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SCIENTIFIC OPINION

Pest categorisation of *Pestalotiopsis microspora*

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Abstract

Following an EFSA commodity risk assessment of bonsai plants (*Pinus parviflora* grafted on *Pinus thunbergii*) imported from China, the EFSA Plant Health Panel performed a pest categorisation of *Pestalotiopsis microspora,* a clearly defined plant pathogenic fungus of the family Pestalotiopsidaceae. The pathogen was reported on a wide range of monocotyledonous, dicotyledonous and gymnosperms, either cultivated or wild plant species, causing various symptoms such as leaf spot, leaf blight, scabby canker, fruit spot, pre- and post-harvest fruit rot and root rot. In addition, the fungus was reported as an endophyte on a wide range of asymptomatic plant species. This pest categorisation focuses on the hosts that are relevant for the EU and for which there is robust evidence that the pathogen was formally identified by a combination of morphology, pathogenicity and multilocus sequencing analyses. *Pestalotiopsis microspora* was reported in Africa, North, Central and South America, Asia and Oceania. In the EU, it was reported in the Netherlands. There is a key uncertainty on the geographical distribution of *P. microspora* worldwide and in the EU, because of the endophytic nature of the fungus, the lack of surveys, and because in the past, when molecular tools were not fully developed, the pathogen might have been misidentified as other *Pestalotiopsis* species or other members of the Pestalodiopsidaceae family based on morphology and pathogenicity tests. *Pestalotiopsis microspora* is not included in Commission Implementing Regulation (EU) 2019/2072. Plants for planting, fresh fruits, bark and wood of host plants as well as soil and other growing media associated with plant debris are the main pathways for the entry of the pathogen into the EU. Host availability and climate suitability in parts of the EU are favourable for the establishment and spread of the pathogen. The introduction and spread of the pathogen into the EU are expected to have an economic and environmental impact where susceptible hosts are grown. Phytosanitary measures are available to prevent the introduction and spread of the pathogen into the EU. Unless the restricted distribution in the EU is disproven, *Pestalotiopsis microspora* satisfies all the criteria that are within the remit of EFSA to assess for this species to be regarded as potential Union quarantine pest.

KEYWORDS

Actinidia chinensis, fruit rot, leaf spot, *Persea americana*, pest risk, plant health, plant pest

CONTENTS

1 | INTRODUCTION

1.1 | Background and terms of reference as provided by the requestor

1.1.1 | Background

The new Plant Health Regulation (EU) 2016/2031, on the protective measures against pests of plants, is applying from 14 December 2019. Conditions are laid down in this legislation in order for pests to qualify for listing as Union quarantine pests, protected zone quarantine pests or Union regulated non-quarantine pests. The lists of the EU regulated pests together with the associated import or internal movement requirements of commodities are included in Commission Implementing Regulation (EU) 2019/2072. Additionally, as stipulated in the Commission Implementing Regulation 2018/2019, certain commodities are provisionally prohibited to enter in the EU (high risk plants, HRP). EFSA is performing the risk assessment of the dossiers submitted by exporting to the EU countries of the HRP commodities, as stipulated in Commission Implementing Regulation 2018/2018. Furthermore, EFSA has evaluated a number of requests from exporting to the EU countries for derogations from specific EU import requirements.

In line with the principles of the new plant health law, the European Commission with the Member States are discussing monthly the reports of the interceptions and the outbreaks of pests notified by the Member States. Notifications of an imminent danger from pests that may fulfil the conditions for inclusion in the list of the Union quarantine pest are included. Furthermore, EFSA has been performing horizon scanning of media and literature.

As a follow-up of the above-mentioned activities (reporting of interceptions and outbreaks, HRP, derogation requests and horizon scanning), a number of pests of concern have been identified. EFSA is requested to provide scientific opinions for these pests, in view of their potential inclusion by the risk manager in the lists of Commission Implementing Regulation (EU) 2019/2072 and the inclusion of specific import requirements for relevant host commodities, when deemed necessary by the risk manager.

1.1.2 | Terms of Reference

EFSA is requested, pursuant to Article 29(1) of Regulation (EC) No 178/2002, to provide scientific opinions in the field of plant health.

EFSA is requested to deliver 53 pest categorisations for the pests listed in Annex 1A, 1B, 1D and 1E (for more details see mandate M-2021-00027 on the Open.EFSA portal). Additionally, EFSA is requested to perform pest categorisations for the pests so far not regulated in the EU, identified as pests potentially associated with a commodity in the commodity risk assessments of the HRP dossiers (Annex 1C; for more details see mandate M-2021-00027 on the Open.EFSA portal). Such pest categorisations are needed in the case where there are not available risk assessments for the EU.

When the pests of Annex 1A are qualifying as potential Union quarantine pests, EFSA should proceed to phase 2 risk assessment. The opinions should address entry pathways, spread, establishment, impact and include a risk reduction options analysis.

Additionally, EFSA is requested to develop further the quantitative methodology currently followed for risk assessment, in order to have the possibility to deliver an express risk assessment methodology. Such methodological development should take into account the EFSA Plant Health Panel Guidance on quantitative pest risk assessment and the experience obtained during its implementation for the Union candidate priority pests and for the likelihood of pest freedom at entry for the commodity risk assessment of HRP.

1.2 | Interpretation of the terms of reference

Pestalotiopsis microspora is one of a number of pests listed in Annex 1C to the terms of reference (ToR) to be subject to pest categorisation to determine whether it fulfils the criteria of a potential Union quarantine pest for the area of the EU excluding Ceuta, Melilla and the outermost regions of Member States referred to in Article 355(1) of the Treaty on the Functioning of the European Union (TFEU), other than Madeira and the Azores, and so inform EU decision-making as to its appropriateness for potential inclusion in the lists of pests of Commission Implementing Regulation (EU) 2019/ 2072. If a pest fulfils the criteria to be potentially listed as a Union quarantine pest, risk reduction options will be identified.

1.3 | Additional information

This pest categorisation was initiated following the commodity risk assessment of bonsai plants (*Pinus parviflora* grafted on *Pinus thunbergii*) from China performed by EFSA (EFSA PLH Panel, 2022), in which *P. microspora* was identified as a relevant non-regulated EU pest which could potentially enter the EU on bonsai plants.

2 | DATA AND METHODOLOGIES

2.1 | Data

2.1.1 | Information on pest status from NPPOs

In the context of the current mandate, EFSA is preparing pest categorisations for new/emerging pests that are not yet regulated in the EU. When official pest status is not available in the European and Mediterranean Plant Protection Organization (EPPO) Global Database (EPPO, online), EFSA consults the NPPOs of the relevant MSs. To obtain information on the official pest status for *P. microspora*, EFSA has consulted the NPPOs of Italy, the Netherlands, Portugal and Spain. The results of this consultation are presented in Section 3.2.2.

2.1.2 | Literature search

A literature search on *P. microspora* 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. Papers relevant for the pest categorisation were reviewed, and further references and information were obtained from experts, as well as from citations within the references and grey literature.

2.1.3 | Database search

Pest information, on host(s) and distribution, was retrieved from the EPPO Global Database, the CABI databases and scientific literature databases as referred above in Section 2.1.1.

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 and TRACES databases were consulted for pest-specific notifications on interceptions and outbreaks. Europhyt is a web-based network run by the Directorate General for Health and Food Safety (DG SANTÉ) of the European Commission as a subproject of PHYSAN (Phyto-Sanitary Controls) specifically concerned with plant health information. TRACES is the European Commission's multilingual online platform for sanitary and phytosanitary certification required for the importation of animals, animal products, food and feed of non-animal origin and plants into the European Union, and the intra-EU trade and EU exports of animals and certain animal products. Up until May 2020, the Europhyt database managed notifications of interceptions of plants or plant products that do not comply with EU legislation, as well as notifications of plant pests detected in the territory of the Member States and the phytosanitary measures taken to eradicate or avoid their spread. The recording of interceptions switched from Europhyt to TRACES in May 2020.

GenBank was searched to determine whether it contained any nucleotide sequences for *P. microspora* which could be used as reference material for molecular diagnosis. GenBank® (www.ncbi.nlm.nih.gov/genbank/) is a comprehensive publicly available database that as of August 2019 (release version 227) contained over 6.25 trillion base pairs from over 1.6 billion nucleotide sequences for 450,000 formally described species (Sayers et al., 2020).

2.2 | Methodologies

The Panel performed the pest categorisation for *P. microspora* following guiding principles and steps presented in the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018), the EFSA guidance on the use of the weight of evidence approach in scientific assessments (EFSA Scientific Committee, 2017) and the International Standards for Phytosanitary Measures No. 11 (FAO, 2013).

The criteria to be considered when categorising a pest as a potential Union quarantine pest (QP) is given in Regulation (EU) 2016/2031 Article 3 and Annex I, Section 1 of the Regulation. Table 1 presents the Regulation (EU) 2016/2031 pest categorisation criteria on which the Panel bases its conclusions. In judging whether a criterion is met the Panel uses its best professional judgement (EFSA Scientific Committee, 2017) by integrating a range of evidence from a variety of sources (as presented above in Section 2.1) to reach an informed conclusion as to whether or not a criterion is satisfied.

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, deemed to be a risk management decision, the Panel will present a summary of the observed impacts in the areas where the pest occurs, and make a judgement about potential likely impacts in the EU. Whilst the Panel may quote impacts reported from areas where the pest occurs in monetary terms, the Panel will seek to express potential EU impacts in terms of yield and quality losses and not in monetary terms, in agreement with the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018). Article 3 (d) of Regulation (EU) 2016/2031 refers to unacceptable social impact as a criterion for quarantine pest status. Assessing social impact is outside the remit of the Panel.

TABLE 1 Pest categorisation criteria under evaluation, as derived from 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 (article 3)
Identity of the pest (Section 3.1)	Is the identity of the pest clearly defined, 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 in a limited part of the EU or is it scarce, irregular, isolated or present infrequently? If so, the pest is considered to be not widely distributed
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 for entry and spread
Potential for consequences in the EU territory (Section 3.5)	Would the pests' introduction have an economic or environmental impact on the EU territory?
Available measures (Section 3.6)	Are there measures available to prevent pest entry, establishment, spread or impacts?
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

3 | PEST CATEGORISATION

3.1 | Identity and biology of the pest

3.1.1 | Identity and taxonomy

Is the identity of the pest clearly defined, or has it been shown to produce consistent symptoms and/or to be transmissible?

Yes, the identity of the fungus *Pestalotiopsis microspora* is clearly defined and the pathogen has been shown to produce consistent symptoms and to be transmissible.

Pestalotiopsis microspora (Speg.) G.C. Zhao & Nan Li is a plant pathogenic fungus of the order Amphisphaeriales and family Pestalotiopsidaceae (Index Fungorum, https://www.indexfungorum.org; accessed Nov 2023). In addition, this species has been commonly found as a saprophyte on bark and decaying plant material, as well as an endophyte in many plant species (Metz et al., 2000; Strobel et al., 1996; Sudhakara Reddy et al., 2016).

In the past, the genus *Pestalotiopsis* was referred to as *Pestalotia*. The genus *Pestalotia* was established by De Notaris (1841), to accommodate a single species, *P. pezizoides*. Later, in 1949, Steyaert revised *Pestalotia* and moved all species from this genus (with exception of *P. pezizoides*) into two new genera, i.e. *Pestalotiopsis* and *Truncatella*, based on conidial morphology (Steyaert, 1949). *Pestalotiopsis* and *Truncatella* were created for species with five- and four-celled conidia, respectively, while *Pestalotia* was retained for species with six-celled conidia (e.g. *P. pezizoides*). However, according to Zhang et al. (2023), Steyaert's introduction of *Pestalotiopsis* was not accepted by some authors (e.g. Guba, 1956, 1961; Moreau, 1949) that used conidial septation only for species delimitation. Later, both Sutton (1980) and Griffiths and Swart (1974a, 1974b) supported Steyaert's division of *Pestalotiopsis*, based on their morphological studies on conidiomatal wall structure of different members of the *Pestalotia-Pestalotiopsis* complex. Based on morphological and molecular data, Maharachchikumbura et al. (2014) split the *Pestalotiopsis* genus into three genera which, in addition to the genus *Pestalotiopsis*, include two newly introduced genera, *Neopestalotiopsis* and *Pseudopestalotiopsis*.

The classification of the genus *Pestalotiopsis* at the family level has been similarly controversial given the divergence or heterogeneity of morphological characters. Indeed, some authors have accommodated this genus into the family Sporocadaceae (Nag Raj, 1993) or Amphisphaeriaceae (Jeewon, Liew, & Hyde, 2003). More recently, Senanayake et al. (2015) introduced the family Pestalotiopsidaceae (derived from Amphisphaeriaceae) to accommodate *Pestalotiopsis* spp. together with other genera, based on morphological and molecular data. However, the introduction of this new family was not accepted by some authors (Jaklitsch et al., 2016; Liu et al., 2019) who revived the older family name Sporocadaceae to accommodate the genus *Pestalotiopsis*.

The EPPO Global Database (EPPO, online) provides the following taxonomic identification for *P. microspora*:

Preferred name: *Pestalotiopsis microspora* (Spegazzini) G. C. Zhao & Nan Li
Order: Amphisphaeriales
Family: Sporocadaceae
Genus: *Pestalotiopsis*
Species: *Pestalotiopsis microspora*

Nevertheless, in this pest categorisation, the Panel adopted the nomenclature provided by Index Fungorum (https://www.indexfungorum.org/; accessed on Nov 2023) according to which the genus *Pestalotiopsis* is accommodated in the family Pestalotiopsidaceae.

