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Pest categorisation of *Apiosporina morbosa*

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Abstract

The Panel on Plant Health performed a pest categorisation of the fungus *Apiosporina morbosa*, the causal agent of black knot, for the EU. The identity of the pest is well established and reliable methods exist for its detection/identification. The pest is listed in Annex IIAI of Directive 2000/29/EC and is not known to occur in the EU. *Apiosporina morbosa* is present in Alaska, Canada, Mexico and the continental states of the USA. The major hosts of *A. morbosa* are *Prunus domestica* and *Prunus cerasus*; the host status of other *Prunus* species and hybrids is uncertain because of contradictory reports or lack of information. The pest could potentially enter the EU on host plants for planting and plant parts originating in infested third countries. Wood of *Prunus* spp. is also a pathway of entry, but of minor importance. The current pest distribution and climate matching suggest that the pest could establish and spread in the EU wherever the hosts are grown. In the infested areas, the pest causes girdling of twigs and occasionally of larger branches, whereas trees with multiple infections loose vigour, bloom poorly, and become unproductive, stunted and susceptible to winter injury and infection by other pathogens. The presence of black knots makes trees unsuitable for timber production. It is expected that the pest introduction and spread in the EU would impact host production. Uncertainty exists on whether the agricultural practices and chemical control methods applied in the EU could prevent the establishment and spread of *A. morbosa*. *A. morbosa* meets all the criteria assessed by EFSA for consideration as potential Union quarantine pest. As the pest is not known to occur in the EU, this criterion to consider it as Union regulated non-quarantine pest is not met.

Keywords: Black knot, *Dibotryon morbosum*, impacts, pest distribution, *Prunus* spp., Quarantine

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

Following the evaluation of the plant health regime, the new basic plant health law, Regulation (EU) 2016/2031[2] on protective measures against pests of plants, was adopted on 26 October 2016 and will apply from 14 December 2019 onwards, repealing Directive 2000/29/EC. In line with the principles of the above mentioned legislation and the follow-up work of the secondary legislation for the listing of EU regulated pests, EFSA is requested to provide pest categorizations 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 pests 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

Aleurocantus 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
Cadang-Cadang viroid
Citrus tristeza virus (non-EU isolates)
Leprosis
Little cherry pathogen (non- EU isolates)
Naturally spreading psorosis
Palm lethal yellowing mycoplasm
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

Apiosporina morbosa 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 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.

1.3. Additional information

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A literature search on *A. morbosa* was conducted at the beginning of the categorisation in the ISI Web of Science bibliographic database. The search focussed on *Apiosporina morbosa*, (including its synonyms) and its geographic distribution, life cycle, host plants and the damage it causes. The following search terms (TS) and combinations were used: TS = ("*Apiosporina morbosa*" OR "*Dibotryon morbosum*" OR "*Botryosphaeria morbosa*" OR "*Cucurbitaria morbosa*" OR "*Otthia morbosa*" OR "*Plowrightia morbosa*" OR "*Sphaeria morbosa*" OR "black knot") AND TS = (geograph* OR distribution OR "life cycle" OR lifecycle OR host OR hosts OR plant* OR damag*). 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 Plan Protection Organization (EPPO) Global Database (EPPO, online) and relevant publications.

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

The Europhyt database (online) was consulted for pest-specific notifications on interceptions and outbreaks. Europhyt is a web-based network launched by the Directorate General for Health and Consumers (DG SANCO), and is a subproject of PHYSAN (Phyto-Sanitary Controls) specifically concerned with plant health information. The Europhyt database manages notifications of interceptions of plants or plant products that do not comply with EU legislation, 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.

2.2. Methodologies

The Panel performed the pest categorisation for *A. morbosa*, following guiding principles and steps presented in the EFSA guidance on the harmonised framework for pest risk assessment (EFSA PLH Panel, 2010) and as defined in the International Standard for Phytosanitary Measures No 11 (FAO, 2013) and No 21 (FAO, 2004).

In accordance with the guidance on a harmonised framework for pest risk assessment in the EU (EFSA PLH Panel, 2010), 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 regulated non-quarantine pest 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 regulated non-quarantine pest. 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 regulated non-quarantine pest that needs to be addressed in the opinion. For the pests regulated in the protected zones only, the scope of the categorisation is the territory of the protected zone; thus, the criteria refer to the protected zone 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, in agreement with EFSA guidance on a harmonised framework for pest risk assessment (EFSA PLH Panel, 2010).

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 regulated non-quarantine pest. (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	The protected zone system aligns with the pest free area system under the International	Is the pest regulated as a quarantine pest? If currently regulated as a quarantine pest,

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
	assessment area, it should be under official control or expected to be under official control in the near future.	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).	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?
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 regulated non-quarantine pest 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 Apiosporina morbosa is well-established.

Apiosporina morbosa (Schwein.) Arx 1954 is a fungus of the family Venturiaceae. The Index Fungorum database (www.indexfungorum.org) provides the following taxonomical identification:

Preferred scientific name: *Apiosporina morbosa* (Schwein.) Arx,
Family – Venturiaceae
Genus – *Apiosporina*
Species – *morbosa*

Other reported synonyms: *Dibotryon morbosum* (Schwein.) Theiss. & Syd., *Botryosphaeria morbosa* (Schwein.) Sorauer, *Cucurbitaria morbosa* (Schwein.) Ellis, *Otthia morbosa* (Schwein.) Ellis & Everhart, *Plowrightia morbosa* (Schwein) Saccardo, *Sphaeria morbosa* Schwein.

Preferred common name: Black knot.

Other common names: Black knot of plum, black knot of cherry, black knot of prunus, black knot of stone fruits.

Apiosporina morbosa is the causal agent of black knot, a major disease of *Prunus* spp. The species has been recently re-examined by Zhang et al. (2011) and has been included in the new order Venturiales. The anamorphic state of *A. morbosum* was described by Schubert et al. (2003) as *Fusicladium* state of *A. morbosa* (Schwein.) Arx.

3.1.2. Biology of the pest

Apiosporina morbosa overwinters in host tissues as mycelium, which develops pseudothecia (Koch, 1935a). At bud emergence of the host plant, ascospores, which are considered the primary source of inoculum, are forcibly discharged from pseudothecia following a period of warm, wet weather (Snover and Arneson, 2002). Laboratory studies showed that ejection of ascospores from pseudothecia formed on *Prunus domestica* trees, was negligible at 5°C, heavy at 21°C and light at 36°C (Smith et al., 1970). However, with pseudothecia from *Prunus serotinia*, ejection of ascospores occurred at temperatures between 3°C and 36°C and it was 135 times greater at 21°C and 29°C than at 5°C (Smith et al., 1970). Few ascospores were released below 5°C or above 31°C, with the greatest release occurring between 10°C and 26.5°C (Koch, 1933; Smith et al., 1970). McFadden-Smith et al. (2000) showed that under orchard conditions, only a few hours of wetness were enough for ascospores to discharge. Laboratory studies showed that ascospores were forcibly ejected up to a horizontal distance of 45 mm (the maximum distance studied) with 50% of the ascospores being ejected at distances < 10 mm (Smith et al., 1970).

