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SCIENTIFIC OPINION

Pest categorisation of *Pestalotiopsis disseminata*

EFSA Panel on Plant Health (PLH) | Claude Bragard | Paula Baptista | Elisavet Chatzivassiliou | Francesco Di Serio | Paolo Gonthier | Josep Anton Jaques Miret | Annemarie Fejer Justesen | Alan MacLeod | Christer Sven Magnusson | Panagiotis Milonas | Juan A. Navas-Cortes | Stephen Parnell | Roel Potting | Emilio Stefani | Hans-Hermann Thulke | Wopke Van der Werf | Antonio Vicent Civera | Jonathan Yuen | Lucia Zappalà | Quirico Migheli | Irene Vloutoglou | Alex Gobbi | Andrea Maiorano | Marco Pautasso | Philippe Lucien Reignault

Correspondence: plants@efsa.europa.eu

Abstract

Following the commodity risk assessments of bonsai plants from China consisting of *Pinus parviflora* grafted on *P. thunbergii* performed by EFSA, the EFSA Plant Health Panel performed a pest categorisation of *Pestalotiopsis disseminata,* a clearly defined plant pathogenic fungus of the family Pestalotiopsidaceae. The pathogen has been reported on herbaceous, woody and ornamental plants causing symptoms such as leaf blight, shoot blight, seedling blight, pod canker, pre- and post-harvest fruit rot, and gummosis. Moreover, the fungus was reported as an endophyte on a wide range of asymptomatic hosts. The pathogen is present in Africa, North and South America, Asia, Europe and Oceania. It has been reported from the EU, with a restricted distribution (Portugal). There is a key uncertainty on the geographical distribution of *P. disseminata* in the EU and worldwide, because of the endophytic nature of the fungus, the lack of surveys and since the pathogen might have been misidentified based only on morphology and pathogenicity tests. The pathogen is not included in Commission Implementing Regulation (EU) 2019/2072. This pest categorisation focuses on those 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 sequence analysis. Plants for planting, fresh fruits, bark and wood of host plants as well as soil and other plant growing media are the main pathways for the entry of the pathogen into the EU. Host availability and climate suitability factors occurring in parts of the EU are favourable for the establishment of the pathogen. Despite the low aggressiveness observed in most reported hosts, and the fact that *P. disseminata* may colonise plants as an endophyte, its introduction and spread in the EU may have an economic and environmental impact (with a key uncertainty) where susceptible hosts are grown. Phytosanitary measures are available to prevent the introduction and spread of the pathogen. The Panel cannot conclude on whether *P. disseminata* satisfies all the criteria that are within the remit of EFSA to assess for this species to be regarded as potential Union quarantine pest, because of the key uncertainties on the restricted distribution in the EU and the magnitude of the impact.

KEYWORDS
endophytes, eucalyptus leaf spot, *Euonymus japonicus*, pest risk, pine shoot blight, plant pest, *Psidium guava*

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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 countries to the EU of the HRP commodities, as stipulated in Commission Implementing Regulation 2018/2018. Furthermore, EFSA has evaluated a number of requests from exporting countries to the EU 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 High Risk Plants.

1.2 | Interpretation of the Terms of Reference

Pestalotiopsis disseminata 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 assessments of bonsai plants from China consisting of *Pinus parviflora* grafted on *Pinus thunbergii* performed by EFSA (EFSA PLH Panel, 2022), in which *P. disseminata* 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. disseminata*, EFSA has consulted the NPPO of Portugal.

2.1.2 | Literature search

A literature search on *P. disseminata* 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 European and Mediterranean Plant Protection Organization (EPPO) Global Database (EPPO, online), 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. disseminata* 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. disseminata*, 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 et al., 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 *Pestalotiopsis disseminata* (Thüm.) Steyaert is clearly defined and the pathogen has been shown to produce consistent symptoms and to be transmissible.

P. disseminata (Thüm.) Steyaert (Steyaert, 1949) has been recognised as a plant pathogenic fungus of the family Pestalotiopsidaceae (*Index Fungorum*, accessed Nov 2023); nevertheless, *P. disseminata* has been commonly isolated as endophyte or saprobe on a wide range of plants (Maharachchikumbura et al., 2011).

The classification of the *Pestalotiopsis* genus at the family level has been controversial given the divergence or heterogeneity of morphological characters. Indeed, some authors have been accommodating this genus into the family Sporocadaceae (Nag Raj, 1993) or Amphisphaeriaceae (Jeewon et al., 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) that revived the older family name Sporocadaceae to accommodate the *Pestalotiopsis* genus.

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

Preferred name: *Pestalotiopsis disseminata* (von Thüm.) Steyaert
Order: Amphisphaeriales
Family: Sporocadaceae
Genus: *Pestalotiopsis*
Species: *Pestalotiopsis disseminata*

The global fungal nomenclature database Index Fungorum (https://www.indexfungorum.org/) accommodates the genus *Pestalotiopsis* in the family Pestalotiopsidaceae (accessed on 31 August 2023). In this pest categorisation, the Panel decided to adopt the nomenclature provided by Index Fungorum.

Synonyms: the EPPO Global Database (EPPO, 2022) also reports the following scientific name:

Pestalotia disseminata von Thümen

Common names: The following common name is provided by the EPPO Global Database (EPPO, online): leaf spot of eucalyptus.

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

[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).

3.1.2 | Biology of the pest

P. disseminata is a plant pathogenic fungus of the family Pestalotiopsidaceae. Like other *Pestalotiopsis* species, *P. disseminata* displays different lifestyles. It has been reported as a pathogen causing diseases on monocotyledonous, dicotyledonous and gymnosperm host plants, as a saprophyte, commonly found on dead leaves and woody plant tissues (Sharma et al., 2011), or as mycoparasite (Hwang et al., 2016). Moreover, it may occur as an endophyte in asymptomatic plant tissues and may eventually switch to a pathogenic behaviour when its host is stressed (Maharachchikumbura et al., 2012). *P. disseminata* is also known to produce a wide range of secondary metabolites with various bioactivities (Hwang et al., 2016) and some isolates were reported as entomopathogenic (Lyu et al., 2014).

In general, species in the genus *Pestalotiopsis* are not host-specific, having the ability to infect a wide range of hosts (Hopkins & McQuilken, 2000; Keith et al., 2006), on which they may cause a variety of diseases, including canker lesions, gummosis, shoot dieback, needle blight, tip blight, grey blight, scabby canker, severe chlorosis, fruit rots and leaf spots (Maharachchikumbura et al., 2011). *Pestalotiopsis* spp. are considered as weak or opportunistic pathogens (Madar et al., 1991), but some species may cause serious damage and the number of known hosts is increasing (Jeewon et al., 2004).

Pestalotiopsis species infect their host through natural openings such as stomata, lenticels and hydathodes or through wounds (Wright et al., 1998). Along with other species of *Pestalotiopsis*, *P. disseminata* is frequently isolated as an endophyte from healthy plant tissues (e.g. Lateef et al., 2018; Liu et al., 2012; Tejesvi et al., 2009; Wei et al., 2007). As many other endophytic species, it may remain dormant until the plant is stressed, and then displays a pathogenic behaviour (Maharachchikumbura et al., 2011). Aging and stress inducers such as pruning, insect damage, high temperatures, strong wind and rainfall may act as triggers of infection or shift to pathogenicity (Tuset et al., 1999; McQuilken and Hopkins, 2004; Keith et al., 2006).

