EPPO Datasheet: *Chrysobothris mali*

Last updated: 2024-05-31

IDENTITY

Preferred name: *Chrysobothris mali*
Authority: Horn
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Coleoptera: Buprestidae
Common names: Pacific flat-headed borer, Pacific flatheaded borer
[view more common names online...](#)
EPPO Categorization: A1 list
[view more categorizations online...](#)
EPPO Code: CHRBMA

Notes on taxonomy and nomenclature

Chrysobothris is a large genus (approximately 690 species worldwide), with over 140 species in North America (Paiero e*t al*., 2012) and many species in the Palaearctic, including in the EPPO region (Löbl & Smetana, 2006).

HOSTS

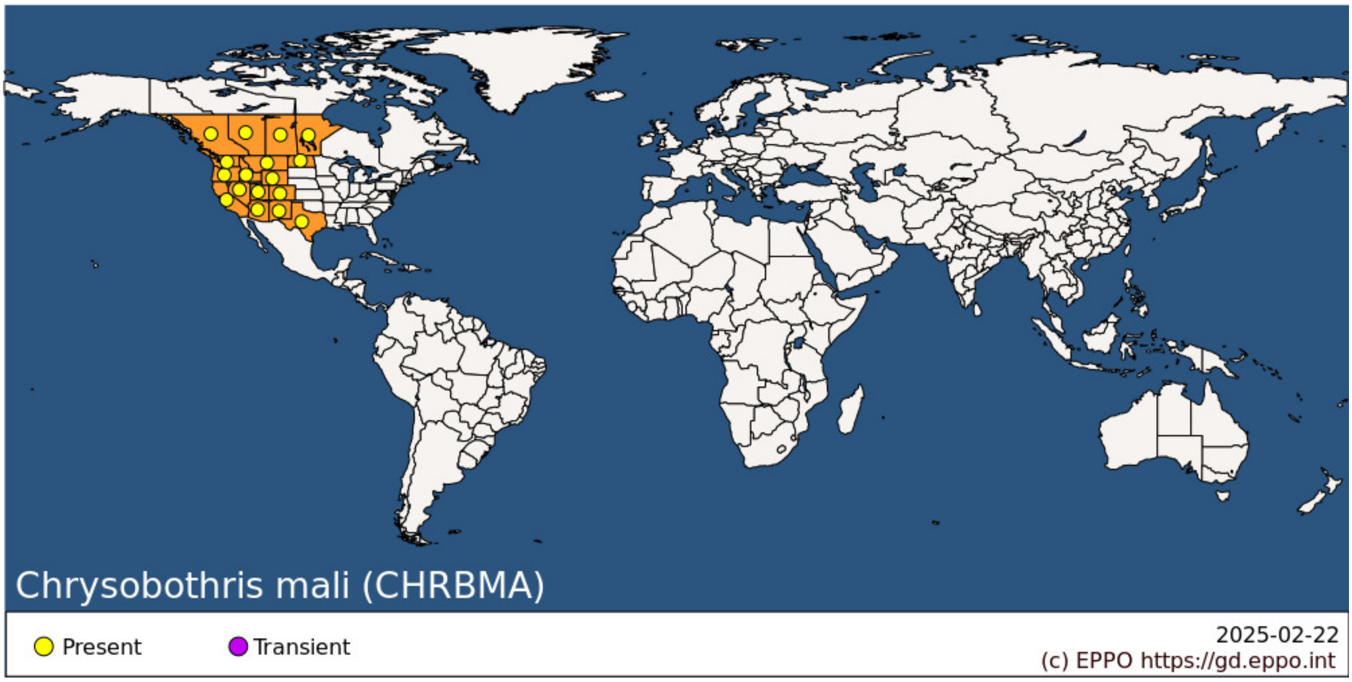
Chrysobothris mali is polyphagous on a wide range of deciduous trees and shrubs in various families. Such a wide host range is unusual among buprestids, which are typically limited to a single host plant family or genus (Hansen, 2010). The host range in North America comprises many native hosts (cultivated or wild) and many exotic hosts (especially fruit and ornamental plants). The EPPO Pest Risk Analysis (EPPO PRA, EPPO, 2021) considered that *C. mali* is likely to be able to attack other deciduous trees and shrubs currently not recorded as hosts.