Synonyms: *Pestalotia dichaeta* Spegazzini, *P. Micheneri* Guba, *P. Microspora* Spegazzini, *Pestalotiopsis dichaeta* (Spegazzini) Steyaert (EPPO, online). Additional synonyms listed in Index Fungorum include *Pestalotia microspora* var. *philippinensis* Sacc., Syd. & P. Syd., *Pestalotiopsis microspora* (Speg.) Bat. & Peres, and *Pestalotiopsis microspora* var. *philippinensis* (Sacc., Syd. & P. Syd.) Bat. & Peres.

The EPPO code[1] (EPPO, 2019; Griessinger & Roy, 2015) for this species is PESTDC (EPPO, online).

3.1.2 | Biology of the pest

The biology of *P. microspora* (along with other *Pestalotiopsis* species) is still largely unclear, particularly in what concerns the relationship that the fungus can establish with the plants. For example, *P. microspora* has been reported to be a pathogen of a wide range of host plants, causing various symptoms such as leaf spots, leaf blight, scabby fruit canker, fruit spots, post-harvest fruit rot and root rot (see Section 3.1.5). In addition, *P. microspora* has been commonly found as an endophyte, colonising stems, leaves, flowers and fruits of many plant species without causing any disease (e.g. Metz et al., 2000; Sudhakara Reddy et al., 2016). It is considered that *P. microspora* acts as an opportunistic pathogen, remaining dormant as an endophyte until the plant is stressed, and then switches life mode to pathogen leading to disease development, as previously reported for other *Pestalotiopsis* species (Hopkins & McQuilken, 2000; Maharachchikumbura et al., 2011, 2012). According to Kimaru et al. (2018), *P. microspora* has been also found associated with other pathogenic fungi (e.g. *Colletotrichum* spp.) on avocado fruits showing symptoms of anthracnose. The authors suggested that both fungi benefit from each other for the development of disease, but further studies are required to establish whether there is coinfection or any interaction. *Pestalotiopsis microspora* can also act as a saprophyte in leaf litter, dead bark and twigs similar to other *Pestalotiopsis* species (Maharachchikumbura et al., 2011; Metz et al., 2000; Sudhakara Reddy et al., 2016).

Pestalotiopsis microspora has also been studied for its ability to degrade synthetic plastic, in particular polyurethane (Russell et al., 2011), and to produce bioactive compounds with antimicrobial, antioxidant (Strobel et al., 2002) and anticancer (paclitaxel) (Strobel et al., 1996) properties.

Information on the infection process and epidemiology of *P. microspora* is scarce. Similar to other *Pestalotiopsis* species, the pathogen is most likely to survive in dead plant organs (twigs, branches) and in plant debris in the soil mainly in the form of mycelium, acervuli (asexual fruiting structures) or perithecia (sexual fruiting structures). Infection of plants by *Pestalotiopsis* spp. begins when fungal conidia or mycelium get into contact with susceptible plant tissues (Espinoza et al., 2008). *Pestalotiopsis microspora* was found in germinated seeds of the common bean, *Phaseolus vulgaris* (Parsa et al., 2016). Although there is no evidence that the pathogen is seed-borne, seeds of host plants could potentially be an additional source of primary inoculum, similar to other *Pestalotiopsis* species or genera of the family Pestalotiopsidaceae (Atieno et al., 2021; Benetti et al., 2009; Sultana et al., 2020).

For most *Pestalotiopsis* species, a sexual stage (teleomorph) is either lacking or unknown, but in cases where a sexual stage has been reported, it belongs to the genus *Pestalosphaeria* (Maharachchikumbura et al., 2014; Index Fungorum, accessed in Nov 2023). So far, no sexual stage of *P. microspora* has been detected in nature. Nevertheless, Metz et al. (2000) reported the in vitro induction of the sexual stage of *P. microspora* isolate N-32 [a taxol-producing endophytic isolate, which was obtained from *Taxus wallichiana* in Nepal (Strobel et al., 1996)] under certain media (e.g. water agar containing dried *Taxus cuspidata* needles) and incubation conditions (i.e. optimum temperatures 16–20°C, 12-h photoperiod). Based on (i) the morphology of the teleomorph, (ii) the sequencing of the 1732 bp fragment of the 18S rDNA of the developed in vitro teleomorph and that of the authentic isolate (type strain) of *Pestalosphaeria hansenii* Shoemaker et Simpson (ATCC 48245) and (iii) the successful interconversion between the teleomorphic and the anamorphic stages, Metz et al. (2000) identified the in vitro-induced teleomorph as *Pestalosphaeria hansenii* and considered it as the sexual stage of *P. microspora*. Because of differences in the size of perithecia and their ostioles between those produced in vitro (Metz et al., 2000) and those observed in nature (Crous, 1993; Shoemaker & Simpson, 1981), and although these differences could be possibly attributed to different culture substrates and/or incubation conditions (e.g. temperature, light), there is uncertainty on the correct identification of the teleomorph at species level by Metz et al. (2000). In addition, in Metz et al. (2000), only one out of the four *P. microspora* isolates used produced perithecia in vitro and the molecular identification was based only on a single DNA region (18S rRNA gene). Moreover, *P. hansenii* is not listed as synonym of *P. microspora* in Index Fungorum (https://www.indexfungorum.org/names/Names.asp, accessed in October 2023).

Although it has not been demonstrated, it is most likely that ascospores released from perithecia of the possible sexual stage would be the primary inoculum of *P. microspora*. As reported for other fungal pathogens, these perithecia can act as survival structures which may contribute to *P. microspora* overwintering (De Silva et al., 2017). Conidia produced in acervuli may also serve as primary inoculum as reported for other *Pestalotiopsis* species (Maharachchikumbura et al., 2011). Conidiomata of this genus were described to be variable in appearance ranging from pycnidia-like to acervuli, depending on the stage of their development (Watanabe et al., 1998). Conidia can be dispersed mainly by wind and water (rain,

[1]An EPPO code, formerly known as a Bayer code, is a unique identifier linked to the name of a plant or plant pest important in agriculture and plant protection. Codes are based on genus and species names. However, if a scientific name is changed, the EPPO code remains the same. This provides a harmonised system to facilitate the management of plant and pest names in computerised databases, as well as data exchange between IT systems (EPPO, 2019; Griessinger & Roy, 2015).

irrigation) (Elliott et al., 2004). Although not specifically reported for *P. microspora*, it was demonstrated that insects can facilitate the spread and establishment of diseases caused by *Pestalotiopsis* spp. by carrying conidia on their bodies or creating infection sites (wounds) (Battisti et al., 1999; Martínez & Plata-Rueda, 2013). Birds and small animals (e.g. rodents) feeding on infected fruits and seeds could also potentially disperse the pathogen (Corlett, 2017).

Upon landing on a susceptible host plant, conidia germinate and enter the plant tissues via natural openings (e.g. stomata, lenticels or hydathodes) or wounds. For some *Pestalotiopsis* species, the presence of wounds is an essential prerequisite for infection (Fail & Langenheim, 1990). Under controlled conditions, conidial germination of *Pestalotiopsis* spp. on leaf surfaces occurred between 6 and 12 h following inoculation, with the plant epidermis being penetrated by the germ tube within 12–24 h after germination (Fail & Langenheim, 1990). In vitro studies demonstrated that temperatures between 23°C and 26°C were optimum for the mycelial growth of several *P. microspora* isolates. At 33°C, the fungus failed to grow while temperatures equal or above 54°C for 30 min were lethal (Chen, Lin, et al., 2016; Fovo et al., 2017). The same studies showed that the optimal temperatures for conidial germination and sporulation of *P. microspora* were 26–28°C and 23–26°C, respectively, whereas temperatures higher than or equal to 56°C (for 20 min) inhibited conidial germination (Chen, Lin, et al., 2016; Fovo et al., 2017). Additionally, relative humidity (RH) can impact the viability and survival of *Pestalotiopsis* spp. conidia, with RH of 70% being the optimum for conidial germination (Das et al., 2010). A study on infection of *Hymenaea coubaril* (L.) leaves by *P. subcuticularis* showed that hyphae grew in, and beneath the cuticle, killing the cells and thus giving rise to lesions which increased in size until almost the entire surface of the leaf was covered (Fail & Langenheim, 1990). At that time, acervuli were formed and, on reaching maturity, released conidia. These conidia may cause secondary infections and increase disease severity (Maharachchikumbura et al., 2011).

3.1.3 | Host range/species affected

Pestalotiopsis microspora is most commonly associated with tropical and semi-tropical plant species (Metz et al., 2000). It has been isolated as a saprophyte from bark and decaying plant material, and as an endophyte from stems, leaves, flowers and fruits. It has also been reported to cause diseases on a wide range of monocotyledonous, dicotyledonous and gymnosperms, either cultivated or wild plant species. In general, *Pestalotiopsis* species are not considered to be host-specific (Hopkins & McQuilken, 2000). Despite its prevalence, the role of *P. microspora* in plant ecology is poorly understood (Keith et al., 2006; Metz et al., 2000).

A detailed list of the cultivated and wild plant species in which the fungus has been detected so far, either as an endophyte or as a pathogen, is included in Appendix A (last updated August 2023). Nevertheless, because of the wide range of plant species associated with *P. microspora* and given that most of the reports refer to this fungal species as an endophyte, this pest categorisation will focus on the hosts that are relevant for the EU and for which there is robust evidence in the literature that (a) the fungus was isolated from symptomatic plant tissues and was identified based on morphology and multilocus gene sequencing analysis, (b) the Koch's postulates were fulfilled through pathogenicity tests and (c) impacts on affected crops were reported. Using the above criteria, the Panel identified the following plant species (crops and ornamentals) as main hosts of *P. microspora* relevant for the EU: *Actinidia chinensis* (Li et al., 2016), *Ampelopsis grossedentata* (Yuan et al., 2022), *Eriobotrya japonica* (Lu et al., 2016), *Musa* spp. (Bhuiyan et al., 2022), *Persea americana* (Kimaru et al., 2018), *Psidium guajava* (El-Argawy, 2015) and *Vaccinium corymbosum* (Yi-Lan et al., 2021).

Nevertheless, similar to other *Pestalotiopsis* species, the actual host range of *P. microspora* is still unknown mainly because of the different lifestyles of the fungus (endophyte, opportunistic pathogen, saprophyte) (see Section 3.1.2) and the uncertainty about its possible misidentification based on non-molecular methods in the past.

3.1.4 | Intraspecific diversity

Based on the available literature, no intraspecific diversity has been reported so far in *P. microspora*. Nevertheless, the fungus appears to be genetically diverse, due to the enormous variation in its biochemical and phenotypic traits (Li et al., 1996; Strobel & Daisy, 2003). This variation among *P. microspora* strains has been reported to be dependent on the cultural conditions of the fungus, but also on the original plant source from which it was isolated (Strobel & Daisy, 2003). In fact, it has been suggested that *P. microspora* can incorporate plant DNA into its own genome, and eventually express and replicate it, allowing the fungus to readily adapt to a new plant (Li et al., 1996; Strobel et al., 1996). This suggestion was based on the capabilities of *P. microspora* isolated from *Taxus* species to synthesise taxol (an anti-cancer drug originally derived from *Taxus* spp.) (Strobel et al., 1996). Moreover, it has been shown that *P. microspora* can be easily genetically modified under laboratory conditions, via the addition of foreign DNA (Long et al., 1998), suggesting that the uptake of plant DNA into its own genome may occur in nature (Strobel & Daisy, 2003).

It is important to note that the ability of *P. microspora* to possibly undergo sexual reproduction may also enhance its genomic plasticity and adaptation to various adverse environmental conditions, including fungicide exposure.

3.1.5 | Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, there are methods available for the detection and identification of *Pestalotiopsis microspora*.

Symptoms and signs

Pestalotiopsis microspora can cause symptoms on several parts of its host plants. However, it affects mainly the leaves, causing leaf spot (De Jesus et al., 2022; Herliyana et al., 2022; Shen et al., 2014; Yuan et al., 2022) and leaf blight (Bhuiyan et al., 2022; Herliyana et al., 2022; Jeon et al., 2007; Jeon & Cheon, 2014; Ngobisa et al., 2018; Wu et al., 2009; Xiao et al., 2016; Zhong Jiu et al., 2010). It can affect roots, causing root rot (Lu et al., 2016), but also fruits, causing fruit spots (Chuanqing et al., 2010; Shi et al., 2015), scabby fruit canker (Keith et al., 2006) and pre- (Sultana et al., 2021) and post-harvest fruit rot (Chen, Chen, et al., 2016; Li et al., 2016), and to a lesser extent twigs, causing twig blight (Ren et al., 2021). Nevertheless, disease symptoms caused by *P. microspora* are similar to those caused by other *Pestalotiopsis* species or other fungal genera, which makes the detection of *P. microspora* based merely on symptoms unlikely. If fruiting structures of the pathogen (acervuli, or possibly perithecia) are detected on the symptomatic plant tissues using a magnifying lens, they are similar in morphology to those of other fungal species of the family Pestalotiopsidaceae. In addition, the pathogen may remain quiescent or latent within the host tissues (see Section 3.1.2). Based on the above, it is unlikely that *P. microspora* could be detected based only on visual inspection of its host plants.

