EPPO Datasheet: *Pityophthorus juglandis*

Last updated: 2020-07-03

Pityophthorus juglandis and its associated fungus ***Geosmithia morbida*** are responsible for the thousand cankers disease of walnut.

IDENTITY

Preferred name: *Pityophthorus juglandis*
Authority: Blackman
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Coleoptera: Curculionidae: Scolytinae
Common names: walnut twig beetle
view more common names online...
EPPO Categorization: A2 list, Alert list (formerly)
view more categorizations online...
EU Categorization: Quarantine pest ((EU) 2019/2072 Annex II B)
EPPO Code: PITOJU



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Notes on taxonomy and nomenclature

The family Scolytidae was recently moved as a subfamily (Scolytinae) within the family Curculionidae.

HOSTS

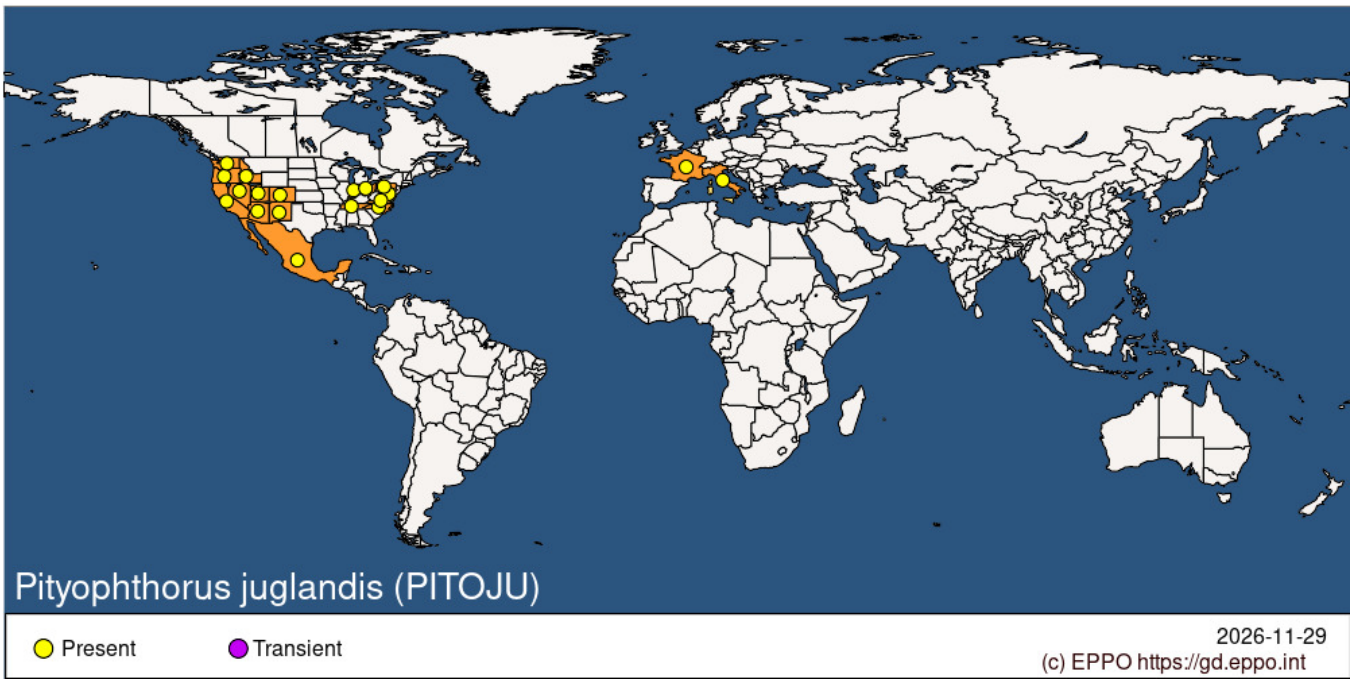
Pityophthorus juglandis infests only walnut (*Juglans* spp.) and wingnut species (*Pterocarya* spp.), with a strong preference for black walnut (*J. nigra*).

Historically, *P. juglandis* was mainly reported on *J. major* in Arizona and New Mexico, the native areas of the beetle, where it was considered as a minor pest. Observations carried out in these States suggest that damage from *P. juglandis* is restricted primarily to shaded or weakened branches and twigs in the upper crown. The expansion of the beetle's host range to *J. regia* and *J. nigra* growing in plantations or in urban landscapes in the Western USA appears to have taken place during the last 20 years (EPPO, 2015). On these new host species, the beetle activity is more aggressive than on native Western American walnuts (e.g. *J. major*).

Host list: *Juglans ailanthifolia, Juglans californica, Juglans cathayensis, Juglans cinerea, Juglans hindsii, Juglans major, Juglans mandshurica, Juglans microcarpa, Juglans mollis, Juglans nigra, Juglans regia, Juglans, Pterocarya fraxinifolia, Pterocarya rhoifolia, Pterocarya stenoptera, Pterocarya*

GEOGRAPHICAL DISTRIBUTION

Species native to Northern Mexico and the South-Western United States (California, Arizona, New Mexico). Since early 1990s, the species began spreading in many US states via the timber trade and wood movement across countries. The walnut twig beetle was reported for the first time in Europe in 2013 in North-Eastern Italy (Veneto Region), on both *J. nigra* and *J. regia* trees (Montecchio and Faccoli, 2014; Montecchio *et al*., 2014). In Italy the species quickly spread in most of the central-northern regions, such as Veneto, Friuli Venezia Giulia, Lombardy, Piedmont, Emilia Romagna and Tuscany.



EPPO Region: France (mainland), Italy (mainland)
North America: Mexico, United States of America (Arizona, California, Colorado, Idaho, Indiana, Maryland, Nevada, New Mexico, North Carolina, Ohio, Oregon, Pennsylvania, Tennessee, Utah, Virginia, Washington)

BIOLOGY

In spring, when the mean air temperature reaches about 18°C, adults begin to fly and colonize rough areas of bark at the base of twigs, but they can also infest the underside of large branches and the warmer side of the trunk (exposed to sun). Mass attacks are mediated by aggregation pheromones. Males colonize the host plant first, boring a nuptial chamber in the phloem of trees that recently died or stressed trees. Males produce a pheromone, and observations showed that this attracts from 2-8 females (usually 2 to 3), and mating occurs. Mated females dig short transverse (across the wood grain) oviposition galleries and then lay small, white eggs in niches along both sides of the egg gallery (Newton and Fowler, 2009; Faccoli *et al*., 2016).

Larvae emerge from eggs and dig longitudinal (along the wood grain) larval tunnels feeding on the phloem. Mature larvae pupate in a pupal chamber enlarged at the end of the larval gallery; new teneral adults emerged from pupae will feed in the phloem to reach sexual maturation before leaving the host tree. Adults will emerge from host via small round emergence holes (Newton and Fowler, 2009; Faccoli *et al*., 2016).

Larval development usually takes 6– 8 weeks. In California, *P. juglandis* has 2 to 3 partially overlapping generations per year; in Northern Italy two generations per year are reported (Faccoli *et al*., 2016). The walnut twig beetle can be observed flying from mid-April to late October, whereas winter is usually spent by the adults under the bark of host trees infested in late summer by the second generation or in cavities excavated in the bark (Newton and Fowler, 2009; Faccoli *et al*., 2016).

DETECTION AND IDENTIFICATION

Symptoms

In the crown. The primary infestation symptoms of the affected trees are crown yellowing, leaf wilting, followed by progressive branch dieback and crown thinning, quickly expanding over the whole crown (Tisserat *et al*., 2009). As the upper branches die, the crown of the tree also dies and the trees will often re-sprout branches from the trunk. Infested trees will die within 3-4 years of the onset of symptoms.

Under the bark. The mating system is composed of 2 - 8 short and thin (1 mm wide) transverse egg galleries, radiating from the nuptial chamber. Egg galleries are different lengths, with 2 galleries frequently longer (approximately 2 - 3 cm in length) than the others and forming an apparent transverse biramous system. Larval galleries are very thin, long, numerous, regular, closely spaced (relative to each other) and perpendicular to egg galleries. Egg niches occur in a very high numbers and are distributed very close together. The whole mating system develops under the bark without engraving the wood surface. Cambial brown discoloration occurs after intensive bark colonization (Faccoli, 2015).

On the branches. At the beginning of the infestation, even when leaf wilting is present, branches with numerous beetle galleries often show no outward appearance of bark damage, except for the small beetle entrance holes, making detection of the colonisation difficult. Over time, a number of small and circular wet dark cankers appear on the bark near to or around the penetration holes due to the infection of the pathogen *Geosmithia morbida* associated with the walnut twig beetle. The cankers expand becoming more evident and showing grey to brown discoloration of both phloem and outer bark (thousand cankers disease). In the advanced stages of decline, beetle galleries and associated cankers occur every 2 to 5 cm in the bark, and the cankers coalesce and girdle twigs and branches.

Morphology

The walnut twig beetle is a minute bark beetle species 1.5–1.9 mm long, with adult males slightly larger than females. This species is distinguished by having four to six concentric rows of pronotal asperities, and by the dull declivity surface.

Eggs: small, pale, white, oblong eggs, less than 1 mm long.

Larva*:* Larvae are white, C-shaped, legless and typical of bark beetles, with a reddish-brown head capsule.

Pupa*:* Pupae are white, exarate with free and distinguishable body parts neither glued to the body nor encapsulated within a cocoon.

Adult*:* Teneral adults are yellowish-brown and soft before they darken to a reddish-brown and their elytra harden. Mature adults are very small, 1.5–1.9 mm long, reddish-brown, about three times as long as wide, with, characteristically, 4–6 concentric rows of asperities on the anterior slope of the pronotum; each row is usually broken near the median line of the pronotum. Males similar to females except for frons very broad, strongly concave, more coarsely punctured, vestiture short, less abundant and inconspicuous; males slightly larger than females (Wood, 1982).

Detection and inspection methods

Early-detection of *P. juglandis* may be carried out in EPPO countries by a specific and intensive survey program, which should be set up especially in those countries importing large quantities of walnut wood from the USA. In particular, surveys could be performed at points of entry (e.g. ports) and facilities (e.g. sawmills and nurseries) receiving *Juglans* wood and plants, and in areas where *Juglans* trees are growing close to such facilities. Moreover, extensive surveys should also be conducted in the regions where the pest has been already found. The survey can be based on the three following points:

Interception of adults using pheromone traps. An aggregation pheromone specific to *P. juglandis* composed of 3-methyl-2-buten-1-ol is commercially available to bait multi-funnel black traps set-up in the areas at most risk of introduction (Seybold *et al.*, 2012). Traps for *P. juglandis* interception and early-detection should be in place from the beginning of June until the end of September, which represents the period of the highest flight activity of the adults (Faccoli *et al.*, 2016). *P. juglandis* has also been trapped by yellow sticky panels on walnut trees and by sticky clear panels stapled to walnut trunks, but captures were very low and incidental (Montecchio *et al*., 2016). Attempts to increase captures using walnut wood, pityol and other compounds useful in trapping some other walnut bark beetles did not increase capture of *P. juglandis*. Other types of traps may be used in addition to the specific pheromone traps (e.g. stickycoated or barrier-type traps), but they are neither easy to use nor convenient (Seybold *et al.*, 2012).

Detection of infested plants. A specific survey aiming to detect infested plants should be carried out in walnut plantations growing close to the potential points of entry. The presence of symptoms of infestation (such as canopy yellowing, leaf wilting, twig and branch dieback, occurrence on the bark of the branches of a large number of small circular entrance holes surrounded by small brown bark cankers (Tisserat *et al*. 2009)) should be looked for on the walnut trees. Detection of infestation symptoms is very difficult in the early stages of the infestation, and surveys need to be performed during the vegetative season, looking at the upper part of the canopy which may show yellowing and flagging of leaves or abnormal thinning and dieback of the canopy (Montecchio *et al*., 2016). These symptoms are not specific to this pest but they are important features for a possible early-detection.

