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Pest categorisation of beet necrotic yellow vein virus

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Abstract

Following a request from the EU Commission, the Panel on Plant Health performed a categorisation of beet necrotic yellow vein virus (BNYVV), the causal agent of the sugar beet rhizomania disease. The virus is currently listed in Annex III as a protected zone (PZ) quarantine pest of the Commission Implementing Regulation (EU) 2019/2072. The identity of the BNYVV is well established. BNYVV is a soil-borne virus transmitted by the obligate root plasmodiophorid endoparasite *Polymyxa betae*. BNYVV is widely distributed in the EU, but is not reported in the following EU PZs: Ireland, France (Brittany), Portugal (Azores), Finland and Northern Ireland. The virus may enter, become established and spread in the PZs via *P. betae* resting spores with soil and growing media as such or attached to machinery and with roots and tubercles of species other than *B. vulgaris* and with plants for planting. Introduction of BNYVV would have a negative impact on sugar beet and other beet crops in PZs, because of yield and sugar content reduction. Phytosanitary measures are available to reduce the likelihood of entry and spread in the PZs. Once the virus and its plasmodiophorid vector have entered a PZ, their eradication would be difficult due to the persistence of viruliferous resting spores in the soil. The main knowledge gaps or uncertainties identified concerning the presence of BNYVV in the PZs and the incidence and distribution of BNYVV in Switzerland, a country to which a range of specific requirements do not apply. BNYVV meets all the criteria that are within the remit of EFSA to qualify as a potential protected zone union quarantine pest. Plants for planting are not considered as a main means of spread, and therefore BNYVV does not satisfy all the criteria evaluated by EFSA to qualify as potential Union regulated non-quarantine pest.

Keywords: beet, *Benyvirus*, plant pest, *Polymyxa betae*, quarantine, rhizomania disease, soil transmission

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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/EC[1] on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community established the previous European Union plant health regime. The Directive laid 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 was prohibited, was 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) 2016/2031[2] on protective measures against pests of plants, was adopted on 26 October 2016 and applied 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

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

(b) Bacteria

Citrus variegated chlorosis
Erwinia stewartii (Smith) Dye
Xanthomonas campestris pv. *oryzae* (Ishiyama) Dye and pv. *oryzicola* (Fang. et al.) Dye

(c) Fungi

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

(d) Virus and virus-like organisms

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

Annex IIB

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

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

(b) Bacteria

Curtobacterium flaccumfaciens pv. flaccumfaciens (Hedges) Collins and Jones

(c) Fungi

Glomerella gossypii Edgerton
Gremmeniella abietina (Lag.) Morelet
Hypoxylon mammatum (Wahl.) J. Miller

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) *Carneocephala fulgida* Nottingham
2) *Draeculacephala minerva* Ball
3) *Graphocephala atropunctata* (Signoret)

Group of Tephritidae (non-EU) such as:

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

(c) Viruses and virus-like organisms

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

1) Andean potato latent virus
2) Andean potato mottle virus
3) Arracacha virus B, oca strain
4) Potato black ringspot virus
5) Potato virus T
6) non-EU isolates of potato viruses A, M, S, V, X and Y (including Yo, Yn and Yc) and Potato leafroll 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
2) Cherry rasp leaf virus (American)
3) Peach mosaic virus (American)
4) Peach phony rickettsia
5) Peach rosette mosaic virus
6) Peach rosette mycoplasm
7) Peach X-disease mycoplasm
8) Peach yellows mycoplasm
9) Plum line pattern virus (American)
10) Raspberry leaf curl virus (American)
11) Strawberry witches' broom mycoplasma
12) Non-EU viruses and virus-like organisms of *Cydonia* Mill., *Fragaria* L., *Malus* Mill., *Prunus* L., *Pyrus* L., *Ribes* L., *Rubus* L. and *Vitis* L.

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

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

(b) Fungi

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

(c) Viruses and virus-like organisms

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

(d) Parasitic plants

Arceuthobium spp. (non-EU)

Annex IAII

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

Meloidogyne fallax Karssen

Popillia japonica Newman

Rhizoecus hibisci Kawai and Takagi

(b) Bacteria

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

Ralstonia solanacearum (Smith) Yabuuchi 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

Beet necrotic yellow vein virus (BNYVV) is one of a number of pests listed in the Appendices to the Terms of Reference (ToR) to be subject to pest categorisation to determine whether it fulfils the criteria of a quarantine pest or those of a regulated non-quarantine pest (RNQP) for the area of the EU excluding Ceuta, Melilla and the outermost regions of Member States (MS) referred to in Article 355(1) of the Treaty on the Functioning of the European Union (TFEU), other than Madeira and the Azores.

Following the adoption of Regulation (EU) 2016/2031[4] on 14 December 2019 and the Commission Implementing Regulation (EU) 2019/2072 for the listing of EU regulated pests, the Plant Health Panel interpreted the original request (ToR in Section 1.1.2) as a request to provide pest categorisations for the pests in the Annexes of Commission Implementing Regulation (EU) 2019/2072[5].

Recognising that beet necrotic yellow vein virus is regulated as a quarantine pest in the EU protected zones (PZs) only, the scope of this categorisation is the territory of the PZs (Ireland, France (Brittany), Portugal (Azores), Finland). Northern Ireland (UK) is also included in Commission Implementing Regulation (EU) 2019/2072 as one of the EU PZs for BNYVV. Following the withdrawal of the UK from the EU and in line with the Withdrawal Agreement[6] allowing free movement between the EU and Northern Ireland after 1/1/2021 (but not free movement for Great Britain) Northern Ireland is considered in this opinion as part of the EU PZs. Nevertheless, when analysing the criteria for qualification as a potential RNQP, the whole Union territory was considered (Article 5, (EU) 2019/2072).

[4] Regulation (EU) 2016/2031 of the European Parliament of the Council of 26 October 2016 on protective measures against pests of plants, amending Regulations (EU) No 228/2013, (EU) No 652/2014 and (EU) No 1143/2014 of the European Parliament and of the Council and repealing Council Directives 69/464/EEC, 74/647/EEC, 93/85/EEC, 98/57/EC, 2000/29/EC, 2006/91/EC and 2007/33/EC.

[5] Commission Implementing Regulation (EU) 2019/2072 of 28 November 2019 establishing uniform conditions for the implementation of Regulation (EU) 2016/2031 of the European Parliament and the Council, as regards protective measures against pests of plants, and repealing Commission Regulation (EC) No 690/2008 and amending Commission Implementing Regulation (EU) 2018/2019.

[6] Agreement on the withdrawal of the United Kingdom of Great Britain and Northern Ireland from the European Union and the European Atomic Energy Community 2019/C 384 I/01.

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A literature search on BNYVV 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. Relevant papers 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 the European and Mediterranean Plant Protection Organization (EPPO) Global Database (EPPO, online) and relevant publications.

Data about the import of commodity types that potentially provide a pathway for the pest to enter the EU and about the area of host plants 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 is a web-based network run by the Directorate General for Health and Food Safety (DG SANTÉ) of the European Commission, and is 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 EU, 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 MS and the phytosanitary measures taken to eradicate or avoid their spread. The recording of interceptions switched from Europhyt to TRACES in May 2020. TRACES is a European Commission online platform used for the importation of plants into the European Union (It is also used for animals, animal products, food and feed of non-animal origin).

2.2. Methodologies

The Panel performed the pest categorisation for beet necrotic yellow vein virus, following guiding principles and steps presented in the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018) and in the International Standard for Phytosanitary Measures No 11 (FAO, 2013) and No 21 (FAO, 2004).

This work was initiated following an evaluation of the EU plant health regime. Therefore, to facilitate the decision-making process, in the conclusions of the pest categorisation, the Panel addresses explicitly each criterion for a Union quarantine pest and for a Union RNQP in accordance with Regulation (EU) 2016/2031 on protective measures against pests of plants, and includes additional information required in accordance with the specific terms of reference received by the European Commission. In addition, for each conclusion, the Panel provides a short description of its associated uncertainty.

Table 1 presents the Regulation (EU) 2016/2031 pest categorisation criteria on which the Panel bases its conclusions. All relevant criteria have to be met for the pest to potentially qualify either as a quarantine pest or as a RNQP. If one of the criteria is not met, the pest will not qualify. A pest that does not qualify as a quarantine pest may still qualify as a RNQP that needs to be addressed in the opinion. For the pests regulated in the PZs only, the scope of the categorisation is the territory of the PZ; thus, the criteria refer to the PZ instead of the EU territory.

It should be noted that 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, the Panel will present a summary of the observed pest impacts. Economic impacts are expressed in terms of yield and quality losses and not in monetary terms, whereas addressing social impacts 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	Criterion in Regulation (EU) 2016/2031 regarding protected zone quarantine pest (articles 32–35)	Criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest
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?	Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible?	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!	Is the pest present in the EU territory? If not, it cannot be a protected zone quarantine organism	Is the pest present in the EU territory? If not, it cannot be a RNQP. (A regulated non-quarantine pest must be present in the risk assessment area)
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	The protected zone system aligns with the pest free area system under the International Plant Protection Convention (IPPC) The pest satisfies the IPPC definition of a quarantine pest that is not present in the risk assessment area (i.e. protected zone)	Is the pest regulated as a quarantine pest? If currently regulated as a quarantine pest, are there grounds to consider its status could be revoked?
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!	Is the pest able to enter into, become established in, and spread within, the protected zone areas? Is entry by natural spread from EU areas where the pest is present possible?	Is spread mainly via specific plants for planting, rather than via natural spread or via movement of plant products or other objects? Clearly state if plants for planting is the main pathway!
Potential for consequences in the EU territory (Section 3.5)	Would the pests' introduction have an economic or environmental impact on the EU territory?	Would the pests' introduction have an economic or environmental impact on the protected zone areas?	Does the presence of the pest on plants for planting have an economic impact as regards the intended use of those plants for planting?
Available measures (Section 3.6)	Are there measures available to prevent the entry into, establishment within or spread of the pest within the EU such that the risk becomes mitigated?	Are there measures available to prevent the entry into, establishment within or spread of the pest within the protected zone areas such that the risk becomes mitigated? Is it possible to eradicate the pest in a restricted area within 24 months (or a period longer than 24 months where the biology of the organism so justifies) after the presence of the pest was confirmed in the protected zone?	Are there measures available to prevent pest presence on plants for planting such that the risk becomes mitigated?

Criterion of pest categorisation	Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Criterion in Regulation (EU) 2016/2031 regarding protected zone quarantine pest (articles 32–35)	Criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest
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	A statement as to whether (1) all criteria assessed by EFSA above for consideration as potential protected zone quarantine pest were met, and (2) if not, which one(s) were not met	A statement as to whether (1) all criteria assessed by EFSA above for consideration as a potential RNQP were met, and (2) if not, which one(s) were not met

The Panel will not indicate in its conclusions of the pest categorisation whether to continue the risk assessment process, but following the agreed two-step approach, will continue only if requested by the risk managers. However, during the categorisation process, experts may identify key elements and knowledge gaps that could contribute significant uncertainty to a future assessment of risk. It would be useful to identify and highlight such gaps so that potential future requests can specifically target the major elements of uncertainty, perhaps suggesting specific scenarios to examine.

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 to be transmissible?

YES, the identity of beet necrotic yellow vein virus is well established.

Beet necrotic yellow vein virus (BNYVV) is a well characterised virus in the genus *Benyvirus*, family *Benyviridae*. BNYVV has multiple genome components that are encapsidated in helical, rod-shaped particles assembled from multiple copies of the capsid protein (CP). The genome of BNYVV comprises positive, single-stranded RNA genome segments (RNAs 1–4) with some isolates having an additional fifth RNA segment (RNA-5). Partial or complete genome sequences of a range of BNYVV isolates have been determined and are available in international sequence databases.

The multipartite BNYVV genome comprises RNA-1 and RNA-2 controlling replication, assembly, cell-to-cell movement and suppression of antiviral RNA silencing (Gilmer et al., 2017). The additional genome components, RNA-3, RNA-4 and RNA-5 play a role in pathogenicity and vector transmission of the virus. RNA-3 determines the severity of rhizomania root symptoms (Schirmer et al., 2005; Tamada et al., 1999) while RNA-4 plays a role in vector transmission (Tamada and Abe, 1989). RNA-5 is associated with symptom severity but is dispensable for survival of BNYVV (Tamada, 2016). This RNA-5 is found only in association with isolates from Asia (Tamada et al., 1989), with BNYVV isolates occurring in specific areas of France (Koenig et al., 1997), Germany (Koenig et al., 2008), Kazakhstan (Koenig and Lennefors, 2000), the UK (Ward et al., 2007) and was identified more recently in BNYVV isolates from Turkey (Yüksel Özmen et al., 2020).

The EPPO code[7] (Griessinger and Roy, 2015; EPPO, 2019) for BNYVV is BNYVV0 (EPPO, online).

3.1.2. Biology of the pest

BNYVV is the causal agent of the rhizomania disease of sugar beet (Tamada and Baba, 1973). Characteristic symptoms of the disease are the extensive proliferation of lateral rootlets, leading to a

[7] 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 harmonized system to facilitate the management of plant and pest names in computerized databases, as well as data exchange between IT systems (Griessinger and Roy, 2015; EPPO, 2019).

root beard appearance hence the term 'rhizomania', for root madness. Severe disease symptoms are the reduced size of the roots and typical constrictions (funnel or 'wineglass'-like shape) of the infected taproots sometimes with nodules (small tumorous growths) along the taproot. Necrosis of vascular tissues (Figure 1) (Liebe et al., 2020) starting with a pale yellow to dark brown discoloration and necrotic rings may also occur. In less heavily infested plants, symptoms may affect only one lateral root of the plant (McGrann et al., 2009; Rush et al., 2006; Neher and Gallian, 2014; EPPO, 2006).