Released ascospores are dispersed over relatively short distances by air currents to infect susceptible hosts (Koch, 1933; Snover and Arneson, 2002). Depending on the region, ascospores were trapped from late April to mid-July (Smith et al., 1970; McFadden-Smith et al., 2000) with a peak after petal fall in Ontario (Canada) and Pennsylvania (USA) and during bloom in Michigan (USA) (Smith et al., 1970; Ritchie et al., 1975; McFadden-Smith et al., 2000). Under field conditions, ascospores have been trapped at a distance of 9.14 m (maximum distance studied) from the nearest infected plum tree (Koch, 1933).

According to Smith et al. (1970), ascospores germinated after 6 h of wetting at temperatures between 18°C and 24°C. However, longer wetness periods were required for the germination of ascospores at 6, 12 and 30°C. Germinated ascospores can penetrate and infect unwounded, elongating green twigs (Snover and Arneson, 2002). As the twigs mature, they become resistant to infection (Snover and Arneson, 2002). Host infection is favoured by temperatures between 16°C and

27°C and wetting periods longer than 6 h (Smith et al., 1970; Snover and Arneson, 2002). Northover and McFadden-Smith (1995) reported that infection of sour cherry and plum trees occurred with 13.8–30.7 mm of rain, 19–42 h of wetting and mean temperatures of 10.4–12.2°C.

On the surface of 1-year-old knots, the pathogen produces asexual conidia, which belong to the genus *Fusicladium* and are disseminated by wind and rain (Snover and Arneson, 2002; EPPO, online). Koch (1933) observed that conidia were present in abundance on plum knots at the time ascospore discharge ceased, and continued to be produced throughout the summer. Although it has been reported that conidia are extremely cold-resistant (they survived for 192 days at −20°C) and could overwinter (EPPO, online), there is uncertainty about their role in the epidemiology of the disease because of the contradictory information available in the literature. According to Koch (1933), the capability of conidia to infect the host and/or spread the disease is very limited compared to that of ascospores. Similarly, Gourley (1962) showed that no symptoms developed on plum or peach seedlings inoculated in the greenhouse with conidia. However, in earlier pathogenicity studies conducted by Smith et al. (1970), one out of the 91 'Stanley' plum trees inoculated with a conidial suspension developed symptoms. Koch (1935b) reported that inoculation of twigs of plum trees with conidia of the pathogen (as *Hormodendrum* sp.) resulted in the production of typical black knots on which pseudothecia of *A. morbosa* (as *Dibotryon morbosum*) were produced.

During the dormant period, the mycelium of the pathogen can internally invade healthy tissues and give rise to secondary knots at some distance from the primary knots (Koch, 1935b). The time required for the pathogen to complete its life cycle varies; it cannot be completed in less than two years on peach and plum in Nova Scotia, Canada (Gourley, 1962), but can be completed in one year on plum in Michigan, USA (Ritchie et al., 1975) and Ontario, Canada (Koch, 1935b).

The knots are often invaded by other fungi, bacteria and yeasts, with *Trichothecium roseum* (syn. *Cephalosporium roseum*) being the most common (Koch, 1934; Gourley, 1962). *T. roseum* causes destruction of perithecial initials resulting in a reduction in the number, and occasionally in a complete inhibition of pseudothecia production (Koch, 1934, 1935a; Gourley, 1962). Certain other fungi (e.g. *Fusarium* spp., *Alternaria* spp., etc.) found to be associated with knots may affect the normal development and maturation of *A. morbosa* pseudothecia (Koch, 1934, 1935a; Gourley, 1962).

A. morbosa has been reported to produce chlamydospores in culture in the presence of certain microorganisms or chemicals (Koch, 1934, 1935b). Chlamydospore production was also induced on twigs of *P. domestica* in the presence of antagonistic bacteria originally isolated from the same host (Koch, 1935b).

The optimum temperature for the *in vitro* mycelial growth of *A. morbosa* was reported to be 18°C (Gourley, 1962). Cultures of the pathogen held at −2°C for 11 and 28 days grew normally when returned to room temperature. However, cultures maintained at 32°C for the same time periods did not resume growth.

3.1.3. Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, *Apiosporina morbosa* can be detected and identified based on symptomatology, morphology and molecular methods.

Apiosporina morbosa is difficult to detect in the field during the growing season, as (i) the pathogen has a long incubation period (from 2.5 months up to 1 year), (ii) the initial symptoms (irregular, olive-green swellings or galls) are similar to those caused by *Agrobacterium tumefaciens* on *Prunus* spp., and (iii) the symptoms are usually obscured by the foliage.

The pathogen can be identified based on the morphology of its sexual fruiting structures (pseudothecia with ascospores) produced on the knots; the apiosporous ascospores of *Apiosporina* readily distinguish them from those of other Venturiales affecting *Prunus* spp. (Zhang et al., 2011). However, as the invasion of knots by *T. roseum* may result in a complete inhibition of pseudothecia production (see Section 3.1.2), making the detection and identification of the pathogen based on the morphology of its sexual stage is difficult. Furthermore, the association of the knots with several other fungi of the genera *Fusarium, Alternaria, Penicillium, Cladosporium*, etc. (Koch, 1934) makes isolation and identification of the pathogen from infected plant tissues more difficult (Zhang et al., 2005).

A fast and sensitive molecular method is available for the identification of the pathogen in cultures and plant tissues (Zhang et al., 2005). As the specificity test conducted by Zhang et al. (2005)

included some saprophytic fungi growing on black knots but not wood pathogens of *Prunus* spp. (e.g. *Venturia carpophila, Botryosphaeria* spp. etc.), the molecular method can provide false positives. On the contrary, negative results showing no detection of *A. morbosa* should be considered as reliable.

For a reliable detection and identification of *A. morbosa* on plants, symptomatology and morphological characteristics of its sexual fruiting structures should be considered in addition to molecular methods.

