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Pest categorisation of *Colletotrichum plurivorum*

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Abstract

The EFSA Plant Health Panel performed a pest categorisation of *Colletotrichum plurivorum* Damm, Alizadeh & Toy. Sato, a well-defined fungus of the *C. orchidearum* species complex which has been reported from Africa, Asia and America to cause anthracnose and pre- and post-harvest fruit rots on more than 30 plant genera. The pathogen has not been reported from the EU territory and is not included in EU Commission Implementing Regulation 2019/2072. Because of the very wide host range, this pest categorisation focused on *Abelmoschus esculentus, Capsicum* spp., *Carica papaya, Glycine max, Manihot esculenta, Phaseolus lunatus, Pyrus bretschneideri* and *Vitis* spp. for which there was robust evidence that *C. plurivorum* was formally identified by morphology and multilocus gene sequencing analysis. Host plants for planting and fresh fruits are the main pathways for the entry of the pathogen into the EU. The host availability and climate suitability factors occurring in some parts of the EU are favourable for the establishment of the pathogen. Economic impact on the production of the main hosts is expected if establishment occurs. Phytosanitary measures are available to prevent the introduction of the pathogen into the EU. *Colletotrichum plurivorum* satisfies the criteria that are within the remit of EFSA to assess for this species to be regarded as a potential Union quarantine pest. However, there is a high uncertainty on the status of *C. plurivorum* in the EU territory because of the lack of specific surveys following the re-evaluation of the taxonomy of the genus Colletotrichum.

Keywords: Anthracnose, *Colletotrichum cliviae*, *Colletotrichum orchidearum* complex, pest risk, plant health, quarantine

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Table of 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 High Risk Plants.

1.2. Interpretation of the Terms of Reference

Colletotrichum plurivorum is one of a number of pests listed in Annex 1 to the Terms of Reference (ToR) (1.1.2) to be subject to pest categorisation to determine whether it fulfils the criteria of a regulated 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 European Commission 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 regulated pest, specific import requirements for relevant host commodities will be identified; for pests already present in the EU additional risk reduction options will be identified.

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A literature search on *Colletotrichum plurivorum* 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.

2.1.2. 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 was 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 interceptions to TRACES in May 2020.

2.2. Methodologies

The Panel performed the pest categorisation for *Colletotrichum plurivorum*, 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) and No. 21 (FAO, 2004).

The criteria to be considered when categorising a pest as an EU-regulated quarantine pest (QP) is given in Regulation (EU) 2016/2031 article 3. 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 [insert appropriate reference to EFSA not reporting impacts in financial/monetary terms] 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 defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

Criterion of pest categorisation	Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest (article 3)
Identity of the pest (Section 3.1)	Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible?
Absence/presence of the pest in the EU territory (Section 3.2)	Is the pest present in the EU territory? If present, is the pest widely distributed within the EU? Describe the pest distribution briefly
Regulatory status (Section 3.3)	If the pest is present in the EU but not widely distributed in the risk assessment area, it should be under official control or expected to be under official control in the near future.
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
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 (specific import requirements) (Section 3.6)	Are there measures available to prevent the entry into the EU such that the likelihood of introduction becomes mitigated?
Conclusion of pest categorisation (Section 4)	A statement as to whether (1) all criteria assessed by EFSA above for consideration as a potential quarantine pest were met and (2) if not, which one(s) were not met.

3. Pest categorisation

3.1. Identity and biology of the pest

3.1.1. Identity and taxonomy

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

Yes, the identity of the pest is well established; the pathogen has been shown to produce consistent symptoms and to be transmissible.

The genus *Colletotrichum* constitutes a large monophyletic group of ascomycetes with more than 200 accepted species classified into at least 14 species complexes and singletons (Damm et al., 2019). The genus includes endophytes, saprobes as well as plant pathogens, the latter being responsible for several diseases of many crops worldwide (Cannon et al., 2012; Udayanga et al., 2013). In the past, cultural and morphological characters (colour and growth rate of the colonies, size and shape of conidia and appressoria, presence or absence of setae, etc.) were used to identify *Colletotrichum* species (Von Arx, 1957; Sutton, 1980, 1992). However, as these characters vary under different culture media and environmental factors (light, temperature, etc.), the identification of *Colletotrichum* species based exclusively on these features is unreliable (Cai et al., 2009; Damm et al., 2012; Liu et al., 2016). Currently, identification of *Colletotrichum* at species level is performed using a polyphasic approach that combines morphological and cultural characteristics with multilocus gene sequencing analysis (Cai et al., 2009; Cannon et al., 2012; Weir et al., 2012; Liu et al., 2016).

Colletotrichum plurivorum is a distinct fungal species belonging to the *C. orchidearum* complex. The *C. orchidearum* complex currently consists of eight closely related species, including three species (*C. orchidearum, C. plurivorum, C. sojae*) that are very common and have a wide host range, four (*C. clivicola, C. musicola, C. cattleyicola, C. piperis*) that seem to be host-specific and one (*C. vittalense*) that seems to be restricted to a specific country and region (Damm et al., 2019). Originally the pathogen was described as *C. sichuanensis* from *Capsicum annum* (pepper) in Sichuan Province of China (Liu et al., 2016). Nevertheless, this name was not valid because no holotype specimen was cited (Mongkolporn and Taylor, 2018; Damm et al., 2019). The fungus was further regarded as a synonym of *C. cliviicola* (syn. *C. cliviae*) (Douanla-Meli et al., 2018), but later it was distinguished from the latter by Damm et al. (2019). The pathogen was described again as *C. plurivorum* based on a strain isolated from *Coffea arabica* (coffee) by Nguyen et al. (2010). The species epithet '*plurivorum*' is based on the wide host range of the pathogen (Damm et al., 2019).

Colletotrichum plurivorum is a fungus of the family *Glomerellaceae*. The EPPO Global Database (online) provides the following taxonomic identification for *C. plurivorum*:

Preferred scientific name: *Colletotrichum plurivorum* Damm, Alizadeh & Toy. Sato, 2018
Order: Phyllachorales
Family: Glomerellaceae
Genus: *Colletotrichum*
Species: *Colletotrichum plurivorum*
Common names: anthracnose, leaf spot, leaf blight, anthracnose fruit rot
Synonyms: *Colletotrichum sichuanense* G.S. Gong & F.L. Liu; *C. sichuanensis* G.S. Gong & F.L. Liu

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

3.1.2. Biology of the pest

Colletotrichum plurivorum has a life cycle similar to that of other C*olletotrichum* species (Figure 1) and may survive between crops during winter as mycelium and perithecia on infected host plants, seeds and plant debris (Scheck, 2019; Boufleur et al., 2020). The pathogen has been shown to produce appressoria (Damm et al., 2019; de Silva et al., 2019), which, similar to other *Colletotrichum* species, may also be related to the survival of the pathogen in the host plant tissues (de Silva, 2002). According to Boufleur et al. (2020), seeds of host plants are possibly the main source of primary inoculum thus contributing to the dispersal of the pathogen over long distances and the introduction of new fungal strains into an area.

The life cycle of *C. plurivorum* includes both sexual and asexual reproductive stages (Cannon et al., 2012; de Silva et al., 2017). The asexual reproductive stage is well studied compared to its *Glomerella* sexual stage, as the former is mostly associated with disease symptoms (Cannon et al., 2012; Jayawardena et al., 2016). During active growth in the plant tissues, the pathogen produces acervuli (asexual fruiting structures) with masses of mucilage-embedded conidia (Figure 1). The mucilaginous matrix is composed of glycoprotein and germinating inhibitors that protect conidia against desiccation and toxins produced by the host defence mechanism (Leite and Nicholson, 1992). These conidia are disseminated by rain splash, wind-driven rain, cultivation tools, equipment and field workers onto healthy leaves, young fruit or blossoms of host plants (de Silva et al., 2017). Conidia germinate and penetrate host tissue by means of specialised hyphae (appressoria) and subsequently invade host tissue. Humid, wet, rainy weather is necessary for infection to occur. These requirements may limit the establishment of the pathogen in driest areas whereas the pathogen may represent a serious problem in the controlled environment of greenhouses where humidity is ensured (Scheck, 2019). Although not yet documented, after infection, *C. plurivorum*, similar to other *Colletotrichum* species, is most likely to remain quiescent or latent within the host tissues until environmental conditions and host physiology are conducive for its reactivation and further development (Boufleur et al., 2020). Upon host infection, the pathogen continues to produce conidia throughout the season resulting in a polycyclic disease cycle.

[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 (Griessinger and Roy, 2015; EPPO, 2019).

