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Pest categorisation of *Anisogramma anomala*

EFSA Panel on Plant Health (PLH),

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Abstract

Following a request from the European Commission, the EFSA Plant Health (PLH) Panel performed a pest categorisation of *Anisogramma anomala*, a well-defined and distinguishable fungal species of the family Valsaceae. The pathogen is regulated in Annex IIAI of Council Directive 2000/29/EC as a harmful organism whose introduction into the EU is banned on plants of *Corylus* L., intended for planting, other than seeds, originating in Canada and the USA. The fungus is native to eastern North America and causes eastern filbert blight on cultivated hazel, *Corylus avellana*, as well as on wild hazel (*Corylus* spp.). In the 1960s, the disease spread on infected plant material to Oregon, where it then threatened US hazelnut production in the Willamette Valley. The pest could enter the EU via plants for planting. Hosts and favourable climatic conditions are common in the EU, thus facilitating establishment. The pest would be able to spread following establishment through infected plants for planting and ascospore dispersal. *A. anomala* leads to canopy and yield loss and can cause death of *Corylus* trees. Should the pathogen be introduced into the EU, impacts can be expected not just on hazel as a crop and as an ornamental but also in coppices and woodlands, where *Corylus* species provide an important habitat. In Oregon, scouting for cankers, therapeutic pruning and copious fungicide applications are reported to be necessary (but costly measures) to continue hazelnut production in the presence of the disease. Breeding for resistance led to the selection of resistant cultivars. The main knowledge gaps concern (i) the role of deadwood and cut branches as potential entry pathways and means of spread and (ii) the susceptibility of *C. avellana* cultivars and of *Corylus* spp. in the wild in the EU. The criteria assessed by the Panel for consideration as a potential quarantine pest are met. For regulated non-quarantine pests, the criterion on the pest presence in the EU is not met.

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Keywords: *Corylus*, eastern filbert blight, forest pathology, hazelnut, pest risk, plant pest, tree health

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1. Introduction

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

1.1.1. Background

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

Following the evaluation of the plant health regime, the new basic plant health law, Regulation (EU) 2016/2031² on protective measures against pests of plants, was adopted on 26 October 2016 and will apply from 14 December 2019 onwards, repealing Directive 2000/29/EC. In line with the principles of the above mentioned legislation and the follow-up work of the secondary legislation for the listing of EU regulated pests, EFSA is requested to provide pest 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 178/2002³, 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 deadline 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 deadline 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 criterion to be taken particularly under consideration for these cases is the analysis of host pest combination, investigation of pathways, the damages occurring and the relevant impact.

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

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

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

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

1.1.2.1. Terms of Reference: Appendix 1

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

Annex IIAI

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

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

(b) Bacteria

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

(c) Fungi

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

(d) Virus and virus-like organisms

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

Annex IIB

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

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

(b) Bacteria

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

(c) Fungi

Glomerella gossypii Edgerton

Hypoxyton mammatum (Wahl.) J. Miller

Gremmeniella abietina (Lag.) Morelet

1.1.2.2. Terms of Reference: Appendix 2

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

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

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

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

Group of Tephritidae (non-EU) such as:

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

(c) Viruses and virus-like organisms

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

- | | |
|----------------------------------|--|
| 1) Andean potato latent virus | 4) Potato black ringspot virus |
| 2) Andean potato mottle virus | 5) Potato virus T |
| 3) Arracacha virus B, oca strain | 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 | 8) Peach yellows mycoplasma |
| 2) Cherry rasp leaf virus (American) | 9) Plum line pattern virus (American) |
| 3) Peach mosaic virus (American) | 10) Raspberry leaf curl virus (American) |
| 4) Peach phony rickettsia | 11) Strawberry witches' broom mycoplasma |
| 5) Peach rosette mosaic virus | 12) Non-EU viruses and virus-like organisms of <i>Cydonia</i> Mill., <i>Fragaria</i> L., <i>Malus</i> Mill., <i>Prunus</i> L., <i>Pyrus</i> L., <i>Ribes</i> L., <i>Rubus</i> L. and <i>Vitis</i> L. |
| 6) Peach rosette mycoplasma | |
| 7) Peach X-disease mycoplasma | |

