

Mini data sheet on *Euwallacea* sp. and its symbiotic fungus *Fusarium euwallaceae*

Euwallacea sp. and its symbiotic fungus *Fusarium euwallaceae* were added to the EPPO A2 List in 2016. A full datasheet will be prepared, in the meantime you can view here the data which was previously available from the EPPO Alert List (added to the EPPO Alert List in May 2016-deleted in September 2016).

Euwallacea* sp. and its symbiotic fungus *Fusarium euwallaceae

Why: since the mid-2000s, an ambrosia beetle, *Euwallacea* sp. (Coleoptera: Curculionidae: Scolytinae) and one of its obligate symbiotic fungi (*Fusarium euwallaceae*, a newly described species) have been reported to cause dieback and mortality on numerous trees and shrubs in Southern California (US) and Israel. One of the main concerns is that this complex has been found on avocado (*Persea americana*) which is an economically important crop. Ambrosia beetles are associated with symbiotic fungi which are introduced by females into the larval galleries and serve as a food source for adults and larvae. The identity of this newly found beetle remains to be clarified. It 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. It is suggested that *E. fornicatus* is a complex of cryptic species, each carrying different symbiotic fungi.

E. fornicatus was originally described as a pest of tea (*Camellia sinensis*) in Ceylon (Sri Lanka), where it is associated with *Fusarium ambrosium*. Experiments have shown that larvae of *E. fornicatus* collected from tea in Sri Lanka were not able to complete their life cycle when fed with *F. euwallaceae*, and likewise larvae of *Euwallacea* sp. were not able to survive on *F. ambrosium*. Associations between ambrosia beetles and their symbionts are complex. Three different fungal species, *F. euwallaceae*, *Graphium euwallaceae* sp. nov. and *Paracremonium pembeum* sp. nov., have recently been identified in association with *Euwallacea* sp. adults and larvae. Although the role of these different fungal species in the insect's biology and plant pathogenicity remains to be further studied, observations and experiments have demonstrated that *F. euwallaceae* is able to cause a severe wilt disease on many tree species. In this short description, it has been assumed that *F. euwallaceae* is the main pathogen associated with the emerging disease that is currently observed in Southern California and Israel. Considering the damage caused by the association of *Euwallacea* sp. and *F. euwallaceae* on avocado, as well as on many other tree species, the EPPO Panel on Phytosanitary Measures suggested that both organisms should be added to the EPPO Alert List.

Where: it is generally accepted that the genus *Euwallacea* is of Asian origin, and that *E. fornicatus* probably originates from Southeastern Asia. According to the literature, the distribution of *E. fornicatus* (sensu lato) is given as follows:

EPPO region: Israel.

Africa: Comoros, Madagascar, Reunion.

Central America: Costa Rica, Guatemala, Panama.

North America: USA (California, Florida, Hawaii).

Asia: Bangladesh, Cambodia, China (Guangdong, Hong Kong, Sichuan, Xizhang, Yunnan), India (Assam, Karnataka, Kerala, Maharashtra, Tamil Nadu, Uttar Pradesh, West Bengal), Indonesia (Java, Kalimantan, Sumatra), Israel, Japan (Honshu, Ryukyu Archipelago), Laos, Malaysia (Sabah, Sarawak, West), Myanmar, Philippines, Sri Lanka, Taiwan, Thailand, Vietnam.

Oceania: Australia, Fiji, Micronesia, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Vanuatu.

The origin and geographical distribution of *Euwallacea* sp. and of its associated fungi are largely unknown. For the moment, *F. euwallaceae* has only been detected in California and in Israel. In 2009, *Euwallacea* sp. was first found in Israel in association with a damaging Fusarium wilt on several tree species (including avocado) in urban and agricultural areas. In the USA, *Euwallacea* sp. was first collected on *Robinia pseudoacacia* in Whitter Narrows near Los Angeles in California. Mortality on *Acer negundo* street trees was first noticed in Long Beach (Los Angeles county) in 2010. In 2012 *Euwallacea* sp. and Fusarium dieback were first detected on backyard avocado trees in Los Angeles county. By 2013, the pest complex was detected in Los Angeles, Orange, and San Bernardino counties on many tree species in urban environments, as well as in some commercial avocado orchards in Los Angeles county (South Gate, Downey and Hacienda Heights). In the county of San Diego, a beetle population presenting some molecular differences from the ones collected from other parts of Southern California has been found. It is suggested that this population might correspond to a separate introduction or even to another *Euwallacea* species which is called 'Kuroshio shot hole borer' in some Internet sources.

On which plants: *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*.

Damage: 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://cirs.ucr.edu/polyphagous_shot_hole_borer.html

https://cirs.ucr.edu/pdf/polyphagous_shot_hole_borer.pdf

http://www.moag.gov.il/agri/files/Ambrosia_problem_Alonim_Israel_2012.pdf

Dissemination: *F. euwallaceae* is transferred into its hosts by the beetle. Adult female beetles have mandibular mycangia in which the fungal symbiont is transported within and from the larval galleries. No data is available about the natural spread of the beetle, but it is likely to be rather limited (only females can fly). It is not known how these organisms have been introduced into California and Israel, but the transport and trade of infested plant material is likely to ensure long distance dispersal.

Pathway: plants for planting, wood with or without bark, wood packaging material not compliant with ISPM 15 of host species from countries where the pest complex occurs.

Possible risks: avocado is an economically important crop in parts of the EPPO region (e.g. Israel, Spain), both *Euwallacea* sp. and *F. euwallaceae* have been identified as posing a serious threat to this crop. Many tree species included in the known range of the pest complex are grown in the EPPO region for ornamental or forestry purposes. Although more studies are needed on the potential for establishment of *Euwallacea* sp. and *F. euwallaceae* in the EPPO region (e.g. under cool/cold climates), they have been able to establish in Israel indicating that other Mediterranean countries are probably at risk. Due to their hidden mode of life, chemical control of ambrosia beetles is difficult. No data is available about the potential use of biocontrol agents or resistant tree varieties. Traps using a lure (quercivorol, an aggregation pheromone of *Platypus quercivorus*) are being developed in the USA to monitor beetle populations. Removal of heavily infested trees may reduce local populations of the beetle, but no data is available to support this as a management option. An Express PRA carried out in Spain for all species belonging to the genus *Euwallacea* that are morphologically similar to *E. fornicatus* concluded that these species presented a high and moderate risk for Southern and Northern Europe, respectively. As the emergence of *Euwallacea* sp. and *F. euwallaceae* is associated with mortality of important tree species used for fruit production, amenity and forestry purposes, it is desirable to avoid any further spread of these organisms within the EPPO region.

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INTERNET

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EPPO RS 2016/096

Panel review date -

Entry date 2016-05