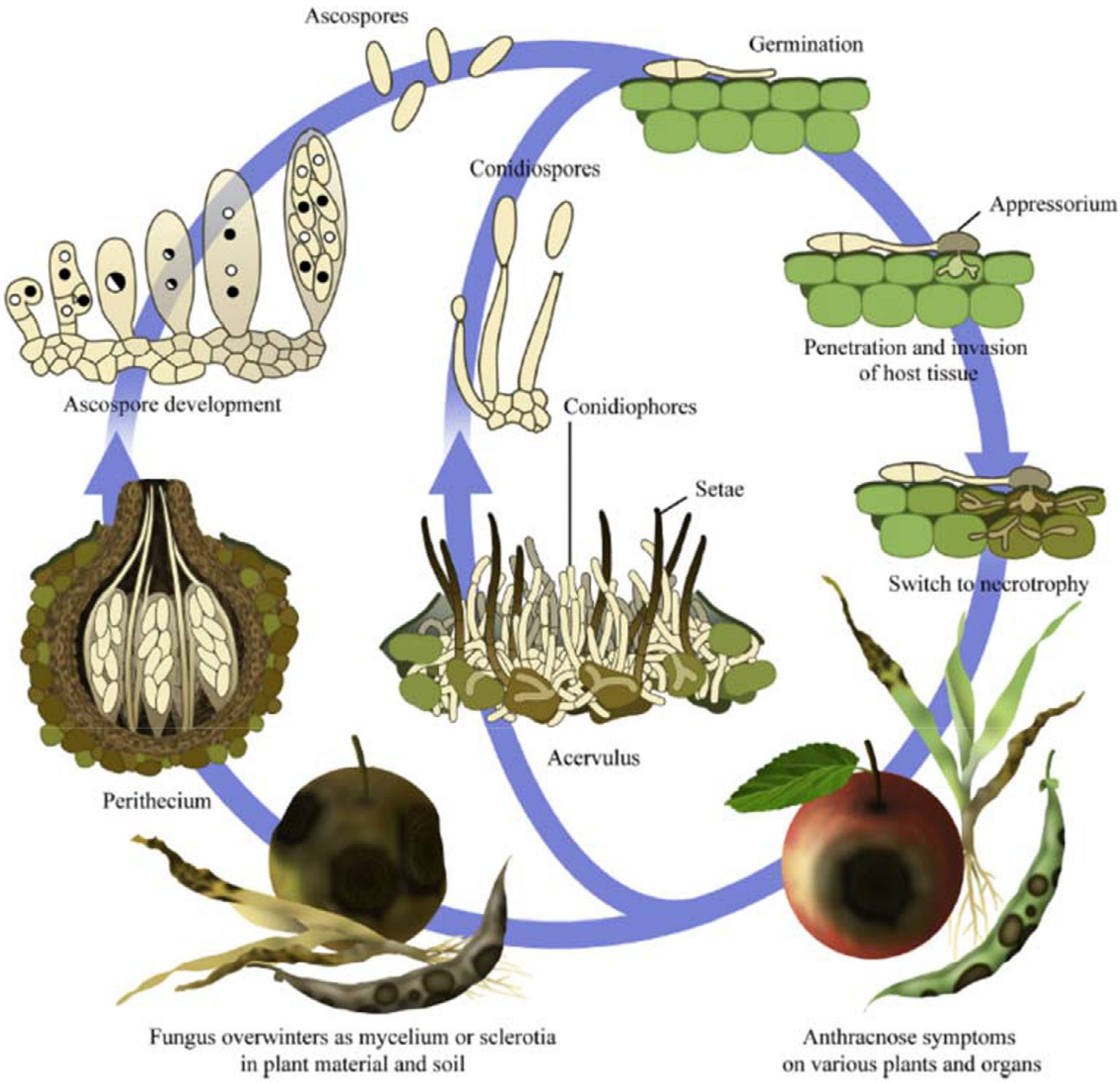

Figure 1: General life cycle of *Colletotrichum* species (from de Silva et al., 2017)

The sexual stage of many *Colletotrichum* species, including *C. plurivorum,* is rarely observed in nature, but readily occurs in *in vitro* cultures (Jayawardena et al., 2021). Nevertheless, the *in vitro* formation of asexual (acervuli with conidia) and sexual (perithecia with ascospores) fruiting structures by *C. plurivorum* seems to depend also on the culture medium and the isolate. In Damm et al. (2019) studies, some strains of *C. plurivorum* predominantly formed a sexual stage in cultures grown on Spezieller Nährstoffarmer Agar (SNA) medium, while the asexual stage was hardly or not observed; other strains formed both sexual and asexual stages, whereas in others the sexual stage was lacking. In the study of Douanla-Meli et al. (2018), isolates of *C. plurivorum* (as *C. cliviae*) from *Citrus limon* in Vietnam produced only the sexual stage in *in vitro* cultures, while isolates from *Myrianthus arboreus* in Cameroon produced both the asexual and the sexual stages. Yang et al. (2011) and de Silva et al. (2019) reported that *C. plurivorum* strains from Orchidaceae and *Capsicum* sp., respectively, formed *in vitro* both the sexual and asexual stages. Nevertheless, sometimes the cultured isolates lose the ability to form perithecia due to storage conditions, nutrients in medium and frequent subculturing (Cannon et al., 2012; Jayawardena et al., 2016). Therefore, reports mentioning *Colletotrichum* species not producing their sexual stage *in vitro* should be treated with caution.

No information specific for the potential of *C. plurivorum* to survive in soil (with or without plant debris) exists. Nevertheless, in general, *Colletotrichum* species do not survive for long periods in soil (Bergstrom and Nicholson, 1999; Ripoche et al., 2008), although there are notable exceptions

(Eastburn and Gubler, 1990; Dillard and Cobb, 1998; Freeman et al., 2002; Feil et al., 2008; Ripoche et al., 2008) and melanised microsclerotia have been observed in several species (e.g. *C. truncatum, C. sublineola* and *C. coccodes*) (Dillard and Cobb, 1998; Boyette et al., 2007; Sukno et al., 2008). However, no information exists in the available literature on the ability of the pathogen to form microsclerotia.

No information is available in the literature on the range of temperatures that favour the mycelial growth and fructifications of *C. plurivorum.*

3.1.3. Host range

Colletotrichum plurivorum has been reported from plant species belonging to 18 families. Reported hosts include:

1) agricultural crops, such as *Abelmoschus esculentus* (okra; Damm et al., 2019), *Capsicum* spp. (pepper; Sakthivel et al., 2018, 2020; Damm et al., 2019; de Silva et al., 2019), *Carica papaya* (papaya; Damm et al., 2019; Sun et al., 2019; García-Estrada et al., 2020), *Citrus limon* (lemon; Douanla-Meli et al., 2018; Damm et al., 2019), *Coffea* sp. (coffee; Damm et al., 2019), *Dioscorea* sp. (yam; Damm et al., 2019), *Glycine max* (soybean; Barbieri et al., 2017; Damm et al., 2019; Zaw et al., 2019), *Gossypium* sp. (cotton; Damm et al., 2019), *Manihot esculenta* (cassava; Liu et al., 2019), *Musa* sp. (banana; Damm et al., 2019), *Passiflora edulis* (passion fruit; Damm et al., 2019), *Phaseolus lunatus* (Lima bean; Cavalcante et al., 2019), *P. vulgaris* (common bean; Damm et al., 2019), *Pyrus bretschneideri* (Chinese white pear; Fu et al., 2019), *Solanum lycopersicum* (tomato; Damm et al., 2019) and *Vitis* spp. (grapevine; Lei et al., 2016; Damm et al., 2019),
2) ornamentals, such as *Arundina graminifolia* (bamboo orchid; Damm et al., 2019), *Cymbidium hookerianum* (hooker's cymbidium; Damm et al., 2019), *Dracaena fragrans* (striped dracaena; Scheck, 2019), *Hoya kerrii* (hoya hearts; Scheck, 2019), *Myrianthus arboreus* (giant yellow mulberry; Damm et al., 2019), *Oncidium* sp. (dancing lady orchid; Damm et al., 2019), *Spathiphyllum wallisii* (peace lily; Damm et al., 2019), *Zamioculcas zamiifolia* (Zanzibar gem; Zhou and Li, 2017; Damm et al., 2019), and
3) wild plants, such as *Amorphophallus rivieri* (Damm et al., 2019).

Pyrus pyrifolia (Asian pear) has been shown to be an experimental host of the pathogen (Liu et al., 2016; Fu et al., 2019). *Colletotrichum plurivorum* has also been detected as an endophyte in *Camellia sinensis* (tea) and *Mangifera indica* (mango) in China and Brazil, respectively (Vieira et al., 2014; Liu et al., 2015).

Nevertheless, the host range of the pathogen might be wider than that currently reported as, in the past, when molecular tools were not available, *Colletotrichum* isolates detected on other than the above-mentioned hosts and identified as *C. cliviae* or *C. clivicola* based on morphology and pathogenicity, might have belonged to *C. plurivorum*.

Given that *Colletotrichum* species are commonly found on many plant species as pathogens, endophytes and occasionally as saprobes, and that the accurate identification of *C. plurivorum* and its discrimination from other closely related *Colletotrichum* species (e.g. *C. clivicola, C. sojae, C. vittalense*), is only possible by using multilocus gene sequencing analysis, this Pest categorisation will focus on those hosts for which there is robust evidence in the literature that the pathogen was isolated and identified by both morphology and multilocus gene sequencing analysis, the Koch's postulates were fulfilled and impacts on crop yield of the disease caused by the pathogen were reported. Based on the above, the following hosts are considered as main hosts of *C. plurivorum*:

- *Abelmoschus esculentus*
- *Capsicum* spp.
- *Carica papaya*
- *Glycine max*
- *Manihot esculenta*
- *Phaseolus lunatus*
- *Pyrus bretschneideri*
- *Vitis* spp.

The complete list of the host plants of *C. plurivorum* reported to date in the literature is included in Appendix B (last updated: 21 July 2021). However, because of the ongoing re-evaluation of the taxonomy of the genus *Colletotrichum* and the lack of systematic surveys, uncertainty exists with respect to the actual host range of the pathogen.

3.1.4. Intraspecific diversity

Fu et al. (2019) studies have shown that strains of the pathogen exhibited a clear organ specificity on *Pyrus bretschneideri*. More specifically, strains isolated from pear leaves showed no pathogenicity to unwounded pear fruits (cv. Huangguan). Pathogenicity testing of *C. plurivorum* isolates originated from chili (*C. annuum*) leaves in Thailand and Malaysia showed that they could infect leaves but not fruit (wounded or unwounded) and suggested they might be specialised leaf pathogens (de Silva et al., 2019). In contrast, two isolates of *C. plurivorum* originated from chili fruit in Bangkok did not infect chili leaves but did infect wounded fruits. These results suggest that a plant organ specificity exists within the population of *C. plurivorum*.

