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Pest categorisation of *Matsucoccus massonianae*

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Abstract

The EFSA Panel on Plant Health performed a pest categorisation of *Matsucoccus massonianae* (Hemiptera: Matsucoccidae), the Massonian pine bast scale, for the EU territory. *M. massonianae* occurs in western China and has been reported as a pest of *Pinus massoniana* (Chinese red pine) and *P. thunbergii* (Japanese black pine). These hosts occur in the EU as ornamental/amenity trees. Other scales in the Matsucoccus genus feed on a variety of Pinus species and the host range of *M. massonianae* could be wider than is currently recorded. There is one generation per year. All stages occur on the branches and stems of hosts with developing nymphs and adult females feeding under the bark on the phloem vessels of the host. Symptoms include the yellowing/browning of host needles, early needle drop, desiccation of shoots and bark necrosis. The most serious infestations occur in hosts aged 8–25 years old and there can be some host mortality. In principle, host plants for planting and plant products such as cut branches and wood with bark could provide entry pathways into the EU. However, prohibitions on the import of Pinus from non-European third countries close these pathways. In China, *M. massonianae* occurs in regions with temperate humid conditions and hot summers. These conditions are also found in parts of southern EU. Were *M. massonianae* to establish in the EU, it is conceivable that it could expand its host range; however, this remains uncertain. *M. massonianae* satisfies all the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest. Some uncertainty exists over the magnitude of potential impacts.

Keywords: pest risk, *Pinus* spp. pine bast scale, plant health, plant pest, quarantine

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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 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

Matsucoccus massonianae is a pest which emerges from Annex 1C to the terms of reference (ToR) as a pest identified as potentially associated with a high-risk plant commodity, in this case artificially dwarfed Pinus parviflora grafted onto *Pinus thunbergii* from China (EFSA PLH Panel, 2022) and is to be subject to pest categorisation to determine whether it fulfils the criteria of being 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. Conclusions from pest categorisations inform European Commission decision-making as to the appropriateness of categorised pests for potential inclusion in the lists of pests of Commission Implementing Regulation (EU) 2019/ 2072. If a pest fulfils the criteria to be potentially listed as a Union quarantine pest, risk reduction options will be identified.

1.3. Additional information

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

2. Data and methodologies

2.1. Data

2.1.1. Database search

Pest information, on host(s) and distribution, was retrieved from the EPPO Global Database (EPPO, online), the CABI databases and scientific literature databases as referred below in Section 2.2.1.

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 Interceptions to TRACES in May 2020.

GenBank was searched to determine whether it contained any nucleotide sequences for *M. massonianae* 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 *M. massonianae* following guiding principles and steps presented in the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel et al., 2018), the EFSA guidance on the use of the weight of evidence approach in scientific assessments (EFSA Scientific Committee, 2017) and the International Standards for Phytosanitary Measures No. 11 (FAO, 2013).

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

The Panel's conclusions are formulated respecting its remit and particularly with regard to the principle of separation between risk assessment and risk management (EFSA founding regulation (EU) No 178/2002); therefore, instead of determining whether the pest is likely to have an unacceptable impact, deemed to be a risk management decision, the Panel will present a summary of the observed impacts in the areas where the pest occurs, and make a judgement about potential likely impacts in the EU. Whilst the Panel may quote impacts reported from areas where the pest occurs in monetary terms, the Panel will seek to express potential EU impacts in terms of yield and quality losses and not in monetary terms, in agreement with the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel et al., 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.

2.2.1. Literature search

A literature search on *Matsucoccus massonianae* was conducted at the beginning of the categorisation in the Scopus, ResearchGate and Google Scholar bibliographic databases, using the scientific name of the pest as a 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.

Where no information on the biology of the pest being categorised is available, information from related species is used and the uncertainty is recognised.

3. Pest categorisation

3.1. Identity and biology of the pest

3.1.1. Identity and taxonomy

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

Yes, the identity of the species is established and *Matsucoccus massonianae* Young & Hu is the accepted name (Ben-Dov, 2011).

Matsucoccus massonianae Young & Hu is an insect within the order Hemiptera and family Matsucoccidae. Its common name is the Massonian pine bast scale or the Chinese pine bast scale (Kosztarab and Kozár, 1988; Ben-Dov, 2011; García Morales et al., 2016).

