EPPO Datasheet: *Chrysobothris femorata*

Last updated: 2024-05-31

IDENTITY

Preferred name: *Chrysobothris femorata*
Authority: (Olivier)
Taxonomic position: Animalia: Arthropoda: Hexapoda: Insecta: Coleoptera: Buprestidae
Other scientific names: *Buprestis femorata* Olivier, *Chrysobothris horni* Kerremans, *Chrysobothris nigritula* Gory & Laporte, *Chrysobothris obscura* LeConte
Common names: flat-headed apple tree borer, flatheaded appletree borer
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EPPO Categorization: A1 list, Alert list (formerly)
view more categorizations online...
EPPO Code: CHRBFE

more photos...

Notes on taxonomy and nomenclature

Chrysobothris is a large genus (approximately 690 species worldwide), with over 140 species in North America (Paiero *et al*., 2012) and many species in the Palaearctic, including in the EPPO region (Löbl & Smetana, 2006). This datasheet relates to *C. femorata* sensu stricto (*C. femorata s.s.*), which belongs to a complex that comprises 12 species according to Wellso and Manley (2007). The number of species in the *femorata* complex and the taxonomy of some species is still debated. Due to identification and taxonomic difficulties, species of the *femorata* complex are not always treated separately in the literature, and all authors do not separate the species of the complex in the same way (EPPO, 2021). It is worth noting that some biological information on *C. femorata* arising from publications that pre-date Wellso and Manley (2007) (such as Fenton, 1942; Potter *et al*., 1988) is repeated in recent literature on *C. femorata s.s.*, and is therefore considered to apply to *C. femorata s.s*. Within the complex, *C. femorata s.s.* is the species with the widest distribution and the largest number of hosts.

HOSTS

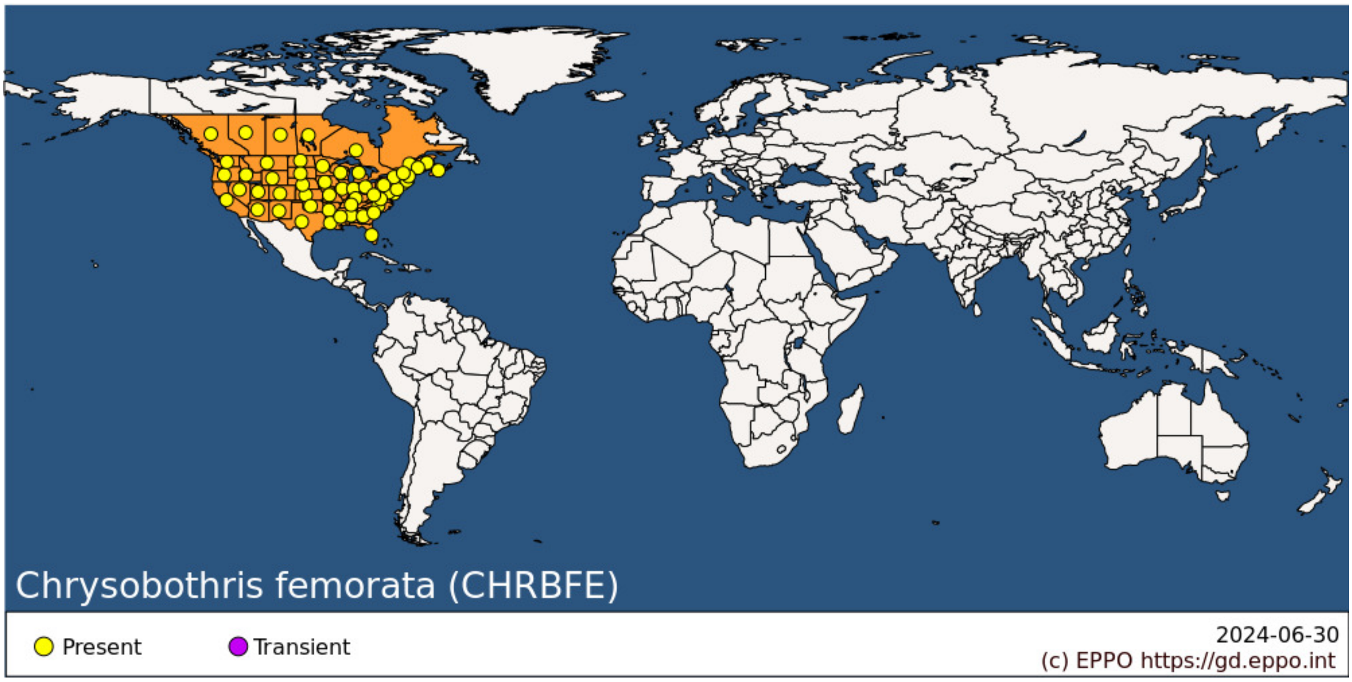
Chrysobothris femorata is polyphagous on a wide range of deciduous trees and shrubs in various families. Such a wide host range is unusual among buprestids, which are typically limited to a single host plant family or genus (Hansen, 2010). The host range in North America comprises many native hosts (cultivated or wild) and many exotic hosts (especially fruit and ornamental plants). The EPPO Pest Risk Analysis (EPPO PRA, EPPO, 2021) considered that *C. femorata* is likely to be able to attack other deciduous trees and shrubs currently not recorded as hosts. The EPPO PRA separates confirmed hosts (i.e. true hosts of *C. femorata s.s*. shown to support the development of the pest) and uncertain hosts either because there is no clear indication that the pest completes its life cycle on these plants, or because there is a doubt on whether the record relates to another species in the *femorata* complex.