Sugar beet leaves may show a variety of symptoms upon infection (Figure 1) (Tamada and Baba, 1973) and foliage appears often light green or yellow but may also show crinkling, wilting and vein yellowing (McGrann et al., 2009). In general, plants appear stunted and show wilting symptoms especially during dry periods, even sometimes without leaf symptoms (McGrann et al., 2009; Rush et al., 2006; EPPO, 2006). Latent infections, with no visible symptoms, can occur under cool spring conditions (Lindsten, 1986), and rhizomania-tolerant cultivars which may show typical symptoms only at high virus inoculum level. A white-yellow discoloration or necrosis alongside the leaf midribs, yellowing and crinkling may be observed in rare cases of upper plant parts infections. However, this symptom that provided the name for the virus is rather rare (Tamada, 2016) and most likely associated with virus isolates that possess RNA-5 (Koenig et al., 1995). Symptom expression in leaves and roots may vary and plants may not exhibit foliar while showing severe root symptoms and vice versa (Neher and Gallian, 2014). Nevertheless, BNYVV is mostly restricted to the taproot and rarely invades above-ground tissues.

Figure 1: Beet necrotic yellow vein virus symptoms on sugar beet. Reduced root size (a), proliferation of rootlets and bearded appearance (b), wineglass taproot shape (c), yellowing of foliage (d), wilting (e) and vein yellowing (f) (courtesy of Yann Galein)

In sugar beet fields, infected plants occur either distributed in irregularly-shaped yellow patches in places that favour high soil humidity or throughout irrigated fields. At the end of the growing season, after rainfall, plants may exhibit upright yellowing foliage consisting of pale lettuce-green to bright yellow sometimes proliferated leaves with elongated petioles and narrowed laminae (McGrann et al., 2009). In late season, BNYVV symptoms of infected plants can easily be confused with nitrogen deficiency because of chlorosis symptoms found on mature, older leaves (Neher and Gallian, 2014).

BNYVV is transmitted by the plasmodiophorid vector *Polymyxa betae*. The life cycle of the obligate root endoparasite *P. betae* is presented in Figure 2. *P. betae* survives in soil as sporosori, a cluster of thick-walled resting spores and BNYVV can survive for very long time within such resting spores. Once a field becomes infested, it remains contaminated permanently (Wisler and Duffus, 2000). *P. betae* resting spores produce biflagellate zoospores which can reach sugar beet rootlets by swimming short distances in soil water. They penetrate the root cells and produce a plasmodium that may evolve into a zoosporangium to produce zoospores to move and infect neighbouring roots. Finally, *P. betae* will again produce resting spores, allowing the persistence of the vector and the virus.

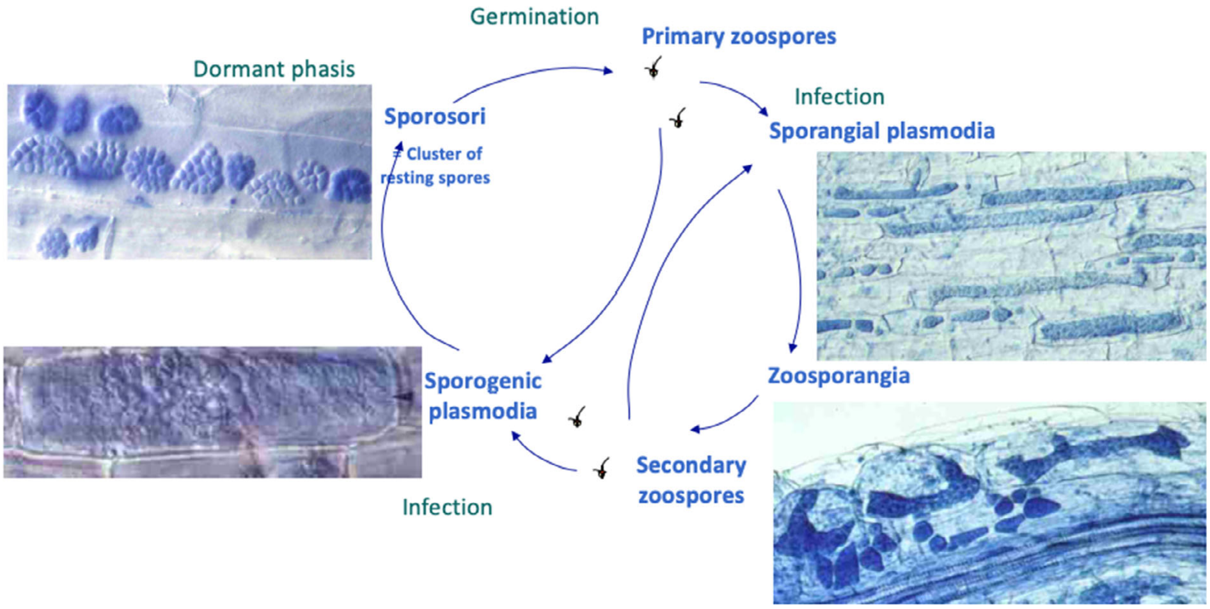

Figure 2: Life cycle of *Polymyxa* spp. (courtesy of Anne Legrève, Université catholique de Louvain)

Rhizomania is a soil-borne disease with spread primarily occurring via movement of contaminated soil attached to machinery moving from one field to another or, with soil on harvested sugar beet roots or other non-host crops such as potato. Contaminated compost might also play a role in disease dissemination (EPPO, 2006). Water plays a major role to facilitate local spread in the field. Humid and basic soils (with pH above 7) are favourable for disease development. The optimal temperature for *P. betae* development ranges between 20°C and 25°C (Prillwitz and Schlosser, 1993) and this may explain the limited virus prevalence in countries with cold climate. BNYVV was also detected in sheep manure showing that *P. betae* sporosori could survive intestinal passage (Heijbroek, 1988; Hillmann, 1984). Because crop residues are often used as animal feed, this might constitute a possible way for soil infestation.

Seed transmission of BNYVV has never been demonstrated. Nevertheless, soil with *P. betae* sporosori carrying the virus contaminating unprocessed beet seeds may contribute to virus spread (Heijbroek, 1988).

3.1.3. Intraspecific diversity

There are up to five RNA components associated with BNYVV of which RNA-1 and RNA-2 are essential for infectivity, while RNA-3 to RNA-5, sometimes referred to as satellites, are dispensable for infection (Schirmer et al., 2005; Tamada et al., 1999). They can be lost upon serial mechanical passage of the virus, but play a crucial role for the pathology of BNYVV in the field. RNA-2 and RNA-4 are required for transmission by the plasmodiphorid vector (Tamada and Abe, 1989) while RNA-3 and RNA-5 interact synergistically to increase symptoms (Tamada et al., 1996). BNYVV isolates with RNA-1 to RNA-4 are most commonly found while virus isolates having an additional RNA-5 are considered more aggressive than those without.

BNYVV occurs worldwide and particular virus types (A, B, J and P) exist that can be discriminated. It is acknowledged that all types have evolved from four BNYVV populations from Asia with China being one of the origins of BNYVV (Li et al., 2008; Chiba et al., 2011). Type A viruses have a worldwide occurrence and are commonly found in Europe, East Asia and the USA (Schirmer et al., 2005). BNYVV type B is prevalent in Germany, France and in various central European countries and 'similar-to-B types' are also found in Japan and China (Li et al., 2008). Based on phylogenetic analyses, BNYVV A isolates form four clades, A-I, A-II, A-III and type B, from which further subgroup isolates can be differentiated (Tamada, 2016). More diverse BNYVV are the J-types from Asia and the type P isolates both carrying RNA-5. BNYVV type P was first found in a restricted area in France, UK, Germany and Kazakhstan, while type J is present in Asia and Japan and was identified once in Germany (Koenig et al., 2008).

Phylogenetic studies of BNYVV isolates from different geographic areas in China (Zhuo et al., 2015) demonstrated gene flow between distant populations indicating that BNYVV populations are not geographically differentiated. A recent study from Turkey (Yüksel Özmen et al., 2020) revealed the emergence of novel variants from genetic reassortment of genome components RNA-2 and RNA-3 derived from the European A type and an RNA-5 related to the East Asian type J. The other genome components were derived from A, B and P-types. While distinct biological characteristics were not yet attributed to these new variants, the occurrence of those recombinant types may have effects on sugar beet that still need to be defined.

Diversity within the species BNYVV is evident from molecular phylogenetic analysis of its genome components but most striking with virus isolates breaking resistance in sugar beet. Because of the broad use of resistance conferred by the Rz1 locus against the rhizomania disease, essentially present in all modern sugar beet varieties, resistance-breaking isolates have emerged. All of those have particular RNA-3 and RNA-5 sequences. Rz1 resistance-breaking isolates have point mutations that lead to single amino acid changes in the p25 protein of RNA-3 (Chiba et al., 2008; Meunier et al., 2003a; Pferdmenges et al., 2009). In A, B and P types, amino acid variations at position 67–70 of p25 were identified having similar resistance breaking effects (Galein et al., 2018). Resistance breaking isolates carry either a Valine at aa position 67 or a Proline at position 69 in p25 (Bornemann et al., 2014). There is considerable diversity in these p25 motifs (Zhuo et al., 2015), but no correlation exists between virus type and p25 diversity (Bornemann and Varrelmann, 2013).

A strong selection pressure is imposed on RNA-3 and RNA-5 of BNYVV both implicated in symptom severity. In addition to the symptom variations associated with RNA-3, very severe symptom phenotypes in Rz1 sugar beet infected with BNYVV P types were attributed to RNA-5.

3.1.4. Detection and identification of the pest

Are detection and identification methods available for the pest?

YES, detection and identification methods are available for BNYVV.

Symptoms of the rhizomania disease, rootlet proliferation and vascular necrosis provide a good indication for BNYVV infection. However, foliar symptoms including wilting can be confused with those resulting from other biotic or abiotic stresses. Since other soil-borne viruses may be found in association with rhizomania, such as beet soil-borne virus (BSBV), beet soil-borne mosaic virus (BSBMV) (Meunier et al., 2003b), beet virus Q (BVQ) and beet black scorch virus (BBSV) (Mehrvar et al., 2009), a correct virus detection and identification relies on serological and molecular methods (Fomitcheva and Kühne, 2019). Serological methods based on enzyme-linked immunosorbent assay (ELISA) are sensitive and robust for virus detection in particular when large sample numbers are to be tested. While ELISA reliably detects presence of BNYVV, only molecular methods can discriminate among virus isolates, differentiate virus types and resolve the resistance breaking variants of p25. Various modifications of reverse transcriptase polymerase chain reaction (RT-PCR) provide sensitive and specific means for distinguishing BNYVV types including resistance breaking strains. Thus, BNYVV detection and identification can be reliably done. Care has to be taken with sampling for virus testing considering that the virus generally invades sugar beet roots only and thus samples need to be taken from the root system of sugar beet (Tamada, 2016).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

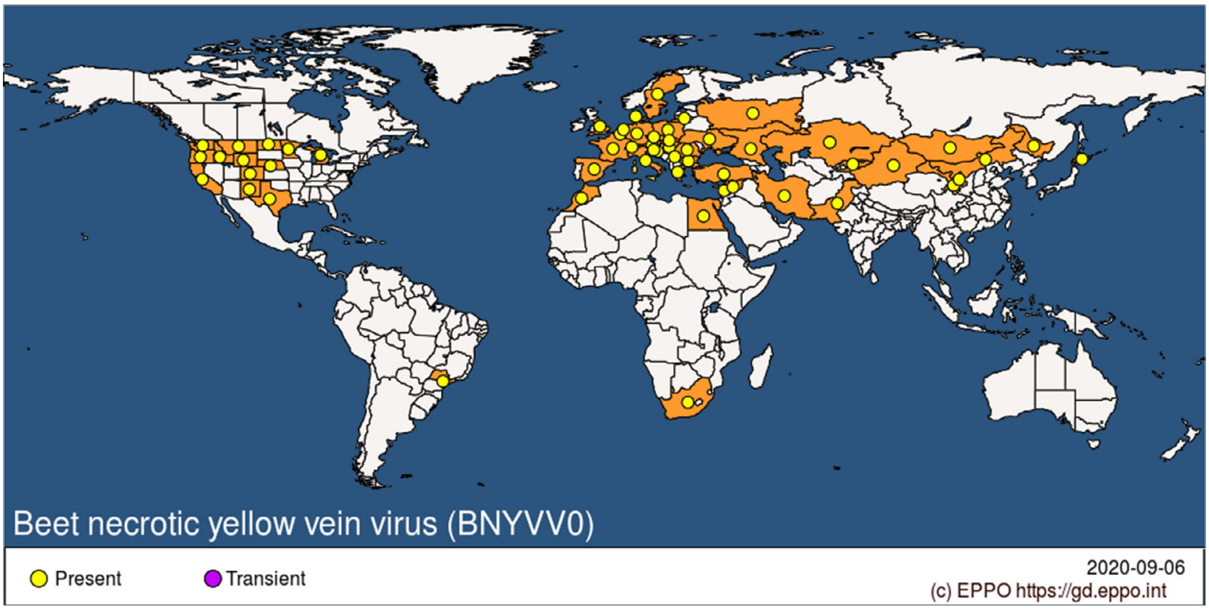

Figure 3: Global distribution map for beet necrotic yellow vein virus (extracted from the EPPO Global Database; last update 6/9/2020, last access 10 September 2020)

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, BNYVV is widely distributed within the EU but BNYVV is absent in the PZs.

BNYVV is widely distributed within the EU and associated with current and past sugar beet production. The virus is absent in the PZs (Table 2), however it is uncertain whether BNYVV may be present but unreported in one or more of the PZs.

