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This PRA document was modified in 2021 and 2025 to clarify and adjust the phytosanitary measures recommended

Report of a Pest Risk Analysis for *Euwallacea fornicatus sensu lato* and *Fusarium euwallaceae*

This summary presents the main features of a pest risk analysis which has been conducted on the pest.

Pest: ***Euwallacea fornicatus sensu lato*** **and** ***Fusarium euwallaceae***
PRA area: EPPO region
Assessors: Assessment based on a Spanish Express Pest Risk Analysis for the ambrosia beetle *Euwallacea* sp. including all the species within the genus *Euwallacea* that are morphologically similar to *E. fornicatus (*associated fungi; *Fusarium* sp. *e.g. Fusarium ambrosium, F. euwallaceae)*.
Pest Risk Management reviewed by the EPPO Panel on Phytosanitary Measures in 2016-2017.

Date: The Spanish was prepared in 2015 and an Alert Datasheet in 2016. The PRA was reviewed by the Panel on Phytosanitary Measures on 2016-11 and on 2017-03. The PRA report was prepared by the EPPO Secretariat and includes new information, regarding the geographical distribution (for sources see EPPO Global Database).

STAGE 1: INITIATION

Reason for doing PRA:

In 2009, an ambrosia beetle, *Euwallacea* sp. (Coleoptera: Curculionidae: Scolytinae) and one of its obligate symbiotic fungi (*Fusarium euwallaceae*, a new described species) have been detected in Israel attacking avocado and becoming a serious problem for the avocado industry in Israel. The identity of this newly found beetle remains to be clarified. The beetle detected in California and Israel is morphologically indistinguishable from *Euwallacea fornicatus* (tea shot hole borer) but significant differences in mitochondrial and nuclear DNA suggest that it is a distinct species. In order to avoid confusion with the 'tea shot hole borer', the common name 'polyphagous shot hole borer' is currently used in the American literature. In this PRA report, Euwallacea *fornicatus sensu lato* is used except when it is certain that it refers to *Euwallacea fornicatus* (tea shot hole borer).

Spanish avocado growers were extremely concerned by this pest and in 2012 a pest risk assessment on *E. fornicatus* for the EU was initiated. This PRA was provided to EPPO and was reviewed by the Panel on Phytosanitary Measures and new information added.

Taxonomic position of pest:

Insect:
Coleoptera: Scolytinae
Species: ***Euwallacea fornicatus sensu lato.*** **Polyphagous** Shot Hole Borer.

Fungus
Ambrosia fungi associated with this beetle are mostly *Fusarium* species.

STAGE 2: PEST RISK ASSESSMENT

PROBABILITY OF INTRODUCTION

Entry

Geographical distribution:

EPPO region: Israel
Africa: Comoros, Madagascar, Réunion Island, Sierra Leona, South Africa.
North America: USA (Florida, California, Hawaii), Mexico
Central America: Panama, Costa Rica
South America: Brazil,
Comment: Euwallacea fornicatus is referred to in a database Coleoptera Neotropical as present in Colombia and Venezuela but this could not be confirmed by other sources.
Asia: Bangladesh, Burma, Cambodia, China (Guangdong, Sichuan, Tibet, Yunnan), Hong Kong, Indonesia (Java, Kalimantan, Sumatra), Laos, Myanmar, Philippines (Rizal), Sri Lanka, Taiwan, Thailand, Vietnam, India, Malaysia, Japan.
Oceania: Australia, Fiji, Micronesia, Papua New Guinea, Samoa, Solomon Islands, Vanuatu, Palau, New Caledonia, Niue

Major host plants or habitats:

