EPPO Datasheet: *Monochamus alternatus*

Last updated: 2022-04-22

IDENTITY

Preferred name: *Monochamus alternatus*
Authority: Hope
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Coleoptera: Cerambycidae
Other scientific names: *Monochamus tesserula* White
Common names: Japanese pine sawyer
view more common names online...
EPPO Categorization: A1 list
view more categorizations online...
EPPO Code: MONCAL

more photos...

HOSTS

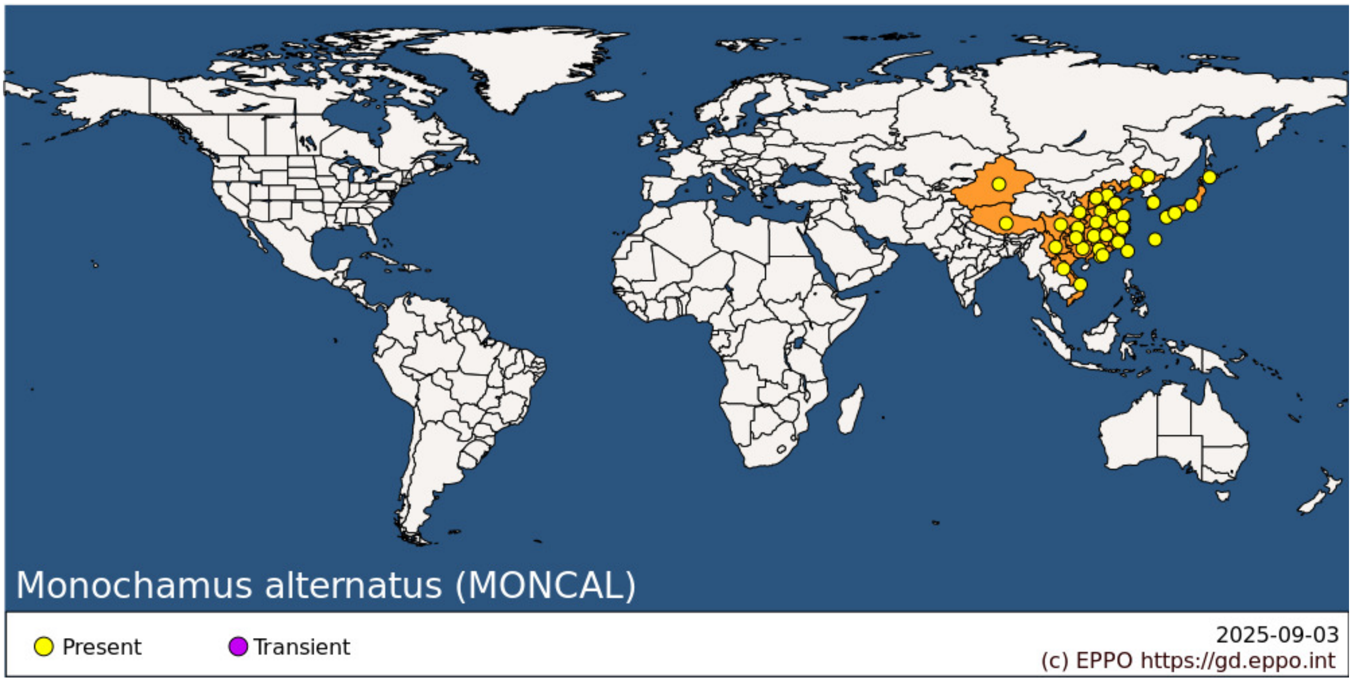
Monochamus alternatus is primarily a pest of pines, but it can also attack other plants in the families Pinaceae and Cupressaceae (Davis *et al.*, 2008; Nakamura, 2008; Akbulut *et al.*, 2017; CABI, online). This insect actively attacks *Pinus densiflora* and *P. thunbergii* in Japan (Kobayashi *et al.*, 1984; Fauziah *et al.*, 1987; Mamiya 1988; Togashi, 1990a; Anonymous, 2016) and *P. massoniana* in China (Fan *et al.*, 2007; Li *et al.*, 2007). In laboratory conditions, *M. alternatus* could infest Japanese cedar (*Cryptomeria japonica*) (Zhou & Togashi, 2006).

There is also data about *M. alternatus* infesting deciduous trees: *Malus* spp. (apple), *Fagus* spp. (beech), *Liquidambar* spp. (sweetgum), *Ginkgo biloba* (maidenhair tree) (Duffy, 1968; Fan & Sun, 2006; Davis *et al.*, 2008; Anonymous, 2016).

Host list: *Abies fabri*, *Abies firma*, *Abies holophylla*, *Cedrus deodara*, *Cedrus libani*, *Cryptomeria japonica*, *Cunninghamia lanceolata*, *Juniperus chinensis*, *Larix gmelinii*, *Larix kaempferi*, *Picea abies*, *Picea asperata*, *Picea jezoensis subsp. hondoensis*, *Picea smithiana*, *Pinus armandii*, *Pinus banksiana*, *Pinus bungeana*, *Pinus densiflora*, *Pinus elliottii*, *Pinus engelmannii*, *Pinus greggii*, *Pinus kesiya var. kesiya*, *Pinus koraiensis*, *Pinus leiophylla*, *Pinus luchuensis*, *Pinus massoniana*, *Pinus nigra*, *Pinus oocarpa*, *Pinus palustris*, *Pinus parviflora*, *Pinus pinaster*, *Pinus ponderosa*, *Pinus radiata*, *Pinus rigida*, *Pinus strobus*, *Pinus tabuliformis*, *Pinus taeda*, *Pinus taiwanensis*, *Pinus thunbergii*, *Pinus yunnanensis*

GEOGRAPHICAL DISTRIBUTION

M. alternatus is common in several southern Asian countries. This species has been detected many times in wood packaging material imported to Europe (Estonia, Germany, United Kingdom, Denmark, Norway) with cargos from China, but there are no cases of its establishment in the natural environment (Kvamme & Magnusson, 2006; EPPO, 2021).



Asia: China (Anhui, Aomen (Macau), Chongqing, Fujian, Guangdong, Guangxi, Guizhou, Hebei, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Shaanxi, Shandong, Shanxi, Sichuan, Xianggang (Hong Kong), Xinjiang, Xizhang, Yunnan, Zhejiang), Japan (Hokkaido, Honshu, Kyushu, Ryukyu Archipelago, Shikoku), Korea, Republic of, Lao People's Democratic Republic, Taiwan, Vietnam

BIOLOGY

M. alternatus has 1 to 2 annual generations depending on climatic conditions, mainly linked to mean annual temperatures. *M. alternatus* spends most of its life within trees. Adults emerge from dead host trees from spring to early autumn, depending on climate, and attack a suitable new host. In Japan, adults emerge from April to August in Okinawa, and in Central Japan from May to August (Ikeda *et al.*, 1980, Kishi, 1995; Akbulut *et al.*, 2017; Futai, 2021). Males emerge before females. The emerging adults are reproductively immature. They fly to conifer host trees and feed on the bark of twigs. This process is referred to as 'maturation feeding' and lasts 1-4 weeks (Kishi, 1995; Togashi, 2008; Nakamura, 2008; CABI, online). The duration and extent of maturation feeding is influenced by temperature.

Usually, adults flying from tree to tree can move up to 40 m per week within a host tree stand (Togashi, 1990b, 2008) but it can fly up to 3 km or more in search of a host plant (Kawabata, 1979).

Adults survive 70-125 days under natural conditions and 100 days, on average, under laboratory conditions at a temperature of 25°C (Kobayashi *et al.*, 1984). According to Zhang and Linit (1998), the average life-span of males and females were 70 and 66 days, respectively, in outdoor cages and 180 days in laboratory conditions.

The development rate of females depends on the quality of the food they consume and the temperature. The ovarian development is faster in females feeding on current year twigs of pine than in females feeding on 1- or 2-year-old twigs. Mating and oviposition occur at night (Katsuyama *et al.*, 1989; Togashi, 2008; Davis *et al.*, 2008).

After maturation feeding and mating females lay eggs. They are attracted to stressed and recently felled trees. The pre-oviposition period depends on daily temperature and usually ranges from 16 to 30 days, although a first oviposition was recorded 6 days after emergence in a warm area of Japan and 61 days in a cool area (Nakamura, 2008).

During oviposition, the female chews a slit in the bark and deposits one egg. It also injects into the slit a gel-like substance (Fauziah *et al.*, 1987; Li & Zhang, 2006). Eggs are usually deposited on host parts with thin bark. Each female lays 60-200 eggs (occasionally more than 200). Oviposition takes place when the air temperature is at least

21.3°C. Egg development requires 65-89 degree days and temperatures above 12.7-13°C (Togashi, 2008; CABI online).