M. massonianae has no synonyms.

The EPPO code[1] (Griessinger and Roy, 2015; EPPO, 2019) for *M. massonianae* is MATSMS (EPPO, online).

Young et al. (1976) provide a detailed description of *M. massonianae* discussing taxonomy issues and how to separate it from other Matsucoccus species.

3.1.2. Biology of the pests

M. massonianae has one generation per year. Figure 1 shows the general life cycle for *Matsucoccus* species (from Choi et al., 2019). The development of the scale occurs in three stages for females: egg, nymph (two instars) and adult, and four stages for males: egg, nymph (three instars) prepupa–pupa and adult (Young et al., 1976; Choi et al., 2019).

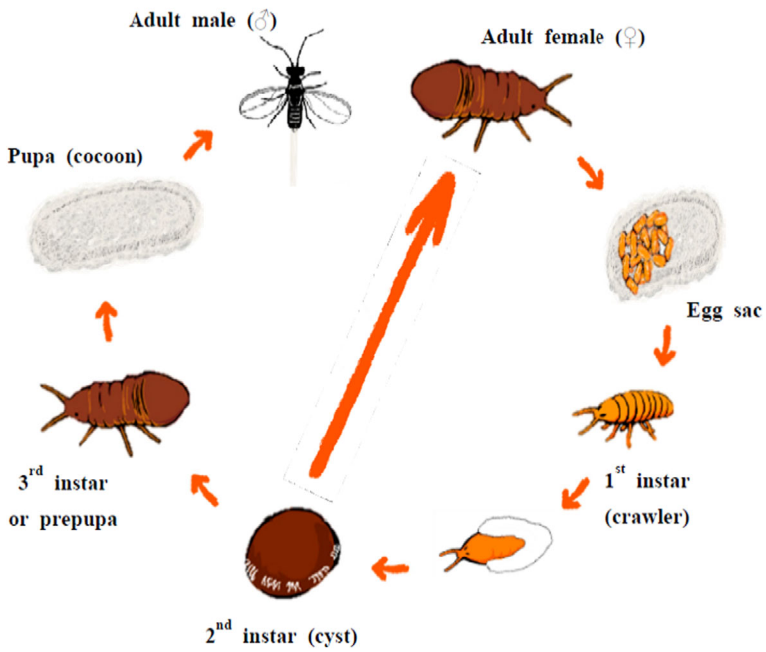

Figure 1: General life cycle of *Matsucoccus* species (Choi et al., 2019; https://creativecommons.org/licenses/by/4.0/).

Young et al. (1976) first described the species and Hu and Wang (1976) studied *M. massonianae* in the Yuwang Forest in Zhejiang (China). These are the only sources on the biology of *M. massonianae* currently available, and a summary of their findings is reported here.

Figure 2 shows the phenology of life stages of *M. massonianae*. Adults begin to emerge in late January, and they can be found up to late March. Frost and low temperatures can delay the adult activity. Adult females can live up to 35 days, while male usually die soon after mating. Eggs are laid from February to early May (72 days on average). On average 235 eggs (90–295) per female are laid in an ovisac formed by waxy filaments that remains attached to the tip of the abdomen of the female. Oviposition lasts 12–20 days, each female can lay 1–39 eggs per day. Eggs hatch after 68–75 days and the hatching rate can reach 98.1%.

The first-instar mobile nymphs appear in April and start to crawl on trunks to find a suitable place for feeding. A summer diapause period can be observed from late June to September. Second-instar nymphs are found in October, when sex differentiation becomes apparent. Second-instar female nymphs are sessile and do not move; they overwinter and then they directly moult to adult females (Figure 1). The third-instar male nymphs (pre-pupa) are mobile and appear from October to November. The male pupa forms an oval cocoon made from waxy filaments and overwinters. The pupal stage lasts approximately 50 days. During winter, the nymphs and male pupae continue to develop. The adults are active on trunk and branches from late January to late March. Adult females

[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).

are apterous (wingless) and crawl on the bark; adult males are winged, but no information on their flight ability is known. Both females and males can mate multiple times (6–11 times for males).

The life cycle can vary depending on locality, altitude, host plant and generation (Rieux, 1976; McClure et al., 1983; Foldi, 2004). The optimum temperature for the rapid growth and development of *M. massonianae* is 10–24°C.