P. disseminata has no known sexual stage, therefore the primary inoculum is likely to be conidia. These are released from acervuli (Keith et al., 2006; Maharachchikumbura et al., 2011; Nag Raj, 1993), that are formed on symptomatic plant tissues during wet weather and are washed-off or splash-dispersed by water to infect susceptible host tissues. In addition to the typical appendage-bearing six-celled alpha-conidia, *P. disseminata* may also produce beta-conidia in culture, but their biological and epidemiological role is unknown (Crous et al., 2006). The sources of the primary inoculum may include infected plant parts (Keith et al., 2006; Pandey, 1990), debris from a previous crop, used growing media and soil (Hopkins and McQuilken, 2000). Secondary inoculum produced on diseased tissues causes secondary infections, thereby increasing the incidence and severity of the disease (Maharachchikumbura et al., 2011).

Optimum conditions for conidial germination and leaf infection were determined at 25°C and 70% RH (Das et al., 2010). Watanabe et al. (2000) provided a detailed description of the adhesion, germination and infection process in the closely related species *P. neglecta*. In the first stage, the lower median cell germinates by firmly attaching to the substrate. Successive infections are achieved by two upper median cells. Adhesion is favoured by a mucilaginous matrix coating the conidia and by the release of fibrillar adhesive substances along the length of the pedicel to the apex of the basal cell, from the apical appendages and at the point of germ tube emergence (Watanabe et al., 2000).

Seeds of certain host plants may represent a source of primary inoculum of *P. disseminata*. The pathogen has been detected by sequencing of the ITS2 region from seeds of *P. pinea*, *P elliottii*, *P. patula*, *P. radiata*, *P. taeda* and *P. pinaster* from various origins (Cleary et al., 2019), and has been isolated from stored seed lots of *Eucalyptus pellita* in Australia (Yuan et al., 1997). Similarly, the closely related species *P. pinicola* has been isolated from pine seed endosperm (Tibpromma et al., 2019), while *P. brassicae* and *P. oryzae* were isolated from *Brassica napus* and *Oryza sativa* seeds, respectively (Maharachchikumbura et al., 2014).

Insects are likely to act as carriers of the pathogen: although not specifically reported for *P. disseminata*, their role has been demonstrated for other *Pestalotiopsis* species, such as *P. funerea* on *Cupressus sempervirens* (Battisti et al., 1999) and *Pestalotiopsis* sp. (possibly *P. palmarum*) on *Elaeis guineensis* (Martínez & Plata-Rueda, 2013).

3.1.3 | Host range/species affected

P. disseminata has been reported on a wide range of monocotyledonous, dicotyledonous and gymnosperms, cultivated and wild plant species worldwide. It was described for the first time from dead leaves of *E. globulus* in Portugal (von Thümen, 1881). Subsequently, the pathogen has been associated with fruit gummosis on *Prunus persica* (Singh et al., 2000), fruit scab on *Psidium guajava* (Bhargava et al., 2003; Keith et al., 2006; El-Argawy, 2016), fruit rot on *Feijoa sellowiana* (Naeimi et al., 2015), *Malus domestica* (Hino, 1966) (also mentioned in a commodity risk assessment; AQIS, 1998), *Persea americana* (Liu et al., 2019) and *Musa sapientium* (Al Ameen et al., 2017), pod canker on *Vicia faba* (Singh & Tombisana Devi, 2001) and *E. pellita* (Yuan et al., 1997), shoot blight on *Pinus* spp. (Cleary et al., 2019; Silva et al., 2020; Watanabe et al., 2010), grey leaf blight on *Persea bombycina* (Das et al., 2010; Paliwal and Paliwal, 2015; Ray et al., 2019), *Euonymus japonicus* (Wang et al., 2023), *Eucalyptus* spp. (Crous et al., 2006) and *Morus alba* (Philip, 1995). More recently, *P. disseminata* has attracted the interest of many scientists due to its wide array of bioactive secondary metabolites (Deyrup et al., 2006; Hwang et al., 2015; Hwang et al., 2016) and, consequently, this species has been repeatedly isolated from wild species along with other endophytic fungi (Lateef et al., 2018; Liu et al., 2012; Tejesvi et al., 2009; Wei et al., 2007).

A detailed list of the cultivated and wild hosts of *P. disseminata* reported so far in the literature is included in Appendix A. Most of the reports refer to *P. disseminata* as an endophyte, rather than a pathogen. Because of the wide host range of the fungus, this pest categorisation will focus on those hosts that are relevant for the EU and for which there is robust evidence in the literature that (a) the pathogen was isolated and identified by both morphological and molecular (multilocus gene sequencing analysis) methods, (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 hosts (crops and ornamentals) as main hosts of *P. disseminata*: *Euonymus japonicus* (Wang et al., 2023) and *Psidium guajava* (Keith et al., 2006).

Nevertheless, the actual host range of *P. disseminata* is still largely unknown, because of the different lifestyles of the fungus (saprobe, endophyte, opportunistic pathogen). Moreover, there is uncertainty on the reports where the identification of the pathogen was based merely on morphology, not supported by multigene phylogenetic analysis.

3.1.4 | Intraspecific diversity

No information on intraspecific diversity of *P. disseminata* was found in the available literature. In addition, the sexual stage of the pathogen, which could potentially enhance its genomic plasticity and adaptation to various adverse environmental conditions, including fungicide exposure, is still unknown.

3.1.5 | Detection and identification of the pest

Are detection and identification methods available for the pest?

YES, methods are available for the detection and identification of *P. disseminata* and for its distinction from other closely related *taxa* in the family *Pestalotiopsidaceae*.

Symptoms induced by *P. disseminata* on susceptible hosts include: fruit gummosis (Singh et al., 2000), fruit scab (Bhargava et al., 2003; Keith et al., 2006; El-Argawy, 2016), fruit rot (Al Ameen et al., 2017; Liu et al., 2019; Naeimi et al., 2015), pod canker (Singh & Tombisana Devi, 2001), seedling blight (Cleary et al., 2019; Yuan et al., 1997), shoot blight (Cleary et al., 2019; Silva et al., 2020; Watanabe et al., 2010) and grey leaf blight (Philip, 1995; Crous et al., 2006; Das et al., 2010; Paliwal and Paliwal, 2015; Ray et al., 2019; Wang et al., 2023). Such symptoms are also produced by other pests. As a consequence, the pathogen cannot be detected based merely on symptoms.

The following description of the morphological features of *P. disseminata* is provided by Crous et al. (2006): 'Colonies on OA (oatmeal agar) reaching 52–54 mm diam in 7 days with an even, glabrous, colourless margin; immersed mycelium colourless, aerial mycelium pure white, fluffy, covering most of the colony surface and very dense and high in the centre and in concentric zones after 7 days; reverse in the centre buff. Colonies on CMA (corn meal agar) reaching 52–55 mm diam after 7 days, as on OA, but aerial mycelium less well-developed and reverse colourless. Colonies on MEA (malt extract agar) reaching 56 mm diam in 7 days, with an even or slightly undulating colourless margin; immersed mycelium colourless, but surface of the colony completely covered by a high, dense mat of pure white, in the centre yellowish, fluffy aerial mycelium, the margin also covered by a diffuse layer of aerial hyphae; reverse with a faint cinnamon tinge. Conidiomata developing from 10 to 14 days (none after 7 days) mainly on the surface of the colony'.