Eggs hatch within 6 to 9 days. During its life cycle, *M. alternatus* completes four to five larval instars before pupation. Larvae feed on the sapwood and phloem tissues of the host plant and construct galleries that become packed with frass and wood fibres. Larvae overwinter in the galleries. The final larval instar makes a U- or an oval-shaped pupal chamber which usually is plugged with wood borings. The pupal stage lasts 17-19 days, and the callow adult stage lasts 6-8 days. Young adults bore round exit holes and emerge from the wood. A comprehensive description of the biology and ecology of *M. alternatus* is given in the reviews by Davis *et al.*, 2008, Mota & Vieira (2008), Nakamura (2008), Togashi (2008), EFSA (2020), and Futai (2021).

DETECTION AND IDENTIFICATION

Symptoms

The mature adults of *M. alternatus* infest stressed trees, recently felled trees, or logs. External signs of *M. alternatus* infestation include oviposition scars on the bark and round emergence holes about 9 mm in diameter. Larval feeding produces S-shaped and vertical galleries packed with frass and shredded wood. Larvae also excrete the frass through small slits in the bark that they create. The larvae create U-shaped or oval pupal chambers in the xylem. All life stages of *M. alternatus* may be found under the bark (Davis *et al.*, 2008; Togashi, 2008; CABI, online).

Morphology

Egg

Eggs are about 4 mm long, milk white in colour, cylindrical and elongate, sickle shaped. Head capsule highly depressed, about 1.3 times as long as wide.

Larva

Larvae are white, legless, on average 43 mm long when mature, with an amber coloured head capsule and black mouth parts.

Pupa

Pupae are white, opaque and cylindrical, 14 to 27 mm in length. Width 3.6 to 7.2 mm across at the base of elytra.

Adult

Adults are 15-28 mm in length and range from 4.5-9.5 mm wide. Females are larger than males. Males have antennae 2x the body length and females have antennae 1.3x the body length. The base part of the first, second and third antennal segments have greyish hairs. There are two orange stripes on the protergum, interlaced with three narrower black stripes. The elytra have five longitudinal bands of black and grey rectangular spots (Davis *et al.*, 2008).

Detection and inspection methods

The oviposition scars can be found on the bark of the trunk and large branches of dying and felled trees, as well as on logs. Galleries and frass created by larvae are clearly visible when the bark is removed. Another sign is the presence of frass on the bark, which is thrown out by the larvae through the slits. Exit holes which are 9 mm in mean diameter suggest prior infestations and possible presence of life-stages remaining in the wood. Large elliptical holes are visible when cross cutting an infected log. Collection of beetles is also possible using pheromone traps. If it is not possible to identify the specimen by morphological methods, for example for larva, then identification of any life stage is possible using DNA analysis (Shota-Kagaya, 2008).

PATHWAYS FOR MOVEMENT

Usually, the emerging adults populate the nearest pine trees at a distance of up to 100 m, however, the beetles are capable of flying over long distances, up to 2-3 km or more (Togashi, 1990b; Davis *et al.*, 2008; EFSA, 2020). Wind may help the adult flight. Infested logs (non-squared wood) in which all life stages of *M. alternatus* may be present are a major pathway for spreading the pest. Sawn wood (squared wood) may also contain larvae or pupae of *M. alternatus* or other longhorn beetles. Most interceptions of *M. alternatus* in consignments are associated with wood packaging material (Kvamme & Magnusson, 2006; EPPO, 2015a,b, 2016, 2017, 2021). These points are taken into account when developing standards for the movement of wood products, including wood packaging material, in international trade (EPPO, 2018a,b; FAO, 2017, 2019). The development of phytosanitary measures related to trade of wood commodities takes into account the possibility of introduction of both *M. alternatus*, and the pine wood nematode *Bursaphelenchus xylophilus*, carried by these beetles and causing pine wilt disease.

PEST SIGNIFICANCE

Economic impact

M. alternatus attacks stressed trees on which it lays its eggs. Feeding and development of larvae that build galleries in the wood accelerates the tree death and reduces the commercial value of such wood. *M. alternatus* causes significant damage in Japan, China, and Taiwan, where it is widespread and is the major vector of the pine wood nematode *B. xylophilus*, the causative agent of the destructive pine wilt disease in Asia. Longhorn beetles transmit nematodes from dead trees to healthy trees during the maturation feeding period. Infection of trees with nematodes under favourable conditions leads to mass death of pine stands within 25 days of adult emergence or by the end of the summer season (Togashi, 1985; Jikumaru & Togashi, 2001). Detailed information on the damage caused by *M. alternatus* and the pine wood nematode to pine plantations in Asia is given by Mamaya 1988; Zhao, 2008; Soliman *et al.*, 2012; Futai, 2021; CABI (online). The heaviest loss of timber per year by the mutualistic cooperation of *M. alternatus* and *B. xylophilus* was recorded as 2.4 million cubic metres in 1979 in Japan (Mamiya, 1988). *B. xylophilus* has spread from Japan to China, South Korea, Taiwan, Laos and Portugal (Mota *et al.*, 2008; Zhao, 2008; Sousa *et al.*, 2015; Futai, 2021).

The environmental damage caused by *M. alternatus* is associated with pine wilt disease, which leads to the mass destruction of pine forests. Pine forests provide significant economic and environmental/social benefits for example in terms of the watershed, erosion control, and recreation and pine trees are closely related to the heritage and culture of Japan and China (Zhao, 2008; Futai, 2021). Epidemics of pine wilt result in mass mortality of pine forests and often favour fires.

Control

In areas where *M. alternatus* and pine wood nematode are common, strategies developed to control pine wilt disease are based primarily on the control of the insect vector. Timely removal of dead or dying trees from the forest to prevent their use as a source for infestation by *M. alternatus* and the use of insecticides are the basic principles of pest and pine wilt disease control. Silvicultural control through preventive felling and manual removal of dead trees is sometimes more effective in suppressing the spread of pine wilt disease than physical or chemical treatment of wilted pines.

Physical control methods include chipping or burning dead trees infested with *M. alternatus*. Burying infested wood at a soil depth of more than 15 cm prevents the emergence of adults of *M. alternatus*. Pheromones and traps play an important role in monitoring and controlling *M. alternatus*.

Insecticide application by spraying tree crowns by sprinkler or helicopter during the *M. alternatus* adult emergence period has shown a high efficacy but has some negative consequences, because it causes mortality of natural enemies and environmental pollution (Kishi, 1995). Injection of nematicides into tree trunks reduced the reproduction rate of *M. alternatus* (Camata, 2008; CABI, online). Parasitoid insects (*Sclerodermus guani* and *Dastarcus helophoroides*), entomopathogenic fungi (*Beauveria bassiana, B. brongniartii, Metarhizium anisopliae, Isaria farinosa, Aspergillus flavus, Verticillium* spp., *Acremonium* sp.), the parasitic bacteria *Serratia marcescens* and the parasitic nematode, *Steinernema feltiae* have been used as biological control agents against *M. alternatus*. The use of the fungus *B. bassiana*

(30 g/ha) to control *M. alternatus* gave 41.5-69.2% efficiency under field conditions in China. Meanwhile, field tests showed that the application of *B. bassiana* could reduce the mortality of pine trees caused pine wilt disease by 95.0% (Xu, 2008). *Sclerodermus guani* is one of the successful natural parasites of *M. alternatus* larvae. Application of 5 000 *Sclerodermus guani* wasps to one hectare of woodland showed a parasitism rate of 67-84% on *M. alternatus* larvae (Xu, 2008).

Phytosanitary risk

The main risk of introduction of *M. alternatus* is associated with the possibility of introducing this pest together with the pine wood nematode *B. xylophilus* from countries where this nematode species is present. The risk of introduction both pests into the countries of the EPPO region is high (Evans *et al.*, 2009, EPPO, 2022). Southern EPPO region are most at risk. Eggs, larvae, and pupae can be transported in unprocessed logs. *M. alternatus* has been detected many times in consignments imported from China to Europe and America (Kvamme & Magnusson, 2006; EPPO, 2015a,b; 2016; 2017; 2021; Anonymous, 2016). Most interceptions were connected with crates, dunnage, and pallets.

PHYTOSANITARY MEASURES

Visual inspection of timber does not always reveal the presence of eggs and insect larvae or pupae, which can be present within internal galleries. In this regard, international standards (FAO, 2017; EPPO 2018a,b) have been developed that include phytosanitary measures to prevent the importation of possibly infested wood products. The phytosanitary measures recommended by the EPPO Standard PM 8/2 (3) 'Coniferae' (EPPO, 2018b) are considered to be effective against longhorn beetles including *M. alternatus*. These guidelines include requirements for conifers wood: round wood, sawn wood, and isolated bark. In particular, they require that wood should be bark-free and heat-treated (EPPO, 2008a), or fumigated, or treated with ionizing radiation (EPPO 2008b), or that wood of the host plants from countries where *M.alternatus* is present should originate from a pest-free area. Requirements for coniferous wood originating from countries where both *M. alterna*tus and *B. xylophilus* are present are given in the EPPO Standard PM 8/2 (3) (EPPO, 2018b). Wood packaging material should meet the requirements of ISPM no. 15 (FAO, 2019).

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Datasheet history

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