Symptoms

The disease affects only woody parts of the host trees and is characterized by elongated, rough, irregular, black, spindle-shaped swellings or knots (Sinclair et al., 1987; Wilcox, 1992; Hickey, 1995; Zhang et al., 2005). Symptoms mainly appear on twigs and occasionally on more than 1-year-old branches (Koch, 1935a). Symptoms may also be observed on trunks, but only in severely infected orchards (Wilcox, 1992). The pathogen is not reported to be seed-borne or to affect fruits. Knots are often formed near the point of leaf attachment (Wilcox, 1992). They are initially olive-green, due to the production of asexual conidia, corky and soft but later they turn brown, harden, and finally become black as they expand and age (Wilcox, 1992; EPPO, online). Their dimensions range from 1 to 15–20 cm in length and from 0.5 to 4 cm in width; very often they coalesce to form larger knots and may even girdle the stem (Snover and Arneson, 2002). The infected twigs often appear bent at the tips because of extra cellular growth on one side (Snover and Arneson, 2002). Knots are easily noticed during the winter when they are not obscured by the leaves (Snover and Arneson, 2002).

In mid- to late summer, some of the mature knots may appear white or pink in colour because of their invasion by the fungus *T. roseum* (Koch, 1935a; Snover and Arneson, 2002; EPPO, online).

The reports in the literature concerning the length of the incubation period vary. In different hosts and field studies, symptoms were visible as swelling during the same season in which infection has occurred or in the following season (Koch, 1935a,b; Northover and McFadden-Smith, 1995). Formation of mature knots may take about 2 years from the time of infection (Koch, 1935a). In pathogenicity studies with seedlings, knots appeared within 2.5 to 5–7 months after inoculation (Gourley, 1962).

Morphology

The stromata are erumpent, variable in shape and size, at first olivaceous-green, later blackish and firm (Fernando et al., 2005). Conidiophores arising from the upper cells of stroma are unbranched or branched at the base, 20–95 × 3–6(–7) μm, septate, pale olivaceous to pale brown. Conidia are solitary or rarely in short chains, often laterally fused in pairs, ovoid, obovoid, ellipsoid or irregular, 4–19 × 3–6 μm, 0–1-septate, pale olivaceous, smooth and thick-walled (Schubert et al., 2003). The colonies of *A. morbosa* are generally slow-growing and initially olive-green turning to a dark brown in about 2 weeks.

Ascomata densely formed in branches are 160–230 μm high × 170–250 μm in diameter (Zhang et al., 2011). Asci are 68–90 × 12.5–15 μm, eight-spored, bitunicate, with a short (8–15 μm), furcate pedicel, with an inconspicuous ocular chamber. Ascospores are 15–18(−19) × (5-)6–7.5 μm, biseriate, clavate, apiosporous, tapered towards the base, apex obtusely rounded, one septate near the lower end, barely constricted at the septum, hyaline to pale brown and smooth-walled (Zhang et al., 2011).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

According to EPPO Global Database, the geographical distribution of *A. morbosa* is restricted to North America and particularly to Canada, continental states of the USA and Mexico (Figure 1 and Table 2). However, in the early 1980s, the pathogen was first reported from Alaska (municipality of Anchorage), where it was affecting ornamental *Prunus padus* and *Prunus virginiana* trees (Anonymous, 2004). Reports on the pathogen affecting ornamental *Prunus* species in the above-mentioned area continued till 2016 (Anonymous, 2017). The pathogen has also been reported from New Zealand (Anonymous, 2003; Agrios, 2005). However, after contacting the Ministry of Primary Industries in New Zealand, it was clarified that the current status of *A. morbosa* is 'absent' (answer received on 28/2/2018).

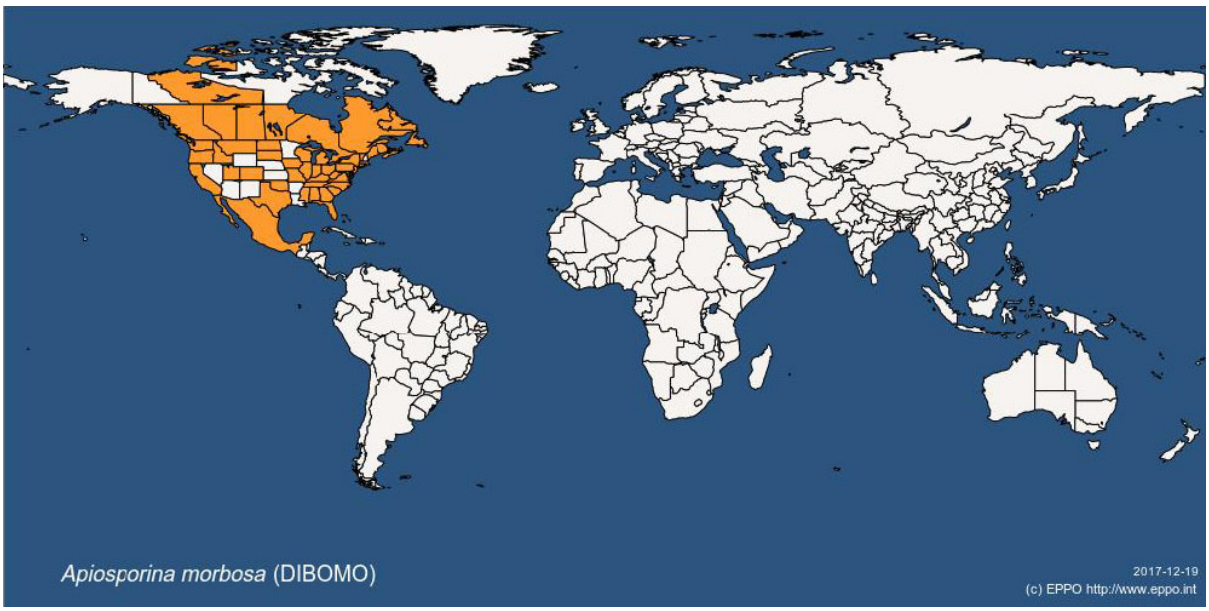

Figure 1: Global distribution map for *Apiosporina morbosa* (extracted from the EPPO Global Database; last updated: 12/9/2017; last accessed: 19/12/2017). The pathogen has also been reported to be present in Alaska (Anonymous, 2004)

Table 2: Global distribution of *Apiosporina morbosa* based on information extracted from the EPPO Global Database (last updated: 12/9/2017; last accessed: 19/12/2017) and other sources

Continent	Country	Status	Source
America	Canada	Present, widespread	EPPO
	Mexico	Present, no details	EPPO
	United States of America*	Present, widespread	EPPO

*: According to Anonymous (2004, 2017), *A. morbosa* is also present in Alaska.

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?

No, Apiosporina morbosa is not known to be present in the risk assessment area

3.3. Regulatory status

3.3.1. Council Directive 2000/29/EC

Apiosporina morbosa is listed in Council Directive 2000/29/EC. Details are presented in Tables 3 and 4.