Table 2: Current distribution of beet necrotic yellow vein virus in the EU and Northern Ireland based on information from the EPPO Global Database (last update 6 September 2020, last access 10 September 2020)

Country	Status
Austria	Present, widespread
Belgium	Present, widespread
Bulgaria	Present, restricted distribution
Croatia	Present, restricted distribution
Czech Republic	Present, few occurrences
Denmark	Present, few occurrences
Finland (PZ)	**Absent, confirmed by survey**
France (Brittany is PZ)	**Present, restricted distribution**
Germany	Present, restricted distribution
Greece	Present, no details
Hungary	Present, restricted distribution
Ireland (PZ)	**Absent, confirmed by survey**

Country	Status
Italy	Present, widespread
Latvia	Absent, confirmed by survey
Lithuania	Present, restricted distribution
Netherlands	Present, no details
Poland	Present, few occurrences
Portugal (Azores are PZ)	**Absent, confirmed by survey**
Romania	Present, restricted distribution
Slovakia	Present, restricted distribution
Slovenia	Present, restricted distribution
Spain	Present, restricted distribution
Sweden	Present, restricted distribution
Northern Ireland[(a)] (PZ)	**Absent, confirmed by survey**

(a): As noted in 1.2 (interpretation of ToR) the United Kingdom has withdrawn from the EU and in line with the Withdrawal Agreement (European Commission, 2019) Northern Ireland is considered part of the EU protected zones in this opinion.

3.3. Regulatory status

3.3.1. Commission Implementing Regulation 2019/2072

Beet necrotic yellow vein virus is listed in Annex III of Commission Implementing Regulation (EU) 2019/2072, the implementing act of Regulation (EU) 2016/2031. Details are presented in Tables 3 and 4.

Table 3: Beet necrotic yellow vein virus in Commission Implementing Regulation 2019/2072

Annex III	**List of protected zones and the respective protected zone quarantine pests and their respective codes** The protected zones listed in the third column of the following table respectively cover one of the following: – the whole territory of the Member State listed; – only the part of the territory of the Member State which is specified within brackets		
Protected zone quarantine pests		**EPPO code**	**Protected zones**
(d)	Virus, viroids and phytoplasmas		
1.	Beet necrotic yellow vein virus	BNYVV0	(a) Ireland; (b) France (Brittany); (c) Portugal (Azores); (d) Finland; (e) United Kingdom (Northern Ireland)[(a)]

(a): As noted in 1.2 (interpretation of ToR) the United Kingdom has withdrawn from the EU and in line with the Withdrawal Agreement (European Commission, 2019) Northern Ireland is considered part of the EU protected zones in this opinion.

3.3.2. Legislation addressing the hosts of beet necrotic yellow vein virus

Table 4: Regulated hosts and commodities that may involve beet necrotic yellow vein virus in Annexes of Commission Implementing Regulation 2019/2072

Annex VI	**List of plants, plant products and other objects whose introduction into the Union from certain third countries is prohibited**		
	Description	*CN Code*	*Third country, group of third countries or specific area of third country*
19.	Soil as such consisting in part of solid organic substances	ex 2530 90 00 ex 3824 99 93	Third countries other than Switzerland
20.	Growing medium as such, other than soil, consisting in whole or in part of solid organic substances, other than that composed entirely of peat or fibre of *Cocos nucifera* L., previously not used for growing of plants or for any agricultural purposes	ex 2530 10 00 ex 2530 90 00 ex 2703 00 00 ex 3101 00 00 ex 3824 99 93	Third countries other than Switzerland

Annex VII	**List of plants, plant products and other objects, originating from third countries and the corresponding special requirements for their introduction into the Union territory**			
	Plants, plant products and other objects	*CN codes*	*Origin*	*Special requirements*
1.	Growing medium, attached to or associated with plants, intended to sustain the vitality of the plants, with the exception of sterile medium of in-vitro plants	N/A	Third countries other than Switzerland	Official statement that: (a) the growing medium, at the time of planting of the associated plants: (i) was free from soil and organic matter and had not been previously used for growing plants or for any other agricultural purposes, or (ii) was composed entirely of peat or fibre of *Cocos nucifera* L. and had not been previously used for growing plants or for any other agricultural purposes, or (iii) was subjected to effective fumigation or heat treatment to ensure freedom from pests and which is indicated on the phytosanitary certificate referred to in Article 71 of Regulation (EU) No 2016/2031, under the rubric 'Additional declaration', or (iv) was subjected to effective systems approach to ensure freedom from pests and which is indicated on the phytosanitary certificate referred to in Article 71 of Regulation (EU) No 2016/2031, under the rubric 'Additional declaration'; and

				in all the cases mentioned in points (i) to (iv) was stored and maintained under appropriate conditions to keep it free from quarantine pests and (b) since planting: (i) appropriate measures have been taken to ensure that the growing medium has been kept free from Union quarantine pests, including at least: — physical isolation of the growing medium from soil and other possible sources of contamination, — hygiene measures, — using water free from Union quarantine pests; or (ii) within two weeks prior to export the growing medium including, where appropriate, soil has been completely removed by washing using water free from Union quarantine pests. Replanting may be performed in the growing medium that meets the requirements laid down in point (a). Appropriate conditions shall be maintained to keep freedom from Union quarantine pests, as provided for in point (b)
2.	Machinery and vehicles which have been operated for agricultural or forestry purposes	ex 8432 10 00 ex 8432 21 00 ex 8432 29 10 ex 8432 29 30 ex 8432 29 50 ex 8432 29 90 ex 8432 31 00 ex 8432 39 11 ex 8432 39 19 ex 8432 39 90 ex 8432 41 00 ex 8432 42 00 ex 8432 80 00 ex 8432 90 00 ex 8433 40 00 ex 8433 51 00 ex 8433 53 10 ex 8433 53 30 ex 8433 53 90 ex 8436 80 10 ex 8701 20 90 ex 8701 91 10	Third countries other than Switzerland	Official statement that machinery or vehicles are cleaned and free from soil and plant debris

		ex 8701 92 10 ex 8701 93 10 ex 8701 94 10 ex 8701 95 10		
12.	Root and tubercle vegetables, other than tubers of *Solanum tuberosum* L	0706 10 00 0706 90 10 0706 90 30 0706 90 90 ex 0709 99 90 ex 0714 10 00 ex 0714 20 10 ex 0714 20 90 ex 0714 30 00 ex 0714 40 00 ex 0714 50 00 ex 0714 90 20 ex 0714 90 90 ex 0910 11 00 ex 0910 30 00 ex 0910 99 91 ex 1212 91 80 ex 1212 94 00 ex 1212 99 95 ex 1214 90 10 ex 1214 90 90	Third countries other than Switzerland	Official statement that the consignment or lot does not contain more than 1% by net weight of soil and growing medium
13.	Bulbs, corms, rhizomes and tubers, intended for planting, other than tubers of *Solanum tuberosum*	0601 10 10 0601 10 20 0601 10 30 0601 10 40 0601 10 90 0601 20 10 0601 20 30 0601 20 90 ex 0706 90 10 ex 0910 11 00 ex 0910 20 10 ex 0910 30 00	Third countries other than Switzerland	Official statement that the consignment or lot does not contain more than 1% by net weight of soil and growing medium
14.	Tubers of *Solanum tuberosum* L.	0701 10 00 0701 90 10 0701 90 50 0701 90 90	Third countries other than Switzerland	Official statement that the consignment or lot does not contain more than 1% by net weight of soil and growing medium

Annex X	**List of plants, plant products and other objects, to be introduced into, or moved within protected zones and corresponding special requirements for protected zones** The protected zones listed in the fourth column of the following table respectively cover one of the following: – the whole territory of the Member State listed; – only the part of the territory of the Member State which is specified within brackets

	Plants, plant products and other objects	*CN code*	*Special requirements for protected zones*	*Protected zones*
1.	Used agricultural machinery	ex 8432 10 00 ex 8432 21 00 ex 8432 29 10 ex 8432 29 30 ex 8432 29 50 ex 8432 29 90 ex 8432 31 00 ex 8432 39 11 ex 8432 39 19 ex 8432 39 90	The machinery has: (a) been cleaned and free from soil and plant debris when brought to places of production, where beets are grown; or (b) come from an area where BNYVV is known not to occur	(a) Ireland; (b) France (Brittany); (c) Portugal (Azores); (d) Finland; (e) United Kingdom (Northern Ireland)[(a)]

		ex 8432 41 00 ex 8432 42 00 ex 8432 80 00 ex 8432 90 00 ex 8433 40 00 ex 8433 51 00 ex 8433 53 10 ex 8433 53 30 ex 8433 53 90 ex 8436 80 10 ex 8701 20 90 ex 8701 91 10 ex 8701 92 10 ex 8701 93 10 ex 8701 94 10 ex 8701 95 10		
2.	Soil from beet and unsterilised waste from beet (*Beta vulgaris* L.)	ex 2303 20 10 ex 2303 20 90 ex 2530 90 00	Official statement that soil or waste: (a) has been treated to eliminate contamination with BNYVV, or (b) is intended to be transported for disposal in an officially approved manner, (c) comes from *Beta vulgaris* plants grown in an area where BNYVV is known not to occur	(a) Ireland; (b) France (Brittany); (c) Portugal (Azores); (d) Finland; (e) United Kingdom (Northern Ireland)[(a)]
4.	Plants of *Allium porrum* L., *Apium* L., *Beta* L., other than those mentioned in point 5 of this Annex and those intended for animal fodder, *Brassica napus* L., *Brassica rapa* L., *Daucus* L., other than plants for planting	ex 0703 90 00 ex 0704 90 90 0706 10 00 0706 90 30 ex 0706 90 90	(a) The consignment or lot does not contain more than 1% by weight of soil, or (b) official statement that the plants are intended for processing at premises with officially approved waste disposal facilities which ensures that there is no risk of spreading of BNYVV	(a) France (Brittany); (b) Finland; (c) Ireland; (d) Portugal (Azores); (e) United Kingdom (Northern Ireland)[(a)]
5.	Plants of *Beta vulgaris* L., intended for industrial processing	ex 1212 91 80 ex 1214 90 10	Official statement that the plants: (a) are transported in such a manner as to ensure that there is no risk of spreading BNYVV, and are intended to be delivered to a processing plant with officially approved waste disposal facilities, which ensures that there is no risk of spreading BNYVV, or (b) have been grown in an area where BNYVV is known not to occur	(a) Ireland; (b) France (Brittany); (c) Portugal (Azores); (d) Finland; (e) United Kingdom (Northern Ireland)[(a)]
6.		0701 10 00	Official statement that the tubers:	(a) France (Brittany); (b) Finland;

	Tubers of *Solanum tuberosum* L., for planting		(a) were grown in an area where Beet necrotic yellow vein virus ("BNYVV") is known not to occur; or (b) were grown on land, or in growing media consisting of soil that is known to be free from BNYVV, or officially tested by appropriate methods and found free from BNYVV; or (c) have been washed free from soil	(c) Ireland; (d) Portugal (Azores); (e) United Kingdom (Northern Ireland)[(a)]
7.	Tubers of *Solanum tuberosum* L., other than those mentioned in point 6 of this Annex	ex 0701 90 10 ex 0701 90 50 ex 0701 90 90	a) The consignment or the lot shall not contain more than 1% by weight of soil; or (b) official statement that the tubers are intended for processing at premises with officially approved waste disposal facilities which ensures that there is no risk of spreading of BNYVV	(a) France (Brittany); (b) Finland; (c) Ireland; (d) Portugal (Azores); (e) United Kingdom (Northern Ireland)[(a)]
8.	Plants for planting of *Beta vulgaris* L., other than seeds	ex 0601 10 90 ex 0601 20 90 ex 0602 90 30 ex 0602 90 50	Official statement that the plants: (a) (i) have been officially individually tested and found free from BNYVV; or (ii) have been grown from seeds complying with the requirements under points 33 and 34 of this Annex and grown in areas where BNYVV is known not to occur, or — grown on land, or in growing media, officially tested by appropriate methods and found free from BNYVV, and — sampled, and the sample tested and found free from BNYVV; (b) and (b) the holding of the material of those plants have been notified by the respective organisation or research body	(a) Ireland; (b) France (Brittany); (c) Portugal (Azores); (d) Finland; (e) United Kingdom (Northern Ireland)[(a)]
33.	Seeds and fodder beet seed of the species *Beta vulgaris* L.	1209 10 00 1209 29 60 ex 1209 29 80 1209 91 30 ex 1209 91 80	Without prejudice to Directive 2002/54/EC, where applicable, official statement that: (a) the seed of the categories 'basic seed' and 'certified seed' satisfies the conditions laid down in Annex I.B.3 to Directive 2002/54/EC;	(a) Ireland; (b) France (Brittany); (c) Portugal (Azores); (d) Finland; (e) United Kingdom (Northern Ireland)[(a)]

			or (b) in the case of 'seed not finally certified', the seed satisfies the conditions laid down in Article 15(2) of Directive 2002/54/EC, and is intended for processing that will satisfy the conditions laid down in part B of Annex I to that Directive and delivered to a processing enterprise with officially approved controlled waste disposal, to prevent the spread of BNYVV; or (c) the seed has been produced from a crop grown in an area where BNYVV is known not to occur	
34.	Vegetable seed of the species *Beta vulgaris* L.	ex 1209 29 80 1209 91 30 ex 1209 91 80	Without prejudice to Directive 2002/55/EC, where applicable, official statement that: (a) the processed seed contains no more than 0.5% by weight of inert matter (in the case of pelleted seed this standard shall be met prior to pelleting); or (b) in the case of non-processed seed, the seed is officially packed in such a manner as to ensure that there is no risk of spread of BNYVV, and is intended for processing that will satisfy the conditions laid down in point a) and delivered to a processing enterprise with officially approved controlled waste disposal, to prevent the spread of BNYVV; or (c) the seed has been produced from a crop grown in an area where BNYVV is known not to occur	(a) Ireland; (b) France (Brittany); (c) Portugal (Azores); (d) Finland; (e) United Kingdom (Northern Ireland)[(a)]