Populations of *M. massonianae* are regulated by several natural enemies, mostly predators and some entomopathogenic fungi and bacteria. No parasitoids have been found to date (Xu et al., 2009).

Hu and Wang (1976) provide a list of predatory insects of *M. massonianae* in China which includes Chrysopidae (*Chrysopa septempunctata*), Cecidomyiidae (*Leptodiplosis* sp.) and Coccinellidae (e.g. *Sospita chinensis, Ballia (=Harmonia) obscurosignata, Harmonia axyridis*), but only generic information is provided about their abundance and incidence on natural populations of *M. massonianae*. For *H. axyridis*, a control effectiveness up to 88% was observed (Wang, 1982). No details are given about the effectiveness of some unidentified pathogenic microorganisms in regulating the scale populations, only stating that they affect 'large number' of nymphs and reduce the occurrence of the pest to a 'certain degree' (Hu and Wang, 1976). At least two of these predators, *H. axyridis* and *Chrysopa pallens* (= *septempunctata*), occur in the EU.

3.1.3. Host range/species affected

M. massonianae is known to have two host species, *Pinus massoniana* (Chinese red pine) and *P. thunbergii* (Japanese black pine) (Appendix A). However, as *Matsucoccus* spp. scales are known as oligophagous species feeding on conifer trees belonging to the genus Pinus (Foldi, 2004), the host range may also include other *Pinus* species.

Pseudolarix amabilis is listed as a host by Ben-Dov (2011) and García Morales et al. (2016), but this might be an error in interpreting a study by Hu and Wang (1976) who artificially infested *Pseudolarix amabilis* with *M. massonianae* and subsequently measured 0% 'parasitism' on the plants, whilst there was 91% parasitism on *P. massoniana* and 40% on *P. thunbergii*.

3.1.4. Intraspecific diversity

There are no reports of intraspecific variation within *M. massonianae*.

3.1.5. Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, there are several methods to detect the scale species but for a reliable identification, morphological and genetic analyses are needed.

Symptoms

Pine trees infested by *Matsucoccus* spp. usually show shortened needles and needle cast (Foldi, 2004). As a consequence of sap sucking, yellowing/browning of weakened crowns and cracked bark can be also observed (Hu and Wang, 1976). Host plants can be asymptomatic when the level of infestation is low, and all insect stage can be difficult to detect within the bark crevices.

Detection

According to Lanier et al. (1989), *M. massonianae* is partially attracted to a synthetic sex pheromone, the matsuone ((2 E,4 E,6R, 10R)-4,6-10,12-tetramethyl-2,4-tridecadiene-7-one). Other lures useful to capture *Matsucoccus* species into traps are ethanol, alpha-pinene and monochamol (2-undecyloxy-1-ethanol) (Ahmed et al., 2020). Lindgren funnel traps and various kinds of sticky traps can be used for *M. feytaudi, M. josephi* and *M. matsumurae* (Branco et al., 2006), *M. thunbergianae* (Kim et al., 2016; Lee et al., 2018) and various *Matsucoccus* species in Florida (Ahmed et al., 2020). Mobile apterous females and mobile nymphs passively transported by air currents can be detected by suspended glue traps of various kinds. Depending on the life cycle, all stages of development can be detected by accurate inspection within bark cervices of trunks and branches.

Description

Morphological characters of *M. massonianae* and comparison with similar species are provided by Hu and Wang (1976), Young et al. (1976), Miller and Park (1987) and Mudan et al. (1999).

Below is a summary description of main life stages of *M. massonianae* by Hu and Wang (1976) and Young et al. (1976).

Egg: oval, initially light yellow, gradually turning to pale brown, 0.27–0.31 mm long and 0.15–0.20 mm wide, encased in a white waxy ovisac 3.5–5.0 mm long and 2.0–4.0 mm wide.

First-instar nymph: long oval-shaped, light yellow, (0.35) 0.42–0.44 mm long, 0.19–0.20 mm wide, with well-developed legs.

Second-instar nymph: from oval to round, purple-brown to black without legs and antennae (sessile cysts). No information on the size.

Third-instar male nymph: body length 1.5–2.5 mm, body shape and colour similar to adult female.

Male pupa: encased in white oval cocoon 2.0–3.0 mm long. Prepupa yellowish-brown, pupa brown.

Adult male: two-winged, 1.5–1.9 (2.2) mm long, wingspan 3.5–4.2 mm, well-developed legs and antennae, silver-white waxy long filaments at the end of abdomen.