The list below contains true 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 negundo*, *Acer platanoides*, *Acer rubrum*, *Acer saccharum*, *Acer truncatum*, *Acer x freemanii*, *Alnus rhombifolia*, *Alnus rubra*, *Betula occidentalis*, *Betula papyrifera*, *Betula pubescens*, *Betula sp.*, *Carpinus betulus*, *Carpinus caroliniana*, *Carpinus japonica*, *Carya illinoinensis*, *Cercis canadensis*, *Cornus florida*, *Cornus kousa*, *Crataegus douglasii*, *Crataegus viridis*, *Eucalyptus sp.*, *Juglans nigra*, *Malus domestica*, *Malus sylvestris*, *Ostrya virginiana*, *Platanus occidentalis*, *Platanus racemosa*, *Populus deltoides*, *Populus fremontii*, *Populus nigra var. italica*, *Populus tremuloides*, *Populus trichocarpa*, *Prunus avium*, *Prunus serotina*, *Prunus sp.*, *Pyrus communis* , *Quercus garryana*, *Quercus gravesii*, *Quercus kelloggii*, *Quercus lobata*, *Salix lasiandra*, *Salix nigra*, *Salix sp.*, *Sorbus hybrida*, *Tilia americana*, *Ulmus americana*, *Ulmus rubra*, *Vaccinium darrowii*

GEOGRAPHICAL DISTRIBUTION

Chrysobothris femorata is native to the USA and Canada and has been found only in these countries to date. In the USA, *C. femorata* has been reported in all continental states except Alaska. In Canada, *C. femorata* has been reported in most of the southern provinces, and its northernmost records are at approximately 52°?N latitude. A number of records in the literature for the rest of the Americas (e.g. Mexico, Costa Rica, Ecuador) and Asia (e.g. India, Thailand) were considered doubtful or invalid in the EPPO PRA (EPPO, 2021).