The list below contains confirmed hosts as listed in the PRA (i.e. true hosts of *C. mali* shown to support the development of the pest) (EPPO, 2021), as well as hosts added later to EPPO Global Database, based on more recent literature. Details on host status and from the PRA are given under each host plant in EPPO Global Database, where available.

Host list: *Acer macrophyllum*, *Acer negundo*, *Acer platanoides*, *Acer pseudoplatanus*, *Acer rubrum*, *Acer saccharinum*, *Aesculus hippocastanum*, *Alnus sp.*, *Amelanchier alnifolia*, *Amelanchier arborea*, *Arbutus menziesii*, *Arctostaphylos canescens*, *Arctostaphylos sp.*, *Arctostaphylos viscida*, *Ceanothus cuneatus*, *Ceanothus dentatus*, *Ceanothus integerrimus*, *Ceanothus lemmonii*, *Ceanothus perplexans*, *Ceanothus prostratus*, *Ceanothus sorediatus*, *Ceanothus velutinus*, *Cercocarpus betuloides*, *Cercocarpus ledifolius*, *Cercocarpus montanus*, *Chrysothamnus sp.*, *Corylus avellana*, *Corylus cornuta subsp. californica*, *Crataegus douglasii*, *Eriobotrya japonica*, *Eucalyptus globulus* , *Fagus sylvatica*, *Ficus carica*, *Frangula californica*, *Heteromeles arbutifolia*, *Juglans regia*, *Juglans sp.*, *Liriodendron tulipifera*, *Malus domestica*, *Malus sylvestris*, *Photinia serratifolia*, *Pickeringia montana*, *Platanus orientalis*, *Platanus racemosa*, *Populus tremuloides*, *Prunus armeniaca*, *Prunus avium*, *Prunus cerasus*, *Prunus domestica*, *Prunus dulcis*, *Prunus emarginata*, *Prunus fremontii*, *Prunus ilicifolia*, *Prunus pendula*, *Prunus persica*, *Prunus serrulata*, *Prunus subcordata*, *Prunus virginiana*, *Pseudotsuga menziesii*, *Purshia stansburiana*, *Pyrus communis*, *Quercus agrifolia*, *Quercus gambelii*, *Ribes erythrocarpum*, *Ribes rubrum*, *Rosa sp.*, *Salix lasiandra*, *Salix lasiolepis*, *Sorbus aucuparia*, *Ulmus americana*, *Ulmus glabra*, *Ulmus x hollandica*, *Vaccinium hybrids*

GEOGRAPHICAL DISTRIBUTION

Chrysobothris mali is native to the USA and Canada and has been found only in these countries to date. In the USA, *C. mali* is reported mostly west of the Rocky Mountains, with only a few records east of this mountain range. In Canada, *C. mali* has been reported from British Colombia to Manitoba, and its northernmost record is at approximately 50°?N latitude. A few records in the literature (Minnesota, Indiana, Mexico) were considered doubtful or invalid in the EPPO PRA (EPPO, 2021).