Conidia (alpha-conidia) of *P. disseminata* are described by Crous et al. (2006) as: 'broadly fusoid to fusoid-clavate, straight or somewhat curved, five-celled, upper cell conical to cylindrical, hyaline, fairly thin-walled, apical setulae central, (2–)3(–4), rather stout, up to 1.2 μm wide, 11–20 μm long, with a blunt tip, three intermediate cells concolorous or the upper two intermediate cells slightly darker, dull olivaceous-brown to vinaceous-brown, contents guttulate, walls smooth, slightly constricted at the septa when mounted in water and thickened up to 1 μm especially in the upper two intermediate cells and in the septa, basal cell hyaline, thin-walled, tapering into a filiform pedicel (2–)2.5–4.5(–5) μm long; conidium body (18–)20–24(–25) × 6.5–7(–8) μm (OA)' (Figure 1).

In addition to the typical alpha-conidia, Crous et al. (2006) reported the production of beta-conidia by two isolates of *P. disseminata* from Colombia and New Zealand grown in vitro. Beta-conidia (Figure 1) occurred in the same conidioma with alpha-conidia, but none could be induced to germinate on malt extract agar, while all alpha-conidia could germinate within 1–2 days. Moreover, none of the colonies derived from alpha-conidia could be induced to form beta-conidia on different substrates (Crous et al., 2006). Hence, the epidemiological and biological role of beta-conidia still needs to be clarified under natural conditions.

It should be noted that the morphological features in *Pestalotiopsis* species are subject to various degrees of cultural variation even within the same species, particularly for such characters as growth rate, conidial morphology and fruiting structures (reviewed by Jeewon et al., 2003). Hu et al. (2007) showed that colony morphology (colour, growth rate and texture) is highly variable even within single isolates of *Pestalotiopsis* during repeated subculturing. Based on the above, it is unlikely that *P. disseminata* could be detected only by visual inspection of its host plants.

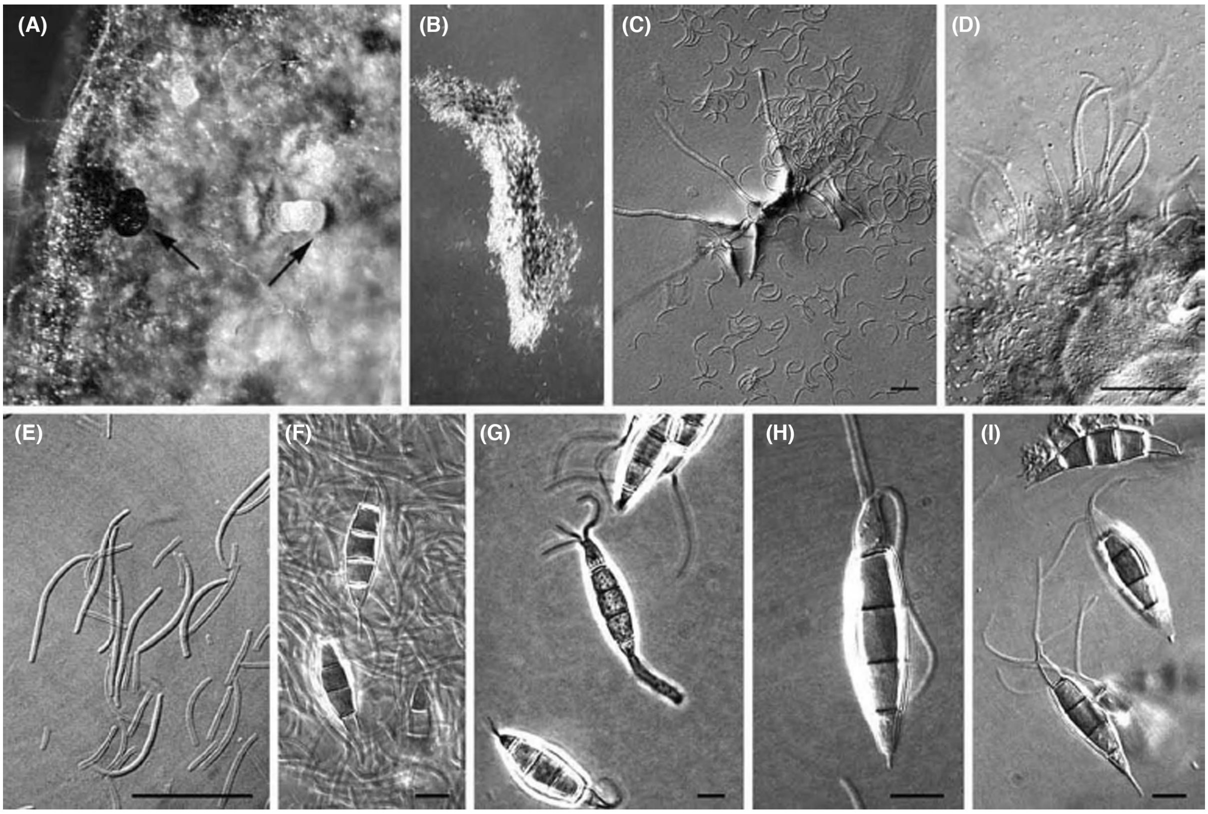

FIGURE 1 *Pestalotiopsis disseminata* morphological features: (A) Conidiomata with exuding alpha- (black) and beta- (cream) conidial masses (arrowed). (B) Conidial cirrus containing back (alpha-) and hyaline (beta-) conidia. (C) Germinating alpha-conidium, among infertile beta-conidia on MEA plate. (D) Conidiogenous cells giving rise to beta-conidia. (E) Beta-conidia. (F–I) Alpha-conidia. Scale bars: C–E = 10 μm, F–I = 7 μm (from Crous et al., 2006).

Attempts to distinguish *Pestalotiopsis* spp. by molecular markers have been reported by Hu et al. (2007), who suggested a combination of the ITS gene and the β-tubulin gene to differentiate endophytic species of *Pestalotiopsis* in *P. armandii* and *Ribes* spp.. Liu et al. (2010) considered that proper analysis and alignment of the ITS region can be a useful character in grouping *Pestalotiopsis* spp. isolates presenting different types of pigmentation, which is used as a key character for the phylogeny of the species. Tejesvi et al. (2009) tested an identification approach based on the ITS – restriction fragment length polymorphism (ITS-RFLP) but failed to achieve clustering of endophytic isolates of *Pestalotiopsis* spp. that could reflect either their host, colonised plant parts or location. Tsai et al. (2021) examined a collection of 98 isolates (including four strains of *P. disseminata*) causing tea grey blight disease in Taiwan by using a multilocus sequencing (MLS) approach based on the combination of ITS, β-tubulin, translation elongation factor 1-α, together with morphological features, and resolved most of the tested *Pestalotiopsis*-like species. As for other fungi, the MLS approach is now considered the most reliable to identify *P. disseminata* from other species, albeit with some degree of uncertainty due to some sequences that may have been misidentified (Tsai et al., 2021). Therefore, a combination of morphological and molecular methods is recommended for a reliable identification of the fungus.

Nucleotide sequences of *P. disseminata* are available in GenBank (https://www.ncbi.nlm.nih.gov/nucleotide/; 89 sequences retrieved on 30 August 2023) and could be used as reference material for molecular diagnosis.