Annex IIAI

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

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

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

1.1.2.3. Terms of Reference: Appendix 3

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

Annex IAI

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

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

(b) Fungi

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

(c) Viruses and virus-like organisms

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

(d) Parasitic plants

Arceuthobium spp. (non-EU)

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

Meloidogyne fallax Karssen

Rhizoecus hibisci Kawai and Takagi

Popillia japonica Newman

(b) Bacteria

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

(c) Fungi

Melampsora medusae Thümen

Synchytrium endobioticum (Schilbersky) Percival

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

Leptinotarsa decemlineata Say

Liriomyza bryoniae (Kaltenbac

(b) Viruses and virus-like organisms

Beet necrotic yellow vein virus

1.2. Interpretation of the Terms of Reference

Anisogramma anomala 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 European Union (EU).

2. Data and methodologies**2.1. Data****2.1.1. Literature search**

A literature search on *A. anomala* was conducted at the beginning of the categorisation in the ISI Web of Science bibliographic database, using the scientific name of the pest as the search term. Relevant papers were reviewed, and further references and information were obtained from experts, from citations within the references and grey literature.

2.1.2. Database search

Pest information, on host(s) and distribution, was retrieved from the EPPO Global Database (EPPO, 2017) (<https://gd.eppo.int>).

Data about the area of hosts grown in the EU were obtained from EUROSTAT (<http://ec.europa.eu/eurostat/web/agriculture/data/database>).

Information on EU Member State (MS) imports of *Corylus* plants for planting from North America was sought in the ISEFOR database (Eschen et al., 2017).

The Europhyt database 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 MSs and the phytosanitary measures taken to eradicate or avoid their spread.

2.2. Methodologies

The Panel performed the pest categorisation for *A. anomala*, 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 started following an evaluation of the EU's 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 as per 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 which 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, while addressing social impacts is outside the remit of the Panel, in agreement with the 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 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?

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
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

Anisogramma anomala (Peck) E. Müll. is a fungus of the family Valsaceae (Mycobank: <http://www.mycobank.org>; Bush, 2015) order Diaporthales.

The fungus has the following synonyms: *Apioportha anomala*, *Cryptospora anomala*, *Cryptosporella anomala* and *Diatrype anomala* (Index Fungorum: <http://www.indexfungorum.org/names/names.asp>).

3.1.2. Biology of the pest

A. anomala is an obligate biotrophic fungus causing eastern filbert blight on cultivated common hazel, *Corylus avellana*, where 'filbert' is the commonly used term for commercial *C. avellana* in North America (EPPO, 2009). The fungus is a native and non-consequential pathogen on *Corylus americana* (American hazelnut), an understory tree in northeastern North America (Bush, 2015).

The fungus produces infectious ascospores in perithecia, which mature by late summer in ascostromata on diseased host branches (Gottwald and Cameron, 1979). Spore maturation begins in late summer, but the proportion of spores germinating increases through autumn (Pinkerton et al., 1998a). Ascospores are released when stromata are wet from rain but not from dew (Pinkerton et al., 1998b) and dispersal is triggered by precipitation (EPPO, 1997; Pinkerton et al., 1998a), with dissemination over long distances on air currents having been reported (Pinkerton et al., 1998a).

Although ascospore release can begin in late autumn (Pinkerton et al., 1998b), the major host, *C. avellana*, is not susceptible to infection until vegetative buds and shoots resume growth in the spring (Pinkerton et al., 1998a). It has been reported that eriophyid mites might facilitate infection of vegetative buds (Johnson et al., 1994). Infection occurs by means of ascospores infecting young vegetative tissue in the spring (Gottwald and Cameron, 1980b), after budburst, through leaf emergence and shoot elongation (Stone et al., 1992; Johnson et al., 1994). Once established, the fungus colonises the cambium layer resulting in the development of a canker (Gottwald and Cameron, 1980b). However, some 12–16 months are normal before symptoms appear in the disease cycle of *A. anomala* (Gottwald and Cameron, 1980b) and sometimes longer (up to 26–28 months) (Mehlenbacher et al., 1994). Death of the cambium in the area of the canker results in a sunken appearance as the surrounding cambium continues to grow (Gottwald and Cameron, 1980b).

Cankers expand at an average rate of 30 cm per year (Gottwald and Cameron, 1980a). Cankers girdle branches, causing dieback of tree canopies and death of mature trees in 5–15 years, while younger trees may be killed within 4–7 years (EPPO, 1997). New susceptible shoots may continue to develop from the root system.