Morphology

Typical cultural and morphological characteristics of *P. microspora* growing in potato dextrose agar medium include greyish to white zonate and cottony colonies, that become later yellowish as fungal age increases, with coloured small acervular conidiomata (de Jesus et al., 2022; Jeon et al., 2007; Keith et al., 2006). In culture, the fungus has a brown to hyaline branched septate hyphae (Strobel et al., 1996). The conidia are fusiform with four septa, with both the basal and terminal cells being hyaline and the median cells brown (Strobel et al., 1996). The conidia vary in size from 18.1 to 35.9 μm long by 4.4 to 6.9 μm wide (Herliyana et al., 2022). The first median cell is 3.3–6.6 μm long, the second 3.3–5.7 μm and third 3.6–6.6 μm. The apical cell is 3.2–6.1 μm long, hyaline, conic, with two to four tubular apical appendages, arising from the apical crest, unbranched, filiform, and 11.2–35.4 μm long. The basal cell is 2.9–6.4 μm long, conic, hyaline, with a single tubular basal appendage, 3.5–10 μm long, and unbranched (Herliyana et al., 2022).

Chang and Chang (1990) provide a detailed morphological description of *Pestalosphaeria hansenii*, the possible sexual stage of *P. microspora*.

Identification of *Pestalotiopsis* to species level solely based on morphology is difficult, since the morphological characters used to differentiate species are limited. For example, *P. microspora*, *P. disseminata*, *P. neglecta* and *P. vismiae*, within the *Pestalotiopsis concolorous* group, produce conidia of similar size (Maharachchikumbura et al., 2011). Moreover, several morphological characters, either at colony level (colour, texture) or conidia level (shape and colour of the median cells), may vary within a single *Pestalotiopsis* species (Hu et al., 2007; Jeewon, Liew, Simpson, et al., 2003). The morphology of *Pestalotiopsis* species can also vary depending on the environment and the host from which they were isolated (Maharachchikumbura et al., 2016). Based on the above, it is unlikely that *P. microspora* could be detected only by cultural and morphological characteristics.

DNA-based identification

The molecular techniques available for the identification of *P. microspora* are mostly based on the sequencing of the internal transcribed spacers (ITS) of genomic rDNA, in particular the region ITS1–5.8S–ITS2 (Bhuiyan et al., 2022; De Jesus et al., 2022; Herliyana et al., 2022; Jeon et al., 2007; Jeon & Cheon, 2014; Lu et al., 2016; Shi et al., 2015; Xiao et al., 2016; Zhong Jiu et al., 2010). Other DNA regions, such as the protein-coding gene beta-tubulin (*tub2*), have been used together with the ITS for a more reliable identification of *P. microspora* (Li et al., 2016; Yuan et al., 2022). As for other fungi, the use of multiple genetic markers, such as ITS, beta-tubulin and translation elongation factor 1-alpha (TEF1-α), are needed to clearly distinguish *Pestalotiopsis* species (Liu et al., 2019; Maharachchikumbura et al., 2014). Nucleotide sequences of *P. microspora* are available in GenBank (www.ncbi.nlm.nih.gov/genbank; 639 sequences retrieved on 22 September 2023) and could be used as reference material for molecular diagnosis. Nevertheless, due to the unsolved nomenclature of the *Pestalotiopsis* genus, the names applied to data in GenBank may be doubtful and most are not linked to any type materials.

No EPPO Standard is available for the detection and identification of *P. microspora* and no species-specific primers for PCR-based identification are available either.

Based on the above, in order to achieve a reliable identification of the pathogen, a combination of morphological and molecular methods is required.

3.2 | Pest distribution

3.2.1 | Pest distribution outside the EU

Pestalotiopsis microspora has been reported from North America (Bermuda, Mexico, United States [Florida, Georgia, Hawaii, Pennsylvania, South Carolina]), Central America (Cuba, Honduras, Panama, West Indies), South America (Argentina, Brazil, Colombia, Ecuador, Peru, Uruguay, Venezuela), Africa (Burkina Faso, Cameroon, Egypt, Ghana, Kenya, Nigeria, Réunion Island, Zambia), Asia (Bangladesh, China, Hong Kong, India, Indonesia, Japan, Lebanon, Malaysia, Myanmar, Nepal, Singapore, South Korea, Sri Lanka, Thailand) and Oceania (Australia, Papua New Guinea). The current geographical distribution of *P. microspora* is shown in Figure 1. A list of the countries and states/provinces from where the fungus has been reported is included in Appendix B. The records are based on CABI (2021), Farr et al. (2021) (https://nt.ars-grin.gov/fungaldatabases/; accessed August 2023) and other literature sources.

Nevertheless, the current geographical distribution of *P. microspora* outside the EU might be wider than reported, as in the past, when molecular tools (particularly multigene phylogenetic analysis) were not available, the pathogen might have been misidentified based only on morphology and pathogenicity tests, which cannot reliably differentiate species within the genus *Pestalotiopsis* or other closely related genera of the family Pestalotiopsidaceae (e.g. *Pestalotia*, *Neopestalotiopsis*). Moreover, given that *P. microspora* may colonise endophytically a wide range of plant species, its distribution might be wider than that shown in Figure 1.

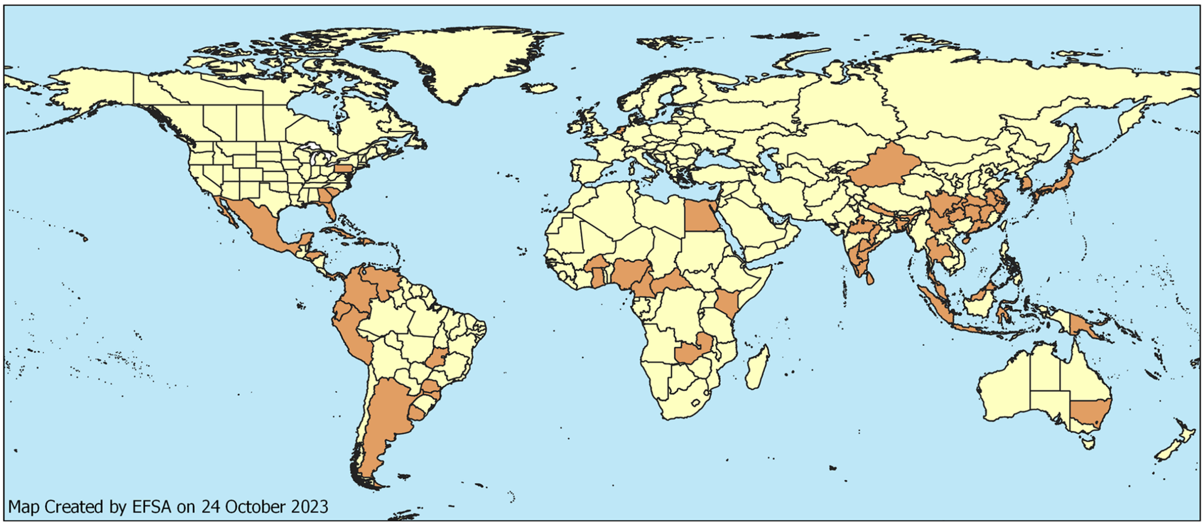

FIGURE 1 Global distribution of *Pestalotiopsis microspora* (based on literature sources listed in Appendix B).

3.2.2 | Pest distribution in the EU

Is the pest present in the EU territory? If present, is the pest in a limited part of the EU or is it scarce, irregular, isolated or present infrequently? If so, the pest is considered to be not widely distributed.

Yes. *Pestalotiopsis microspora* was reported to be present in the EU (the Netherlands).

Pestalotiopsis microspora was reported from the Valencia region in Spain in a study of circular leaf spot caused by *Plurivorosphaerella nawae*, a new disease of persimmon (*Diospyros kaki*) in Spain (Berbegal et al., 2010). The authors isolated a *Pestalotiopsis* species together with *Phomopsis* sp. and *P. nawae* from symptomatic leaves and fruit of *D. kaki*. However, (i) the identification of the isolated *Pestalotiopsis* species was based on morphology and ITS sequence with none of these methods (used either alone or in combination) being reliable for the accurate identification of *Pestalotiopsis* at species level, (ii) the authors conducted pathogenicity tests with all the above three fungi, but only the *P. nawae* isolate was proven to be pathogenic. The Spanish NPPO confirmed in October 2023 that the used methodology would be insufficient to confirm the identity of the isolates as *P. microspora*, since the taxonomy of the genus has changed and, currently, for the correct identification of species of the genus *Pestalotiopsis*, multilocus phylogenies with sequencing of several genes are needed. The status of *P. microspora* in Spain is thus considered as: Absent, invalid record.

According to EFSA PLH Panel (2022), Farr and Rossman (online, https://nt.ars-grin.gov/fungaldatabases/) reported one point-data of *P. microspora* in Italy. The KNAW-CBS Culture Collection of the Westerdijk Fungal Biodiversity Institute (https://wi.knaw.nl/Collection; accessed on 29 August 2023) includes one observation of *P. microspora* on a leaf of *Chamaerops* *humilis* collected in Sardinia, Italy, in 1971. According to the KNAW database (https://wi.knaw.nl/details/80/21661), this observation was attributed in 2015 to a different *Pestalotiopsis* species (*P. chamaerops*). The Italian NPPO stated in October 2023 that they are not aware of further reports of *P. microspora*.

Cleary et al. (2019) reported that the DNA of the pathogen was detected in seed lots of *Pinus radiata* from Portugal. However, in the supplementary information available online, *P. microspora* is not listed as detected in Portugal. EFSA contacted the authors and Cleary confirmed (pers. comm., October 2023) that the information regarding *P. microspora* is correct in the main text of their paper (where they reported that the DNA of the pathogen was detected in seed lots of *Pinus radiata* from Portugal), not in the supplementary information online. However, the report is considered inconclusive as the identification of the fungal community associated with *Pinus* spp. seed lots was based only on the sequence of the ITS2 region by using metabarcoding approach, which does not allow the accurate identification of the fungi at species level. In addition, there is uncertainty about the actual origin of the seed lots and no other reports exist in the available literature on the presence of *P. microspora* in Portugal.

The KNAW-CBS Culture Collection of the Westerdijk Fungal Biodiversity Institute (https://wi.knaw.nl/Collection; accessed on 29 August 2023) includes one observation of *P. microspora* isolated from dead leaves of *Taxus baccata* in the Netherlands. The Dutch NPPO confirmed in September 2023 that, although they do not officially monitor the presence of this fungus, the Mycological Society of the Netherlands considers *P. microspora* to be indigenous(see: https://www.nederlandsesoorten.nl/linnaeus_ng/app/views/species/nsr_taxon.php?id=134377&cat=CTAB_PRESENCE_STATUS).[2] The Panel considers that, based on the definition reported in the footnote, the fungus seems established in the Netherlands. The status of *P. microspora* in the Netherlands is reported by the Dutch NPPO as 'Present, no details'.

Based on the above, the lack of systematic surveys, and the reasons mentioned in Section 3.2.1 (in the past, when molecular tools (particularly multigene phylogenetic analysis) were not available, the pathogen might have been misidentified based only on morphology and pathogenicity tests, which cannot reliably differentiate species within the genus *Pestalotiopsis* or other closely related genera of the family Pestalotiopsidaceae (e.g. *Pestalotia, Neopestalotiopsis*). Moreover, given that *P. microspora* may colonise endophytically a wide range of plant species, its distribution might be wider than reported), there is a key uncertainty on the presence and distribution of *P. microspora* in the EU.

3.3 | Regulatory status

3.3.1 | Commission implementing regulation 2019/2072

Pestalotiopsis microspora is not listed in Annex II of Commission Implementing Regulation (EU) 2019/2072, an implementing act of Regulation (EU) 2016/2031, or in any emergency plant health legislation.

3.3.2 | Hosts or species affected that are prohibited from entering the union from third countries

None of the main hosts identified in Section 3.1.3 are included in Commission Implementing Regulation 2019/2072. A list of commodities included in Annex VI of Commission Implementing Regulation (EU) 2019/2072 is provided in Table 2. One of the main hosts, *Persea americana*, is included in the Commission Implementing Regulation (EU) 2018/2019 on high-risk plants.

TABLE 2 List of plants, plant products and other objects that are *Pestalotiopsis microspora* hosts whose introduction into the Union from certain third countries is prohibited (Source: Commission Implementing Regulation (EU) 2019/2072, Annex VI).

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

[2]In the Netherlands, an organism is considered indigenous ('oorspronkelijk') when it is assessed as having been successfully reproducing for at least 10 years (and can be thus considered as settled in the natural habitat; Gerard Verkley, Westerdijk Institute, pers. comm., October 2023).

3.4 | Entry, establishment and spread in the EU

3.4.1 | Entry

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

Yes. *Pestalotiopsis microspora* could mainly further enter the EU via host plants for planting, fruits, parts of host plants (e.g. foliage, branches, bark, wood), and soil/plant growing media associated with debris of host plants.

Comment on plants for planting as a pathway.

Plants for planting are a main pathway of further entry of the pathogen into the EU.

The Panel identified the following main pathways for the further entry of *P. microspora* into the EU:

1) host plants for planting,
2) fresh fruits of host plants,
3) bark and wood of host plants and
4) soil and other plant growing media contaminated with infected host plant debris, all originating in infested third countries.

