SCIENTIFIC OPINION

EFSA Journal

ADOPTED: 16 May 2018

doi: 10.2903/j.efsa.2018.5297

Pest categorisation of *Hirschmanniella* spp.

EFSA Panel on Plant Health (PLH),
Michael Jeger, Claude Bragard, David Caffier, Thierry Candresse, Elisavet Chatzivassiliou, Katharina Dehnen-Schmutz, Gianni Gilioli, Jean-Claude Grégoire, Josep Anton, Jaques Miret, Alan MacLeod, Maria Navajas Navarro, Stephen Parnell, Roel Potting, Trond Rafoss, Vittorio Rossi, Gregor Urek, Ariena Van Bruggen, Wopke Van der Werf, Jonathan West, Stephan Winter, Tomasz Kaluski and Björn Niere

Abstract

The Panel on Plant Health performed a pest categorisation of nematodes belonging to the genus *Hirschmanniella* (Nematoda: Pratylenchidae). Twenty-nine species in this genus have been considered of which five species are present in the EU (*Hirschmanniella behningi*, *Hirschmanniella gracilis*, *Hirschmanniella halophila*, *Hirschmanniella loofi* and *Hirschmanniella zostericola*). The whole genus except *H. gracilis* is regulated by Council Directive 2000/29/EC (Annex IAI). *Hirschmanniella* species are root endoparasites uniquely adapted to aquatic environments. Most species are reported from tropical regions. Monocotyledons including aquatic plants are main hosts and some *Hirschmanniella* species are important pests of rice. Plants for planting are potential pathways for entry. *Hirschmanniella* species are frequently intercepted on imported aquarium plants. Measures are available to avoid entry. Environmental conditions in greenhouses and potentially in rice production areas of the EU are suitable for establishment. The nematode may be spread with irrigation, tools or plants for planting. *Hirschmanniella* species were categorised into four groups. The first group includes species reported as pests of crop plants; those satisfy all the criteria that are within the remit of EFSA to assess to be regarded as Union quarantine pests. The second group includes species that are not reported to cause economic damage to crop plants; those species do not satisfy all the criteria to be regarded as Union quarantine pests. Uncertainty exists whether species in this group can cause damage once introduced into the EU. The third group includes species that are known to be present in the EU and do not cause damage; they do not satisfy the criteria to be regarded as Union quarantine pests or regulated non-quarantine pests. The fourth group consists of *H. gracilis* only. This worldwide occurring species is present in the EU where it does not cause economic damage. It does not satisfy all the criteria to be regarded as a Union quarantine pest.

Keywords: European Union, pest risk, plant health, plant pest, quarantine

Requestor: European Commission

Question number: EFSA-Q-2017-00377

Correspondence: alpha@efsa.europa.eu

Panel members: Claude Bragard, David Caffier, Thierry Candresse, Elisavet Chatzivassiliou, Katharina Dehnen-Schmutz, Gianni Gilioli, Jean-Claude Grégoire, Josep Anton Jaques Miret, Michael Jeger, Alan MacLeod, Maria Navajas Navarro, Björn Niere, Stephen Parnell, Roel Potting, Trond Rafoss, Vittorio Rossi, Gregor Urek, Ariena Van Bruggen, Wopke Van der Werf, Jonathan West and Stephan Winter.

Acknowledgements: The Panel wishes to acknowledge all European competent institutions, Member State bodies and other organisations that provided data for this scientific output.

Suggested citation: EFSA PLH Panel (EFSA Panel on Plant Health), Jeger M, Bragard C, Caffier D, Candresse T, Chatzivassiliou E, Dehnen-Schmutz K, Gilioli G, Grégoire J-C, Anton J, Miret J, MacLeod A, Navajas Navarro M, Parnell S, Potting R, Rafoss T, Rossi V, Urek G, Van Bruggen A, Van der Werf W, West J, Winter S, Kaluski T and Niere B, 2018. Scientific Opinion on the pest categorisation of *Hirschmanniella* spp.. EFSA Journal 2018;16(6):5297, 31 pp. https://doi.org/10.2903/j.efsa.2018.5297

ISSN: 1831-4732

The EFSA Journal is a publication of the European Food Safety Authority, an agency of the European Union.

Table of contents

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

Hirschmanniella spp., other than *Hirschmanniella gracilis* (de Man) Luc and Goodey, is 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) 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. For the purpose of this pest categorisation, the Panel considers the whole genus *Hirschmanniella* including *H. gracilis*.

2. Data and methodologies

2.1. Data

2.1.1. Literature search

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

2.1.2. Database search

Pest information, on host(s) and distribution, was retrieved from the European and Mediterranean Plan Protection Organization (EPPO) Global Database (EPPO) 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 was consulted for pest-specific notifications on interceptions and outbreaks. Europhyt is a web-based network run by the Directorate General for Health and Food Safety (DG SANTÉ) of the European Commission and is a subproject of PHYSAN (Phyto-Sanitary Controls) specifically concerned with plant health information. 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 *Hirschmanniella spp.*, following guiding principles and steps presented in the European Food Safety Authority (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 ToR 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)

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
Regulatory status (Section 3.3)	If the pest is present in the EU but not widely distributed in the risk assessment area, it should be under official control or expected to be under official control in the near future	The protected zone system aligns with the pest-free area system under the International Plant Protection Convention (IPPC) The pest satisfies the IPPC definition of a quarantine pest that is not present in the risk assessment area (i.e. protected zone)	Is the pest regulated as a quarantine pest? If currently regulated as a quarantine pest, are there grounds to consider its status could be revoked?
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	Is the pest able to enter into, become established in and spread within the EU territory? If yes, briefly list the pathways!	Is the pest able to enter into, become established in and spread within the protected zone areas? Is entry by natural spread from EU areas where the pest is present possible?	Is spread mainly via specific plants for planting, rather than via natural spread or via movement of plant products or other objects? Clearly state if plants for planting is the main pathway!
Potential for consequences in the EU territory (Section 3.5)	Would the pests' introduction have an economic or environmental impact on the EU territory?	Would the pests' introduction have an economic or environmental impact on the protected zone areas?	Does the presence of the pest on plants for planting have an economic impact, as regards the intended use of those plants for planting?
Available measures (Section 3.6)	Are there measures available to prevent the entry into, establishment within or spread of the pest within the EU such that the risk becomes mitigated?	Are there measures available to prevent the entry into, establishment within or spread of the pest within the protected zone areas such that the risk becomes mitigated? Is it possible to eradicate the pest in a restricted area within 24 months (or a period longer than 24 months where the biology of the organism so justifies) after the presence of the pest was confirmed in the protected zone?	Are there measures available to prevent pest presence on plants for planting such that the risk becomes mitigated?
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?

The genus *Hirschmanniella* is a valid genus. The genus contains several species some of which are important plant parasites.

Hirschmaniella Luc and Goodey, 1964, is a nematode genus in the family Pratylenchidae (Nematoda: Tylenchida) which contains several species which differ in biology and distribution. More than 30 species have been described (Siddiqi, 2000), but some species are now considered invalid (Sturhan and Hallmann, 2010; Khun et al., 2015). The previously described species *Hirschmaniella indica, Hirschmaniella dubia, Hirschmaniella magna, Hirschmaniella orycrena, Hirschmaniella ornata, Hirschmaniella kaverii* and *Hirschmaniella mangalorensis* are now considered synonyms of *Hirschmaniella mucronate* (Luc and Hunt, 2005; Khun et al., 2015); *Hirschmaniella appapilata, Hirschmaniella nana, Hirschmaniella exigua, Hirschmaniella exacta* and *Hirschmaniella abnormalis* are considered junior synonyms of *Hirschmanniella oryzae*; *Hirschmanniella asteromucronata* is considered a synonym of *Hirschmanniella loofi* (Khun et al., 2015). According to the most recent study carried out by Khun et al. (2015) on *Hirschmanniella*, the genus contains 29 species; these are listed in Table 2.

