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. 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.

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**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.

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1. Introduction

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

1.1.1. Background

Council Directive 2000/29/EC\(^1\) on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community establishes the present European Union plant health regime. The Directive lays down the phytosanitary provisions and the control checks to be carried out at the place of origin on plants and plant products destined for the Union or to be moved within the Union. In the Directive's 2000/29/EC annexes, the list of harmful organisms (pests) whose introduction into or spread within the Union is prohibited, is detailed together with specific requirements for import or internal movement.

Following the evaluation of the plant health regime, the new basic plant health law, Regulation (EU) 2016/2031\(^2\) on protective measures against pests of plants, was adopted on 26 October 2016 and will apply from 14 December 2019 onwards, repealing Directive 2000/29/EC. In line with the principles of the above mentioned legislation and the follow-up work of the secondary legislation for the listing of EU regulated pests, EFSA is requested to provide pest categorizations of the harmful organisms included in the annexes of Directive 2000/29/EC, in the cases where recent pest risk assessment/pest categorisation is not available.

1.1.2. Terms of reference

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

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

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

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

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

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\(^1\) 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

| Organism                                                      | Reference                                      |
|---------------------------------------------------------------|------------------------------------------------|
| Aleurocanthus spp.                                            |                                                |
| Anthonomus bisignifer (Schenkling)                            |                                                |
| Anthonomus signatus (Say)                                     |                                                |
| Aschistonyx eppoi Inouye                                      |                                                |
| Carposina niponensis Walsingham                               |                                                |
| Enarmonia packardi (Zeller)                                   |                                                |
| Enarmonia prunivora Walsh                                     |                                                |
| Grapholita inopinata Heinrich                                |                                                |
| Hispomonos phycitis                                           |                                                |
| Leucaspis japonica Ckll.                                     |                                                |
| Listronotus bonariensis (Kuschel)                             |                                                |

(b) Bacteria

| Organism                                                      | Reference                                      |
|---------------------------------------------------------------|------------------------------------------------|
| Citrus variegated chlorosis                                   |                                                |
| Erwinia stewartii (Smith) Dye                                  |                                                |

(c) Fungi

| Organism                                                      | Reference                                      |
|---------------------------------------------------------------|------------------------------------------------|
| Alternaria alternata (Fr.) Keissler (non-EU pathogenic isolates) |                                                |
| Anisogromma 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                         |                                                |

(d) Virus and virus-like organisms

| Organism                                                      | Reference                                      |
|---------------------------------------------------------------|------------------------------------------------|
| 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                                                      |                                                |

Annex IIB

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

| Organism                                                      | Reference                                      |
|---------------------------------------------------------------|------------------------------------------------|
| Anthonomus grandis (Boh.)                                     |                                                |
| Cephalcia lariophila (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                                          |                                                |
| Sterochetes mangiferae Fabricius                             |                                                |
(b) Bacteria

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

(c) Fungi

*Glomerella gossypii* Edgerton

*Hypoxylon 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) *Carneocephala fulgida* Nottingham

2) *Draeculacephala minerva* Ball

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 tsunekonis* Miyake

10) *Dacus zonatus* Saund.

11) *Epochra canadensis* (Loew)

(b) 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 minutorus* Drury
- *Choristoneura* spp. (non-EU)
- *Conotrachelus nenuphar* (Herbst)
- *Dendrolimus sibiricus* Tscheretverikov
- *Diabrotica barberi* Smith and Lawrence
- *Diabrotica undecimpunctata howardi* Barber
- *Diabrotica undecimpunctata undecimpunctata* Mannerheim
- *Diabrotica virgifera zeae* Krysan & Smith
- *Diaphorina citri* Kuway
- *Heliothis zeas* (Boddie)
- *Hirschmanniella* spp., other than *Hirschmanniella gracilis* (de Man)
- *Liriomyza sativae* Blanchard

(b) Fungi

- *Ceratocystis fagacearum* (Bretz) Hunt
- *Chrysomyxa arctostaphyl* 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

(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 I AII

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

Meloidogyne fallax Karssen
Popillia japonica Newman

Rhizoeus hibisci Kawai and Takagi

(b) Bacteria

Clavibacter michiganensis (Smith) Davis et al. ssp.
Ralstonia solanacearum (Smith) Yabuuchi et al.

sepedonicus (Spieckermann and Kotthoff) Davis et al.