3.1.5. Detection and identification of the pest

Are detection and identification methods available for the pest?
Yes, detection and identification methods are available.

Plants infected by *C. plurivorum* show symptoms of anthracnose, which include dark brown stem and fruit spots, stem cankers, pre- and post-harvest fruit rot, leaf spots and wilt, shoot-tip dieback and defoliation (Liu et al., 2019; de Oliveira et al., 2020). However, these symptoms are similar to those caused by other *Colletotrichum* species. If fruiting structures (acervuli with conidia and/or perithecia with ascospores) are detected on the symptomatic plant tissues using a magnifying lens, they are similar to those of other *Colletotrichum* species. Therefore, it is unlikely that the pathogen could be detected based on visual inspection only.

The pathogen can be readily isolated on culture media and description of its cultural and morphological characteristics is available in the literature (Damm et al., 2019; Liu et al., 2019; de Silva et al., 2019). However, as some of these characteristics are similar to or overlap with those of other *Colletotrichum* species, and moreover, they vary under changing environmental conditions (Cai et al., 2009; Liu et al., 2016), the pathogen cannot be reliably identified based only on morphology (Damm et al., 2019; Zaw et al., 2019). Molecular methods, such as multilocus gene (e.g. ITS, cal, *tub2*, *his3, act, chs-1, gapdh*, *cmdse*) sequencing analysis are available in the literature (Damm et al., 2019; Fu et al., 2019; de Silva et al., 2019) and may be used in combination with morphology-based methods for the identification of *C. plurivorum* and its discrimination from other closely related *Colletotrichum* species.

No EPPO Standard is available for the detection and identification of *C. plurivorum*.

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

Colletotrichum plurivorum has been so far reported from Africa, America and Asia.

In Africa, *C. plurivorum* is reported from Cameroon (Damm et al., 2019) and Benin (Damm et al., 2019).

In America, the pathogen is reported from Brazil (Barbieri et al., 2017; Santos et al., 2018; Damm et al., 2019; Batista et al., 2020), Mexico (Damm et al., 2019), Puerto Rico (Damm et al., 2019) and USA (Scheck, 2019).

In Asia, the pathogen is reported from China (Yang et al., 2011; Lei et al., 2016; Wang et al., 2016; Zhou and Li, 2017; Damm et al., 2019; Fu et al., 2019; Liu et al., 2019), India (Sakthivel et al., 2018, 2020), Iran (Damm et al., 2019), Japan (Damm et al., 2019; Sun et al., 2019), Malaysia (de Silva et al., 2019), Myanmar (Zaw et al., 2019), Taiwan (Sun et al., 2019), Thailand (de Silva et al., 2019) and Vietnam (Douanla-Meli et al., 2018; Damm et al., 2019).

Details of the current distribution of the pathogen outside the EU are presented in Appendix A. No map on the global distribution of *C. plurivorum* is available in the EPPO Global Database.

There is uncertainty with respect to the actual distribution of the pathogen outside the EU, as in the past, when molecular tools (i.e. multigene phylogenetic analysis) were not available, the pathogen might have been misidentified based on morphology and pathogenicity tests, which cannot reliably identify *C. plurivorum*.

3.2.2. Pest distribution in the EU

Is the pest present in the EU territory? If present, is the pest widely distributed within the EU?

No, *Colletotrichum plurivorum* is not reported to be present in the EU.

No records exist in the available literature on the occurrence of *C. plurivorum* in the EU territory. Nevertheless, because of the small differences in morphology (e.g. conidial size and shape) between the species of the *C. orchidearum* complex and the large interspecific variation (Damm et al., 2019), there is uncertainty with respect to the actual distribution of the pathogen in the EU, as in the past, when molecular tools (i.e. multigene phylogenetic analysis) were not available, the pathogen might have been misidentified based on morphology and pathogenicity tests, which cannot reliably identify *C. plurivorum*.

3.3. Regulatory status

3.3.1. Commission Implementing Regulation 2019/2072

Colletotrichum plurivorum is not listed in Annex II of Commission Implementing Regulation (EU) 2019/2072, the implementing act of Regulation (EU) 2016/2031.

3.3.2. Hosts of *Colletotrichum plurivorum* that are prohibited from entering the Union from third countries

Table 2: List of plants, plant products and other objects that are *Colletotrichum plurivorum* 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**
8.	Plants for planting of [...] *Pyrus* L. [...], other than dormant plants free from leaves, flowers and fruits	ex 0602 10 90 ex 0602 20 20 ex 0602 20 80 ex 0602 40 00 ex 0602 90 41 ex 0602 90 45 ex 0602 90 46 ex 0602 90 47 ex 0602 90 48 ex 0602 90 50 ex 0602 90 70 ex 0602 90 91 ex 0602 90 99	Third countries other than Albania, Andorra, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canary Islands, Faeroe Islands, Georgia, Iceland, Liechtenstein, Moldova, Monaco, Montenegro, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny federalny okrug), Northwestern Federal District (Severo- Zapadny federalny okrug), Southern Federal District (Yuzhny federalny okrug), North Caucasian Federal District (Severo-Kavkazsky federalny okrug) and Volga Federal District (Privolzhsky federalny okrug)), San Marino, Serbia, Switzerland, Turkey, Ukraine and the United Kingdom (1)

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**
9.	Plants for planting of [. . .] *Pyrus* L. [. . .], and their hybrids other than seeds	ex 0602 10 90 ex 0602 20 20 ex 0602 90 30 ex 0602 90 41 ex 0602 90 45 ex 0602 90 46 ex 0602 90 48 ex 0602 90 50 ex 0602 90 70 ex 0602 90 91 ex 0602 90 99	Third countries other than Albania, Algeria, Andorra, Armenia, Australia, Azerbaijan, Belarus, Bosnia and Herzegovina, Canada, Canary Islands, Egypt, Faeroe Islands, Georgia, Iceland, Israel, Jordan, Lebanon, Libya, Liechtenstein, Moldova, Monaco, Montenegro, Morocco, New Zealand, North Macedonia, Norway, Russia (only the following parts: Central Federal District (Tsentralny federalny okrug), Northwestern Federal District (Severo- Zapadny federalny okrug), Southern Federal District (Yuzhny federalny okrug), North Caucasian Federal District (Severo- Kavkazsky federalny okrug) and Volga Federal District (Privolzhsky federalny okrug)), San Marino, Serbia, Switzerland, Syria, Tunisia, Turkey, Ukraine, the United Kingdom (1) and United States other than Hawaii
10-	Plants of *Vitis* L., other than fruits	0602 10 10 0602 20 10 ex 0604 20 90 ex 1404 90 00	Third countries other than Switzerland
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 pest could potentially enter the EU territory via the host plants for planting and the fresh fruit pathways.

Host plants for planting is a main pathway for the entry of the pathogen into the EU territory

The Panel identified the following main pathways for the entry of the pathogen into the EU territory:

1) host plants for planting, and
2) fresh fruit of host plants,

originating in infested third countries (Table 3).

Although seeds are reported as one of the primary sources of inoculum for many *Colletotrichum* species, there is no evidence of *C. plurivorum* being transmitted by seeds of its host plants. On the contrary, Cavalcante et al. (2019) reported that among *C. truncatum, C. plurivorum, C. brevisporum,* *C. lobatum* and *C. musicola* causing anthracnose on lima beans (*Phaseolus lunatus*) in Brazil, only *C. truncatum* was found to be associated with seeds.

No information specific for *C. plurivorum* exists in the available literature on its survival in soil, but in general, *Colletotrichum* species appear to be poor competitors in soil (see Section 3.1.2). Therefore, uncertainty exists on the soil and other substrates associated or not with host plants for planting as a pathway of entry of the pathogen into the EU territory.

The pathogen is unlikely to enter the EU by natural means (rain, wind-driven rain, insects, etc.) because of the long distance between the infested third countries and the EU Member States. Although there are no quantitative data available, spores of the pathogen may be also present as contaminants on other substrates (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 *C. plurivorum* into the EU territory.

Given its biology, *C. plurivorum* could potentially be transferred from the fruit pathway to host plants grown in the EU territory. However, the frequency of this transfer will depend on the volume and frequency of imported fruits, their final destination (e.g. retailers, packinghouses) and its proximity to the hosts as well as on the management of fruit waste.

Table 3: Potential entry pathways for *Colletotrichum plurivorum* into the EU 27

Pathways	Life stage	Relevant mitigations [e.g. prohibitions (Annex VI) or special requirements (Annex VII) within Implementing Regulation 2019/2072]
Plants for planting of *Pyrus* L., other than dormant plants free from leaves, flowers and fruits	Mycelium, acervuli with conidia, perithecia with ascospores, appressoria	Annex VI (8.) bans the introduction of plants for planting of *Pyrus* with leaves, flowers and fruits from certain third countries. Among the third countries from where the introduction of the above-mentioned plant material is not prohibited is USA, which has been reported to be infested by *C. plurivorum* (see Section 3.3.2).
Plants for planting of *Pyrus* L. and their hybrids, other than seeds	Mycelium, acervuli with conidia, perithecia with ascospores, appressoria	Annex VI (9.) bans the introduction of plants for planting of *Pyrus* with leaves, flowers and fruits from certain third countries. Among the third countries from where the introduction of the above-mentioned plant material is not prohibited is USA which has been reported to be infested by *C. plurivorum* (see Section 3.3.2).
Plants of *Vitis* L., other than fruits	Mycelium, acervuli with conidia, perithecia with ascospores, appressoria	Annex VI (10.) bans the introduction of plants of *Vitis* L., other than fruits from third countries other than Switzerland (see Section 3.3.2).
Soil consisting in part of solid organic substances	Microsclerotia, with high uncertainty because of lack of information	Annex VI (19.) bans the introduction of soil from third countries other than Switzerland
Growing medium, attached to or associated with plants, intended to sustain the vitality of the plants.	Microsclerotia, with high uncertainty because of lack of information	Annex XI A (1.) requires Phytosanitary Certificate for growing medium, attached to or associated with plants, intended to sustain the vitality of the plants originating in third countries other than Switzerland.
Leaves of *Manihot esculenta* Crantz	Mycelium, acervuli with conidia, perithecia with ascospores, appressoria	Annex XI A (3.) requires Phytosanitary Certificate for (i) leaves of cassava (fresh or chilled), and (ii) fresh vegetable products of cassava, not elsewhere specified or included originating in third countries other than Switzerland.
Fruits of *Carica papaya* L., *Pyrus* L. and *Vitis* L.	Mycelium, acervuli with conidia, perithecia with ascospores, appressoria	Annex XI A (5.) requires Phytosanitary Certificate for fruits (fresh or chilled) of *Carica papaya* L., *Pyrus* L. and *Vitis* L. originating in third countries other than Switzerland.

