EPPO Datasheet: *Agrilus mali*

Last updated: 2026-09-04

IDENTITY

Preferred name: *Agrilus mali*
Authority: Matsumura
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Coleoptera: Buprestidae
Other scientific names: *Agrilus jenissejensis* Obenberger
Common names: apple buprestid, apple jewel beetle
view more common names online...
EPPO Categorization: A2 list, Alert list (formerly)
view more categorizations online...
EPPO Code: AGRLMA

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Notes on taxonomy and nomenclature

Type specimens of *A. mali* have not been found. Although it was suggested that *A. mali* may be conspecific with *A. sachalinensis* (as *A. sinuatus sachalinensis*) (Jendek & Grebennikov, 2011), there is currently no evidence that this is the case, nor that *A. mali* and *A. sinuatus* are synonyms (EPPO, 2024). *Agrilus sinuatus* and *A. mendax* are the most closely related species to *A. mali* in Europe, and elements of their aedeagi are the key characters to distinguish these species (Volkovitsh et al., 2020).

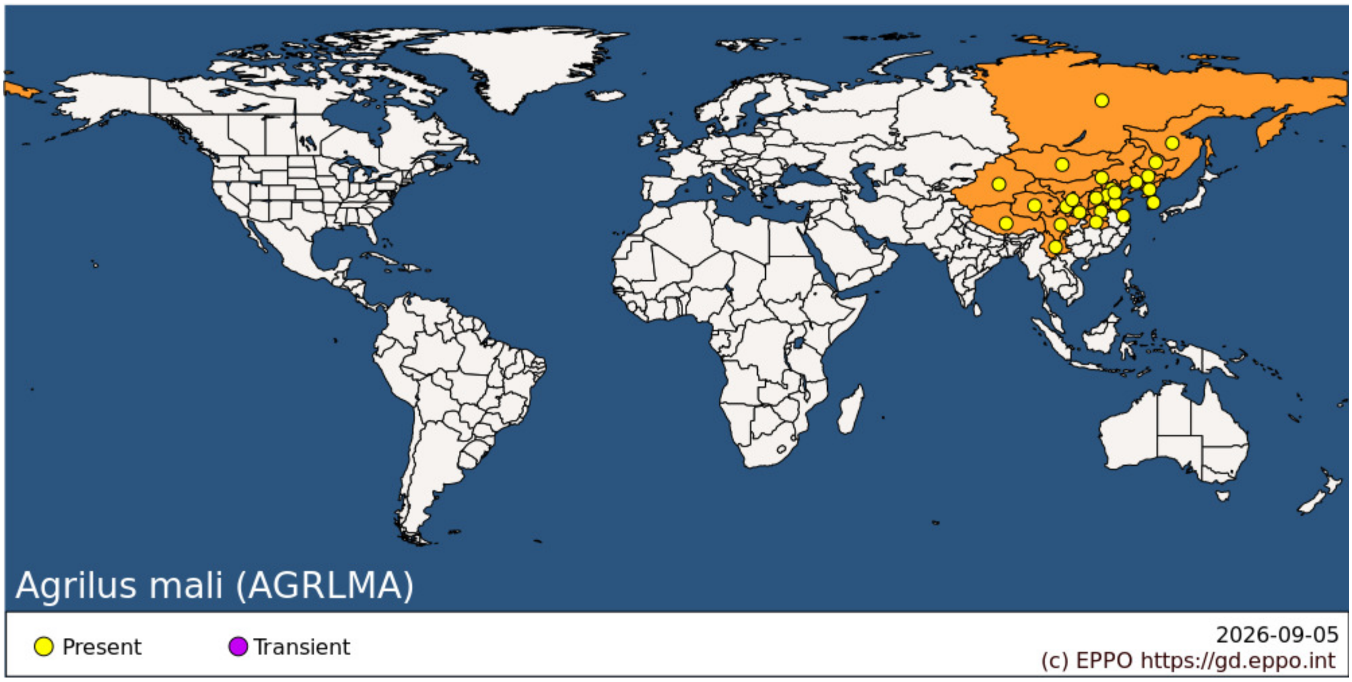
HOSTS

Agrilus mali attacks several species of *Malus* (Rosaceae), including cultivated apple *M. domestica* and the wild apple *M. sieversii*. *Malus halliana* and a few Rosaceae species in the genera *Prunus*, *Sorbus*, *Cydonia*, and *Pyrus* are mentioned in the literature, but are considered doubtful hosts (no detailed studies available; EPPO, 2024). Some *Malus* species are able to hybridize, and it is not clear if some of these hybrids are hosts for *A. mali*.