***Material inspection*.** Careful inspections of potentially infested material and the most relevant walnut commodities (i.e. round wood, firewood, bark, plants for planting) should be carried out at points of entry into the EPPO region to prevent or reduce further introductions and dispersal. Bark branches and logs may be inspected looking for numerous small (less than 1 mm diameter) and circular entrance holes. Roughly circular cankers that develop around the walnut twig beetle galleries are usually not visible until a thin layer of the outer bark is removed (Tisserat *et al.*, 2009; Grant *et al.*, 2011). Beetle galleries and wood cankers often show no outward appearance of bark damage, except for the beetle entrance holes, making detection of infestation symptoms difficult (Newton and Fowler, 2009). In this respect, debarking allows an inspector to check for the presence of phloem degradation and occurrence of insect galleries and feeding larvae.

PATHWAYS FOR MOVEMENT

Non-squared fresh wood, non-debarked timber (including logs, firewood, sawn wood), and fresh wood packaging material (with bark) of *Juglans* spp. and *Pterocarya* spp. from the USA, Mexico and Italy are the main pathways for movement of walnut twig beetle across countries. Results show that kiln-dried wood and off-cuts (slabs) are however unsuitable for *P. juglandis* reproduction, and that the risk of kiln-dried walnut bark becoming colonized by *P. juglandis* during movement of dried commercial wood products is very low (Mayfield *et al*., 2018).

As *P. juglandis* is reported to be often found on branches with diameters as small as 1 cm, the movement of young nursery plants has been considered as a possible pathway. Unlike many other species of “twig” beetles (*Pityophthorus* spp.), walnut twig beetle colonizes the largest branches and main stem of large diameter trees in advanced stages of decline. Thus, it is never solely a twig-infesting beetle, even in its putative native host and distribution (*Juglans major* in Arizona and New Mexico), where it also colonizes the larger dimensional parts of trees. Moreover, when infesting twigs and small branches, they are those occurring on the upper part of the crown of large trees. Colonization of small plants for planting has been never clearly demonstrated. There have been no reports of walnut twig beetle infesting nursery stock (Newton and Fowler, 2009). No more recent publication on this has been found.

Natural spread of adults also occurs. In the literature, laboratory studies carried out using flight mills found that *P. juglandis* can fly actively over a mean distance of 372 m per flight, with a maximum flight distance of 3.6 km. During the 24 h trial period, beetles flew on average for 34 min. Male and female flight capacities were similar. These results suggest that without anthropogenic transport, the capacity of *P. juglandis* for active spread is limited (Kees *et al*., 2017).

Nevertheless, passive flight with wind-aided dispersal may allow the adults to cover longer distances. In North Italy *P. juglandis* is believed to spread naturally on average by about 60 km per year (Faccoli *et al*., 2016).

The finding of both *P. juglandis* and *G. morbida* in Italy clearly shows that introduction pathways of walnut twig beetle and thousand cankers disease into the EPPO region exist.

PEST SIGNIFICANCE

Economic impact

Since the mid-1990s, the walnut twig beetle - thousand cankers disease association has been responsible for

widespread mortality of many walnut species in the USA (Randolph *et al*., 2013), where both the walnut twig beetle and thousand cankers disease have spread from south-western (Cranshaw, 2011) to north-eastern states and the east coast via the national movement of infested timber (Newton and Fowler, 2009; Jacobi *et al*., 2012; Seybold *et al*., 2013). The presence of the walnut twig beetle and thousand cankers disease in Europe is considered a serious threat to *J. nigra* and to *J. regia*, which is also susceptible to the disease (Utley *et al*., 2013; Montecchio *et al*., 2014). During the last 90 years, several areas of southern Europe have been reforested with mixed tree species for wood production, and both black and English walnuts are now present in high proportions (Eichhorn *et al.*, 2006). Nowadays, in Europe walnuts are economically, culturally and environmentally highly valued trees, being cultivated for fruits, timber and as traditional landscape trees (Eichhorn *et al*., 2006). The high susceptibility of *J. nigra* and *J. regia* to the walnut twig beetle and thousand cankers disease may hence have serious impacts on the landscape and economy of many European agricultural and forest areas.

Control

No specific control methods (chemical, cultural, biological, resistant varieties) are currently available against *P. juglandis*. Various chemical control methods (sprays, soil applied systemic insecticides, trunk injections) have been investigated, involving insecticides against *P. juglandis*, but to date none have been reported to adequately control the pest (Hasey and Seybold, 2010; Tisserat and Cranshaw, 2012, Cranshaw and Tisserat, 2012).

Concerning biological control, several natural enemies are found associated with *P. juglandis*, including some specific natural enemies (such as *Theocolax* sp., *Aeletes floridae*, *Leptophloeus angustulus*, *Bitoma quadriguttata*) and some generalist predators, notably clerid beetles (family *Cleridae*) (Nix, 2013), and under some conditions may provide some suppression. However, an active biological control programme for *P. juglandis* has not yet been developed.

Specific pheromones have been identified for *P. juglandis*, and are effectively used in detection and monitoring. But they are not used for control. More recently, repellent compounds have been reported but their use in management of walnut twig beetle infestations has not yet been developed.

Use of resistant cultivars is a possibility. Differences of susceptibility for *P. juglandis* infestation have been observed between walnut species and between trees within the same species. Studies are in progress to evaluate whether differences occur between different populations of *J. nigra*. Surviving trees in affected areas may be particularly promising sources of genetic material to develop resistant cultivars. Identifying resistant or less susceptible cultivars would provide a very promising and sustainable control method for the long term.

Phytosanitary risk

In the EPPO region, the most widely grown *Juglans* species is *J. regia* which has long been cultivated for nut production, amenity purposes and wood production. In this respect, the EPPO PRA (2015) notes that *P. juglandis* and *G. morbida* have the potential to establish throughout the EPPO region where *Juglans* species occur. They are likely to be more damaging in the Southern and Eastern parts of the EPPO region, according to the higher number of generations of *P. juglandis* per year and where walnuts are also grown more widely. However, the susceptibility of these EPPO regions to thousand cankers disease remains to be further studied. The most susceptible species, *J. nigra*, has been introduced during the 17th Century into the EPPO region, first for amenity purposes and later for the production of high-quality wood. Although more data is needed on its distribution and economic importance, this insect-disease association probably has the potential to establish and spread if no measures are taken.

The introduction of the walnut twig beetle and the associated thousand cankers disease clearly represents a threat to the cultivation of *Juglans* species in the EPPO region, and it is desirable that measures are taken to prevent or reduce any further spread.

PHYTOSANITARY MEASURES

EPPO Standard PM 8/12 *Juglans* (EPPO, 2020) reports a detailed list of the recommended phytosanitary measures and the requirements for *Juglans* needed for the containment of *Juglans* pests, including walnut twig beetle and

thousand cankers disease. The measures are based mainly on the movement restriction of products potentially infested and destruction of those already infested, as follows:

Movement restriction. In the USA and Italy, phytosanitary measures have been taken to protect walnuts still free from the insect infestation from extensive mortality. The directly applied phytosanitary measures mainly consist of restrictions on the movement of walnut wood and plants for planting to prevent insect spread.

Sanitation felling. Beside movement restriction, the other main phytosanitary measures are based on the prompt cut and harvesting of infested trees that can reduce beetle populations and are useful for containment. In particular, walnut wood may allow development of *P. juglandis* until it has thoroughly dried, and infested wood must be destroyed or isolated. The efficacy of this phytosanitary practice depends on the situation and to be effective they need to be done over a wide area. Infested wood must be disposed of in a way that will reduce further emergence and not allow dispersal of beetles. It is recognized that sanitation has rarely been used in the USA, and the situation is further complicated by the long time lag between tree infestation and symptom expression, and difficulties in detecting *P. juglandis* when populations are low. Nevertheless, some measures may be useful as part of containment plans to dispose of infested trees and wood or to reduce populations within an infested area, such as, for example, isolation, storage, debarking, chipping and appropriate disposal of the wood by grinding or burning of the infested trees and material.

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