Similar to other *Pestalotiopsis* species (Tibpromma et al., 2019) or other closely related genera of the family Pestalotiopsidaceae (e.g. *Pestalotia, Neopestalotiopsis*) (Agarwal et al., 2006; Atieno et al., 2021; Benetti et al., 2009; Nicholson & Sinclair, 1971; Parashurama & Shivanna, 2012; Sultana et al., 2020), *P. microspora* could potentially enter the EU via seeds of its host plants, although, so far, there has been no evidence of the pathogen being seed-borne.

Pestalotiopsis microspora has been frequently isolated as an endophyte from a wide range of plant species. Therefore, the pathogen may enter the EU on asymptomatic parts (e.g. stems, branches, fruits) of its hosts. Moreover, its ability to survive as a saprophyte in dead plant tissues (leaves, bark, wood) may facilitate its entry into the EU through soil and growing media associated with infected plant debris imported from infested third countries.

The pathogen is unlikely to enter the EU by natural means (e.g. wind, rain, wind-driven rain, insects) because of the long distance between the infested third countries (see Section 3.2.1) and the EU MSs. Uncertainty exists on the potential of *P. microspora* to enter the EU from Türkiye by natural means given that the report of its presence in that neighbouring to the EU country is inconclusive as only the DNA of the fungus has been detected in seed lots of *P. brutia* and *P. radiata* based on the sequence of the ITS2 region (Cleary et al., 2019), which cannot reliably identify fungi at species level.

Although there are no data available, spores of the pathogen may also be present as contaminants on other substrates or objects (e.g. second hand agricultural machinery and equipment, crates, etc.) imported into the EU. Nevertheless, these are considered minor pathways for the entry of the pathogen into the EU territory.

A list of all the potential pathways for the further entry of the pathogen into the EU is included in Table 3.

TABLE 3 Potential pathways for the further entry of *Pestalotiopsis microspora* into the EU 27.

Pathways (e.g. host/intended use/source)	Life stage	Relevant mitigations (e.g. prohibitions [Annex VI], special requirements [Annex VII] or phytosanitary certificates [Annex XI] within Implementing Regulation 2019/2072)
Host plants for planting, other than seeds	Mycelium, acervuli and possibly perithecia	None of the main hosts identified in Section 3.1.3 are included in Commission Implementing Regulation 2019/2072. There is a temporary prohibition for high-risk plants (Regulation 2018/2019)
Seeds of host plants for sowing	Mycelium	A phytosanitary certificate is required for the introduction into the Union from third countries, other than Switzerland, of seeds of host plants for sowing
Fresh fruits of host plants	Mycelium, acervuli	• A phytosanitary certificate is required for the introduction into the Union from third countries other than Switzerland, of kiwi, guava and blueberry fruits fresh or dried [Annex XI, Part A, point 5 of Commission Implementing Regulation (EU) 2019/2072]. • There are no special requirements, including a phytosanitary certificate, for the introduction into the Union from third countries of banana fruits, including plantains, fresh or dried.
Parts of host plants, other than fruits and seeds (cut flowers, foliage, branches, etc.)	Mycelium, acervuli and possibly perithecia	A phytosanitary certificate is required for the introduction into the Union from third countries other than Switzerland, of parts of host plants other than fruits and seeds [Annex XI, Part B of Commission Implementing Regulation (EU) 2019/2072]
Soil as such not attached or associated with plants for planting	Mycelium	The introduction into the Union from third countries, other than Switzerland, of soil as such consisting in part of solid organic substances is banned [Annex VI (19) of Commission Implementing Regulation (EU) 2019/2072]

TABLE 3 (Continued)

Pathways (e.g. host/intended use/source)	Life stage	Relevant mitigations (e.g. prohibitions [Annex VI], special requirements [Annex VII] or phytosanitary certificates [Annex XI] within Implementing Regulation 2019/2072)
Growing medium as such, other than soil not attached or associated with plants for planting	Mycelium	The introduction into the Union from third countries, other than Switzerland, of growing medium as such is banned [Annex VI (20) of Commission Implementing Regulation (EU) 2019/2072]
Growing medium, attached to or associated with host and non-host plants for planting carrying infected plant debris, with the exception of sterile medium of in vitro plants	Mycelium, acervuli and possibly perithecia	A phytosanitary certificate is required for the introduction into the Union from third countries, other than Switzerland, of growing medium attached to or associated with plants, intended to sustain the vitality of the plants [Annex XI, Part A (1) of Commission Implementing Regulation (EU) 2019/2072]. Special requirements also exist for this commodity [Annex VII (1) of Commission Implementing Regulation (EU) 2019/2072]
Machinery and vehicles with contaminated soil and/or infected debris of host plants	Mycelium, acervuli and possibly perithecia	A phytosanitary certificate is required for the introduction into the Union from third countries, other than Switzerland, of machinery and vehicles [Annex XI, Part A (1) of Commission Implementing Regulation (EU) 2019/2072]. Special requirements also exist for this commodity [Annex VII (2) of Commission Implementing Regulation (EU) 2019/2072]

The quantity of fresh produce of main hosts imported into the EU from countries where *P. microspora* is present is provided in Table 4 and Appendix C.

TABLE 4 EU annual imports of fresh produce from countries where *Pestalotiopsis microspora* is present, 2017–2021 (in 100 kg) Source: Eurostat (accessed on 11 July 2023).

Commodity	HS code	2017	2018	2019	2020	2021
Avocado fruits	08040000	2,325,840	3,201,507	3,167,556	3,997,215	4,817,091
Kiwi fruits	08105000	13,402.6	14,510.57	18,327.64	29,265.21	27,952.47
Fresh or dried guavas, mangoes[a]	08045000	2,170,967.57	2,570,207.88	2,675,957.92	2,980,902.60	3,193,951.46
Bananas, excl. plantains	08039010	6,387,322.32	5,986,408.50	5,653,462.73	5,522,554.22	4,924,495.53
Fresh cranberries, bilberries and other fruits of the genus *Vaccinium*[b]	081040	150,564.46	185,050.88	324,883.74	489,342.00	527,155.39
	Sum	8,722,256.95	8,756,177.83	8,672,632.03	9,022,064.03	8,673,554.85

[a]This code includes also mangosteens, which is not known to be hosts of *P. microspora*.

[b]Only Vaccinium corymbosum is a host of *P. microspora*.

Notifications of interceptions of harmful organisms began to be compiled in Europhyt in May 1994 and in TRACES in May 2020. As of 10 September 2023, there were no records of interception of *P. microspora* in the Europhyt and TRACES databases.

3.4.2 | Establishment

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

Yes. Both the biotic (host availability) and abiotic (climate suitability) factors occurring in the EU suggest that *P. microspora* could further establish where susceptible hosts are grown, similarly to other established *Pestalotiopsis* species.

Following its entry into the EU, *P. microspora* could establish in parts of the EU where susceptible hosts are grown, and the climatic conditions are conducive for completing its life cycle, similar to other *Pestalotiopsis* species or other genera of the family Pestalotiopsidaceae established in the EU (Ismail et al., 2013; Lorenzini & Zapparoli, 2018; Maharachchikumbura et al., 2011, 2014; Morales-Rodriguez et al., 2019).

Based on its biology (see Section 3.1.2), *P. microspora* could potentially be transferred from the pathways of entry to the host plants grown in the EU by wind, water (irrigation, rain) splash, soil or other plant growing media associated with infested plant debris, and possibly insects, similar to other *Pestalotiopsis* species (Bateman et al., 2016; Martínez & Plata-Rueda, 2013), as well as with birds and small animals (see Section 3.4.3). The frequency of this transfer depends on the volume and frequency of the imported commodities, their destination (e.g. nurseries, retailers, packinghouses) and its proximity to the hosts grown in the EU, as well as on the management of plant debris and fruit waste.

3.4.2.1 | *EU distribution of main host plants*

As noted above and shown in Appendix A, *P. microspora* has a wide host range, being also able to colonise several of those plant species endophytically. Some of its main hosts (e.g. *Actinidia chinensis, Eriobotrya japonica, Musa* spp., *Vaccinium corymbosum*; see Section 3.1.3) are widely distributed in the EU, both in commercial production (nurseries, open fields, orchards) and in home gardens and forests. The harvested area of most of the main hosts of *P. microspora* cultivated in the EU in recent years is shown in Table 5. Appendix D provides production statistics for individual MSs.

TABLE 5 Harvested area of *Pestalotiopsis microspora* main hosts in the EU, 2017–2021 (1000 ha). Source: EUROSTAT (accessed on 1 June 2023; for individual Member States, see Appendix D).

Crop	HS code	2017	2018	2019	2020	2021
Avocado	F2300	12.72	13.22	17.50	19.69	22.85
Bananas	F2400	18.91	17.94	18.27	22.11	22.01
Blueberries	F3300	16.86	19.35	21.13	24.01	26.07
Kiwi	F2200	43.83	44.20	44.18	44.98	46.53
Fruits from subtropical and tropical climate zones	F2000	138.99	139.62	150.40	167.23	173.23
	Total	218.59	221.11	233.98	258.33	267.84

3.4.2.2 | *Climatic conditions affecting establishment*

Based on the data available in the literature on the geographical coordinates of the locations from where *P. microspora* has been reported, the pathogen is present in non-EU areas with BSh, BSk, Cfa and Cfb, Cfc, Csa, Csb, Csc Köppen–Geiger climate zones. These climate zones also occur in the EU where susceptible hosts of *P. microspora* are grown (Figure 2).

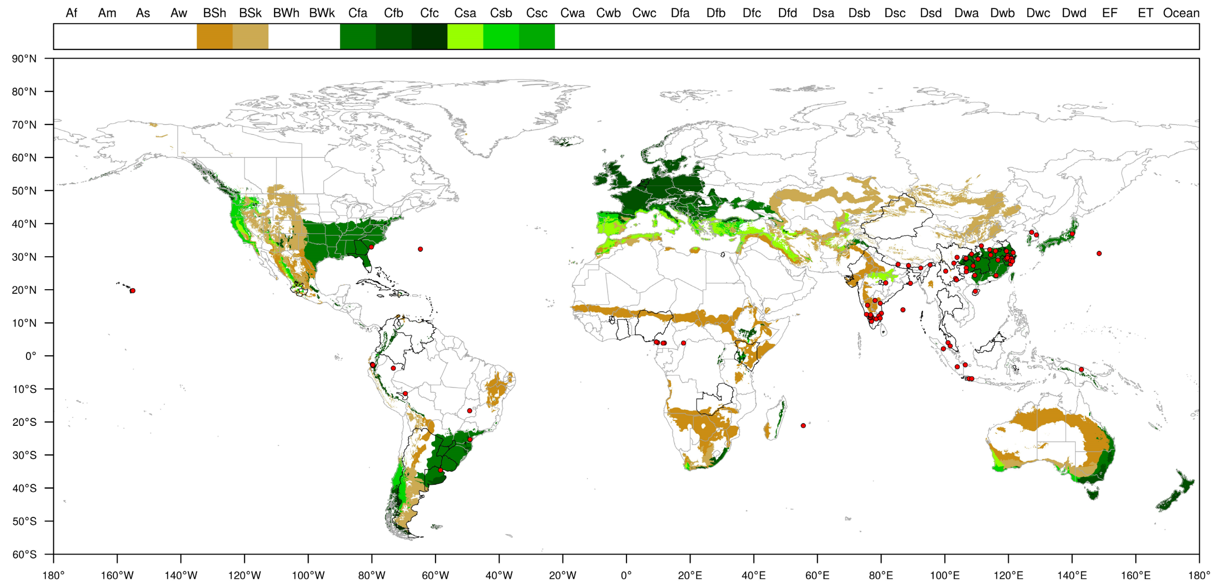

FIGURE 2 Distribution of eight Köppen–Geiger climate types, i.e. BSh, BSk, Cfa, Cfb, Cfc, Csa, Csb, Csc that occur in the EU and in third countries where *Pestalotiopsis microspora* has been reported. The legend shows the list of Köppen–Geiger climates. Red dots indicate point locations where *P. microspora* was reported.

3.4.3 | Spread

Describe how the pest would be able to spread within the EU territory following establishment.

Following its further establishment in the EU, *Pestalotiopsis microspora* could potentially spread within the territory by both natural and human-assisted means.

Comment on plants for planting as a mechanism of spread.

Host plants for planting are a main means of spread of *P. microspora* within the EU.

Pestalotiopsis microspora could potentially spread within the EU by natural and human-assisted means.

Spread by natural means. Conidia of the pathogen, like those of other species of the genus *Pestalotiopsis* or other genera of the family Pestalotiopsidaceae (e.g. *Pestalotia, Neopestalotiopsis*), are dispersed over relatively short distances (up to 0.7 m for conidia of *P. sydowiana*) by water splash (rain, overhead irrigation) (Hopkins, 1996). Although it has not been studied in the case of *P. microspora*, wind may increase the dispersal distance of water-splashed conidia. In addition, the pathogen could potentially spread by the wind-disseminated spores (ascospores) of its sexual stage (see Section 3.1.2). However, the role of those spores in the epidemiology of the diseases caused by *P. microspora* is still unknown. Similar to other *Pestalotiopsis* species (Battisti et al., 1999; Martínez & Plata-Rueda, 2013; Mitchell, 2004), conidia of *P. microspora* could potentially be passively dispersed on the bodies of arthropods. Birds, rodents and other small animals could also disperse the pathogen via infected fruits and seeds (Corlett, 2017).