E. fornicatus sensu lato is one of the few ambrosia beetles which can infest healthy plants. In Asia, it has been recorded on more than 200 plant species and is considered to be a destructive pest of several economically important woody plants, such as tea (*Camellia sinensis*), avocado (*Persea americana*), *Citrus* and cacao (*Theobroma cacao*). Plants in at least 48 other families have been reported as occasional hosts, including *Anacardiaceae, Burseraceae, Fabaceae, Moraceae,* and *Salicaceae*.
Studies have been conducted in California to determine the main hosts of both *Euwallacea* sp. and *F. euwallaceae*, and in particular those which could sustain the whole life cycle of the beetle. This list includes the following species but is likely to be an underestimate of the host range: *Acer buergerianum, Acer macrophyllum, Acer negundo, Acer palmatum, Acer paxii, Albizia julibrissin, Alectryon excelsus, Ailanthus altissima, Alnus rhombifolia, Castanospermum australe, Cercidium floridum, Erythrina corallodendrum, Eucalyptus ficifolia, Ilex cornuta, Liquidambar styraciflua, Parkinsonia aculeata, Persea americana, Platanus racemosa, Platanus x acerifolia, Populus fremontii, Populus trichocarpa, Prosopis articulata, Quercus suber, Quercus agrifolia, Quercus engelmannii, Quercus lobata, Quercus robur, Ricinus communis, Salix babylonica, Salix gooddingii, Salix laevigata, Wisteria floribunda*.
In Israel, the main host of economic importance is avocado but damage has also been reported on several ornamental trees including *Acer negundo, Quercus robur, Quercus robur* subsp. *pedunculiflora,* and *Ricinus communis*. The beetle attacks the major avocado cultivars grown in Israel (i.e. cvs. 'Haas', 'Pinkerton' and 'Ettinger' - cv. 'Haas' being the most susceptible). *F. euwallaceae* has been isolated from these cultivars in several avocado growing areas and from *A. negundo*.

It is considered that the beetle has reproductive hosts ('real hosts' in which it can reproduce and the associated fungi can develop), and 'non-reproductive hosts' (in which the beetle can drill and infect the associated fungi without being able to reproduce)
The host range has increased when the beetle has spread to new areas.

Which pathway(s) is the pest likely to be introduced on:

Only the hosts which can sustain the whole life cycle of the beetle were considered as potential pathways for entry as the beetle is unlikely to be associated with non-reproductive hosts.

The main pathways of entry are:

- **Plants for planting (except seeds) of reproductive host species from where *Euwallacea fornicatus sensu lato* occurs**

Plants for planting of host plants can support all life stages of *Euwallacea* sp.
The ambrosia beetle commonly attacks the main stem and larger branches of trees and shrubs, but **injury can be found on branches and twigs as small as 2 cm or 2.5 cm in diameter**
Import of Citrus plants for planting is prohibited at EU level, but not all EPPO Member countries apply this prohibition. However, current regulations for other host species would not prevent the entry of the pest.

- **Wood (round or sawn, with or without bark) of reproductive host species from where *Euwallacea fornicatus sensu lato* occurs**

Host plants include species that are grown for wood production e.g. *Acer, Populus, Quercus, Robinia pseudoacacia, Ulmus*) All life stages may be present in round wood and sawn wood (with or without bark).

- **Wood packaging material (WPM)** such as crates, boxes, packing cases, dunnage, pallets, cable drums and spools/reels treated according to ISPM 15: Wood packaging may be a pathway for the beetle but not if it is follows the requirements of ISPM 15 (debarked and then heat treated, or fumigated with methyl bromide). **Scolytinae are commonly intercepted on non-compliant WPM. If the pest is introduced in the EU, this pathway should be revised, since ISPM 15 is not applied for internal movements of WPM.**

Other pathways identified but not further studied as considered less likely:

- Wood chips: the process of producing wood chips, i.e. chipping and grinding, is generally considered as destructive to wood inhabiting insect pests. Trials showed that, chipping (including for chips more than 5 cm) was effective, reducing dramatically the number of beetles that emerged of infected material (Spann, 2013a). However, due to the small size of *Euwallacea* spp. (adult females, approximately 1.83±0.07 mm. long and 0.80±0.6 mm wide), the process of **wood chipping is likely to reduce the concentration, but it will not guarantee completely the elimination of the pest. If wood chips are intended for industrial processes, the probability of transfer is unlikely. If chips are used as much, the risk of introduction would be higher.**
- Wood waste: The intended use of imported wood waste is not known. Survival of all life stages of the pest will depend if wood pieces were subjected to processing. If it is used for energy production, then the probability of transfer is very unlikely. It may be higher if the wood waste is stored outdoors for some weeks in suitable condition for pest emergence in the vicinity of host plants

- **Hitchhiking in contaminated crates, sea containers, etc**

According to NPAG, 2013 and Leathers, 2015, ambrosia beetles may hitchhike on shipments of cut flowers and fruit. There is a high uncertainty that enable deciding the actual risk of this pathway. This pathway needs a broader approach and the IPPC is currently developing an international standard on **Minimizing pest movement by sea containers.**

- **Cut branches of host species from where *Euwallacea fornicatus sensu lato* occur**

Cut branches can support all life stages of *Euwallacea* sp. However, **there are no data on trade** of the relevant hosts species in the form of cut branches. Conifer species are not reproductive hosts. If the beetle were able to enter into the EU with cut branches, transfer is unlikely since this

commodities are supposed to be traded only for ornamental purposes. **Then the likelihood of introduction is low mainly due to the difficulties associated with the transfer to a suitable host.**

Pathways considered unlikely and not studied

- Natural spread: although there is conflicting information, **spread (beetle and fungus) is only considered as local.**
- Bark of host species: The pest would not be able to complete its life cycle in the bark, as it lives and mates in the xylem of plants.
- Fodder, fruit, seed, grain, soil: no life stages are associated with these commodities.

Establishment

Plants at risk in the PRA area:

In the PRA area there are many agricultural, forest and urban species that could be attacked: e.g. *Acacia* spp., *Acer negundo*, *Citrus* spp., *Ficus carica* (fig); *Persea americana* (Avocado), *Platanus, Populus, Quercus, Salix.*

Climatic similarity of present distribution with PRA area (or parts thereof):

The beetle is native to equatorial climates. However, it has also successfully established in temperate climates.

Southern EPPO region: The existence of an established population in Israel and USA (California) (both of them temperate climates, Csa) indicates that there are ecoclimatic conditions suitable in the PRA area. In particular, the following countries have the temperate climate Csa: southern France, Greece, Cyprus, south-southwestern Italy, south Spain and south Portugal. Therefore, the likelihood of establishment outdoors is high.

Northern EPPO region: *Euwallacea fornicatus sensu lato* have not been reported in warm temperate (Csb and Cfb), snow (Dfb, Dfc) and polar (ET) climatic zones. Nevertheless, uncertainties concerning the establishment of *Euwallacea* spp. in this area are rated as high, especially for temperate climates Csb and Cfb. These climatic conditions are not the most favourable for the development of this beetle; however, as it spends almost its entire life within their hosts, climate may not be critical for its establishment. It is important to note that other ambrosia beetles originating from Asia have been able to adapt to different and colder climates (e.g. *Euwallacea validus)*

Characteristics (other than climatic) of the PRA area that would favour establishment:

The introduction of a single mated female may lead to the establishment of a new population of *E. fornicatus*.

Which part of the PRA area is the area of potential establishment:

According to Köppen-Geiger climate classification, this pest is most likely to establish outdoors in Southern Europe (i.e. southern France, Greece, Cyprus, Malta, south-southwestern Italy, south of Spain and south of Portugal). Nevertheless, there is a moderate probability of establishment in northern areas with moderate uncertainty.

With regard to protected conditions, the pest has the potential of establishing in greenhouses of botanical gardens in the entire PRA area.

POTENTIAL ECONOMIC CONSEQUENCES

How much economic impact does the pest have in its present distribution:

In Asia, *E. fornicatus* is an **important pest of tea crops** in southern India and Sri Lanka (CABI (2015); Walgama, 2012), but there is little precise information about quantified losses caused. In southern India, *E. fornicatus* has recently become a **serious pest of pomegranate.** Currently, the beetle is present in avocado orchards in Israel where the largest economic impact on crops is noted. The damage level is ranked as **moderate to high**.

E. fornicatus and *Euwallacea* sp. are listed as quarantine pests by several California´s trading partners. The presence of this pest on consignments may disrupt trade.
Environmental impact: the pest complex was detected in native forest in California.
Social impact: many recorded hosts are commonly planted as street trees. In California, there have been significant impacts on trees in the urban environment leading to social impacts.
The magnitude of impact in the current area of distribution is considered high with a low uncertainty.

Describe damage to potential hosts in PRA area:

Signs of infestation can include entry holes, presence of frass and small tubes of compacted sawdust, discoloration of the outer bark surrounding the beetle penetration site, large amounts of white powdery exudate covering penetration sites, brownish staining of the xylem under the infested spot, gumming, wilting of branches and leaf yellowing, branches broken at the site of beetle galleries, and death of both young and mature trees. In Southern California, tree mortality has been observed on *Acer negundo, Alnus rhombifolia, Platanus racemosa, Ricinus communis, Quercus robur, Salix laevigata*, and the pest complex is considered to be a serious threat to avocado production. Extensive damage on avocado has also been reported in Israel, as well as on some ornamental trees.
Euwallacea sp. is a small beetle which is difficult to see. Females are black (1.8–2.5 mm long). Males are rarely found; they are small (1.5-1.67 mm long), wingless and brown coloured. Larvae and pupae develop inside galleries in the wood.
Pictures can be viewed on the Internet:
http://cisr.ucr.edu/polyphagous_shot_hole_borer.html
https://cisr.ucr.edu/pdf/polyphagous_shot_hole_borer.pdf
http://www.moag.gov.il/agri/files/Ambrosia_problem_Alonim_Israel_2012.pdf

How much economic impact would the pest have in the PRA area:

Several host plants (including Citrus and avocado) are major agricultural hosts. The presence of *Euwallacea* sp. will have an impact on internal markets and on exports of wood and plants for planting
As *Euwallacea* spp. spend almost its entire life hidden in galleries, **insecticides have a limited efficacy after its establishment in the crop**. The biology of *Euwallacea* sp. makes it also a challenging candidate for biological control.

CONCLUSIONS OF PEST RISK ASSESSMENT

Summarize the major factors that influence the acceptability of the risk from this pest:

The beetle and associated fungi have a high probability to establish and cause damage both in agricultural crops and in forests in at least the South of the EPPO region. The beetle has a large host range that has further increased when establishing in new areas. Possibility for control are limited.

Estimate the probability of entry:

The overall probability of entry is considered as high with low uncertainty.
The main pathways for entry are
- plants for planting (except seeds) of reproductive hosts
- wood (round or sawn, with or without bark) of reproductive host species
- wood packaging material non-compliant with ISPM 15

Other pathways are considered negligible.

Estimate the probability of establishment:

The likelihood of establishment in the South of the EPPO region is considered to be high with a low uncertainty**.**
The likelihood of establishment in the North of the EPPO region is

	considered to be moderate with a moderate uncertainty.
Estimate the probability of spread:	Natural spread: There are divergences in the literature about the flying capacity of *Euwallacea* sp. It is considered in the PRA that the beetle is able to fly up to about 500 yards (457m). Magnitude of natural spread is considered moderate with moderate uncertainty. Human-assisted spread is assessed to be high with low uncertainty (see entry).
Estimate the potential economic impact:	The magnitude of impact in the area of potential establishment is considered high with a low uncertainty for Southern Europe and Moderate with a moderate uncertainty for Northern Europe.
Degree of uncertainty	Uncertainties are as follows: - Distribution of the pest (because of difficulty of identification) - Host range of the beetle and the fungi (and which are 'real hosts') - Detailed data on trade of plants for planting, wood and cut branches - Possibility of establishment in Northern Europe. - Possibility of hitchhiking - Rate of natural spread
OVERALL CONCLUSIONS	It is concluded that ***Euwallacea fornicatus sensu lato* and *Fusarium euwallaceae*** poses a risk to the EPPO region and phytosanitary measures should be identified which could substantially reduce the risk.

STAGE 3: PEST RISK MANAGEMENT

IDENTIFICATION OF THE PATHWAYS

Pathways studied in the pest risk management

- Plants for planting (except seeds) of host species from where *Euwallacea* spp. occur.
- Wood of host species (round or sawn, with or without bark) from where *Euwallacea* spp. occur.
- Wood chips, processing wood residues and hogwood from where *Euwallacea* spp. occur.