Table 3: *Apiosporina morbosa* in Council Directive 2000/29/EC

Annex II, Part A	**Harmful organisms whose introduction into, and spread within, all member states shall be banned if they are present on certain plants or plant products**	
Section I	**Harmful organisms not known to occur in the community and relevant for the entire community**	
(c)	Fungi	
	Species	Subject of contamination
2.	*Apiosporina morbosa* (Schwein.) v. Arx	Plants of *Prunus* L. intended for planting, other than seeds

3.3.2. Legislation addressing the hosts of *Apiosporina morbosa*

Table 4: Regulated hosts and commodities that may involve *Apiosporina morbosa* in Annexes III, IV and V of Council Directive 2000/29/EC

Annex III, Part A	**Plants, plant products and other objects the introduction of which shall be prohibited in all Member States**	
	Description	Country of origin
9.	Plants of *Chaenomeles* Ldl., *Cydonia* Mill., *Crateagus* L., *Malus* Mill., *Prunus* L., *Pyrus* L., and *Rosa* L., intended for planting, other than dormant plants free from leaves, flowers and fruit	Non-European countries
18.	Plants of *Cydonia* Mill., *Malus* Mill., *Prunus* L. and *Pyrus* L. and their hybrids, and *Fragaria* L., intended for planting, other than seeds	Without prejudice to the prohibitions applicable to the plants listed in Annex III A (9), where appropriate, non-European countries, other than Mediterranean countries, Australia, New Zealand, Canada, the continental states of the USA
Annex V	**Plants, plant products and other objects which must be subject to a plant health inspection (at the place of production if originating in the Community, before being moved within the Community—in the country of origin or the consignor country, if originating outside the Community) before being permitted to enter the Community**	
Part A	Plants, plant products and other objects originating in the Community	
Section I	Plants, plant products and other objects which are potential carriers of harmful organisms of relevance for the entire Community and which must be accompanied by a plant passport	
1.1	Plants, intended for planting, other than seeds, of *Amelanchier* Med., *Chaenomeles* Lindl., *Cotoneaster* Ehrh., *Crataegus* L., *Cydonia* Mill., *Eriobotrya* Lindl., *Malus* Mill., *Mespilus* L., *Photinia davidiana* (Dcne.) Cardot, *Prunus* L., other than *Prunus laurocerasus* L. and *Prunus lusitanica* L., *Pyracantha* Roem., *Pyrus* L. and *Sorbus* L.	
2.1	Plants intended for planting, other than seeds, of the genera *Abies* Mill., *Apium graveolens* L., *Argyranthemum* spp., *Asparagus officinalis* L., *Aster* spp., *Brassica* spp., *Castanea* Mill., *Cucumis* spp., *Dendranthema* (DC.) Des Moul., *Dianthus* L. and hybrids, *Exacum* spp., *Fragaria* L., *Gerbera* Cass., *Gypsophila* L., all varieties of New Guinea hybrids of *Impatiens* L., *Lactuca* spp., *Larix* Mill., *Leucanthemum* L., *Lupinus* L., *Pelargonium* l'Hérit. ex Ait., *Picea* A. Dietr., *Pinus* L., *Platanus* L., *Populus* L., *Prunus laurocerasus* L., *Prunus lusitanica* L., *Pseudotsuga* Carr., *Quercus* L., *Rubus* L., *Spinacia* L., *Tanacetum* L., *Tsuga* Carr., *Verbena* L. and other plants of herbaceous species, other than plants of the family Gramineae, intended for planting, and other than bulbs, corms, rhizomes, seeds and tubers	
Part B	Plants, plant products and other objects originating in territories, other than those referred to in Part A	
Section I	Plants, plant products and other objects which are potential carriers of harmful organisms of relevance for the entire Community	

1.	Plants, intended for planting, other than seeds but including seeds of Cruciferae, Gramineae, *Trifolium* spp., originating in Argentina, Australia, Bolivia, Chile, New Zealand and Uruguay, genera *Triticum*, *Secale* and X *Triticosecale* from Afghanistan, India, Iran, Iraq, Mexico, Nepal, Pakistan, South Africa and the USA, *Citrus* L., *Fortunella* Swingle and *Poncirus* Raf., and their hybrids, *Capsicum* spp., *Helianthus annuus* L., *Solanum lycopersicum* L., *Medicago sativa* L., *Prunus* L., *Rubus* L., *Oryza* spp., *Zea mais* L., *Allium ascalonicum* L., *Allium cepa* L., *Allium porrum* L., *Allium schoenoprasum* L. and *Phaseolus* L.
2.	Parts of plants, other than fruits and seeds, of:— *Prunus* L., originating in non-European countries,
6.	Wood within the meaning of the first subparagraph of Article 2(2), where it: (b) meets one of the following descriptions laid down in Annex I, Part two to Council Regulation (EEC) No 2658/87:

CN code	Description
ex 4407 99	Non-coniferous wood (other than tropical wood specified in subheading note 1 to Chapter 44 or other tropical wood, oak (*Quercus* spp.), beech (*Fagus* spp.), maple (*Acer* spp.), cherry (*Prunus* spp.) or ash (*Fraxinus* spp.)), sawn or chipped lengthwise, sliced or peeled, whether or not planed, sanded or end-jointed, of a thickness exceeding 6 mm

3.4. Entry, establishment and spread in the EU

3.4.1. Host range

Apiosporina morbosa affects a wide variety of cultivated, ornamental and wild *Prunus* species (Table 5). According to the EPPO Global Database, the major host is *P. domestica* (plum). *Prunus cerasus* (sour cherry), *Prunus salicina* (Japanese or Chinese plum) and *P. domestica* subsp. *insititia* (damson) are considered minor hosts, whereas *Prunus armeniaca* (apricot) and *Prunus persica* (peach) are reported as incidental hosts (EPPO, online). In North America, the pathogen has also been found to affect wild *Prunus* species, such as *P. americana* (American plum), *Prunus pensylvanica* (pin cherry), *Prunus serotina* (black cherry) and *P. virginiana* (chokecherry) (Koch, 1935b; EPPO, online).

Although in the EPPO Global Database, *P. cerasus* is included in the list of minor hosts, there are reports in the literature that the disease is widely distributed on *P. cerasus* in Ontario (Canada) reducing production in important sour cherry-growing areas (Northover and McFadden-Smith, 1994, 1995; McFadden-Smith et al., 2000).