3.1.3. Intraspecific diversity

Studies on the genetic diversity of *A. anomala* based on Single Sequence Repeats (SSR) markers revealed (i) distinct genetic differences between populations of genotypes collected from different regions and (ii) that tested isolates were more genetically diverse than initially hypothesised based on prior internal transcribed spacer region sequence studies (Muehlbauer et al., 2014). A preliminary study on 11 polymorphic SSR loci in 30 *A. anomala* genotypes revealed that genotypes grouped into two clades: one including genotypes from New Jersey and the other genotypes originating from areas surrounding the Great Lakes (Cai et al., 2013). Genotypes from Oregon clustered in this last clade (Cai et al., 2013).

3.1.4. Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes

A full description of *A. anomala* useful for diagnostic purposes is available (Gottwald and Cameron, 1979; EPPO, 2009). *A. anomala* can be grown in culture only with difficulty (Stone et al., 1994). A real-time polymerase chain reaction (PCR) assay for the early detection of the pathogen in asymptomatic host tissues was developed by Molnar et al. (2013).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

A. anomala is native to a wide area east of the Rocky Mountains, where it occurs on the wild American hazelnut, *C. americana* (Molnar et al., 2013). The fungus is currently reported from both Canada and USA, including areas in the Pacific Northwest (Figure 1).

In Canada, the fungus is present in British Columbia, Manitoba, Nova Scotia, Ontario and Quebec. In the USA, reports are from Connecticut, Delaware, Illinois, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Washington and Wisconsin (EPPO, 2017).

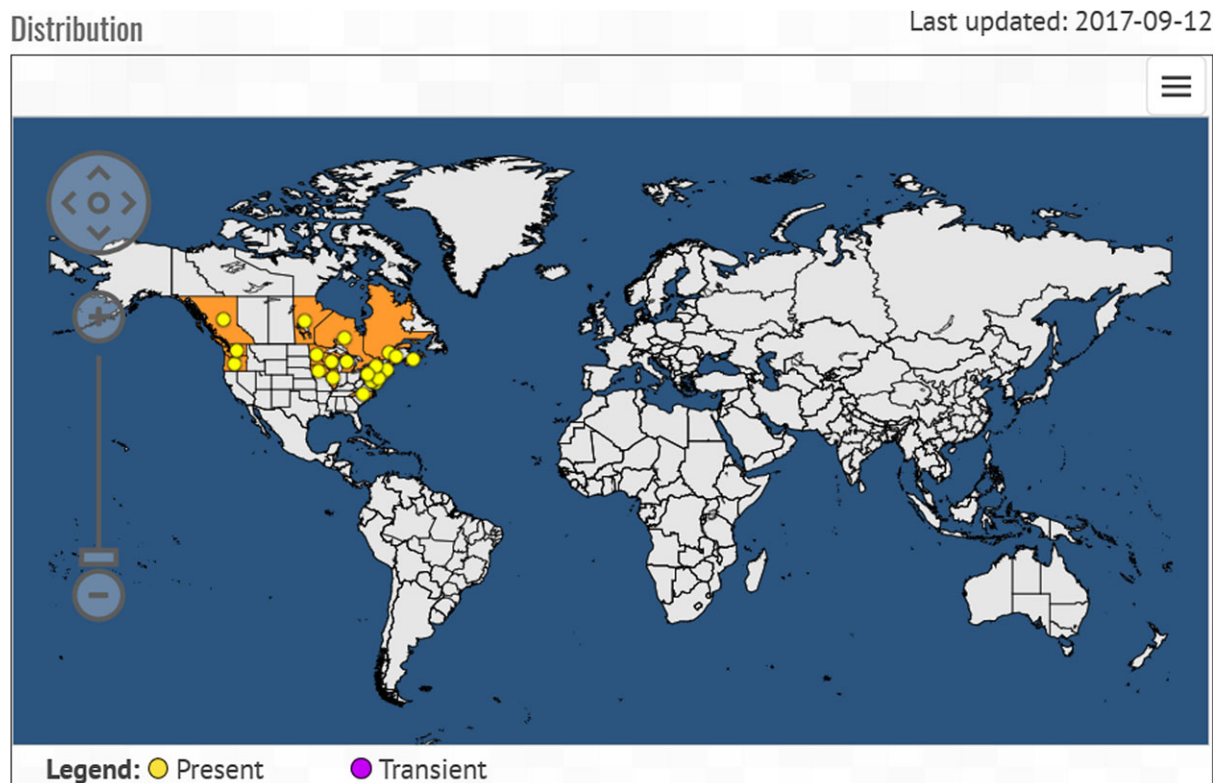


Figure 1: Global distribution map for *Anisogramma anomala* (extracted EPPO, 2017, accessed November 2017). There are no reports of transient populations

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, the pest is not reported to be present in the EU.