North America: Canada (Alberta, British Columbia, Manitoba, Saskatchewan), United States of America (Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, Texas, Utah, Washington, Wyoming)

BIOLOGY

Chrysobothris mali generally has one generation per year, but 2–3?years may be necessary in the northern part of its range and at higher altitudes (Beddes & Caron, 2014; Burke, 1929; Solomon, 1995; Steed & Burton, 2015). Adults are found from April to August depending on latitude, with a narrower emergence period in some locations (Rijal, 2019; Solomon, 1995; Steed & Burton, 2015). There is no data on the feeding habits of adults nor their longevity (EPPO, 2021). Females lay up to 100 eggs (Steed & Burton, 2015), generally in bark cracks and crevices (Bright, 1987; Steed & Burton, 2015). *C. mali* eggs may be oviposited on, and larvae develop in, trunks or branches (Burke, 1929; Rijal & Seybold, 2019a) at various heights. Adults of *C. mali*, like those of *C. femorata*, are attracted to recently cut parts of host plants (EPPO, 2021). Eggs are laid singly, sometimes close enough to form a group (Beddes & Caron, 2014; Burke, 1929), and hatch within 2–3?weeks depending on the temperature (Beddes & Caron, 2014; Capizzi *et al.*, 1982). First-instar larvae bore into the bark. Larvae tunnel galleries and feed primarily in the phloem and cambium (inner bark) and the sapwood (outer wood) (Beddes & Caron, 2014; Burke, 1929; Solomon, 1995). In young trees with thin bark or in weakened trees, galleries can girdle the trunk or branch (Bright, 1987; Steed & Burton, 2015). Mature pupae tunnel from the cambium deeper into the sapwood, and in young and small trees, sometimes the hardwood, to pupate (Bright, 1987; EPPO, 2021; Solomon, 1995). Larvae may tunnel up to 5?cm-deep (Capizzi *et al.*, 1982). There may be several galleries in a tree, and several adults emerging from one tree (EPPO, 2021). Overwintering of *C. mali* may occur at different stages: feeding larvae, prepupal larvae (last instar larvae that have finished the feeding stage) and pupae (Burke, 1929, Capizzi *et al.*, 1982; Steed & Burton, 2015).

Chrysobothris mali attacks different size trees including large trees, although it is normally known as a pest of young trees (Rijal, 2019). On walnut in California, damage was found on trees of different ages, and was distributed randomly throughout the trees (incl. twigs, branches and trunks) (Rijal & Seybold, 2019a). On small trees, the trunk is generally attacked (Burke, 1929; Steed & Burton, 2015). *C. mali* appears to prefer weakened and stressed trees (Beddes & Caron, 2014; Burke, 1929; Rijal, 2019). Newly-planted trees are especially sensitive (Beddes & Caron, 2014; Bright, 1987). Other stresses mentioned in the literature in relation to attacks by *C. mali* include drought and sunscald (Beddes & Caron, 2014; Burke, 1929). However, in observations in walnut orchards in California, branches on healthy trees were also attacked (Rijal & Seybold, 2019a).

DETECTION AND IDENTIFICATION

Signs and symptoms

Signs and symptoms of infestation on stems and branches may resemble those caused by other wood boring insects. They include sap oozing and broad and sinuous larval galleries under the bark (Beddes & Caron, 2014; Steed & Burton, 2015). In young trees, larval galleries may measure 5?cm in length (EPPO, 2021), but on young hazelnut trees, *C. mali* larvae may create spiralling galleries 50?cm-long or more (N. Wiman, personal communication in EPPO, 2021). There may be sawdust-like frass at bark cracks, under flaking bark and in galleries, but little or no sawdust is ejected except at bark cracks (Beddes & Caron, 2014; Steed & Burton, 2015). Trees may present wounds or sunken/depressed areas on the bark (Beddes & Caron, 2014). The bark may gradually take on a darkened, wet and greasy appearance, and may present splitting, peeling and flaking (Beddes & Caron, 2014; Steed & Burton, 2015). Exit holes of *C. mali* are typical for Buprestidae and are D-shaped to oval, and measure 3–5?mm wide (Beddes & Caron, 2014; EPPO, 2021). Infested trees are weakened, branch dieback may occur, and newly-planted trees may die (Beddes & Caron, 2014; Bright, 1987; Steed & Burton, 2015).