Spread by human-assisted means. The pathogen can spread over long distances through the movement of infected host plants for planting (e.g. rootstocks, grafted plants, scions), including dormant plants, as well as fresh fruits, contaminated soil/plant growing media associated with plant debris and agricultural machinery, tools, etc. Like other *Pestalotiopsis* species or other closely related genera of the family Pestalotiopsidaceae, the pathogen could potentially spread within the EU via seeds of its host plants, although, so far, there has been no evidence of *P. microspora* being seed-borne.

3.5 | Impacts

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

Yes, the further introduction into and spread within the EU *of Pestalotiopsis microspora* is expected to have economic and environmental impact in parts of the territory where susceptible hosts are grown. Nevertheless, there is uncertainty on the magnitude of this impact.

Although very limited quantitative data are available from the areas of its present distribution, *P. microspora* has been reported to have a direct impact on its hosts by causing a variety of disease symptoms (see Section 3.1.5).

Shen et al. (2014) identified *P. microspora* as the causal agent of a leaf spot disease of oil palm (*Elais guineensis*) in China, with a 15%–20% incidence during the typhoon season (July to October). A similar disease incidence (18%–23%) caused by the pathogen on moyeam (*Ampelopsis grossedentata*) was reported by Yuan et al. (2022). In July 2020, the disease on moyeam plants caused by *P. microspora* resulted in production losses of up to $1.7 million in China (Yuan et al., 2022). Bhuiyan et al. (2022) reported that *P. microspora* caused a new banana (*Musa* spp.) leaf blight disease in various districts of Gazipur, Bangladesh, with disease incidences of 5%–10% in June 2020 and 15%–20% in January 2021. Scabby fruit canker, caused by *P. psidii, P. microspora, P. clavispora*, *P. neglecta* and *Pestalotiopsis* sp. is one of the most common fruit diseases of guava (*Psidium guajava*), as it affects all the developmental stages of the fruit (El-Argawy, 2015; Kwee & Chong, 1990). The disease can drastically reduce fruit yield during the preharvest stage, but it can also result in great losses during fruit storage. According to Chen et al. (2016, 2018), *P. microspora* is the dominant pathogen causing fruit rots in Chinese olive (*Canarium album*) resulting in considerable quality losses and a shorter shelf-life. In China, leaf spot caused by *P. microspora* is one of the major fungal diseases of blueberry (*Vaccinium corymbosum*) which can result in plant death, if not treated promptly (Yi-Lan et al., 2021). Li et al. (2016) identified *P. microspora* as the causal agent of a serious post-harvest fruit rot of kiwifruit (*Actinidia chinensis*) in China with the infected fruits becoming severely decayed and sour smelling when transferred from the cold storage to room temperature. *Pestalotiopsis microspora* has been reported to cause a leaf blight disease and a root rot disease of loquat (*Eriobotrya japonica*) in China, with an incidence of 10–15% and 30%, respectively.

Based on the above, it is expected that the introduction into and spread within the EU of *P. microspora* would potentially have an economic and environmental impact in parts of the territory where susceptible hosts are grown. However, there is uncertainty on the magnitude of this impact particularly considering the increased frequency of heavy precipitations and extreme extratropical cyclones in Europe due to global warming (Priestley & Catto, 2022), which not only may create climatic conditions more conducive to the growth and development of the pathogen but also act as stress factors causing wounds on susceptible hosts and/or triggering the fungus to switch from the endophytic to the pathogenic lifestyle. Moreover, it is not known whether the agricultural practices and chemical control measures currently applied in the EU could potentially reduce the impact caused by *P. microspora*.

3.6 | Available measures and their limitations

Are there measures available to prevent pest entry, establishment, spread or impacts such that the risk becomes mitigated?

Yes. Although not specifically targeted against *P. microspora*, existing phytosanitary measures (see Sections 3.3.2 and 3.4.1) mitigate the likelihood of the pathogen's further entry into the EU on certain host plants. Potential additional measures are also available to further mitigate the risk of entry, establishment, spread and impacts of the pathogen in the EU (see Section 3.6.1).

3.6.1 | Identification of potential additional measures

Phytosanitary measures (prohibitions) are currently applied to some host plants for planting (see Section 3.3.2).

Additional potential risk reduction options and supporting measures are shown in Sections 3.6.1.1 and 3.6.1.2.

3.6.1.1 | *Additional potential risk reduction options*

Potential additional control measures are listed in Table 6.

TABLE 6 Selected control measures (a full list is available in EFSA PLH Panel, 2018) for pest entry/establishment/spread/impact in relation to currently unregulated hosts and pathways. Control measures are measures that have a direct effect on pest abundance.

Control measure/risk reduction option (blue underline = Zenodo doc, blue = WIP)	RRO summary	Risk element targeted (entry/establishment/spread/impact)
Require pest freedom	Plants, plant products and other objects come from a pest-free country or a pest-free area or a pest-free place of production	Entry/Spread
Growing plants in isolation	Description of possible exclusion conditions that could be implemented to isolate the crop from pests and if applicable relevant vectors. E.g. a dedicated structure such as glass or plastic greenhouses Growing nursery plants in isolation may represent an effective control measure	Entry/Establishment/ Spread
Managed growing conditions	Proper field drainage, plant distancing, use of pathogen-free agricultural tools (e.g. pruning scissors, saws and grafting blades), and removal of infected plants and plant debris in the nursery/field/orchard could potentially mitigate the likelihood of infection at origin as well as the spread of the pathogen	Entry/Spread/Impact
Crop rotation, associations and density, weed/ volunteer control	Crop rotation, associations and density, weed/volunteer control are used to prevent problems related to pests and are usually applied in various combinations to make the habitat less favourable for pests The measures deal with (1) allocation of crops to field (over time and space) (multi-crop, diversity cropping) and (2) to control weeds and volunteers as hosts of pests/ vectors Although *P. microspora* has been isolated either as an endophyte or as a pathogen from a wide range of hosts (Appendix A), crop rotation (wherever feasible) may represent an effective means to reduce inoculum sources and potential survival of the pathogen	Establishment/spread/ impact
Use of resistant and tolerant plant species/ varieties	Resistant plants are used to restrict the growth and development of a specified pest and/or the damage they cause when compared to susceptible plant varieties under similar environmental conditions and pest pressure. • It is important to distinguish resistant from tolerant species/varieties. There are studies showing variations in host plant resistance to *P. microspora* among varieties or clones of several plant species (e.g. *Hevea brasiliensis*, *Myrica rubra*, *Carya illinoinensis*) (Alchemi & Jamin, 2022; Chen et al., 2022; Ren et al., 2021). Therefore, the identification and selection of resistant and tolerant host species/varieties may contribute to the restriction of the growth and development of *P. microspora*	Entry/Establishment/ Impact
Roguing and pruning	Roguing is defined as the removal of infested plants and/or uninfested host plants in a delimited area, whereas pruning is defined as the removal of infested plant parts only without affecting the viability of the plant *Pestalotiopsis microspora* survives also on infected attached plant organs, which can act as inoculum sources. Thus, pruning of the symptomatic plant organs and roguing of host plants may be an effective measure for reducing the inoculum sources and the spread capacity of the pathogen in the field	Spread/impact

TABLE 6 (Continued)

Control measure/risk reduction option (blue underline = Zenodo doc, blue = WIP)	RRO summary	Risk element targeted (entry/establishment/spread/impact)
Biological control, biopesticides and behavioural manipulation	Biological control of *P. microspora* is still limited to the laboratory. Some microbial antagonists, mostly of the genus *Bacillus*, were also reported to inhibit the growth of *P. microspora* in vitro (Bin et al., 2018; Mohamad et al., 2018) Plant extracts from *Allium sativum, Syzygium aromaticum* and *Zingiber officinale* were shown to inhibit the in vitro growth or conidial germination of *P. microspora* (Chen et al., 2018; Yaouba et al., 2021) or to suppress disease development in artificially inoculated Chinese olive fruits (Chen et al., 2018)	Entry/Establishment/Spread/Impact
Chemical treatments on crops including reproductive material	Several fungicides (e.g. pyraclostrobin, cuprous oxide, metalaxyl) were shown to be effective in vitro in inhibiting *P. microspora* mycelial growth or conidial germination (Ngobisa et al., 2018; Zhang et al., 2012), but none of them was tested under field conditions. Despite this, some fungicides were found to be effective in the field (Hopkins, 1996; Sanjay et al., 2008) and/or nursery against other *Pestalotiopsis* species (McQuilken & Hopkins, 2001) The application of beta-aminobutyric acid (not allowed as a plant protection product in the EU) proved to be effective in inducing disease resistance of blueberries (*Vaccinium corymbosum*) to leaf spot caused by *P. microspora* (Yi-Lan et al., 2021)	Entry/Establishment/Spread/ Impact
Chemical treatments on consignments or during processing	The application of fungicides to plants or plant products after harvest, during process or packaging operations and storage may contribute to mitigate the likelihood of entry or spread of *P. microspora* Post-harvest application of botanical fungicides on Chinese olive fruits has been reported to decrease the development of the disease caused by *P. microspora* (Chen et al., 2018)	Entry/Spread/Impact
Physical treatments on consignments or during processing	Physical treatments (irradiation, mechanical cleaning, sorting, etc.) may reduce or mitigate the risk of entry/spread of *P. microspora* although no specific information is available for this fungal species	Entry/Spread
Cleaning and disinfection of facilities, tools and machinery	The physical and chemical cleaning and disinfection of facilities, tools, machinery, transport means, facilities and other accessories (e.g. boxes, pots, pallets, palox, supports, hand tools). The measures addressed in this information sheet are: washing, sweeping and fumigation *Pestalotiopsis microspora* infects its host plants through wounds created by pruning or grafting. Therefore, and although no specific information is available on this species, cleaning and surface sterilisation of pruning and grafting tools as well as of equipment and facilities (including premises, storage areas) are good cultural and handling practices employed in the production and marketing of any commodity and may mitigate the likelihood of entry or spread of the pathogen	Entry/Spread
Limits on soil	*Pestalotiopsis microspora* survives in the soil and on plant debris lying on the soil surface. Therefore, plants, plant products and other objects (e.g. used farm machinery) should be free from soil to ensure freedom from *P. microspora*	Entry/Spread
Soil treatment	Although no specific studies are available on *P. microspora*, it is likely that soil and substrate disinfestation with chemical, biological or physical (heat, soil solarisation) means could potentially reduce the persistence and availability of inoculum sources	Entry/Establishment/Spread/Impact
Use of non-contaminated water	Chemical and physical treatment of water to eliminate waterborne microorganisms. The measures addressed in this information sheet are chemical treatments (e.g. chlorine, chlorine dioxide, ozone); physical treatments (e.g. membrane filters, ultraviolet radiation, heat); ecological treatments (e.g. slow sand filtration) Considering that *P. microspora* may spread via contaminated irrigation water, physical or chemical treatment of irrigation water may be applied in nurseries and greenhouses	Entry/Spread/Impact
Waste management	Treatment of the waste (deep burial, composting, incineration, chipping, production of bio-energy…) in authorised facilities and official restriction on the movement of waste Waste management in authorised facilities and official restriction on its movement may prevent the pathogen from escaping in the environment. On-site proper management of pruning residues is also recommended as an efficient measure	Entry/Establishment/Spread
Heat and cold treatments	Controlled temperature treatments aimed to kill or inactivate pests without causing any unacceptable prejudice to the treated material itself. The measures addressed in this information sheet are: autoclaving; steam; hot water; hot air; cold treatment Although not specifically tested against *P. microspora*, hot water treatment (50°C for 30 min) of guava fruits reduced fruit rot caused by *Pestalotiopsis versicolor* (Madhukar & Reddy, 1990)	Entry/Spread

(Continues)

TABLE 6 (Continued)

Control measure/risk reduction option (blue underline = Zenodo doc, blue = WIP)	RRO summary	Risk element targeted (entry/establishment/spread/impact)
Conditions of transport	Specific requirements for mode and timing of transport of commodities to prevent escape of the pest and/or contamination. a. physical protection of consignment b. timing of transport/trade If plant material, potentially infected or contaminated with *P. microspora* (including waste material) must be transported, specific transport conditions (type of packaging/protection, transport means) should be defined to prevent the pathogen from escaping. These may include, albeit not exclusively: physical protection, sorting prior to transport, sealed packaging, etc	Entry/Spread
Controlled atmosphere	Treatment of plants by storage in a modified atmosphere (including modified humidity, O_2, CO_2, temperature, pressure) Although no specific reports are available on *P. microspora*, controlled atmosphere could be employed to achieve prevention/delay of symptoms in infected commodities, particularly fruit. For example, ozone treatment has been successfully applied against *P. mangiferae* on mango fruit (Guillen et al., 1999)	Entry/Spread/Impact
Post-entry quarantine and other restrictions of movement in the importing country	This information sheet covers post-entry quarantine (PEQ) of relevant commodities; temporal, spatial and end-use restrictions in the importing country for import of relevant commodities; prohibition of import of relevant commodities into the domestic country 'Relevant commodities' are plants, plant parts and other materials that may carry pests, either as infection, infestation or contamination Recommended for plant species known to be hosts of *P. microspora*. This measure does not apply to fruits of host plants	Establishment/Spread

3.6.1.2 | *Additional supporting measures*

Potential additional supporting measures are listed in Table 7.