According to Harrell and Blodgett (2016), common hosts of *A. morbosa* in the Great Plains (USA) include cultivated, ornamental and wild cherries, such as *P. padus, Prunus emarginata, P. serotina, P. virginiana, Prunus mahaleb, Prunus tomentosa, P. pensylvanica, Prunus pumila, P. cerasus* and *Prunus avium*, as well as apricot (*P. armeniaca*), peach (*P. persica*), American plum (*P. americana*), Canadian plum (*Prunus nigra*), and European plum (*P. domestica*). Hedrick (1915) reported that *P. cerasus* is very susceptible to black knot, while *P. avium* is almost immune.

Field studies have shown that various strains of the pathogen may have some specificity to certain *Prunus* species and/or varieties (Gilbert, 1913; Koch, 1935b; Gourley, 1962; Smith et al., 1970). In addition, a *Prunus* species or variety may appear to be susceptible in one region and resistant in another (Koch, 1935b). Recent phylogenetic studies suggest that the genetic diversity and population differentiation of *A. morbosa* are associated with host genotypes and geographic locations (Zhang et al., 2005).

It is not known whether hybrids of *Prunus* (e.g. *P. persica* × *P. americana*, *P. speciosa* × *P. pendula* f. *ascendens, P. simonii* × *P. salicina*, etc.) grown mainly as ornamentals in North America are susceptible to the infection by the pathogen because of lack of information in the available literature.

Based on the above, *P. domestica* and *P. cerasus* are considered the major hosts of *A. morbosa* in the infested areas. However, there is uncertainty on the host status of other cultivated, ornamental and wild species of *Prunus*.

Table 5: Hosts of *Apiosporina morbosa* according to EPPO Global Database (last updated: 12/9/2017; last accessed: 19/12/2017)

Host[(a)]	Status
Cultivated *Prunus* species	
P. domestica	Major
P. domestica subsp. *insititia*	Minor
P. cerasus[(b)]	Minor
P. salicina	Minor
P. armeniaca	Incidental
P. persica	Incidental
Wild *Prunus* species	
P. americana	
P. pensylvanica	
P. serotina	
P. virginiana	

(a): All these hosts are regulated in the EU.
(b): According to McFadden-Smith et al. (2000), Koch (1933, 1934, 1935a) and Hedrick (1915), *P. cerasus* is a major host of *A. morbosa* in Ontario (Canada) and the USA.

3.4.2. Entry

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

Yes, under the current EU legislation, *Apiosporina morbosa* could potentially enter the risk assessment area on (i) dormant host plants for planting originating in infested third countries, (ii) host plants for planting originating in Canada and the continental states of the USA, and (iii) host plant parts, such as bud-wood, scions and cuttings, originating in infested third countries

In the absence of the current EU legislation and given that no evidence exists for the pathogen to be seed-borne or to affect fruits, the PLH Panel identified the following pathways for the entry of *A. morbosa* into the EU territory:

1) Plants for planting of *Prunus* spp., other than fruits and seeds,
2) Plant parts (e.g. bud-wood, scions, cuttings, etc.) of *Prunus* spp., and
3) Wood of *Prunus* spp.

originating in infested third countries.

Uncertainty exists whether the pathogen could enter the risk assessment area on plants for planting, plant parts or wood of *Prunus* hybrids originating in infested areas, because there is lack of information on their susceptibility to infection by the pathogen.

The wood pathway is of minor importance because of the following reasons:

1) The pathogen affects mainly twigs and only occasionally branches more than one-year-old, whereas trunks are affected only in the case of severely infected orchards.
2) If black knots are present on wood, it is most likely that they will be removed before wood is exported to the EU and it is known that the mycelium spreads in the wood at short distances from the knots (up to 5 cm for knots of 2.5 cm in diameter – Zhang et al., 2005).
3) The main *Prunus* species used for production of wood (wood for furniture, cabinetry timber) is *P. serotina* (black cherry), which, according to the literature, is an incidental host of *A. morbosa.* Snover and Arneson (2002) indicated that the knots formed on *P. serotina* render the trees unsuitable for timber production.
4) No information exists in the literature on the pathogen being transmitted from infected *Prunus* wood to host plants.

Therefore, the wood pathway is not further considered in this pest categorisation.

The current EU legislation prohibits the import into the risk assessment area of (i) *Prunus* plants for planting, other than dormant plants (free from leaves, flowers and fruit), from non-European countries, and (ii) plants of *Prunus* spp. and their hybrids intended for planting, other than seeds,

originating in non-European countries, other than the Mediterranean countries, Australia, New Zealand, Canada and the continental states of the USA.

Therefore, under the current EU legislation, the relevant pathways for the entry of the pathogen into the risk assessment area are as follows:

1) dormant host plants for planting, particularly latently infected (asymptomatic), originating in infested third countries,
2) host plants for planting, particularly latently infected (asymptomatic) plants, originating in Canada and the continental states of the USA,
3) parts of host plants (bud-wood, scions, cuttings), particularly latently infected (asymptomatic), originating in infested third countries.

No data exists in Eurostat (online) on imports of *Prunus* spp. plants for planting from the infested third countries into the EU. However, the Netherlands National Plant Protection Organisation kindly provided detailed trade inspection data regarding imports of plants for planting from 2012 to 2014 (unpublished data). These data show that in 2014, seven *Prunus* spp. trees were imported from infested third countries, indicating that this is a possible pathway of entry into the EU.

There is no record of interception of *A. morbosa* in the Europhyt database (online; search performed on 10 January 2018).

3.4.3. Establishment

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

Yes, both the biotic (host availability) and abiotic (climate suitability) factors suggest that *Apiosporina morbosa* could potentially establish in the risk assessment area.

3.4.3.1. EU distribution of main host plants

Cultivated, ornamental and wild *Prunus* spp. are widely distributed in the risk assessment area. The areas of *Prunus* spp. grown for fruit production (*P. domestica, P. cerasus, P. armeniaca, P. persica* and *P. avium*) are reported in Table 6.

Table 6: Area cultivated with *Prunus* spp. for fruit production *(P. domestica, P. cerasus, P. armeniaca, P. persica* and *P. avium)* in the EU between 2011 and 2015 (in 1,000 ha) – Source: Eurostat, extracted on 7 February 2018

Countries*	2011	2012	2013	2014	2015	Mean of EU area grown with *Prunus* spp. (in 1,000 ha)
European Union (28 countries)	Not applicable due to data gaps					
Spain[(a)]	86.65	86.32	88.51	86.25	112.84	92.11
Italy[(b)]	86.12	81.53	79.60	77.96	75.07	80.06
Romania	79.32	79.76	79.86	77.66	76.29	78.58
Greece	52.88	55.34	57.82	65.42	60.18	58.33
Poland[(a),(c)]	59.40	58.10	49.40	46.00	56.50	53.88
France	46.27	44.53	42.75	41.78	40.21	43.11
Hungary[(d)]	30.77	30.66	31.46	33.43	32.98	31.86
Bulgaria[(a)]	15.40	13.97	13.46	10.45	22.13	15.08
Germany	13.29	11.82	11.77	11.71	11.55	12.03
Portugal	10.43	10.70	10.95	10.98	11.43	10.90

*: Only Member States growing more than 10,000 ha (on average for the period 2011–2015) are reported.
(a): No data on sweet cherry production for the years 2011, 2012, 2013 and 2014.
(b): No data for sour and sweet cherries.
(c): No data on peach production for the year 2014.
(d): No data on sweet cherry production for the years 2011, 2012 and 2013.