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

3.2 | Pest distribution

3.2.1 | Pest distribution outside the EU

P. disseminata has been reported to be present in Europe (UK), Africa (Congo, Ghana, Kenya, Malawi, Nigeria, South Africa, Tanzania, Zimbabwe), North America (USA, Hawaii), South America (Brazil, Cuba, Venezuela, West Indies), Asia [Brunei, China, India, Japan, Malaysia, Myanmar, Philippines, Türkiye] and Oceania [Australia, Cook Islands, Fiji, Micronesia, New Zealand (North Island), Papua New Guinea, Samoa, Solomon Islands]. The current geographical distribution of *P. disseminata* is shown in Figure 2.

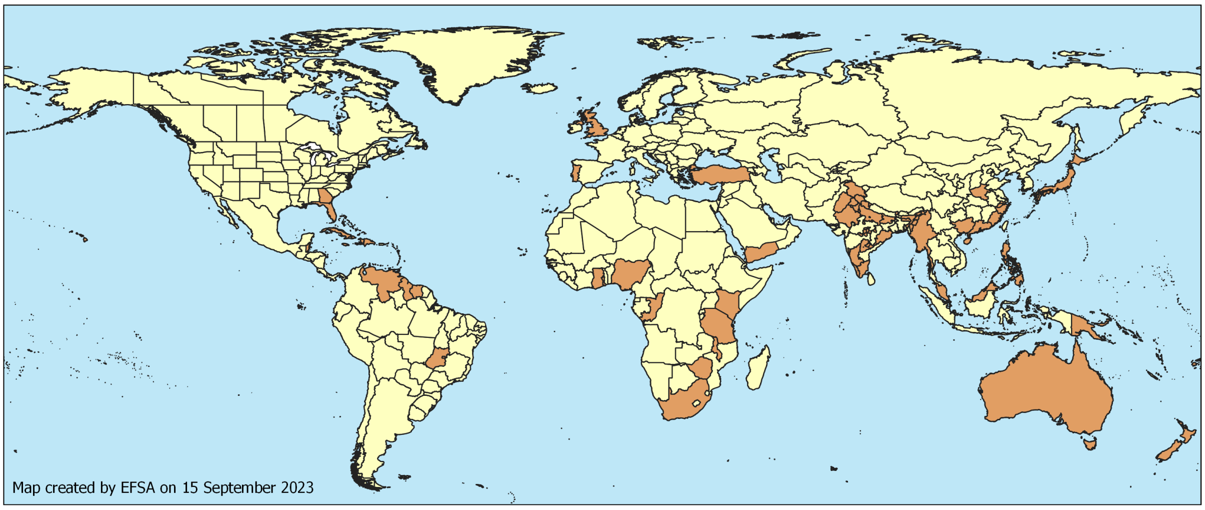

FIGURE 2 Global distribution of *Pestalotiopsis disseminata* (Source: EPPO Global Database accessed on 28 April 2023 and literature).

A list of the countries and states/provinces from where *P. disseminata* has been reported is included in Appendix B. The records are based on CABI (2019), EPPO (online), Farr et al. (2021) and other literature sources (Appendix B).

Nevertheless, the current geographical distribution of *P. disseminata* outside the EU might be wider than that reported, as in the past, when molecular tools (particularly multigene phylogenetic analysis) were not fully developed, the pathogen might have been misidentified based only on morphology and pathogenicity tests, which cannot reliably differentiate species within the genus *Pestalotiopsis* or from other closely related species of the genera *Pestalotia* and *Neopestalotiopsis*.

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, *P. disseminata* has been reported from Portugal.

P. disseminata has been first described (as *Pestalozzia disseminata*) on dead leaves of *E. globulus* in Coimbra, Portugal (von Thümen, 1881). There are two additional collections from Portugal in herbaria listed at mycoportal.org, in 1883 by Rabenhorst and Winter, and in 1879 by Moller). Silva et al. (2020) detected *P. disseminata* in blighted shoots of *P. pinea* collected in Cascais (Portugal). While the molecular identification was based on MLS, and the isolates from Portugal were clustered with two Westerdijk Institute isolates from *Persea americana* and *E. botryoides* from New Zealand, the authors did not perform any pathogenicity assay on pine. Cleary et al. (2019) detected operational taxonomic units corresponding to the fungus in *P. pinaster* seed lots from Portugal. However, it is worth mentioning that there is uncertainty about the origin of the seed lots and that this study was based merely on the sequence of ITS2 region, hence the identity of the fungus may be questionable as more loci are needed for a reliable identification; moreover, there is no evidence for its pathogenicity in the positive seed lots.

The current geographical distribution of *P. disseminata* in the EU might be wider than that reported, as in the past, when molecular tools (particularly multigene phylogenetic analysis) were not fully developed, the pathogen might have been misidentified based only on morphology and pathogenicity tests, which cannot reliably differentiate species within the genus *Pestalotiopsis* or from other closely related species of the genera *Pestalotia* and *Neopestalotiopsis*.

3.3 | Regulatory status

3.3.1 | Commission Implementing Regulation 2019/2072

P. disseminata 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. Also, hosts of the genera *Acer* L., *Albizia* Durazz., *Persea* Mill. and *Prunus* L. are 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 disseminata* 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

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, the pathogen can enter into the EU, via host plants for planting, fruits, parts of host plants (e.g. foliage, branches, bark, wood) and soil/plant growing media.

Comment on plants for planting as a pathway.

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

The Panel identified the following main pathways for the entry of *P. disseminata* 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, associated with infected host plant debris, all originating in infested third countries.

The pathogen is frequently isolated as an endophyte, hence it may enter into the EU territory on asymptomatic plant parts (e.g. stems, branches, fruits) of its hosts. Moreover, the ability to survive as a saprobe in dead plant tissues (leaves, bark, wood) may favour its entry into the EU through compost and potting substrate imported from infested countries.

P. disseminata and other species of the family Pestalotiopsidaceae have been detected on seeds (Cleary et al., 2019; Hu et al., 2007; Maharachchikumbura et al., 2014; Tibpromma et al., 2019; Yuan et al., 1997). Although there is no evidence so far of *P. disseminata* being transmitted from the seeds to the emerging seedlings, seeds of host plants are likely to be a pathway of entry of the pathogen into the EU. Pine nuts for consumption are also considered a possible entry pathway, although minor.

The pathogen is unlikely to enter into the EU by natural means (e.g. rain, wind-driven rain, insects) because of the long distance or natural barriers between the infested third countries and the EU MSs.

Although there are no data available, conidia of the pathogen may also be present as contaminants on other substrates or objects (e.g. non-host plants, 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 entry of the pathogen into the EU territory is included in Table 3.

TABLE 3 Potential pathways for the entry of *Pestalotiopsis disseminata* into the EU.