IDENTIFICATION OF POSSIBLE MEASURES

Pathway 1: Plants for planting (except seeds) of host species

- **Inspections** of plants: detection by visual inspection is difficult as all life stages are hidden and exit holes are less than 1 mm. The presence of *Euwallacea* spp. is not easy to detect during the early stages of infestation.
- **PFA** (based on specific surveys) according to ISPM 4. The establishment and maintenance of a PFA is difficult, due to the wide range of hosts and environments (agricultural crops, gardens, streets) and the fact that most life stages are hidden. In order to guarantee the level of assurance of pest freedom in countries where Euwallacea spp. is established, detailed surveys and monitoring should be conducted in the area prior to establishment of the PFA and continued every year. Specific surveys should also be carried out in the zone between the PFA and known infestation to demonstrate pest freedom.
- **Pest-free place of production**: this measure is difficult to implement outdoors in countries where the pest is present because of its wide host range and difficulty of detection.
- **Pest-free site under physical isolation** according to EPPO Standard PM 5/8 is considered possible.
- **Plants in vitro** are not a pathway.
- **Plants with stem thinner than 2 cm**: According to the literature *Euwallacea* sp. usually attacks trunks and thick branches. Nevertheless, in some hosts (i.e. avocado) this beetle colonizes branches of 2 cm or 2.5 cm. Due to the small size of adult females (1.83±0.07 mm. long and 0.80±0.6 mm wide), it cannot be completely dismissed an attack in thinner stems or branches. The EPPO Panel on Phytosanitary Measures (P PM) agreed that this option was not suitable as well as 'plants at early growth stages' because of the high uncertainty.

- **Transport/storage requirements:** requirements during storage/transport identified in Spanish PRA (for pathway 1). The Panel on Quarantine Pests for Forestry (P QPF) considered in 2023 that plants for planting may be stressed when transported, and more attracted to ambrosia beetles than healthy trees. However, in absence of sufficient scientific data, the P PM and P QPF supported in 2024-10 that storage/transport requirements are not recommended for plants for planting.
- **Pre-entry quarantine or Post entry quarantine** (45 days at a temp 26-35ºC, relative humidity 75-95 %). The Panel considered that pre- or post-entry quarantine were not appropriate given the biology of the pest.
- **Systems approach**: the Spanish PRA suggest a similar approach to the one used for *Anoplophora chinensis* and *A. glabripennis* in the EU Decisions 2012/138/UE and 2015/893/EU. The Panel on Phytosanitary Measures considered that these measures were not transposable to *Euwallacea* sp. (e.g. there is no preventive treatment available for *Euwallacea* sp.) and should not be recommended.

For reference text from the Spanish PRA on the systems approach

"The plants should be grown, for at least 6 months* in a site of production established as free from *Euwallacea* spp. in accordance with International Standards for Phytosanitary Measures:

(i) which is registered and supervised by the NPPO in the country of origin; and

(ii) which has been subjected to official meticulous inspections for any sign of *Euwallacea* spp. carried out at appropriate times and no signs of the organism have been found; and

(iii) where the plants have been grown in a site:

with traps and the application of appropriate preventive treatments and surrounded by a buffer zone with a radius of at least 2 km** where official surveys for the presence or signs of *Euwallacea* spp. are carried out annually at appropriate times. In case signs of *Euwallacea* spp. are found, eradication measures are immediately taken to restore the pest freedom of the buffer zone; and

(iv) where immediately prior to export consignments of the plants have been subjected to a meticulous official inspection, for the presence of the specified organism, in particular in stems and branches of the plants. This inspection shall include targeted destructive sampling. The size of the sample for inspection shall be such as to enable at least the detection of 1 % level of infestation with a level of confidence of 99 %. Where consignments include plants originating in sites which at the time of their production were located in a buffer zone where presence or signs of the specified organism had been found, destructive sampling of the plants of that consignment shall be carried out".

**According to the biology of the pest and due to the fact that it is difficult to detect early stages of infestation by visual inspection, it is estimated that a minimum of generations should be developed to show any symptom.*

*** As according to Dr. Akif Eskalen the beetle is able to fly up to 500 yards (≈457 m.)*

Pathway 2: Wood of host plants (round or sawn, with or without bark)
Pathway 3. Wood chips, processing wood residues and hogwood

- **PFA** according to ISPM 4 (specific surveys, restrictions on movement of firewood into the PFA, and into the area between PFA and closest area of known infestation)
- **Pest free place of production** is not feasible and the risk is high as trees for wood production would be large and therefore attractive to the beetle
- **Pest-free site under physical isolation** is not feasible for wood production
- **Treatment**:
    - Heat treatment (the schedule of 56°C for 30 min is considered suitable)
    - Kiln drying to below 20% moisture: kiln drying is not a phytosanitary measure, as reducing the moisture content of the wood does not kill the pest in itself, but it is the heat treatment used to reach this reduced moisture content that kills the pest. Kiln-drying was not retained here as an option although it is in the national PRA record.
    - Irradiation (1kGy) (not for Pathway 3, no specific data)

Remark: appropriate fumigation (details to be specified on the phytosanitary certificate) with other products than methyl bromide may also be an option (EPPO, 2020), but no pest-specific data for such products was identified in the PRA.

- **Transport/storage requirements:** requirements during storage/transport identified in Spanish PRA (for pathway 2) and in the EPPO *Study on the risk of bark and ambrosia beetles associated with imported non-coniferous wood* (EPPO, 2020). The P QPF considered kiln-drying as possible transport/storage requirements for wood of host plants because it reduces the risk of infestation.[1]
- **Pre-entry quarantine or Post entry quarantine:** not relevant for wood production

EVALUATION OF THE MEASURES IDENTIFIED IN RELATION TO THE RISKS PRESENTED BY THE PATHWAYS

Measures would have costs linked to monitoring, establishment and maintenance of free sites of production/pest free areas. Production under isolation is a standard measure for the production of plants for planting.
The pest would be difficult to eradicate if introduced and could spread. The possible measures have a lower cost than attempting eradication or of bearing the costs of impacts caused by the pest if it established.

Degree of uncertainty Uncertainties in the management part are:

- Spread capacity of the pest to guarantee a PFA or a Pest-free place of production
- Efficacy of traps to detect low populations
- Minimal diameter of stems that may be infested by the beetle

IDENTIFICATION OF POSSIBLE MEASURES

Pathway 1: Plants for planting of hosts	Pest-free area (ISPM 4, ISPM 29) **OR** Pest free place/site of production established according to EPPO Standard PM 5/8 *Guidelines on the phytosanitary measure 'Plants grown under physical isolation'*
Pathway 2: Wood of host plants (round or sawn, with or without bark)	Pest-free area (ISPM 4, ISPM 29) and Transported in appropriate conditions to prevent infestation (i.e. outside the flight period, or not through infested areas, or after kiln drying or closed) **OR** Heat treatment according to EPPO Standard PM 10/6 and Stored in conditions to prevent infestation prior to export and Transported in appropriate conditions to prevent infestation (i.e. outside the flight period, or after kiln drying or closed) **OR** Treatment with ionizing radiation according to EPPO Standard PM 10/8 and Stored in conditions to prevent infestation prior to export and Transported in appropriate conditions to prevent infestation (i.e. outside the flight period, or after kiln drying or closed)

[1] Transport/storage requirements are not included for '*wood chips, processing wood residues and hogwood*' (Pathway 3) in absence of data available. This will be reconsidered for this pathway after finalizing the Guidance document on wood chipping as a phytosanitary measure.

Pathway 3: Wood chips, processing wood residues and hogwood	Pest-free area (ISPM 4, ISPM 29) **OR** Heat treatment according to EPPO Standard PM 10/6 **OR** Treated with ionizing radiation according to EPPO Standard PM 10/8

References

See references in the Spanish PRA

Anonymous (2015) Express Pest Risk Analysis for the ambrosia beetle *Euwallacea* sp. including all the species within the genus *Euwallacea* that are morphologically similar to *E. fornicatus*. Ministerio de Agricultura Alimentacion y Medio Ambiante. Spain, 61 pp.

EPPO (2016) Reporting Service 2016/096 *Euwallacea* sp. and its symbiotic fungus *Fusarium euwallaceae*: addition to the EPPO Alert List.

EPPO (2020) EPPO Technical Document No. 1081, EPPO Study on the risk of bark and ambrosia beetles associated with imported non-coniferous wood. EPPO Paris Available at https://www.eppo.int/RESOURCES/eppo_publications