Prunus spp. are also grown, but to a lesser extent, in Croatia, the Czech Republic, Lithuania, Denmark, Cyprus, Belgium, Latvia, Luxembourg, the Netherlands, Austria, Slovenia, Slovakia, Sweden and the United Kingdom.

3.4.3.2. Climatic conditions affecting establishment

In America, the pest is present in Canadian provinces, continental states of the USA and Mexico. These areas are characterised by several climate types (Peel et al., 2007) (Figure 2), which are also present in the risk assessment area (Figure 3). In the east coast of North America (Figure 2), Cfa (temperate, without dry season, hot summer), Dfa (cold, without dry season, hot summer) and Dfb (cold, without dry season, warm summer) climate types predominate, which are also present in the eastern part of the risk assessment area, in the Alps area and in north Italy (Figure 3). In the west coast of North America (Figure 2), Cfb (temperate, without dry season, warm summer), Csa (temperate dry and hot summer), Csb (temperate, dry and warm summer), Bsk (arid, steppe and cold) types are present, which are prevalent in western EU MSs and in the Mediterranean EU MSs (Figure 3). Finally, the Dfc (cold, without dry season, cold summer) type is present both in Canada (Figure 2) and in some Scandinavian areas (Figure 3). Based on the above, *A. morbosa* could potentially establish under the climatic conditions prevailing in the risk assessment area.

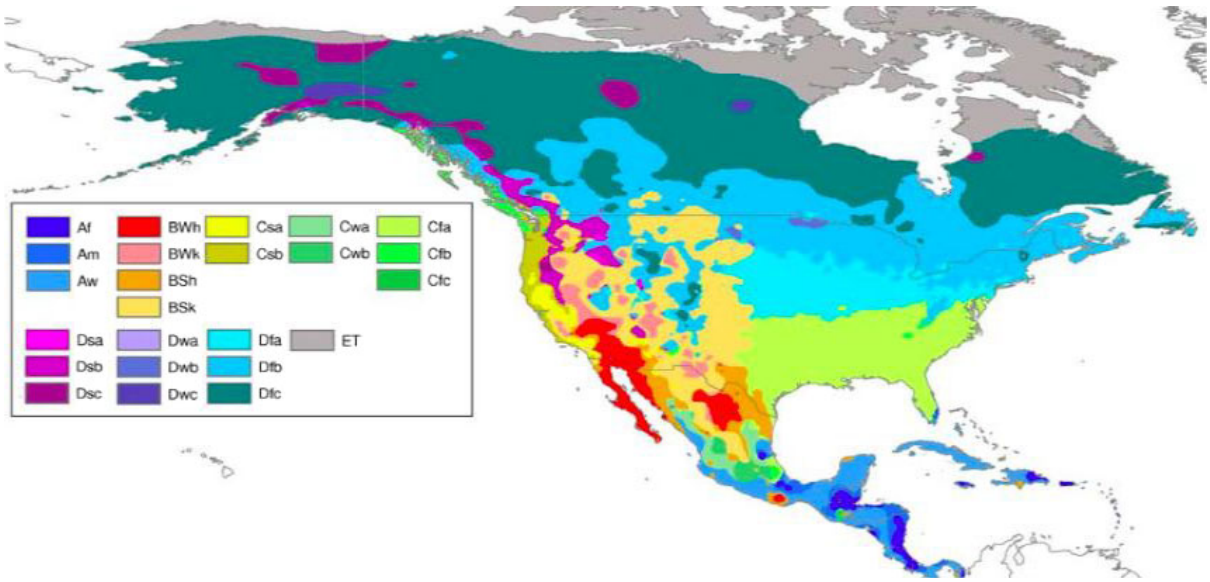

Figure 2: Köppen–Geiger climate type map of North America, from Peel et al. (2007)