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, alpha-conidia	Plants for planting, other than seeds, that are hosts of *P. disseminata* and are prohibited from being imported from third countries (Annex VI of Commission Implementing Regulation (EU) 2019/2072) are listed in Table 2. There is a temporary prohibition for high-risk plants (Regulation 2018/2019)
Seeds of host plants for sowing	Mycelium, acervuli, alpha-conidia	A phytosanitary certificate is required for the introduction into the Union from third countries, other than Switzerland, of seeds of host plants for sowing
Pine seeds (with and without teguments) for consumption	Mycelium, acervuli, alpha-conidia	
Fresh fruits of host plants	Mycelium, acervuli, alpha-conidia	A phytosanitary certificate is required for the introduction into the Union from third countries other than Switzerland, of guava fruits fresh or dried [Annex XI, Part A, point 5 of Commission Implementing Regulation (EU) 2019/2072]
Parts of host plants, other than fruits and seeds	Mycelium, acervuli, alpha-conidia	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]
Bark of host plants	Mycelium, acervuli, alpha-conidia	A phytosanitary certificate is required for the introduction into the Union from certain third countries of isolated bark of Conifers (Pinales) [Annex XI, Part A (11) of Commission Implementing Regulation (EU) 2019/2072]
Wood of host plants	Mycelium, acervuli, alpha-conidia	A phytosanitary certificate is required for the introduction into the Union from certain third countries of wood of Conifers (Pinales) and including wood, which has not kept its natural round surface [Annex XI, Part A (12) of Commission Implementing Regulation (EU) 2019/2072]
Soil as such not attached or associated with plants for planting	Mycelium, alpha-conidia	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]
Growing medium as such, other than soil not attached or associated with plants for planting	Mycelium, alpha-conidia	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]
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, alpha-conidia	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, alpha-conidia	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. disseminata* is present is provided in Table 4 and Appendix C.

TABLE 4 EU annual imports of fresh produce from countries where *Pestalotiopsis disseminata* is present, 2017–2021 (in 100 kg) Source: Eurostat (accessed on 1 June 2023).

Commodity*	HS code	2017	2018	2019	2020	2021
Fresh or dried **guavas,** mangoes and mangosteens	0804 50 00	1,195,960	1,278,765	1,475,892	1,625,763	1,839,990

*Hosts are in bold.

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

3.4.2 | Establishment

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

YES, *P. disseminata* has been already reported in Portugal (see Section 3.2.2). Both the biotic (host availability) and abiotic (climate suitability) factors occurring in the EU suggest that the pathogen could establish in other parts of the EU territory where susceptible hosts are grown.

Based on its biology, *P. disseminata* could potentially be transferred from the pathways of entry to the host plants grown in the EU via splash-dispersed alpha-conidia, contaminated soil or other plant growing media associated with plants for planting, as well as by surface (rain or irrigation) water. Other potential means of dispersion include insects, similarly to other *Pestalotiopsis* species (Martínez & Plata-Rueda, 2013), as well as birds and small animals. The frequency of this transfer will depend 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 territory, 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. disseminata* has a wide host range, as it is able to colonise several plant species endophytically. Some of its hosts (e.g. *Pinus* spp) are widely distributed in the EU, both in commercial production (nurseries, open fields, orchards) and in home gardens or forests. Of the two main hosts, *Euonymus japonicus* is cultivated as an ornamental and *Psidium guajava* is cultivated in Greece and Spain (Rojas-Sandoval & Acevedo-Rodríguez, 2013).

3.4.2.2 | *Climatic conditions affecting establishment*

Based on the data available in the literature on the geographic coordinates of the locations from where *P. disseminata* has been reported, the pathogen is present in non-EU areas with BSh, BSk, Cfa, Cfb, Cfc, Csa, Csb, Dfb and Dfc Köppen-Geiger climate zones. These climate zones also occur in the EU territory, where hosts of *P. disseminata* are also grown (Figure 3).

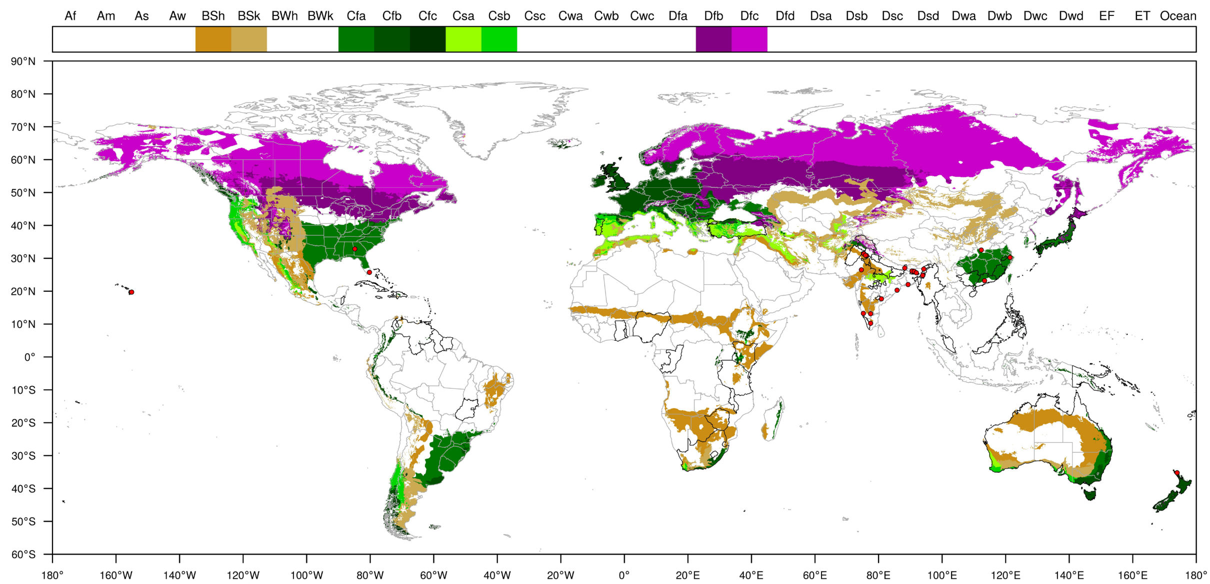

FIGURE 3 Distribution of seven Köppen–Geiger climate types, i.e. BSh, BSk, Cfa, Cfb, Cfc, Csa, Csb, Dfb and Dfc that occur in the EU and in third countries where *Pestalotiopsis disseminata* has been reported. The legend shows the list of Köppen–Geiger climates. Red dots indicate point locations where *P. disseminata* was reported.

3.4.3 | Spread

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

P. disseminata could potentially spread within the EU by both natural and human- assisted means.

Host plants for planting are a main means of spread of the pathogen within the EU territory.

P. disseminata could potentially spread within the EU via natural and human-assisted means.

Spread by natural means. Alpha-conidia of *Pestalotiopsis* spp. are able to spread over relatively short distances by water (rain, overhead irrigation) splash (McQuilken and Hopkins, 2004; Tuset et al., 1999). Wind may increase the dispersal distance of water-splashed conidia (Xu et al., 1999). Although not specifically reported for *P. disseminata*, the role of insects as means of spread has been demonstrated for other *Pestalotiopsis* species (Battisti et al., 1999; Martínez & Plata-Rueda, 2013).

Spread by human-assisted means. The pathogen can spread over long distances via the movement of infected host plants for planting (rootstocks, grafted plants, scions, seeds, etc.), including dormant plants, as well as fresh fruits, contaminated soil /plant growing media and agricultural machinery, tools, etc.

P. disseminata can also spread via contaminated/infected seed of host plants, such as *Pinus* spp. (Cleary et al., 2019) and *Eucalyptus* spp. (Yuan et al., 1997), with some uncertainty.

3.5 | Impacts

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

Yes, despite the low aggressiveness observed in most reported hosts, and the fact that *P. disseminata* has often been found as an endophyte, the introduction and/or spread of this fungus into the EU may have an economic impact in the territory where susceptible hosts are grown, with uncertainty on the magnitude of such impact.

P. disseminata has been reported as a weak parasite and an endophyte on a wide range of plant hosts. However, few reports quantified the extent of the disease or the economic impact on cultivated crops.

Recently, the pathogen was reported as causing a 'serious grey blight disease' on *E. japonicus* grown in the Henan Province (China), determining severe defoliation with a disease incidence ranging from 52% to 70% (Wang et al., 2023).

Although peach is not considered here as a main host (Koch postulates were fulfilled, but without molecular identification; see Section 3.1.3), Singh et al. (2000) defined gummosis on peach fruits caused by *P. disseminata* as 'a critical disease', widely distributed in all surveyed orchards in the Manipur district (India); the loss in fruit production in some areas reached 85% and the disease was recurrent during several years.

Albeit not relevant to the EU, *P. disseminata* has been reported as the main foliar pathogen on som (*Persea bombycina* Kost.), the primary food plant of muga silkworm (*Antheraea assamensis* Helfer), grown in the northeastern regions of India (particularly in Assam) to produce the shiny golden silk (Das et al., 2010).

Despite the lack of information on the impact of the pathogen in Portugal, its introduction and/or spread in the EU could have an economic and environmental impact, with a key uncertainty concerning the magnitude of such impact, particularly considering the increased frequency of heavy precipitations and extreme extratropical cyclones forecast in Europe as a consequence of global warming (Priestley & Catto, 2022), that may act as stress factors favouring the shift of the fungus from endophytic to pathogenic.

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. disseminata*, existing phytosanitary measures (see Sections 3.3.2 and 3.4.1) mitigate the likelihood of the pathogen's entry into the EU territory 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 5.

TABLE 5 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	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 field 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	Although *P. disseminata* has been isolated over a wide range of potential hosts (Appendix A), crop rotation (wherever feasible) may represent an effective means to reduce inoculum sources and potential survival of the pathogen. Although weeds have not been reported as hosts of *P. disseminata*, their control could potentially make the micro-climatic conditions less favourable (e.g. by reducing moisture) to pathogen infection and spread	Establishment/Spread/Impact
Use of resistant and tolerant plant species/varieties	Although limited information is available only on the differential susceptibility of guava cultivars (Keith et al., 2006), the identification and selection of resistant and tolerant host species/varieties may contribute to the restriction of the growth and development of *P. disseminata*	Establishment/Spread/Impact
Roguing and pruning	*P. disseminata* overwinters on infected attached plant parts which can act as inoculum sources. Thus, pruning of the symptomatic plant organs may be important in reducing the sources of inoculum and spread capacity	Spread/Impact
Biological control and behavioural manipulation	No data are available on the biocontrol of *P. disseminata*. However, biocontrol agents such as *Trichoderma*, *Gliocladium* and *Pseudomonas* proved effective in field control of the grey blight disease on *Camellia sinensis* caused by *Pestalotiopsis theae* (Sanjay et al., 2008). Moreover, Won et al. (2021) achieved effective control of leaf blight disease caused by *P. maculans* on *Quercus acutissima* seedlings grown in containers by the application of *Bacillus velezensis*	Entry/Establishment/Spread/Impact
Chemical treatments on crops including reproductive material	The resistance inducer of natural origin chitosan (2.5%) proved effective against scab disease caused by *P. disseminata* and other *Pestalotiopsis* species in guava fruits (El-Argawy, 2016). Fungicide application achieved field control of grey blight disease on *Camellia sinensis* caused by *P. theae* (Sanjay et al., 2008). Chemical control has been also reported on *Pestalotiopsis* spp. affecting ornamental *Camellia* spp. (reviewed by Hopkins, 1996).	Entry/Establishment/Spread/Impact

(Continues)

TABLE 5 (Continued)

Control measure/risk reduction option (blue underline = Zenodo doc, blue = WIP)	RRO summary	Risk element targeted (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. disseminata*	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, but no specific information for *P. disseminata* is available	Entry/Spread
Cleaning and disinfection of facilities, tools and machinery	*P. disseminata* may also infect its host plants through wounds created by pruning or grafting. Therefore, 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* spp. survive in plant debris (e.g. bark, wood, leaf litter) in soil. Therefore, plants, plant products and other objects (e.g. used farm machinery) should be free from soil to ensure freedom from the pathogen	Entry/Establishment/Spread
Soil treatment	Given that *Pestalotiopsis* spp. survive in soil associated with plant debris and despite the lack of specific studies for this pathogen, it is reasonable to assume 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	Considering that *P. disseminata* 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	Waste management in authorised facilities and official restriction on the movement of infected plant material prevent the pest from escaping. On-site proper management of pruning residues is recommended as an efficient measure	Entry/Establishment/Spread
Heat and cold treatments	No specific studies are available for *P. disseminata*. However, protection of guava fruit from decay was achieved by hot water treatment at 50°C for 30 min after artificial inoculation with *Pestalotiopsis versicolor* (Madhukar & Reddy, 1990)	Entry/Spread
Conditions of transport	If plant material, potentially infected or contaminated with *P. disseminata* (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	Although no specific reports are available on *P. disseminata*, controlled atmosphere could be employed to achieve prevention/delay of symptoms in infected commodities, particularly fruit. Storage in the presence of 9%–12% carbon dioxide extended shelf-life of rambutan fruits (*Nephilium lappaceum* L.) infected by *Pestalotiopsis* spp., whereas ozone treatment has been successfully applied against *P. mangiferae* on mango fruit (Guillen et al., 1999)	Spread
Post-entry quarantine and other restrictions of movement in the importing country	Recommended for plant species known to be hosts of *P. disseminata*. 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 6.

TABLE 6 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 (blue underline = Zenodo doc, blue = WIP)	**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 *Pestalotiopsis disseminata* may remain quiescent or latent within the asymptomatic host tissues. On symptomatic hosts, symptoms may be confused with those caused by other pathogens or abiotic disorders, making it unlikely that the pathogen 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 observation of cultural and morphological characteristics of fungal colonies, conidiomata with alpha- and possibly beta conidia is required for the reliable detection and identification of *P. disseminata* (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
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. disseminata*, 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. disseminata*	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. disseminata* 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 produce originate from a pest-free area could be an option *Pestalotiopsis disseminata* has been reported in the EU (Portugal). Therefore, surveillance would be an efficient supporting measure to define pest-free areas or pest-free places of production as well as to prevent spread of the pathogen	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 caused by *P. disseminata* and of signs (e.g. acervuli with alpha- and beta conidia) formed by the pathogen with those of other *Pestalotiopsis* species poses 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 analyses 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

Uncertainty applies over the current geographical distribution of *P. disseminata*, because of the lack of surveys, and because in the past, when molecular tools (particularly multigene phylogenetic analysis) were not fully developed, the pathogen might have been misidentified based only on morphology and pathogenicity tests, which cannot reliably differentiate species within the genus *Pestalotiopsis*. Moreover, the pathogen may colonise endophytically a wide range of host plants, therefore its distribution might be wider than reported.

The magnitude of the impact of the pest is also a key uncertainty.

4 | CONCLUSIONS

P. disseminata has been reported in the EU (Portugal, where the species was originally described in 1881), with a restricted distribution (with a key uncertainty). There is also a key uncertainty on the magnitude of the impact. Therefore, the Panel cannot conclude on whether 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 7).

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

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Key uncertainties
Identity of the pest (Section 3.1)	The identity of *P. disseminata* 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 disseminata* is known to be present in the EU, with a restricted distribution (Portugal)	The geographical distribution of *P. disseminata* in the EU
Pest potential for entry, establishment and spread in the EU (Section 3.4)	*Pestalotiopsis disseminata* has already been reported to be present in the EU and it may spread within the EU. The main pathways for the additional entry of the pathogen into and spread within 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, originating in infested third countries. Both the biotic (host availability) and abiotic (climate suitability) factors occurring in parts of the EU are favourable for the establishment of the pathogen. *Pestalotiopsis disseminata* could potentially spread within the EU by both natural and human-assisted means	None
Potential for consequences in the EU (Section 3.5)	Despite the low aggressiveness observed in most reported hosts, and the fact that *P. disseminata* has often been found as an endophyte, the introduction and/or spread of this fungus into the EU may have an economic and environmental impact where susceptible hosts are grown	There is uncertainty about the magnitude of the impacts
Available measures (Section 3.6)	Although not specifically targeted against *P. disseminata*, existing phytosanitary measures mitigate the likelihood of the pathogen's introduction and spread in the EU. Potential additional measures also exist to mitigate the risk of introduction and spread of the pathogen in the EU	None

TABLE 7 (Continued)

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Key uncertainties
Conclusion (Section 4)	The Panel cannot conclude on whether *Pestalotiopsis disseminata* satisfies all the criteria that are within the remit of EFSA to assess for this species to be regarded as potential Union quarantine pest, because of the key uncertainties on the restricted distribution in the EU and the magnitude of the impact	The geographical distribution of *P. disseminata* in the EU and the magnitude of the impact
Aspects of assessment to focus on/scenarios to address in future if appropriate:	The main knowledge gap concerns the present geographical distribution of *P. disseminata* within the EU. To reduce this uncertainty, systematic surveys would need to be carried out and isolates of *Pestalotiopsis* spp. 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) to define the current geographical distribution of the pathogen in the EU. Further research is needed on the role of seeds as dispersal pathway and on the magnitude of impacts on hosts of EU relevance	

ABBREVIATIONS

EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization
IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
MS	Member State
PLH	EFSA Panel on Plant Health
PFA	pest-free production area
PFPP	pest-free production place
PFPS	pest-free production site
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

If you wish to access the declaration of interests of any expert contributing to an EFSA scientific assessment, please contact interestmanagement@efsa.europa.eu.

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PANEL MEMBERS

Claude Bragard, Paula Baptista, Elisavet Chatzivassiliou, Francesco Di Serio, Paolo Gonthier, Josep Anton Jaques Miret, Annemarie Fejer Justesen, Alan MacLeod, Christer Sven Magnusson, Panagiotis Milonas, Juan A. Navas-Cortes, Stephen Parnell, Roel Potting, Philippe L. Reignault, Emilio Stefani, Hans-Hermann Thulke, Wopke Van der Werf, Antonio Vicent Civera, Jonathan Yuen, and Lucia Zappalà.

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APPENDIX A

Pestalotiopsis disseminata host plants/species affected

Source: EPPO Global Database (EPPO online), CABI (2019) and literature.

Host status	Host name	Plant family	Common name	Reference[A]
Cultivated hosts	*Acer laevigatum*	Sapindaceae	–	Lu et al. (2000)
	Agropyron cristatum	Poaceae	Crested couch grass	Mathur (1979)
	Albizia odoratissima	Fabaceae	Black siris	Mathur (1979)
	Aleurites montana	Euphorbiaceae	Mu-oil tree	Peregrine and Siddiqi (1972)
	Anacardium occidentale	Anacardiaceae	Cashew apple	Peregrine and Ahmad (1982)
	Camellia sinensis	Theaceae	Tea plant	Zhang et al. (2012)
	Cocos nucifera	Arecaceae	Common coconut palm	Shaw (1984)
	Coffea arabica	Rubiaceae	Arabian coffee	Hughes (1953)
	Comocladia dentata	Anacardiaceae	–	Arnold (1986)
	Dactylis glomerata	Poaceae	Hardgrass	Roane and Roane (1996)
	Desmodium ovalifolium	Fabaceae	–	Lenne (1990)
	Desmodium floribundum	Fabaceae	–	Adhikari (1989)
	Elaeis guineensis	Arecaceae	African oil palm	Williams and Liu (1976)
	Eucalyptus	Myrtaceae	–	EPPO (online)
	Eucalyptus alba	Myrtaceae	White gum	Morales-Rodríguez et al. (2019)
	Eucalyptus botryoides	Myrtaceae	Southern mahogany	Crous et al. (2006)
	Eucalyptus citriodora	Myrtaceae	Lemon gum	Crous et al. (1989)
	Eucalyptus globulus	Myrtaceae	Southern blue gum	Maharachchikumbura et al. (2011)
	Eucalyptus lehmannii	Myrtaceae	Lehmann's gum	Crous et al. (2000)
	Eucalyptus maidenii	Myrtaceae	Maiden's gum	Nattrass (1961)
	Eucalyptus robusta	Myrtaceae	Beakpod eucalyptus	Lu et al. (2000)
	Eucalyptus saligna	Myrtaceae	Sydney blue gum	Urtiaga (1986)
	Eugenia sp.	Myrtaceae	–	Mathur (1979)
	Euonymus japonicus	Cleastraceae	Japanese spindle	Wang et al. (2023)
	Euphorbia milii	Euphorbiaceae	Christ thorn	Urtiaga (1986)
	Fragaria vesca	Rosaceae	Wild strawberry	Mathur (1979)
	Helianthus annuus	Asteraceae	Sunflower	Kumar and Dwivedi (1981)
	Hemidesmus indicus	Apocynaceae	–	Mathur (1979)
	Hymenaea torreana	Fabaceae	–	Urtiaga (1986)
	Ixora sp.	Rubiaceae	–	Johnston (1960)
	Ixora coccinea	Rubiaceae	Burning love	Thaung (2008)
	Juniperus lucayana	Cupressaceae	–	Urtiaga (1986)
	Kandelia candel	Rhizophoraceae	–	Carrieri et al. (2013)
	Lagerstroemia indica	Lythraceae	Cannonball	Ge et al. (2009)
	Litchi chinensis	Sapindaceae	Litchee	Liu (1977)
	Macadamia sp.	Proteaceae	–	Peregrine and Siddiqi (1972)
	Machilus bombycina	Lauraceae	–	Sarbhoy et al. (1971)
	Manglietia fordiana	Magnoliaceae	–	Ge et al. (2009)
	Morus	Moraceae	Mulberry tree	CABI (2019)
	Musa x paradisiaca	Musaceae	Banana	Johnston (1960)
	Oryza sativa	Poaceae	Rice	CABI (2019)
	Persea americana	Lauraceae	Avocado	Silva et al. (2020)
	Persea bombycina	Lauraceae	Som	Ray et al. (2019)