Annex XI	**List of plants, plant products and other objects subject to phytosanitary certificates and those for which such certificates are not required for their introduction into the Union territory**		
Part A	List of plants, plant products and other objects, as well as the respective third countries of origin or dispatch, for which, pursuant to Article 72(1) of Regulation (EU) 2016/2031 phytosanitary certificates are required for their introduction into the Union territory		
	Plants, plant products and other objects	*CN code and its respective description under Council Regulation (EEC) No 2658/87*	*Country of origin or dispatch*

1.	Miscellaneous		
	Machinery and vehicles which have been operated for agricultural or forestry purposes	Agricultural, horticultural or forestry machinery for soil preparation or cultivation already having been operated; lawn or sportsground rollers – already operated: – Ploughs: ex 8432 10 00 – Harrows, scarifiers, cultivators, weeders and hoes: ex 8432 21 00 ex 8432 29 10 ex 8432 29 30 ex 8432 29 50 ex 8432 29 90 – Seeders, planters and transplanters: ex 8432 31 00 ex 8432 39 11 ex 8432 39 19 ex 8432 39 90 – Manure spreaders and fertiliser distributors: ex 8432 41 00 ex 8432 42 00 – Other machinery: ex 8432 80 00 – Parts: ex 8432 90 00 Harvesting or threshing machinery, including straw or fodder balers; grass or hay mowers; machines for cleaning, sorting or grading eggs, fruit or other agricultural produce, other than machinery of heading 8437 – already operated: – Straw or fodder balers, including pick-up balers: ex 8433 40 00 – – Combine harvesters-threshers: ex 8433 51 00 – – Root or tuber harvesting machines: ex 8433 53 10 ex 8433 53 30 ex 8433 53 90 Other agricultural, horticultural, forestry, poultry-keeping or bee-keeping machinery, including germination plant fitted with mechanical or thermal equipment; poultry incubators and brooders – already operated: – – Forestry machinery: ex 8436 80 10 Tractors (other than tractors of heading 8709) – already operated:	Third countries other than Switzerland

		– Road tractors for semi-trailers: ex 8701 20 90 – Other than single axle tractors, road tractors or track-laying tractors: – – – Agricultural tractors and forestry tractors, wheeled: ex 8701 91 10 ex 8701 92 10 ex 8701 93 10 ex 8701 94 10 ex 8701 95 10	
	Growing medium, attached to or associated with plants, intended to sustain the vitality of the plants	N/A	Third countries other than Switzerland
2.	General categories		
	Plants for planting, other than seeds	Bulbs, tubers, tuberous roots, corms, crowns and rhizomes, dormant, in growth or in flower; chicory plants and roots other than roots of heading 1212: 0601 10 10 0601 10 20 0601 10 30 0601 10 40 0601 10 90 0601 20 10 0601 20 30 0601 20 90 Other live plants (including their roots), cuttings and slips; other than mushroom spawn: 0602 10 90 0602 20 20 0602 20 80 0602 30 00 0602 40 00 0602 90 20 0602 90 30 0602 90 41 0602 90 45 0602 90 46 0602 90 47 0602 90 48 0602 90 50 0602 90 70 0602 90 91 0602 90 99 Onions, shallots, garlic, leeks and other alliaceous vegetables, fresh, for planting: ex 0703 10 11 ex 0703 10 90 ex 0703 20 00 Cabbages, cauliflowers, kohlrabi, kale and similar edible brassicas, fresh, planted in a growing substrate: ex 0704 10 00 ex 0704 90 10 ex 0704 90 90	Third countries other than Switzerland

		Lettuce (*Lactuca sativa*) and chicory (*Cichorium* spp.), fresh, planted in a growing substrate: ex 0705 11 00 ex 0705 19 00 ex 0705 21 00 ex 0705 29 00 Celery other than celeriac, planted in a growing substrate: ex 0709 40 00 Salad vegetables, other than lettuce (*Lactuca sativa*) and chicory (*Cichorium* spp.), planted in a growing substrate: ex 0709 99 10 Other vegetables, planted in a growing substrate: ex 0709 99 90 Ginger, saffron, turmeric (curcuma), and other spices, for planting or planted in a growing substrate: ex 0910 11 00 ex 0910 20 10 ex 0910 30 00 ex 0910 99 31 ex 0910 99 33	
	Root and tubercle vegetables	Carrots, turnips, salad beetroot, salsify, celeriac, radishes and similar edible roots, fresh or chilled: 0706 10 00 0706 90 10 0706 90 30 0706 90 90 Other root and tubercle vegetables, fresh or chilled: ex 0709 99 90 Manioc, arrowroot, salep, Jerusalem artichokes, sweet potatoes and similar roots and tubers with high starch or inulin content, fresh, chilled, not frozen nor dried, not sliced or in the form of pellets: ex 0714 10 00 ex 0714 20 10 ex 0714 20 90 ex 0714 30 00 ex 0714 40 00 ex 0714 50 00 ex 0714 90 20 ex 0714 90 90 Ginger, saffron, turmeric (curcuma), and other spices in the form of root or tubercle plant parts, fresh or chilled, other than dried: ex 0910 11 00 ex 0910 30 00 ex 0910 99 91	Third countries other than Switzerland

		Sugar beet, not ground, fresh and chilled: ex 1212 91 80 Chicory roots, fresh and chilled: ex 1212 94 00 Other root and tubercle vegetables, fresh and chilled: ex 1212 99 95 Swedes, mangolds, fodder roots, similar forage products, not in the form of pellets, fresh or chilled, other than dried: ex 1214 90 10 ex 1214 90 90	
Annex XII	**List of plants, plant products and other objects for which a phytosanitary certificate is required for their introduction into a protected zone from certain third countries of origin or dispatch**		
	Plants, plant products and other objects	*CN code and its respective description under Council Regulation (EEC) No 2658/87*	*Country of origin or dispatch*
1.	Plants of		
	Beta vulgaris L., intended for industrial processing	Sugar beet, fresh: ex 1212 91 80 Mangold roots, fresh: ex 1214 90 10	Third countries other than Switzerland
4.	Seeds of		
	Beta vulgaris L.	Sugar beet seeds, for sowing: 1209 10 00 Fodder beet seed (*Beta vulgaris* var. *alba*), for sowing: 1209 29 60 Other fodder beet seeds (other than *Beta vulgaris* var. *alba*), for sowing: ex 1209 29 80 Salad beet seed or beetroot seed (*Beta vulgaris* var. *conditiva*), for sowing: 1209 91 30 Other beet seeds (*Beta vulgaris*), for sowing: ex 1209 91 80	Third countries other than Switzerland
8.	Other		
	Soil from beet and unsterilised waste from beet (*Beta vulgaris* L.)	Residues of starch manufacture and similar residues, beet-pulp, bagasse and other waste of sugar manufacture, brewing or distilling dregs and waste, whether or not in the form of pellets, other: ex 2303 20 10 ex 2303 20 90 Mineral substances not elsewhere specified or included, other: ex 2530 90 00	Third countries other than Switzerland
Annex XIII	**List of plants, plant products and other objects for which a plant passport is required for movement within the Union territory**		
1.	All plants for planting, other than seeds		
Annex XIV	**List of plants, plant products and other objects for which a plant passport with the designation 'PZ' is required for introduction into, and movement within certain protected zones**		

2.	Plants for planting, other than seeds, of *Ajuga* L., *Beta vulgaris* L., *Cedrus* Trew, *Crossandra* Salisb., *Dipladenia* A.DC., *Euphorbia pulcherrima* Willd., *Ficus* L., *Hibiscus* L., *Mandevilla* Lindl., *Nerium oleander* L., *Platanus* L., *Populus* L., *Prunus* L., *Quercus* spp., other than *Quercus suber*, *Ulmus* L. and plants for planting of *Begonia* L., other than corms, seeds and tubers
7.	Plants of *Beta vulgaris* L., intended for industrial processing
8.	Soil from beet and unsterilised waste from beet (*Beta vulgaris* L.)
9.	Seeds of *Beta vulgaris* L., *Castanea* Mill., *Dolichos* Jacq. and *Gossypium* spp.

(a): As noted in Section 1.2 (interpretation of ToR) the United Kingdom has withdrawn from the EU and in line with the Withdrawal Agreement (European Commission, 2019) Northern Ireland is considered part of the EU protected zones in this opinion.

3.4. Entry, establishment and spread in the EU

3.4.1. Host range

BNYVV infects mainly plants in the family Amaranthaceae (former Chenopodiaceae). *Beta vulgaris* (synonym *B. orientalis*) is the major host of BNYVV, and especially *B. vulgaris* ssp. *vulgaris* that contains all cultivated groups (Lange et al., 1999), e.g. sugar beet group, fodder beet group, leaf beet group (referred to as mangold, spinach beet, silver beet, chard or Swiss chard) and garden beet group (including all beets that their roots are used as vegetables). Other susceptible cultivated species in the Amaranthaceae are spinach (*Spinacea oleracea*) and the ornamental *Gomphrena globosa*. Chicory (*Cichorium intybus,* Asteraceae)*,* New Zealand spinach (*Tetragonia tetragonioides* (synonym *T. expansa,* Aizoaceae) and *Petunia hybrida* (Solanaceae) are also susceptible.

BNYVV may infect naturally or experimentally (by inducing local lesions and/or systemic infection) a number of weeds/wild species (Appendix A). The test plants *Nicotiana benthamiana, N. clevelandii*, *N. tabacum* H423*, N. tabacum Xanthi, N. glutinosa* (Solanaceae) are also susceptible, the first two exhibiting systemic symptoms (Brunt et al., 1996; EPPO, online; Horvath, 1994; Hugo et al., 1996; Mouhanna et al., 2008; Tamada and Baba, 1973; Yanar et al., 2010; Kutluk et al., 2000; Legreve et al., 2005; Yilmaz et al., 2016).

3.4.2. Entry

> *Is the pest able to enter into the EU territory (protected zones)? If yes, identify and list the pathways.*
>
> **YES**, the virus may enter the PZs via infected plants, including plants for planting of other species than *B. vulgaris,* or *P. betae* resting spores in soil and growing media as such or attached to machinery, roots and tubercle vegetables.

The Panel restricts its analyses to the pathways of entry into the PZs. The virus is widely distributed in other parts of the EU and therefore entry pathways into all other countries except the PZ regions were not evaluated because this was considered of limited relevance.

BNYVV may enter a PZ via infected plants or via spores of its viruliferous soil-borne vector *P. betae* carried with soil and growing media or, attached to various commodities and coming from third countries or, from within the EU, by internal trade with EU MSs.

The Panel identified several pathways for entry of BNYVV/*P. betae* into the PZs and reviewed the existing legislation (Section 3.3.2) applicable to these pathways. All pathways are regulated by legislation, but can be divided in two categories: those prohibited by legislation and those permitted and managed by legislation. Uncertainty exists on the relative importance for entry into the PZs of the pathways identified below.

Pathways regulated and closed:

- **Plants for planting (P4P) of *Beta vulgaris* other than seeds:**
- while other requirements [Phytosanitary certificate (Annex XI, part A, point 2), Plant passport (Annex XIV, point 2)] also apply, an official statement that specific requirements are met is required for plants for planting of *B. vulgaris*, other than seeds if they are to enter a PZ (Annex X, point 8).

The Panel highlights that those specific requirements are appropriate. However, because of ongoing changes in the taxonomy of *B. vulgaris,* several host plants are no longer recognised as *B. vulgaris* subspecies but classified as new species within the *Beta* genus. This blurs the regulation because plants of these *Beta* spp. would no longer be regulated as *B. vulgaris* and fall under the legislation regulating plants for planting of species other than *B. vulgaris*.

— **Plants of *B. vulgaris* intended for industrial processing:**
    — while other requirements [Phytosanitary certificate (Annex XII, point 1) Plant passport (Annex XIV, point 7)] also apply, an official statement that appropriate specific requirements are met is required for plants of *B. vulgaris* intended for industrial processing if they are to enter a PZ (Annex X, point 5).
— **Soil from beet and unsterilised waste of beet (*B. vulgaris:*)**
    — while other requirements [Phytosanitary certificate (Annex XII, point 8), Plant passport (Annex XIV, point 8)] also apply, an official statement that soil or waste meet appropriate criteria is required to import in the PZs (Annex X, point 2).
— **Seeds and fodder beet seed of *B. vulgaris:***
    — while other requirements [Phytosanitary certificate (Annex XII, point 4), Plant passport (Annex XIV, point 9)] also apply, an official statement that appropriate specific requirements are met is required for seeds of *B. vulgaris* if they are to enter a PZ (Annex X, points 33 and 34).
— **Soil and growing media attached to (agricultural) machinery:**
    — while other requirements [Official statement (Annex VII, point 2), Phytosanitary certificate (Annex XI, part A, point 1)] also apply, special requirements that used agricultural machinery be cleaned and free from soil and plant debris when brought to places of production, where beets are grown or come from an area where BNYVV is known not to occur apply if it is to enter a PZ (Annex X, point 1).