Adult female: oblong oval-shaped, well-developed legs, orange-brown or yellow, (2.5) 3.2–4.6 mm long, 1.8–2.1 mm wide.

A search of GeneBank did not reveal any accessions of *M. massonianae*.

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

M. massonianae is known to be present only in China in the provinces of Anhui (EFSA PLH Panel, 2022) and Zehjiang (Ben-Dov, 2011; García Morales et al., 2016). In Zehjiang, it was first found in the Yuwang Forest Zone (Tiantong Forestry Station) and in the suburban area of Ningbo City. Other areas of Zehjiang in which the scale is found are Huangyan, Tiantai and Linhai Counties; Dinghai County, Yuhang County and Wuxing County (Hu and Wang, 1976). Young et al. (1976) believe that *M. massonianae* could have a wider distribution in China and also in Taiwan. However, there are no confirmations to date, and details on the presence of the scale in Anhui province are not available.

Appendix B provides national and subnational records of the species occurrence of *M. massonianae* in China.

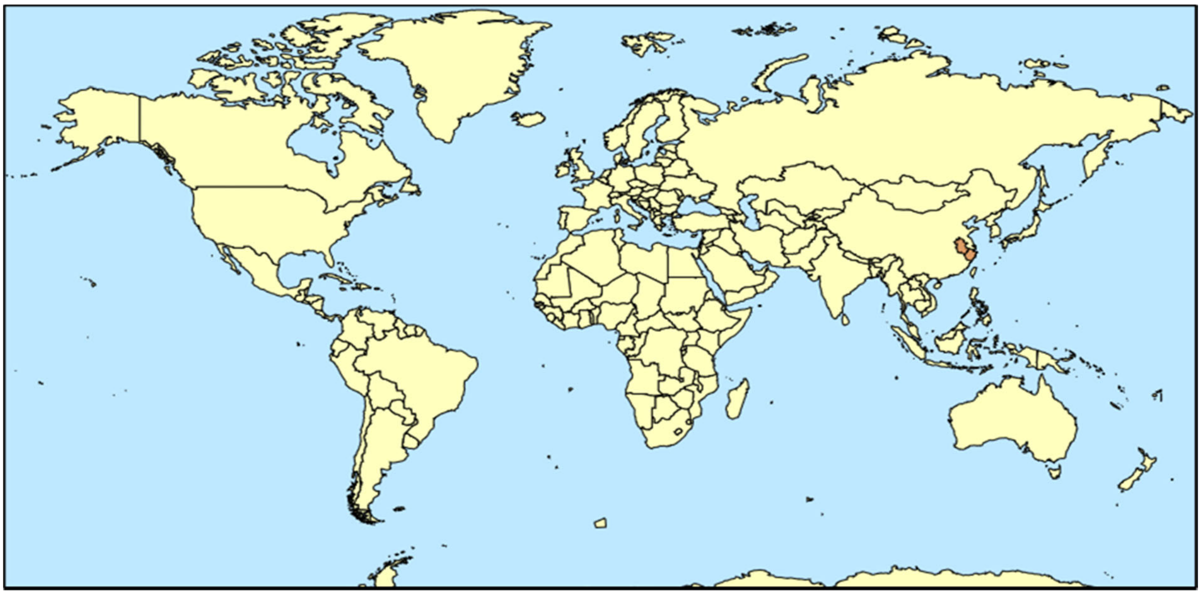

Figure 2: Global distribution of *Matsucoccus massonianae* (Source: literature cited in the opinion)

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.

No, *M. massonianae* is not known to be present in the EU territory.

Matsucoccus massonianae is considered absent from the EU (García Morales et al., 2016).

3.3. Regulatory status

3.3.1. Commission implementing regulation 2019/2072

M. massonianae is not listed in Annex II of Commission Implementing Regulation (EU) 2019/2072, an implementing act of Regulation (EU) 2016/2031.

3.3.2. Hosts or species affected by *Matsucoccus massonianae* that are prohibited from entering the Union from third countries

As specified in Annex VI, 1, of 2019/2072 (Table 2) plants of Pinus (which are host plants of *M. massonianae*, see Section 3.1.3), other than from specified European third countries, are prohibited from entering the EU. Thus, Pinus from Asia where the species occur are prohibited.