Table 2: List of *Hirschmanniella* species according to Khun et al. (2015)

Species	Economic damage reported
H. anchoryzae Ebsary & Anderson, 1982	No
H. areolata Ebsary & Anderson, 1982	No
H. behningi (Micoletzky, 1923) Luc & Goodey, 1964	No
H. belli Sher, 1968	No
H. brassicae Duan, Liu, Liu, zhao et al., 1996	No
H. caribbeana Van Den Berg & Queneherve, 2000	No
H. caudacrena Sher, 1968	No
H. diversa Sher, 1968	Yes
H. furcata Razjivin, Fernandez, Ortega & Quincosa, 1981	No
H. gracilis (de Man, 1880) Luc & Goodey, 1964	Yes (but not in EU)
H. halophila Sturhan and Hallmann, 2010	No
H. imamuri Sher, 1968	Yes
H. kwazuna Van den Berg, Subbotin, Handoo & Tiedt, 2009	No
H. loofi Sher, 1968	No
H. marina Sher, 1968	No
H. mexicana (Chitwood, 1961) Sher, 1968	No
H. microtyla Sher, 1968	No
H. miticausa Bridge, Mortimer & Jackson (1984)	Yes
H. mucronata (Das, 1960) Luc & Goodey (1964)	Yes
H. obesa Razjivin, Fernandez, Ortega & Quincosa, 1981	No
H. oryzae (van Breda de Haan, 1902) Luc & Goodey (1964)	Yes
H. pisquidensis Ebsary & Pharoahm 1982	No
H. pomponiensis Abdel-Rahman & Maggenti, 1987	No
H. santarosae Tandingan De Ley, Mundo-Ocampo, Yoder & De Ley (2007)	No
H. shamimi Ahmad, 1972	No
H. spinicaudata (Schuurmans Stekhoven, 1944) Luc & Goodey (1964)	Yes
H. thornei Sher, 1968	No

Species	Economic damage reported
H. truncata Razjivin, Fernandez, Ortega & Quincosa, 1981	No
H. zostericola (Allgen, 1924) Luc & Goodey (1964)	No

Further information can be found in Appendices A and B.

3.1.2. Biology of the pest

Hirschmanniella species are migratory endoparasites of roots. They have a stylet which allows the nematode to penetrate plant tissue. Generally, they are able to cause lesions in the root cortex (lesion nematodes).

Hirschmaniella species are adapted to an aquatic environment and some are marine species (Luc, 1987). This is rare among tylenchid nematodes (which may be generally controlled by flooding events). They have a worldwide distribution with many species found in tropical areas. Several species are important pests of rice (the 'rice root nematodes'). *H. oryzae, Hirschmaniella spinicaudata* (the type species) and *Hirschmaniella imamuri* are considered the three most important 'rice root nematode' species; they have been described from flooded rice or on weeds associated with rice (Bridge et al., 2005). It should be noted that many other species in the genus *Hirschmanniella* are not reported to cause damage to plants (see Table 2).

The description of the life cycle is mainly based on *H. oryzae*. Eggs of *H. oryzae* are deposited in the roots and hatching occurs a few days after oviposition. Life cycle length is variable, development from egg to adult takes about 1 month (Nemaplex, accessed 1.2.2018). The number of generations may vary and range from one to several generations. In Japan, two generations are commonly observed (Kuwahara and Iyatomi, 1970). Nematode population increases of up to 10-fold per generation were reported by Babatola and Bridge (1979).

Temperature requirements of the different species within this genus vary as expected for tropical species and those from temperate zones. Maung et al. (2013) found *H. oryzae* in fields with temperatures ranging from 20°C to 34°C (with an average of around 25°C). Apparently, the nematode can survive lower temperatures, but survival of tropical species is reduced at temperatures below 10°C (Babatola, 1981). Species present in the EU territory apparently have lower temperature requirements, but exact data are lacking.

Because of their lifestyle adapted to aquatic conditions, the nematodes are most common in moist soils such as paddy rice fields (Bridge et al., 2005) or marsh land (Sturhan and Hallmann, 2010). The nematodes may survive poorly in dry soils. However, *Hirschmanniella* species may also occur in (non-paddy) agricultural soils in Europe (Sturhan and Hallmann, 2010). They may survive for several weeks in roots (Ichinohe, 1988) or in soil (Bridge et al., 2005). Survival in roots is better than in soil except when the soil is dry (Fortuner and Merny, 1979). Weeds are also important as alternative hosts (Bridge et al., 2005).

3.1.3. Intraspecific diversity

The genus *Hirschmanniella* consists of 29 species (Khun et al., 2015) and large intraspecific morphological variation within species has been reported (Sturhan and Hallmann, 2010; Khun et al., 2015). However, when considering a whole genus, the question of intraspecific diversity (i.e. within one species) is less important than interspecific diversity.

3.1.4. Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, detection is possible using standard techniques in nematology and there are keys available for the identification to the genus level. Species can also be identified but identification is extremely difficult.

Nematodes can be detected by standard extraction techniques from plant (or soil) samples (e.g. EPPO PM 7/119). Identification to genus level is possible using identification keys (EPPO, 2009). Species identification is complicated by high variability of certain morphological and morphometric characters of some *Hirschmanniella* species. This complicates species identification, especially when only few specimens are available. Species identification is further complicated by the fact that species often occur in mixtures (Sturhan and Hallmann, 2010). Additionally, certain characters considered to

be of high relevance for diagnostics have been found unreliable by Sturhan and Hallmann (2010). Molecular methods for species identification have been proposed by Khun et al. (2015) but are lacking for routine diagnostics.

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

Hirschmanniella species are widespread mainly in tropical and subtropical areas (Asia, Africa, Americas, Oceania). Many of the 29 currently recognised *Hirschmanniella* species are associated with rice. Economically important *Hirschmanniella* species are listed in Table 3. The species *H. gracilis* has a worldwide distribution. *Hirschmanniella behningi* was reported from Russia (it also occurs in the EU); however, damage was not reported.

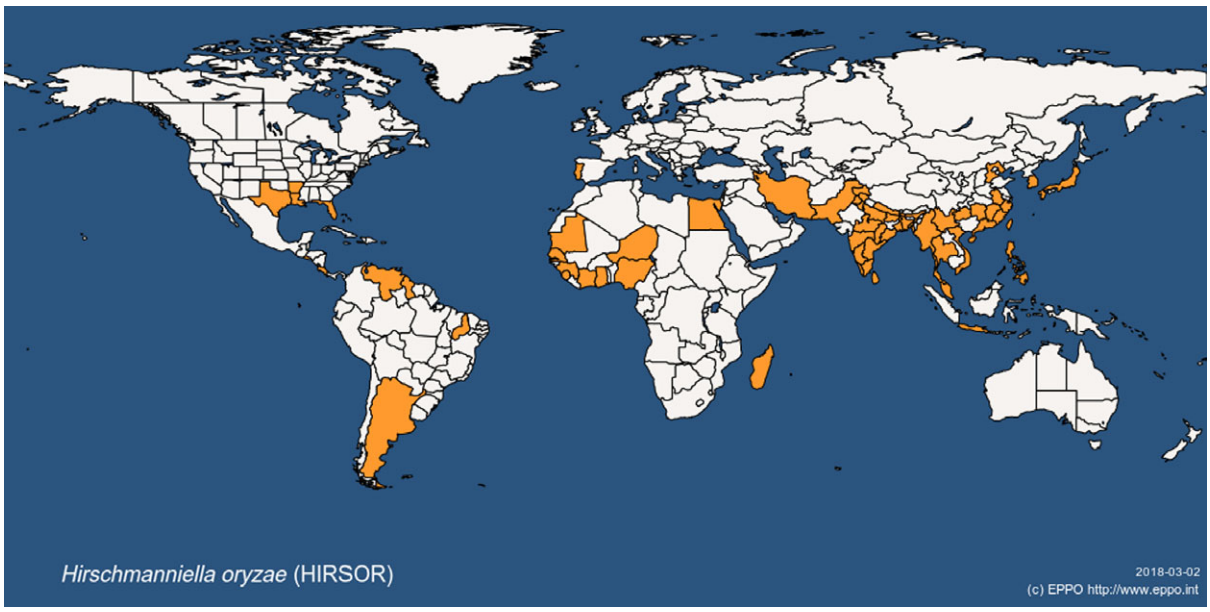
Table 3: Distribution of *Hirschmanniella* spp. which are considered to be of economic importance (EPPO GD, accessed on 7.2.2018; (Sher, 1968; Ahmad et al., 1984; Karim and Rahman, 1991; Loof, 1991; Chong Bin et al., 2001; Khun et al., 2015)

Continent	Country	State/region	*H. oryzae*	*H. gracilis*[(a)]	*H. spinicaudata*	*H. imamuri*	*H. mucronata*	*H. diversa*	*H. miticausa*
Africa	Benin				x				
	Burkina Faso				x				
	Cameroon				x				
	Congo				x				
	Cote d'Ivoire		x		x				
	Egypt		x						
	Gambia		x		x				
	Ghana		x		x				
	Guinea		x						
	Madagascar		x						
	Mauritania		x						
	Niger		x						
	Nigeria		x		x				
	Senegal		x		x				
	Sierra Leone		x						
	Togo				x				
	Zambia				x				
America	Argentina		x						
	Brazil		x		x				
	Canada			x					
	Costa Rica		x		x				
	Cuba				x				
	El Salvador		x						
	Guyana		x						
	USA	Arkansas	x						
	USA	California		x	x				
	USA	Florida	x						
	USA	Hawaii						x	x
	USA	Kansas		x					
	USA	Louisiana	x						

Continent	Country	State/region	*H. oryzae*	*H. gracilis*(a)	*H. spinicaudata*	*H. imamuri*	*H. mucronata*	*H. diversa*	*H. miticausa*
	USA	Ohio		x					
	USA	Texas	x	x					
	USA	Wyoming		x					
	USA	Wisconsis		x					
	Venezuela		x		x				
Asia	Bangladesh		x						
	Cambodia						x		
	China		x		x	x	x	x	
	India		x				x		
	Indonesia		x						
	Iran		x						
	Japan	Honshu, Kyushu	x			x			
	Korea, Republic		x						
	Malaysia		x				x		
	Myanmar		x						
	Nepal		x						
	Pakistan		x		x				
	Philippines		x				x		
	Singapore		x						
	Sri Lanka		x						
	Taiwan		x						
	Thailand		x				x		
	Vietnam		x					x	
Oceania	Solomon Islands								x
Europe (non EU)	Russia			x					

H. oryzae, *H. gracilis, H. spinicaudata, H. imamuri* and *H. mucronata* are pests of rice; *H. diversa* causes serious damage to Indian lotus; *H. miticausa* is a causal agent of corm rot of taro (miti-miti disease).
(a): *H. gracilis* is not regulated; the species has a worldwide distribution and is present in the EU.

The distribution of the most widely distributed rice root nematodes *H. oryzae* and *H. spinicaudata* is presented in Figures 1 and 2; see also Table 3.



Presence of *H. oryzae* in Portugal is dubious (see Section 3.2.2).

Figure 1: Global distribution map for *H. oryzae* (extracted from the EPPO Global Database accessed on 1.3.2018)

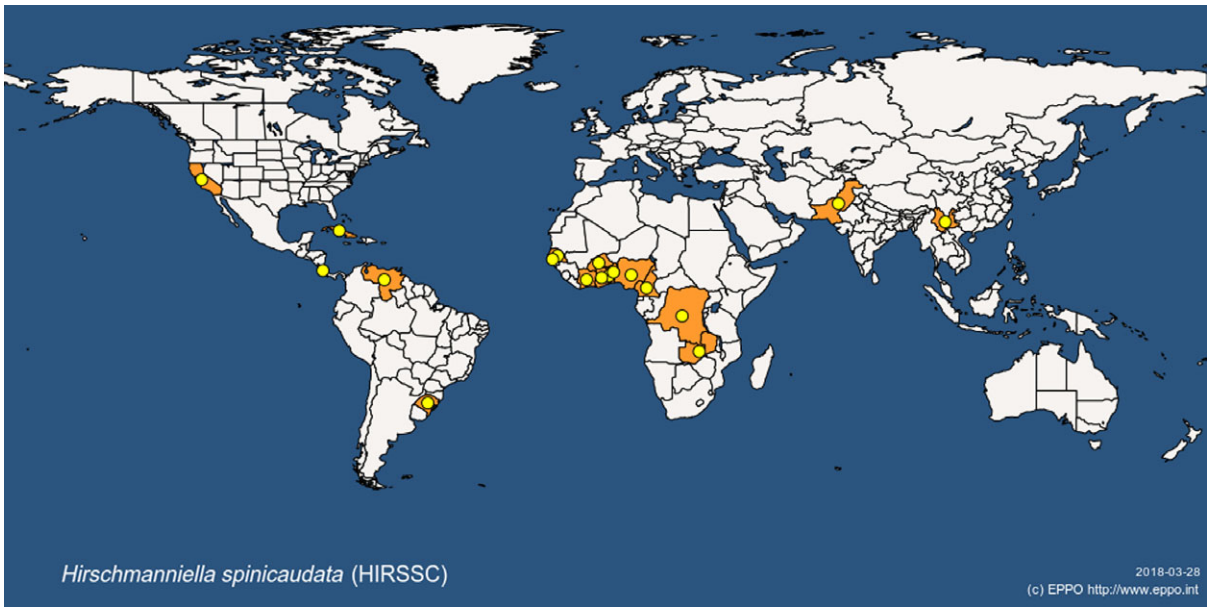


Figure 2: Global distribution map for *H. spinicaudata* (extracted from the EPPO Global Database accessed on 28.3.2018)

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?

Some *Hirschmanniella* species are reported from the EU but are not considered economically important. *H. oryzae*, the most important nematode threat to rice production has been reported from the EU (Portugal) only once; damage in the EU has not been reported.

Five *Hirschmanniella* species have been described in the EU so far (Table 4): *H. gracilis, H. loofi, H. behningi, H. zostericola* and *H. halophila* (Sturhan and Hallmann, 2010). *Hirschmanniella gracilis* is the most common species of this genus in the EU, and its presence was reported in Belgium, Czech Republic, Denmark, Estonia, Germany, Greece, Hungary, France, Romania, Slovak Republic, Spain and the Netherlands (Sturhan and Hallmann, 2010). Arable soils have also been found in some cases to harbour *H. gracilis* (Sturhan and Hallmann, 2010), and in one case, this species was reported to cause necrosis on roots of tall fescue, but no details on economic damage was given (Prior et al., 2010). This species is not regulated in the EU and has a worldwide distribution.

The other four species are less common and have a limited EU distribution. *H. behningi* was found in Sweden and Germany (and was also found in Russia); *H. loofi* was reported from the Netherlands, Belgium, Germany, Italy and Poland and *H. zostericola* and *H. halophila* were discovered only from Sweden and Germany, respectively (EPPO, 2009; Sturhan and Hallmann, 2010).

Table 4: List of *Hirschmanniella* species present in the EU

Species	Economic damage reported
H. behningi (Micoletzky, 1923) Luc & Goodey, 1964	No
H. gracilis (de Man, 1880) Luc & Goodey, 1964	Yes (but not in EU)
H. halophila Sturhan and Hallmann, 2010	No
H. loofi Sher, 1968	No
H. zostericola (Allgen, 1924) Luc & Goodey, 1964	No

In addition to the five aforementioned species, there are also records of interceptions of some other *Hirschmanniella* species, e.g. *H. caudacrena* was intercepted from aquarium plants in Belgium, Denmark, France, Germany and Poland (Ryss and Karnkowski, 2010; Sturhan and Hallmann, 2010).

A report on the presence of *H. oryzae* in rice fields in Portugal was published in 1990 (Reis, 1990). Following the finding of *H. oryzae* specimens in soil samples collected from a vineyard in 1980, investigations in rice fields were carried out in the period 1986–1988. This is the only information about the presence of this nematode in the EU. The presence was not officially confirmed by the NPPO of Portugal (Maria Cláudia Duarte de Araujo e Sá, 1.3.2018). Although *H. oryzae* was found in more than 50% of soil samples at that time (Reis, 1990), there are no reports of damage caused by this nematode in Portugal. Because the report is not confirmed by the NPPO, there are no other reports about the presence of *H. oryzae,* and no reports of damage to rice that could have been caused by this nematode in Portugal, there is uncertainty regarding the presence of *H. oryzae* in the EU.

3.3. Regulatory status

3.3.1. Council Directive 2000/29/EC

Hirschmanniella spp., other than *H. gracilis* (de Man) Luc and Goodey, is listed in Council Directive 2000/29/EC. Details are presented in Table 4.

Table 5: *Hirschmanniella* spp. in Council Directive 2000/29/EC

Annex I, Part A	**Harmful organisms whose introduction into, and spread within, all member states shall be banned**
Section I	**Harmful organisms not known to occur in any part of the community and relevant for the entire community**
(a)	Insects, mites and nematodes, at all stages of their development
	Species
11.1.	*Hirschmanniella* spp., other than *Hirschmanniella gracilis* (de Man) Luc and Goodey

A single species in the genus *Hirschmanniella*, *H. gracilis*; has been exempted from the EU regulation. This species is present in the EU but has also a worldwide distribution. Ahmad et al. (1984) reported damage to rice caused by *H. gracilis*.

3.4. Entry, establishment and spread in the EU

3.4.1. Host range

Some species of the genus *Hirschmanniella* present outside the EU have been reported to be important pests of rice (Panda and Rao, 1971; Babatola and Bridge, 1979) and other crops such as lotus (Koyama et al., 2013) and taro (Hodda et al., 2012). Some agricultural crops such as sugarcane, tomato and maize have also been reported to be hosts of *Hirschmanniella* spp. (Bridge, 2005)*;* see Table 3 and Appendix B.

There are also reports from bonsai plants (EPPO, 2009). Some *Hirschmanniella* species have been found associated with wild plants or weeds such as *Leptochloa fascicularis* and *Echinochloa colona* (Razjivin et al., 1981) or marine plants (*Diplanthera wrightii*) (Sher, 1968). However, many species within the genus have not been associated with damage to crop plants.

Hirschmanniella species are mostly recorded from wet or moist environments. Species of this genus present in the EU are associated with plant species in the family Poaceae; Cyperaceae species are also putative hosts. No economic damage has been reported for the *Hirschmanniella* species present in the EU and there are no indications that these nematode species are of any agricultural significance (Sturhan and Hallmann, 2010).

3.4.2. Entry

Is the pest able to enter into the EU territory? (Yes or No) If yes, identify and list the pathways!

Yes, the pest is able to enter into the EU territory on plants, particularly on aquatic plants.

The pest has been frequently intercepted on aquatic plants mostly from tropical countries. Until 25.1.2018, there were 175 records of interception of *Hirschmanniella* spp. in the EUROPHYT database.

Most of the interceptions reported in EUROPHYT (except two reports) specify the pest to genus level only (*Hirschmanniella* spp.). It is therefore possible that some of the interceptions include *H. gracilis* (which has a worldwide distribution); this species is not listed as a quarantine pest according to current EU legislation (2000/29/EC). Some *Hirschmanniella* species (including *H. gracilis*) are already present in the EU.

The reasons for generally reporting only the genus in EUROPHYT are not clear. This may be due to the above-mentioned difficulties in identification to species level. It may also be due to a misinterpretation of the legislation which only specifies the genus except *H. gracilis*. Because one species is excluded from regulation, species identification should be a requirement to ascertain that *H. gracilis* has not been the reason for interception.

3.4.3. Establishment

Is the pest able to become established in the EU territory? (Yes or No)

Yes, the pest is able to establish in the EU and some species of the genus are present in the EU.

The genus *Hirschmanniella* includes many species some of which are already present in the EU. The current legislation does not make a distinction between species that are present in the EU and which are probably endemic and those that are not present in the EU.

Most of the records of *Hirschmanniella* spp. refer to moist sites along or in water bodies, moist soils or sediments and some wet permanent pasture soils (Sturhan and Hallmann, 2010).

Species parasitising rice are expected to establish in rice production areas in the EU. Nematodes from tropical areas, however, will not thrive in temperatures below 10°C (Babatola, 1981) but a small proportion of nematodes may survive for 1 week at −2°C (Mathur and Prasad, 1973).

3.4.3.1. EU distribution of main host plants

Distribution of host plants depends on the species considered. Host plants of *Hirschmanniella* species present in the EU are present throughout the EU. Rice (*Oryza sativa*) affected by the 'rice nematodes' of *Hirschmanniella* is grown in some parts of the EU (Table 6).

Table 6: EU area of rice production 2012–2017 (thousands of hectares). Only EU MS where rice is produced are reported

	2012	2013	2014	2015	2016	2017
EU 28	455.60	432.94	432.27	440.58	448.80	No data
Bulgaria	9.90	10.21	11.04	12.41	11.99	11.00
Greece	30.21	29.10	30.72	32.33	35.14	36.56
Spain	112.82	112.15	110.42	109.29	109.27	107.93
France	22.18	20.71	16.68	16.17	16.78	16.66
Italy	235.05	216.02	219.53	227.33	234.13	229.55
Hungary	2.96	2.64	2.40	2.80	2.91	2.76
Portugal	31.17	30.18	28.75	29.14	29.15	27.69
Romania	11.30	11.93	12.72	11.11	9.44	8.75

3.4.3.2. Climatic conditions affecting establishment

Since some of the species within the genus *Hirschmanniella* (*H. behningi*, *H. gracilis*, *H. halophila*, *H. loofi* and *H. zostericola*) are already present in the EU, climatic conditions are considered suitable for those species. For the tropical *Hirschmanniella* species (e.g. *H. oryzae*), climatic conditions are expected to be suitable in the warmer regions of the EU. However, the temperature requirements for most of the 29 species are not precisely known and hence lead to uncertainty.

Hirschmanniella spp. can establish in greenhouses for the production of several crops, e.g. tomato, and may also establish in aquaponic systems due to their unique lifestyle adapted to aquatic conditions. Aquaponic production is increasing in the EU (Villarroel et al., 2016). Whether *Hirschmanniella* spp. infestations in aquaponics production will lead to economic damage in the future is uncertain but needs to be considered.

3.4.4. Spread

Is the pest able to spread within the EU territory following establishment? (Yes or No) How?

Yes, the pest is able to spread within the EU territory on plants, particularly on aquatic plants, and soil. Water (irrigation and flooding in rice production) helps to disseminate the nematodes within fields.

Spread is mainly human assisted but plants for planting are not the main means of spread. The nematodes are spread with irrigation water and soil attached to tools, shoes and machinery as well as rice seedlings (Bridge et al., 2005).

3.5. Impacts

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

Yes, some species of the genus *Hirschmanniella* can affect the production of rice.

Hirschmanniella species are primarily associated with moist habitats including fresh and marine waters and swamps. They are migratory endoparasites infesting the roots, corms and rhizomes of numerous host plants including aquatic plants, rice field weeds and a few crops such as rice (major host crop), maize, sugarcane and tomato (Bridge et al., 2005).

Several *Hirschmanniella* species were reported in association with rice, of which only few of them may cause significant yield losses and are considered to be of economic importance for rice: *H. oryzae, H. gracilis, H. imamuri, H. mucronata* and *H. spinicaudata*. Among them, the most important is *H. oryzae* which can cause damage to rice plants and is considered as a key pest of rice in Far East and tropical countries (Bohra and Sultana, 2013). Symptoms of *Hirschmanniella* spp. attack on rice are expressed as inhibiting growth, stunting, chlorosis and reduced tillering and finally as a reduction of grain yield (Babatola and Bridge, 1979; Prot, 1992). The damage is most evident in soils with poor nutrient content, but it also depends on many other factors including tolerance of cultivated rice cultivars (Whitehead, 1998). Yield reduction of rice in Asia and West Africa due to parasitisation of *Hirschmanniella* spp. is estimated in the range of up to 35% (Prot, 1992).

Two *Hirschmanniella* species, *H. imamuri* and *H. diversa*, are known to cause serious damage to Indian lotus *Nelumbo nucifera* and are considered a major nematode threat to lotus production in Tokushima prefecture, Japan (Koyama et al., 2013).

Hirschmanniella miticausa is a causal agent of corm rot disease of taro (*Colocasia esculenta*) also known as miti-miti disease (Bridge et al., 1983). Symptoms of the disease are expressed as wilting, chlorosis and at heavy infestations also as plant death due to decaying of corm due to brown soft rot (Bridge et al., 1983).

H. gracilis was reported to reduce rice yields in India between 12% and 19% by Ahmad et al. (1984). Sturhan and Hallmann (2010) found *H. gracilis* in arable soils a few times in Germany, but they state that the nematode does not cause damage to crop plants. However, Prior et al. (2010) reported necrosis and stunting of tall fescue (*Festuca arundinacea* Schreb.) but not details on economic damage was provided.

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, prohibition of import of soil and growing media and plants for planting with soil attached from areas where the nematodes are present would prevent introduction of *Hirschmanniella* spp. into and spread within the PRA area.

3.6.1. Phytosanitary measures

- Phytosanitary certificate for which a general plant health inspection must be done prior to export, which is generally based on sampling,
- Pest-free production site, inspection and testing and soil treatment,
- Prohibition of import of all host plants for planting and aquatic plants.

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

- Detection and identification – symptoms caused by *Hirschmanniella* spp. may be confused with symptoms of nutrient deficiency or other pathogenic organisms; the presence of the nematodes can therefore be overlooked and the introduction of *Hirschmanniella* spp. into the PRA area can remain undetected.
- Only few species of the genus *Hirschmanniella* are economically important and appropriate species identification is important. Identification of *Hirschmanniella* spp. is extremely difficult due to huge intraspecific morphological variation (Sturhan and Hallmann, 2010) and can only be carried out by trained personnel. No molecular tools for species identification are available so far. Appropriate identification procedures may indirectly affect the effectiveness of measures to prevent the entry, establishment and spread of *Hirschmanniella* spp.

3.6.2. Pest control methods

- Cultural control: Crop rotation is an important control strategy for this nematode. In areas where rice is not grown in the dry season, the inclusion of non-host dry season crops such as soybean, millet, onion, sorghum and cotton in crop rotation has suppressive effect on *Hirschmanniella* spp. populations (Prot and Rahman, 1994). A relatively good control effect can be achieved by trap cropping (*Aeschynomene afrasperma, Sesbania rostrata, Sphenoclea zeylanica*) and by incorporation of organic amendments such as castor (*Ricinus communis*) or neem (*Azadirachta indica*) into paddy soil (Prot, 1992; Prot and Rahman, 1994). Some rice cultivars show a certain degree of resistance to *Hirschmanniella* spp., but only one, TKM9 has been reported to be truly resistant to *H. oryzae* from India (Prot, 1992). Management of weeds, which are hosts of *Hirschmanniella* spp., will decrease nematode population. Fallowing the land (at least 12 months in wet and even longer in dry conditions) might be effective in reducing population of *Hirschmanniella* spp.
- Biological control: Sulfate-reducing bacteria (*Desulfovibrio* sp.) have been reported to reduce *Hirschmanniella* spp. Populations (Jacq and Fortuner, 1979).
- Chemical control: Use of nematicides can significantly reduce the population of *Hirschmanniella* spp. and increase yields of rice (Prot, 1992).

3.7. Uncertainty

- Identification of species within the genus *Hirschmanniella* is extremely difficult and often only the nematode genus is indicated in, e.g. interception reports. Therefore, uncertainty regarding number and identity of nematode species intercepted exists.
- Host preference of *Hirschmanniella* spp. is mostly unknown. It is therefore unclear which nematode species are associated with certain plant species. This also applies to aquatic plants on which the nematodes are frequently intercepted.
- There is uncertainty regarding the presence of *Hirschmanniella oryzae* in Portugal. The species was reported once from Portugal, but the presence of the pest has not been confirmed by the NPPO of Portugal.
- Uncertainty exists regarding pathogenicity and damage potential of the nematode species not known to be present in the EU. This concerns species not known to cause damage. For those species transfer of the nematodes to new environments might lead to changes in pathogenicity and damage potential of the pest. On the contrary, pests of rice (the 'rice root nematode') may not cause as much damage in the EU as in their area of origin.

4. Conclusions

Four groups of species within the genus *Hirschmanniella* were considered for the purpose of this pest categorisation.

The first group includes all the species that are reported to be pests of crop plants and are not present in the EU (Table 7). This group includes *H. diversa*, *H. imamuri*, *H. miticausa*; *H. mucronata*, *H. oryzae* and *H. spinicaudata*. Those species satisfy all the criteria that are within the remit of EFSA to assess to be regarded as Union quarantine pests.

The second group includes species that are not reported to cause damage to crop plants (Table 8). This group includes *H. anchoryzae*, *H. areolata*; *H. belli*, *H. brassicae*, *H. caribbeana*, *H. caudacrena*, *H. furcata*, *H. kwazuna*, *H. marina*, *H. mexicana*, *H. microtyla*, *H. obesa*, *H. pisquidensis*, *H. pomponiensis*; *H. santarosae*, *H. shamimi*, *H. thornei* and *H. truncata*. Those species do not satisfy all the criteria to be regarded as Union quarantine pests. Uncertainty exists whether species in this group can cause damage once introduced into the EU.

The third group includes all the species that are present in the EU (Table 9) excluding *H. gracilis*. This group includes *H. behningi*, *H. halophila*, *H. loofi* and *H. zostericola*. Those species are not reported to cause damage to crop plants in the EU. Those species do not satisfy the criteria that are within the remit of EFSA to assess to be regarded as Union quarantine pests or regulated non-quarantine pests.

The fourth group consists of *H. gracilis* only (Table 10). This species is not regulated according to 2000/29/EC. It is present in the EU but also has a worldwide distribution. The species is not known to cause economic damage in the EU to plants (but lesions and stunting of plants have been observed by Prior et al. (2010) but has been reported as a pest of rice outside the EU. No indications for differences in pathogenicity among populations of this species have been found. Influence of environmental conditions affecting pathogenicity may be suspected, but no data was found.

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) for *Hirschmanniella* species reported to cause economic damage outside the EU (*H. diversa*, *H. imamuri*, *H. miticausa*, *H. mucronata*, *H. oryzae* and *H. spinicaudata*)

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)	Yes the identities of *Hirschmanniella diversa, H. imamuri, H. miticausa; H. mucronata, H. oryzae and H. spinicaudata* are established	Yes the identities of *Hirschmanniella diversa, H. imamuri, H. miticausa; H. mucronata, H. oryzae and H. spinicaudata* are established	Identification is only possible for experienced nematologists. Molecular methods are not available for routine diagnostics

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
Absence/ presence of the pest in the EU territory (Section 3.2)	No, the pests are not present in the EU	No, the pests are not present in the EU	*Hirschmanniella oryzae* has been reported once from Portugal, but the presence of the pest is not confirmed by the NPPO
Regulatory status (Section 3.3)	*Hirschmanniella* spp. other than *H. gracilis*. are currently regulated by Council Directive 2000/29/EC as harmful organisms whose introduction into and spread within all member states shall be banned	*Hirschmanniella* spp. other than *H. gracilis* are currently regulated by Council Directive 2000/29/EC as harmful organisms whose introduction into and spread within all member states shall be banned	Reporting during inspection is usually only at genus level which is not sufficient because *H. gracilis* is not regulated. Identification to species level is required but difficult. It is not clear how many times *H. gracilis* is intercepted (when *Hirschmanniella* spp. is reported)
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	*Hirschmanniella diversa, H. imamuri, H. miticausa; H. mucronata, H. oryzae* and *H. spinicaudata* are able to enter and spread with plants (in particular aquatic plants), soil, soil attached to plants for planting or to machinery, tools etc. Spread occurs with irrigation water and flooding events. The pest survives under wet conditions suitable for rice production	*Hirschmanniella diversa, H. imamuri, H. miticausa; H. mucronata, H. oryzae and H. spinicaudata* are able to enter and spread with plants but plants for planting are not the main pathway	No uncertainties
Potential for consequences in the EU territory (Section 3.5)	*Hirschmanniella diversa, H. imamuri, H. miticausa; H. mucronata, H. oryzae* and *H. spinicaudata* would potentially have an economic impact on rice production in the EU	The presence of the pest on plants for planting would have an economic impact	The extent of damage caused by nematodes to plants in the EU is not clear at present. Environmental conditions may influence the damage potential in the EU New production systems such as aquaponics may also be affected
Available measures (Section 3.6)	Measures are available to inhibit entry via traded commodities (e.g. prohibition on the importation of host plants for planting, soil and the introduction of plants for planting with soil or growing media attached)	Pest-free area and pest free places/sites of production reduce the risk of the pest being present on plants for planting	No uncertainties
Conclusion on pest categorisation (Section 4)	*Hirschmanniella diversa, H. imamuri, H. miticausa, H. mucronata, H. oryzae* and *H. spinicaudata* do satisfy all the criteria that are within the remit of EFSA to assess to be regarded as a Union quarantine pest	*Hirschmanniella diversa, H. imamuri, H. miticausa, H. mucronata, H. oryzae* and *H. spinicaudata* do not meet the criteria of (a) occurring in the EU territory, and (b) plants for planting being the only means of spread	The presence of *H. oryzae* in the EU (Portugal) and the fact that no damage was reported

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	Routine identification methods (molecular tools) are needed		

Table 8: 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) for non-EU *Hirschmanniella* species not reported to cause economic damage (*H. anchoryzae*, *H. areolata*, *H. belli*, *H. brassicae*, *H. caribbeana*, *H. caudacrena*, *H. furcata*, *H. kwazuna*, *H. marina*, *H. mexicana*, *H. microtyla*, *H. obesa*, *H. pisquidensis*, *H. pomponiensis*, *H. santarosae*, *H. shamimi*, *H. thornei* and *H. truncata*)

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)	Yes, the identities of above-mentioned species are established	Yes, the identities of above-mentioned species are established	Identification is only possible for experienced nematologists. Molecular methods are not available for routine diagnostics
Absence/ presence of the pest in the EU territory (Section 3.2)	No, above-mentioned pests are not present in the EU	No, the pests are not present in the EU	No uncertainties
Regulatory status (Section 3.3)	*Hirschmanniella* spp. other than *H gracilis* are currently regulated by Council Directive 2000/29/EC as harmful organisms whose introduction into and spread within all member states shall be banned	*Hirschmanniella* spp. other than *H. gracilis* are currently regulated by Council Directive 2000/29/EC as harmful organisms whose introduction into and spread within all member states shall be banned	Reporting during inspection is usually only at genus level which is not sufficient because *H. gracilis* is not regulated. Identification to species level is required but difficult. It is not clear how many times *H. gracilis* is intercepted
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	Species mentioned above are able to enter and spread with plants (in particular aquatic plants), soil, soil attached to plants for planting or to machinery, tools etc. Spread occurs with irrigation water and flooding events. The pest survives under wet conditions suitable for rice production	Species mentioned above are able to enter and spread with plants but plants are not the only pathway	No uncertainties

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
Potential for consequences in the EU territory (Section 3.5)	Species mentioned above are not reported to cause economic damage therefore no impact is expected	The presence of the pest on plants for planting is not reported to cause economic damage; therefore, no impact is expected	Transfer of the nematodes to new environments (EU) might lead to changes in pathogenicity and damage potential of the pest New production systems such as aquaponics may also be affected
Available measures (Section 3.6)	Measures are available to inhibit entry via traded commodities (e.g. prohibition on the importation of host plants for planting, soil and the introduction of plants for planting with soil or growing media attached)	Pest-free area and pest-free places/sites of production reduce the risk of the pest being present on plants for planting	No uncertainties
Conclusion on pest categorisation (Section 4)	Species mentioned above do not satisfy all the criteria that are within the remit of EFSA to assess to be regarded as a Union quarantine pest. The species are not known to cause economic or environmental damage	Species mentioned above do not meet the criteria of (a) occurring in the EU territory, and (b) plants for planting being the only means of spread	Pathogenicity and damage potential of the nematodes species in the EU are not known
Aspects of assessment to focus on/ scenarios to address in future if appropriate	Routine identification methods (molecular tools) are needed		

Table 9: 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) for EU *Hirschmanniella* species not reported to cause economic damage (*H. behningi*, *H. halophila*, *H. loofi* and *H. zostericola*)

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)	Yes, the identities of *H. behningi*, *H. halophila*, *H. loofi* and *H. zostericola* are established	Yes, the identities of *H. behningi*, *H. halophila*, *H. loofi* and *H. zostericola* are established	Identification is only possible for experienced nematologists. Molecular methods are not available for routine diagnostics
Absence/ presence of the pest in the EU territory (Section 3.2)	Yes, *H. behningi*, *H. halophila*, *H. loofi* and *H. zostericola* are present in the EU	Yes, *H. behningi*, *H. halophila*, *H. loofi* and *H. zostericola* are present in the EU	No uncertainties

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
Regulatory status (Section 3.3)	*Hirschmanniella* spp. other than *H. gracilis* are currently regulated by Council Directive 2000/29/EC as a harmful organisms whose introduction into and spread within all member states shall be banned	*Hirschmanniella* spp. other than *H. gracilis* are currently regulated by Council Directive 2000/29/EC as a harmful organisms whose introduction into and spread within all member states shall be banned	Reporting during inspection is usually only at genus level which is not sufficient because *H. gracilis* is not regulated. Identification to species level is required but difficult. It is not clear how many times *H. gracilis* is intercepted
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	*H. behningi*, *H. halophila*, *H. loofi* and *H. zostericola* are present in the EU	*H. behningi*, *H. halophila*, *H. loofi* and *H. zostericola* are present in the EU	No uncertainties
Potential for consequences in the EU territory (Section 3.5)	*H. behningi*, *H. halophila*, *H. loofi* and *H. zostericola* are mostly associated with plants of no commercial value (except moist pastures). They are not reported to cause economic damage in the EU	*H. behningi*, *H. halophila*, *H. loofi* and *H. zostericola* are not reported to cause economic damage in the EU	No uncertainties
Available measures (Section 3.6)	Not relevant	Not relevant	No uncertainties
Conclusion on pest categorisation (Section 4)	*H. behningi*, *H. halophila*, *H. loofi* and *H. zostericola* do not satisfy the criteria that are within the remit of EFSA to assess to be regarded as a Union quarantine pest. The species are present in the EU and are not known to cause economic or environmental damage	*H. behningi*, *H. halophila*, *H. loofi* and *H. zostericola* do not meet the criterion of plants for planting being the only means of spread	No uncertainties
Aspects of assessment to focus on/ scenarios to address in future if appropriate	Routine identification methods (molecular tools) are needed		

Table 10: The Panel's conclusions on the pest categorisation criteria defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column) for *Hirschmanniella gracilis*

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)	Yes, the identity *Hirschmanniella gracilis* is established	Yes, the identity *Hirschmanniella gracilis* is established	Identification is only possible for experienced nematologists. Molecular methods are not available for routine diagnostics
Absence/ presence of the pest in the EU territory (Section 3.2)	Yes, the pest is present in the EU	Yes, the pest is present in the EU	No uncertainties
Regulatory status (Section 3.3)	*Hirschmanniella* spp. other than *H. gracilis* are currently regulated by Council Directive 2000/29/EC as harmful organisms whose introduction into and spread within all member states shall be banned	*Hirschmanniella* spp. other than *H. gracilis* are currently regulated by Council Directive 2000/29/EC as harmful organisms whose introduction into and spread within all member states shall be banned	
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	*Hirschmanniella gracilis* is already present in the EU and is also able to enter and spread with plants (in particular aquatic plants), soil, soil attached to plants for planting or to machinery, tools etc. Spread occurs with irrigation water and flooding events. The pest survives under wet conditions	*Hirschmanniella gracilis* is already present in the EU and is also able to enter and spread with plants for planting, but plants for planting are not the main pathway	No uncertainties
Potential for consequences in the EU territory (Section 3.5)	*Hirschmanniella gracilis* populations present in the EU have not been reported to cause economic damage. Root necrosis and stunting have been reported on tall fescue However, *H. gracilis* populations outside the EU have been reported to cause damage on rice	The presence of the pest on plants for planting is not reported to cause economic damage	The extent of damage caused by *H. gracilis* populations from outside the EU to plants in the EU is not clear at present. Environmental conditions may influence the damage potential in the EU Morphological variability is enormous, and therefore, species identification is difficult. This may lead to misidentification of the organism causing damage

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
Available measures (Section 3.6)	No measures are available for populations that are already present in EU Measures to inhibit entry via traded commodities are available for non-EU populations (e.g. prohibition on the importation of host plants for planting, soil and the introduction of plants for planting with soil or growing media attached). Currently, H. gracilis is not regulated	Not relevant for EU populations	No uncertainties
Conclusion on pest categorisation (Section 4)	*Hirschmanniella gracilis* does not satisfy all the criteria that are within the remit of EFSA to assess to be regarded as a Union quarantine pest because it is already present in the EU and is not known to cause economic damage in the EU	*Hirschmanniella gracilis* does not meet the criteria of plants for planting being the main means of spread	
Aspects of assessment to focus on/ scenarios to address in future if appropriate	Routine identification methods (molecular tools) are needed		

References

Abdel-Rahman F and Maggenti AR, 1987. *Hirschmanniella pomponiensis* n. sp. (Nemata: Pratylenchidae), parasitic on bulrush, *Scirpus robustus* Pursh. Journal of Nematology, 19, 147–151.

Ahmad N, Das PK and Baqri QH, 1984. Evaluation of yield losses in rice due to *Hirschmanniella gracilis* (de Man, 1880) Luc & Goodey, 1963 (Tylenchida: Nematoda) at Hooghly (West Bengal). Bulletin of the Zoological Survey of India, 5, 85–91.

Babatola JO, 1981. Effect of pH, oxygen and temperature on the activity and survival of *Hirschmanniella* spp. Nematologica, 27, 285–291.

Babatola JO and Bridge J, 1979. Pathogenicity of *Hirschmanniella oryzae, H. spinicaudata,* and *H. imamuri* on rice. Journal of Nematology, 11, 128–132.

Bert W and Geraert E, 2000. Nematode species of the order Tylenchida, new to the Belgian Nematofauna with additional morphological data. Belgian Journal of Zoology, 130, 47–57.

Bohra P and Sultana R, 2013. Plant and soil nematodes. In: Bohra P (ed.). Zoological Survey of India, Kumbhalgarh Wildlife Sanctuary, Conservation Area Series. pp. 7–29.

Bridge J, Mortimer JJ and Jackson VH, 1983. *Hirschmanniella miticausa* n. sp. (Nematoda: Pratylenchidae) and its pathogenicity on taro (*Colocasia esculenta*). Revue de Nematologie, 6, 285–290.

Bridge J, Plowright RA and Peng D, 2005. Nematode parasites of rice. In: Luc M, Sikora RA, Bridge J (eds.). Plant parasitic nematodes in subtropical and tropical agriculture, 2nd Edition. CABI Publishing, Wallingford, Oxfordshire, England. pp. 87–130.

Chaturvedi Y and Khera S, 1979. Studies on taxonomy, biology and ecology of nematodes associated with jute crop. 105 pp.

Chong Bin L, Qi YuH, Ke Qiang X and Shun Qin M, 2001. Incidence of *Hirschmanniella diversa* in Nelumbo nucifera Gaertn and its infection pattern. Plant Protection, 27, 26–27.

Duan Y, Liu W, Liu Y and Zhao H, 1996. A New Species of *Hirschmanniella* (Pratylenchidae) associated with the Breassicae (*Brassica oleracea* var. capitata). Journal of Shengyang Agricultural University, 1.

Ebrahim P, Geraert E and Azizollah A, 2000. Some pratylenchids from Iran (Nematoda: Tylenchina). Nematology, 2, 855–869.

Ebsary BA and Anderson RV, 1982. Two new species of *Hirschmanniella* Luc and Goodey, 1963 (Nematoda: Pratylenchidae) with a key to the nominal species. Canadian Journal of Zoology, 60, 530–535.
EFSA PLH Panel (EFSA Panel on Plant Health), 2010. PLH Guidance on a harmonised framework for pest risk assessment and the identification and evaluation of pest risk management options by EFSA. EFSA Journal 2010;8(2):1495, 66 pp. https://doi.org/10.2903/j.efsa.2010.1495
EPPO (European and Mediterranean Plant Protection Organization), 2009. *Hirshmanniella* spp. OEPP/EPPO Bulletin, 39, 369–375.
EPPO (European and Mediterranean Plant Protection Organization), online. EPPO Global Database. Available online: https://gd.eppo.int
FAO (Food and Agriculture Organization of the United Nations), 2004. ISPM (International Standards for Phytosanitary Measures) 21—Pest risk analysis of regulated non-quarantine pests. FAO, Rome, 30 pp. Available online: https://www.ippc.int/sites/default/files/documents//1323945746_ISPM_21_2004_En_2011-11-29_Refor.pdf
FAO (Food and Agriculture Organization of the United Nations), 2013. ISPM (International Standards for Phytosanitary Measures) 11—Pest risk analysis for quarantine pests. FAO, Rome, 36 pp. Available online: https://www.ippc.int/sites/default/files/documents/20140512/ispm_11_2013_en_2014-04-30_201405121523-494.65%20KB.pdf
Fernandez M and Ortega J, 1981. Nematodes of rice in Cuba. Especies de nematodos encontradas en arroz en Cuba. Ciencias de la Agricultura, 9, 121.
Fortuner R and Merny G, 1979. Root-parasitic nematodes of rice. Revue de Nematologie, 2, 79–102.
Hodda M, Banks N and Singh S, 2012. Nematode threats in the NAQS region. CSIRO, 82 pp.
Ichinohe M, 1988. Current research on the major nematode problems in Japan. Journal of Nematology, 20, 184–190.
Jacq VA and Fortuner R, 1979. Biological control of rice nematodes using sulphate reducing bacteria. Revue de Nematologie, 2, 41–50.
Karim SA and Rahman RA, 1991. Plant parasitic nematodes associated with tobacco plants in Kelantan, Malaysia. MARDI Research Journal, 19, 77–84.
Khun K, Decraemer W, Couvreur M, Karssen G, Steel H and Bert W, 2015. Deceptive morphological variation in *Hirschmanniella mucronata* (Nematoda: Pratylenchidae) and a polytomous key to the genus. Nematology, 17, 377–400.
Koyama Y, Thar SP, Kizaki C, Toyota K, Sawada E and Abe N, 2013. Development of specific primers to *Hirschmanniella* spp. causing damage to lotus and their economic threshold level in Tokushima prefecture in Japan. Nematology, 15, 851–858.
Kuwahara M and Iyatomi K, 1970. Studies on the bionomics of rice-root nematodes *Hirschmanniella imamuri* and *Hirschmanniella oryzae* with special reference to the mode of life and population dynamics. Japanese Journal of Applied Entomology and Zoology, 14, 117–121.
Loof PAA, 1991. The family Pratylenchidae Thorne, 1949. In: Nickle WR (ed.). Manual of Agricultural Nematology. Marcel Dekker, Inc, New York. pp. 363–421.
Luc M, 1987. A reappraisal of Tylenchina (Nemata). 7. The family Pratylenchidae Thorne, 1949. Revue de Nematologie, 10, 203–218.
Luc M and Hunt JH, 2005. Appendix B: Plant Parasitic Nematode Genera and Species Cited. In: Luc M, Sikora RA and Bridge J (eds.). Plant Parasitic Nematodes in Subtropical and Tropical Agriculture. Postbus 380, Wageningen, The Netherlands. pp. 831–840.
Mathur VK and Prasad SK, 1973. Control of *Hirschmanniella oryzae* associated with paddy. Indian Journal of Nematology, 3, 54–60.
Maung ZTZ, Win PP, Kyi PP, Myint YY and De Waele D, 2013. Population dynamics of the rice root nematode *Hirschmanniella oryzae* on monsoon rice in Myanmar. Archives of Phytopathology and Plant Protection, 46, 348–356.
Nemaplex. Available online: http://nemaplex.ucdavis.edu/Nemabase2010/NematodePageHostRangeResults.aspx?NgenusNspec=Xiphinema%20americanum [Accessed: February 1, 2018]
Panda M and Rao YS, 1971. Evaluation of losses caused by the root-nematode (*Hirschmanniella mucronata Das*) in rice (*Oryza sativa* L.). Indian Journal of Agricultural Science, 41, 611–614.
Prior T, Hockland S, Lawson R and Karssen G, 2010. First report of *Hirschmanniella gracilis* in the UK causing necrosis to roots of tall fescue. New Disease Reports, 22, 23.
Prot JC, 1992. Rice-root nematodes. In: Webster RK and Gunnell PS (eds.). *Compendium of rice diseases*. APS Press, The American Phytopathological Society, University of California, Davis. pp. 48–49.
Prot JC and Rahman ML, 1994. Nematode ecology, economic importance, and management in rice ecosystems in South and Southeast Asia. In: Teng PS, Heong KL and Moody K (eds.). Rice pest science and management. IRRI, Los Banos, Laguna, Philippines. pp. 129–144.
Pudasaini MP and Bert W, 2000. Seven species of Tylenchida (Nematoda) from Nepal. Journal of Nematode Morphology and Systematics, 3, 77–93.
Razjivin A, Fernandez M, Ortega J and Quincosa A, 1981. New species of *Hirschmanniella* Nematoda Pratylenchinae undesirable parasites of plants in rice plantations. Poeyana Instituto de Zoologia Academia de Ciencias de Cuba, 1–11.

Reis LGL, 1990. Occurence of rice root nematode *Hirschmanniella oryzae* in Portugal. International Rice Research Notes, 16, 34.
Ryss AY and Karnkowski W, 2010. *Hirschmanniella caudacrena* Sher, 1968 intercepted in aquarium plants imported to Poland. Bulletin OEPP, 40, 204–210.
Sher SA, 1968. Revision of the genus *Hirschmanniella* Luc & Goodey, 1963 (Nematoda: Tylenchoidea). Nematologica, 14, 243–275.
Siddiqi MR, 2000. *Tylenchida: Parasites of Plants and Insects*, 2nd Edition. CABI Publishing, Wallingford, UK.
Sperandio CA, Amaral AS and Lopes LF, 1994. Occurrence of the rice root nematode Hirschmanniella spinicaudata in flooded rice in Rio Grande do Sul, Brazil. Nematologia Brasileira, 18, 108–109.
Sturhan D and Hallmann J, 2010. The genus *Hirschmanniella* (Tylenchida: Pratylenchidae) in Europe, with description of *H. halophila* sp. n. from Germany and notes on *H. caudacrena*. Nematology, 12, 809–826.
Talame M and Tullio V, 1977. *Hirschmanniella loofi* Sher, 1968 (Nematoda: Tylenchoidea) in the Fucino river bed. Informatore fitopatologico, 27, 21–23.
Tandingan De Ley I, Mundo-Ocampo M, Yoder M and De Ley P, 2007. Nematodes from vernal pools in the Santa Rosa Plateau Ecological Reserve, California I. *Hirschmanniella santarosae* sp. n. (Nematoda: Pratylenchidae), a cryptic sibling species of *H. pomponiensis* Abdel-Rahman & Maggenti, 1987. Nematology, 9, 405–429.
Van Den Berg E and Queneherve P, 2000. Hirschmanniella caribbeana sp n. and new records of Pratylenchus spp. (Pratylenchidae : Nematoda) from Guadeloupe, French West Indies. Nematology, 2, 179–190.
Van Den Berg E, Subbotin SA, Handoo ZA and Tiedt LR, 2009. *Hirschmanniella kwazuna* sp. n. from South Africa with notes on a new record of *H. spinicaudata* (Schuurmans Stekhoven, 1944) Luc & Goodey, 1964 (Nematoda: Pratylenchidae) and on the molecular phylogeny of *Hirschmanniella* Luc & Goodey, 1964. Nematology, 11, 523–540.
Villarroel M, Junge R, Komives T, Konig B, Plaza I, Bittsanszky A and Joly A, 2016. Survey of aquaponics in Europe. Water, 8, 7.
Whitehead AG, 1998. *Plant Nematode Control*. CAB International, New York, USA.
XianQi H, Min Y, LiFei L, Yang W and ShengFu Y, 2004. Species and distribution of rice root nematode in Yunnan Province, China. Agricultural Sciences in China, 3, 598–603.
Yin KC, 1986. The identification of rice root nematodes in a Guangzhou suburb. Plant Protection, 1, 14–17.
Zhuo K, Liao J, Cui R and Li Y, 2009. First record of female intersex in Hirschmanniella shamimi Ahmad, 1972 (Nematoda: Pratylenchidae), with a checklist of intersexes in plant nematodes. Zootaxa, 1973, 61–68.

Abbreviations

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

Appendix A – List of *Hirschmanniella* spp. reported from the EU (excluding interceptions)

Species	Economic damage reported	Distribution – reported from	Reference
***H. behningi* (Micoletzky, 1923) Luc & Goodey, 1964**	No	Germany Sweden (EPPO), Russia	Sturhan and Hallmann (2010), EPPO
***H. gracilis* (de Man, 1880) Luc & Goodey, 1964**	Necrotic lesions and stunting of roots (Prior et al., 2010)	Belgium, Czech Republic, Denmark, Estonia, Germany, Greece, Hungary, France, Romania, Slovak Republic, Spain and the Netherlands	Sturhan and Hallmann (2010)
***H. halophila* Sturhan and Hallmann, 2010**	No	Germany	Sturhan and Hallmann (2010)
***H. loofi* Sher, 1968**	No	Reported from the Netherlands, Belgium, Germany, Italy and Poland	Talame and Tullio (1977), Bert and Geraert (2000), Sturhan and Hallmann (2010)
***H. zostericola* (Allgen, 1924) Luc & Goodey, 1964**	No	Germany Sweden	Sturhan and Hallmann (2010), EPPO

Appendix B – List of *Hirschmanniella* spp. not reported from the EU

Species	Damage reported (yes/no)	Distribution (reported from)/reference
***H. anchoryzae* Ebsary & Anderson, 1982**	No	Nematode described by Ebsary and Anderson (1982) in Canada; found also in Iran – no damage reported (Ebrahim et al., 2000)
***H. areolata* Ebsary & Anderson, 1982**	No	Hong Kong (Ebsary and Anderson, 1982); Nepal (Pudasaini and Bert, 2000) – no damage reported
***H. belli* Sher, 1968**	No	Reported by XianQi et al. (2004) as rice-infesting species, pest status not clear
***H. brassicae* Duan, Liu, Liu, Zhao et al., 1996**	No	Reported by Duan et al. (1996) from China as species associated with *Brassica oleracea* var. *capitata*
***H. caribbeana* Van Den Berg & Queneherve, 2000**	No	No damage reported; described by Van Den Berg and Queneherve (2000) from mangrove vegetation, Guadalope
***H. caudacrena* Sher, 1968**	No	Intercepted from aquarium plants in Belgium, Denmark, France, Germany and Poland (Ryss and Karnkowski, 2010; Sturhan and Hallmann, 2010)
***H. diversa* Sher, 1968**	Yes	Cause serious damage to Indian lotus (Chong Bin et al., 2001; Koyama et al., 2013)
***H. furcata* Razjivin, Fernandez, Ortega & Quincosa, 1981**	No	Nematode associated with rice rhizosphere (Fernandez and Ortega, 1981); found also inside the roots of some wild plant species (*Leptochloa fascicularis* and *Echinochloa colona*) (Razjivin et al., 1981)
***H. gracilis* (de Man, 1880) Luc & Goodey, 1964**	Yes	Yield losses of rice are estimated at the range between 12% and 19% (Ahmad et al., 1984)
***H. imamuri* Sher, 1968**	Yes	Cause yield reduction of rice (Babatola and Bridge, 1979); cause serious damage to Indian lotus (Koyama et al., 2013)
***H. kwazuna* Van Den Berg, Subbotin, Handoo & Tiedt, 2009**	No	Described from unidentified grass, South Africa, no damage reported (Van Den Berg et al., 2009)
***H. marina* Sher 1968**	No	Species described from rhizomes of the marine plant *Diplanthera wrightii*; it may cause necrosis and swelling and shortening of internodes (Sher, 1968); No economical damage reported
***H. mexicana* (Chitwood, 1961) Sher, 1968**	No	Reported by XianQi et al. (2004) as rice-infesting species, pest status not clear
***H. microtyla* Sher, 1968**	No	Reported by XianQi et al. (2004) as rice-infesting species, pest status not clear
***H. miticausa* Bridge Mortimer & Jackson, 1984**	Yes	Miti-miti disease or corm rot of taro (Hodda et al., 2012)
***H. mucronata* (Das, 1960) Luc & Goodey, 1964**	Yes	Potential plant pests that may cause considerable yield losses of rice (Panda and Rao, 1971)
***H. obesa* Razjivin, Fernandez, Ortega & Quincosa, 1981**	No	No damage reported; found also inside the roots of some wild plant species (*Leptochloa fascicularis* and *Echinochloa colona*) (Razjivin et al., 1981)
***H. oryzae* (van Breda de Haan, 1902) Luc & Goodey, 1964**	Yes	Cause yield reduction of rice (Babatola and Bridge, 1979)
***H. pisquidensis* Ebsary & Pharoahm 1982**	No	No reports on damage found
***H. pomponiensis* Abdel-Rahman and Maggenti, 1987**	No	No reports on damage found; found in bulrush roots, California, USA (Abdel-Rahman and Maggenti, 1987)
***H. santarosae* Tandingan De Ley, Mundo-Ocampo, Yoder & De Ley**	No	No reports on damage found; described by Tandingan De Ley et al. (2007)

Species	Damage reported (yes/no)	Distribution (reported from)/reference
***H. spinicaudata* (Schuurmans Stekhoven, 1944) Luc & Goodey, 1964**	Yes	Reported by XianQi et al., 2004 as rice-infesting species in China; associated with rice rhizosphere in Brazil (Sperandio et al., 1994); cause yield reduction of rice (Babatola and Bridge, 1979)
***H. shamimi* Ahmad, 1972**	No	No damage reported; associated with rice rhizosphere China (Zhuo et al., 2009) and with the rhizosphere of jute in India (Chaturvedi and Khera, 1979)
***H. thornei* Sher, 1968**	No	No damage reported; associated with rice rhizosphere (Fernandez and Ortega, 1981; Yin, 1986)
***H. truncata* Razjivin, Fernandez, Ortega & Quincosa, 1981**	No	No damage reported; associated with rice rhizosphere (Fernandez and Ortega, 1981); found also inside the roots of some wild plant species (*Leptochloa fascicularis* and *Echinochloa colona*) (Razjivin et al., 1981)