Pathways	Life stage	Relevant mitigations [e.g. prohibitions (Annex VI) or special requirements (Annex VII) within Implementing Regulation 2019/2072]
Seeds of *Capsicum* spp. and *Phaseolus* spp. for sowing	Mycelium	Annex XI A (8.) requires Phytosanitary Certificate for seeds for sowing of beans (*Phaseolus* spp.) and *Capsicum* spp. originating in third countries other than Switzerland.
Seeds of *Glycine max* L. Merrill for sowing	Mycelium	Annex XI A (11.) requires Phytosanitary Certificate for soya bean seeds for sowing originating in third countries
Seeds of *Carica papaya* L. for sowing	Mycelium	None
Seeds of *Abelmoschus esculentus* L. for sowing	Mycelium	None
Manihot esculenta plants for planting	Mycelium, acervuli with conidia, perithecia with ascospores, appressoria	None
Machinery and vehicles which have been operated for agricultural or forestry purposes	chlamydospores, sclerotia	Annex VII (2.) requires official statement that the machinery or vehicles are cleaned and free from soil and plant debris Annex XI, A (1.) requires phytosanitary certificate for the introduction into the Union territory from third countries other than Switzerland.

The volume of fresh produce of *C. plurivorum* main hosts originated in infested third countries and imported into the EU territory during the period 2016–2020 is presented in Table 4. Appendix C provides import statistics for individual third countries.

Table 4: EU 27 annual imports of fresh produce of main hosts from countries where *Colletotrichum plurivorum* is present, 2016–2020 (in 100 kg) Source: Eurostat accessed on 26/7/2021

Commodity	HS code	2016	2017	2018	2019	2020
Okra (other vegetables fresh or chilled)	0709 99 90	59966.55	66364.19	77706.24	74205.39	66822.89
Capsicum spp. (fresh or chilled)	0709 60	8956.15	9317.59	6862.17	10055.53	7693.61
Papayas (fresh)	0807 20 00	276421.32	331983.49	338038.53	350162.13	334889.38
Manioc (cassava)	0714 10 00	22780.02	24238.27	38160.46	68688.99	115518.99
Beans (fresh or chilled)	0708 20	2711.09	3405.35	3261.44	4064.25	3717.80
Pears (fresh)	0808 30	102502.26	98646.31	117748.73	83681.26	99301.42
Grapes (fresh)	836806.60	1085982.51	1001362.83	1149796.24	963655.30	836806.60
	Sum	1310143.99	1619937.71	1583140.40	1740653.79	1591599.39

Notifications of interceptions of harmful organisms began to be compiled in Europhyt in May 1994 and in TRACES in May 2020. As of 29 June 2021, there were nine records of interception of *Colletotrichum* and *Colletotrichum* sp. in the Europhyt database and two records of interception of *C. acutatum* in the TRACES database. No interceptions specific for *C. plurivorum* exist 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 *Colletotrichum plurivorum* could potentially establish in some parts of the risk assessment area, similarly to other well-established *Colletotrichum* species.

Climatic mapping is the principal method for identifying areas that could provide suitable conditions for the establishment of a pest taking key abiotic factors into account (Baker et al., 2000). Availability of hosts is considered in Section 3.4.2.1. Climatic factors are considered in Section 3.4.2.2.

3.4.2.1. EU distribution of main host plants

As noted above and shown in Appendix B, *C. plurivorum* has a wide host range. Most of the main hosts of the pathogen are widely distributed in the EU territory, in commercial production (fields, orchards, greenhouses) and in home gardens. The harvested area of most of the main hosts of *C. plurivorum* cultivated in the EU 27 in recent years is shown in Table 5. Appendix D provides production statistics for individual Member States.

Although there is no data available in EUROSTAT, *Carica papaya* is grown commercially in Spain (Andalucía, Canary Islands, Comunitat Valenciana), Italy (Sicily) and Greece (Crete) (Lionakis, 2010; Carella et al., 2018; MAPA, 2019).

Table 5: Harvested area of *Colletotrichum plurivorum* main hosts in EU 27, 2016–2020 (1,000 ha). Source EUROSTAT (accessed 26/7/2021) https://ec.europa.eu/eurostat/databrowser/view/apro_cpsh1/default/table?lang=en

Crop	2016	2017	2018	2019	2020
Broad and field beans	477.86	495.80	469.39	410.79	451.14
Soya	831.18	962.39	955.40	907.91	939.80
Pears	115.76	114.84	114.84	111.84	108.83
Peppers (*Capsicum* spp.)	57.59	57.47	56.27	59.68	59.66
Grapes	3,136.04	3,134.93	3,137.17	3,160.68	3,162.48

3.4.2.2. Climatic conditions affecting establishment

Colletotrichum plurivorum has been reported from three continents, i.e. Africa, America and Asia. Very limited data are available on the exact location of the areas of the current global distribution of *C. plurivorum.* Nevertheless, based on the few data available, the climatic zones in parts of China, Brazil, Iran, Japan, Myanmar, Taiwan and USA, where the pathogen is present are comparable to climatic zones within the EU (Figure 2).

The global Köppen–-Geiger climate zones (Kottek et al., 2006) describe terrestrial climate in terms of average minimum winter temperatures and summer maxima, amount of precipitation and seasonality (rainfall pattern).

Colletotrichum plurivorum occurs in several climate zones, such as BSh, BSk, Cfa, Csa, Dfb and Dfc (Figure 2). These climate zones also occur in the EU territory, where many hosts of the pathogen are grown (Figure 2).

Based on the above, it may be assumed that the climatic conditions occurring in some parts of the EU territory are favourable for the establishment of *C. plurivorum*. Given the limited data available on the exact locations of the current distribution of *C. plurivorum* outside the EU, uncertainty exists on whether the pathogen could potentially establish in EU areas belonging to other than the above-mentioned climate zones where hosts are also present.

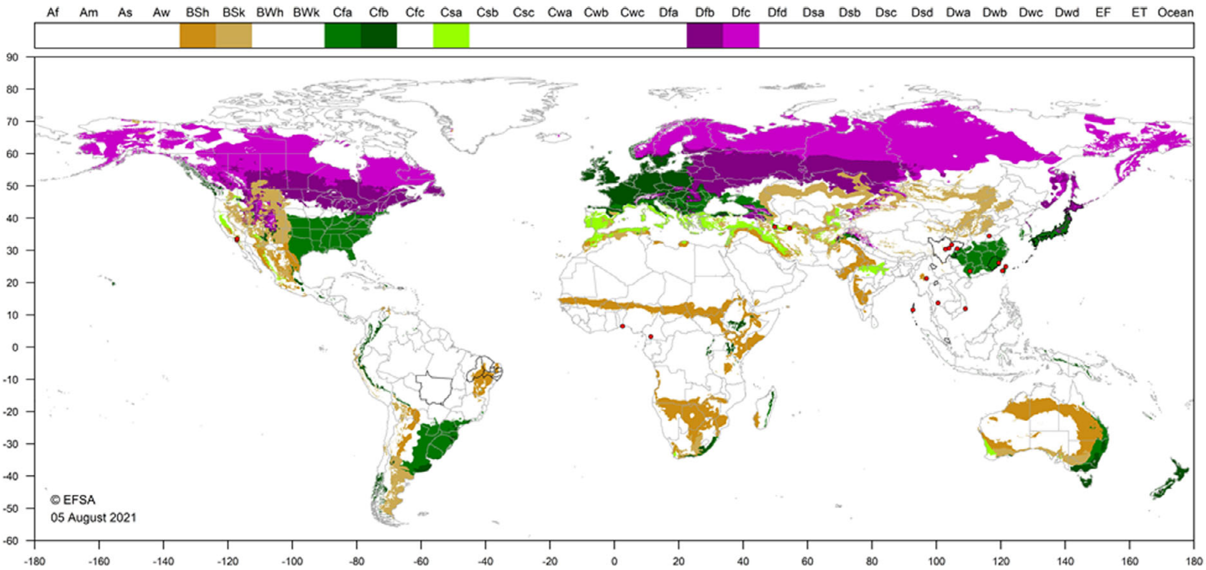

Figure 2: Köppen–Geiger climate types that occur in the EU compared with those in non-EU areas (America, Asia, Africa) where *Colletotrichum plurivorum* has been reported

3.4.3. Spread

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

Following establishment, *C. plurivorum* could potentially spread within the EU territory by natural and human-assisted means. Trading/movement of host plants for planting and fresh fruit are the main means of long-distance spread of the pathogen.

