included. Furthermore, EFSA has been performing horizon scanning of media and literature.

As a follow-up of the above-mentioned activities (reporting of interceptions and outbreaks, HRP, derogation requests and horizon scanning), a number of pests of concern have been identified. EFSA is requested to provide scientific opinions for these pests, in view of their potential inclusion by the risk manager in the lists of Commission Implementing Regulation (EU) 2019/2072 and the inclusion of specific import requirements for relevant host commodities, when deemed necessary by the risk manager.

1.1.2. Terms of Reference

EFSA is requested, pursuant to Article 29(1) of Regulation (EC) No 178/2002, to provide scientific opinions in the field of plant health.

EFSA is requested to deliver 53 pest categorisations for the pests listed in Annex 1A, 1B, 1D and 1E (for more details see mandate M-2021-00027 on the Open.EFSA portal). Additionally, EFSA is requested to perform pest categorisations for the pests so far not regulated in the EU, identified as pests potentially associated with a commodity in the commodity risk assessments of the HRP dossiers (Annex 1C; for more details see mandate M-2021-00027 on the Open.EFSA portal). Such pest categorisations are needed in the case where there are not available risk assessments for the EU.

When the pests of Annex 1A are qualifying as potential Union quarantine pests, EFSA should proceed to phase 2 risk assessment. The opinions should address entry pathways, spread, establishment, impact and include a risk reduction options analysis.

Additionally, EFSA is requested to develop further the quantitative methodology currently followed for risk assessment, in order to have the possibility to deliver an express risk assessment methodology. Such methodological development should take into account the EFSA Plant Health Panel Guidance on quantitative pest risk assessment and the experience obtained during its implementation for the Union candidate priority pests and for the likelihood of pest freedom at entry for the commodity risk assessment of High Risk Plants.

1.2. Interpretation of the Terms of Reference

Apium virus Y is one of a number of pests listed in Annex 1 to the Terms of Reference (ToR) (Section 1.1.2.1) to be subject to pest categorisation to determine whether it fulfils the criteria of a regulated pest for the area of the EU excluding Ceuta, Melilla and the outermost regions of Member States referred to in Article 355(1) of the Treaty on the Functioning of the European Union (TFEU), other than Madeira and the Azores, and so inform European Commission decision-making as to its appropriateness for potential inclusion in the lists of pests of Commission Implementing Regulation (EU) 2019/ 2072. If a pest fulfils the criteria to be potentially listed as a regulated pest, specific import requirements for relevant host commodities will be identified; for pests already present in the EU additional risk reduction options to slow spread will be identified.

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A literature search on Apium virus Y was conducted at the beginning of the categorisation in the ISI Web of Science bibliographic database, using the scientific name of the pest as search term. Papers relevant for the pest categorisation were reviewed, and further references and information were obtained from experts, as well as from citations within the references and grey literature.

2.1.2. Database search

Pest information, on host(s) and distribution, was retrieved from CABI crop compendium database and relevant publications. Additional searches for hosts and distribution of the pest were performed using GenBank.

Data about the import of commodity types that could potentially provide a pathway for the pest to enter the EU and about the area of hosts grown in the EU were obtained from EUROSTAT (Statistical Office of the European Communities).

The Europhyt and TRACES databases were consulted for pest-specific notifications on interceptions and outbreaks. Europhyt was a web-based network run by the Directorate General for Health and Food Safety (DG SANTÉ) of the European Commission as a subproject of PHYSAN (Phyto-Sanitary Controls) specifically concerned with plant health information. TRACES is the European Commission's multilingual online platform for sanitary and phytosanitary certification required for the importation of animals, animal products, food and feed of non-animal origin and plants into the European Union, and the intra-EU trade and EU exports of animals and certain animal products. Up until May 2020, the Europhyt database managed notifications of interceptions of plants or plant products that do not comply with EU legislation, as well as notifications of plant pests detected in the territory of the Member States and the phytosanitary measures taken to eradicate or avoid their spread. The recording of interceptions switched from Europhyt to TRACES in May 2020.

2.1.3. Information on pest status from NPPOs

In the context of the current mandate, EFSA is preparing pest categorisations for new/emerging pests that are not yet regulated in the EU and for which, when the pest is reported in an MS, an official pest status is not always available. In order to obtain information on the official pest status for this pest, EFSA has consulted the NPPOs of Germany and Slovenia. The results of this consultation with NPPOs on pest status are presented in Section 3.2.2.

2.2. Methodologies

The Panel performed the pest categorisation for Apium virus Y, following guiding principles and steps presented in the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018), the EFSA guidance on the use of the weight of evidence approach in scientific assessments (EFSA Scientific Committee, 2017) and the International Standards for Phytosanitary Measures No. 11 (FAO, 2013) and No. 21 (FAO, 2004).

The criteria to be considered when categorising a pest as an EU-regulated quarantine pest (QP) is given in Regulation (EU) 2016/2031 article 3. Table 1 presents the Regulation (EU) 2016/2031 pest categorisation criteria on which the Panel bases its conclusions. In judging whether a criterion is met the Panel uses its best professional judgement (EFSA Scientific Committee, 2017) by integrating a range of evidence from a variety of sources (as presented above in Section 2.1) to reach an informed conclusion as to whether or not a criterion is satisfied.

The Panel's conclusions are formulated respecting its remit and particularly with regard to the principle of separation between risk assessment and risk management (EFSA founding regulation (EU) No 178/2002); therefore, instead of determining whether the pest is likely to have an unacceptable impact, deemed to be a risk management decision, the Panel will present a summary of the observed impacts in the areas where the pest occurs, and make a judgement about potential likely impacts in the EU. Whilst the Panel may quote impacts reported from areas where the pest occurs in monetary terms, the Panel will seek to express potential EU impacts in terms of yield and quality losses and not in monetary terms, in agreement with [insert appropriate reference to EFSA not reporting impacts in financial/monetary terms] Article 3 (d) of Regulation (EU) 2016/2031 refers to unacceptable social impact as a criterion for quarantine pest status. Assessing social impact is outside the remit of the Panel.

Table 1: Pest categorisation criteria under evaluation, as defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

Criterion of pest categorisation	Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest (article 3)
Identity of the pest (Section 3.1)	Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible?
Absence/presence of the pest in the EU territory (Section 3.2)	Is the pest present in the EU territory? If present, is the pest widely distributed within the EU? Describe the pest distribution briefly
Regulatory status (Section 3.3)	If the pest is present in the EU but not widely distributed in the risk assessment area, it should be under official control or expected to be under official control in the near future.
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	Is the pest able to enter into, become established in, and spread within, the EU territory? If yes, briefly list the pathways
Potential for consequences in the EU territory (Section 3.5)	Would the pests' introduction have an economic or environmental impact on the EU territory?
Available measures (Specific import requirements) (Section 3.6)	Are there measures available to prevent the entry into the EU such that the likelihood of introduction becomes mitigated?
Conclusion of pest categorisation (Section 4)	A statement as to whether (1) all criteria assessed by EFSA above for consideration as a potential quarantine pest were met and (2) if not, which one(s) were not met.

3. Pest categorisation

3.1. Identity and biology of the pest

3.1.1. Identity and taxonomy

Is the identity of the pest established, or has it been shown to produce consistent symptoms and/or to be transmissible?

Yes, the identity of Apium virus Y is well established

Apium virus Y (ApVY) is classified in a species (*Apium virus Y*) belonging to the genus *Potyvirus* in the family *Potyviridae*, order *Patatavirales* (https://talk.ictvonline.org/taxonomy/). Non-enveloped virus particles are filamentous, flexuous, 680–900 nm in length and 11–13 nm wide, containing a monopartite single-stranded positive-sense RNA molecule. The fully sequenced genomic RNA consists of *ca*. 9,900 nucleotides (nt) and possesses a VPg at the 5'end and a poly(A) tail at the 3' end. The genomic RNA of ApVY has been completely sequenced and the reference sequence is publicly available in GenBank database under the accession number NC_014905 (Xu et al., 2011). As generally reported for potyviruses, ApVY genomic RNA contains one open reading frame (ORF), coding for a large polyprotein of 3,184 amino acids (aa) (320 kDA), which is self-cleaved to give 10 mature protein products (P1, HC-Pro, P3, 6K1, CI, 6K2, VPg, NIa-Pro, NIb and CP), having protease, polymerase, VPg, aphid transmission or coat functions (Xu et al., 2011; Wylie et al. 2017).

The EPPO code[1] (Griessinger and Roy, 2015; EPPO, 2019) for this species is: APVY00 (EPPO, online).

3.1.2. Biology of the pest

ApVY is reported to infect plant species of the family Apiaceae in which it may induce leaf mosaic, interveinal chlorosis, vein clearing, leaf crumple, deformation and/or stunting. Infection of some hosts, such as parsley and the weed poison hemlock (*Conium maculatum*), may be asymptomatic (Eastwell et al., 2008; Tian et al., 2008), suggesting these plants may act as reservoirs for ApVY (Eastwell et al., 2008; Koike et al., 2012). ApVY has been mechanically transmitted to several hosts in the family Apiaceae and to *Nicotiana benthamiana* (family Solanaceae) (Appendix A), in which symptoms of chlorosis, chlorotic ring, crumple, mottling, necrotic local lesions, necrotic line pattern and vein clearing or stunting were observed (Xu et al., 2011). The virus has been experimentally transmitted by the green peach aphid (*Myzus persicae*) to several hosts (Xu et al., 2011; Koike et al., 2012), supporting a role of non-persistent aphid transmission in the virus natural spread. Whether other aphid species would be involved in the virus spread is unknown. Seeds from infected poison hemlock and celery (*Apium graveolens*) plants may test positive for the virus at harvest, but virus transmission to the seedlings has not been confirmed, suggesting that the virus can be located at the seed surface, without being able to infect the seedlings of these plant species (Xu et al., 2011; Koike et al., 2012). No information is available on seed transmission for other hosts of ApVY. However, seed transmission in the family *Potyviridae* is not uncommon (Simmons and Munkvold, 2014; Wiley et al., 2017). Transmission by pollen is not reported for ApVY and members of the family *Potyviridae* are generally not reported to be pollen-transmitted (Card et al., 2007).

3.1.3. Host range

Both natural and experimental hosts are known for ApVY. Natural infections have been reported in cultivated species of the family Apiaceae, such as celery (*Apium graveolens* L.), coriander (*Coriandrum sativum* L.), parsley (*Petroselinum crispum* Mill.) and bishop's weed (*Ammi majus* L.), and in weed hosts, such as poison hemlock (*Conium maculatum* L.). Other natural hosts may also exist. Several species of the families Apiaceae and Chenopodiaceae, and *Nicotiana benthamiana* (family Solanaceae) have been reported as experimental hosts of ApVY. A detailed list of natural and experimental hosts of ApVY is reported in Appendix A.

3.1.4. Intraspecific diversity

Due to the error-prone viral replication system and the subsequent selection of the fittest variants in a certain environment, viruses have the typical features of quasi-species (Andino and Domingo, 2015). This means that, even in a single host, they accumulate as a cluster of closely related sequence variants slightly differing from each other. Therefore, a certain level of intraspecific diversity is expected for all viruses. This genetic variability may interfere with the efficiency of detection methods, especially when they are based on amplification of variable genomic viral sequences, thus generating uncertainties on the reliability and/or sensitivity of the detection methods for all the existing viral isolates.

Three full genome sequences of ApVY (ranging in size from 9,917 to 9,936 nt) and nine partial coding sequences (ranging in size from 387 to about 1,700 nt) are currently available in the NCBI GenBank database (https://www.ncbi.nlm.nih.gov/nucleotide/). Xu et al. (2011) performed a phylogenetic analysis based on the deduced coat protein sequences of eight ApVY isolates and showed that isolates from the USA, except for one isolate infecting celery from Washington state, cluster separately from those reported in Australia, supporting a limited long-distance dispersal of the virus. The same authors stated that additional data on isolates from the same and other regions would be needed to achieve a more complete picture of the genomic stability and evolutionary history of ApVY. Since 2011, additional ApVY sequences have been submitted to NCBI GenBank database only from Slovenia (from parsley isolates collected in 2016). Overall, the available data on genetic variability of ApVY are considered limited.

[1] An EPPO code, formerly known as a Bayer code, is a unique identifier linked to the name of a plant or plant pest important in agriculture and plant protection. Codes are based on genus and species names. However, if a scientific name is changed, the EPPO code remains the same. This provides a harmonised system to facilitate the management of plant and pest names in computerised databases, as well as data exchange between IT systems (Griessinger and Roy, 2015; EPPO, 2019).

3.1.5. Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, detection and identification methods are available for ApVY

ApVY was initially identified by RT-PCR, using a poly-dT primer and degenerated primers for detecting most members of the family *Potyviridae* (Gibbs and Mackenzie, 1997; Chen et al., 2001), followed by restriction fragment length polymorphism (RFLP) assay and/or direct sequencing of the amplicons (Moran et al., 2002; Eastwell et al., 2008; Tian et al., 2008). Several primer pairs for the specific detection of ApVY by RT-PCR have been designed in the coat protein gene of the virus (Tang et al., 2007; Tian et al., 2008; Koike et al., 2012). However, considering the limited available data on ApVY genetic variability (see Section 3.1.3) and the lack of specific validation tests, there is uncertainty on whether these primer pairs may detect the majority of ApVY isolates. A serological method to specifically detect ApVY by double-antibody sandwich ELISA is commercially available. ApVY has been recently identified in parsley also by high-throughput sequencing (HTS) and bioinformatic analysis (Mehle et al., 2019); however, this methodology is not yet applied to large-scale surveys.

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

ApVY was first identified in Australia (Moran et al., 2002), where it is considered endemic (Gibbs et al., 2008). The virus was then reported in New Zealand (Tang et al., 2007) and in the USA, where it was identified in Florida (Baker et al., 2008), California (Tian et al., 2008; Koike et al., 2012) and Washington State (Eastwell et al., 2008). In a survey during 2007–2009 in three locations of Monterey and Santa Clara counties in California, ApVY was detected in 52 out of 74 celery samples (70%) and 45 out of 63 poison hemlock samples (71%), respectively, indicating that the ApVY infection in these plants was common in the area (Xu et al., 2011). Details on ApVY distribution outside EU are summarised in Figure 1 and in Appendix B.

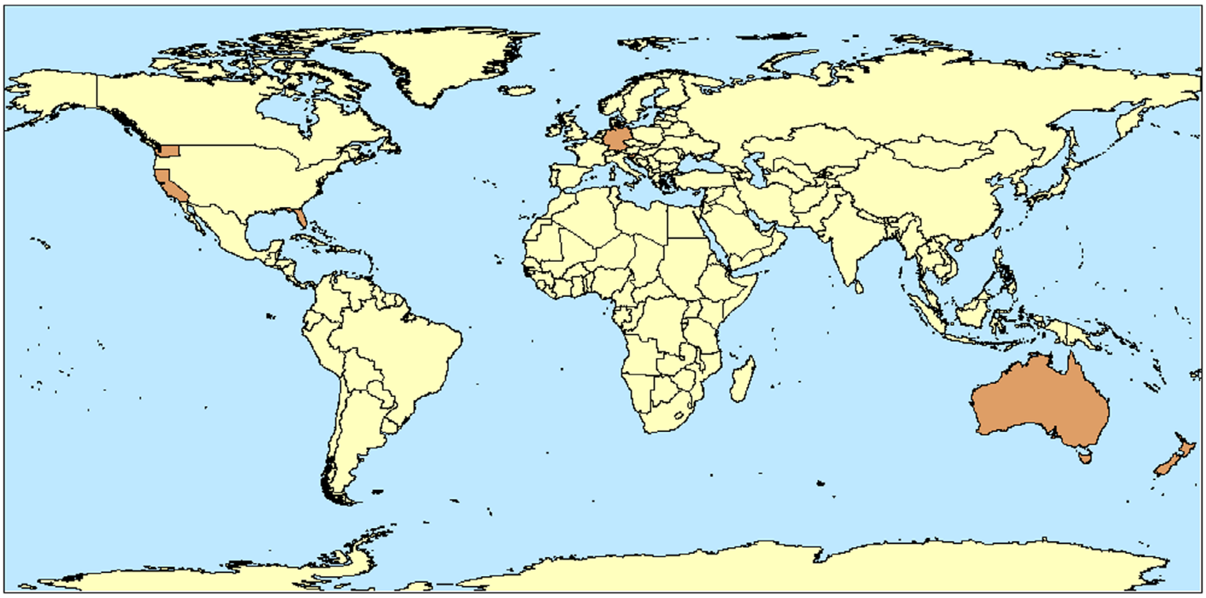

Figure 1: Global distribution map for Apium virus Y

3.2.2. Pest distribution in the EU

Is the pest present in the EU territory? If present, is the pest widely distributed within the EU?

Yes, the pest has been reported in Slovenia and Germany. ApVY is not widely distributed in the EU territory, with uncertainty.

ApVY was reported in Slovenia on plants of parsley growing in a private garden (in 2014) and in a production field (in 2016) (Mehle et al., 2019). In both cases, the virus was detected in mixed infection with another potyvirus, carrot thin leaf virus (CTLV), although plants infected by ApVY alone were also reported (Mehle et al., 2019). Although systematic surveys on Apiaceae crops were not carried out in Slovenia, CTLV was detected again by high-throughput sequencing in 2019 and 2020 in weeds, while ApVY was not detected (Slovenian NPPO).

A personal communication by Dr. H. Josef Vetten, reported in Gibbs et al. (2008) and Koike et al. (2012), stated that ApVY is common in Germany in parsley, celery and dill (*Anethum graveolens*). The German NPPO was contacted for information on the presence of ApVY and possible adopted measures and the following information was received via the Julius Kühn Institute. According to information gathered from the Plant Protection Services of the German Federal Länder and supplemented by data available at the JKI Institute for Epidemiology and Pathogen Diagnostics, since the year 2003 there were records about findings of ApVY in samples (~ 20) taken from different hosts of the family Apiaceae. The virus was found in at least four Federal Länder. The vast majority of samples originated from parsley, and individual samples were taken from dill (*Anethum graveolens*), celery (*Apium graveolens*) and coriander (*Coriandrum sativum*). Samples were collected from conventional and organic production of these herbs and from private gardens. In addition, Dr. Wulf Menzel informed by written communication that an ApVY isolate from dill (*Anethum* sp.) originating from a small town (Riddagshausen) near Braunschweig/Lower Saxony is included, since 2010, in the DSMZ – German Collection of Microorganisms and Cell Cultures GmbH of the Leibniz Institute (https://www.dsmz.de/collection/catalogue/details/culture/PV-1001). The ApVY isolate infecting dill was collected in the frame of a project dating back to 2005 and added to DSMZ collection in 2010. ApVY was identified by RT-PCR followed by amplicon sequencing and by ELISA. Dr. W. Menzel also informed the Panel that he is not aware of specific surveys on the ApVY performed during the last 10 years. Based on information gathered from the Plant Protection Services of the German Federal Länder and supplemented by data available at the JKI Institute for Epidemiology and Pathogen Diagnostics, no targeted monitoring has been carried out; therefore, it is not possible to estimate the actual distribution of ApVY in Germany (Julius Kühn-Institut, written communication).

Based on the above, ApVY is present in Germany and Slovenia (Figure 1). However, there is uncertainty on the current virus distribution in these Member States and in the EU territory.

3.3. Regulatory status

3.3.1. Commission Implementing Regulation 2019/2072

ApVY is not listed in Annex II of Commission Implementing Regulation (EU) 2019/2072, the implementing act of Regulation (EU) 2016/2031.

3.3.2. Hosts of Apium virus Y that are prohibited from entering the Union from third countries

None of the host plants of ApVY, either natural or experimental, are prohibited from entering the Union from third countries under Commission Implementing Regulation (EU) 2019/2072.

3.3.3. Legislation addressing the organisms that vector Apium virus Y (Commission Implementing Regulation 2019/2072)

The known vector of ApVY, the green peach aphid *Myzus persicae*, is not regulated under Commission Implementing Regulation (EU) 2019/2072.

3.4. Entry, establishment and spread in the EU

3.4.1. Entry

Is the pest able to enter into the EU territory? If yes, identify and list the pathways

Yes, ApVY is able to enter in the EU. Potential pathways are plants for planting, including seeds

Comment on plants for planting as a pathway

No information on international trade of ApVY host plants for planting is available.

Akin other viruses, ApVY moves together with the host plants. Therefore, host plants for planting are a potential entry pathway, although there is no evidence of trade of plants for planting of ApVY hosts from non-EU countries in Eurostat. Conversely, imports of fresh and chilled edible hosts from countries where ApVY is present are reported in Eurostat. The data on these commodities are aggregated with other non-ApVY host plants (Table 3). *Ammi majus* is used as a cut flower, but no information on imports of this commodity is available in Eurostat. Fresh produce for consumption or floristry could provide a potential for virus entry. Aphid vectors could acquire the virus from infected fresh produce and later transmit it, as shown for other potyviruses such as papaya ringspot virus and zucchini yellow mosaic virus from melons, and plum pox virus from peach fruits (Lecoq et al., 2003; Gildow et al., 2004). However, considering the relatively unlikely set of events involved (aphids feeding on imported fresh produce then moving to susceptible plants), this pathway is considered as minor for the virus introduction. ApVY is transmitted by aphids in a non-persistent way, which implies that viruliferous aphids will lose the ability to transmit the virus within a short period. Therefore, the aphid pathway is considered as negligible and is not listed in Table 2. Data on transmission of ApVY by seeds are limited to poison hemlock (*C. maculatum*) and celery (*A. graveolens*). Seeds from ApVY-infected poison hemlock and celery plants have been shown to be externally infected by the virus, but ApVY, is not transmitted to the seedlings (Xu et al., 2011; Koike et al., 2012). These data allowed to exclude celery seeds as a source of primary inoculum for ApVY in the initial outbreaks of the virus on celery in California in 2007 (Koike et al., 2012). Therefore, although imported seeds of poison hemlock and celery may carry ApVY in the EU, infection of the emerging plants does not occur, thus impairing establishment and further spread of the virus. Anyway, other potyviruses are known to be transmitted by seeds (Simmons and Munkvold, 2014; Wylie et al., 2017). Therefore, it cannot be excluded that seed transmission of ApVY in some hosts other than celery and poison hemlock may play a role in the virus epidemiology. Seeds for sowing of such plant species (i.e. parsley, bishop's weed, dill, coriander) could provide an open entry pathway, with uncertainty as there is no data in Eurostat on seeds of ApVY host plants imported into the EU from third countries in which this virus is present. Potyviruses are generally not transmitted by soil and there is no evidence that this pathway may be relevant in the case of ApVY.

Table 2: Potential pathways for Apium virus Y into the EU 27

Pathways	Life stage	Relevant mitigations [e.g. prohibitions (Annex VI) or special requirements (Annex VII) within Implementing Regulation 2019/2072]
***Ammi majus, Anethum graveolens, Apium graveolens, Coriandrum sativum, Petroselinum crispum* plants for planting**	Not applicable	None
Seeds for sowing of *Petroselinum crispum, Ammi majus, Anethum graveolens, Coriandrum sativum,* and other hosts	Not applicable	None

Table 3: EU 27 annual imports of carrots, turnips, salad beetroot, salsify, celeriac, radishes and similar edible roots, fresh or chilled (CN 0706 90) from countries where Apium virus Y is present, 2016–2020 (Hundreds of kg) Source: Eurostat. Extraction date: 25.5.2021.

Source/Year	2016	2017	2018	2019	2020
New Zealand	8,694.6	0.0	–	–	–
United States	60.89	31.82	150.85	13.7	119.48

Notifications of interceptions began to be compiled in Europhyt in May 1994 and in TRACES in June 2021. As at (29 June 2021) there were no records of interception of ApVY in the Europhyt and Traces databases.

3.4.2. Establishment

Is the pest able to become established in the EU territory?

Yes, the virus could potentially establish wherever the hosts are available in the EU

The presence of ApVY in Germany since at least 2003 and a more recent report from Slovenia indicates that, at least in some parts of the EU territory, establishment is possible. The virus can potentially establish wherever the hosts are available in the EU.

3.4.2.1. EU distribution of main host plants

Natural hosts of ApVY are widespread in the EU. Celery, one of the two cultivated hosts of ApVY, widely occurs in the EU as commercial crop. Details on the celery production areas in individual EU MSs are provided in Table 4. Parsley, another cultivated host of ApVY, is also cultivated in the EU, with several MSs (Belgium, Netherland, France, Poland, Spain) reported to be among the top 10 global exporters of parsley (https://www.tridge.com/intelligences/parsley/export). *A. majus* grows spontaneously in EU MSs, especially in the Mediterranean area, where it is also used for a medicinal purpose and as cut flower (Hossain and Al Touby, 2020).

Table 4: Celery area (cultivation/harvested/production) (1,000 ha). Eurostat database, date of extraction 17/5/2021. 'na' stands for data not available. (Source: https://www.tridge.com/intelligences/parsley/export)

MS/TIME	2016	2017	2018	2019	2020
Belgium	0.42	0.42	0.42	0.39	0.40
Bulgaria	0.00	0.00	0.00	0.00	0.00
Czechia	0.00	0.00	0.00	0.00	0.00
Denmark	0.00	0.00	0.00	0.00	0.00
Germany	0.28	0.33	0.32	0.34	0.36
Estonia	0.00	0.00	0.00	0.00	0.00
Ireland	0.05	0.07	0.07	0.07	0.07
Greece	0.63	0.57	0.37	0.32	0.69
Spain	1.74	1.79	1.88	2.00	2.03
France	0.47	0.49	0.59	0.54	0.60
Croatia	0.00	0.00	0.00	0.00	0.00
Italy	3.08	3.00	3.00	2.93	2.95
Cyprus	0.05	0.05	0.04	0.03	0.03
Latvia	0.00	0.00	0.00	0.00	0.00
Lithuania	0.02	0.02	0.03	0.05	0.04
Luxembourg	0.00	0.00	0.00	0.00	0.00
Hungary	0.01	0.01	0.01	0.01	0.01
Malta	0.00	0.00	0.00	0.00	0.00
Netherlands	0.16	0.20	0.16	0.17	0.19
Austria	0.00	0.00	0.00	0.00	0.00

MS/TIME	2016	2017	2018	2019	2020
Poland	0.37	0.45	0.43	0.40	0.40
Portugal	0.03	0.03	0.02	0.02	0.02
Romania	0.03	0.02	0.02	0.02	0.02
Slovenia	0.04	0.04	0.04	0.05	0.05
Slovakia	0.00	0.00	na	na	na
Finland	0.01	0.11	0.01	0.01	0.01
Sweden	0.04	0.05	0.04	0.05	0.05

3.4.2.2. Climatic conditions affecting establishment

Except for the climatic conditions affecting the hosts, no ecoclimatic constraints exist for ApVY.

3.4.3. Spread

Following its establishment in the EU, ApVY could potentially spread by aphid transmission. Human-assisted spread cannot be excluded.

Comment on plants for planting as a mechanism of spread.

Local trade of ApVY-infected plants for planting could favor the spread of the virus.

ApVY spread in the field is mainly mediated by aphid transmission in a non-persistent manner. *Myzus persicae*, which is present in the EU (Figure 2), has been identified as ApVY vector (Xu et al., 2011; Koike et al., 2012). Contribution of other aphid species to ApVY spread in the field could be possible. Wild hosts may represent natural reservoirs of the virus that could be transmitted by aphids to cultivated crops (Eastwell et al., 2008; Koike et al., 2012). Spread through seeds can be excluded for celery and poison hemlock, but not for some hosts (i.e. bishop's weed, dill, coriander, parsley) for which experimental data on seed transmission are not available. In addition, trade of ApVY-infected plants for planting could favour the spread of the virus, however information on such a trade is not available.

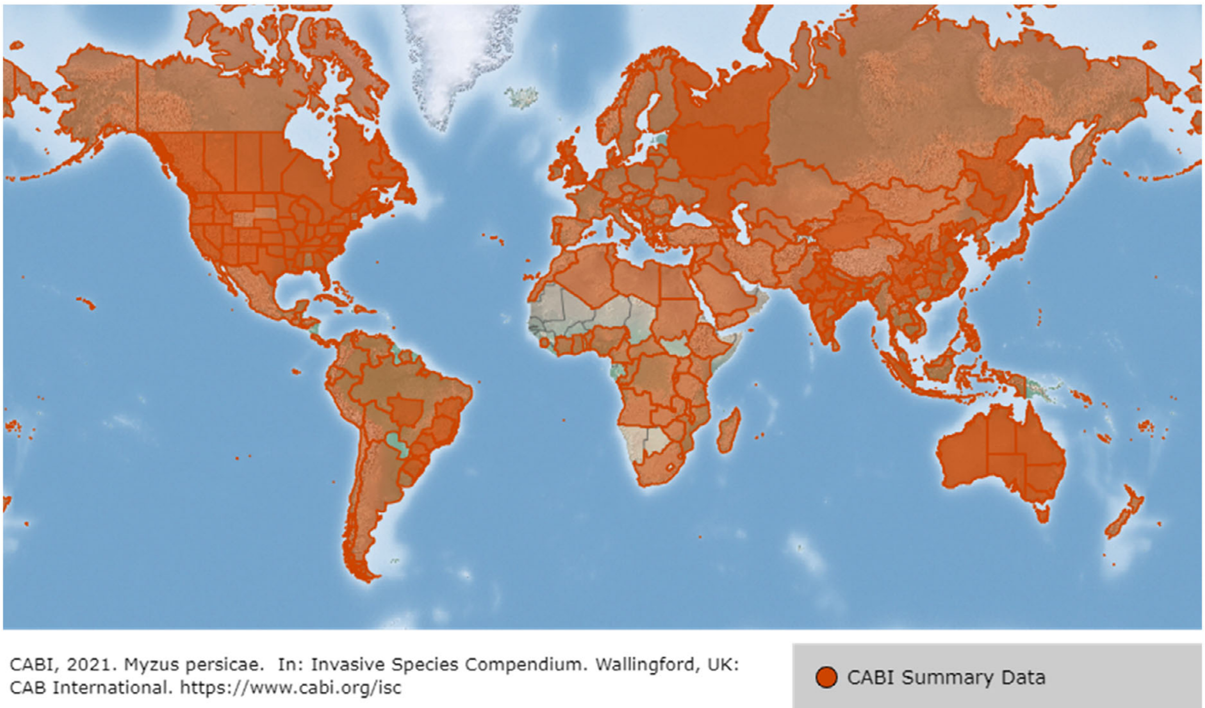

Figure 2: Global distribution map for *Myzus persicae* (extracted from the CABI Crop Compendium accessed on 17 May 2021)

3.5. Impacts

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

Yes, ApVY may induce symptoms in celery, parsley, coriander, bishop's weed and poison hemlock. The introduction (or re-introduction) of ApVY is likely to have yield and quality impacts on the EU territory. The magnitude of the impact under EU conditions is uncertain.

In celery plants, ApVY induces symptoms ranging from slight to severe chlorosis of leaves, which may also show chlorotic or necrotic line patterns, mottling, ring spots on the lamina and necrotic and elongated lesions on the petioles. Severe symptoms make celery plants unmarketable. The severity of symptom expression may vary depending on the celery cultivar (Xu et al., 2011; Koike et al., 2012). Significant economic impact caused by ApVY has been recorded on certain celery cultivars in some areas of California, where up to 55% (2007) and 71% (2008) of symptomatic plants were observed, with the cvs. '414' and 'Utah tall improved' being among the most susceptible (Xu et al., 2011).

Symptoms of mosaic, vein clearing and stunting were reported in ApVY-infected coriander (*Coriandrum sativum*) cultivated in California (Tian et al., 2008). ApVY may induce stunting in dill and chlorosis and leaf crumple in parsley (Xu et al., 2011). However, asymptomatic parsley plants infected by ApVY were reported (Tian et al., 2008; Mehle et al., 2019). In Slovenia, parsley plants showing severe mosaic, leaf distortion and stunting were found to be simultaneously infected by ApVY and carrot thin leaf virus (CTLV), while plants infected by ApVY only were symptomless, thus generating uncertainty on whether the symptoms observed in the field would be caused by any of the two viruses alone or by the mixed infection (Mehle et al., 2019). Also in Germany, symptoms observed on infected plants were rather unspecific and it was difficult to attribute them directly to ApVY as in many cases mixed infections with other viruses were noted. No targeted monitoring was carried out; therefore, it was not possible to estimate the actual ApVY distribution in Germany. No information has been provided on the extent of damage in Germany (Julius Kühn-Institut, written communication).

Ammi majus (bishop's weed) plants showing symptoms of mosaic, vein clearing and leaf rugosity, which rendered the cut flowers unmarketable, were found to be infected by ApVY in Florida (Baker et al., 2008). Leaf mosaic and vein banding symptoms were also reported in weed poison hemlock (*Conium maculatum*) that grew in the edges of celery fields in New Zealand (Tang et al., 2007). However, mature poison hemlock plants in the fields did not show these symptoms in California and Washington State (Xu et al., 2011; Eastwell et al., 2008).

Based on the above, it is expected that the introduction (or re-introduction) of ApVY is likely to cause yield and quality impacts on the EU territory. Nevertheless, the magnitude of the impact under EU conditions is uncertain.

3.6. Available measures and/or potential specific import requirements and limits of mitigation measures

Are there measures available to prevent the entry into the EU such that the risk becomes mitigated?

No measures are in force to prevent the entry of ApVY into the EU on host plants and seeds. Potential additional measures exist to further mitigate the risk of entry and spread (see Section 3.6.1).

3.6.1. Identification of potential additional measures

Potential control measures on hosts that are imported are listed in Table 5.

Table 5: Selected control measures (a full list is available in EFSA PLH Panel, 2018) for pest entry in relation to currently unregulated hosts and pathways

Special requirements summary (with hyperlink to information sheet if available)	Control measure summary in relation to Apium virus Y
Pest freedom	Used to mitigate likelihood of infestation by specified pest at origin, hence to mitigate entry Host plants and plant products originated in a ApVY-free country or a ApVY-free area or a ApVY-free place of production would impair the introduction of the virus
Managed growing conditions	Used to mitigate likelihood of infestation at origin Avoiding the presence of wild Apiaceae weeds potentially hosting ApVY at the edges of the fields would impair spread and incidence of the virus. Use of ApVY-free seeds
Growing plants in isolation	Used to mitigate likelihood of infestation by specified pest in vicinity of growing site Growing plants in insect-proof greenhouses would impair the spread of the virus by aphids
Certification of reproductive material (voluntary/official)	Used to mitigate pests that are included in a certification scheme Certified seeds and plants for planting would avoid spread of the virus
Chemical treatments on crops including reproductive material	Used to mitigate likelihood of infestation of pests susceptible to chemical treatments Chemical control of possible vectors would impair the virus spread
Roguing and pruning	Used to mitigate likelihood of infestation by specified pest (usually a pathogen) at growing site where pest has limited dispersal Roguing of symptomatic plants would decrease the inoculum in the field
Inspections	Used to mitigate likelihood of infestation by specified pest at origin, Inspection to identify early symptoms may contribute to improve the efficacy of roguing
Cleaning and disinfection of facilities, tools and machinery	Used to mitigate likelihood of entry or spread of soil-borne pests Disinfection of tools could reduce virus spread
Phytosanitary certificate and plant passport	Used to attest which of the above requirements have been applied Phytosanitary certificate and plant passport would reduce virus entry and spread

3.6.1.1. Biological or technical factors limiting the effectiveness of measures to prevent the entry of the pest

- Asymptomatic plants may reduce the efficacy of inspections and roguing.
- The limited information of genome variability of ApVY could reduce the efficiency of detection methods used to certify the sanitary status of plant material.
- Limited information on natural aphid vectors may reduce the efficiency of measures to mitigate the pest spread.
- Weeds providing the natural reservoir of the virus may favour virus establishment and spread.

3.7. Uncertainty

- Current distribution of the pest in the EU.
- Natural host range.
- Existence of aphid vectors other than *Myzus persicae*.
- Seed transmission for hosts other than celery and poison hemlock and volume of seed trade.

- Host plants for consumption as a potential pathway for virus introduction and trade volumes of plants for planting and seeds for sowing.
- Magnitude of impact.

4. Conclusions

ApVY has been reported from Germany and Slovenia in both crops and weeds. Reports in Germany and Slovenia have been confirmed by the NPPOs of the respective Member States. No information on the adoption of official control measures by these EU MSs is available. The virus can be considered as present with restricted distribution in some Member States of the EU and so far not under official control. Therefore, currently ApVY does not fulfil the criterion of being absent or present with restricted distribution and under official control to be regarded as a potential Union quarantine pest, unless official control is implemented. This conclusion is associated with high uncertainty regarding the current virus distribution in the EU.

Table 6: The Panel's conclusions on the pest categorisation criteria defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Key uncertainties
Identity of the pest (Section 3.1)	The identity of Apium virus Y is well established	None
Absence/presence of the pest in the EU (Section 3.2)	The pest has been reported in Slovenia and Germany. Reports in Germany and Slovenia have been confirmed by the NPPOs of the respective Member States	The geographic distribution in the EU is associated with uncertainty
Regulatory status (Section 3.3)	The pest is not regulated in the EU	None
Pest potential for entry, establishment and spread in the EU (Section 3.4)	ApVY is able to enter into the EU. The main potential pathway is plants for planting, including seeds for sowing. The potential of ApVY for entry through plants for planting is considered extremely limited because of lack of evidence for this trade. Entry through infected seeds cannot be excluded for some hosts. If ApVY were to enter in the EU territory, it could become established and further spread.	Natural host range Seed transmission for some natural hosts Existence of aphid vectors other than *Myzus persicae* Trade volumes of plants for planting and seeds for sowing of ApVY hosts
Potential for consequences in the EU (Section 3.5)	Introduction and further spread of ApVY could have negative impact on the EU yield and quality production of the cultivated hosts of ApVY	Magnitude of the impact of ApVY under the EU conditions.
Available measures (Section 3.6)	No specific phytosanitary measures are currently in place, but potential control measures are available to mitigate the risk of entry, establishment and spread of ApVY in the EU	None
Conclusion (Section 4)	ApVY does not fulfil the criterion of being absent or present with restricted distribution and under official control to be regarded as a potential Union quarantine pest, unless official control is implemented.	High uncertainty exists on the current virus distribution in the EU.

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Key uncertainties
Aspects of assessment to focus on/ scenarios to address in future if appropriate:	Given the very limited available information on this virus, the development of a full PRA will not allow to resolve the uncertainties identified in the present categorisation until more data on distribution and host range become available.	

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Abbreviations

EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization
IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
MS	Member State
PLH	EFSA Panel on Plant Health
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference

Glossary

Containment (of a pest)	Application of phytosanitary measures in and around an infested area to prevent spread of a pest (FAO, 2018)
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO, 2018)
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO, 2018)
Eradication (of a pest)	Application of phytosanitary measures to eliminate a pest from an area (FAO, 2018)
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2018)
Greenhouse	A walk-in, static, closed place of crop production with a usually translucent outer shell, which allows controlled exchange of material and energy with the surroundings and prevents release of plant protection products (PPPs) into the environment.
Impact (of a pest)	The impact of the pest on the crop output and quality and on the environment in the occupied spatial units
Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO, 2018)
Pathway	Any means that allows the entry or spread of a pest (FAO, 2018)
Phytosanitary measures	Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO, 2018)
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO, 2018)
Risk reduction option (RRO)	A measure acting on pest introduction and/or pest spread and/or the magnitude of the biological impact of the pest should the pest be present. A RRO may become a phytosanitary measure, action or procedure according to the decision of the risk manager
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO, 2018)

Appendix A – Apium virus Y host plants

Source: Web of Science and Scopus

Host status	Host name	Plant family	Common name	Reference
Cultivated hosts	*Apium graveolens*	Apiaceae	Celery, celeriac	Tang et al. (2007), Tian et al. (2008)
	Ammi majus	Apiaceae	Bishop's weed	Baker et al. (2008)
	Anethum graveolens	Apiaceae	Dill	German NPPO, DSMZ Catalogue
	Coriandrum sativum	Apiaceae	Coriander	Tian et al. (2008)
	Petroselinum crispum	Apiaceae	Parsley	Tian et al. (2008), Mehle et al. (2019)
Wild weed hosts	*Conium maculatum*	Apiaceae	Poison hemlock	Tang et al. (2007), Eastwell et al. (2008)
Artificial/ experimental host	*Pimpinella anisum*	Apiaceae	Aniseed	Xu et al. (2011)
	Carum carvi	Apiaceae	Caraway	Xu et al. (2011)
	Daucus carota	Apiaceae	Carrot	Xu et al. (2011)
	Apium graveolens	Apiaceae	Celery	Xu et al. (2011)
	Anthriscus cerefolium	Apiaceae	Chervil	Xu et al. (2011)
	Coriandrum sativum	Apiaceae	Coriander	Xu et al. (2011)
	Anethum graveolens	Apiaceae	Dill	Xu et al. (2011)
	Petroselinum crispum	Apiaceae	Parsley	Xu et al. (2011)
	Pastinaca sativa	Apiaceae	Parsnip	Xu et al. (2011)
	Conium maculatum	Apiaceae	Poison hemlock	Xu et al. (2011)
	Chenopodium quinoa	Chenopodiaceae	Quinoa	Tang et al. (2007), Xu et al. (2011), Mehle et al. (2019)
	C. amaranticolor	Chenopodiaceae		Tang et al. (2007)
	C. capitatum	Chenopodiaceae		Xu et al. (2011)
	Beta macrocarpa	Chenopodiaceae	Beet	Xu et al. (2011)
	Nicotiana benthamiana	Solanaceae		Xu et al. (2011)

Appendix B – Distribution of Apium virus Y

Distribution records based on CABI crop compendium and literature search.

Region	Country	Subnational (e.g. State)	Status	Reference
North America	USA	Florida	Present	CABI, Baker et al. (2008), Adkins et al. (2011)
		California		Tian et al. (2008), Koike et al. (2012)
		Washington State		Eastwell et al. (2008)
EU (27)	Slovenia			Mehle et al. (2019)
	Germany			NPPO/Julius Kühn-Institut, written communication)
Oceania	Australia			Moran et al. (2002), Gibbs et al. (2008)
	New Zealand			Tang et al. (2007)