Host status	Host name	Plant family	Common name	Reference[A]
	Pieris japonica	Ericaceae	Japanese pieris	Watanabe et al. (2012)
	Pinus armandi	Pinaceae	Armand's pine	Silva et al. (2020)
	Pinus densiflora	Pinaceae	Japanese red pine	Kobayashi (2007)
	Pinus elliottii	Pinaceae	American pitch pine	Silva et al. (2020)
	Pinus parviflora	Pinaceae	Japanese white pine	Silva et al. (2020)
	Pinus patula	Pinaceae	Mexican weeping pine	Silva et al. (2020)
	Pinus pentaphylla	Pinaceae	–	Watanabe et al. (2010)
	Pinus pinaster	Pinaceae	Bournemouth pine	Silva et al. (2020)
	Pinus pinea	Pinaceae	Italian stone pine	EPPO (online)
	Pinus radiata	Pinaceae	Monterey pine	Silva et al. (2020)
	Pinus taeda	Pinaceae	Loblolly pine	Silva et al. (2020)
	Pithecolobium bigeminum	Fabaceae	–	Thaung (2008)
	Podocarpus imbricatus	Podocarpaceae	Java dacryberry	Tejesvi et al. (2009)
	Podocarpus macrophyllus	Podocarpaceae	Big-leaf podocarp	Zhuang (2001)
	Podocarpus macrophyllus var. maki	Podocarpaceae	–	Lu et al. (2000)
	Prunus persica	Rosaceae	Peach	CABI (2019)
	Psidium guajava	Myrtaceae	Guava	Keith et al. (2006)
	Rhizophora mucronata	Rhizophoraceae	–	Mathur (1979)
	Rhodomyrtus tomentosa	Myrtaceae	Hill gooseberry	Ge et al. (2009)
	Saraca indica	Fabaceae	Asoka tree	Urtiaga (1986)
	Sideroxylon tomentosum	Sapotaceae	Hairy xantolis	Thaung (2008)
	Stigmaphyllon sagraeanum	Malpighiaceae	–	Urtiaga (1986)
	Strychnos sp.	Loganiaceae	–	
	Syzygium cumini	Myrtaceae	Java plum	Mathur (1979)
	Terminalia arjuna	Combretaceae	–	Mathur (1979)
	Terminalia catappa	Combretaceae	Barbados almond	Arnold (1986)
	Terminalia ivorensis	Combretaceae	–	Ebbels and Allen (1979)
	Trachycarpus fortunei	Arecaceae	Chinese windmill palm	Taylor and Hyde (2003)
	Tripterygium wilfordii	Celastraceae	–	Kumar and Hyde (2004)
	Vicia faba	Fabaceae	Broad bean	Singh and Tombisana Devi (2001)
Wild weed hosts	–	–	–	–
Artificial/experimental host	*Malus domestica*	Rosaceae	Apple	Wollenweber and Hochapfel (1936), Hino (1966)

APPENDIX B

Distribution of *Pestalotiopsis disseminata*

Distribution records based on EPPO Global Database (EPPO, online) and CABI (2019).

Region	Country	Sub-national (e.g. state)	Status	References
North America	USA		Present, no details	EPPO (online)
		Florida	Present, no details	Jenkins (1943)
		Georgia	Present, no details	Hwang et al. (2016)
		Hawaii	Present, no details	EPPO (online)
Asia	Bangladesh		Present, no details	Al Ameen et al. (2017)
	Brunei Darussalam		Present, no details	Peregrine and Ahmad (1982)
	China	Fujian	Present, no details	Liu et al. (2012)
		Guangxi	Present, no details	Huang et al. (2002)
		Guangzhou	Present, no details	Kumar and Hyde (2004)
		Hainan	Present, no details	Liu et al. (2012)
		Hangzhou	Present, no details	Lou et al. (2002), Chen et al. (2013)
		Henan	Present, no details	Wang et al. (2023)
		Hong Kong	Present, no details	Lu et al. (2000)
	Japan		Present, no details	EPPO (online)
		Fukuoka	Present, no details	Suto and Kobayashi (1993)
		Kumamoto	Present, no details	Suto and Kobayashi (1993)
	India	Andhra Pradesh	Present, no details	Giri et al. (1996)
		Assam	Present, no details	Ray et al. (2019)
		Bihar	Present, no details	Singh et al. (2004)
		Delhi	Present, no details	Singh et al. (2004)
		Himachal Pradesh	Present, no details	Singh et al. (2004)
		Haryana	Present, no details	Singh et al. (2004)
		Kerala	Present, no details	CABI (2019)
		Madhya Pradesh	Present, no details	Rai (1986)
		Maharashtra	Present, no details	Thite and Patil (1975)
		Manipur	Present, no details	CABI (2019)
		Odisha	Present, no details	CABI (2019)
		Punjab	Present, no details	Singh et al. (2004)
		Uttarakhand	Present, no details	Singh et al. (2004)
		Uttar Pradesh	Present, no details	Singh et al. (2004)
		Sundarbans	Present, no details	Purkait and Purkayastha (1999)
	Malaysia		Present, no details	Johnston (1960)
	Myanmar		Present, no details	Thaung (2008)
	Philippines		Present, no details	Kobayashi & de Guzman (1988)
	Türkiye		Present, no details	Cleary et al. (2019)
South America	Brazil		Present, no details	Mendes et al. (1998)
	Venezuela		Present, no details	Turner (1971)
Caribbean	Cuba		Present, no details	Arnold (1986)
	West Indies		Present, no details	Minter et al. (2001)
Africa	Congo		Present, no details	Turner (1971)

Region	Country	Sub-national (e.g. state)	Status	References
	Ghana		Present, no details	Turner (1971)
	Kenya		Present, no details	Nattrass (1961)
	Malawi		Present, no details	Peregrine and Siddiqi (1972)
	Nigeria		Present, no details	Turner (1971)
	South Africa		Present, no details	Crous et al. (1989)
	Tanzania		Present, no details	Ebbels and Allen (1979)
	Zimbabwe		Present, no details	Whiteside (1966)
Oceania	Australia		Present, no details	Morales-Rodríguez et al. (2019)
	Cook Islands		Present, no details	Dingley et al. (1981)
	Fiji		Present, no details	Dingley et al. (1981)
	Micronesia		Present, no details	EPPO (online)
	New Zealand	North Island	Present, no details	Crous et al. (2006)
	Papua New Guinea		Present, no details	Shaw (1984)
	Samoa		Present, no details	Dingley et al. (1981)
	Solomon Islands		Present, no details	EPPO (online)
EU	Portugal	Cascais	Present, no details	Silva et al. (2020)
		Coimbra	Present, no details	Maharachchikumbura et al. (2011)
Other Europe	UK		Present, no details	Taylor and Hyde (2003), Mycoportal.org

APPENDIX C

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

Source: Eurostat accessed on 1 June 2023

		2017	2018	2019	2020	2021
Fresh or dried guavas, mangoes and mangosteens	New Zealand	0.08	0.09	0.07	0.10	0.22
	South Africa	13,015.45	9739.99	12,116.95	8656.28	5777.96
	United States	:	:	:	:	103.68
	Australia	94.18	62.92	:	:	0.01
	Kenya	4.08	65.09	10.30	66.53	1497.11
	Malaysia	197.22	170.64	72.72	44.56	19.01
	Philippines	519.88	795.56	368.97	128.10	153.67
	Ghana	9114.51	10,672.35	11,138.06	30,296.55	15,263.44
	Malawi	:	:	:	648.00	110.83
	Nigeria	0.10	1.13	1.95	0.03	28.59
	Venezuela	2033.75	2401.44	1939.11	282.69	522.30
	India	8148.87	9470.36	9315.51	7347.61	16576.61
	Japan	:	:	:	0.01	7.66
	Brazil	1,158,717.06	1,241,860.63	1,437,569.20	1,577,043.99	1,799,012.86
	Myanmar	0.28	1.47	1.00	:	:
	Tanzania		0.50	1.14	:	0.09
	China	51.87	180.81	78.23	104.34	248.77
	Cuba	216.57	14.36	103.34	230.60	135.11
	Türkiye	0.21	24.09	68.86	38.93	86.48
	Sum	1,195,960.47	1,278,764.57	1,475,892.29	1,625,763.33	1,839,989.72