Slovenia reported the pest as absent in 2017 (EPPO, 2017).

3.3. Regulatory status

3.3.1. Council Directive 2000/29/EC

A. anomala is listed in Council Directive 2000/29/EC. Details are presented in Tables 2 and 3.

Table 2: *Anisogramma anomala* 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
1.1	<i>Anisogramma anomala</i> (Peck) E. Müller	Plants of <i>Corylus L.</i> , intended for planting, other than seeds, originating in Canada and the USA

3.3.2. Legislation addressing the hosts of *A. anomala*

Table 3: Regulated hosts and commodities that may involve *Anisogramma anomala* in Annexes III, IV and V of Council Directive 2000/29/EC

Annex IV, Part A	Special requirements which must be laid down by all Member States for the introduction and movement of plants, plant products and other objects into and within all Member States	
Section I	Plants, plant products and other objects originating outside the community	
	Plants, plant products and other objects	Special requirements
11.3	Plants of <i>Corylus</i> L., intended for planting, other than seeds, originating in Canada and the United States of America	Official statement that the plants have been grown in nurseries and: <ul style="list-style-type: none"> (a) originate in an area, established in the country of export by the national plant protection service in that country, as being free from <i>Anisogramma anomala</i> (Peck) E. Müller, in accordance with relevant International Standards for Phytosanitary Measures, and which is mentioned on the certificates referred to in Articles 7 or 8 of this Directive under the rubric 'Additional declaration', or (b) originate in a place of production, established in the country of export by the national plant protection service in that country, as being free from <i>Anisogramma anomala</i> (Peck) E. Müller on official inspections carried out at the place of production or its immediate vicinity since the beginning of the last three complete cycles of vegetation, in accordance with relevant International Standards for Phytosanitary Measures, and which is mentioned on the certificates referred to in Articles 7 or 8 of this Directive under the rubric 'Additional declaration' and declared free from <i>Anisogramma anomala</i> (Peck) E. Müller

3.4. Entry, establishment and spread in the EU

3.4.1. Host range

The fungus has been reported to be causing symptoms on various species of the genus *Corylus*. While *A. anomala* is indigenous on the common understorey shrub *C. americana* (EPPO, 1997), its major host is the cultivated hazel *C. avellana* (EPPO, 1997), which is native to Europe and adjacent areas in Asia (Martins et al., 2015). *C. maxima*, a species of hazel native to southeastern Europe and southwestern Asia, is also reported as a wild host (EPPO, 2017).

As the pathogen is regulated on plants of the genus *Corylus* (see Section 3.3), the hosts for which the pest is regulated are comprehensive of the host range. Wood and cut branches of *Corylus* spp. are not regulated but might provide a pathway of entry (see Entry Section 3.4.2).

3.4.2. Entry

Is the pest able to enter into the EU territory?

Yes, the pest could enter the EU through the movement of infected planting material

The introduction of the pathogen in western Washington (Davidson and Davidson, 1973) is thought to have occurred through the importation of infected *C. avellana* nursery stock or of wild *C. americana* seedlings from the Eastern regions of the USA (EPPO, 1997).

Therefore, the pathogen could enter the EU through the movement of:

- plants for planting.

In the ISEFOR database of plants for planting, there are some records of shipments of *Corylus* spp. plants for planting imported by the EU from the USA.

As of November 2017, there were no records of interception of *A. anomala* in the Europhyt database.

- Other pathways

Infected living wood of *Corylus* spp. can be a source of inoculum (in Oregon, infected wood in the affected area near Portland is burnt to prevent this from happening; Mehlenbacher et al., 1994). *A. anomala* is a biotrophic parasite and needs a living host to grow, but not necessarily to release ascospores (Heckert et al., 2014). The role of infected deadwood and cut branches as a potential pathway of entry is thus unclear. Information is lacking on EU import from North America of *Corylus* spp. cut branches for ornamental purposes (e.g. of the variety 'Contorta').