Table 2: List of plants, plant products and other objects that are *Matsucoccus massonianae* 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**
1.	Plants of [. . .] *Pinus* L., [. . .] other than fruit and seeds	Various codes from ex 0602 20 20 to ex 0604 20 40	Third countries other than: specified European third countries (see Annex VI for details)

3.4. Entry, establishment and spread in the EU

3.4.1. Entry

Is the pest able to enter in the EU territory?

Yes, all stages of development of *M. massonianae* could enter in the EU territory on *Pinus* plants, cut branches, wood with bark and isolated bark.

Comment on plants for planting as a pathway.

Plants for planting would provide the principle pathway for introduction into the EU.

M. massonianae live in the bark crevices of stems, branches and twigs of adult and young pine host trees where they can be found in all development stages (eggs, mobile and sessile nymphs, pupae, adults of both sexes) all year round. Plants of *Pinus* species are possible pathways. Table 3 lists possible pathways and associated mitigations, which prohibits entry.

Table 3: Potential pathways for *Matsucoccus massonianae* into the EU

Pathways	Life stage	Relevant mitigations [e.g. prohibitions (Annex VI) special requirements (Annex VII) or phytosanitary certificates (Annex XI) within Implementing Regulation 2019/2072]
Plants for planting of host trees	Eggs, nymphs, pupae and adults on bark	2019/2072 Annex VI prohibition
Cut branches of host plants (including Christmas trees)	Eggs, nymphs, pupae and adults on bark	2019/2072 Annex VI prohibition
Wood with bark of host plants	Eggs, nymphs, pupae and adults on bark	2019/2072 Annex VI prohibition Wood of conifers (Pinales) coming from China, can be imported if it meets the requirements listed in Annex VII. (76–82).
Isolated bark of host plants	Eggs, nymphs, pupae and adults on bark	2019/2072 Annex VI prohibition

There are no records of interceptions or outbreaks of *M. massonianae* in the EUROPHYT or TRACES databases (search covered the period from 1995 until 7 October 2022).

3.4.2. Establishment

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

Yes, *M. massonianae* could establish in parts of the EU territory as there are climatic conditions that are similar to that of its native range, and potential hosts are present. Temperate regions of the EU with hot summers would provide areas that are the most suitable for establishment.

Unless moved with plants for planting, there are uncertainties over the pests' ability to transfer to a suitable host following arrival into the EU. Uncertainties also include its ability of wingless females to attract a male and Allee effects (effects causing reduced survival of new colonies with a small number of individuals) (Tobin et al., 2011) as well as the impact of natural enemies in the EU.

3.4.2.1. EU distribution of main host plants

M. massonianae has at least two host species, *P. massoniana* (Chinese red pine) and *P. thunbergii* (Japanese black pine). They are grown as ornamental/amenity plants in the EU (Appendix A). It is unknown where in the EU, the hosts are grown.

As noted above, *Matsucoccus* scales are reported as oligophagous species feeding on a number of Pinus species; the host range of *M. massonianae* could be wider than that recorded. If *M. massonianae* did enter the EU, it could potentially expand its known host range to include Pinus species of forestry importance.

3.4.2.2. Climatic conditions affecting establishment

The records for *M. massonianae* in China indicate that it has limited distribution, being reported only from the Chinese provinces of Anhui and Zhejiang. These provinces have a single climate type in common with the EU; climate type Cfa (temperate, no dry season, hot summer, also described as a humid, subtropical; Kottek et al., 2006) (Figure 3).

Young et al. (1976) believe that *M. massonianae* could have a wider distribution in China and also in Taiwan. However, no records were found to support this. If *M. massonianae* does occur more widely in China or Taiwan, its climatic tolerances could encompass other climate types, including Cfb and Cfc which occurs in Taiwan and also across large parts of the EU (MacLeod and Korycinska, 2019).