Morphology

Eggs

Eggs are disk-like, whitish, flattened and wrinkled, and measure approximately 1?mm in diameter (Burke, 1929; Steed & Burton, 2015).

Larvae

Larvae are yellowish-white to yellow, with greatly enlarged and flattened thoracic segments. Mature larvae measure 15–18?mm long (Burke, 1929; Steed & Burton, 2015).

Pupae

Pupae are pale yellow, sometimes becoming brown, and measure 6–11?mm long (Beddes & Caron, 2014; Steed & Burton, 2015).

Adults

Adults are typical buprestids, with a broad oval shape, metallic colours and large compound eyes (EPPO, 2021). Adults are dark-bronze to reddish-copper, with dull to coppery spots and short inconspicuous white hairs covering elytra, and measure 6–11?mm long and 3–5?mm wide (Burke, 1929; Steed & Burton, 2015).

Detection methods

Detection in the field relies mostly on visual examination of vulnerable trees for symptoms (Beddes & Caron, 2014). The EPPO PRA (EPPO, 2021) considered that detection is difficult as infestations are usually not apparent until larvae are large enough to produce visible injury on the trunk surface or branch dieback occurs. Trapping is possible, for example using sticky traps, but there is no specific attractant available. Such traps also capture other Buprestidae and identification is required. In surveys in California, where both species occur, *C. femorata* was captured in purple traps, while *C. mali* adults were more attracted to green traps (Rijal & Seybold, 2019a).

Morphological identification of *Chrysobothris* species should be done by a specialist of the genus *Chrysobothris*. For a reliable morphological identification, adults should be available. *C. mali* can be distinguished from species in the *C. femorata* complex by morphological methods. In addition, *C. mali* can also be identified using DNA barcoding (Acheampong *et al.*, 2017).

PATHWAYS FOR MOVEMENT

Chrysobothris mali adults can fly, but no specific data was found on their flight capacity. As with other Buprestidae, it is expected that when host trees are abundant, spread is minimal. *C. mali* is polyphagous, which would favour it finding hosts in the vicinity of the tree or shrub from which it emerged. Trees planted along roads or in cities may be in a condition favouring attacks (e.g. due to stress) and may constitute biological corridors for the spread of the pest. Large areas of new plantings may also favour the rapid build-up of populations and further spread. Unlike monophagous species like *Agrilus planipennis*, polyphagous species such as *C. mali* will have more potential corridors for spread (EPPO, 2021).

Over long distances, *C. mali* could spread via the transportation of plants for planting, wood, wood products, and wood packaging material (if not treated according to ISPM 15). There is a large trade of deciduous woody plants for planting and wood within the EPPO region so, once introduced, the pest could rapidly spread in the EPPO region. Transport as a contaminant on vehicles or non-host commodities may also play a role locally (EPPO, 2021).

PEST SIGNIFICANCE

Larval feeding can disrupt nutrient and water movement in trees (EPPO, 2021). In young trees, galleries may girdle the trunk and lead to tree death (Beddes & Caron, 2014; Bright, 1987; Steed & Burton, 2015). On walnut in California and hazelnut in Oregon and Washington, *C. mali* commonly attacks young trees (1–2?years) and can seriously damage trees and lead to mortality (Rijal & Seybold, 2019a; N. Wiman, personal communication). In several walnut orchards, a wide range of tree ages were infested, from young trees (1–2?years old) to mature trees (15–20?years old). High-density of galleries led to the flagging and breakage of nut-bearing branches (Rijal & Seybold, 2019a). In hazelnut, the main economic issue is the loss of young hazelnut trees due to girdling of the main stem/trunk. Attacks by *C. mali* also occur in branches throughout the canopy in diseased orchards, especially in hazelnuts attacked by the fungus *Anisogramma anomala* (N. Wiman, personal communication). Attacks by *C. mali* rarely kill mature trees (Steed & Burton, 2015).

Higher damage by *C. mali* has been reported in areas with a dry climate or dry summers, especially in California and Oregon. In other areas of North America, the species may become an more important pest in certain conditions (e.g. extensive planting of trees at a sensitive stage or a tree species not suited to a particular area).

Historically, *C. mali* was considered one of the worst pests of newly planted trees and shrubs in the continental Pacific coast states to British Columbia (Capizzi *et al.*, 1982), and it has long been recognized as a problematic pest of young new orchards, shade trees and certain forest species (Wiman *et al.*, 2019). In the 1920s, attacks in orchards were common in some localities of California (for example on apple, plums, sweet and sour cherry, peach, apricot), with losses ranging from a few trees per orchard to 95% (Burke, 1929). In the end of the 1990s, *C. mali* was an occasional pest on apple in California but a serious problem in newly planted orchards, where up to 25% of trees in a young orchard could be killed unless preventive measures were taken (IPM Centers Crop Profiles, 1999a). Similar issues were reported on pear in Oregon (IPM Centers Crop Profiles, 1999b). *C. mali* was also considered a minor pest of almond and plum in California (IPM Centers Crop Profiles, 1999c, 1999d; Strand & Ohlendorf, 2002).

Recent reports of damage relate to nurseries and fruit crops. *C. mali* can be an issue in shade tree production blocks, particularly grafted species, and where stress occurs (Rosetta, 2019 citing others). In 2018–2019, *C. mali* has become a widespread issue in English walnut (*Juglans regia*) in Central California (Rijal & Seybold, 2019a). In two young orchards (1- and 2- year old), over 90% of trees were infested (trunk) (Rijal & Seybold, 2019b). In Oregon, *C. mali* has caused serious problems for the establishment of hazelnut orchards with up to 35% loss in some orchards, and it also attacks apples and cherries (Wiman *et al.*, 2019). On hazelnut, *Anisogramma anomala* is the main concern, and attacks by *C. mali* are not considered an economic issue (N. Wiman, personal communication in EPPO, 2021). Recent dry, hot summers, suboptimal planting sites, rapid rise in new acreage, and poor management are mentioned as possible factors favouring the recent increased attacks in hazelnut crops (Keyes *et al.*, 2020; Mugica *et al.*, 2020). Damage to blueberry (*V. corymbosum* hybrids) has been reported from California (serious damage in some years in the Central valley) and to a lesser extent Oregon (Cahill, 2020). Guidance on the management of this pest is provided in the Pacific Northwest and California for apple, apricot, blueberry, cherry, prune, plum and peach (IPM Centers Crop Profiles, 2018; Pacific Northwest Extension, 2023; UC IPM, 2020). Finally, there is one report of *C. mali* as a pest of apple saplings in an area of British Columbia with low rainfall (Acheampong *et al.*, 2017).

There are no reports of environmental or social impacts in North America. *C. mali* is part of the forest environment, but no extensive damage is reported.

Control

Management is complicated by the wide host range and the fact that infestations are usually not apparent until larvae are large enough to produce visible injury on the trunk surface or branch dieback occurs (EPPO, 2021). Chemical control methods similar to those for *C. femorata* are available (such as soil drenches and trunk sprays; Beddes & Caron, 2014). However, the availability of labelled insecticides for fruit or nut bearing crops commonly attacked by *C. mali* is probably more limited (EPPO, 2021). In walnut orchards in California cultural methods are critical as there are no insecticides registered against *C. mali* (Rijal & Seybold, 2019a).