Host list: *Malus asiatica*, *Malus baccata*, *Malus domestica*, *Malus prunifolia*, *Malus sieversii*, *Malus spectabilis*, *Malus yunnanensis*

GEOGRAPHICAL DISTRIBUTION

Agrilus mali is native to Asia, and it is one of the most widespread species of *Agrilus* in that region (Jendek & Grebennikov, 2023).



EPPO Region: Russian Federation (Eastern Siberia, Far East)
Asia: China (Beijing, Gansu, Hebei, Heilongjiang, Henan, Hubei, Jiangsu, Jilin, Liaoning, Neimenggu, Ningxia, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Tianjin, Xinjiang, Xizhang, Yunnan), Korea, Democratic People's Republic of, Korea, Republic of, Mongolia

BIOLOGY

Voltinism of *A. mali* varies in different locations from one generation per year to one generation every 2?years. The lifespan of adults is up to 60?days if apple leaves are available (Cui etal.,2019), and 4–7?days without food (EPPO,2024; Li et al., 2017). The flight period is 14.0–19.5?days (in the laboratory at 25°C). Females can lay up to 60–70 eggs during an oviposition period of 10–20?days. Eggs are laid in cracks on the sunny side of branches, close to the base of buds and twigs. After hatching, larvae bore into the host epidermal tissue to feed (Li & Zhang,2017). The 1st instar larvae construct irregular, winding and crossing galleries. They start feeding on the phloem and then reach the cambium where they mostly feed in serpentine galleries (EPPO, 2024; Zhang et al., 2021). Larvae can also make deeper feeding galleries extending into the outer xylem tissues (sapwood; Bozorov et al., 2019) and possibly even into heartwood, especially in smaller branches (EPPO, 2024). The final instar larvae bore an exit channel which ends under a thin layer of bark and allows adult emergence (Nikritin, 1994; Nikritin & Shutova, 1985). Pupal chambers are formed in the outer xylem and average 0.83?±?0.02?cm in length (Lu etal.,2022; Zhang et al., 2021). The pupation takes 10–15?days (Chen & Zhan,2007; Ding, 2019). After the final moulting, adults usually remain in the pupal chambers for 8–10?days (Ji etal.,2004). Then they make their way through the existing exit channels and bark and emerge through the bark from D-shaped exit holes (Zhang et al., 2021). Before reproduction, adults feed on the edge of leaves (Ji et al., 2004), buds or young bark (Sokolov et al., 1995), on which bite marks can be seen. After maturation feeding (up to 2?weeks; Li,2019) the adults begin to mate, and females start to lay eggs.

In the univoltine life cycle, larvae of earlier instars overwinter under the bark. In other *Agrilus* species, larvae may overwinter in the xylem and resume feeding in the cambium after the winter, but this has not been studied in *A. mali*. In the cooler regions where the pest needs more than 1?year to complete its development, there might be two overwintering periods: the first by younger larvae and the second by mature larvae (likely the final instar). The diapause of the earlier instars is obligatory, and it is not known how the second diapause is induced.

Infestations are mostly reported on branches of 10–55?mm in diameter (EPPO,2024), but galleries have also been found in twigs of smaller (down to 4?mm; Sun etal.,1979; Wang, 2013; Zhang et al., 2021) or larger diameter (up to 70–100?mm; Wang,2013; Zhang et al., 2021). On large trees, infestation of the trunk is rare (Bozorov et al., 2019; Feng et al., 2013). *A. mali* attacks both trees that are weakened and those that are apparently healthy. Stress factors can make the trees more susceptible to attacks (Sun et al., 2022).

Population density can be very high: well over 100 larvae per cultivated tree has been reported (Nikritin, 1994; Plant Protection, 1977; Yang & Chen, 1956).

Agrilus mali is a relatively poor flyer in comparison to other *Agrilus* species, and its dispersal capacity is low (EPPO, 2024). The pest is usually referred to as being ‘sedentary’ (Sun et al., 2022). Adults are thermophilic, generally flying only during the warmest part of the day, and are not active in the morning, evening or on cloudy days (Chen & Yao, 1997).

DETECTION AND IDENTIFICATION

Signs and symptoms

Larval feeding on the phloem results in the disruption of nutrient and water transportation, causing the bark to become sunken (subcortical necrosis) and cracked longitudinally (Ji et al., 2004; Zhang et al., 2021). The damaged branches of apple trees usually wither in a short time. Larval galleries can destroy all of the available phloem when larval densities are high. Serious infestations of *A. mali* can cause early leaf drop, death of branches, reduction of fruit production due to a reduction of the tree vigour, exposure to colonization and damage by fungal pathogens, and even death of the whole tree (Han, 2002; Liu et al., 2014). Feeding by adults on leaves, buds or young bark (as a result of maturation feeding of adults) causes little damage (Ji et al., 2004).

D-shaped exit holes (which have a width of 0.11–0.28?cm; Zhang et al., 2021) are not easily visible on large trees as they may be situated high in the canopy. Red and later yellowish/brown liquid can be observed which exudes from the ventilation holes of galleries on branches and congeals after exposure to air; this liquid is called ‘oozing red oil’ (Chen & Yao, 1997; Han, 2002; Liu et al., 2013).

These signs are not specific to *A. mali* (except, potentially, the ‘oozing red oil’; Duan et al., 2024). However, depending on which *Agrilus* species are present in a certain region it may be possible to use D-shaped exit holes with a width of 0.11–0.28?cm as a sign which is predominately associated with *A. mali* infestations on certain *Malus* hosts.

Morphology

Eggs: Milky white when laid, then yellowish brown after a few days; oval or ellipsoid (Linyi Agro-Forestry Bureau, 1973); approximately 1.0–1.5?mm long, 0.7–1.0?mm wide (Bozorov et al., 2019; Feng et al., 2013; Guli & Wang, 2013; Guo & Ma, 2010; Ji et al., 2004; Li, 2019).

Larva: Larva is typical for the genus *Agrilus*. Milky white, yellowish or brown, with 13 segments (3 thoracic and 10 abdominal; Linyi Agro-Forestry Bureau, 1973). Head is small and brown, almost completely retracted into prothorax, transparent; external brown part is a peristome bearing mouth parts. Elongated, flattened, slender, with very broad prothorax. End of body nearly triangular, with a pair of toothed brown terminal processes at the end (Linyi Agro-Forestry Bureau, 1973; Chamorro et al., 2015). Ji et al. (2004) reported five larval instars, whereas normally *Agrilus* spp. have four larval instars (Chamorro et al., 2015). Larvae of the first instar are approximately 2.2–3.0?mm long (Wang, 2013). Larvae of the final instar are up to 16.0–22.0?mm long and 1.7–2.5?mm wide (Linyi Agro-Forestry Bureau, 1973; Wang et al., 2013).

Pupa: Milky or creamy white at the initial stage, gradually darkening in the later stage, and turning blackish brown before emergence of the adult (Linyi Agro-Forestry Bureau, 1973; Li, 2019). Exarate, spindle or fusiform. Up to 6.0–10.0?mm long, and 2.0–4.0?mm wide (Linyi Agro-Forestry Bureau, 1973).

Adult: Body is unicolor, metallic purple- or coppery-red, underside sometimes with greenish reflection; head flattened in dorsal view; elytra with three pairs of white tomentose spots. The body is densely covered with small incised dots on all parts; long and columnar (Bozorov et al., 2019; Han, 2002; Ji et al., 2004; Li, 2019), 6.1–8.7?mm long, 2.0–3.0?mm wide (Volkovitsh et al., 2020).

Detection and inspection methods

All life stages (except adults) remain hidden (eggs in bark cracks; larvae and pupae in the cambial region and xylem), making their detection more difficult. Trees infested by *A. mali* can look healthy or slightly weakened for some time and present clear symptoms only if they are heavily attacked. First emergence, and therefore the first appearance of D-shaped exit holes, can only be observed 1–2?year(s) after the first infestation. Symptoms on infested trees as listed above are more easily observed in the years after the initial attack. Dry thin bark with cracks/scars above larval galleries may be visible, but experience is needed to recognize these signs.

Several *Agrilus* species present in the EPPO region have common hosts with *A. mali* (incl. *M. domestica* for *A. sinuatus, A. roscidus*, and *A. malicola*; unconfirmed hosts for *A. macroderus* and *A. mendax*) (Bílý, 2002; de Jong et al., 2014; Jendek & Poláková, 2014; EPPO, 2024) and may cause similar signs. D-shaped exit holes are produced by all species from the subfamily Agrilinae, in Europe particularly from the genera *Agrilus*, *Coraebus*, and *Meliboeus* (Duan et al., 2024; EPPO, 2019). Thus, first signs may not be quickly detected in an area following an introduction of *A. mali*, especially if population density is low.

Different coloured sticky traps (green, purple, white, and yellow) have been used to capture adults of other *Agrilus* species. Wang et al. (2013) found that yellow and white were the most attractive colours for *A. mali* among all sticky traps. In China, yellow or light green sticky traps with cis-3-hexenol are used for monitoring *A. mali* in the field (Ma et al., 2021).

The attraction of males from several *Agrilus* species to dead adults used as decoys on host plants suggests a common behavioural template for visual mate-finding among buprestids (Domingue et al., 2011; Lelito et al., 2007, 2011). 3D-printed decoys have also been used for *A. planipennis* (Domingue et al., 2015). Therefore, adding dead adults as decoys or silhouettes of an adult *Agrilus* may possibly be used to improve the attractiveness of traps (EPPO, 2024).

General monitoring methods such as trapping, visual examination for external signs and symptoms on trees and tree sampling may be used, but they may not allow detection of low levels of infestations (EPPO, 2013). Careful visual examination of the trees (mostly branches, as trunks are very seldom infested) for presence of signs and symptoms may enable the detection of the presence of the genus *Agrilus* in particular if D-shaped exit holes are present. Girdled trees have been found to be more attractive to *A. mali* (Chen & Zhan, 2007), and may be used in specific situations (e.g. for monitoring purposes; Gninenko et al., 2012).

The keys to distinguish adults of *A. mali* from other *Agrilus* species found in the Far East of the Russian Federation (*A. sachalinensis*, *A. zhelochovtsevi*) are given in Alexeev (1989) and Alexeev and Volkovitsh (1989).

There are currently no keys to distinguish *A. mali* from its European congeners (Jendek & Grebennikov, 2011). However, *A. mali* adults can be distinguished from European species of *Agrilus* based on the morphological characters given in Volkovitsh et al. (2020) and in the EPPO Pest Risk Analysis (PRA) (EPPO, 2024). Based on the current literature, *A. mali* larvae cannot be distinguished from other *Agrilus* species by their morphology (EPPO, 2024).

Molecular identification is possible. A rapid test using recombinase polymerase amplification and a lateral flow test was developed for *A. mali* (Li et al., 2023).

PATHWAYS FOR MOVEMENT

Agrilus species can be transported in plants for planting as well as wood products such as round wood, wood packaging material, sawn wood, bark, and wood chips (Duan et al., 2024; Meurisse et al., 2018). The main hosts of *A. mali* are not used to produce wood. No cases of interception of this pest are documented. The EPPO PRA (EPPO, 2024) concluded that, compared to other *Agrilus* species, the likelihood of entry with wood commodities into the EPPO region is very low and wood commodities are likely to be more important pathways at the local/regional scale (e.g. from China into Central Asian countries close by) than internationally to the rest of the EPPO region.

The EPPO PRA (EPPO, 2024) considered that the likelihood of entry of *A. mali* into Kazakhstan through natural spread is very high, because of the very close proximity and continuous presence of *M. sieversii* between places in northern Xinjiang (Yili Valley, China), where *A. mali* is present, and Kazakhstan. For the rest of the EPPO region, natural spread is not considered as a significant pathway for entry.