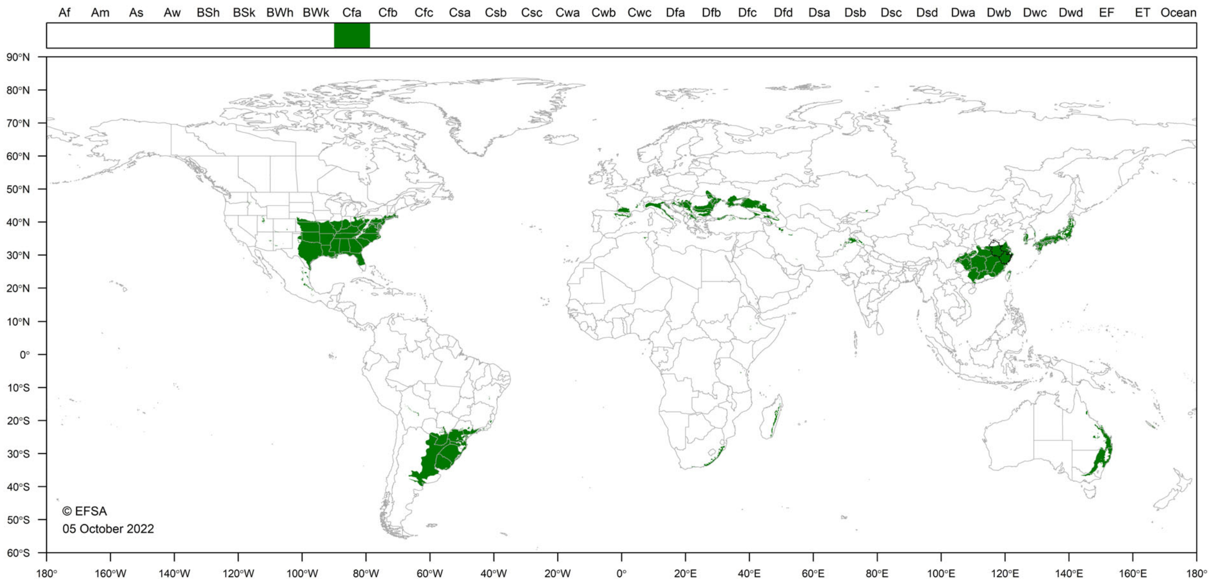

Figure 3: World distribution of Köppen–Geiger climate type Cfa (temperate, no dry season, hot summer) which occurs in the EU and in Chinese provinces where *Matsucoccus massonianae* has been reported

3.4.3. Spread

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

Mobile nymphs crawling, being carried via wind and air currents, and phoretically provide the main mechanisms for natural spread.

All development stages could be moved on host plants, including plants for planting.

Comment on plants for planting as a mechanism of spread.

The movement of infested plants for planting could facilitate spread within the EU and this would be the major mechanism for long distance spread.

There are no specific data on the spread of *M. massonianae*, but we assume that mechanisms for spread would be similar to those of *M. matsumurae* for which there are available data as described below.

M. matsumurae can spread over a short distance (300–1,600 m) through the transport of mobile stages by air currents (Anderson et al., 1976; Stephens and Aylor, 1978; Mudan et al., 1999; Yuan et al., 2014). Experimental tests have shown that a wind speed of 5 m/s is able to transport mobile stages up to 1.6 km and this is considered sufficient to start a new infestation at that distance (Stephens and Aylor, 1978). The insects can attach to animals (woodpeckers, great tits, squirrels) and humans to spread.

3.5. Impacts

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

Yes, the introduction of *M. massonianae* could have economic and environmental impacts on host pine species in the EU.

There is very little information on the impact of *M. massonianae* on pine forests in China. The scale is reported to seriously infest only *Pinus massoniana*, while *P. thunbergii* is slightly damaged. As with other harmful species of *Matsucoccus*, *M. massonianae* causes non-specific symptoms on needles and bark, resulting from sucking sap from the phloem vessels in the stem and branches; symptoms include discoloration (yellowing/browning) of needles, early needle cast, desiccation of shoots and bark necrosis.

In 1974–1975, *M. massonianae* infested pine stands in the Yuwang forest causing damage to 86% of hosts over approximately 53 ha, but serious damage was observed in only 20 ha. The most serious damage was observed on pines 8–25 years old and growing in dense stands with the majority of infested pines showing drooping branches; there was also sporadic pine mortality (Hu and Wang, 1976).

There are considerable uncertainties about the possible consequences of the introduction of *M. massonianae* given the lack of recent reports from China.

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, *Pinus* spp. plants from China and other third countries are prohibited from entering into the EU (see Sections 3.3.2 and 3.4.1). For other Pinales plants from third countries, a phytosanitary certificate is required (see Section 3.4.1).

Wood of conifers (Pinales) from third countries can be imported under certain conditions (see Section 3.4.1).