Cultural control methods are applied to maintain tree health, avoid stress and control *C. mali* populations. These relate to the choice of appropriate planting sites, tree species and cultivars, avoiding planting too deep, providing appropriate watering, mulch and fertilization, and avoiding injuries to trees. Host tree trunks can be inspected during the growing season, and infested material removed to prevent emergence of adults (Beddes & Caron, 2014; Capizzi *et al.*, 1982; Solomon, 1995). In walnut orchards weakened, injured, dead, and flagged branches should be removed (Rijal & Seybold, 2019a). In shade tree production blocks, growers destroy infested trees (Rosetta, 2019 citing others). Finally, natural enemies can reduce populations under natural conditions (Solomon, 1995). There are no commercial biological control agents available against *C. mali* (EPPO, 2021).

Phytosanitary risk

Most host genera and species of *C. mali* occur in the EPPO region, where they are planted as fruit, forest, plantation or ornamental (private and public gardens, landscaping) trees and shrubs, or are native and grow in the wild, in some cases over wide areas. As in North America, *C. mali* would probably be able to attack new hosts in the EPPO region. According to EPPO (2021), the areas in the EPPO region conducive to impact would include at least the southern part of the region, from the Mediterranean Basin to Central Asia. More damage is reported from areas with dry climate or dry summers. Economic damage is also expected in part of the temperate areas from Europe to Central Asia. The northern limit of establishment and impact is uncertain, but there may be occasional outbreaks in more northern areas when conditions are appropriate (e.g. during warm dry summers), and the pest may also extend its life cycle to 2–3?years.

Chrysobothris mali could cause the same type of damage in the EPPO region as in the USA, i.e. mortality or damage to trees, but impact could potentially be higher in the EPPO region, because insecticide treatments that are effective in the USA are not available in at least part of the EPPO region. *C. mali* is likely to affect primarily newly planted trees and weakened/stressed trees, especially in the landscape, nurseries, orchards and forest plantations. Young organic fruit orchards may experience greater attack rates (i.e. young trees, and limited availability of plant protection products). *C. mali* may also pose a risk for older trees, based on current issues with branch attacks in larger walnut trees in California (Rijal & Seybold, 2019a). The presence of many other *Chrysobothris* species in the EPPO region is likely to make early detection difficult. In addition, unlike in North America, environmental impact may occur where host species play an important ecological role. For example, common hosts grown as ornamental plants in the USA (e.g. *Corylus avellana* and *Juglans regia*) are common trees in the environments and forests in the EPPO region.

PHYTOSANITARY MEASURES

The EPPO PRA (EPPO, 2021) recommends phytosanitary measures for plants for planting (except seeds, tissue cultures and pollen), cut branches, round wood and sawn wood (>6?mm) of hosts confirmed to be true hosts of *C. mali*, as well as for deciduous wood chips and similar commodities. For plants for planting and cut branches, risk management options are pest free area and pest free production site under complete physical isolation. For plants for planting only, post-entry quarantine is also an option as well as a systems approach combining plants of a diameter below a certain size (dependent on the host species), growing vegetation of 30–45?cm height around the base of the plants, and visual inspection of the crop and of the consignment. As is the case for *C. femorata*, the presence of vegetation at the base of the trees is expected to modify the female egg-laying behaviour or larval survival (Addesso et al., 2020), and has been identified as a possible component of control methods. For round wood and sawn wood, risk management options are pest free area, heat treatment, irradiation and fumigation with sulfuryl fluoride, and for wood chips, pest free area. In addition, where a risk of infestation exists following the application of a risk management option, consignments should be stored and transported in conditions preventing infestation. The establishment of pest free areas was considered possible in Eastern USA and part of Canada, with the condition that the absence of the pest should be fully demonstrated (EPPO, 2021). Wood packaging material should be treated according to ISPM 15 (FAO, 2018). Finally, for plants for planting, cut branches, round wood and sawn wood of hosts that have an uncertain status in the PRA (not confirmed hosts), the only measure recommended is that they should be accompanied with a phytosanitary certificate (EPPO, 2021).

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Datasheet history

This datasheet was first published in the EPPO Bulletin in 2024 and is now maintained in an electronic format in the EPPO Global Database. The sections on 'Identity' and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

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