TABLE 7 Selected supporting measures (a full list is available in EFSA PLH Panel, 2018) in relation to currently unregulated hosts and pathways. Supporting measures are organisational measures or procedures supporting the choice of appropriate risk reduction options that do not directly affect pest abundance.

Supporting measure	Summary	Risk element targeted (entry/establishment/spread/impact)
Inspection and trapping	Inspection is defined as the official visual examination of plants, plant products or other regulated articles to determine if pests are present or to determine compliance with phytosanitary regulations (ISPM 5) The effectiveness of sampling and subsequent inspection to detect pests may be enhanced by including trapping and luring techniques Due to its endophytic lifestyle, *P. microspora* may remain quiescent or latent within asymptomatic host tissues. On symptomatic plants, the symptoms caused by *P. microspora* are similar to those caused by other *Pestalotiopsis* species. Therefore, it is unlikely that *P. microspora* could be detected based on visual inspection only	Entry/Establishment/Spread
Laboratory testing	Examination, other than visual, to determine if pests are present using official diagnostic protocols. Diagnostic protocols describe the minimum requirements for reliable diagnosis of regulated pests Multilocus gene sequencing analysis combined with the macroscopic examination of fungal colony and microscopic analysis of fruiting bodies and conidia is required for the reliable detection and identification of *P. microspora* (see Section 3.1.5)	Entry/Establishment/Spread
Sampling	According to ISPM 31, it is usually not feasible to inspect entire consignments, so phytosanitary inspection is performed mainly on samples obtained from a consignment. It is noted that the sampling concepts presented in this standard may also apply to other phytosanitary procedures, notably selection of units for testing For inspection, testing and/or surveillance purposes the sample may be taken according to a statistically based or a non-statistical sampling methodology Necessary as part of other risk reduction options	Entry/Establishment/Spread

TABLE 7 (Continued)

Supporting measure	Summary	Risk element targeted (entry/establishment/spread/impact)
Phytosanitary certificate and plant passport	An official paper document or its official electronic equivalent, consistent with the model certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements (ISPM 5) a) export certificate (import) b) plant passport (EU internal trade) Recommended for plant species known to be hosts of *P. microspora*, including plant parts and seeds for sowing	Entry/Spread
Certified and approved premises	Mandatory/voluntary certification/approval of premises is a process including a set of procedures and of actions implemented by producers, conditioners and traders contributing to ensure the phytosanitary compliance of consignments. It can be a part of a larger system maintained by the NPPO in order to guarantee the fulfilment of plant health requirements of plants and plant products intended for trade. Key property of certified or approved premises is the traceability of activities and tasks (and their components) inherent the pursued phytosanitary objective. Traceability aims to provide access to all trustful pieces of information that may help to prove the compliance of consignments with phytosanitary requirements of importing countries Certified and approved premises may reduce the likelihood of the plants and plant products originating in those premises to be infected by *P. microspora*	Entry/Spread
Certification of reproductive material (voluntary/official)	Plants come from within an approved propagation scheme and are certified pest free (level of infestation) following testing; Used to mitigate against pests that are included in a certification scheme The risk of entry and/or spread of *P. microspora* is reduced if host plants for planting, including seeds for sowing, are produced under an approved certification scheme and tested free of the pathogen	Entry/Spread
Delimitation of Buffer zones	ISPM 5 defines a buffer zone as 'an area surrounding or adjacent to an area officially delimited for phytosanitary purposes in order to minimise the probability of spread of the target pest into or out of the delimited area, and subject to phytosanitary or other control measures, if appropriate' (ISPM 5). The objectives for delimiting a buffer zone can be to prevent spread from the outbreak area and to maintain a pest-free production place (PFPP), site (PFPS) or area (PFA) Delimitation of a buffer zone around an outbreak area can prevent spread of the pathogen and maintain a pest-free area, site or place of production	Spread
Surveillance	Surveillance to guarantee that plants and plant products originate from a pest-free area could be an option	Entry/Establishment/Spread

3.6.1.3 | *Biological or technical factors limiting the effectiveness of measures*

- Latently infected (asymptomatic) host plants and plant products are unlikely to be detected by visual inspection.
- The similarity of symptoms and fruiting structures (e.g. acervuli) of *P. microspora* with those of other *Pestalotiopsis* species or other genera of the family Pestalotiopsidaceae pose a serious challenge to the detection and identification of the pathogen based solely on visual inspection.
- The lack of rapid diagnostic methods based on molecular approaches (i.e. species-specific primers) does not allow proper *in planta* identification of the pathogen at entry. In addition, thorough post-entry laboratory analysis may not be feasible for certain commodities as isolation in pure culture is needed prior to DNA extraction as well as molecular identification based on multigene sequencing.
- The wide host range of the pathogen and its ability to survive endophytically on asymptomatic plants limits the possibility to develop standard diagnostic protocols for all potential hosts.

3.7 | Uncertainty

There is a key uncertainty with respect to the geographical distribution of *P. microspora* worldwide and in the EU because, in the past, the pathogen might have been misidentified as other *Pestalotiopsis* species or other members of the Pestalodiopsidaceae family based only on morphology and pathogenicity tests. In addition, given that *P. microspora* may colonise endophytically a wide range of host plants, its distribution might be wider than currently reported.

4 | CONCLUSIONS

Pestalotiopsis microspora is known to be present in the EU, but with a restricted distribution (with uncertainty). Unless the assumed restricted distribution in the EU is disproven, the pathogen satisfies all the criteria that are within the remit of EFSA to assess for this species to be regarded as potential Union quarantine pest (Table 8).

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).

Criterion of pest categorisation	Panel's conclusions against criterion in regulation (EU) 2016/2031 regarding union quarantine pest	Key uncertainties
Identity of the pest (Section 3.1)	The identity of *Pestalotiopsis microspora* is clearly defined. The pathogen has been shown to produce consistent symptoms and to be transmissible	None
Absence/presence of the pest in the EU (Section 3.2)	*Pestalotiopsis microspora* is reported to be present in the EU, but with a restricted distribution (the Netherlands)	The geographical distribution of *P. microspora* in the EU
Pest potential for entry, establishment and spread in the EU (Section 3.4)	*Pestalotiopsis microspora* could potentially further enter, establish in and spread within the EU. The main pathways for the further entry of the pathogen into the EU are: (i) host plants for planting (ii) fresh fruits of host plants, (iii) bark and wood of host plants, and (iv) soil and other plant growing media associated with plant debris, all originating in infested third countries. Both the biotic (host availability) and abiotic (climate suitability) factors occurring in parts of the EU where susceptible hosts are grown are favourable for the further establishment of the pathogen. Following its establishment, the pathogen could spread further within the EU by both natural and human-assisted means	None
Potential for consequences in the EU (Section 3.5)	Even though *P. microspora* has often been found as an endophyte on several plant species, its introduction into and spread within the EU may have an economic and environmental impact where susceptible hosts are grown	None
Available measures (Section 3.6)	Although not specifically targeted against *P. microspora*, existing phytosanitary measures mitigate the likelihood of the pathogen's further entry, establishment and spread in the EU. Potential additional measures also exist to further mitigate the risk of introduction and spread of the pathogen in the EU	None
Conclusion (Section 4)	Unless the restricted distribution in the EU is disproven, *Pestalotiopsis microspora* satisfies all the criteria that are within the remit of EFSA to assess for this species to be regarded as potential Union quarantine pest	The geographical distribution of *P. microspora* in the EU
Aspects of assessment to focus on/scenarios to address in future if appropriate	The main knowledge gap concerns the current worldwide distribution of *P. microspora*. To reduce this uncertainty, systematic surveys would need to be carried out and isolates of *P. microspora* and of related genera (e.g. *Pestalotia*, *Neopestalotiopsis*, etc.) available in culture collections would need to be re-evaluated using appropriate pest identification methods (e.g. multilocus gene sequencing analysis) In addition, the nomenclature of the genus *Pestalotiopsis* at family level should be clarified and the sequences deposited in the GenBank must be re-examined and be supported with type material (living cultures) in order to have reliable species-based taxonomic system for the genus *Pestalotiopsis*	

ABBREVIATIONS

EPPO	European and Mediterranean Plant Protection Organisation
FAO	Food and Agriculture Organisation
IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
MS	Member State
PLH	EFSA Panel on Plant Health
PZ	Protected Zone
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference

GLOSSARY

Containment (of a pest)	Application of phytosanitary measures in and around an infested area to prevent spread of a pest (FAO, 2022)
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO, 2022)
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO, 2022)
Eradication (of a pest)	Application of phytosanitary measures to eliminate a pest from an area (FAO, 2022)
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2022)
Greenhouse	A walk-in, static, closed place of crop production with a usually translucent outer shell, which allows controlled exchange of material and energy with the surroundings and prevents release of plant protection products (PPPs) into the environment
Hitchhiker	An organism sheltering or transported accidentally via inanimate pathways including with machinery, shipping containers and vehicles; such organisms are also known as contaminating pests or stowaways (Toy & Newfield, 2010)
Impact (of a pest)	The impact of the pest on the crop output and quality and on the environment in the occupied spatial units

Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO, 2022)
Pathway	Any means that allows the entry or spread of a pest (FAO, 2022)
Phytosanitary measures	Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO, 2022)
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO, 2022)
Risk reduction option (RRO)	A measure acting on pest introduction and/or pest spread and/or the magnitude of the biological impact of the pest should the pest be present. A RRO may become a phytosanitary measure, action or procedure according to the decision of the risk manager
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO, 2022)

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CONFLICT OF INTEREST

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APPENDIX A

Pestalotiopsis microspora host plants/species affected

Host status	Host name[a]	Plant family	Common name	Reference[A]
Cultivated hosts	*Acer rubrum*	Sapindaceae	Red maple	Cui et al. (2015)
	A. palmatum	Sapindaceae	Japanese maple	Ge et al. (2009), cited by Farr et al. (2021)
	Actinidia chinensis	Actinidaceae	Kiwifruit	Li et al. (2016)
	Adenium obesum	Apocynaceae	Mock azalea	de Jesus et al. (2022)
	Alnus rubra	Betulaceae	Red alder	Rossman and Lu (1980)
	Ampelopsis grossedentata	Vitaceae	Vine tea	Yuan et al. (2022)
	Anacardium occidentale	Anacardiaceae	Cashew	da Ponte et al. (1987)
	Ananas comosus	Bromeliaceae	Pineapple	Yaouba et al. (2021)
	Annona muricata	Annonaceae	Soursop	Kruschewsky (2010)
	Araucaria spp.	Araucariaceae	Araucaria	Thaung (2008), cited by Farr et al., 2021); Mordue (1980)
	Archontophoenix alexandrae	Arecaceae	Alexandra palm	Ge et al. (2009), cited by Farr et al. (2021)
	Artocarpus heterophyllus	Moraceae	Jack tree	Riga et al. (2020)
	Azadirachta indica	Meliaceae	Neem tree	Tejesvi et al. (2009)
	Berberis bealei	Berberidaceae	Leatherleaf mahonia	Ge et al. (2009), cited by Farr et al. (2021)
	Bletia sp.	Orchidaceae	–	Deeba et al. (2012)
	Butea monosperma	Fabaceae	Flame of the forest	Sudhakara Reddy et al. (2016)
	Camelia oleifera	Theaceae	Oil-seed camelia	Li et al. (2011)
	C. sinensis	Theaceae	Tea	Wei et al. (2007)
	Canarium album	Burseraceae	Chinese olive	Chen et al. (2018)
	Carya cathayensis	Juglandaceae	Chinese hickory	Chuanqing et al. (2010)
	C. illinoinensis	Juglandaceae	Pecan	Huang and Hanlin (1975), Shi et al. (2015)
	Caryota mitis	Arecaceae	Fishtail palm	Chen et al. (2011)
	Citrus spp.	Rutaceae	Citrus	Qin et al. (2017), Sessa et al. (2018)
	Cupressus lusitanica	Cupressaceae	Mexican cedar	Mordue (1980)
	C. funebris	Cupressaceae	Chinese weeping cypress	Ge et al. (2009), cited by Farr et al. (2021)
	Cunninghamia lanceolata	Cupressaceae	–	Ge et al. (2009), cited by Farr et al. (2021)
	Dendrobium speciosum	Orchidaceae	Rock orchid	Tejesvi et al. (2009)
	Diospyros kaki	Ebenaceae	Persimmon	Berbegal et al. (2010)
	Dracaena sp.	Asparagaceae	Dracaena	Kruschewsky (2010)
	Elaeis guineensis	Arecaceae	Oil palm	Shen et al. (2014)
	Eriobotrya japonica	Rosaceae	Loquat	Lu et al. (2016), Xiao et al. (2016)
	Eucalyptus grandis	Myrtaceae	Flooded gum	da Silva (2016)
	Eugenia sp.	Myrtaceae	–	Westerdijk Fungal Biodiversity Institute (online, accessed on 29 August 2023)
	Ficus elastica	Moraceae	Rubber tree	Alchemi and Jamin (2022)
	Hedera helix	Araliaceae	Common ivy, English ivy	Guba (1932), Nag Raj (1993), cited by Farr et al. (2021)
	Hedychium coronarium	Zingiberaceae	White ginger lily	Camino-Vilaro et al. (2019), cited by Farr et al. (2021)
	Heliconia sp.	Heliconiaceae	Heliconia	Kruschewsky (2010)
	Hevea spp.	Euphorbiaceae	Rubber trees	Gazis et al. (2011)
	Hypericum patulum	Hypericaceae	Yellow mosqueta	Zhang et al. (2010)
	H. androsaemum	Hypericaceae	Sweet-amber	Ge et al. (2009), cited by Farr et al. (2021)
	Ilex asprella	Aquifoliaceae	Rough-leaved holly	Fu et al. (2019)
	Jatropha curcas	Euphorbiaceae	Barbados nut	Zhong Jiu et al. (2010)
	Juniperus bermudiana	Cupressaceae	Bermuda cedar	Mordue (1980)
	J. chinensis	Cupressaceae	Chinese juniper	Ge et al. (2009), cited by Farr et al. (2021)
	Lagerstroemia speciosa	Lythraceae	Giant crepe-myrtle	Ge et al. (2009), cited by Farr et al. (2021)
	Lanxangia tsaoko (syn. Amomum tsao-ko)	Zingiberaceae	–	Guo et al. (2016)
	Lindera obtusiloba	Lauraceae	Blunt-lobed spice bush	Jeon et al. (2007)
	Machilus nanmu	Lauraceae	–	Han et al. (2019)