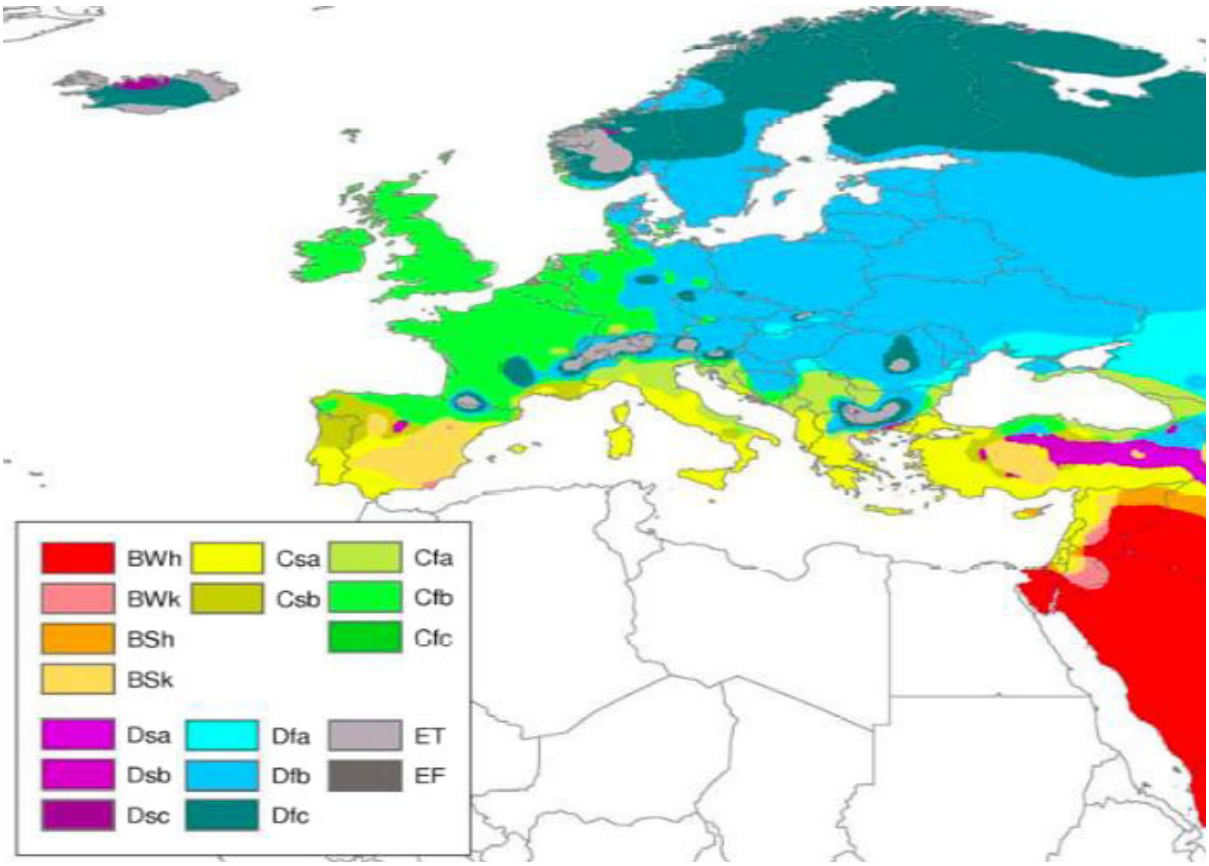

Figure 3: Köppen–Geiger climate type map of Europe, from Peel et al. (2007)

3.4.4. Spread

3.4.4.1. Vectors and their distribution in the EU (if applicable)

Is the pest able to spread within the EU territory following establishment? **Yes**

How? By natural and human-assisted means

Once established, *A. morbosa* could potentially spread in the risk assessment area by both natural and human-assisted means.

Spread by natural means. The pathogen can spread over relatively short distances by rain and air currents (Koch, 1933; McFadden-Smith et al., 2000). In field studies, ascospores of *A. morbosa* have been trapped at 9.14 m (maximum distance studied) from the inoculum source (Koch, 1933) (see Section 3.1.2). Based on Wall (1986) field studies, in which the use of *A. morbosa* for the biological control of wild *P. pensylvanica* trees was investigated, there was evidence of disease spread 10–20 m from the inoculum source. The author also reported that, in natural stands of *P. pensylvanica*, the disease progressively killed 26% of the trees within 6 years.

Spread by human-assisted means. The pathogen can spread over long distances via the movement of infected host plants for planting and plant parts (bud-wood, scions, cuttings), particularly latently infected (asymptomatic).

3.5. Impacts

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

Yes, the introduction of the pest would potentially cause yield and quality losses to *Prunus* spp. grown in the risk assessment area.

When infected, small twigs are frequently killed; however, larger branches usually survive for several years, due to the localised spread of the pathogen (Koch, 1935a). The disease causes girdling of twigs and occasionally of larger branches 1–2 years after infection (Koch, 1935a; Northover and McFadden-Smith, 1995). Trees with multiple infections lose vigour, bloom poorly, and become increasingly unproductive, stunted and susceptible to winter injury and infection by other pathogens (Wilcox, 1992; Snover and Arneson, 2002; EPPO, online).

In North America, *A. morbosa* can be destructive in cultivated and ornamental plums but is not of economic importance in peaches (Gourley, 1962). The disease was considered to be responsible for the disappearance of cherry trees from orchards in Ontario (Canada) in the 19th century and is the main factor limiting plum cultivation in Nova Scotia (Canada) (Gourley, 1962). On the contrary, Cramer (1967) reported yield losses of 10% and 1% on plums and cherries, respectively. The knots formed on *P. serotina* (black cherry) render the trees unsuitable for timber (Snover and Arneson, 2002).

The introduction and spread of the pathogen in the risk assessment area is expected to cause impacts to *Prunus* spp. production.

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 such that the risk becomes mitigated?

Yes, the likelihood of pest entry can be mitigated if host plants for planting and plant parts are sourced from pest-free areas or pest-free places of production and are inspected and lab-tested for the detection of *Apiosporina morbosa,* both at the place of origin and the EU entry point. In the infested areas, agricultural practices combined with sanitation and chemical measures are used for disease management.

Measures for preventing the entry of the pest into the risk assessment area include:

- sourcing host plants for planting and plant parts (bud-wood, scions, cuttings) from pest-free areas or pest-free places of production;
- phytosanitary certificate for the export of host plants for planting and plant parts (bud-wood, scions, cuttings) from infested third countries;
- inspection and lab testing of host plants for planting and plant parts (bud-wood, scions, cuttings) prior to export to the EU and at the EU entry point.

Measures for preventing the establishment and spread of the pest in the risk assessment area include:

- use of resistant *Prunus* species and varieties;
- surveillance for the early detection of the pathogen;
- use of sanitation measures (e.g. removal of infected plants or plant parts and pruning residues, etc.);
- management of crop residues;
- application of fungicide sprays;
- prevent the movement of infected host plants for planting and plant parts.

3.6.1. Phytosanitary measures

The current EU legislation covers all the hosts but not all the pathways of entry of *A. morbosa*:

- Host plants for planting at dormant stage and host plant parts (bud-wood, scions, cuttings) originating in infested third countries are not regulated.
- Host plants for planting from Canada and continental states of the USA are not regulated.

Cherry wood importation is regulated in the EU. However, the Panel does not consider wood of *Prunus* spp. as a relevant pathway of entry for the reasons listed in Section 3.4.2.

According to the EU legislation, *Prunus* spp. plants for planting shall be sourced from pest-free areas or countries. Because of the long incubation period (symptoms can appear during the growing season following the year of infection (Section 3.1.3)), the Panel suggests that host plants for planting could also be sourced from any place of production or production site, provided that no symptoms of the disease have been observed during the last two cycles of vegetation.

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

Factors limiting the feasibility and effectiveness of measures to prevent the entry, establishment and spread of *A. morbosa* in the EU:

- The long incubation period of the pathogen (from 2.5 months up to 1 year, see Section 3.1.2) may reduce the effectiveness of visual inspection and detection, as latently infected (asymptomatic) host plants for planting and plant parts (bud-wood, scions, cuttings) will most likely go undetected.
- The similarity of black knot initial symptoms (olive-green swellings or galls) on current season's twigs with those caused by *Agrobacterium tumefaciens* (see Section 3.1.3) makes visual inspection and detection more complicated.
- The difficulty in detecting the black knot symptoms on plants during the growing season as they are often obscured by the foliage (see Section 3.1.3).