EPPO (2018) suggests specific phytosanitary measures for Coniferae.

3.6.1. Identification of potential additional measures

Phytosanitary measures are currently applied to *Pinus* plants for planting, to naturally and artificially dwarfed plants for planting, to Pinales plants and to imported wood of conifers (see Sections 3.3.2 and 3.4.1 for prohibitions and specific requirements).

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 4.

Table 4: Selected control measures (a full list is available in EFSA PLH Panel et al., 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	Source imports from pest-free countries or areas.	Entry/Spread
Growing plants in isolation	Small plants could be grown in a dedicated structure such as glass or plastic greenhouses. However, growing plants under insect-proof net may have only a limited effect (EFSA PLH Panel, 2022)	Entry/Spread
Roguing and pruning	Roguing is defined as the removal of infested plants and/or uninfested host plants in a delimited area, whereas pruning is defined as the removal of infested plant parts only without affecting the viability of the plant. Infested plants may be felled and removed from the stands (Zhang et al., 2007).	Entry/Spread/Impact
Biological control and behavioural manipulation	Several predators and some entomopathogenic fungi may regulate the population of the pest (see Section 3.1.2). In China, Wang (1982) and McClure (1986) indicate that the predatory coccinellid *Harmonia axyridis* can significantly reduce *M. massonianae* populations. This predator is widespread and has naturalised in Europe where it is an invasive species affecting native coccinellid species.	Spread/Impact
Chemical treatments on crops including reproductive material	Natural insecticides (neem extracts and carvacrol) mixed with phosphamidon by trunk injection are effective on ornamental trees or nurseries (Lee et al., 2000). Contact insecticides could reduce the infestation by mobile stages, but sessile stages hidden in the bark are difficult to be reached (EFSA PLH Panel, 2022).	Entry/Spread/Impact
Chemical treatments on consignments or during processing	Chemical fumigation of infested wood and wood chips with methyl bromide at a dosage of 30 g*m-3 and at a temperature of no more than 20°C for 24 h may be applied (Zhang et al. 2007). Whilst we recognise that the use of methyl bromide as a quarantine treatment for the EU is banned, alternatives to methyl bromide could be used.	Entry/Spread
Physical treatments on consignments or during processing	Bark peeling of felled trees (Zhang et al., 2007)	Entry/Spread
Waste management	Chipping, burning, incineration of infested trees and residual bark after felling. Restriction in waste movement.	Establishment/Spread
Heat and cold treatments	High-temperature treatment of infested wood (70°C for 6 h) is effective but expensive and unpractical (Zhang et al., 2007)	Entry/Spread
Post-entry quarantine and other restrictions of movement in the importing country	PEQ could be used, especially for plants for planting.	Entry/Spread

3.6.1.2. Additional supporting measures

Potential additional supporting measures are listed in Table 5.

Table 5: Selected supporting measures (a full list is available in EFSA PLH Panel et al., 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	Visual examination of plants or other regulated articles before and at export to assess the presence of the pests or to determine compliance with phytosanitary regulations (ISPM 5). Eggs and sessile stages are not easy to detect visually. Trapping and luring techniques can enhance the possibility to detect the pests. 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.	Entry/Establishment/Spread
Laboratory testing	Appropriate diagnostic protocols, based on both morphology and molecular techniques are needed for a reliable identification of the pests (See Section 3.1.1) 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.	Entry
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.	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)	Entry/Spread
Certified and approved premises	Plants or plant material coming from an approved premises e.g. in a pest-free area (Table 4) can enhance the likelihood that the commodity is not infested. 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	Entry/Spread

Supporting measure (Blue underline = Zenodo doc, Blue = WIP)	Summary	Risk element targeted (entry/ establishment/ spread/impact)
	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.	
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).	Spread
Surveillance	ISPM 5 defines surveillance as an official process which collects and records data on pest occurrence or absence by survey, monitoring or other procedures.	Spread

3.6.1.3. Biological or technical factors limiting the effectiveness of measures

- Plants can be asymptomatic in early phase of infestation or when infestation is low.
- All life stages are small and cannot easily be detected.
- Potential host plants (*Pinus* spp.) are widely distributed throughout the EU.
- Mobile stages can easily spread via air currents, birds and mammals; sessile stages can be transported via wood with bark.