Following its introduction into the EU territory, *C. plurivorum*, similarly to other *Colletotrichum* species, could potentially spread via natural and human-assisted means.

Spread by natural means. *Colletotrichum* species can spread locally mainly by water (rain, irrigation) droplets (Madden et al., 1996; Freeman et al., 2002; Mouen Bedimo et al., 2007; Penet et al., 2014). Wind-driven rain and insects may also contribute to the dispersal of *Colletotrichum* spp. spores (Gasparoto et al., 2017). In some pathosystems (e.g. *C. acutatum* and *C. gloeosporioides* affecting citrus), spread of the pathogens may also occur via the wind-disseminated ascospores (Silva-Junior et al., 2014).

Spread by human assistance. The pathogen can spread over long distances via the movement of infected host plants for planting (rootstocks, grafted plants, scions, etc.), including dormant plants, as well as fresh fruits, contaminated agricultural machinery, tools, etc.

Uncertainty exists on the potential of the pathogen to spread via the seeds of its host plants and soil or other substrates, due to lack of evidence.

3.5. Impacts

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

Yes, the introduction of *C. plurivorum* is likely to have yield and quality impacts as well as environmental consequences in some parts of the EU territory. Nevertheless, the magnitude of the impacts is not known.

The genus *Colletotrichum* includes important plant fungal pathogens affecting more than 30 plant genera by causing anthracnose and pre- and post-harvest fruit rots on several tropical, subtropical and temperate fruit crops, vegetables and ornamentals (Bailey and Jeger, 1992; Lima et al., 2011; Anderson et al., 2013; Guarnaccia et al., 2016; de Silva et al., 2017). In the areas of its current distribution, *C. plurivorum* is reported to cause anthracnose on its host plants. Disease symptoms include dark brown stem and fruit spots, stem cankers, pre- and post-harvest fruit rot, shoot-tip dieback, leaf spots, wilting of leaves and defoliation (Liu et al., 2019; de Oliveira et al., 2020). Yield losses caused by *C. plurivorum* vary a lot. Moreover, there is very limited quantitative data available in the literature on the yield and/or quality losses caused by the pathogen. Anthracnose fruit rot is the main post-harvest problem of papaya in Taiwan (Sun et al., 2019) and chili pepper in China (Liu et al., 2016). In 2017, severe leaf blight caused by *C. plurivorum* that resulted in substantial yield loss was observed in chili crops in Andaman and Nicobar Islands in India (Sakthivel et al., 2018). Batista et al. (2020) reported that in 2016, 60% anthracnose incidence caused by *C. plurivorum* was recorded on leaves of okra crops in Altamira Pará, Brazil. *Colletotrichum plurivorum,* initially identified by Zhou and Li (2017) as *C. cliviae,* was the causal agent of a leaf spotting disease of *Zamioculcas zamifolia* potted plants grown for ornamental purposes in Henan Province, China (Zhou and Li, 2017; Damm et al., 2019). The disease incidence was 80% and the affected leaves gradually fell off resulting in reduction of the ornamental value of the plants. According to Fu et al. (2019) studies, *C. plurivorum* was identified as one of the several *Colletotrichum* species associated with anthracnose of *Pyrus* spp. in China. Pear anthracnose is an important disease in major pear-cultivation areas of China, occurring during the growth and fruit maturation periods of pear, mainly damaging leaves and fruits. In China, the disease has led to substantial economic losses due to excessive fruit rot or severe suppression of tree growth (Fu et al., 2019). In China (Fujian Province), *C. plurivorum*, initially characterised by Lei et al. (2016) as *Colletotrichum* sp. (Damm et al., 2019), was reported to be associated with grape ripe rot, a serious disease that occurs preharvest on mature grapes or during the harvest period resulting in substantial yield and quality losses (Lei et al., 2016).

Potential consequences of the introduction of *C. plurivorum* into the EU territory may be associated with the additional fungicide treatments required for disease control. Increasing the frequency of fungicide applications may interfere with the current integrated pest management (IPM) programmes that aim to reduce the use of chemical pesticides.

Based on the information available in the literature on the impacts caused by *C. plurivorum* in the areas of its current distribution, it is expected that the introduction of the pathogen into the EU would potentially cause yield and quality losses in some parts of the risk assessment area. Nevertheless, it is not known if the agricultural practices and chemical control measures currently applied in the EU could potentially reduce the impact of the pest introduction.

3.6. Available measures and/or potential specific import requirements and limits of mitigation measures

Are there measures available to prevent the entry into the EU such that the risk becomes mitigated?

Yes. Although not specifically targeted against *C. plurivorum*, existing phytosanitary measures (see sections 3.3.2 and 3.4.1) mitigate the likelihood of the pathogen's entry into the EU territory. Potential additional measures also exist to further mitigate the risk of entry (see section 3.6.1).

3.6.1. Identification of potential additional measures

Phytosanitary measures (prohibitions) are currently applied to plants for planting and fruit of some main hosts of *C. plurivorum*, although measures in Annex VI of Commission Implementing Regulation 2019/2072 do not specifically refer to this pest (see Section 3.3.2).

Potential additional control measures are listed in Table 6.

Table 6: Selected control measures (a full list is available in EFSA PLH Panel et al., 2018) for pest entry and spread in relation to currently unregulated hosts and pathways

Special requirements summary (with hyperlink to information sheet if available)	Control measure summary in relation to *Colletotrichum plurivorum*
Pest freedom	*Used to mitigate likelihood of infestation by specified pest at origin, hence to mitigate entry* Plant or plant products come from a country officially free from the pest, or from a pest-free area or from a pest-free place of production.
Managed growing conditions	*Used to mitigate likelihood of infestation at origin* Anthracnose diseases are generally more severe in tropical and subtropical countries. Hot and humid environmental conditions support the spread of these pathogens. Hence, the use of pathogen-free propagation material, proper field drainage, avoidance of unclean water for canopy irrigation, plant distancing, destroying infected parts of plants into small pieces for faster decomposition using limes, crop rotation and removal of any infected plant parts in the field represent effective strategies to manage *C. plurivorum* at origin.
Growing plants in isolation	*Used to mitigate likelihood of infestation by specified pest in vicinity of growing site* The use of transplants raised from pathogen-free propagative material, as well as growing transplants in weed-free areas and away from other crops that are known host of *C. plurivorum* may represent an effective control measure.
Certification of reproductive material (voluntary/official)	Plants should be produced under an approved propagation scheme and be certified pest-free following laboratory testing.
Chemical treatments on crops including reproductive material	*Used to mitigate likelihood of infestation of pests susceptible to chemical treatments* Several effective fungicides are available to control *C. plurivorum* and other anthracnose-causing species of *Colletotrichum*. Copper compounds, triazoles and strobilurins are effective in field treatment as well as when applied on propagation material. The possibility of selection of fungicide-resistant populations to triazoles and strobilurins has to be considered.
Roguing and pruning	*Used to mitigate likelihood of infestation by specified pest (usually a pathogen) at growing site where pest has limited dispersal* On some susceptible hosts, the infection by *C. plurivorum* may occur from conidia or ascospores formed on infected plants or plant residues, which can act as sources of inoculum. These propagules are dispersed from the infected organs and plant residues to newly established plant by rain splash, free water or high humidity. To reduce the sources of inoculum, pruning of the infected or damaged by the pathogen plant organs is highly recommended. Weed control may also represent an effective means to reduce inoculum sources and potential survival of the pathogen on alternative hosts
Soil treatment	*Used to mitigate likelihood of infestation of soil at origin* Although no specific studies are available on *C. plurivorum*, it is likely that the pathogen could potentially survive in infected plant residues in soil, similarly to other *Colletotrichum* species. Therefore, soil and substrates disinfection with chemical or physical (heat, soil solarisation) means could potentially eliminate the pathogen in contaminated soil and substrates.
Inspections	*Used to mitigate likelihood of infestation by specified pest at origin* The symptoms caused by *C. plurivorum* are similar to those caused by other *Colletotrichum* species. If signs (acervuli with conidia and/or perithecia with ascospores) are detected on the symptomatic plant tissues using a magnifying lens, they are also similar to those of other *Colletotrichum* species. Therefore, it is unlikely that the pathogen could be detected based on visual inspection only.