There is no evidence that the disease is a nut-borne disease, either in the kernel or as a surface contaminant (Mehlenbacher et al., 1994).

3.4.3. Establishment

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

Yes, the pest could establish in the EU, as hosts and favourable climatic conditions are widespread.

3.4.3.1. EU distribution of main host plants

The major host *C. avellana* is native to Europe and is widely distributed in the EU either as an understorey species in mixed deciduous forests or as a cultivated species, although its presence is mostly marginal (Figure 2).

According to EUROSTAT, about 94,000–96,000 ha of hazel were cultivated in the EU between 2012 and 2015. About 71–73% of this hazelnut crop area was located in Italy (between about 66,800 and 69,100 ha), and about 14–15% of it was located in Spain (between about 13,300 and 13,900 ha). Other EU MSs reporting significant (> 1,000 ha) hazelnut cultivation for the same period are Croatia, France and Poland, whereas Bulgaria, Greece, Hungary, Portugal, Romania and Slovenia reported cultivation areas smaller than 1,000 ha. Italy produces about 17% of the hazelnut crop worldwide (Molnar et al., 2010).

C. avellana is absent only in Iceland, in some Mediterranean islands (Cyprus, Malta and Balearics) and in the northernmost and southernmost areas of the continent (reviewed in: Enescu et al., 2016).

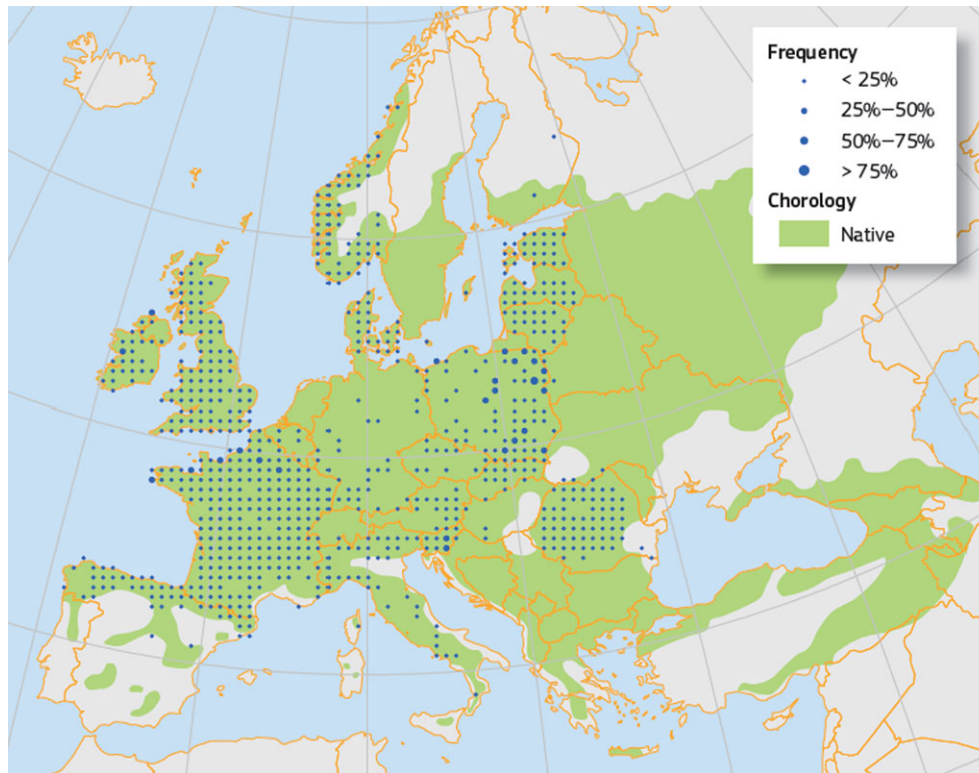


Figure 2: Plot distribution and simplified chorology map for *Corylus avellana*. Frequency of *C. avellana* occurrences within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *C. avellana* is derived from several sources (cited in Enescu et al., 2016)

3.4.3.2. Climatic conditions affecting establishment

The distribution of *A. anomala* in North America (Figure 1; Section 3.2.1) covers areas with cold and temperate Köppen–Geiger climate types (Peel et al., 2007). These climate types overlap to a large extent with the distributions of *C. avellana* in Europe. Therefore, the Panel assumes climate will not be a limiting factor for the establishment of the pathogen in most of the EU.