3.7. Uncertainty

At least two host species, *P. massoniana* (Chinese red pine) and *P. thunbergii* (Japanese black pine) occur in the EU and grow as ornamental/amenity plants. However, there is no data about where the hosts are grown in the EU.

There is considerable uncertainty about (1) whether *M. massonianae* could attack additional species of *Pinus* common in the EU, and (2) the possible impacts that *M. massonianae* could cause given the lack of recent reports from China. Hu and Wang (1976) reported serious damage to only 20 ha of forest over 40 years ago. However, none of these uncertainties are key.

4. Conclusions

M. massonianae satisfies the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest. Some uncertainty exists over the host range and consequently on the magnitude of potential impacts. Table 6 provides a summary of the PLH Panel conclusions.

Table 6: 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 species is established.	None
Absence/presence of the pest in the EU (Section 3.2)	*M. massonianae* is not known to be present in the EU.	None
Pest potential for entry, establishment and spread in the EU (Section 3.4)	In principle *M. massonianae* could enter the EU on host plants for planting and plant products such as cut branches or wood with bark. However, Annex VI of 2019/2072 prohibits the introduction of the host	None

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Key uncertainties
	genera (*Pinus*) from China. If *M. massonianae* did enter, it could establish on ornamental *Pinus* plants in parts of the EU. The scale insect could spread phoretically and via wind or air currents as well as via *Pinus* hosts, especially plants for planting.	
Potential for consequences in the EU (Section 3.5)	The introduction of *M. massonianae* could have economic and environmental impacts on host pine species in the EU. Hosts could become discoloured, and needles could drop early; young pines (8–25 years old) could suffer the most serious damage.	Recognising the uncertainty over the complete host range, there is uncertainty over the magnitude of potential impacts.
Available measures (Section 3.6)	Measures are available to prevent pest entry, establishment and spread.	None
Conclusion (Section 4)	*M. massonianae* satisfies the criteria that are within the remit of EFSA to assess for this species to be regarded as a potential Union quarantine pest.	
Aspects of assessment to focus on/scenarios to address in future if appropriate:	It would be useful to find out the complete host range of *M. massonianae* and to determine whether it could harm conifer species commonly used in EU forestry to quantify impacts and better inform any future risk assessment.	

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Abbreviations

EPPO	European and Mediterranean Plant Protection Organisation
FAO	Food and Agriculture Organisation
IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
MS	Member State
PLH	EFSA Panel on Plant Health
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, 2021)
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO, 2021)
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, 2021)
Eradication (of a pest)	Application of phytosanitary measures to eliminate a pest from an area (FAO, 2021)
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2021)
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 and 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, 2021)
Pathway	Any means that allows the entry or spread of a pest (FAO, 2021)
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, 2021)
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, 2021)
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, 2021)

Appendix A – *Matsucoccus massonianae* hosts

Host name (all are *Pinus* species)	Common name	Reference	Grown in EU as an amenity or ornamental plant?	Listed by JRC as a species used in European forestry?
P. massoniana	Chinese red pine	Ben-Dov, 2011 García Morales et al., 2016	Yes	No
P. thunbergii	Japanese black pine	Ben-Dov, 2011 García Morales et al., 2016	Yes	No

Pseudolarix amabilis is listed as a host by Ben-Dov (2011) and García Morales et al. (2016), but this might be an error in interpreting a study by Hu and Wang (1976) who artificially infested *Pseudolarix amabilis* with *M. massonianae* and subsequently measured 0% 'parasitism' on the plants, whilst there was 91% parasitism on *P. massoniana* and 40% on *P. thunbergii*.

Appendix B – Distribution of *Matsucoccus massonianae*

Distribution records based on García Morales et al., 2016; Foldi, 2004.

Region	Country	Sub-national (e.g. State)	Status
North America			No records, presumed absent
Central America			No records, presumed absent
Caribbean			No records, presumed absent
South America			No records, presumed absent
EU (27)			
Other Europe			No records, presumed absent
Africa			No records, presumed absent
Asia			
	China[(a)]	Anhui	EFSA PLH Panel (2022)
		Zhejiang	Hu and Wang (1976); Ben-Dov (2011); García Morales et al. (2016)
Oceania			No records, presumed absent

(a): Young et al. (1976) believe that *M. massonianae* could have a wider distribution in China and also in Taiwan. However, no records were found to support this.