(Continued)

Host status	Host name[a]	Plant family	Common name	Reference[A]
	Madhuca indica	Sapotaceae	Chiuri	Gupta et al. (2007)
	Mahonia confusa	Berberidaceae	–	Ge et al. (2009), cited by Farr et al. (2021)
	Malus halliana	Rosaceae	Hall crabapple	Ge et al. (2009), cited by Farr et al. (2021)
	Mangifera indica	Anacardiaceae	Mango	Kruschewsky (2010), Dianda et al. (2018)
	Manilkara zapota	Sapotaceae	Chicoo	Nalin Rathnayake et al. (2019)
	***Musa* spp.**	Musaceae	Banana	Bhuiyan et al. (2022)
	Myrica rubra	Myricaceae	Bayberry	Ren et al. (2013, 2021)
	Nandina spp.	Berberidaceae	Sacred bamboo	Ge et al. (2009), cited by Farr et al. (2021)
	Neolamarckia spp.	Rubiaceae	Jabon	Herliyana et al. (2022)
	Nymphaea nouchali	Nymphaeaceae	Red water lily	Rajagopal et al. (2018)
	Persea americana	Lauraceae	Avocado	Kimaru et al. (2018)
	Phalaris spp.	Poaceae	–	Steyaert (1953)
	Phoenix reclinata	Arecaceae	Arabian date palm	Mordue (1980)
	Photinia fraseri	Rosaceae	Red tip photinia	Guan et al. (2013)
	P. serratifolia (syn. *P. Serrulata*)	Rosaceae	Photinia	Yu et al. (2017)
	Phyllostachys spp.	Poaceae	Mōsō bamboo	Zhang et al. (2008)
	Pinus brutia	Pinaceae	Turkish pine	Cleary et al. (2019)
	P. caribaea var. hondurensis	Pinaceae	Caribbean pine	Maggiorani et al. (2008)
	P. oocarpa	Pinaceae	Mexican yellow pine	Ortiz et al. (2022)
	P. parviflora	Pinaceae	Japanese white pine	EFSA PLH Panel (2022)
	P. radiata	Pinaceae	Monterey pine	Nattrass (1961), cited by Farr et al. (2021); Cleary et al. (2019)
	Platanus occidentalis	Platanaceae	American sycamore	Maharachchikumbura et al. (2011)
	P. orientalis	Platanaceae	Oriental plane	Ge et al. (2009), cited by Farr et al. (2021)
	Platycladus orientalis	Cupressaceae	Chinese thuja	Ge et al. (2009), cited by Farr et al. (2021)
	Podocarpus macrophyllus	Podocarpaceae	Yew plum pine	Wei et al. (2007)
	Populus deltoides	Salicaceae	Eastern cottonwood	Lin et al. (2023)
	Prunus salicina	Rosaceae	Japanese plum	Wu et al. (2022)
	Psidium guajava	Myrtaceae	Guava	Keith et al. (2006), El-Argawy (2015)
	Quercus acutissima	Fagaceae	Sawtooth oak	Ge et al. (2009), cited by Farr et al. (2021)
	Q. coccinea	Fagaceae	Scarlet oak	Nag Raj (1993)
	Reineckea carnea	Asparagaceae	–	Wu et al. (2009)
	Ricinodendron heudeloti	Euphorbiaceae	–	Fovo et al. (2017)
	Rubus fructicosus	Rosaceae	Blackberry	Hemphill et al. (2020)
	Schinus molle	Anacardiaceae	Peruvian pepper	Kruschewsky (2010)
	S. terebinthifolius	Anacardiaceae	Brazilian pepper tree	Mordue (1980)
	Stanhopea oculata (syn. *S. bucephalus*)	Orchidaceae	–	Guba (1961), cited by Farr et al. (2021)
	Taxodium distichum	Cupressaceae	Bald cypress	Deshmukh et al. (2017)
	T. mucronatum	Cupressaceae	–	Subban et al. (2017)
	Taxus baccata	Taxaceae	Common yew; European yew	Westerdijk Fungal Biodiversity Institute (online, accessed on 29 August 2023)
	T. chinensis	Taxaceae	Chinese yew	Li et al. (2015)
	T. cuspidata	Taxaceae	Japanese yew	Jeon and Cheon (2014)
	T. walliciana	Taxaceae	Himalayan yew	Strobel et al. (1996)
	Terminalia spp.	Combretaceae	–	Tejesvi et al. (2009)
	Theobroma cacao	Malvaceae	Cacao tree	Kruschewsky (2010)
	Vaccinium corymbosum	Ericaceae	Blueberry	Yi-Lan et al. (2021)
	V. meridionale	Ericaceae	Andean blueberry	Socha et al. (2009)
	Vallisneria spiralis	Hydrocharitaceae	Tape grass	Rajagopal et al. (2018)
	Viburnum spp.	Adoxaceae		Mordue (1980), Sudhakara Reddy et al. (2016)
	Vanilla planifolia	Orchidaceae	Flat-leaved vanilla	Khoyratty et al. (2015)
	Vitis vinifera	Vitaceae	Grapevine	Ma et al. (2009)

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Host status	Host name[a]	Plant family	Common name	Reference[A]
Wild weed hosts	*Abies beshanzuensis*	Pinaceae	Baishanzu fir	Yuan et al. (2011)
	Aegiceras corniculatum	Primulaceae	Black mangrove	Linnakoski et al. (2012)
	Aleurites spp.	Euphorbiaceae	–	Saccos and Drouillon (1951); Mordue (1980)
	Ampelopsis grossedentata	Vitaceae	Moyeam	Yuan et al. (2022)
	Anisomeles malabarica	Lamiaceae	Malabar catmint	Jayanthi et al. (2014)
	Ardisia sp.	Primulaceae	Coralberry	Zhuang (2001), cited by Farr et al. (2021)
	Artemisia argyi	Asteraceae	Chinese mugwort	Qian et al. (2023)
	Atractylodes macrocephala	Asteraceae	–	Xiao and Li (2013)
	Avicennia marina	Acanthaceae	Grey mangrove	Joel and Valentin Bhimba (2012)
	A. officinalis	Acanthaceae	Indian mangrove	Joel and Valentin Bhimba (2012)
	Bridelia monoica (syn. *Cleistanthus monoicus*)	Phyllanthaceae	–	Tai (1979), cited by Farr et al. (2021)
	B. retusa	Phyllanthaceae	–	Singh (1976)
	Campomanesia sp.	Myrtaceae		Kruschewsky (2010)
	Casearia esculenta	Salicaceae	–	Sudhakara Reddy et al. (2016)
	Copaifera spp.	Fabaceae	–	Arrhenius and Langenheim (1986), Mendes et al. (1998), cited by Farr et al. (2021)
	Cordia dichotoma	Boraginaceae	–	Sudhakara Reddy et al. (2016)
	Corylus chinensis	Betulaceae	Chinese hazel	Wu et al. (2015)
	Dalbergia oojeinensis	Fabaceae	–	Sudhakara Reddy et al. (2016)
	Dillenia pentagyna	Dilleniaceae	–	Chowdhury et al. (2023)
	Drepanocarpus lunatus	Fabaceae	–	Rashmi et al. (2019)
	Eucalyptus dunni	Myrtaceae	White gum	Oliveira Odos et al. (1991)
	E. viminalis	Myrtaceae	Ribbon gum	Oliveira Odos et al. (1991)
	E. nitens	Myrtaceae	Shining gum	Oliveira Odos et al. (1991)
	Garcinia lanceifolia	Malpighiales	–	Arolla et al. (2022)
	Gymnema sylvestre	Apocynaceae	–	Rashmi et al. (2019)
	Gymnosporia emarginata	Celastraceae	–	Sudhakara Reddy et al. (2016)
	Hedychium coronarium	Zingiberaceae	White ginger lilly	Camino-Vilaro et al. (2019)
	Heritiera fomes	Malvaceae	–	Nurunnabi et al. (2020)
	Holarrhena antidysenterica	Apocynaceae	–	Tejesvi et al. (2009)
	Huperzia serrata	Lycopodiaceae	Toothed clubmoss	Fu et al. (2011)
	Hymenaea sp.	Fabaceae	–	Mendes et al. (1998), cited by Farr et al. (2021)
	Hyptis dilatata	Lamiaceae		Aguilar-Pérez et al. (2020)
	Juniperus bermudiana	Cupressaceae	–	Mordue (1980)
	Lindera obtusiloba	Lauraceae		Jeon et al. (2007)
	Lithocarpus glaber	Fagaceae	–	Ge et al. (2009), cited by Farr et al. (2021)
	Lythrea molleoides	Anacardiaceae	–	Guba (1932)
	Maytenus ilicifolia	Celastraceae	–	Maharachchikumbura et al. (2011)
	Milletia auriculata	Fabaceae	–	Purohit (1974)
	Olea dioica	Oleaceae	Rose sandalwood	Sudhakara Reddy et al. (2016)
	Oryza australiensis	Poaceae	Wild rice	Pak et al. (2017)
	Otoba gracilipes	Myristicaceae	–	Caicedo et al. (2018)
	Pandanus sp.	Pandanaceae	Pandan	Hyde et al. (2018)
	Persea macrantha	Lauraceae	Large-flowered bay tree	Sudhakara Reddy et al. (2016)
	Phoebe bournei	Lauraceae	–	Chen et al. (2018)
	Pontederia crassipes	Pontederiaceae	Water hyacinth	Rajagopal et al. (2018)
	Rhizophora spp.	Rhizophoraceae	Red mangrove	Ukoima et al. (2010), Joel and Valentin Bhimba (2012), Zhou et al. (2018)
	Schleichera oleosa	Sapindaceae	Kusum tree	Harsh et al. (1989), cited by CABI online
	Shorea macrophylla	Dipterocarpaceae	Light red meranti	Lateef et al. (2018)
	S. robuta	Dipterocarpaceae	Sal tree	Harsh et al. (1989), cited by CABI online
	Terminalia morobensis	Combretaceae		Deshmukh et al. (2017)
	Torreya taxifolia	Taxaceae	Florida torreya	Schwartz et al. (1996); Vargas and Negron-Ortiz (2013)
	T. grandis	Taxaceae	–	Ge et al. (2009), cited by Farr et al. (2021)
	Typha angustata	Typhaceae	Lesser bulrush	Mordue (1980)
	Vanilla planifolia	Orchidaceae	Vanilla orchid	Khoyratty et al. (2015)
	Wollemia nobilis	Araucariaceae	Wollemi pine	Tejesvi et al. (2009)
Artificial/experimental host				

[a]Plant species in bold have been identified as main hosts (see Section 3.1.3).

APPENDIX B

Distribution of *Pestalotiopsis microspora*

Distribution records based on CABI (2019) and literature.