3.4.4. Spread

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

Yes, by human movement of infected plants for planting and by dissemination of ascospores.

Although dissemination of ascospores over long distances on air currents has been reported (Pinkerton et al., 1998a), spread usually occurs locally (Gottwald and Cameron, 1980a) by means of spores released through precipitation (EPPO, 1997; Pinkerton et al., 1998a). In Oregon, the annual rate of disease spread has been reported as 2–3 km per year (Johnson et al., 1996), assumed to be through ascospore dispersal.

Despite quarantine laws established in the early 1900s to prevent the introduction of the pathogen into the western United States (Molnar et al., 2010; Bush, 2015), movement of infected plants from New England (USA) is thought to have been responsible for the introduction of *A. anomala* in the Pacific northwest (EPPO, 1997) and to have contributed to the current population structure of the fungus in North America (Cai et al., 2013; Muehlbauer et al., 2014).

Infected trees of *Corylus* spp. can be a source of inoculum (ascospores are produced in stromata associated with cankers on living wood; Johnson et al., 1994), but there is evidence that also cankered deadwood, prunings and cut branches can produce ascospores and thus be a potential means of spread (Heckert et al., 2014).

As noted in the Entry Section 3.4.2, there is no evidence that the disease is nut-borne (Mehlenbacher et al., 1994), and therefore, movement of nuts would not contribute to spread.

3.5. Impacts

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

Yes, the pest introduction could have an impact, where the host is cultivated and in the wild.

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?⁴

Yes, the introduction of the pest could have an impact on the intended use of plants for planting.

A. anomala is responsible for canopy and yield loss (Figure 3) and can cause death of mature trees in 5–15 years with younger trees being killed within 4–7 years. As the canopy dies back, new shoots and suckers may emerge from the tree base and these in turn become infected and die.

A. anomala is considered to be the major limiting factor of hazelnut production in the eastern United States (Thompson et al., 1996). In fact, when *C. avellana* was introduced to North America and cultivation was attempted at the beginning of the 20th century, eastern filbert blight was identified and found to be so destructive that cultivation of European hazelnut was abandoned (Bush, 2015).

The pathogen was discovered in a commercial orchard in southwest Washington in the late 1960s (Davidson and Davidson, 1973). Most orchards within a 10-km radius of the putative introduction site of the disease are reported to have been destroyed (EPPO, 1997). Since then, the disease has spread southward throughout the Willamette Valley of Oregon where it threatens the long-term viability of the US hazelnut industry (Mehlenbacher et al., 1994; Mehlenbacher, 2005).

Should the pathogen be introduced into the EU, similar impacts can be expected not just on hazelnut as a nut crop (see Section 3.4.3.1 on the cultivated areas in the EU) but also in coppices and woodlands. However, wild hazel might be more resilient than cultivated hazel due to its higher genetic diversity, lower host density and variety of habitat conditions. *C. avellana* is commonly found in understorey of mixed-hardwood stands, along forest edges and in meadows and provides an important habitat and food resource for many organisms. *Corylus* plants are also a valued ornamental shrub often planted in gardens and parks (Enescu et al., 2016).

⁴ See Section 2.1 on what falls outside EFSA's remit.



Figure 3: Symptoms of *Anisogramma anomala* on ornamental *Corylus avellana*. Picture of Tom Creswell, Purdue University, Bugwood.org, available online at <https://www.forestryimages.org/browse/detail.cfm?imgnum=5505565>

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, please see Section 3.6.1.

3.6.1. Phytosanitary measures

Phytosanitary measures are currently applied to plants for planting of *Corylus* spp. other than seeds (see Section 3.3.2). However, wood and cut branches of *Corylus* spp. are not regulated, but might provide a pathway of entry (see Section 3.4.2). The following phytosanitary measures are available for them: import banning of the commodity, chemical and heat treatment.

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

- A 12–16 month latent period is deemed normal in the disease cycle of *A. anomala* (Gottwald and Cameron, 1980b)
- Use of fungicides in nurseries may mask symptom development
- Long-distance spread of the disease due to human movement of infected planting material will make local attempts to limit spread of the disease ineffective
- In Oregon, eradication was attempted but without success as wild *Corylus* plants in nearby woodland provided an unmanageable source of inoculum (EPPO, 1997).