For all EPPO countries, the most likely commodity pathway for entry is host plants for planting.

PEST SIGNIFICANCE

Economic impact

Despite the wide distribution of *A. mali* in Asia, significant economic impact has only been reported in China and only on *M. domestica* and *M. sieversii*.

In an original description of *A. mali*, Matsumura (1924) mentions that heavy damage on apple trees by this pest had occurred in the southern district of Liaoning Province of China since ancient times (i.e. likely not the western *M. domestica* at that time; EPPO, 2024). Around the 1950s, the pest became widespread in north-eastern China, and until the 1990s continued to spread westwards and southwards and was then found in the 1990s in Xinjiang Province (Lu et al., 2022).

In north-western China, *A. mali* is now widespread in wild apple forests in the Tian Shan Mountains in Xinjiang Province (Lu et al., 2022). From 1995 to 2005 it spread from Xinyuan County to Gongliu, Nilek, and Turks counties, and has spread from cultivated orchards to the wild apple forest infesting a total area of 5000?ha, of which 4867?ha are wild apple forest and account for about 60% of the wild apple forest area (Cui et al., 2015; Ji et al., 2004). Sun et al. (2022) noted that recent outbreaks in Xinjiang Province might be the result of both environmental factors and poor management in apple orchards.

Apart from causing serious economic impact to apple fruit production, both in orchards and wild apple forests (affecting yield and, in extreme cases, causing death of trees), *A. mali* is affecting regeneration of wild apple trees in the natural environment, and threatening the existence of the unique natural gene bank of economical fruit resources in China (Tian Shan wild fruit forest; Ji et al., 2004). *Malus sieversii* is listed as ‘vulnerable’ on the IUCN Red List of Threatened Species and subject to a continuous decline in its current range (IUCN, 2023).

Attacks by *A. mali* have been recorded in wild apple forests, large industrial orchards, nurseries, and small private orchards (Linyi Agro-Forestry Bureau, 1973; Chen & Yao, 1997). Damage can be especially severe in orchards located in mountainous areas and in young orchards with poor management (Feng et al., 2013; Guli & Wang, 2013). In apple orchards with intensive appropriate management, the infestation level is much lower than in poorly managed ones (Cui et al., 2018; Lu et al., 2022). Currently, *A. mali* is considered a secondary pest in *M. domestica* orchards in China, as most apple orchards are managed carefully (EPPO, 2024).

Very limited information about the economic impact of this pest is available from the Russian Federation and no information was found for the Republic of Korea, Democratic People's Republic of Korea, and Mongolia. Lack of publications suggests that the pest has a limited impact in these countries (EPPO, 2024).

Control

Agrilus mali is regulated as a quarantine pest in some provinces and regions of China and has been included in the list of dangerous pests for forestry of China since 2013 (State Forestry Administration, 2013). Risk management measures are applied to this pest in its current range. *Agrilus mali* has been controlled in orchards using a combination of sanitation measures and application of insecticides (Cui et al., 2018; Xiang, 1997). The pest is in the Quarantine List of the Eurasian Economic Union (among pests with limited distribution on the territory of the Union; EAEU, 2016), but currently no measures are being taken (EPPO, 2024).

Sanitation and physical control. In apple orchards, it is usually recommended to cut off infested branches and dispose of them safely (the cut branches are burned or caged; using fine wire netting) to eliminate the pest (Chen & Yao, 1997; Chen & Zhan, 2007; Cui et al., 2018; Guli & Wang, 2013; Guo & Ma, 2010; Xiang, 1997). This sanitation pruning is the most effective and widely used control method (EPPO, 2024; Zhang, Li, et al., 2024). The wounds are treated with commercially available tree wound dressings for pruning and grafting to avoid infestation by fungal diseases.

Cultural practices. Because the pest preferentially infests weakened trees, maintaining tree vigour through appropriate fertilization, irrigation, and careful pruning is recommended (Linyi Agro-Forestry Bureau, 1973; Chen & Zhan, 2007; Duan et al., 2024).

Chemical control. Chemical control by spraying or injection has been used in the past in China using different active substances (EPPO, 2024) but most of them are currently not approved in the EU (EC, 2023). Chemical control is currently considered less effective as a stand-alone measure compared with sanitation by pruning of infested branches (EPPO, 2024).

Aerial spraying of ultra-low volume of thiacloprid (a systemic neonicotinoid insecticide) has been attempted in Xinjiang Province of China, with the aim to eliminate adults while they are feeding on leaves, but the effect on *A. mali* infestation were not conclusive (Zhang et al., 2021). This was in contrast with studies in Xinyun region, where the same compound was used, but the larval density of *A. mali* declined by 65% in the second season (Zhang et al., 2021).

Fumigation of insect-bearing seedlings and scions using sodium cyanide was also considered effective and suggested for application (Chen & Zhan, 2007), as well as application of pyrethrins (Li, 2019).

Biological control. Sclerodermus parasitoids (Hymenoptera: Bethylidae) such as *S. pupariae* and *S. guani* are used to control larvae of *A. mali* and are available commercially in China (EPPO, 2024). *Pyemotes moseri* (Acriformis: Pyemotidae) has been used to control various insects, including larvae and pupae of *A. mali* and is available commercially in China. In laboratory studies, this predatory mite showed excellent efficacy (Cui et al., 2019; Tang et al., 2022; Zhang et al., 2020). This species can be used for augmentative release in orchards and forests (Cui et al., 2019; Wang, 2013).

Some other native natural enemies were identified in China, e.g. *Atanycolus denigrator* (Hymenoptera: Braconidae) (Liu et al., 2010; Wang et al., 2014; Cao et al., 2019; Cui et al., 2019) and *Tetrastichus* sp. (Hymenoptera: Eulophidae) (Sun et al., 1979), but these parasitoids have not been mass produced and used in practice.

Integrated pest management (IPM). Integrated pest management measures used for the control of *A. mali* include cutting infested branches, releasing of biological control agents, limiting grazing by animals (to protect natural biodiversity and support natural enemies, and facilitate natural regeneration of wild apple), and providing food sources and overwintering shelters for natural enemies in wild forests. In orchards, IPM also includes chemical control (EPPO, 2024).

Phytosanitary risk

In the EPPO region, *A. mali* may be able to establish wherever *M. domestica* and/or *M. sieversii* are present, (EPPO, 2024). However, the northern limit of the potential area of establishment cannot be defined precisely, because if thermal conditions in a particular area are not sufficient, larval development of the pest can continue after the first overwintering. Within the potential area of establishment, it is expected that the largest impact would occur in *M. sieversii* wild apple forests in Central Asia. In addition, impact is expected in the rest of the potential area of establishment, but it would likely be lower in areas close to the northern limit of establishment.

In the EPPO PRA (EPPO, 2024), the phytosanitary risk was rated as high for Kazakhstan (because of the proximity of the species' range in China). For other EPPO countries that prohibit the importation of *Malus* plants for planting, the phytosanitary risk was rated low, and for those that do not have such prohibitions, the phytosanitary risk was rated as moderate.

In the context of climate change, the area of potential establishment of *A. mali* might extend northwards and to higher altitudes, and impact is expected to increase (Zhang et al., 2024b). Increased temperature, frequency and duration of severe droughts might increase the negative impact of the pest (EPPO, 2024).

PHYTOSANITARY MEASURES

Risk management options have been identified and evaluated in the EPPO PRA (EPPO, 2024) for host plants for planting, cut branches, round wood and sawn wood of host plants. A common option for all pathways was pest free area; see EPPO PRA (EPPO, 2024) for other options proposed for specific pathways. The measures should be applied to the genus *Malus*. If more scientific information confirming new host status become available, the same measures should be recommended for these additional hosts. With the currently available information, some countries may decide to regulate unconfirmed hosts to achieve a higher level of protection. A number of apple wood commodities from China are available to consumers on the internet for fuel for barbecues, food smoking, or as material for pets or crafting, and the EPPO PRA (EPPO, 2024) recommended that such internet trade should be placed under scrutiny. ISPM 15 (FAO, 2018) phytosanitary measures are considered to be sufficient for wood packaging material produced from apple wood.

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