(c) Fungi

Melampsora medusae Thümen
Synchytrium endobioticum (Schilbersky) Percival

Annex I B

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

Leptinotarsa decemlineata Say

Liriomyza bryoniae (Kaltenbach)

(b) Viruses and virus-like organisms

Beet necrotic yellow vein virus

1.2. Interpretation of the Terms of Reference

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 SANTE) 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

*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 *Hirschmaniella oryzae*; *Hirschmaniella asteromucronata* is considered a synonym of *Hirschmaniella loofi* (Khun et al., 2015). According to the most recent study carried out by Khun et al. (2015) on *Hirschmaniella*, the genus contains 29 species; these are listed in Table 2.

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**Table 2:** List of *Hirschmaniella* 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. bellii* Sher, 1968 | No                        |
| *H. brassicae* Duan, Liu, Liu, zha 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. shanими* Ahmad, 1972 | No                        |
| *H. spinicaudata* (Schuurmans Stekhoven, 1944) Luc & Goodey (1964) | Yes                       |
| *H. thornei* Sher, 1968 | No                        |
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   |              |           |              |               |            |             |            |             |
|           | Burkina Faso |          |           |              |               |            |             |            |             |
|           | Cameroon |              |           |              |               |            |             |            |             |
|           | Congo   |              |           |              |               |            |             |            |             |
|           | Cote d’Ivoire |         |           |              |               |            |             |            |             |
|           | Egypt   |              |           |              |               |            |             |            |             |
|           | Gambia  |              |           |              |               |            |             |            |             |
|           | Ghana   |              |           |              |               |            |             |            |             |
|           | Guinea  |              |           |              |               |            |             |            |             |
|           | Madagascar |           |           |              |               |            |             |            |             |
|           | Mauritania |            |           |              |               |            |             |            |             |
|           | Niger   |              |           |              |               |            |             |            |             |
|           | Nigeria |              |           |              |               |            |             |            |             |
|           | Senegal |              |           |              |               |            |             |            |             |
|           | Sierra Leone |          |           |              |               |            |             |            |             |
|           | Togo    |              |           |              |               |            |             |            |             |
|           | Zambia  |              |           |              |               |            |             |            |             |
| America   | Argentina |            |           |              |               |            |             |            |             |
|           | Brazil  |              |           |              |               |            |             |            |             |
|           | Canada  |              |           |              |               |            |             |            |             |
|           | Costa Rica |           |           |              |               |            |             |            |             |
|           | Cuba    |              |           |              |               |            |             |            |             |
|           | El Salvador |           |           |              |               |            |             |            |             |
|           | Guyana  |              |           |              |               |            |             |            |             |
|           | USA     | Arkansas      |           |              |               |            |             |            |             |
|           | USA     | California    |           |              |               |            |             |            |             |
|           | USA     | Florida       |           |              |               |            |             |            |             |
|           | USA     | Hawaii        |           |              |               |            |             |            |             |
|           | USA     | Kansas        |           |              |               |            |             |            |             |
|           | USA     | Louisiana     |           |              |               |            |             |            |             |

*H. oryzae:* Damage caused by this species is associated with rice. *H. gracilis:* Damage caused by this species is associated with rice. *H. spinicaudata:* Damage caused by this species is associated with rice. *H. imamuri:* Damage caused by this species is associated with rice. *H. mucronata:* Damage caused by this species is associated with rice. *H. diversa:* Damage caused by this species is associated with rice. *H. miticausa:* Damage caused by this species is associated with rice.
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.

*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.
3.2.2. Pest distribution in the EU

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).

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 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                        |

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

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

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).
3.4.3.2. Climatic conditions affecting establishment

Since some of the species within the genus *Hirschmanniella* (*H. behningi*, *H. gracilis*, *H. halophila*, *H. loofii* 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 aerasperma, 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 (Jaq 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) | 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 | | |
| **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 |

**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. bellii, H. brassicarum, H. caribbeana, H. caudacrenae, 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 |
|----------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------|
| 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 |
|---------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------|
| 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 | | |

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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

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. bellii* 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 & Queneherven, 2000 | No                       | No damage reported; described by Van Den Berg and Queneherven (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) |