Region	Country	Sub-national (e.g. state)	Status	References
North America	Bermuda		Present, no details	Global Biodiversity Information Facility (GBIF, online, gbif.org; accessed on 29 August 2023)
	Mexico		Present, no details	Rebollar-Alviter et al. (2013)
	USA		Present, no details	Vargas and Negron-Ortiz (2013), CABI (2019)
		Florida	Present, no details	Schwartz et al. (1996), CABI (2019)
		Georgia	Present, no details	Vargas and Negron-Ortiz (2013), CABI (2019)
		Hawaii	Present, no details	Keith et al. (2006), CABI (2019)
		Pennsylvania	Present, no details	Guba (1932)
		South Carolina	Present, no details	Li et al. (1996)
Central America	Honduras		Present, no details	Ortiz et al. (2022)
	Panama		Present, no details	Aguilar-Pérez et al. (2020)
South America	Argentina		Present, no details	Steyaert (1949), Maharachchikumbura et al. (2011), Farr et al. (2021)
	Brazil		Present, no details	Mendes et al. (1998), Farr et al. (2021)
		Goias	Present, no details	de Jesus et al. (2022)
		Panarà	Present, no details	Gomes-Figueiredo et al. (2007)
		Santa Catarina	Present, no details	Oliveira Odos et al. (1991)
	Colombia		Present, no details	Caicedo et al. (2018)
	Ecuador		Present, no details	Villavicencio et al. (2020)
	Peru		Present, no details	Gazis et al. (2011)
	Uruguay		Present, no details	Sessa et al. (2018), Farr et al. (2021)
	Venezuela		Present, no details	Arrhenius and Langenheim (1986), Urtiaga (1986), Farr et al. (2021)
Africa	Burkina Faso		Present, no details	Dianda et al. (2018)
	Cameroon		Present, no details	Gazis et al. (2011)
	Egypt		Present, no details	El-Argawy (2015)
	Ghana		Present, no details	Kimaru et al. (2018)
	Kenya		Present, no details	Kimaru et al. (2018, 2020)
	Nigeria		Present, no details	Ukoima et al. (2010)
	Réunion		Present, no details	Khoyratty et al. (2015)
	Zambia		Present, no details	Mordue (1980)
Asia	Bangladesh		Present, no details	Bhuiyan et al. (2022)

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Region	Country	Sub-national (e.g. state)	Status	References
	China		Present, no details	Wu et al. (2009), Jeon and Cheon (2014), Cui et al. (2015), Shi et al. (2015), Xiao et al. (2016), CABI (2019)
		Anhui	Present, no details	Xiao et al. (2016), CABI (2019)
		Chongqung	Present, no details	Fu et al. (2011)
		Guangdong	Present, no details	Fu et al. (2019)
		Guizhou	Present, no details	Xiao et al. (2010), CABI (2019)
		Hainan	Present, no details	Shen et al. (2014)
		Henan	Present, no details	Yuzir et al. (2017)
		Hubei	Present, no details	Li et al. (2016), CABI (2019)
		Hunan	Present, no details	Yuan et al. (2022)
		Jiangsu	Present, no details	Chen et al. (2022)
		Jiangxi	Present, no details	Cui et al. (2015)
		Shanghai	Present, no details	Ma et al. (2009)
		Sichuan	Present, no details	Wu et al. (2020)
		Xinjang	Present, no details	Li et al. (2011), CABI (2019)
		Yunnan	Present, no details	Guo et al. (2016), CABI (2019)
		Zheijiang	Present, no details	Zhang et al. (2012)
	Hong Kong		Present, no details	Urbez-Torres et al. (2012), Farr et al. (2021)
	India		Present, no details	Tejesvi et al. (2009), Farr et al. (2021)
		Andhra Pradesh	Present, no details	Goukanapalle et al. (2020)
		Assam	Present, no details	Arolla et al. (2022)
		Chhattisgagh	Present, no details	Chowdhury et al. (2023)
		Karnataka	Present, no details	Kouipou Toghueo and Boyom (2019)
		Tamil Nadu	Present, no details	Rajagopal et al. (2018)
		Telandana	Present, no details	Netala et al. (2016)
	Indonesia		Present, no details	Suwandi Akino and Kondo (2012), Farr et al. (2021)
		Zhejiang	Present, no details	Shi et al. (2015), CABI (2019)
	Japan		Present, no details	Zhang et al. (2010), CABI (2019)
		Honshu	Present, no details	Zhang et al. (2010), CABI (2019)
	Korea		Present, no details	Jeon et al. (2007)
	Lebanon		Present, no details	Schlosser (1972)
	Malaysia		Present, no details	Baharom et al. (2020)
	Nepal		Present, no details	Metz et al. (2000), CABI (2019)
	Singapore		Present, no details	Taylor and Hyde (2003)
	South Korea		Present, no details	Jeon and Cheon (2014), CABI (2019)
	Sri Lanka		Present, no details	Nalin Rathnayake et al. (2019)
	Thailand		Present, no details	Hyde et al. (2018)
Caribbean	Cuba		Present, no details	Urtiaga (1986)
	West Indies		Present, no details	Minter et al. (2001)
Oceania	Australia		Present, no details	Pak et al. (2017), Farr et al. (2021)
	Papua New Guinea		Present, no details	Maharachchikumbura et al. (2011), Deshmukh et al. (2017)
Europe	Netherlands		Present, no details	Dutch NPPO (pers. comm, September 2023)

APPENDIX C

EU 27 annual imports of fresh produce of hosts from countries where *Pestalotiopsis microspora* is present, 2017–2021 (in 100 kg)

Eurostat accessed on: 11 July 2023

		2017	2018	2019	2020	2021
Avocado fresh fruit	Brazil	71,003	68,687	78,674	48,159	50,797
	Cameroon	173	221	259	206	358
	Colombia	210,139	251,050	387,367	663,149	852,653
	Cuba	74	41	131	34	56
	Ecuador	1052	1265	2314	1763	3368
	Egypt	5.3	4.6	79	364	38
	Ghana	135	23	40	22	19
	Kenya	243,947	404,594	346,232	435,308	487,979
	Mexico	445,611	463,741	767,878	716,113	751,530
	Peru	1,353,466	2,009,222	1,584,511	2,132,092	2,670,248
	USA	1.2	2547	0	4.7	45
	Venezuela	233	111	71	–	–

		2017	2018	2019	2020	2021
Bananas, fresh (excl. plantains)	Mexico	558,381.69	348,613.96	239,116.91	133,925.52	34,747.26
	United States	:	:	:	0.04	1901.63
	Argentina	:	:	:	240.00	:
	Peru	1,154,920.56	1,258,008.91	1,084,384.23	1,011,803.71	978,297.14
	Bangladesh	:	5.40	:	:	39.57
	Honduras	166,045.40	194,617.89	158,316.17	87,599.22	3607.65
	Brazil	26,845.28	59,661.57	104,890.48	98,391.90	83,124.00
	Panama	2,139,456.21	2,333,948.39	2,546,130.91	2,611,200.69	2,155,014.59
	India	396.17	494.23	369.60	276.35	819.52
	Indonesia		11.02	14.68	0.30	0.01
	Thailand	82.12	85.55	108.63	46.61	59.42
	Sri Lanka	43.19	39.54	41.34	28.24	134.62
	Lebanon	:	:	:	:	0.08
	Cuba	:	:	:	1.28	:
	Japan	:	:	:	:	3.82
	Cameroon	2,341,151.70	1,790,920.74	1,520,089.78	1,579,040.36	1,666,746.16
	Kenya	:	1.30	:	:	0.06
	Total	6,387,322.32	5,986,408.50	5,653,462.73	5,522,554.22	4,924,495.53

		2017	2018	2019	2020	2021
Fresh kiwifruits	United States	:	:	207.19	1487.08	1873.54
	Argentina	7486.34	7977.86	13,309.66	24,464.88	22,521.62
	Peru	:	:	:	36.00	460.00
	Brazil	0.16	226.80	:	:	:
	China	196.10	3.91	323.61	272.32	852.29
	India	:	:	:	0.00	3.92
	Thailand	:	:	:	:	0.08
	Lebanon	:	:	35.75	:	:
	Japan	:	:	:	:	0.99
	Australia	5720.00	6302.00	4451.43	3004.93	2240.03
	Total	13,402.6	14,510.57	18,327.64	29,265.21	27,952.47

		2017	2018	2019	2020	2021
Fresh or dried guavas, mangoes and mangosteens	Mexico	40,848.36	46,001.68	50,935.79	51,841.89	46,677.91
	United States	45,478.21	54660.34	82,580.54	82,852.21	51,111.01
	Peru	850,046.15	1146171.88	1,012,834.88	1,187,835.17	1,207,726.01
	Bangladesh	256.66	331.27	310.73	323.91	1538.10
	Honduras	:	:	:	41.90	0.36
	Venezuela	2033.75	2401.44	1939.11	282.69	522.30
	Brazil	1,158,717.06	1,241,860.63	1,437,569.20	1,577,043.99	1,799,012.86
	Panama	0.18	0.70	:	:	:
	China	51.87	180.81	78.23	104.34	248.77
	Hong Kong	:	:	:	6.56	8.01
	India	8148.87	9470.36	9315.51	7347.61	16,576.61
	Indonesia	2004.36	2926.64	2386.27	1406.94	1629.72
	Thailand	7401.80	6911.89	6743.91	5260.84	4919.06
	Sri Lanka	1003.35	765.31	813.83	423.16	540.13
	Lebanon	0.62	5.29	0.42	20.13	3.96
	Singapore	:	:	0.23	0.15	0.02
	Malaysia	197.22	170.64	72.72	44.56	19.01
	Myanmar	0.28	1.47	1.00		
	Cuba	216.57	14.36	103.34	230.60	135.11
	Japan	:	:	:	0.01	7.66
	Burkina Faso	45,732.84	52,399.48	65,354.19	64,404.44	60,340.55
	Australia	94.18	62.92			0.01
	Cameroon	4884.80	2502.54	1800.84	489.96	991.86
	Kenya	4.08	65.09	10.30	66.53	1497.11
	Guinea	3846.36	3303.14	3106.88	875.01	445.32
	Total	2,170,967.57	2,570,207.88	2,675,957.92	2,980,902.60	3,193,951.46

		2017	2018	2019	2020	2021
Fresh cranberries, bilberries and other fruits of the genus Vaccinium	Mexico	1012.68	2037.56	2228.58	211.38	409.76
	United States	5842.46	4891.68	8219.02	6685.87	5766.72
	Argentina	29,475.81	30,148.42	40,843.31	28,801.34	33,019.31
	Peru	110,384.41	143,419.52	270,539.03	450,502.38	486,345.97
	Bangladesh	:	0.45	:	:	0.01
	Uruguay	3847.86	4452.52	2984.56	2598.80	1605.67
	Brazil	:	57.60	:	416.80	:
	Panama	:	:	:	0.29	:
	China	0.23	5.63	28.90	:	0.06
	India	:	:	0.04	0.70	0.99
	Indonesia	:	0.18	:	:	0.45
	Thailand	0.51	:	0.07	0.02	1.22
	Lebanon	:	:	:	:	0.55
	Singapore	:	:	:	0.03	:
	Australia	0.50	0.57	:	:	:
	Cameroon	:	:	:	0.44	:
	Kenya	:	36.75	40.23	123.95	4.68
	Total	150,564.46	185,050.88	324,883.74	489,342.00	527,155.39

APPENDIX D

EU and member state cultivation/harvested/production area of Pestalotiopsis microspora hosts (in 1000 ha)

Avocado	2017	2018	2019	2020	2021
EU[a]	12.72	13.22	17.5	19.69	22.85
Greece	0.6	0.72	1.08	1.1	1.93
Spain	11.81	12.16	14.1	15.85	18.06
France	0.23	0.24	0.24	0.24	0.13
Cyprus	0.08	0.1	0.1	0.16	0.16
Portugal	0	0	1.98	2.34	2.57

[a]Eurostat does not provide data for Italy's avocado production.

Bananas	2017	2018	2019	2020	2021
EU	18.91	17.94	18.27	22.11	22.01
Greece	0.09	0.09	0.10	0.10	0.10
Spain	9.08	9.09	9.06	9.10	9.10
France	8.49	7.50	7.78	11.58	11.48
Cyprus	0.21	0.22	0.21	0.22	0.21
Portugal	1.04	1.05	1.12	1.12	1.12

Blueberries	2017	2018	2019	2020	2021
EU	16.86	19.35	21.13	24.01	26.07
Belgium	0.10	0.11	0.11	0.12	0.12
Bulgaria	0.02	0.03	0.00	0.04	0.07
Germany	2.84	3.04	3.16	3.29	3.36
Spain	3.26	3.72	4.03	4.21	4.57
Croatia	0.17	0.25	0.29	0.36	0.38
Italy	0.00	0.00	0.00	1.09	1.20
Latvia	0.20	0.50	0.51	0.50	0.60
Lithuania	0.08	0.07	0.20	0.27	0.30
Hungary	0.01	0.02	0.04	0.04	0.04
Netherlands	0.83	0.93	1.11	0.92	0.85
Austria	0.16	0.20	0.20	0.21	0.22
Poland	7.07	8.09	8.48	9.70	10.70
Portugal	1.70	1.93	2.48	2.49	2.59
Romania	0.13	0.18	0.21	0.40	0.71
Slovenia	0.05	0.06	0.06	0.06	0.07
Slovakia	0.03	0.03	0.05	0.07	0.07
Finland	0.08	0.09	0.08	0.12	0.09
Sweden	0.05	0.04	0.04	0.04	0.05

Kiwi	2017	2018	2019	2020	2021
EU	43.83	44.20	44.18	44.98	46.53
Bulgaria	0.00	0.00	0.01	0.01	0.05
Greece	9.22	9.55	10.29	11.07	12.57
Spain	1.49	1.47	1.55	1.59	1.64
France	3.80	3.80	3.81	3.93	3.93
Italy	26.65	26.62	25.08	24.90	24.85
Cyprus	0.00	0.00	0.00	0.00	0.01
Portugal	2.65	2.74	3.41	3.46	3.47
Slovenia	0.02	0.02	0.03	0.02	0.02

Fruits from subtropical and tropical climate zones	2017	2018	2019	2020	2021
EU	138.99	139.62	150.40	167.23	173.23
Greece	13.73	14.14	15.46	16.66	15.75
Spain	70.20	71.09	73.42	76.45	78.67
France	15.58	14.77	18.47	18.10	22.30
Croatia	0.27	0.27	0.42	0.57	0.57
Italy	28.91	28.85	27.23	39.12	39.35
Cyprus	0.73	0.76	0.81	1.30	1.27
Portugal	9.43	9.58	14.43	14.85	15.06
Slovenia	0.14	0.15	0.16	0.16	0.17