Pathways regulated and partially closed:

— **Plants for planting (P4P) of species other than *Beta vulgaris*:** BNYVV can spread via infected host plants or via viruliferous *P. betae* present in the soil attached to the roots of plants for planting of both host and non-host species:
    — a special requirement applies to all bulbs, corms and rhizomes intended for planting imported in the EU from third countries other than Switzerland that the consignment or lot does not contain more than 1% by net weight of soil and growing medium (Annex VII, points 13 and 14);
    — a phytosanitary certificate is required for plants for planting, other than seeds, including specifically (i) bulbs, tubers, tuberous roots, corms, crowns and rhizomes, dormant, in growth or in flower, (ii) other live plants (including their roots), cuttings and slips, (iii) chicory plants and roots other than roots of heading, and (iv) other vegetables, planted in a growing substrate for their introduction in the EU from third countries other than Switzerland (Annex XI, part A, point 2);
    — an official statement that specific requirements are met is required for tubers of *Solanum tuberosum* for planting if they are to enter a PZ (Annex X, point 6);
    — a plant passport certificate is required for all plants for planting, other than seeds, for movement within the Union territory (Annex XIII, point 1) while a plant passport with the designation 'PZ' is required for a number of number of plants, plant products and other objects for introduction into, and movement within certain protected zones (Annex XIV).

The Panel highlights that BNYVV is reported from Switzerland (Section 3.2.2) although there is uncertainly on its prevalence and distribution. However, the pathway would be open for plants for planting of species other than *B. vulgaris* and *S. tuberosum* (including *Beta* species other than *B. vulgaris*) coming from Switzerland but closed for those coming from other third countries. BNYVV is not specifically addressed in the legislation embodied in Annexes XIII and XIV. Thus, it is not clear to which extent entry into the PZs, of BNYVV or of viruliferous *P. betae* spores, may be limited.

- **Roots and tubercle vegetables:**
  - a special requirement applies to root and tubercle vegetables other than *S. tuberosum* imported in the EU from third countries other than Switzerland that the consignment or lot does not contain more than 1% by net weight of soil and growing media (Annex VII, point 12);
  - a phytosanitary certificate is required for root and tubercle vegetables for their introduction in the EU from third countries other than Switzerland (Annex XI, part A, point 2);
  - an official statement that specific requirements are met is required for tubers of *S. tuberosum* (Annex X, point 7) as well as for plants of *Allium porrum*, *Apium* and *Brassica napus, Brassica rapa* and *Daucus,* other than plants for planting if they are to enter a PZ (Annex X, point 4).

The Panel highlights that the specific requirements specifically addressing BNYVV and PZs (i) do not cover all root and tubercle vegetables species and (ii) do not completely close the pathway for intra-EU trade because of the limit of 1% by weight of soil present in consignments. Similarly, the specific requirements do not completely close the pathway of import from third countries, since BNYVV is reported to be present in Switzerland.

- **Soil and growing media**:
  - the import of soil as such consisting in part of solid organic substances (Annex VI, point 19) and of growing medium as such consisting whole or in part of solid organic substances (Annex VI, point 20) is prohibited from third countries other than Switzerland;
  - specific requirements apply to growing medium, attached to or associated with plants, intended to sustain the vitality of the plants, with the exception of sterile medium of in-vitro plants (Annex V, point 1).

Soil or growing media may contain viruliferous spores of the BNYVV vector *P. betae*. The Panel notices that current legislation does not limit the entry of soil or growing media into the PZs from Switzerland were BNYVV is reported and furthermore that there are no specific restrictions for soil and growing media coming from other EU MSs. Thus, uncertainties exist on the extent of BNYVV presence in Switzerland and on the volumes of soil and growing media that are moved from other MSs to the PZs.

Table 5: List of regulated pathways for the entry of beet necrotic yellow vein virus in the PZs

Pathways regulated and closed	Legislation	Comments
Plants for planting (P4P) of *Beta vulgaris* other than seeds	Annex X, point 8	Due to ongoing changes in taxonomy, *Beta* plant species, previously classified as *Beta vulgaris* subspecies, would not fall anymore under this regulation but would fall under legislation regulating plants for planting of other species than *B. vulgaris*
Plants of *B. vulgaris* intended for industrial processing	Annex X, point 5	
Soil from beet and unsterilised waste of beet (*Beta vulgaris*)	Annex X, point 2	
Seeds and fodder beet seed of *B. vulgaris*	Annex X, points 33 and 34	
Soil and growing media attached to (agricultural) machinery	Annex X, point 1	
Pathways regulated and only partially closed	**Legislation**	**Comments**
Plants for planting (P4P) of species other than *Beta vulgaris*	Annex VII, points 13 and 14 Annex XI, part A, point 2 Annex X, point 6 Annex XIII, point 1 Annex XIV	The pathway is closed for third countries but would be open for plants for planting of species other than *B. vulgaris* and *S. tuberosum* (including *Beta* species other than *B. vulgaris*) coming from Switzerland. In addition, Annexes XIII and XIV do not specifically address BNYVV

Roots and tubercle vegetables	Annex VII, point 12 Annex XI, part A, point 2 Annex X, point 7 Annex X, point 4	The specific requirements addressing BNYVV and PZs (i) do not cover all root and tubercle vegetables species and (ii) do not completely close the pathway for intra-EU trade because of the limit of 1% by weight of soil present in consignments. The specific requirements do not completely close the pathway of import from third countries since BNYVV is reported to be present in Switzerland
Soil and growing media	Annex VI, point 19 Annex VI, point 20 Annex V, point 1	The current legislation does not limit entry of soil or growing media from Switzerland were BNYVV is reported. In addition, no specific regulations are currently in place to restrict the introduction of soil or growing media coming from EU MSs into the PZs

Between 1995 and 2020, there were 0 records of interception of beet necrotic yellow vein virus in the Europhyt database. No interceptions were recorded in the TRACES database from May to October 2020 (accessed on 5th October 2020).

3.4.3. Establishment

Is the pest able to become established in the EU (protected zones) territory?

YES, BNYVV is already established in many parts of the EU.

3.4.3.1. EU distribution of main host plants

BNYVV is present in sugar beet fields in several EU countries (Figure 4, Tables 6 and 7). The virus is maintained in its systemically infected plant and in viruliferous resting spores of its *P. betae* vector. All other BNYVV virus types and strains are expected to have similar ecoclimatic requirements and would therefore be able to establish in areas where BNYVV already is endemic.

BNYVV can infect a number of wild species including relatives of sugar beet (see Section 3.4.1) and weeds. Therefore, the virus can establish in PZs even in the absence of its main cultivated hosts (beets spinach, chicory). In the PZ of Ireland, where currently there is no sugar beet production, BNYVV can establish in its wild host plant *B. maritima* widely present in coastal regions.

Table 6: Crop production area (1,000 ha) at national level of sugar beet (excluding seeds) beetroot, spinach, chicory, in the period 2015–2019. Source Eurostat crop production in EU standard humidity [apro_cpsh1], accessed 20/8/2020 and 5/10/2020)

CROPS	**R2000 – Sugar beet (excluding seed)**				
GEO/TIME	**2015**	**2016**	**2017**	**2018**	**2019**
IE – Ireland	0.00	0.00	0.00	0.00	0.00
FR – France	385.05	405.23	486.10	485.85	446.59
PT – Portugal	0.10	0.10	0.11	0.00	0.00
FI – Finland	12.40	11.60	11.80	9.80	10.50

CROPS	**V4300 – Beetroot**				
GEO/TIME	**2015**	**2016**	**2017**	**2018**	**2019**
IE – Ireland	0.00	0.00	0.00	0.00	0.00
FR – France	2.87	3.03	3.12	3.10	3.13
PT – Portugal	0.20	0.17	0.14	0.22	0.22
FI – Finland	0.42	0.43	0.42	0.46	0.47

CROPS	V2500 – Spinach				
GEO/TIME	**2015**	**2016**	**2017**	**2018**	**2019**
Ireland	0.10	0.10	0.28	0.23	0.23
France	5.86	5.57	5.31	6.06	5.92
Portugal	0.60	0.61	0.54	0.44	0.44
Finland	0.05	0.07	0.02	0.01	0.04

CROPS	V2700 – Chicory				
GEO/TIME	**2015**	**2016**	**2017**	**2018**	**2019**
Ireland	0.00	0.00	0.00	0.00	0.00
France	10.02	9.99	10.68	10.39	9.79
Portugal	0.01	0.04	0.04	0.06	0.06
Finland	0.00	0.00	0.00	0.00	0.00

Table 7: Crop production area (1,000 ha) of sugar beet (excluding seeds) at NUTS 2 level, in the period 2015–2019. No respective data for beetroot, spinach and chicory exist. Source Eurostat crop production in EU standard humidity [apro_cpsh1], accessed 20/8/2020

CROPS	R2000 – Sugar beet (excluding seed)				
GEO/TIME	**2015**	**2016**	**2017**	**2018**	**2019**
IE – Ireland	0.00	0.00	0.00	0.00	0.00
IE04 – Northern and Western	0.00	0.00	0.00	0.00	0.00
IE05 – Southern	0.00	0.00	0.00	0.00	0.00
IE06 – Eastern and Midland	0.00	0.00	0.00	0.00	0.00
FR - France	385.05	405.23	486.10	485.85	446.59
FRH0 – Bretagne	:	0.26	0.33	0.33	:
PT - Portugal	0.10	0.10	0.11	0.00	0.00
PT20 – Região Autónoma dos Açores (PT)	0.10	0.10	0.11	0.00	:
FI - Finland	12.40	11.60	11.80	9.80	10.50
FI19 – Länsi-Suomi	5.20	4.80	4.70	4.00	:
FI1B – Helsinki-Uusimaa	0.30	0.30	0.30	0.20	:
FI1C – Etelä-Suomi	6.80	6.40	6.70	5.50	:
FI1D – Pohjois- ja Itä-Suomi	0.20	0.20	0.10	0.10	:
FI20 – Åland	0.00	0.00	0.00	0.00	:
UK - United Kingdom	90.00	86.00	111.00	114.20	108.00
UKN0 – Northern Ireland (UK)[(a)]	0.00	0.00	0.00	0.00	:

(a): As noted in Section 1.2 (interpretation of ToR) the United Kingdom has withdrawn from the EU and in line with the Withdrawal Agreement (European Commission, 2019) Northern Ireland is considered part of the EU protected zones in this opinion.

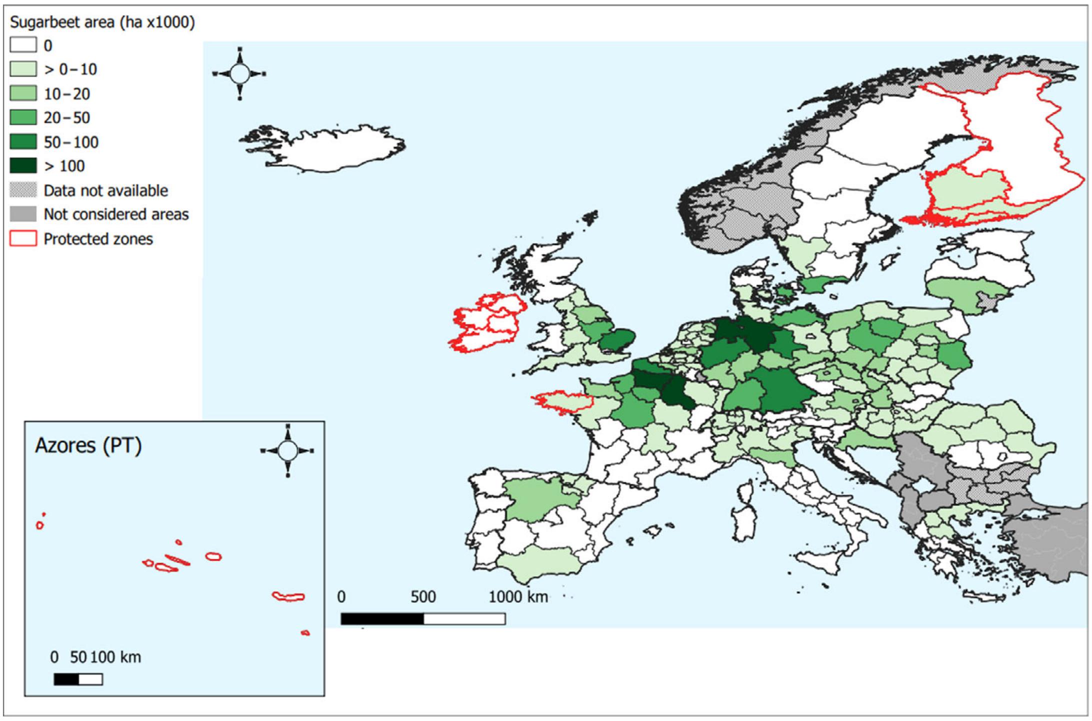

Figure 4: Sugar beet (excluding seeds) production area (1,000 ha) in the EU at NUTS2 level in 2018. For LT02 (Vidurio ir vakaru Lietuvos regionas), data from 2017 were used due to lack of data for 2018. For HU10 (Közép-Magyarország) and PL12 (Mazowieckie), data from 2016 were used due to lack of data for 2017 and 2018. (Source: Eurostat crop production in EU standard humidity [apro_cpsh1], accessed 20/8/2020

3.4.3.2. Climatic conditions affecting establishment

BNYVV is established in many parts of the EU and ecoclimatic conditions in the EU, including the PZs, are compatible with those of its vector *P. betae* and host plants.

Since BNYVV may only enter with resting spores of *P. betae* or with infected plants or with soils contaminated by BNYVV–*P. betae* complex, its establishment is only limited by the ability of the vector to infect new plants. High soil moisture and warm temperatures are essential for the resting spores to germinate and consequently for the virus to establish an infection. A minimum temperature between 10°C and 15°C is necessary for germination of resting spores and subsequent infection by zoospores (Horak and Schlosser, 1982; Abe, 1987; Blunt et al., 1991). The BNYVV-*P.betae* complex may also infect common wild plants (see also Section 3.4.1) and it can establish in the PZs provided that susceptible wild hosts are present. Even in the absence of host plants and favourable conditions, resting spores may survive for long periods (Schlösser, 1988) and plant reinfections may occur from persisting resting spores originating from past infections.

3.4.4. Spread

Is the pest able to spread within the EU (protected zones) territory following establishment?

YES, BNYVV is able to spread within the EU PZs, following establishment.

RNQPs: Is spread mainly via specific plants for planting, rather than via natural spread or via movement of plant products or other objects?

NO, BNYVV spread is considered to occur mainly via soil attached to machinery or to agricultural commodities

BNYVV is not known to be transmitted through seeds (Heijbroeck, 1988). The virus can be disseminated with plants for planting and seedlings of susceptible plant species like red beet or spinach, horticultural species that are mostly intended for gardening. The main virus spread is with its plasmodiophorid vector *P. betae* and thus resting spores of this organism as a contamination of soil and growing media or, attached to planting material, present a main pathway of virus dissemination and spread. Contaminated soil on agricultural machines or vehicles or, on tuber crops like potato, steckling, compost or manure and even livestock feeding on contaminated plant materials are efficient means of virus distribution.

Over short distances, resting spores may be distributed with surface water in the field, with drainage water and irrigation and with waste water from processing infected sugar beet or vegetables from infested fields (Dickens et al., 1995) (see Section 3.4.2).

With regard to the whole of the EU, plants for planting of susceptible species are not considered as main means of virus spread because of the negligible trade volumes. In contrast, spread via soil attached to machinery or agricultural commodities (harvested beets, roots and tubers, plants of planting of non-host species, etc.) are efficient to disseminate BNYVV and its vector.

3.5. Impacts

Would the pests' introduction have an economic or environmental impact on the EU (protected zones) territory?

YES, BNYVV introduction to the PZs would have negative impact on beet production in these areas.

RNQPs: Does the presence of the pest on plants for planting have an economic impact, as regards the intended use of those plants for planting?[8]

YES, BNYVV presence on plants for planting of cultivated hosts (beet, spinach, etc.) would have a negative impact on their intended use.

The rhizomania is considered the most damaging disease of sugar beet (Scholten and Lange, 2000) and occurs in almost all the regions where sugar beet is produced (McGrann et al., 2009). It is estimated that approximately half of the sugar beet crops grown worldwide are affected by this disease with an estimated overall loss of 10% of the world's beet sugar production (around 36 Mt a year) (Biancardi and Lewellen, 2016). In 1990, the acreage affected by rhizomania in the EU was approximately 15% of the 1.6 Mha cropped area, increased to 36% in 2000 and is expected to reach 56% in 2020 (Richard-Molard and Cariolle, 2001).

The main impact of the disease is from reduced taproot size and from an abnormal proliferation of partially necrosed fibrous side-roots around the main taproot (bearding). Especially when virus infections occur early in the season, considerable losses occur from the low root yields and sugar content and processing into juice is also affected. Leaf area may be reduced up to 24% (Rezaei et al., 2014), and the fresh root weight by up to 50%, with sugar losses of about 50–60% or even 80% (Asher and Henry, 1993; Henry et al., 1996). Compare to roots from healthy plants, diseased roots have high contents of reducing sugars, K and Na, and lower concentrations of total N, NH_2–N, NH_4–N and betaine (Uchino and Kanzawa, 1995). BNYVV infections decrease also root storability (Strausbaugh et al., 2008, 2015) and increase sucrose losses in storage (Strausbaugh, 2018). Plant resistance to low temperatures is decreased and freezing during storage causes tissue discoloration, further weight losses and a reduction of sugar (Strausbaugh and Eujayl, 2018). Finally, the abnormal proliferation of rootlets renders harvesting more difficult because of an increased amount of soil attached to roots and furthermore complicating the sugar extraction process at the refinery.

In general, symptom severity and subsequent losses highly depend on the sugar beet cultivar, environmental factors and the time of infection. Early infections result in more severe losses, while late-season infections may not result in visible root symptoms but still cause significant reductions in sucrose content (Neher and Gallian, 2014). In addition, RNA-5-containing isolates may cause more severe symptoms (scab-like symptoms on the surface of taproots) leading to more than 90% sugar yield reduction in susceptible cultivars and about 17%–59% reduction in resistant cultivars (Tamada et al., 2020). In red table beet (*B. vulgaris* subsp. *vulgaris*) BNYVV infections in spring cause rhizomania which significantly reduces dry weight of storage-roots by 64.6%, while infections in autumn have lower effects on storage roots (27.5% reduction) (Camelo-Garcia et al., 2019). In spinach, BNYVV incidence may vary from 8% to 44%, depending on the variety and strain of the virus. Infected plants exhibit yellow-green interveinal chlorosis, mottling or yellow-green chlorotic lesions on

[8] See Section 2.1 on what falls outside EFSA's remit.

younger leaves. Leaves may become stiff, deformed and with necrotic spots. Infected plants often become stunted, deformed and die of subsequent wilting (Mou et al., 2012).

3.6. Availability and limits of mitigation measures

Are there measures available to prevent the entry into, establishment within or spread of the pest within the EU (protected zones) such that the risk becomes mitigated?

YES, measures are already in place (see Section 3.3). Additional measures could be implemented to further regulate the identified pathways or, to limit entry, establishment, spread and impact.

RNQPs: Are there measures available to prevent pest presence on plants for planting such that the risk becomes mitigated?

YES, measures are already in place (see section 3.3) and additional measures could be implemented to further prevent virus/ vector presence in plants for planting

3.6.1. Identification of additional measures

Phytosanitary measures are currently in place to prevent the introduction and spread of BNYVV in the protected zones (i.e. Azores (Portugal), Brittany (France), Finland, Ireland and Northern Ireland[(a)]) and laid down in Commission Implementing Regulation (EU) 2019/2072.

Annex X lists the special requirements for the introduction and movement within those protected zones of plants, plant products and other objects (i.e. agricultural machinery, soil from beet and unsterilised waste from beet, plants of *Beta*, plants of *B. vulgaris* for industrial processing, plants for planting of *B. vulgaris*, seeds and fodder beet seeds of *B. vulgaris*, tubers of *S. tuberosum*).

In addition, Annexes VI and VII regulate the introduction within the entire Union of soil, growing medium, agricultural machinery, roots, tubers and bulbs.

Annexes XI and XII lists the plants, plant products and other objects for which a phytosanitary certificate is required for the introduction into the Union and into the protected zones, respectively.

The requirements of a plant passport for the movement of plants, plant products and other objects within the Union and within the protected zones are laid down in Annexes XIII and XIV.

Overall, all pathways identified are regulated, however some of them were found to be incompletely closed by legislation.

3.6.1.1. Additional control measures

Potential additional control measures are listed in Table 8.

Table 8: Selected control measures (a full list is available in EFSA PLH Panel, 2018) for pest entry/establishment/spread/impact in relation to currently unregulated hosts and pathways. Control measures are measures that have a direct effect on pest abundance

Information sheet title (with hyperlink to information sheet if available)	Control measure summary	Risk component (entry/establishment/spread/impact)
Growing plants in isolation	Growing plants in isolation cannot be envisioned for sugar beet which is an arable crop and isolation would not be feasible. However, plants for planting are sometimes used and commercialised for a range of species other than *B. vulgaris* and *S. tuberosum,* in particular for home gardeners. Growing such plants in isolation, using disinfested or uninfested soil or substrates would reduce the risk of BNYVV entry or spread through these plants for planting	Entry and spread

(a) As noted in 1.2 (interpretation of ToR) the United Kingdom has withdrawn from the EU and in line with the Withdrawal Agreement (European Commission, 2019) Northern Ireland is considered part of the EU protected zones in this opinion.

Information sheet title (with hyperlink to information sheet if available)	Control measure summary	Risk component (entry/ establishment/spread/ impact)
Soil treatment	While not feasible on a large scale, soil treatment by fumigation or solarisation targeting viruliferous spores could be used as part of eradication efforts in case of an outbreak in a protected zone	Establishment and spread
Physical treatments on consignments or during processing	Mechanical cleaning (brushing, washing) of roots and tubercle vegetables consignments to remove attached soil (to lower than the current 1% requirement) and viruliferous spores can potentially further limit entry and spread of BNYVV	Entry and spread
Crop rotation, associations and density, weed/ volunteer control	Resting spores of *P. betae* can remain viable and viruliferous over long periods therefore short crop rotations are inefficient. Long crop rotations (or crop avoidance) and the use of trap plants that are not susceptible to BNYVV but induce germination of the resting spores of the vector (Dieryck et al., 2009) could be used as complementary measures in case of eradication efforts following an outbreak in a protected zone. Similarly, control of BNYVV-susceptible weeds and volunteer beets would prove a valuable complementary measure in support of eradication efforts	Establishment
Use of resistant and tolerant plant species/ varieties	The use of resistant beet varieties is considered the most practical and effective control measure against BNYVV. Several resistance genes have been identified (Rz1 to Rz5) and resistant Rz1 or Rz1+Rz2 varieties are available and widely used in a number of countries. However, Rz1 resistance-breaking isolates may limit the value of varieties with Rz1 resistance alone	Establishment and spread
Post-entry quarantine and other restrictions of movement in the importing country	Relevant commodities are plants for planting of hosts species other than *B. vulgaris* that may carry BNYVV, either as infection or as infestation of viruliferous *P. betae* spores	Entry

3.6.1.2. Additional supporting measures

Potential additional supporting measures are listed in Table 9.

Table 9: Selected supporting measures (a full list is available in EFSA PLH Panel, 2018) in relation to currently unregulated hosts and pathways. Supporting measures are organisational measures or procedures supporting the choice of appropriate risk reduction options that do not directly affect pest abundance

Information sheet title (with hyperlink to information sheet if available)	Supporting measure summary	Risk component (entry/ establishment/ spread/impact)
Inspection and trapping	Inspection is defined as the official visual examination of plants, plant products or other regulated articles to determine if pests are present or to determine compliance with phytosanitary regulations (ISPM 5) Inspections apply to the observation of BNYVV symptoms	Entry, establishment and spread
Laboratory testing	Examination, other than visual, to determine if BNYVV is present using official diagnostic protocols	Entry, establishment and spread

Information sheet title (with hyperlink to information sheet if available)	Supporting measure summary	Risk component (entry/ establishment/ spread/impact)
Certified and approved premises	Mandatory/voluntary certification/approval of premises is a process including a set of procedures and of actions implemented by producers, conditioners and traders contributing to ensure the phytosanitary compliance of consignments. It can be a part of a larger system maintained by a National Plant Protection Organization in order to guarantee the fulfilment of plant health requirements of plants and plant products intended for trade. Key property of certified or approved premises is the traceability of activities and tasks (and their components) inherent the pursued phytosanitary objective. Traceability aims to provide access to all trustful pieces of information that may help to prove the compliance of consignments with phytosanitary requirements of importing countries Production of plants for planting of host species other than *B. vulgaris*, although likely limited in scale, could be limited to certified, approved premises	Entry and spread
Delimitation of Buffer zones	ISPM 5 defines a buffer zone as "an area surrounding or adjacent to an area officially delimited for phytosanitary purposes in order to minimise the probability of spread of the target pest into or out of the delimited area, and subject to phytosanitary or other control measures, if appropriate" (ISPM 5). The objectives for delimiting a buffer zone can be to prevent spread from the outbreak area and to maintain a pest free production place, site or area	Spread
Sampling	According to ISPM 31, it is usually not feasible to inspect entire consignments, so phytosanitary inspection is performed mainly on samples obtained from a consignment. It is noted that the sampling concepts presented in this standard may also apply to other phytosanitary procedures, notably selection of units for testing For inspection, testing and/or surveillance purposes the sample may be taken according to a statistically based or a non-statistical sampling methodology	Entry, establishment and spread
Phytosanitary certificate and plant passport	An official paper document or its official electronic equivalent, consistent with the model certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements (ISPM 5) a) export certificate (import) b) plant passport (EU internal trade)	Entry and spread
Certification of reproductive material (voluntary/ official)	–	Entry and spread
Surveillance	Official surveillance may contribute to early detection of BNYVV, favouring immediate adoption of control measures if it came to establish in new areas. While surveys are carried out to maintain the PZ status of an area, the extent and intensity of surveys and surveillance would likely be increased in case of an outbreak in a PZ	Establishment and spread

3.6.1.3. Biological or technical factors limiting the effectiveness of measures to prevent the entry, establishment and spread of the pest

- The unreliable visual inspection because of a long incubation period for root symptoms to become visible or, the absence of symptoms under cool spring conditions or in late-season infections;
- The confusion of symptoms in late season infections when BNYVV leaf symptoms may resemble those of abiotic factors (e.g. nitrogen deficiency);

- The weak symptoms in rhizomania-tolerant cultivars expressing symptoms only at high virus inoculum pressure;
- The existence of resistance-breaking isolates;
- The virus and the vector persisting in weeds serving as reservoirs;
- The long persistence of viruliferous *P. betae* resisting spores in the soil;
- The widespread presence and the difficulty to control *P. betae* vector populations.

3.7. Uncertainty

The main uncertainties associated with this pest categorisation are:

- the prevalence and distribution of BNYVV in Switzerland, a country exempt from regulations (e.g., Annex XI part A), especially the existence of resistance breaking isolates of the virus;
- the movement of soil and growing media from MSs to PZs and the associated risk of transferring viruliferous *P. betae*;
- the volume of trade of BNYVV susceptible host plants to the PZs;
- the movement of plants for planting other than BNYVV hosts and the associated risk of transferring viruliferous *P. betae* into the PZs;
- the occurrence and prevalence of BNYVV in the PZs in which sugar beet is currently cultivated (Finland) and in PZs in which sugar beet is not currently produced (Ireland), since there BNYVV can establish unnoticed in wild plants;
- the volume of sugar beet cultivation in the PZs.

4. Conclusions

Beet necrotic yellow vein virus meets all the criteria assessed by EFSA for consideration as a potential protected zone quarantine pest for the territory of the current protected zones: Ireland, France (Brittany), Portugal (Azores), Finland and Northern Ireland[(a)].

Of the criteria evaluated by EFSA for consideration as a potential RNQP, BNYVV does not meet the criterion of plants for planting of host species being a main mean of spread.

Table 10: 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 protected zone quarantine pest (articles 32–35)	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest	Key uncertainties
Identity of the pests (section 3.1)	The identity of BNYVV is well established and diagnostic techniques are available	The identity of BNYVV is well established and diagnostic techniques are available	No uncertainty
Absence/ presence of the pest in the EU territory (section 3.2)	BNYVV is not known to be present in the various PZs	BNYVV is widely distributed in the EU outside of the various PZs	Uncertainty as to whether BNYVV could be present but unreported in one or more of the PZs
Regulatory status (section 3.3)	BNYVV is regulated in Annex III of Commission Implementing Regulation (EU) 2019/2072	BNYVV is regulated in Annex III of Commission Implementing Regulation (EU) 2019/2072	No uncertainty
Pest potential for entry, establishment and spread in	BNYVV can enter, become established and spread in the various PZs. The main pathways identified are	Plants for planting of host species are not considered to constitute a main means of spread for BNYVV	Uncertainty on the extent of the occurrence of BNYVV in Switzerland Uncertainty on movement of

(a) As noted in 1.2 (interpretation of ToR) the United Kingdom has withdrawn from the EU and in line with the Withdrawal Agreement (European Commission, 2019) Northern Ireland is considered part of the EU protected zones in this opinion.

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding protected zone quarantine pest (articles 32–35)	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest	Key uncertainties
the EU territory (section 3.4)	(i) plants for planting of species other than *B. vulgaris*, (ii) roots and tubercle vegetables and (iii) soil and growing media		soil and growing media from other MSs to PZs Uncertainty on relative importance of pathways for entry in the PZs Uncertainty on the volume of traded plants for planting of host species
Potential for consequences in the EU territory (section 3.5)	Introduction and spread of BNYVV would have a negative impact on PZs sugar beet and other beet crops	The presence of BNYVV on plants for planting of host species would have a negative impact on their intended use	Magnitude of the impact under PZs conditions, taking into account the relative local importance of beet crops and the additional impact that could be caused by resistance breaking isolates
Available measures (section 3.6)	Phytosanitary measures are available to reduce the likelihood of entry and spread in the PZs Once the virus and its plasmodiophorid vector have entered, their eradication would be difficult due to the soil-borne nature and to the long survival of resting viruliferous spores	Certification of planting materials of susceptible hosts is an efficient method against long distance spread	No uncertainty
Conclusion on pest categorisation (section 4)	BNYVV meets all the criteria evaluated by EFSA to qualify as potential Union Quarantine Protected Zone Pest	Of the criteria evaluated by EFSA to qualify as potential Union Regulated non-Quarantine Pest, BNYVV does not meet the criterion of plants for planting of host species being the main mean of spread	Uncertainty as to whether BNYVV could be present but unreported in one or more of the PZs
Aspects of assessment to focus on / scenarios to address in future if appropriate	The main knowledge gaps or uncertainties identified concern: – whether BNYVV could be present but unreported in one or more of the PZs; – extent of presence of BNYVV in Switzerland and nature of the BNYVV isolates involved; – uncertainty on movement of soil and growing media from other MSs to PZs		

References

Abe H, 1987. Studies on the ecology and control of Polymyxa betae Keskin, as a fungal vector of the causal virus (beet necrotic yellow vein virus) of rhizomania disease of sugar beet. Rep Hokkaido Prefectural Agric Exp Station, 60, 1–99.

Asher MJC and Henry CM, 1993. Research to contain beet Rhizomania in the UK. In Ebbels D (ed.). Plant Health and the European Single Market. pp. 111–122.

Biancardi E and Lewellen RT, 2016. Introduction. In: Biancardi E and Tamada T (eds.). Rhizomania. Springer, Cham. https://doi.org/10.1007/978-3-319-30678-0_1.

Blunt SJ, Asher MJC and Gilligan CA, 1991. Infection of sugar-beet by polymyxa-betae in relation to soil-temperature. Plant Pathology, 40, 257–267. https://doi.org/10.1111/j.1365-3059.1991.tb02375.x

Bornemann K and Varrelmann M, 2013. Effect of sugar beet genotype on the Beet necrotic yellow vein virusP25 pathogenicity factor and evidence for a fitness penalty in resistance-breaking strains. Molecular Plant Pathology, 14, 356–364. https://doi.org/10.1111/mpp.12012

Bornemann K, Yilmaz NDK, Khan MF and Bolton MD, 2014. Sequence analysis of the Beet necrotic yellow vein virus P25 pathogenicity factor in Turkey. Phytopathology, 104, 17.

Brunt A, Crabtree K, Dallwitz MJ, Gibbs AJ, Watson L and Zurcher EJ, 1996. Plant Viruses Online: Descriptions and Lists from the VIDE Database. Version. Available online: http://bio-mirror.im.ac.cn/mirrors/pvo/vide/descr086.htm [Accessed: 20 August 1996].

Camelo-Garcia VM, Molina JPE, Nagata T, Rezende JAM and Silva JMF, 2019. Effect of rhizomania on red table-beet biomass production and molecular characterization of an isolate of Beet necrotic yellow vein virus from Brazil. European Journal of Plant Pathology, 154, 1021–1028. https://doi.org/10.1007/s10658-019-01722-1

Chiba S, Miyanishi M, Andika IB, Kondo H and Tamada T, 2008. Identification of amino acids of the beet necrotic yellow vein virus p25 protein required for induction of the resistance response in leaves of Beta vulgaris plants. Journal of General Virology, 89, 1314–1323. https://doi.org/10.1099/vir.0.83624-0

Chiba S, Kondo H, Miyanishi M, Andika IB, Han CG and Tamada T, 2011. The Evolutionary History of Beet necrotic yellow vein virus Deduced from Genetic Variation, Geographical Origin and Spread, and the Breaking of Host Resistance. Molecular Plant-Microbe Interactions, 24, 207–218. https://doi.org/10.1094/mpmi-10-10-0241

Dickens JSW, Wright AJ and Reed PJ, 1995. Survival of Polymyxa betae during processing of vegetables and sugarbeet. EPPO Bulletin, 25, 673–679. https://doi.org/10.1111/j.1365-2338.1995.tb01120.x

Dieryck B, Otto G, Doucet D, Legrève A, Delfosse P and Bragard C, 2009. Seed, soil and vegetative transmission contribute to the spread of pecluviruses in Western Africa and the Indian sub-continent. Virus Research, 141, 184–189. https://doi.org/10.1016/j.virusres.2008.08.017

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger M, Bragard C, Caffier D, Candresse T, Chatzivassiliou E, Dehnen-Schmutz K, Gregoire J-C, Jaques Miret JA, MacLeod A, Navajas Navarro M, Niere B, Parnell S, Potting R, Rafoss T, Rossi V, Urek G, Van Bruggen A, Van Der Werf W, West J, Winter S, Hart A, Schans J, Schrader G, Suffert M, Kertesz V, Kozelska S, Mannino MR, Mosbach-Schulz O, Pautasso M, Stancanelli G, Tramontini S, Vos S and Gilioli G, 2018. Guidance on quantitative pest risk assessment. EFSA Journal 2018;16(8):5350, 86 pp. https://doi.org/10.2903/j.efsa.2018.5350

EPPO (European and Mediterranean Plant Protection Organization), 2006. Beet necrotic yellow vein virus (benyvirus). Bulletin OEPP/EPPO Bulletin, 36, 429–440.

EPPO, 2019. EPPO codes. Available online: https://www.eppo.int/RESOURCES/eppo_databases/eppo_codes

EPPO (European and Mediterranean Plant Protection Organization), online. EPPO Global Database. Available online: https://gd.eppo.int [Accessed 10 September 2020].

European Commission, 2019. Information from European Union institutions, bodies, offices and agencies. Council agreement on the withdrawal of the United Kingdom of Great Britain and Northern Ireland from the European Union and the European Atomic Energy Community (2019/C 384 I/01). Official Journal of the European Union C 384 I/1 12.11.2019. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:12019W/TXT(02)&from=EN

FAO (Food and Agriculture Organization of the United Nations), 1995. ISPM (International standards for phytosanitary measures) No 4. Requirements for the establishment of pest free areas. Available online: https://www.ippc.int/en/publications/614/

FAO (Food and Agriculture Organization of the United Nations), 2004. ISPM (International Standards for Phytosanitary Measures) 21—Pest risk analysis of regulated non-quarantine pests. FAO, Rome, 30 pp. Available online: https://www.ippc.int/sites/default/files/documents//1323945746_ISPM_21_2004_En_2011-11-29_Refor.pdf

FAO (Food and Agriculture Organization of the United Nations), 2013. ISPM (International Standards for Phytosanitary Measures) 11—Pest risk analysis for quarantine pests. FAO, Rome, 36 pp. Available online: https://www.ippc.int/sites/default/files/documents/20140512/ispm_11_2013_en_2014-04-30_201405121523-494.65%20KB.pdf

FAO (Food and Agriculture Organization of the United Nations), 2017. ISPM (International standards for phytosanitary measures) No 5. Glossary of phytosanitary terms. Available online: https://www.ippc.int/en/publications/622/

Fomitcheva VW and Kühne T, 2019. Beet soil-borne mosaic virus: development of virus-specific detection tools. Journal of Plant Diseases and Protection, 126, 255–260. https://doi.org/10.1007/s41348-019-00219-7

Galein Y, Legreve A and Bragard C, 2018. Long term management of Rhizomania disease-insight into the changes of the beet necrotic yellow vein virus RNA-3 observed under resistant and non-resistant sugar beet fields. Frontiers in Plant Science, 9. https://doi.org/10.3389/fpls.2018.00795

Gilmer D, Ratti C and Consortium IR, 2017. ICTV Virus Taxonomy Profile: Benyviridae. Journal of General Virology, 98, 1571–1572. https://doi.org/10.1099/jgv.0.000864

Griessinger D and Roy A-S, 2015. EPPO codes: a brief description. Available online: https://www.eppo.int/media/uploaded_images/RESOURCES/eppo_databases/A4_EPPO_Codes_2018.pdf

Heijbroek W, 1988. Dissemination of rhizomania by soil, beet seeds, and stable manure. Netherlands Journal of Plant Pathology, 94, 9–15. https://doi.org/10.1007/bf01999803

Henry CM, Barker I, Morris J and Hugo SA, 1996. Comparison of novel molecular methods for the detection of beet necrotic yellow vein virus (BNYVV). In McKim FM (ed.). Diagnostics in Crop Production. pp. 199–204.

Hillmann U, 1984. Neue Erkenntnisse über die Rizomania an Zuckerrüben mit besonderer Berücksichtigung Bayerischer Anbaugebiete. Dissertation, Universität Giessen, Germany.

Horak I and Schlosser E, 1982. Rizomania.1. Demonstration of beet necrotic yellow vein virus (BNYVV) by indicator plants. Zuckerindustrie, 107, 23–26.

Horvath J, 1994. Beet necrotic yellow vein furovirus.1. New hosts. Acta Phytopathologica Et Entomologica Hungarica, 29, 109–118.

Hugo SA, Henry CM and Harju V, 1996. The role of alternative hosts of Polymyxa betae in transmission of beet necrotic yellow vein virus (BNYVV) in England. Plant Pathology, 45, 662–666. https://doi.org/10.1046/j.1365-3059.1996.d01-182.x

Koenig R and Lennefors BL, 2000. Molecular analyses of European A, B and P type sources of Beet necrotic yellow vein virus and detection of the rare P type in Kazakhstan. Archives of Virology, 145, 1561–1570. https://doi.org/10.1007/s007050070076

Koenig R, Luddecke P and Haeberle AM, 1995. Detection of beet necrotic yellow vein virus-strains, variants and mixed infections by examining single-strand conformation polymorphisms of immunocapture RT-PCR Products. Journal of General Virology, 76, 2051–2055. https://doi.org/10.1099/0022-1317-76-8-2051

Koenig R, Haeberle AM and Commandeur U, 1997. Detection and characterization of a distinct type of beet necrotic yellow vein virus RNA 5 in a sugarbeet growing area in Europe. Archives of Virology, 142, 1499–1504. https://doi.org/10.1007/s007050050176

Koenig R, Kastirr U, Holtschulte B, Deml G and Varrelmann M, 2008. Distribution of various types and P25 subtypes of Beet necrotic yellow vein virus in Germany and other European countries. Archives of Virology, 153, 2139–2144. https://doi.org/10.1007/s00705-008-0234-3

Kutluk ND, Erkan S and Bicken S, 2000. Weeds as hosts for Rhizomania's agent. Zeitschrift Fur Pflanzenkrankheiten Und Pflanzenschutz-Journal of Plant Diseases and, Protection, 167–171.

Lange W, Brandenburg WA and De Bock TSM, 1999. Taxonomy and cultonomy of sugar beet (Beta vulgaris L.). Botanical Journal of the Linnean Society, 130, 81–96.

Legreve A, Schmit JF, Bragard C and Maraite H, 2005. The role of climate and alternative hosts in the epidemiology of Rhizomania.

Li M, Liu T, Wang B, Han CG, Li DW and Yu JL, 2008. Phylogenetic analysis of Beet necrotic yellow vein virus isolates from China. Virus Genes, 36, 429–432. https://doi.org/10.1007/s11262-008-0202-8

Liebe S, Wibberg D, Maiss E and Varrelmann M, 2020. Application of a reverse genetic system for beet necrotic yellow vein virus to study Rz1 resistance response in sugar beet. Frontiers in Plant Science, 10. https://doi.org/10.3389/fpls.2019.01703

Lindsten K, 1986. Rhizomania - a complicated disease in sugar beets which can occur also in Sweden. Växtskyddsnotiser, 50, 111–118.

McGrann GRD, Grimmer MK, Mutasa-Goettgens ES and Stevens M, 2009. Progress towards the understanding and control of sugar beet rhizomania disease. Molecular Plant Pathology, 10, 129–141. https://doi.org/10.1111/j.1364-3703.2008.00514.x

Mehrvar M, Valizadeh J, Koenig R and Bragard CG, 2009. Iranian beet necrotic yellow vein virus (BNYVV): pronounced diversity of the p25 coding region in A-type BNYVV and identification of P-type BNYVV lacking a fifth RNA species. Archives of Virology, 154, 501–506. https://doi.org/10.1007/s00705-009-0322-z

Meunier A, Schmit JF and Bragard C, 2003a. Sequences analysis of Belgian BNYVV and development of a simultaneous detection of soil-borne sugar-beet viruses by RT-PCR. In Rush CM and Merz U (eds.). Proceedings of the Fifth Symposium of the International Working Group on Plant Viruses with Fungal Vectors, Zurich, July 22–25, 2002, pp. 9–12. Denver, CO, American Society of Sugar Beet Technologists. Available online: http://www.rothamsted.bbsrc.ac.uk/ppi/Iwgpvfv/Proceedings/2002_Proceedings.pdf

Meunier A, Schmit JF, Stas A, Kutluk N and Bragard C, 2003b. Multiplex reverse transcription-PCR for simultaneous detection of Beet necrotic yellow vein virus, Beet soilborne virus, and Beet virus Q and their vector Polymyxa betae KESKIN on sugar beet. Applied and Environmental Microbiology, 69, 2356–2360. https://doi.org/10.1128/aem.69.4.2356-2360.2003

Mou B, Richardson K, Benzen S and Liu HY, 2012. Effects of Beet necrotic yellow vein virus in Spinach Cultivars. Plant Disease, 96, 618–622. https://doi.org/10.1094/pdis-09-11-0748

Mouhanna AM, Langen G and Schlosser E, 2008. Weeds as alternative hosts for BSBV, BNYVV, and the vector Polymyxa betae (German isolate). Journal of Plant Diseases and Protection, 115, 193–198. https://doi.org/10.1007/bf03356263

Neher OT and Gallian JJ, 2014. Rhizomania on sugar beet: importance, identification, control. Pacific Northwest Publication 657, U of ID. Available online: http://www.cals.uidaho.edu/edComm/pdf/PNW/PNW657.pdf

Pferdmenges F, Korf H and Varrelmann M, 2009. Identification of rhizomania-infected soil in Europe able to overcome Rz1 resistance in sugar beet and comparison with other resistance-breaking soils from different geographic origins. European Journal of Plant Pathology, 124, 31–43. https://doi.org/10.1007/s10658-008-9388-9

Prillwitz H and Schlosser E, 1993. Comparative investigations on the damage of sugar-beet by polymyxa-betae keskin, beet soil-borne virus and beet necrotic yellow vein virus. Mededelingen Van De Faculteit Van De Landbouwwetenschappen, 58(Pts 2a, 2b, 3a, 3b), 1085–1091.
Rezaei J, Bannayan M, Nezami A, Mehrvar M and Mahmoodi B, 2014. Growth analysis of rhizomania infected and healthy sugar beet. J Crop Sci Biotechnol, 17, 59–69.
Richard-Molard M and Cariolle M, 2001. Water and abiotic stresses and genetic improvement. Proc IIRB, 64, 153–158.
Rush CM, Liu HY, Lewellen RT and Acosta-Leal R, 2006. The continuing saga of rhizomania of sugar beets in the United States. Plant Disease, 90, 4–15. https://doi.org/10.1094/pd-90-0004
Schirmer A, Link D, Cognat V, Moury B, Beuve M, Meunier A, Bragard C, Gilmer D and Lemaire O, 2005. Phylogenetic analysis of isolates of Beet necrotic yellow vein virus collected worldwide. Journal of General Virology, 86, 2897–2911. https://doi.org/10.1099/vir.0.81167-0
Schlösser E, 1988. Epidemiology and management of *Polymyxa betae* and beet necrotic yellow vein virus. In: Cooper JI and Asher MJC (eds.). Viruses with fungal vectors. Vol 2. Developments in applied biology, Association of Applied Biologists, Wellesbourne UK. pp. 281–292.
Scholten OE and Lange W, 2000. Breeding for resistance to rhizomania in sugar beet: A review. Euphytica, 112, 219–231. https://doi.org/10.1023/a:1003988003165
Strausbaugh CA, 2018. Incidence, Distribution, and Pathogenicity of Fungi Causing Root Rot in Idaho Long-Term Sugar Beet Storage Piles. Plant Disease, 102, 2296–2307. https://doi.org/10.1094/pdis-03-18-0437-re
Strausbaugh CA and Eujayl IA, 2018. Influence of Beet necrotic yellow vein virus and Freezing Temperatures on Sugar Beet Roots in Storage. Plant Disease, 102, 932–937. https://doi.org/10.1094/pdis-10-17-1575-re
Strausbaugh CA, Rearick E, Camp S, Gallian JJ and Dyer AT, 2008. Influence of Beet necrotic yellow vein virus on sugar beet storability. Plant Disease, 92, 581–587. https://doi.org/10.1094/pdis-92-4-0581
Strausbaugh CA, Neher O, Rearick E and Eujayl IA, 2015. Influence of Harvest Timing, Fungicides, and Beet necrotic yellow vein virus on Sugar Beet Storage. Plant Disease, 99, 1296–1309. https://doi.org/10.1094/pdis-10-14-0998-re
Tamada T, 2016. In: Biancardi E and Tamada T (eds.). General Features of Beet Necrotic Yellow Vein Virus. Rhizomania. Springer, Cham. https://doi.org/10.1007/978-3-319-30678-0_3
Tamada T and Abe H, 1989. Evidence that beet necrotic yellow vein virus RNA-4 is essential for efficient transmission by the fungus polymyxa-betae. Journal of General Virology, 70, 3391–3398. https://doi.org/10.1099/0022-1317-70-12-3391
Tamada T and Baba T, 1973. Beet necrotic yellow vein virus from rizomania-affected sugar beet in Japan. Ann Phytopathol Soc Jpn, 39, 325–332.
Tamada T, Shirako Y, Abe H, Saito M, Kiguchi T and Harada T, 1989. Production and pathogenicity of isolates of beet necrotic yellow vein virus with different numbers of RNA components. Journal of General Virology, 70, 3399–3409. https://doi.org/10.1099/0022-1317-70-12-3399
Tamada T, Schmitt C, Saito M, Guilley H, Richards K and Jonard G, 1996. High resolution analysis of the readthrough domain of beet necrotic yellow vein virus readthrough protein: a KTER motif is important for efficient transmission of the virus by Polymyxa betae. Journal of General Virology, 77, 1359–1367. https://doi.org/10.1099/0022-1317-77-7-1359
Tamada T, Uchino H, Kusume T and Saito M, 1999. RNA 3 deletion mutants of beet necrotic yellow vein virus do not cause rhizomania disease in sugar beets. Phytopathology, 89, 1000–1006. https://doi.org/10.1094/phyto.1999.89.11.1000
Tamada T, Uchino H, Kusume T, Iketani-Saito M, Chiba S, Andika IB and Kondo H, 2020. Pathogenetic roles of beet necrotic yellow vein virus RNA5 in the exacerbation of symptoms and yield reduction, development of scab-like symptoms, and Rz1-resistance breaking in sugar beet. Plant Pathology, n/a.. https://doi.org/10.1111/ppa.13266
Uchino K and Kanzawa K, 1995. Evaluation of yellowing intensity of sugar beet leaves infected with rhizomania by using a handheld chlorophyll meter. Ann Phytopathol Soc Jpn, 61, 123–126.
Ward L, Koenig R, Budge G, Garrido C, McGrath C, Stubbley H and Boonham N, 2007. Occurrence of two different types of RNA-5-containing beet necrotic yellow vein virus in the UK. Archives of Virology, 152, 59–73. https://doi.org/10.1007/s00705-006-0832-x
Wisler G and Duffus J, 2000. A century of plant virus management in the Salinas Valley of California, 'East of Eden'. Virus Research, 71, 161–169. https://doi.org/10.1016/S0168-1702(00)00196-9
Yanar Y, Kutluk ND and Erkan S, 2010. Alternative weed hosts of Beet necrotic yellow vein virus and Beet soil borne virus in North East of Turkey. International Journal of Virology, 6, 56–60.
Yilmaz NDK, Sokmen MA, Kaya R, Sevik MA, Tunali B and Demirtas S, 2016. The widespread occurrences of Beet soil borne virus and RNA-5 containing Beet necrotic yellow vein virus isolates in sugar beet production areas in Turkey. European Journal of Plant Pathology, 144, 443–455. https://doi.org/10.1007/s10658-015-0780-y
Yüksel Özmen C, Khabbazi SD, Khabbazi AD, Gürel S, Kaya R, Oğuz MÇ, Turan F, Rezaei F, Kibar U, Gürel E and Ergül A, 2020. Genome composition analysis of multipartite BNYVV reveals the occurrence of genetic re-assortment in the isolates of Asia Minor and Thrace. Scientific Reports, 10. https://doi.org/10.1038/s41598-020-61091-2

Zhuo N, Jiang N, Zhang C, Zhang ZY, Zhang GZ, Han CG and Wang Y, 2015. Genetic diversity and population structure of beet necrotic yellow vein virus in China. Virus Research, 205, 54–62. https://doi.org/10.1016/j.virusres.2015.05.009

Abbreviations

BNYVV	beet necrotic yellow vein virus
BSBV	beet soil-borne virus
BSBMV	beet soil-borne mosaic virus
BBSV	beet black scorch virus
BVQ	beet virus Q
DG SANTÉ	Directorate General for Health and Food Safety
ELISA	enzyme-linked immunosorbent assay
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
PZ	Protected Zone
RT-PCR	reverse transcriptase polymerase chain reaction
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, 1995, 2017)
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO, 1995, 2017)
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, 2017)
Eradication (of a pest)	Application of phytosanitary measures to eliminate a pest from an area (FAO, 2017)
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2017)
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, 2017)
Measures	Control (of a pest) is defined in ISPM 5 (FAO 2017) as "Suppression, containment or eradication of a pest population" (FAO, 1995). Control measures are measures that have a direct effect on pest abundance. Supporting measures are organisational measures or procedures supporting the choice of appropriate Risk Reduction Options that do not directly affect pest abundance
Pathway	Any means that allows the entry or spread of a pest (FAO, 2017)
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, 2017)
Protected zones (PZ)	A Protected zone is an area recognised at EU level to be free from a harmful organism, which is established in one or more other parts of the Union
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, 2017)

Regulated non-quarantine pest	A non-quarantine pest whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing contracting party (FAO, 2017)
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 2017)

Appendix A – List of weeds/wild species

List of weeds/wild species that may be infected naturally or experimentally by BNYVV (source: Brunt et al., 1996; EPPO, online; Horvath, 1994; Hugo et al., 1996; Mouhanna et al., 2008; Tamada and Baba, 1973; Yanar et al., 2010; Kutluk et al., 2000; Legreve A et al., 2005; Yilmaz et al., 2016).

Family	Weeds/wild host species
Amaranthaceae	*Amaranthus retroflexus,* *A. bouchonii,* *A. mitchellii,* *A. quitensis,* *Atriplex patula,* *A. hortensis,* *Axyris* sp., *Acroglochin* sp., *B. macrocarpa* (synonym *Beta vulgaris* spp. *macrocarpa*), *B. vulgaris* ssp. *maritima* (sea beet, synonyms *B. maritima* and *B. perennis*), *Patellifolia procumbens* (synonym *B. patellaris*), *Chenopodium album,* *C. amaranticolor,* *C. bonus-henricus,* *C. capitatum,* *C. hybridum,* *C. murale,* *C. quinoa,* *C. polyspermum,* *Ragodia* sp., *Spinacia turkestanica*
Asteraceae	*Matricaria inodora,* *Chamomilla recutita,* *Cichorium intybus,* *Cirsium arvense,* *Centaurea cyanus,* *Galinsorga parviflora,* *Xanthium strumarium*
Boraginaceae	*Heliotropium europaeum*
Brasicaceae	*Capsella bursa-pastoris,* *Descurainia sophia,* *Raphanus raphanistrum*
Caryophyllaceae	*Silene alba,* *S. vulgaris,* *S. noctiflora,* *Stellaria media,* *Stellaria graminea*
Convolvulaceae	*Calystegia sepium,* *Convolvulus arvensis*
Plantaginaceae	*Plantago major,* *Veronica hederifolia*
Poaceae	*Alopecurus myosuroides,* *Apera spica-venti,* *Lolium multiflorum,* *Poa pratensis,* *Sorghum halepense,* *S. vulgare*
Polygonaceae	*Polygonum aviculare*
Solanaceae	*Datura stramonium,* *Solanum nigrum,* *Nicotiana benthamiana,* *N. clevelandii,* *N. tabacum* H423,

Family	Weeds/wild host species
	N. tabacum var. Xanthi, *N. glutinosa*
Zygophyllaceae	*Tribulus terrestris*