3.6.2. Pest control methods

In the infested areas, black knot is managed using a combination of cultural practices, sanitation measures, properly timed fungicide sprays, and resistant/tolerant varieties (Douglas, 2008). Of the above management measures, pruning and sanitation are considered the most important for disease management. All shoots and branches bearing knots should be pruned out during the winter (Northover and McFadden-Smith, 1995; Snover and Arneson, 2002). Pruning should be completed before ascospore discharge begins in the spring, usually about the time of bud break. To be sure that even the unseen internal mycelium is removed, affected twigs and branches should be cut at least 15–20 cm below the knot. As the knots may produce ascospores for some time after their removal from the tree, they should be burned, buried or removed from the site regardless of the time of year the pruning takes place. Koch (1933) showed that removing knots during pruning provided more than 80% reduction in disease incidence. Sanitation also includes scouting and removing or pruning of any wild host trees (particularly plum and cherry trees) grown in the vicinity of the orchards, as those trees are important sources of inoculum (Douglas, 2008).

Because of the long incubation period, this disease is often overlooked by home gardeners and fruit producers (Snover and Arneson, 2002). In addition, leaves can mask the symptoms (swellings, knots) until firmly established infections are in place. Once established, it is very difficult to manage the disease. Awareness and strict monitoring of susceptible plants should be a priority for all commercial growers and home gardeners.

In the infested areas, fungicides are mainly recommended for sites with various *Prunus* trees and/or severe infection levels (Snover and Arneson, 2002). Sites with severe black knot infection usually require protective applications from early spring around bud break through summer. In some seasons, the sprays can be terminated earlier if monitoring determines that inoculum (ascospores) is no longer available. Sites with low levels of inoculum may only need protection during the most susceptible period, when ascospores are abundant in the spring. Regardless of frequency, fungicides have been found to be most effective when applied prior to a rain event and temperatures above 16°C (Snover and Arneson, 2002). Fungicide sprays are applied as a protectant measure and are ineffective if cultural practices and sanitation measures are not also employed.

Uncertainty exists on whether the agricultural practices, sanitation and chemical control methods currently applied in the *Prunus*-growing areas of the EU would be effective in preventing the establishment of *A. morbosa* in the risk assessment area.

3.7. Uncertainty

1) Host range: except for *P. domestica* and *P. cerasus*, which are considered the major hosts of the pathogen in this pest categorisation, there is uncertainty on the host status of other cultivated, ornamental and wild *Prunus* species and hybrids due to either contradictory reports in the available literature or lack of information (see Section 3.4.1).
2) Entry: absence of data on the quantity of host plants for planting and plant parts (bud-wood, scions, cuttings) imported from Alaska, Canada, Mexico and the continental states of the USA into the EU28 (see Section 3.4.2).
3) Establishment: it is unknown whether cultural practices, sanitation and chemical control methods currently applied in the *Prunus*-growing areas of the EU would be effective in preventing the establishment of *A. morbosa* in the risk assessment area (see Section 3.6.2).

4) Spread: uncertainty whether conidia of the pathogen contribute to the spread of the disease, because of contradictory information in the available literature on the role of conidia in the epidemiology of the disease (see Section 3.1.2).
5) Spread: uncertainty on the maximum distance ascospores and conidia of *A. morbosa* can travel by natural means (see Section 3.4.4.1).

4. Conclusions

Apiosporina morbosa meets all the criteria assessed by EFSA for consideration as a potential EU quarantine pest. As the pest is not known to occur in the EU, it does not meet at least one of the criteria assessed by EFSA for consideration as Union regulated non-quarantine pest (see Table 7).

Table 7: The Panel's conclusions on the pest categorisation criteria defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest	Key uncertainties
Identity of the pest (Section 3.1)	The identity of the pest (*A. morbosa*) is clearly defined and there are reliable methods for its detection and identification	The identity of the pest (*A. morbosa*) is clearly defined and there are reliable methods for its detection and identification	None
Absence/ presence of the pest in the EU territory (Section 3.2)	The pest is not known to occur in the EU	The pest is not known to occur in the EU	None
Regulatory status (Section 3.3)	The pest is currently officially regulated as quarantine pest on *Prunus* spp. intended for planting, other than seeds (Dir 2000/29/EC)	The pest is currently officially regulated as quarantine pest on *Prunus* spp. intended for planting, other than seeds (Dir 2000/29/EC)	None
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	The pest could potentially enter, establish and spread in the EU Pathways of entry: 1) Dormant host plants for planting from infested third countries 2) Host plants for planting from Canada and the continental states of the USA 3) Parts of host plants (bud wood, scions and cuttings) originating in infested third countries	The pest could potentially spread in the EU through movement of host plants for planting, parts of host plants (bud wood, scions and cuttings), and by natural means. Therefore, plants for planting is a main pathway, but not the only one	Except for *P. domestica* and *P. cerasus*, there is uncertainty on the host status of other *Prunus* species and hybrids (Uncertainty 1). There is no import data on host plants for planting and plant parts (bud-wood, scions, cuttings) from infested third countries (Uncertainty 2). It is not known whether cultural practices and chemical control methods currently applied in the risk assessment area would be effective in preventing the establishment of the pest (Uncertainty 3).

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest	Key uncertainties
			There is contradictory information in the literature on the role of conidia in the spread of the disease (Uncertainty 4). There is no information on the maximum distance ascospores and conidia of the pest can travel by natural means (Uncertainty 5).
Potential for consequences in the EU territory (Section 3.5)	The introduction and spread of the pest in the EU could potentially cause yield and quality losses on *Prunus* spp. grown in the risk assessment area	The spread of the pest in the EU could potentially cause yield and quality losses as regards the intended use of *Prunus* spp. plants for planting	None
Available measures (Section 3.6)	There are measures to prevent the entry of the pest into the EU but the currently applied phytosanitary measures are not fully effective. *A. morbosa* could potentially enter the risk assessment area on: • dormant host plants for planting (free from leaves, fruits and flowers) originating in infested third countries, • host plants for planting and their hybrids originating in Canada and the continental states of the USA, and • host plant parts (bud wood, scions and cuttings) originating in infested third countries. There are no fully effective measures to prevent pest establishment and spread	There are no fully effective measures to prevent pest presence on host plants for planting	None
Conclusion on pest categorisation (Section 4)	*Apiosporina morbosa* meets all the criteria assessed by EFSA above for consideration as potential Union quarantine pest	*Apiosporina morbosa* is not known to occur in the EU. Therefore, it does not meet at least one of the criteria assessed by EFSA for consideration as Union regulated non-quarantine pest	None

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest	Key uncertainties
Aspects of assessment to focus on/ scenarios to address in future if appropriate	None		

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Abbreviations

DG SANCO	Directorate General for Health and Consumers
EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization
IPPC	International Plant Protection Convention
MS	Member State
PLH	EFSA Panel on Plant Health
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference