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List of non-EU viruses and viroids infecting potato (*Solanum tuberosum*) and other tuber-forming *Solanum* species

EFSA Panel on Plant Health (PLH),
Claude Bragard, Katharina Dehnen-Schmutz, Paolo Gonthier, Marie-Agnès Jacques,
Josep Anton Jaques Miret, Annemarie Fejer Justesen, Alan MacLeod,
Christer Sven Magnusson, Panagiotis Milonas, Juan A Navas-Cortes, Stephen Parnell,
Roel Potting, Philippe Lucien Reignault, Hans-Hermann Thulke, Wopke van der Werf,
Antonio Vicent Civera, Jonathan Yuen, Lucia Zappalà, Thierry Candresse,
Christophe Lacomme, Bernard Bottex, Tomasz Kaluski, Carla Oplaat, Annelien Roenhorst,
Martijn Schenk and Francesco Di Serio

Abstract

The European Commission requested a pest categorisation of the non-EU viruses and viroids of potato (hereafter referred to as viruses). As a first step, a systematic literature and database search was carried out to identify the viruses reported to naturally infect *Solanum tuberosum* and other tuber-forming *Solanum* spp (hereafter referred to as potato). Based on the global distribution and on the prevalence inside the European Union (EU), the Panel identified 40 non-EU viruses known to occur only outside the EU or with only a limited presence in the EU (reported in only one or few Member States (MSs) and/or with restricted distribution, outbreaks). Twenty-seven viruses were identified as having a significant presence in the EU (known to occur in several MSs, frequently reported in the EU, widespread in several MSs) or reported only from the EU so far, and will be excluded from further categorisation in the frame of the present mandate. Five viruses remained with an undetermined standing because the available information did not allow their allocation to one of the above groups. The viruses considered non-EU and those with undetermined standing will be further categorised if not addressed by EFSA in previous scientific opinions. Seven viruses for which non-European isolates are specifically regulated in Annex I of directive 2000/29/EC will be categorised separately. The main knowledge gaps and uncertainties of this grouping concern the natural host status of potato, the taxonomy, and/or information on the geographical distribution and prevalence of some of the analysed viruses.

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Correspondence: alpha@efsa.europa.eu

Panel members: Claude Bragard, Katharina Dehnen-Schmutz, Francesco Di Serio, Paolo Gonthier, Marie-Agnès Jacques, Josep Anton Jaques Miret, Annemarie Fejer Justesen, Alan MacLeod, Christer Sven Magnusson, Panagiotis Milonas, Juan A Navas-Cortes, Stephen Parnell, Roel Potting, Philippe L Reignault, Hans-Hermann Thulke, Wopke Van der Werf, Antonio Vicent Civera, Jonathan Yuen and Lucia Zappalà.

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1. Introduction

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

1.1.1. Background

Council Directive 2000/29/EC¹ on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community establishes the present European Union plant health regime. The Directive lays down the phytosanitary provisions and the control checks to be carried out at the place of origin on plants and plant products destined for the Union or to be moved within the Union. In the Directive's 2000/29/EC annexes, the list of harmful organisms (pests) whose introduction into or spread within the Union is prohibited, is detailed together with specific requirements for import or internal movement.

Following the evaluation of the plant health regime, the new basic plant health law, Regulation (EU) 2016/2031² on protective measures against pests of plants, was adopted on 26 October 2016 and will apply from 14 December 2019 onwards, repealing Directive 2000/29/EC. In line with the principles of the above mentioned legislation and the follow-up work of the secondary legislation for the listing of EU regulated pests, EFSA is requested to provide pest categorisations of the harmful organisms included in the annexes of Directive 2000/29/EC, in the cases where recent pest risk assessment/pest categorisation is not available.

1.1.2. Terms of Reference

EFSA is requested, pursuant to Article 22(5.b) and Article 29(1) of Regulation (EC) No 178/2002,³ to provide scientific opinion in the field of plant health.

EFSA is requested to prepare and deliver a pest categorisation (step 1 analysis) for each of the regulated pests included in the appendices of the annex to this mandate. The methodology and template of pest categorisation have already been developed in past mandates for the organisms listed in Annex II Part A Section II of Directive 2000/29/EC. The same methodology and outcome is expected for this work as well.

The list of the harmful organisms included in the annex to this mandate comprises 133 harmful organisms or groups. A pest categorisation is expected for these 133 pests or groups and the delivery of the work would be stepwise at regular intervals through the year as detailed below. First priority covers the harmful organisms included in Appendix 1, comprising pests from Annex II Part A Section I and Annex II Part B of Directive 2000/29/EC. The delivery of all pest categorisations for the pests included in Appendix 1 is June 2018. The second priority is the pests included in Appendix 2, comprising the group of *Cicadellidae* (non-EU) known to be vector of Pierce's disease (caused by *Xylella fastidiosa*), the group of *Tephritidae* (non-EU), the group of potato viruses and virus-like organisms, the group of viruses and virus-like organisms of *Cydonia* Mill., *Fragaria* L., *Malus* Mill., *Prunus* L., *Pyrus* L., *Ribes* L., *Rubus* L. and *Vitis* L., and the group of *Margarodes* (non-EU species). The delivery of all pest categorisations for the pests included in Appendix 2 is end 2019. The pests included in Appendix 3 cover pests of Annex I part A section I and all pest categorisations should be delivered by end 2020.

For the above mentioned groups, each covering a large number of pests, the pest categorisation will be performed for the group and not the individual harmful organisms listed under "such as" notation in the Annexes of the Directive 2000/29/EC. The criteria to be taken particularly under consideration for these cases, is the analysis of host pest combination, investigation of pathways, the damages occurring and the relevant impact.

Finally, as indicated in the text above, all references to 'non-European' should be avoided and replaced by 'non-EU' and refer to all territories with exception of the Union territories as defined in Article 1 point 3 of Regulation (EU) 2016/2031.

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

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

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

1.1.2.1. Terms of Reference: Appendix 1

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

Annex IIAI

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

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

(b) Bacteria

Citrus variegated chlorosis	<i>Xanthomonas campestris</i> pv. <i>oryzae</i> (Ishiyama)
<i>Erwinia stewartii</i> (Smith) Dye	Dye and pv. <i>oryzicola</i> (Fang, et al.) Dye

(c) Fungi

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

(d) Virus and virus-like organisms

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

Annex IIB

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

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

(b) Bacteria

Curtobacterium flaccumfaciens pv. *flaccumfaciens*
(Hedges) Collins and Jones

(c) Fungi

Glomerella gossypii Edgerton

Hypoxyton mammatum (Wahl.) J. Miller

Gremmeniella abietina (Lag.) Morelet

1.1.2.2. Terms of Reference: Appendix 2

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

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

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

- | | |
|--|---|
| 1) <i>Carneocephala fulgida</i> Nottingham | 3) <i>Graphocephala atropunctata</i> (Signoret) |
| 2) <i>Draeculacephala minerva</i> Ball | |

Group of Tephritidae (non-EU) such as:

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

(c) Viruses and virus-like organisms

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

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

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

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

Annex IIAI

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

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

- 1) *Margarodes vitis* (Phillipi)
- 2) *Margarodes vredendalensis* de Klerk
- 3) *Margarodes prieskaensis* Jakubski

1.1.2.3. Terms of Reference: Appendix 3

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

Annex IAI

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

<i>Acleris</i> spp. (non-EU)	<i>Longidorus diadecturus</i> Eveleigh and Allen
<i>Amauromyza maculosa</i> (Malloch)	<i>Monochamus</i> spp. (non-EU)
<i>Anomala orientalis</i> Waterhouse	<i>Myndus crudus</i> Van Duzee
<i>Arrhenodes minutus</i> Drury	<i>Nacobbus aberrans</i> (Thorne) Thorne and Allen
<i>Choristoneura</i> spp. (non-EU)	<i>Naupactus leucoloma</i> Boheman
<i>Conotrachelus nenuphar</i> (Herbst)	<i>Premnotrypes</i> spp. (non-EU)
<i>Dendrolimus sibiricus</i> Tschetverikov	<i>Pseudopityophthorus minutissimus</i> (Zimmermann)
<i>Diabrotica barberi</i> Smith and Lawrence	<i>Pseudopityophthorus pruinus</i> (Eichhoff)
<i>Diabrotica undecimpunctata howardi</i> Barber	<i>Scaphoideus luteolus</i> (Van Duzee)
<i>Diabrotica undecimpunctata undecimpunctata</i> Mannerheim	<i>Spodoptera eridania</i> (Cramer)
<i>Diabrotica virgifera zea</i> Krysan & Smith	<i>Spodoptera frugiperda</i> (Smith)
<i>Diaphorina citri</i> Kuway	<i>Spodoptera litura</i> (Fabricus)
<i>Heliothis zea</i> (Boddie)	<i>Thrips palmi</i> Karny
<i>Hirschmanniella</i> spp., other than <i>Hirschmanniella gracilis</i> (de Man) Luc and Goodey	<i>Xiphinema americanum</i> Cobb sensu lato (non-EU populations)
<i>Liriomyza sativae</i> Blanchard	<i>Xiphinema californicum</i> Lamberti and Bleve-Zacheo

(b) Fungi

<i>Ceratocystis fagacearum</i> (Bretz) Hunt	<i>Mycosphaerella larici-leptolepis</i> Ito et al.
<i>Chrysomyxa arctostaphyli</i> Dietel	<i>Mycosphaerella populorum</i> G. E. Thompson
<i>Cronartium</i> spp. (non-EU)	<i>Phoma andina</i> Turkensteen
<i>Endocronartium</i> spp. (non-EU)	<i>Phyllosticta solitaria</i> Ell. and Ev.
<i>Guignardia laricina</i> (Saw.) Yamamoto and Ito	<i>Septoria lycopersici</i> Speg. var. <i>malagutii</i> Ciccarone and Boerema
<i>Gymnosporangium</i> spp. (non-EU)	<i>Thecaphora solani</i> Barrus
<i>Inonotus weirii</i> (Murril) Kotlaba and Pouzar	<i>Trechispora brinkmannii</i> (Bresad.) Rogers
<i>Melampsora farlowii</i> (Arthur) Davis	

(c) Viruses and virus-like organisms

Tobacco ringspot virus	Pepper mild tigré virus
Tomato ringspot virus	Squash leaf curl virus
Bean golden mosaic virus	Euphorbia mosaic virus
Cowpea mild mottle virus	Florida tomato virus
Lettuce infectious yellows virus	

(d) Parasitic plants

Arceuthobium spp. (non-EU)

Annex I A II**(a) Insects, mites and nematodes, at all stages of their development**

Meloidogyne fallax Karssen

Rhizoecus hibisci Kawai and Takagi

Popillia japonica Newman

(b) Bacteria

Clavibacter michiganensis (Smith) Davis et al. ssp. *Ralstonia solanacearum* (Smith) Yabuuchi et al. *sepedonicus* (Spieckermann and Kotthoff)
Davis et al.

(c) Fungi

Melampsora medusae Thümen

Synchytrium endobioticum (Schilbersky) Percival

Annex I B**(a) Insects, mites and nematodes, at all stages of their development**

Leptinotarsa decemlineata Say

Liriomyza bryoniae (Kaltenbach)

(b) Viruses and virus-like organisms

Beet necrotic yellow vein virus

1.2. Interpretation of the Terms of Reference

This scientific opinion presents the list of viruses and viroids (hereafter referred to as viruses) that are known to infect potato (*Solanum tuberosum* L.) and/or other tuber-forming *Solanum* spp. (hereafter referred to as potato). The list is based on information collected from various literature sources and databases.

Non-EU viruses of potato are listed in the Appendices to the Terms of Reference (ToR) and are thus subject to pest categorisation to determine whether they fulfil the criteria of quarantine pests or those of regulated non-quarantine pests for the area of the EU excluding Ceuta, Melilla and the outermost regions of Member States (MSs) referred to in Article 355(1) of the Treaty on the Functioning of the European Union (TFEU), other than Madeira and the Azores.

According to the ToR, European Food Safety Authority (EFSA) is asked to develop pest categorisations for the non-EU viruses of potato. As a first step towards this goal, the EFSA Panel on Plant Health (PLH Panel) made a list of viruses infecting tuber-forming *Solanum* spp. All tuber-forming *Solanum* spp. are included, due to inconsistencies in the use of the term 'potato' in the literature, and to the increased likelihood that viruses infecting other tuber-forming *Solanum* species can also infect *S. tuberosum*. Viruses for which only partial molecular and/or biological data are available are also considered in this opinion to include the widest possible selection of relevant viruses. Virus-like diseases of unknown aetiology or phytoplasmas are not addressed. The main aim at this stage is to identify the 'non-EU' viruses of potato before proceeding with the pest categorisation.

Potato virus A, M, S, V, X, Y, and potato leafroll virus are widely present in Europe but are not addressed in the present opinion because the mandate requests the specific analysis of their non-EU isolates. These viruses will be addressed in separate opinions.

The listed viruses are organised in three groups:

- 1) Non-EU viruses: viruses defined by their current absence or limited presence in the EU. As such, viruses not reported from the EU are considered as non-EU. Likewise, viruses that occur outside the EU and have a limited presence in the EU (reported in one or a few Member States (MSs) and/or with restricted distribution, outbreaks) are also considered as non-EU. The following viruses and viroids have been addressed by EFSA in previous scientific opinions: beet curly top virus (EFSA PLH Panel, 2017), capsicum chlorosis virus (EFSA PLH Panel, 2012a), cherry rasp leaf virus (EFSA PLH Panel, 2013a,b, 2019a,b), chrysanthemum

stunt viroid (EFSA PLH Panel, 2011, 2012b), groundnut bud necrosis virus (EFSA PLH Panel, 2012a), groundnut ringspot virus (EFSA PLH Panel, 2012a), tomato chlorotic spot virus (EFSA PLH panel, 2012a), tomato planta macho viroid (EFSA PLH Panel, 2011), tomato ringspot virus (EFSA PLH Panel, 2013b, 2019a,b), tomato yellow leaf curl virus (EFSA PLH Panel, 2013a, 2014b), tomato yellow ring virus (EFSA PLH Panel, 2012a), tomato zonate spot virus (EFSA PLH Panel, 2012a). Following exchange with the European Commission, it was decided that they will not be further considered in the present categorisation.

- 2) Viruses excluded from further categorisation in the frame of the present mandate: viruses with significant presence in the EU (known to occur in several MSs, frequently reported in the EU, widespread in several MSs) or so far reported only from the EU.
- 3) Viruses with undetermined standing: available information did not allow allocation of these viruses to one of the above groups.

This opinion provides the methodology and results of this grouping which precedes the actual pest categorisation. The Panel will perform pest categorisations for the viruses that are allocated to the aforementioned groups 1 and 3. Viruses of group 2 are listed in this opinion but will be excluded from further categorisation within the present mandate. It should be noted that several viruses may lack sufficient information on biological, taxonomic identity and/or geographical distribution. Therefore, additional viruses might be excluded from pest categorisation. At any time, the Commission may present a request to EFSA to categorise some or all the viruses excluded from the current pest categorisation.

2. Data and methodologies

A preliminary list of viruses infecting potato was generated based on reviews and expert knowledge as described in Sections 2.1 and 2.2. The list was extended by including additional species found by literature and database searches as described in Sections 2.2–2.4. The collected information was summarised per virus; the tables in Appendices A–C and supplementary file in Annex A provide information on nomenclature and geographical distribution for each virus with the corresponding key references or sources. Nomenclature and distribution are reported as described in Sections 2.3 and 2.4. Any additional virus described or published after 14 December 2018 is not analysed here and, therefore, will not be included in the pest categorisation.

When the collected information was sufficient to allocate a virus to either the group of non-EU viruses (1) or the group of viruses with significant presence in the EU (2), no further literature search was performed; as a consequence, the information provided on virus distribution is not necessarily exhaustive.

To obtain additional information, MSs were consulted on completeness and correctness of the listed viruses and their geographical distribution. The information provided was evaluated by the EFSA Panel on Plant Health (PLH) to arrive at a definitive classification of the viruses.

The viruses considered as non-EU (1) and those with an undetermined standing (3) will be included for pest categorisation within the present mandate.

2.1. List of tuber-forming *Solanum* spp

The list of tuber-forming *Solanum* species was retrieved from the Atlas of Wild Potatoes from Hijmans et al. (2002).

2.2. List of viruses infecting potato

The list of viruses infecting potato was generated using international standards, published reviews, literature searches in ISI Web of Science, searches in NCBI GenBank and expert knowledge.

EPPO standard PM3/21(3) Post-entry quarantine for potato (EPPO, 2019), and reviews by Valkonen (1994, 2007) and Jeffries (1998), Jeffries and Lacomme (2018) were used to compile a preliminary list.

Literature searches were performed in ISI Web of Science, using the queries specified below. The scientific name of each relevant *Solanum* species was combined with the keywords virus/viroid according to query 1, resulting in 874 references that were individually analysed. In addition, the keywords virus/viroid were combined with the common name 'Potato' in query 2, resulting in 7423 references. The Panel considered that most relevant viruses would be covered by the standards and reviews outlined above, and by query 1. Therefore, the screening of the references obtained by query 2 was limited to the period 2014–2018, resulting in 1287 references. The query 2 results (without time

constraint) were refined to find reports on novel viruses and viruses identified by high throughput sequencing (HTS) using queries 3 and 4. All selected hits obtained from the different queries in ISI Web of Science were reviewed by title and, if needed, by abstract with the objective of selecting those providing novel viruses for the list and additional information on distribution and nomenclature.

ISI Web of Science topic search queries (last access 9th of November 2018):

- 1) ((virus* OR viroid*) AND (Latin name of the species – e.g. *Solanum tuberosum*)
- 2) ((virus* OR viroid*) AND (Potato))
- 3) (Next generation sequencing OR NGS OR highthroughput sequencing OR high-throughput sequencing OR HTS)
- 4) (first report OR disease note OR new host OR novel virus OR new virus)

Additional searches were performed in NCBI GenBank, using *Solanum tuberosum* and potato combined with the keywords virus/viroid. The search results were restricted by choosing viruses or viroids under 'result by taxon'. Additionally, the virus search results were refined by excluding the keyword 'sweet' and excluding 'PVY' and the viroid search results by excluding 'potato spindle tuber viroid', resulting in queries 5–8. The resulting hits, 3306 for query 5, 921 for query 6, 4 for query 7 and 20 for query 8, were screened for viruses supplemental to the preliminary list.

NCBI GenBank nucleotide searches (last access on 14 January 2019):

- 5) (virus* AND potato) AND "viruses"[porgn:__txid10239] NOT sweet NOT PVY
- 6) (virus* AND solanum tuberosum) AND "viruses"[porgn:__txid10239] NOT sweet NOT PVY
- 7) (viroid* AND solanum tuberosum) AND "viroids"[porgn:__txid12884] NOT potato spindle tuber viroid
- 8) (viroid* AND potato) AND "viroids"[porgn:__txid12884] NOT potato spindle tuber viroid

2.3. Geographical distribution

Information on the geographical distribution of the listed viruses was retrieved from the European and Mediterranean Plant Protection Organization Global Database (<https://gd.eppo.int/>, last access 14 December, 2018) the Centre for Agriculture and Biosciences International (CABI, last access 14 December, 2018), crop protection compendium (CABI cpc, last access 14 December, 2018), Distribution Maps of Plant Diseases (CABI) and from publications already collected in Section 2.2.

When the collected information was insufficient to decide on allocation of a virus to a group, an additional search in NCBI GenBank was performed, using the name of the specific virus. Data on geographical distribution from NCBI GenBank (last access 14 December 2018) were retrieved by using the following strategy:

- Search for "virus name";
- Select the virus name within the "Results by taxon";
- Open the obtained list as "GenBank full format";
- Search for "country" as keyword.

2.4. Nomenclature

Virus nomenclature was based on the latest release of the official classification by the International Committee on Taxonomy of Viruses (ICTV, Release 2018b.v1, <https://talk.ictvonline.org/taxonomy/>). Virus names are not italicised throughout this opinion, corresponding to ICTV instructions. The integration of genus within the name of the species is currently not consistently adopted by ICTV working groups and, therefore, the Panel decided to use the species name without genus names. Names of viruses not included in the official ICTV classification were based on first reports.

3. Pest categorisation

All viruses identified in the literature and database searches which naturally infect potato have been listed and subsequently organised into the three groups specified below.

3.1. Viruses considered as non-EU

Viruses considered as non-EU (Appendix A) are:

- not known to be present in the EU, or

- known to be present outside the EU and with limited presence in the EU (reported in one or a few member states (MSs) and/or with restricted distribution, outbreaks).

Viruses in this group vary from well-known viruses for which biological (host range, transmission), genomic and geographic distribution data exist, to viruses for which only limited information is available.

3.2. Viruses excluded from further categorisation in the frame of the present mandate

Viruses excluded from further categorisation (Appendix B) are:

- known to be significantly present in the EU (known to occur in several MSs, frequently reported in the EU, widespread in several MSs), or
- so far only reported from the EU.

It should be emphasised that between relatively clear-cut cases of widespread or limited presence in the EU, there is a 'grey zone' in which it is difficult to decide whether a virus should be considered as non-EU or not. In these cases, the Panel considered the number of EU MSs with known presence, prevalence within individual MSs and prevalence outside the EU. When this information was missing, the Panel was unable to reach a conclusion and decided to allocate the corresponding viruses to the group of viruses with undetermined standing (see Section 3.3).

3.3. Viruses with undetermined standing

Viruses with an undetermined standing (Appendix C) correspond to situations for which, due to the limited information available, the Panel was unable to allocate the virus to one of the above groups. According to the present mandate, these viruses will be subjected to further categorisation.

4. Uncertainty

Compiling the list of viruses that infect potato as well as their allocation to one of the groups based on the geographical distribution is hampered by several uncertainties:

- Uncertainty on whether potato is a natural host of some of the viruses, because of limitations in the methods used for identification.
- Uncertainty on the geographical distribution and prevalence of some of the viruses because of the absence of systematic surveys, particularly when they are poorly characterised, recently described or have been subject to taxonomical changes.
- Limitations of some records in GenBank which do not provide any supporting data on the occurrence in a country or a given host.
- Uncertainty on the taxonomy of some of the viruses.

5. Conclusions

The European Commission requested a pest categorisation of the non-EU viruses and viroids of potato (hereafter referred to as viruses). As a first step, a systematic literature and database search was carried out to identify the viruses reported to naturally infect *Solanum tuberosum* and other tuber-forming *Solanum* spp. (hereafter referred to as potato). Based on the global distribution and on the prevalence inside the EU, the Panel identified 40 non-EU viruses known to occur only outside the EU or with only a limited presence in the EU (reported in only one or few Member States (MSs) and/or with restricted distribution, outbreaks). Twenty-seven viruses were identified as having a significant presence in the EU (known to occur in several MSs, frequently reported in the EU, widespread in several MSs) or reported only from the EU so far, and will be excluded from further categorisation in the frame of the present mandate. Five viruses remained with an undetermined standing because the available information did not allow their allocation to one of the above groups. The viruses considered non-EU and those with undetermined standing will be further categorised if not addressed by EFSA in previous scientific opinions. Seven viruses for which non-European isolates are specifically regulated in Annex I of directive 2000/29/EC will be categorised separately. The main knowledge gaps and uncertainties of this grouping concern the natural host status of potato, the taxonomy and/or information on the geographical distribution and prevalence of some of the analysed viruses.

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Abbreviations

CABI	Centre for Agriculture and Bioscience International
EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization
HTS	High throughput sequencing
IPPC	International Plant Protection Convention
MS	Member State
NCBI	National Center for Biotechnology Information
PLH	EFSA Panel on Plant Health
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference

Appendix A – Viruses and viroids of potato considered as non-EU

The appendix lists the name and acronym of the virus or viroid, the main considerations for inclusion in this specific Appendix, the associated uncertainties and the main references from which this information was extracted.

Name	Acronym	Rationale	Uncertainties	Included in pest categorisation	Reference ⁽²⁾
Andean potato latent virus	APLV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported on potato, without specification of <i>Solanum</i> species	Yes	EPPO (online), Kreuze et al. (2013)
Andean potato mild mosaic virus	APMMV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported on potato, without specification of <i>Solanum</i> species	Yes	EPPO (online), Kreuze et al. (2013)
Andean potato mottle virus	APMoV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported on potato, without specification of <i>Solanum</i> spp.	Yes	EPPO (online), Fribourg et al. (1977), Avila et al. (1984)
Arracacha virus B	AVB	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Oca strain reported on potato, without specification of <i>Solanum</i> species	Yes	EPPO (online), Jones (1981), Adams et al. (2013)
Beet curly top virus	BCTV	Reported in several countries outside the EU. Reported in two MSs, but considered absent with uncertainty from the EU territory (EFSA PLH Panel, 2017)	Might be present, but not reported in additional EU MSs Reported on potato, without specification of <i>Solanum</i> species	No, previously addressed by EFSA PLH Panel (2017)	EPPO (online), Jones et al. (1982), Pourrahim et al. (2007), EFSA PLH Panel (2017)
Capsicum chlorosis virus⁽¹⁾	CaCV	Reported in several countries outside the EU with a single recent report in Greece	Might be present, but not reported in additional EU MSs Reported in three GenBank accessions (FN994898, FN994897, FN994896) on <i>Solanum tuberosum</i>	No, previously addressed by EFSA PLH Panel (2012a)	CABI, NCBI, EFSA (2012a)
Cherry rasp leaf virus	CRLV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys No natural infection reported on <i>Solanum tuberosum</i> . Infection reported on diploid potato breeding clone W5281-2 (University of Wisconsin)	No, previously addressed by EFSA PLH Panel (2013a, b, 2019a,b)	CABI, Thompson et al. (2004) EFSA PLH Panel (2013a,b, 2019a,b)

Name	Acronym	Rationale	Uncertainties	Included in pest categorisation	Reference ⁽²⁾
Chilli leaf curl virus	ChiLCV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys One report in potato and a complete genome sequence (FM179613) from potato reported as Chilli leaf curl Multan virus is probably Chilli leaf curl virus	Yes	NCBI, Mubin et al. (2009)
Chrysanthemum stunt viroid	CSVd	Reported in several countries outside the EU. Reported in many EU MSs with restricted distribution	Might be present, but not reported or more prevalent than reported in the EU. 'Present, widespread' report in Sweden based on data from 1993 (EPPO) One reported from <i>Solanum tuberosum</i>	No, previously addressed by EFSA PLH Panel (2011, 2012b)	EPPO (online), CABI, NCBI, EFSA PLH Panel (2011, 2012b), Matsushita et al. 2019)
Colombian potato soil-borne virus	CPSbV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported once based on a baiting experiment using soil from potato fields	Yes	Gil et al. (2016)
Groundnut bud necrosis virus	GBNV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported on potato, without specification of <i>Solanum</i> species	No, previously addressed by EFSA PLH Panel (2012a)	CABI, Kaushal et al. (2010), Pundhir et al. (2012), EFSA PLH Panel (2012a), Baswaraj et al. (2017)
Groundnut ringspot virus	GRSV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported on <i>Solanum tuberosum</i> in one reference (conference abstract) and identification based on only one technique (DAS-ELISA)	No, previously addressed by EFSA PLH Panel (2012a)	EPPO (online), Granval de Millan et al. (1998), EFSA PLH Panel (2012a)
Papaya leaf crumple virus	PaLCrV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys. Reported in one GenBank accession (KY216071) from potato, without specification of <i>Solanum</i> species	Yes	NCBI
Papaya mosaic virus	PapMV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported once on potato, without specification of <i>Solanum</i> species	Yes	EPPO (online), Salazar, (2006), Santa Cruz et al. (2009)
Potato black ringspot virus	PBRV	Only reported in Peru. No reports on presence in the EU, with the exception of an isolate reported with unclear origin from a collection in the UK	Absence in the EU uncertain because of lack of systematic surveys Reported on potato, without specification of <i>Solanum</i> species	Yes	EPPO (online), Salazar and Harrison (1978), Richards et al. (2014)
Potato latent virus	PotLV	No reports on presence in the EU	Might be present, but not reported in the EU	Yes	EPPO (online)

Name	Acronym	Rationale	Uncertainties	Included in pest categorisation	Reference ⁽²⁾
Potato virus B	PVB	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported on potato, without specification of <i>Solanum</i> species	Yes	SS
Potato virus H	PVH	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported on potato, without specification of <i>Solanum</i> species	Yes	EPPO (online), Li et al. (2013), Abouelnasr et al. (2014)
Potato virus P	PVP	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported on potato, without specification of <i>Solanum</i> species	Yes	Massa et al. (2006), Nisbet et al. (2006)
Potato virus T	PVT	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys	Yes	EPPO (online)
Potato virus U	PVU	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Isolated once from potato and experimental transmission proved difficult	Yes	Jones et al. (1983), Adams et al. (2018)
Potato yellow dwarf virus	PYDV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys	Yes	EPPO (online), Al-Shahwan et al. (1997), EFSA PLH Panel (2017), Jackson et al. (2018)
Potato yellow mosaic virus	PYMV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys. Rare on potato	Yes	CABI, Jeffries (1998), Geraud-Pouey et al. (2016)
Potato yellow vein virus	PYV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys	Yes	EPPO (online), Chaves-Bedoya and Guzmán-Barney (2014)
Potato yellowing virus⁽¹⁾	PYV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys	Yes	EPPO (online), Valkonen et al. (1992), Fuentes and Jayasinghe (1993), Silvestre et al. (2011)

Name	Acronym	Rationale	Uncertainties	Included in pest categorisation	Reference ⁽²⁾
SB26/29⁽¹⁾	–	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported on potato once, without specification of <i>Solanum</i> species. Identity is unclear	Yes	Tenorio et al. (2003)
SB41⁽¹⁾	–	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported on potato once, without specification of <i>Solanum</i> species. Identity is unclear	Yes	Salazar (2006)
Solanum apical leaf curling virus⁽¹⁾	SALCV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys	Yes	Hooker and Salazar, (1983), Hooker et al. (1985)
Tobacco vein banding mosaic virus	TVBMV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys One report in <i>Solanum tuberosum</i> and one GenBank accession (DQ917752) from potato, without specification of <i>Solanum</i> species	Yes	Geng et al. (2014), NCBI
Tomato chlorosis virus	ToCV	Reported in several countries outside the EU. Reports in the EU associated with restricted distribution. In some MSs, eradication is ongoing	Might be present in more EU MSs, but not reported. Might be more prevalent in those MSs where it is reported	Yes	EPPO (online), CABI
Tomato chlorotic spot virus	TCSV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported on <i>Solanum tuberosum</i> once (conference abstract) and identification based on only one technique (DAS-ELISA)	No, previously addressed by EFSA PLH Panel (2012a)	EPPO (online), Nagata et al. (1995), Granval de Milan et al. (1998), EFSA PLH Panel (2012a)
Tomato leaf curl New Delhi virus	ToLCNDV	Reported in several countries outside the EU. Reported from two MSs, with restricted distribution	Might be present, but not reported in additional EU MSs	Yes	EPPO (online)
Tomato mosaic Havana virus	ToMHaV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported in five GenBank accessions (HE820051, HE820052, HE820053, HE820054, HE820055) from <i>Solanum tuberosum</i>	Yes	EPPO (online), NCBI

Name	Acronym	Rationale	Uncertainties	Included in pest categorisation	Reference ⁽²⁾
Tomato mottle Taino virus	ToMoTV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported on potato once	Yes	EPPO (online), Cordero et al. (2003)
Tomato planta macho viroid	TPMVd	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Natural infection reported on <i>Solanum cardiophyllum</i>	No, previously addressed by EFSA PLH Panel (2011)	EPPO (online), EFSA (2011)
Tomato ringspot virus	ToRSV	Reports in the EU are associated with intercepted material or restricted distribution, generally under official control. In some MSs, eradication is ongoing or has been achieved	Might be present but not reported in other EU MSs Reported on potato once, without specification of <i>Solanum</i> species and identification only based on serology and immune-electron microscopy	No, previously addressed by EFSA PLH Panel (2013b, 2019a,b)	EPPO (online), Sato et al. (2000), EFSA PLH Panel (2013b, 2019a,b)
Tomato severe rugose virus	ToSRV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys	Yes	Souza-Dias et al. (2008), Macedo et al. (2017)
Tomato yellow vein streak virus	ToYVSV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported on potato, without specification of <i>Solanum</i> species	Yes	EPPO (online), Ribeiro et al. (2005), Albuquerque et al. (2010)
Tomato zonate spot virus⁽¹⁾	TZSV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys Reported on potato once	No, previously addressed by EFSA PLH Panel (2012a)	EPPO (online), Dong et al. (2008), EFSA PLH Panel (2012a), Huang et al. (2015)
Wild potato mosaic virus	WPMV	No reports on presence in the EU	Absence in the EU uncertain because of lack of systematic surveys No natural infection reported on <i>Solanum tuberosum</i> . Infection reported in <i>S. chancayense</i>	Yes	Jones and Fribourg (1979), Spetz and Valkonen (2003), Spetz et al. (2003)

(1): Species not included in ICTV taxonomy.

(2): Sources for geographical distribution and identified uncertainties.

Appendix B – Viruses and viroids of potato excluded from further categorisation

The appendix lists the name and acronym of the virus or viroid, the main considerations for inclusion in this specific Appendix, the associated uncertainties and the main references from which this information was extracted.

Viruses and viroids with significant presence in the EU (known to occur in several MSs, frequently reported in the EU, widespread in several MSs) or so far reported only from the EU.

Potato virus A, M, S, V, X, Y, and potato leafroll virus are widely present in the EU but are not addressed in the present opinion because the mandate requests the specific analysis of their non-EU isolates. These viruses will be addressed in (a) separate opinion(s).

Name	Acronym	Rationale	Uncertainties	Included in pest categorisation	References ⁽²⁾
Alfalfa mosaic virus	AMV	Reported in many EU MSs, in particular on alfalfa	Limited uncertainties	No, present in the EU	EPPO (online)
Bean common mosaic virus	BCMV	Reported in many EU MSs, in particular on legumes	Limited uncertainties Reported on <i>Solanum tuberosum</i> once and identification based on one technique (DAS-ELISA)	No, present in the EU	CABI, Al-Shahwan et al. (2017)
Bean leafroll virus	BLRV	Reported in four EU MSs	Reported on <i>Solanum tuberosum</i> once and identification based on only one technique (DAS-ELISA)	No, present in the EU	CABI, Al-Shahwan et al. (2017)
Beet ringspot virus	BRSV	Formerly considered a strain of TBRV and likely having a similar distribution in the EU. Limited presence, if any, outside the EU	Limited uncertainties Natural infection reported on <i>Solanum tuberosum</i>	No, present in the EU	Harrison (1957, 1958), NCBI
Belladonna mottle virus	BeMV	Only reported in three EU MSs	Might be present, but not reported outside the EU Reported on potato, without specification of <i>Solanum</i> species	No, present in the EU	NCBI, Salazar (1996)
Cherry leaf roll virus	CLRV	Reported in many EU MSs	Limited uncertainties No natural infection reported in <i>Solanum tuberosum</i> . Infection reported in <i>S. acaule</i> Previously addressed by EFSA PLH Panel (2014a)	No, present in the EU	EPPO (online), Crosslin et al. (2010), EFSA PLH Panel (2014a), Viršček Marn and Mavrič Pleško (2018)
Cucumber mosaic virus	CMV	Reported in many EU MSs, on a range of hosts	Limited uncertainties	No, present in the EU	EPPO (online)
Eggplant mottled dwarf virus	EMDV	Reported in many EU MSs	Limited uncertainties	No, present in the EU	EPPO (online), Menzel et al. (2016)

Name	Acronym	Rationale	Uncertainties	Included in pest categorisation	References ⁽²⁾
Impatiens necrotic spot virus	INSV	Reported in many EU MSs	Limited uncertainties	No, present in the EU	EPPO (online), Crosslin and Hamlin, (2010), Pourrahim et al. (2012)
Papaya ringspot virus	PRSV	Reported in many EU MSs, on cucurbits	Limited uncertainties Reported in one GenBank accession (KJ562216) from <i>Solanum tuberosum</i>	No, present in the EU	EPPO (online), NCBI
Pepino mosaic virus	PepMV	Reported in many EU MSs, on tomato	Limited uncertainties	No, present in the EU	EPPO (online)
Potato mop-top virus	PMTV	Reported in many EU MSs	Limited uncertainties	No, present in the EU	EPPO (online)
Potato necrosis virus⁽¹⁾	PoNV	Only reported in the UK	Might be present, but not reported from elsewhere	No, present in the EU	Monger and Jeffries (2018)
Potato spindle tuber viroid	PSTVd	Reported in many EU MSs, on ornamentals. Several outbreaks on potato and tomato in EU MSs but reported to be eradicated	Limited uncertainties	No, present in the EU	EPPO (online)
Potato stunt virus⁽¹⁾	PSTV	Only reported in Scotland	Might be additionally present both inside and outside the EU. Identity is unclear	No, present in the EU	Cockerham and McGhee (1953), Salazar (1996)
Potato yellow blotch virus⁽¹⁾	PYBV	Only reported in the UK	Might be present, but not reported from elsewhere Natural infection reported on a <i>Solanum tuberosum</i> breeding line. Mechanical transmission to several <i>S. tuberosum</i> cultivars	No, present in the EU	Nisbet et al. (2018)
Southern potato latent virus	SoPLV	Strain of Potato virus S present in the EU and will be addressed in a separate opinion (see Section 1.2)	Limited uncertainties	No, present in the EU	Kobayashi et al. (1985)
Sowbane mosaic virus	SoMV	Reported in five EU MSs	Might be present in more EU MSs, but not reported Reported on potato, without specification of <i>Solanum</i> species	No, present in the EU	CABI, Jeffries (1998)
Tobacco mosaic virus	TMV	Reported in many EU MSs, on a range of hosts	Limited uncertainties	No, present in the EU	CABI, Hansen, (1960), Chatzivassiliou et al. (2004)

Name	Acronym	Rationale	Uncertainties	Included in pest categorisation	References ⁽²⁾
Tobacco necrosis virus D	TNV D	Reported in many EU MSs, on a range of hosts	Limited uncertainties	No, present in the EU	CABI, NCBI, Cardoso et al. (2004), Beuch et al. (2014)
Tobacco rattle virus	TRV	Reported in many EU MSs, on a range of hosts	Limited uncertainties	No, present in the EU	EPPO (online)
Tobacco streak virus	TSV	Reported in many EU MSs	Might be present in more EU MSs, but not reported	No, present in the EU	EPPO (online)
Tomato black ring virus	TBRV	Reported in many EU MSs. Limited presence outside the EU	Limited uncertainties	No, present in the EU	EPPO (online)
Tomato mosaic virus	ToMV	Reported in many EU MSs, on a range of hosts	Limited uncertainties	No, present in the EU	CABI, Horvath et al. (1978), EFSA PLH (2018)
Tomato spotted wilt virus	TSWV	Reported in many EU MSs	Limited uncertainties	No, present in the EU	Chatzivassiliou et al. (2007)
Watermelon mosaic virus	WMV	Reported in many EU MSs, on cucurbits	Limited uncertainties Reported in two GenBank accessions (JX683534 and JX683531) from potato, without specification of <i>Solanum</i> species	No, present in the EU	CABI, NCBI
Zucchini yellow mosaic virus	ZYMV	Reported in many EU MSs, on cucurbits	Reported in one GenBank accession (KJ620410) from <i>Solanum tuberosum</i>	No, present in the EU	EPPO (online), CABI, NCBI

(1): species not included in ICTV taxonomy.

(2): sources for geographical distribution and identified uncertainties.

Appendix C – Viruses of potato with undetermined standing

The appendix lists the name and acronym of the virus or viroid, the main considerations for inclusion in this specific Appendix, the associated uncertainties and the main references from which this information was extracted.

Name	Acronym	Rationale	Uncertainties	Included in pest categorisation	References ⁽²⁾
Cucurbit yellow stunting disorder virus	CYSDV	Reported outside the EU in Africa, America and Asia. Restricted distribution in four MSs. Reported as widespread in Cyprus before 2005	Might be present but not reported in more EU MSs. Might be more widespread than reported in those EU MSs reporting restricted distribution Reported on potato once, without specification of <i>Solanum</i> spp.	Yes	EPPO (online), CABI, NCBI, Orfanidou et al. (2019)
Potato aucuba mosaic virus	PAMV	Reported with worldwide distribution in the 1970s on potato cultivars that are no longer used. No recent reports in the EU. Recent report in China	Might no longer be present in the EU	Yes	NCBI, Kassanis and Govier, (1972), Wu et al. (2018)
Red clover vein mosaic virus	RCVMV	Reported outside the EU in Africa, America, Asia, Oceania and in five EU MSs	Might be present, but not reported in more EU MSs Reported on <i>Solanum tuberosum</i> once and identification based on only one technique (DAS-ELISA)	Yes	NCBI, Freeman (2008), Fletcher et al. (2016), Al-Shahwan et al. (2017)
Tomato yellow leaf curl virus	TYLCV	Reported outside the EU in Africa, America, Oceania and in many EU MSs	TYLCV is of non-European origin. The extent to which it can be considered established in the EU is unclear Reported on <i>Solanum tuberosum</i> once and identification based on only one technique (DAS-ELISA) and one GenBank accession (EU224315)	No, previously addressed by EFSA PLH Panel (2013a, 2014b)	EPPO (online), NCBI, Abdel-Salam (1991), EFSA PLH Panel (2013a, 2014b)
Tomato yellow ring virus⁽¹⁾	TYRV	Reported in Iran and Kenya Reported in Poland, on tomato	Might be present, but not reported in additional EU MSs	No, previously addressed by EFSA PLH Panel (2012a)	CABI, Hassani-Mehraban et al. (2007), EFSA (2012a), Zarzyńska-Nowak et al. (2016)

(1): Species not included in ICTV taxonomy.

(2): Sources for geographical distribution and identified uncertainties.

Annex A – List of potato viruses considered in the opinion

Annex A can be found in the online version of this output ('Supporting information' section):
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