3.6.1.2. Biological or technical factors limiting the ability to prevent the presence of the pest on plants for planting

- The length of the latent period makes sanitation measures, including destruction of infested wood, of little importance (EPPO, 1997)

3.6.2. Control methods

- In Oregon, scouting for cankers, therapeutic pruning and copious fungicide applications are reported to be necessary (but costly measures) to continue hazelnut production in the presence of the disease (Johnson et al., 1996).
- Breeding for resistance led to the selection and release of resistant cultivars producing nuts of commercial quality (Mehlenbacher et al., 2007, 2009, 2011; Capik et al., 2013).

3.7. Uncertainty

There is a lack of knowledge on the level of susceptibility of European *Corylus* species other than *C. avellana*, including *C. maxima*, for which there is uncertainty on the distribution in the EU.

Similarly, there is uncertainty about the susceptibility of *C. avellana* cultivars and of *Corylus* spp. in the wild in the EU, although European *Corylus* spp. germplasm has been used for resistance breeding programmes in the US (Capik et al., 2013).

Whether infected deadwood and cut branches could play a role in entry or spread is unknown.

4. Conclusions

A. anomala meets the criteria assessed by EFSA for consideration as a potential quarantine pest (Table 4).

Table 4: 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 as a species is clear	The identity of the pest as a species is clear	None
Absence/ presence of the pest in the EU territory (Section 3.2)	The pest is not reported to be present in the EU	The pest is not reported to be present in the EU	There are no records from EU MSs available to the Panel of the absence of the pathogen other than Slovenia in 2017
Regulatory status (Section 3.3)	<i>A. anomala</i> is regulated by Council Directive 2000/29/EC (Annex IIAI) on plants of <i>Corylus</i> L., intended for planting, other than seeds, originating in Canada and the USA	<i>A. anomala</i> is regulated by Council Directive 2000/29/EC (Annex IIAI) on plants of <i>Corylus</i> L., intended for planting, other than seeds, originating in Canada and the USA	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
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	<p>Entry: the pest could enter the EU via plants for planting</p> <p>Establishment: hosts and favourable climatic conditions are widespread in the risk assessment (RA) area</p> <p>Spread: the pest would be able to spread following establishment by movement of ascospores and infected plants for planting</p>	<p>Entry: the pest could enter the EU via plants for planting</p> <p>Establishment: hosts and favourable climatic conditions are widespread in the RA area</p> <p>Spread: the pest would be able to spread following establishment by movement of ascospores and infected plants for planting</p>	The role of infected deadwood and cut branches as a potential pathway of entry and means of spread is unclear
Potential for consequences in the EU territory (Section 3.5)	The pest introduction would have impacts on both cultivated and wild <i>Corylus</i> spp.	The pest introduction would have an impact on the intended use of <i>Corylus</i> spp. plants for planting	There is uncertainty about the susceptibility of <i>C. avellana</i> cultivars and of <i>Corylus</i> spp. in the wild in the EU
Available measures (Section 3.6)	Scouting for cankers, therapeutic pruning and copious fungicide applications are reported to be necessary (but costly measures) to continue hazelnut production in the presence of the disease. Breeding for resistant cultivars has been shown to be successful in limiting the impacts of the disease	Breeding for resistant cultivars has been shown to be successful in limiting the impacts of the disease on the intended use of plants for planting	The transferability of these measures from North America to the EU is uncertain
Conclusion on pest categorisation (Section 4)	The criteria assessed by the Panel for consideration as a potential quarantine pest are met	The criterion on the pest presence in the EU is not met	
Aspects of assessment to focus on/ scenarios to address in future if appropriate	The main knowledge gaps concern: (i) the role of deadwood and cut branches as potential pathways and (ii) the level of susceptibility of the <i>C. avellana</i> cultivars and of <i>Corylus</i> spp. in the wild in the EU		

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Abbreviations

EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization
IPPC	International Plant Protection Convention
MS	Member State
PCR	polymerase chain reaction
PLH	EFSA Panel on Plant Health
RA	risk assessment
RNQP	Regulated Non-Quarantine Pest
SSR	Single Sequence Repeats
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference