

This text is an integral part of the *EPPO Study on bark and ambrosia beetles associated with imported non-coniferous wood* and should be read in conjunction with the study

Pest information sheet

Ambrosia beetle

***PLATYPUS QUERCIVORUS* (COLEOPTERA: PLATYPODINAE)**

oak ambrosia beetle. Associated disease: Japanese oak wilt

EPPO Lists: Not listed. The fungus associated with *Platypus quercivorus*, i.e. *Raffaelea quercivora*, was added to the EPPO Alert List in 1999, deleted in 2002, added again in 2003, and deleted in 2008 (it was then assessed that insufficient data was available to conclude about the risks for the EPPO region, especially the susceptibility of European species of oak). The assessment of potential risks in this information sheet is not based on a full PRA for the EPPO region, but on an assessment of the limited information for that species used to prepare the information sheet.

PEST OVERVIEW

Taxonomy

Platypus quercivorus (Murayama, 1925). Synonyms: *Crossotarsus quercivorus* Murayama, 1925; *Crossotarsus sexfenestratus* Beeson, 1937.

Associated fungi

Raffaelea quercivora (Kubono and Ito, 2002). Kinuura and Kobayashi (2006) demonstrated that *P. quercivorus* is a vector of *R. quercivora*, and that the mass mortality of Japanese oak trees is caused by mass attacks of *P. quercivorus*. Japanese oak wilt was the first known occurrence of mass-mortality of trees in the family Fagaceae, caused by a species of *Platypus* and an associated ambrosia fungus of the genus *Raffaelea* (CABI CPC, 2017, citing others). The loss of water conductance in sapwood colonized by *R. quercivora* around the galleries of *P. quercivorus* is the cause of oak wilt (Kuroda, 2001; Kusumoto *et al.*, 2014).

Other fungi were found associated with *P. quercivorus*, such as *Ophiostoma longicolla* (Masuya *et al.*, 1998), 38 fungus species, three of which were associated with all trees tested (*Candida* sp. 3, *Candida kashinagacola*, *R. quercivorus*), others included the yeasts *Ambrosiozyma* spp. (Endoh *et al.*, 2011). No information on their pathogenicity was found.

Morphology and biology

Adults measure ca. 4.5 mm (Davis *et al.*, 2005 citing Murayama, 1925). *P. quercivorus* is mostly univoltine in Japan, with occasionally a second generation. A male selects a tree for a breeding site, bores an entrance tunnel, and releases volatiles that attract other adults. After mating, the female tunnels into the tree. On average, 50 to 60 larvae develop in a single gallery system but the number of larvae can reach 160 (CABI CPC, citing others). *P. quercivorus* uses an aggregation pheromone (Kamata *et al.*, 2008). The parents are presumed to die before or during winter months because no eggs have been found in the spring. Most individuals overwinter as a larval stage and pupate in the following season (Esaki *et al.*, 2004, citing others).

P. quercivorus bores into the sapwood and occasionally the heartwood of oak trees (Endoh *et al.*, 2011). Entrance holes are mostly located in the lower part of a tree (<1.5 m, with a higher concentration close to the root collar) (Esaki *et al.*, 2004, 2009). There may be many individuals on a tree during an attack: Esaki *et al.* (2009) observed a final attack density of 173 entry holes per m² on average.

In Japan, *P. quercivorus* appears to attack both healthy and weakened trees (Kamata *et al.*, 2002), although Igeta *et al.* (2003 citing others) state that it has shown a tendency to invade trees that had been either cut down or blown down by typhoons. Outside of Japan (Taiwan, Thailand, Vietnam and Indonesia), Kusumoto *et al.* (2013) collected *P. quercivorus* only from fallen trees or big broken branches, and not from the healthy living trees.

P. quercivorus has been reported to preferentially attacks trees >15 cm DBH, with few attacks found on smaller trees (Esaki *et al.*, 2004 citing others). Similar observations were made by Akaishi *et al.* (2006) on *Q. serrata*

and *Q. variabilis*, with no entry holes on trees < 15 cm DBH. On *Lithocarpus (Pasania) edulis*, Sato (2003) found no entry holes on trees < 8 cm DBH (Sato, 2003). In experiments on *Q. crispula*, Kinuura and Kobayachi (2006) found galleries with offspring on trees > 8.5 cm DBH (their experiment contained only 1 tree < 8 cm DBH). Similar values were found when analysing the DBH threshold for male flight (50% probability when DBH was 9.0 cm) and male beetles boring holes in trees (50% probability when DBH was 11.2 cm for trees with no infection history) (Yamasaki and Futai, 2008).

In experiments on logs, adult males bored holes into the water-soaked logs, but not on unsoaked logs when they were both provided together. The 50% cumulative adult emergence day ranged from 92 days to 127 days after the females were introduced to the galleries (Kitajima and Goto, 2004). This may indicate that males are less likely to choose dry logs.

The susceptibility of hosts varies. In Japan, *Q. crispula*¹ and *Q. serrata* were found to be more susceptible to *R. quercivora* than evergreen Fagaceae species (Murata *et al.*, 2005, 2007 cited in Kusumoto *et al.*, 2013, Kamata *et al.*, 2002, Endoh *et al.*, 2011). *Q. crispula* is preferred to *Q. serrata* and *Castanea crenata* (Yamasaki *et al.*, 2014b citing others). Yamasaki *et al.* (2007) showed that *Q. salicina* is less susceptible to attacks than *Q. crispula*.

Spread biology

Adults show a positive phototaxis, and the highest concentrations of flying beetles usually occur at the forest margins or at the edge of forest gaps. Adults tend to move upward along hillsides (Kamata *et al.*, 2002 Igeta *et al.*, 2003; Long Pham *et al.*, 2017). Adults were found to mostly fly below 2.5 m (Igeta *et al.*, 2004). CABI CPC (2017) mentions that adults are capable of sustained flight for at least 1 km and may also be dispersed on air currents (no reference is given). In experiments in a flight mill, some individuals flew 27 km (Fukaya *et al.*, 2015, 2016, Okada *et al.*, 2018).

Nature of the damage

P. quercivorus tunnels in the wood of host trees, and *R. quercivora* develops in the wood. *R. quercivora* can induce discoloration of the sapwood (Kusumoto *et al.*, 2013). Attacks can result in the loss of structural integrity in the wood and loss of wood quality (CABI CPC). In addition, attacks by *P. quercivorus* and *R. quercivora* may lead to tree wilting and mortality. Mentions of mortality were found in the literature especially in relation to *Q. crispula* (Kamata *et al.*, 2002), but also *Lithocarpus edulis* (Sato, 2003), *Castanea crenata* (Yamasaki *et al.*, 2014a), *Q. serrata*, *Q. robur*, *Q. laurifolia*, *Castanopsis cuspidata* (Endoh *et al.*, 2011). On *Q. crispula* and *Q. serrata* (trees that were later killed), it took three weeks from the first collection of the beetle to discoloration of all leaves (Kobayashi and Ueda, 2003). Oak trees with a 20-50 cm DBH and 20-30 m height generally wilt within 2-3 months following a major attack by *P. quercivorus* (Kubono and Ito, 2002).

Mortality differs greatly among species: in observations in outbreak areas (Kamata *et al.*, 2002), mortality of newly attacked *Q. crispula* reached 40%, and no mortality was observed in associated species of Fagaceae with similar numbers of entry holes. Few trees have also been killed in stands of evergreen Fagaceae in Japan (Kamata *et al.*, 2002). Tree death can occur the same year as a mass attack by *P. quercivorus*, but most oaks die within three years (Esaki *et al.*, 2009; Kamata *et al.*, 2002, Kubono and Ito 2002, Kobayashi and Ueda 2003). In a forest in eastern Kyoto Prefecture, the mortality of attacked *Q. crispula* reached 40-45% while that of *Castanea crenata* reached 13-23% (Yamasaki *et al.*, 2014a). Mortality of 8-28 cm diameter *Lithocarpus edulis* trees has been reported (Sato *et al.*, 2003). Attacks by *P. quercivorus* do not always result in the death of oak trees; ca. 40% of *Q. serrata* attacked by *P. quercivorus* have survived for 10 years following an attack (Hata *et al.*, 2014 citing Saito and Shibata 2012).

Detection and identification

- **Symptoms.** Symptoms of infestation include wilting in summer and/or reddish-brown discoloration of leaves, frass tubes projecting from the tree and sawdust near the base of the tree (CAPS-CERIS, 2013 citing others). Dead trees may be present. On wood, galleries and brown discoloration caused by *R. quercivora* may be observed.

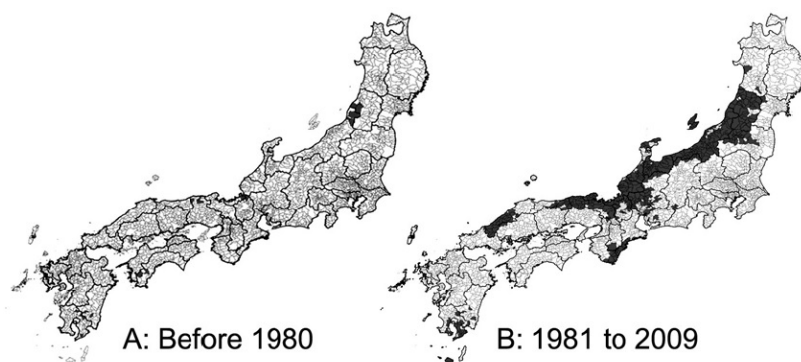
¹ The most recent literature refers to '*Q. crispula*', and this name was also used here. Earlier references sometimes treat it as a synonym of *Q. mongolica*. *Q. crispula* is *Q. mongolica* subsp. *crispula* or *Q. mongolica* var. *grosseserrata*, and apparently a different entity than *Q. mongolica*.

- **Trapping.** Monitoring surveys may use visual inspection of symptoms, interception traps (Esaki *et al.*, 2002; Davis *et al.*, 2005 citing others), bait logs (Kobayashi *et al.* 2003, 2004), trapping with the synthetic aggregation pheromone for *P. quercivorus* (called quercivorol) [(1S,4R)-4-isopropyl-1-methyl-2-cyclohexen-1-ol abbreviated (-)-IMCH] (Kamata *et al.*, 2008, Tokoro *et al.*, 2007).
- **Identification.** Adults of *P. quercivorus* are described in various publications. Davis *et al.* (2005) mentions that there is no identification key of *Platypus* spp. allowing to discriminate species in the USA. Molecular methods have been developed for *P. quercivorus* (e.g. Hamaguchi *et al.*, 2011) with some sequences in GenBank. The Draft Genome Sequence of *R. quercivora* JCM 11526 has been determined (Masuya *et al.*, 2016).

Distribution (see Table 1)

P. quercivorus is present only in Asia, from the Indian subcontinent to Japan, as well as in Papua New Guinea (Oceania) (see Table 1). Japan represents the northernmost distribution of the beetle (Kamata *et al.*, 2002). In Japan, it has sometimes been considered as exotic, but other authors argue that both the beetle and its fungus have been present for a long time (Kamata *et al.*, 2002; Ida and Takahashi, 2010). Japanese oak wilt disease has not been observed outside Japan, but *R. quercivora* has been collected in 4 other countries (Taiwan, Vietnam, Indonesia, Thailand - Kusumoto *et al.*, 2013).

A map of the spread of Japanese oak wilt in Japan is given in Kuroda *et al.* (2012) (the black shading highlights the spread).



Host plants (see Table 2)

Kamata *et al.* (2002, citing others) reports that 45 species of woody plants (in 27 genera of 17 families) have been recorded as hosts of *P. quercivorus*, but that attack density is significantly higher on Fagaceae. Hosts found in the available literature are in Table 2 (representing only 7 families). The reproductive hosts of *P. quercivorus* are Fagaceae, including many *Quercus* spp., *Castanea crenata* (Japanese chestnut), *Lithocarpus* spp. and *Castanopsis* spp. It is worth noting that attack on *Fagus* has never been reported, even in mixed oak-beech forests where oaks were attacked (e.g. Nakagima and Isida, 2014). Among the *Quercus* spp. present in the EPPO region, some Asian species are present in Far-East Russia, and *Q. robur* has a wide distribution in the western part of the region.

In field observations, *P. quercivorus* showed the lowest preference for *Q. crispula* in terms of number of trees attacked, but its reproductive success was highest on that tree, which is also susceptible to *R. quercivora*, leading to mortality. Three other Fagaceae (*Castanopsis sieboldii*, *Q. serrata* and *Q. acuta*) were preferred in terms of numbers of trees attacked, but showed lower reproductive success and susceptibility to *R. quercivora*. The spread of oak dieback and density of *P. quercivorus* was influenced by the percentage of *Q. crispula* in each stand. The authors also suggested that Japanese oak wilt resulted from the warmer climate since the late 1980s, which made it possible for *P. quercivorus* to extend its range to more northerly latitudes and higher altitudes, and encounter the susceptible *Q. crispula* (Kamata *et al.*, 2002).

Known impacts and control in current distribution

Countries other than Japan. No report of impact by *P. quercivorus* and *R. quercivora* was found in the literature, and Japanese oak wilt is not reported outside Japan, although both are known to occur together at least in some countries (see *Distribution*). Some isolates of *R. quercivora* collected outside of Japan were shown to be able to induce wide discoloration on oak wood, and *P. quercivorus* was collected only from fallen trees or big broken branches, and not from healthy living trees. The authors make the hypothesis that host trees

outside Japan may not be susceptible to *R. quercivora* or are able to resist attacks by *P. quercivorus*, or that *P. quercivorus* strains in other countries may not be as aggressive as in Japan, and not be able to attack healthy living trees (Kusumoto *et al.*, 2013).

Japan. The impact reported in Japan relates to oak. No information was found on damage to other Fagaceae or other hosts. Oak dieback has been recorded since the 1930s, but up to 1980, epidemics lasted for only a few years and were confined to a few areas on the west side of Japan; more recently epidemics have lasted for more than ten years, and the area of dieback has been spreading to new localities (Kamata *et al.*, 2002). Mass mortalities of oak trees (*Q. serrata* and *Q. crispula*) have been occurring since 1990 in Honshu, predominantly on Prefectures of the Coast of the Sea of Japan (Kubono and Ito, 2002, citing Ito and Yamada 1998), and also in the southern part of Kyushu Island and on the Kii Peninsula (Kinuura and Kobayashi, 2006 citing others). Ida and Takahashi (2010), based on old sources, support that Japanese oak wilt caused by *R. quercivora* and *P. quercivorus* has recurred occasionally in local areas with many large trees in the Nagano Prefecture since 1750; the disease was observed in an area since 2004, but similar damage had occurred in that area in 1750, in association with an insect infestation of trunks.

P. quercivorus and *R. quercivora* have killed approximately 100 000–200 000 trees annually since about 1980, the majority being *Q. serrata* and *Q. crispula* (Davis *et al.* 2005, citing Ito *et al.* 2003). The damage has affected 325 000 m³ of *Q. crispula* and *Q. serrata* in 2010 (Takahashi *et al.*, 2015 citing the Japanese Forestry Agency). Oak wilt disease has been responsible for over 80 000 m³ of damage (in stem volume) per year since 2007, and the damage in the Tohoku district (Northeastern Honshu), accounts for more than 30 % of the total damage (Saito *et al.*, 2016).

Davis *et al.* (2005) consider that the economic impact of *P. quercivorus* in Japan is difficult to measure, especially because it occurs together with other secondary pests. Damage associated with *P. quercivorus* was reported ca. 70 years ago, but it is not clear if it referred to mortality, and was caused by the beetle alone or the beetle together with *R. quercivora*. In Japan, mortality from *P. quercivorus* has been less severe in evergreen oaks than on deciduous oaks (Davis *et al.*, 2005 citing others).

Damage in secondary forests ('satoyama') surrounding rural communities have increased recently. Oak wilt has been observed on 40–70 years old stands that were previously used for fuel wood and charcoal production (coppiced), but were left unmanaged following the replacement of wood fuels in the 1950s. The traditional coppicing at 15–30 year intervals had been discontinued in Japan by 1980, leading to an increase in the size of tree trunks, making them more suitable to attacks by *P. quercivorus*, and populations have increased in aged 'satoyama' (Yamanaka *et al.*, 2011; Kuroda *et al.*, 2012).

In Kyoto National Garden, where 13 species of Fagaceae trees are present, *P. quercivorus* tunnelled in 342 trees, 71 of which died (Sekine *et al.*, 2011).

Environmental impact: *P. quercivorus* and *R. quercivora* have caused extensive tree mortality in oak forests, especially *Q. crispula* and *Q. serrata*. Serious damage occurs in 'satoyamas', where the disease kills tall trees, and sika deers eat seedlings and prevent forest regeneration (Sasaki *et al.*, 2014). Kuroda *et al.* (2012) noted concern linked to deterioration of biodiversity and soil erosion due to changes in the vegetation following mass mortality of oak trees. Tree mortality differs among species and over several years, the tree composition of forests changes (Kamata *et al.*, 2002).

Control: Several control methods have been proposed in Japan, including mass-trapping using pheromone baited traps, injection of *N*-methyl dithiocarbamic acid ammonium salt into the trunk of infected oak trees, application of creosote or fenitrothion on the bark surface, and wrapping oak trunks with vinyl sheeting or linen cloth (Iitzuka *et al.*, 2016, citing others). No biological control agent is available to date although some species have been investigated (e.g. in Qi *et al.*, 2011).

To reduce oak mortality in 'satoyama' forests, Kuroda *et al.* (2012) proposed that rejuvenation of trees by coppicing will be effective because *P. quercivorus* cannot propagate in thin trunks, including clear-cutting of aged forest to promote sprouting from the oak stumps (Kuroda *et al.*, 2012).

Oak log pile traps were found to be effective to reduce attacks by *P. quercivorus* in forests (Saito *et al.*, 2015, 2016). Saito *et al.* (2016) estimated that in 2009-2014, a total of 26 491 701 beetles were attracted to oak log pile traps, i.e. the preventive effect was claimed to be equivalent to ca. 26 500 oak trees. More trees were defoliated in the trapping area than in the trap-free area (3.3 trees per ha of oak forest versus 11.5 trees per ha of oak forest). Logs used for oak log pile traps were converted to wood chips in the following spring, before adult emergence, and used as fuel or for pulp.

POTENTIAL RISKS FOR THE EPPO REGION

Pathways

Entry

Life stages are associated with the xylem of host trees. *P. quercivorus* is reported to attack trees of a diameter >8 cm. All wood commodities may be a pathway. Processes applied to produce wood commodities would destroy some individuals; however, there may be many individuals in an infested log. The likelihood of entry on wood chips, hogwood and processing wood residues would be lower than on round wood, as individuals would have to survive processing and transport, and transfer to a suitable host is less likely. *P. quercivorus* has been found associated with the Fagaceae genera *Quercus*, *Castanea*, *Lithocarpus*, *Castanopsis*, though never with *Fagus* (although present in Japan). The wood would also degrade and not be able to sustain development of the pest. *P. quercivorus* and *R. quercivora* may not survive in logs with low moisture content according to Kobayashi *et al.* (2003, 2004). Current imports of *Quercus* or non-coniferous wood appear to be minor from Japan, based on data in the EPPO PRA on *Massicus raddei* (EPPO, 2018). Bark on its own is an unlikely pathway.

The fact that *P. quercivorus* is reported to attack trees of a diameter >8 cm would limit its association with plants for planting, although some traded nursery plants (incl. bonsais) may reach this size. However, no mention of attacks in nurseries were found in the literature. From the information available, *P. quercivorus* is associated with trunks, not branches.

Summary of pathways:

- wood (round or sawn, with or without bark, incl. firewood) of hosts
- non-coniferous wood chips, hogwood, processing wood residues (except sawdust and shavings)
- wood packaging material if not treated according to ISPM 15
- plants for planting of hosts of a DBH >8 cm?

Spread (following introduction, i.e. within EPPO region)

P. quercivorus is known to have spread in Japan. In the EPPO region, it could spread naturally and through human-assisted pathways. Spread will depend on whether *P. quercivorus* is able to attack *Quercus* or *Castanea* species present in the EPPO region, which would favour both natural spread and human-assisted spread (especially with *Quercus* wood). There has been one record on *Q. robur* in Japan; this species is widespread in the EPPO region and could facilitate spread.

Establishment

Areas with suitable climates and host plants are available in the EPPO region, therefore establishment is possible.

P. quercivorus has been reported in tropical and subtropical climates, as well as in Japan, where the change of climatic conditions in the 1980s is hypothesized to have allowed its spread to temperate areas and higher altitudes. *Q. crispula* is present in the cool temperate forests in Japan. Based on the climate classification of Köppen Geiger (see Annex 6 of the study), *P. quercivorus* in Japan is present in areas of climate Cfa and Dfb², which in the EPPO region occur in Northern Italy, part of the Balkan and Black Sea area, as well as Eastern Europe, the south of Scandinavia, European part of Russia and Russian Far-East. The climates in the rest of the distribution are not represented in the EPPO region. However, many areas in the EPPO region have climates that are intermediate between tropical/subtropical climates and the Dfb² climate type.

Among the known Fagaceae hosts, no data was found on the occurrence of *Q. crispula* in the EPPO region. *Q. mongolica* is present in Far-East Russia, which is however more northern than the northernmost distribution of *P. quercivorus* (climatic conditions may not be suitable). *Q. robur* is widespread in a large part of the EPPO region. Other known hosts of *P. quercivorus* have a limited presence in the EPPO region (mostly as ornamentals). However, some *Castanea* and *Quercus* species that are not recorded as hosts are widespread in

² Cfa: warm temperate climate, fully humid, hot summer; Dfb: snow climate, fully humid, warm summer.

the PRA area, such as *C. sativa*, *Q. pubescens*, *Q. petraea* and *Q. cerris*, as well as many other *Quercus* species; they may be attacked by *P. quercivorus* if it was introduced into other parts of the EPPO region. A list of native *Quercus* is provided in the EPPO PRA on *Massicus raddei* (EPPO, 2018). The list of non-Fagaceae hosts in Table 2 is incomplete (see *Host plants*), but contains some plants that are grown as ornamentals in the EPPO region.

Potential impact (including consideration of host plants)

Quercus are economically and environmentally important trees in the EPPO region, and are present in the wild, and cultivated for wood or as amenity trees. Mortality is reported in Japan on *Quercus* species that are not widespread in the EPPO region, and damage may be limited to ornamental trees. Impact in the EPPO region would depend on the susceptibility (to *P. quercivorus* and *R. quercivora*) of the species of *Quercus* present in the region. *P. quercivorus* has been recorded on *Q. robur*, a species that is widespread and economically and environmentally invaluable in the EPPO region, but its susceptibility is not known. It is noted that when *P. quercivorus* and *R. quercivora* reached the new host *Q. crispula* in the temperate part of Japan, it proved to be the most susceptible species. Environmental impact may occur due to damage and death of trees (mainly *Quercus*, but possibly other hosts) in natural environments, effects on biodiversity, changes in forest composition, effects on endangered hosts, impact on sensitive habitats, etc.

In other Fagaceae host genera, *P. quercivorus* may have an impact trees grown as ornamentals in the EPPO region, as well as on *Castanea sativa* (currently not known as host), which is widely grown in the wild, and cultivated for fruit, wood, and as an ornamental tree. There is not enough data on non-Fagaceae hosts to analyse potential impact.