Special requirements summary (with hyperlink to information sheet if available)	Control measure summary in relation to *Colletotrichum plurivorum*
Chemical treatments on consignments or during processing	*Used to mitigate likelihood of infestation of pests susceptible to chemical treatments* Copper compounds, triazoles and strobilurins are effective as postharvest treatments against *C. plurivorum*. Calcium chloride is reported to improve the shelf-life and quality of fruits that are known hosts of anthracnose pathogens. The possibility of selection of fungicide-resistant populations should not be ruled out.
Physical treatments on consignments or during processing	*Used to mitigate likelihood of infestation of pests susceptible to physical treatments* Irradiation, mechanical cleaning (brushing, washing), sorting and grading, and removal of diseased plant parts could be adopted on consignment or during processing of susceptible host plants or fruit. In the packinghouse, proper sanitation practices (e.g. good drainage systems to channel out wastewater or sewage during on-farm fruit disinfection) should be built and regularly cleaned.
Heat and cold treatments	*Used to mitigate likelihood of infestation of pests susceptible to physical treatments* Hot water treatment at temperatures of 50–60°C for 5–60 min – depending on the host tolerance – may be applied to reduce the likelihood of infestation of *C. plurivorum* in susceptible plants or plant organs. The combination of hot water and calcium chloride may increase the efficacy of the treatment. As a warmth-adapted microorganism, cold treatments could also mitigate infection of consignments by *C. plurivorum*.
Controlled atmosphere	*Used to mitigate likelihood of infestation of pests susceptible to modified atmosphere (usually applied during transport) hence to mitigate entry* Modified and controlled atmosphere packages using polymeric films with different permeability for O_2, CO_2, other gases and H_2O can be used to maintain relative humidity, reduce water loss and contamination in various fruit commodities.
Timing of planting and harvesting and timing of export to EU	*Used to mitigate likelihood of entry of pests associated with particular phenological stages of host* Not relevant for *C. plurivorum*
Cleaning and disinfection of facilities, tools and machinery	*Used to mitigate likelihood of entry or spread of soil borne pests* Cleaning, disinfection and disinfestation (sanitation) 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 contribute to mitigate likelihood of entry or spread of *C. plurivorum*.
Conditions of transport	*Used to mitigate likelihood of entry of pests that could otherwise infest material post-production* When potentially infected/contaminated material must be transported (including proper disposal of infested waste material), specific transport conditions (kind of packaging/protection, time of transport, transport mean) should be defined to prevent the pest from escaping. These may include, though not exclusively: cold treatment and controlled atmosphere, physical protection, removal of leaves and peduncles from fruit commodities, sealed packaging.
Limits on soil	*Used to mitigate likelihood of entry or spread via pests in soil* No additional measures
Phytosanitary certificate and plant passport	*Used to attest which of the above requirements have been applied* Recommended for plant species known as hosts of *C. plurivorum.*
Post-entry quarantine (PEQ) and other restrictions of movement in the importing country	*Plants in PEQ are held in conditions that prevent the escape of pests; they can be carefully inspected and tested to verify they are of sufficient plant health status to be released, or may be treated, re-exported or destroyed. Tests on plants are likely to include laboratory diagnostic assays and bioassays on indicator hosts to check whether the plant material is infected with particular pathogens* Recommended for plant species known as hosts of *C. plurivorum.*

3.6.1.1. Biological or technical factors limiting the effectiveness of measures to prevent the entry of the pest

- Latently infected (asymptomatic) plants and plant products are unlikely to be detected by visual inspection.
- The similarity of symptoms and signs caused by *C. plurivorum* with those of other *Colletotrichum* species makes the detection of the pathogen based only on symptomatology and morphology impossible.
- The lack of rapid diagnostic methods based on serological or molecular approaches does not allow proper identification of the pathogen at entry. Thorough post-entry laboratory analyses may not be feasible for certain commodities as isolation in pure culture is needed prior to DNA extraction and molecular identification based on multigene sequencing analysis.
- The wide host range of the pathogen limits the possibility to set standard diagnostic protocols for all potential hosts.
- The genome plasticity and the possibility of sexual recombination in *C. plurivorum* may favour the selection of fungicide-resistant populations, thereby limiting the efficacy of chemical control approaches.

3.7. Uncertainty

- Host range of the pathogen, particularly after the recent developments in the taxonomy of *Colletotrichum* species and the availability of molecular tools for the identification of *C. plurivorum* and its discrimination from other closely related *Colletotrichum* species.
- Global distribution of the pathogen, particularly with respect to records where multilocus gene sequencing analysis was not used for the identification of the isolated *Colletotrichum* species.
- The status of the pathogen in the EU territory because of the ongoing re-evaluation of the taxonomy of the genus *Colletotrichum* and the lack of systematic surveys.
- Seeds of host plants as potential pathway of entry into and means of spread within the EU territory of *C. plurivorum*, because of lack of evidence.
- *Colletotrichum plurivorum* could potentially be transferred from fruits to host plants grown in the EU territory. However, the frequency of this transfer depends on several factors such as the volume and frequency of imported fruits, their final destination (e.g. retailers, packinghouses) and its proximity to the hosts as well as on the management of fruit waste.
- Soil and other substrates associated or not with host plants for planting as a pathway of entry into and means of spread within the EU territory of *C. plurivorum* due to lack of evidence.
- Potential areas of establishment of the pathogen in the EU. *Colletotrichum plurivorum* has been reported from several climate zones worldwide, such as BSh, BSk, Cfa, Csa, Dfb and Dfc. These climate zones also occur in some parts of the EU territory, where many hosts of the pathogen are grown. However, given the limited data available on the exact locations of the current distribution of *C. plurivorum* outside the EU, uncertainty exists on whether the pathogen could potentially establish in EU areas belonging to other than the above-mentioned climate zones where hosts are also present.
- Whether the agricultural practices and chemical control measures currently applied in the EU could potentially reduce the impact of pest introduction.

Nevertheless, none of the above-mentioned uncertainties affects the conclusion of this pest categorisation, as the pathogen has a wide host range, with some of the hosts being present in the EU and, moreover, some parts of the risk assessment area have climatic conditions similar to those of the areas of the pathogen's current distribution.

4. Conclusions

Colletotrichum plurivorum has not been reported to be present in the EU. The pathogen satisfies the criteria that are within the remit of EFSA to assess for this species to be regarded as a potential Union quarantine pest. However, there is a high uncertainty on its status in the EU territory because of the ongoing re-evaluation of the taxonomy of the genus *Colletotrichum* and the lack of systematic surveys.

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 the pathogen is well-established; 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)	*C. plurivorum* has not been reported to be present in the EU.	Uncertainty exists on the status of *C. plurivorum* in the EU, as in the past, when molecular tools were not available, the pathogen might have been misidentified based on morphology and pathogenicity tests, which cannot reliably identify the *Colletotrichum* species under current taxonomic criteria.
Regulatory status (Section 3.3)	*Colletotrichum plurivorum* has not been reported to be present in the EU and it is currently not regulated.	None
Pest potential for entry, establishment and spread in the EU (Section 3.4)	The pathogen can enter, become established, and spread within the EU territory. The main pathways for the entry of the pathogen into and spread within the EU territory are: (i) host plants for planting, and (ii) fresh fruit of host plants originating in infested third countries. Spores of the pathogen may be also present as contaminants on other substrates (e.g. non-host plants, second hand agricultural machinery and tools, crates, etc.) imported into the EU. However, these are considered minor pathways for the entry of *C. plurivorum* into the EU territory. The biotic and abiotic factors occurring in some parts of the EU territory suggest that *C. plurivorum* could potentially establish in the risk assessment area. Following establishment, *C. plurivorum* could potentially spread within the EU territory by natural and human-assisted means. Trading/movement of host plants for planting is the main means of long-distance spread of the pathogen.	There is uncertainty about (i) the host range of the pathogen, particularly following the recent developments in the taxonomy of *Colletotrichum* species, (ii) seeds of host plants, and soil and other substrates associated or not with host plants for planting as potential pathways of entry into and spread within the EU territory of *C. plurivorum,* (iii) the frequency of transfer of the pest from fruits to host plants grown in the EU territory and (iv) the potential of the pathogen to establish in EU areas belonging to climate zones other than BSh, BSk, Cfa, Csa, Dfb and Dfc, where hosts are also present.
Potential for consequences in the EU (Section 3.5)	Yes, the introduction of *C. plurivorum* is likely to have yield and quality impacts as well as environmental consequences in some parts of the EU territory.	Uncertainty exists on whether the agricultural practices and chemical control measures currently applied in the EU could reduce the impact of pest introduction.
Available measures (Section 3.6)	Yes. Although not specifically targeted against *C. plurivorum*, existing phytosanitary measures mitigate the likelihood of the pathogen's entry into the EU territory. Potential additional measures also exist to further mitigate the risk of entry into, establishment and spread of the pathogen within the EU	None

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Key uncertainties
Conclusion (Section 4)	*C. plurivorum* meets all the criteria assessed by EFSA above for consideration as a potential Union quarantine pest.	High uncertainty exists about the actual status of *C. plurivorum* in the EU territory because of the ongoing re-evaluation of the taxonomy of the genus *Colletotrichum* and the lack of systematic surveys.
Aspects of assessment to focus on/scenarios to address in future if appropriate:	The development of taxon-specific primers could contribute the detection of the pathogen in plant tissues. Given that all the data available in the literature have been explored, the Panel considers that to reduce uncertainty associated with the status of *C. plurivorum* in the EU, systematic surveys should be carried out and *Colletotrichum* isolates originated in the EU and maintained in culture collections should be re-evaluated using appropriate pest identification methods (e.g. multilocus gene sequencing analysis).	

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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
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, 2018).
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO, 2018).
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, 2018).
Eradication (of a pest)	Application of phytosanitary measures to eliminate a pest from an area (FAO, 2018).
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2018).
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.
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, 2018).
Pathway	Any means that allows the entry or spread of a pest (FAO, 2018).
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, 2018).
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, 2018).

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, 2018).

Appendix A – Distribution of *Colletotrichum plurivorum*

Distribution records based on EPPO Global Database (accessed on 14.7.2021) and additional literature.

Region	Country	Subnational (e.g. State)	Status
North America	USA	California – San Diego County, Vista – Riverside County, Menifee	Present, no details
	Mexico	Veracruz State	Present, no details
Caribbean	Puerto Rico		Present, no details
South America	Brazil	Pernambuco State Paraíba State Piauí State Ceará State Alagoas State Mato Grosso State	Present, no details
Africa	Benin	Porto Novo city	Present, no details
	Cameroon	Mbalmayo Forest Reserve (Department of Nyong and So'O, Central Province)	Present, no details
Asia	Japan		Present, no details
	China	Yunnan Province, Baoshan Guangxi Province, Pingnan Sichuan Province Anhui Province, Dangshan Mianyang Province, Jiangyou Guangan Province, Yuechi Chengdu Province, Wengjiang West-central Sichuan Province, Baoxing County Fujian Province – Fuzhou – Jin'an – Pudang Taiwan, New Taipei, Xindian district	Present, no details
	Vietnam	Lam Dong Province, Da Lat	Present, no details
	India	South Andaman Island, Andaman district, Manglutan	Present, no details
	Iran	Golestan province, Gorgan Guilan province, Koochesfehan	Present, no details
	Myanmar	Southern Shan State, Lawksawk	Present, no details
	Taiwan	Yunlin County, Dounan	Present, no details
	Thailand	Bangkok Chiang Rai Province	Present, no details
	Malaysia	Johor State	Present, no details

Appendix B – *Colletotrichum plurivorum* host plants

Host status	Host name	Plant family	Common name	Reference[A]
Cultivated hosts				
	Abelmoschus esculentus	Malvaceae	Okra	Damm et al. (2019), Batista et al. (2020)
	Arundina graminifolia	Orchidaceae	Bamboo orchid	Damm et al. (2019)
	Capsicum spp.	Solanaceae	Bell pepper, chili pepper	Liu et al. (2016), as *C. sichuanensis);* Douanla-Meli et al. (2018), as *C. sichuanensis;* Damm et al. (2019), De Silva et al. (2019), Sakthivel et al. (2018, 2020)
	Carica papaya	Caricaceae	Papaya	Damm et al. (2019), García-Estrada et al. (2020), Sun et al. (2019)
	Citrus limon	Rutaceae	Lemon	Douanla-Meli et al. (2018), as *C. sichuanensis*); Damm et al. (2019)
	Coffea sp.	Rubiaceae	Coffee	Damm et al. (2019)
	Cymbidium hookerianum	Orchidaceae	Hooker's cymbidium	Damm et al. (2019)
	Dioscorea sp.	Dioscoraceae	Yam	Damm et al. (2019)
	Dracaena fragrans	Asparagaceae	Striped dracaena, compact dracaena, corn plant	Scheck (2019)
	Glycine max	Fabaceae	Soybean	Barbieri et al. (2017), as *C. cliviae*); Damm et al. (2019); Zaw et al. (2019)
	Gossypium sp.	Malvaceae	Cotton	Damm et al. (2019)
	Hoya kerrii	Apocynaceae	Hoya hearts, sweet-heart hoya	Scheck (2019)
	Manihot esculenta	Euphorbiaceae	Cassava, yuca, manioc	Liu et al. (2019)
	Musa sp.	Musaceae	Bananas, plantains	Damm et al. (2019)
	Myrianthus arboreus	Urticaceae	Giant yellow mulberry, monkey fruit	Damm et al. (2019)
	Oncidium sp.	Orchidaceae	Dancing-lady orchid, golden shower orchid	Damm et al. (2019)
	Passiflora edulis	Passifloraceae	Passion fruit	Damm et al. (2019)
	Phaseolus lunatus	Fabaceae	Lima bean	Cavalcante et al. (2019), as *C. sichuanensis)*
	Phaseolus vulgaris	Fabaceae	Common bean, French bean	Damm et al. (2019)
	Pyrus bretschneideri	Rosaceae	Chinese white pear	Fu et al. (2019)
	Solanum lycopersicum	Solanaceae	Tomato	Damm et al. (2019)
	Spathiphyllum wallisii	Araceae	Peace lily, white sails, spathe flower	Damm et al. (2019)

Host status	Host name	Plant family	Common name	Reference[A]
	Vitis spp.	Vitaceae	Grapevine	Lei et al. (2016), as a *Colletotrichum* species sister to *C. cliviae*); Damm et al. (2019)
	Zamioculcas zamiifolia	Araceae	Zanzibar gem, ZZ plant, Zuzu plant, aroid palm, eternity plant, emerald palm	Zhou and Li (2017); as *C. cliviae*); Damm et al. (2019)
Wild weed hosts				
	Amorphophallus rivieri	Araceae	Devil's tongue, umbrella arum, leopard palm, snake palm	Damm et al. (2019)
Experimental hosts				
	Pyrus pyrifolia	Rosaceae	Asian pear, Japanese pear, apple pear, sand pear	Liu et al. (2016), as *C. sichuanensis*); Fu et al. (2019)

Appendix C – EU 27 annual imports of fresh produce of hosts from countries where *Colletotrichum plurivorum* is present, 2016–2020 (in 100 kg)

Source: Eurostat accessed on 26/7/2021.

		2016	2017	2018	2019	2020
Okra (other vegetables fresh or chilled)	United States	408.56	47.13	115.96	77.64	25.65
	Mexico	2565.95	6537.70	10645.43	7636.80	14278.13
	Brazil	2315.89	630.49	3140.18	1324.72	864.07
	Benin			67.61	15.38	1.40
	Cameroon	10398.90	8666.12	9566.60	6134.33	6712.83
	Japan	96.78	69.64	97.71	23.76	20.36
	China	5622.08	7596.63	9230.97	9891.02	9742.27
	Vietnam	2641.87	2971.85	3304.39	3085.03	1499.47
	India	21711.79	23457.81	25457.13	26844.49	21725.12
	Iran	0.53	788.11	2248.73	5112.80	3756.15
	Myanmar		0.39			
	Taiwan		0.00		1.00	
	Thailand	13223.54	14195.43	13174.34	13617.10	8138.08
	Malaysia	980.66	1402.89	657.19	441.32	59.36
	Sum	59966.55	66364.19	77706.24	74205.39	66822.89
		2016	**2017**	**2018**	**2019**	**2020**
***Capsicum* spp (fresh or chilled)**	United States		0.05	2.87		11.28
	Mexico	405.23	250.70	151.26	428.28	439.98
	Brazil	82.93	14.86	12.00	0.11	
	Benin					
	Cameroon	6.79	108.04	14.62	0.58	4.44
	Japan	77.33	116.92	88.74	81.08	12.54
	China	25.82	0.01	13.76	100.05	162.18
	Vietnam	790.11	1017.46	1508.27	1342.48	403.35
	India	6273.94	6456.37	3756.12	7004.07	6095.44
	Iran		0.00	5.30	125.95	8.12
	Myanmar		0.00			
	Taiwan		0.00			
	Thailand	783.97	682.20	777.61	650.60	492.89
	Malaysia	510.03	670.98	531.62	322.33	63.39
	Sum	8956.15	9317.59	6862.17	10055.53	7693.61
		2016	**2017**	**2018**	**2019**	**2020**
Papaya (fresh)	United States	200.21	84.83	118.34	19.80	42.16
	Mexico	456.27	2793.18	2613.06	2918.40	2191.29
	Brazil	268020.30	320873.67	326553.52	338527.11	327546.56
	Benin		5.15	0.80	1.39	0.98
	Cameroon	204.30	240.93	149.05	110.38	88.78
	Japan		0.00			
	China		0.00		3.00	
	Vietnam	726.15	200.97	381.47	413.60	327.07
	India	266.16	336.28	378.24	564.48	130.39
	Iran		0.00			
	Myanmar		0.00			
	Taiwan		0.00		1.99	
	Thailand	6494.24	7334.28	7831.20	7562.99	4561.88
	Malaysia	53.69	114.20	12.85	38.99	0.27
	Sum	276421.32	331983.49	338038.53	350162.13	334889.38

		2016	**2017**	**2018**	**2019**	**2020**
Manioc (Cassava)	United States		0.00		0.61	
	Mexico		0.00	0.01		
	Brazil	110.00	433.90	1086.50	1523.14	2330.27
	Benin	128.55	204.89	35.60	57.00	
	Cameroon	7556.84	12406.55	16852.39	19496.19	44107.50
	Japan	0.60	0.00	1.40		
	China	1645.78	530.60	234.00	3457.80	3594.54
	Vietnam	3636.02	4109.10	3335.76	4128.32	5028.66
	India	2396.37	2290.83	1264.71	1369.01	2135.28
	Iran		0.00			
	Myanmar		0.00			
	Taiwan		0.00			
	Thailand	6852.06	4035.52	15350.09	38201.30	58322.74
	Malaysia	453.80	226.88		455.62	
	Sum	22780.02	24238.27	38160.46	68688.99	115518.99
		2016	**2017**	**2018**	**2019**	**2020**
Beans (fresh or chilled)	United States	0.09	5.45	7.37	0.01	0.02
	Mexico	26.30	53.28	3.52	154.72	317.69
	Brazil		0.00		10.50	
	Benin					
	Cameroon	14.03	54.04	110.96	120.79	253.96
	Japan	0.24	0.08	0.02		
	China	1772.30	2288.18	2260.37	2841.09	2115.28
	Vietnam	171.56	97.89	83.80	71.75	43.74
	India	295.23	345.15	281.29	413.13	234.25
	Iran		15.75	28.92	9.08	194.04
	Myanmar	0.85	0.51	0.50		
	Taiwan		0.00			
	Thailand	299.48	362.84	380.58	370.81	291.66
	Malaysia	131.01	182.18	104.11	72.37	267.16
	Sum	2711.09	3405.35	3261.44	4064.25	3717.80
		2016	**2017**	**2018**	**2019**	**2020**
Pears (fresh)	United States	214.47	454.76	471.49	12.54	
	Mexico		0.00			
	Brazil	208.68	0.00	251.27	926.88	
	Benin					
	Cameroon		0.00			
	Japan	2.50	0.02	0.45		
	China	102076.61	98191.53	116993.12	82741.84	99293.92
	Vietnam		0.00			
	India		0.00			
	Iran		0.00	32.40		7.50
	Myanmar		0.00			
	Taiwan		0.00			
	Thailand		0.00			
	Malaysia		0.00			
	Sum	102502.26	98646.31	117748.73	83681.26	99301.42

		2016	2017	2018	2019	2020
Grapes (fresh)	United States	1714.93	8868.74	4413.37	1866.20	1072.48
	Mexico		358.96		186.71	184.62
	Brazil	194152.79	249279.81	271987.56	196465.22	228095.15
	Benin					
	Cameroon		0.00			
	Japan	4.84	1.19	1.17	1.15	20.67
	China	0.00	6.00	0.03		
	Vietnam		0.00			
	India	640933.67	827467.67	722802.04	950910.96	733881.71
	Iran		0.00	2158.50	366.00	399.80
	Myanmar		0.00			
	Taiwan		0.00			
	Thailand	0.37	0.14	0.16		0.87
	Malaysia		0.00			
	Sum	836806.60	1085982.51	1001362.83	1149796.24	963655.30

Appendix D – EU 27 and member state cultivation/harvested/production area of *Colletotrichum plurivorum* hosts (in 1000 ha)

Source EUROSTAT (accessed 26/7/2021).

Broad and field beans	2016	2017	2018	2019	2020
EU 27	477.86	495.80	469.39	410.79	451.14
Belgium	0.76	0.85	1.07	1.15	1.20
Bulgaria	2.49	2.76	1.88	1.59	2.00
Czechia	0.00	0.00	0.93	0.76	0.83
Denmark	10.90	15.20	25.40	17.00	19.20
Germany	38.80	46.40	55.30	49.20	58.70
Estonia	16.53	26.76	17.08	11.06	13.83
Ireland	11.52	13.05	7.79	7.48	12.95
Greece	5.00	5.64	5.58	3.67	3.46
Spain	47.11	36.57	23.23	22.07	21.40
France	77.79	77.43	57.22	63.11	76.66
Croatia	1.57	1.54	1.40	1.11	0.90
Italy	56.06	57.14	56.83	65.59	67.52
Cyprus	0.14	0.10	0.06	0.06	0.06
Latvia	30.70	38.20	40.10	24.90	28.50
Lithuania	67.46	67.14	69.94	55.07	58.35
Luxembourg	0.10	0.08	0.06	0.07	0.04
Hungary	1.03	0.98	0.85	0.74	0.67
Malta	0.00	0.00	0.00	0.00	0.00
Netherlands	1.44	2.15	2.07	2.80	3.45
Austria	10.82	10.30	7.65	5.71	5.53
Poland	32.90	31.22	36.00	27.24	24.82
Portugal	3.21	3.55	4.19	5.03	5.53
Romania	15.93	12.08	12.28	11.89	9.30
Slovenia	0.00	0.00	0.00	0.00	0.00
Slovakia	0.07	0.09	0.09	0.10	0.06
Finland	16.00	16.10	16.10	15.20	16.40
Sweden	29.54	30.49	26.29	18.19	19.78

Soya	2016	2017	2018	2019	2020
EU 27	831.18	962.39	955.40	907.91	939.80
Belgium	0.00	0.00	0.00	0.00	0.00
Bulgaria	14.16	11.53	2.32	3.86	4.50
Czechia	10.61	15.34	15.23	12.24	14.15
Denmark	0.00	0.00	0.00	0.00	0.00
Germany	15.80	19.10	24.10	28.90	33.80
Estonia	0.00	0.00	0.00	0.00	0.00
Ireland	0.00	0.00	0.00	0.00	0.00
Greece	1.55	1.46	0.61	1.03	0.80
Spain	1.00	1.69	1.48	1.57	1.41
France	136.52	141.83	153.85	163.80	186.95
Croatia	78.61	85.13	77.09	78.33	86.30
Italy	288.06	322.42	326.59	273.33	256.13
Cyprus	0.00	0.00	0.00	0.00	0.00
Latvia	0.00	0.00	0.00	0.00	0.00
Lithuania	1.85	2.47	1.92	1.82	2.07
Luxembourg	0.00	0.00	0.00	0.00	0.00
Hungary	61.03	75.67	62.12	58.23	59.16
Malta	0.00	0.00	0.00	0.00	0.00
Netherlands	0.00	0.00	0.54	0.48	0.00

Soya	2016	2017	2018	2019	2020
Austria	49.79	64.47	67.62	69.21	68.50
Poland	7.60	9.33	5.45	7.92	7.87
Portugal	0.00	0.00	0.00	0.00	0.00
Romania	127.27	165.14	169.42	158.15	165.46
Slovenia	2.47	2.91	1.76	1.43	1.64
Slovakia	34.87	43.90	45.30	47.60	51.07
Finland	0.00	0.00	0.00	0.00	0.00
Sweden	0.00	0.00	0.00	0.00	0.00
Pears	**2016**	**2017**	**2018**	**2019**	**2020**
EU 27	115.76	114.84	114.84	111.84	108.93
Belgium	9.69	10.02	10.15	10.37	10.66
Bulgaria	0.41	0.45	0.57	0.7	0.6
Czechia	0.74	0.71	0.75	0.8	0.83
Denmark	0.3	0.3	0.29	0.3	0.3
Germany	1.93	2.14	2.14	2.14	2.14
Estonia	0	0	0	0	0
Ireland	0	0	0	0	0
Greece	4.08	4.07	4.41	4.34	4.34
Spain	22.55	21.89	21.33	20.62	20.22
France	5.3	5.25	5.24	5.25	5.61
Croatia	0.93	0.71	0.8	0.86	0.72
Italy	32.29	31.73	31.34	28.71	25.75
Cyprus	0.07	0.07	0.06	0.06	0.06
Latvia	0.2	0.2	0.2	0.2	0.2
Lithuania	0.8	0.82	0.82	0.82	0.85
Luxembourg	0.02	0.02	0.02	0.02	0.02
Hungary	2.87	2.9	2.84	2.81	2.6
Malta	0	0	0	0	0
Netherlands	9.4	9.7	10	10.09	10
Austria	0.46	0.46	0.49	0.5	0.54
Poland	7.49	7.26	7.3	7.22	7.39
Portugal	12.62	12.56	12.5	12.5	12.5
Romania	3.15	3.12	3.1	3.08	3.1
Slovenia	0.2	0.2	0.21	0.21	0.23
Slovakia	0.11	0.11	0.12	0.11	0.1
Finland	0.04	0.04	0.05	0.04	0.05
Sweden	0.12	0.12	0.11	0.1	0.13
Peppers (*Capsicum* spp.)	**2016**	**2017**	**2018**	**2019**	**2020**
EU 27	57.59	57.47	56.27	59.68	59.66
Belgium	0.10	0.10	0.09	0.10	0.10
Bulgaria	3.66	3.35	2.95	3.22	2.72
Czechia	0.00	0.00	0.42	0.27	0.29
Denmark	0.00	0.00	0.00	0.00	0.00
Germany	0.08	0.09	0.11	0.11	0.11
Estonia	0.00	0.00	0.00	0.00	0.00
Ireland	0.00	0.00	0.00	0.00	0.00
Greece	3.77	4.03	3.84	3.39	4.18
Spain	19.62	20.50	20.58	21.43	21.75
France	0.84	0.96	0.95	0.94	1.17
Croatia	1.35	1.02	1.02	0.56	0.69
Italy	8.67	8.29	7.87	10.28	10.01
Cyprus	0.04	0.03	0.04	0.03	0.04

Peppers (*Capsicum* spp.)	**2016**	**2017**	**2018**	**2019**	**2020**
Latvia	0.00	0.00	0.00	0.00	0.00
Lithuania	0.00	0.00	0.00	0.00	0.00
Luxembourg	0.00	0.00	0.00	0.00	0.00
Hungary	2.79	2.57	1.91	1.85	1.62
Malta	0.00	0.00	0.00	0.00	0.00
Netherlands	1.32	1.32	1.31	1.50	1.53
Austria	0.17	0.18	0.16	0.16	0.16
Poland	3.78	3.63	3.71	3.70	3.80
Portugal	0.97	1.21	0.93	0.93	1.09
Romania	9.93	9.71	9.96	10.78	10.01
Slovenia	0.17	0.16	0.16	0.20	0.23
Slovakia	0.32	0.31	0.27	0.22	0.17
Finland	0.01	0.01	0.01	0.01	0.01
Sweden	0.00	0.00	0.00	0.00	0.00
Grapes	**2016**	**2017**	**2018**	**2019**	**2020**
EU 27	3,136.04	3,134.93	3,137.17	3,160.68	3,162.48
Belgium	0.24	0.24	0.30	0.38	0.49
Bulgaria	36.55	34.11	34.11	30.05	28.81
Czechia	15.80	15.81	15.94	16.08	16.14
Denmark	0.00	0.00	0.00	0.00	0.00
Germany	:	:	:	:	:
Estonia	0.00	0.00	0.00	0.00	0.00
Ireland	0.00	0.00	0.00	0.00	0.00
Greece	98.09	101.75	100.34	101.85	101.85
Spain	935.11	937.76	939.92	936.89	931.96
France	751.69	750.46	750.62	755.47	758.86
Croatia	23.40	21.90	20.51	19.82	20.63
Italy	673.76	670.09	675.82	697.91	703.90
Cyprus	6.07	5.93	6.67	6.67	6.79
Latvia	0.00	0.00	0.00	0.00	0.00
Lithuania	0.00	0.00	0.00	0.00	0.00
Luxembourg	1.26	1.26	1.25	1.24	1.24
Hungary	68.12	67.08	66.06	64.92	62.90
Malta	0.68	0.68	0.42	0.42	0.42
Netherlands	0.14	0.16	0.17	0.16	0.17
Austria	46.49	48.05	48.65	48.72	48.06
Poland	0.62	0.67	0.73	0.74	0.76
Portugal	179.05	178.84	178.78	178.78	178.78
Romania	174.17	175.32	172.80	176.34	176.76
Slovenia	15.84	15.86	15.65	15.57	15.29
Slovakia	8.71	8.47	8.01	7.92	7.73
Finland	0.00	0.00	0.00	0.00	0.00
Sweden	0.05	0.04	0.05	0.05	0.06