Table 1. Distribution

	Reference	Comments
EPPO region		
Absent		
Asia		
India	EPPO Global Database	
Indonesia	EPPO Global Database	
Japan - Honshu, Kyushu - <i>uncertain records</i> : Hokkaido, Ryukyu Archipelago	- EPPO Global Database - CABI CPC citing Hamaguchi and Goto, 2003	At least since the 1930s, possibly before (see <i>Distribution</i>) - original source was a poster at a conference, no other record was found in the Japanese literature
Taiwan	EPPO Global Database	
Thailand	Kusumoto <i>et al.</i> (2013)	
Vietnam	Kusumoto <i>et al.</i> (2013)	
Oceania		
Papua New Guinea	EPPO Global Database	

Table 2. Hosts

- **Fagaceae** (note: Davis *et al.*, 2005 cite others)

Genus/Species	Reference
<i>Castanea crenata</i>	Michimasa and Kazuyoshi, 2012
<i>Castanopsis cuspidata</i>	Endoh <i>et al.</i> , 2011
<i>Castanopsis fabri</i>	Kusomoto <i>et al.</i> , 2013
<i>Castanopsis carlesii</i>	Kusomoto <i>et al.</i> , 2013
<i>Castanopsis javanica</i>	Kusomoto <i>et al.</i> , 2013
<i>Castanopsis sieboldii</i> (C. <i>cuspidata</i> var. <i>sieboldii</i>)	Kamata <i>et al.</i> , 2002
<i>Castanopsis</i> sp.	Kusomoto <i>et al.</i> , 2013
<i>Lithocarpus coalitus</i>	Kusomoto <i>et al.</i> , 2013
<i>Lithocarpus edulis</i> (<i>Pasania edulis</i>)	Soné <i>et al.</i> , 1998
<i>Lithocarpus glaber</i>	Sekine <i>et al.</i> , 2011
<i>Lithocarpus</i> sp.	Kusomoto <i>et al.</i> , 2013
<i>Quercus acuta</i>	Kamata <i>et al.</i> , 2002
<i>Quercus acutissima</i>	CABI CPC

Genus/Species	Reference
<i>Quercus crispuloserrata</i>	Davis <i>et al.</i> , 2005
<i>Quercus crispula</i> (=Q. <i>mongolica</i> subsp. <i>crispula</i> , Q. <i>mongolica</i> var. <i>grosseserrata</i>)	Kamata <i>et al.</i> , 2002; Kubono and Ito, 2002
<i>Quercus gilva</i>	Davis <i>et al.</i> , 2005
<i>Quercus glauca</i>	Kobayashi and Ueda, 2005
<i>Quercus laurifolia</i>	Endoh <i>et al.</i> , 2011
<i>Quercus myrsinifolia</i> (or <i>myrsinaefolia</i>)	Davis <i>et al.</i> , 2005
<i>Quercus phillyraeoides</i>	Kusomoto <i>et al.</i> , 2013
<i>Quercus robur</i>	Endoh <i>et al.</i> , 2011
<i>Quercus salicina</i>	Igeta <i>et al.</i> , 2004
<i>Quercus serrata</i>	Kamata <i>et al.</i> , 2002
<i>Quercus sessilifolia</i>	Davis <i>et al.</i> ,
<i>Quercus variabilis</i>	Akaishi <i>et al.</i> , 2006

- **Other families** (note: Davis *et al.*, 2005 cite others)

Family	Genus/Species	Reference
Aquifoliaceae	<i>Ilex chinensis</i>	Davis <i>et al.</i> , 2005
Aquifoliaceae	<i>Ilex rotunda</i>	Sato, 2003
Araliaceae	<i>Fatsia japonica</i>	Sato, 2003
Cupressaceae	<i>Cryptomeria japonica</i>	Tarno <i>et al.</i> , 2011
Lauraceae	<i>Cinnamomum japonicum</i>	Sato, 2003
Lauraceae	<i>Lindera erythrocarpa</i>	Davis <i>et al.</i> , 2005
Lauraceae	<i>Neolitsea sericea</i>	Davis <i>et al.</i> , 2005
Lauraceae	<i>Persea</i> (=Machilus) <i>japonica</i>	Davis <i>et al.</i> , 2005

Family	Genus/Species	Reference
Lauraceae	<i>Persea</i> (=Machilus) <i>thunbergii</i>	Sato, 2003
Myricaceae	<i>Myrica rubra</i>	Sato, 2003
Rosaceae	<i>Prunus</i>	Davis <i>et al.</i> , 2005
Rosaceae	<i>Sorbus alnifolia</i>	Davis <i>et al.</i> , 2005
Rosaceae	<i>Sorbus japonica</i>	Tarno <i>et al.</i> , 2011

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