North America: Canada (Alberta, British Columbia, Manitoba, New Brunswick, Nova Scotia, Ontario, Québec, Saskatchewan), United States of America (Alabama, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, South

Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, Wyoming)

BIOLOGY

Chrysobothris femorata generally has one generation per year (Hansen *et al*., 2009; Potter *et al.*, 1988), but 2–3?years may be necessary in the northern part of its range (Beddes & Caron, 2014; Fenton, 1942; Steed & Burton, 2015). Adults are found from March to November depending on latitude, with a narrower emergence period in some locations (Potter *et al*., 1988). The emergence of *C. femorata* adults from 1st January at base 10°C (from the life stage present in the tree at the start of the year) corresponds to 412 Celsius degree-days (Potter *et al.*, 1988).

Adults feed mainly on tender bark, occasionally eating through leaf petioles, and live for about 3–5?weeks (Fenton, 1942). Females lay on average 60–100 eggs (Fenton, 1942; Steed & Burton, 2015), generally in bark scales, crevices, or irregularities (Bright, 1987; Steed & Burton, 2015). *C. femorata* eggs may be oviposited on, and larvae develop in, trunks or branches (Fenton, 1942) at various heights. *C. femorata* adults are also attracted to recently cut parts of host plants (Eaton, 2011; Oliver *et al.*, 2019a). On nursery trees, attacks and trunk damage have been reported within 10?cm–1?m above the ground (Oliver *et al.*, 2019a; Potter *et al*., 1988; Seagraves *et al*., 2013). The presence of vegetation at the base of the trees modifies the female egg-laying behaviour or larval survival (Addesso *et al*., 2020), and has been identified as a possible component of control methods.

Eggs are laid singly, sometimes close enough to form a group (Beddes & Caron, 2014; Burke, 1919). Eggs hatch within 1–3?weeks depending on the temperature (Beddes & Caron, 2014; Solomon, 1995). 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) (Frank *et al.*, 2013; Solomon, 1995). In young trees with thin bark or in weakened trees, galleries can be long and winding, sometimes girdling the trunk or branch. In older trees with thick bark, the galleries are mostly confined to the inner bark, sometimes confined to a circular area (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 (Frank *et al*., 2013; Hansen *et al*., 2009; 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. femorata* may occur at different stages: feeding larvae, prepupal larvae (last instar larvae that have finished the feeding stage) and pupae (Burke, 1919; Hansen *et al.*, 2009; Potter *et al*., 1988; Steed & Burton, 2015).

Chrysobothris femorata attacks trees of all sizes (Fenton & Maxwell, 1937; Solomon & Payne, 1986). In Tennessee, growers identified most issues for nursery trees with a diameter in the range of 2.5–3.8?cm, especially for stressed trees (Oliver *et al*., 2019b). *C. femorata* is reported to preferably attack weakened or stressed trees, but when infestations are high, it may attack healthy trees (Hansen *et al*., 2009). Newly-planted trees are especially sensitive (Oliver *et al*., 2010, 2019a, 2019b). Other stresses mentioned in the literature in relation to attacks by *C. femorata* include: drought, sunscald, defoliation, or soil compaction (Bright, 1987; Fenton, 1942; Steed & Burton, 2015).

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; Hansen *et al.*, 2009; Steed & Burton, 2015). In young trees, larval galleries may measure 5?cm in length (Bright, 1987) but longer galleries (approximately 20?cm) are commonly observed on nursery trees in the field (J. Oliver, 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 a darkened, wet and greasy appearance, and may present splitting, peeling and flaking (Beddes & Caron, 2014; Steed & Burton, 2015). On old/large trees, loss of large patches of bark on trunks can occur (Krischik & Davidson, 2013). Exit holes of *C. femorata* are typical for Buprestidae and are D-shaped to oval, and measure 5–7?mm wide and may be covered with frass (Beddes & Caron, 2014; Frank *et al.*, 2013). Infested trees are weakened with less foliage, they may have branch dieback or dead branches, and newly-planted trees may die. Basal shoots may form on the trunk in response to girdling damage, at least on *Acer* and *Cornus* (EPPO, 2021).

Morphology

Descriptions of *C. femorata s.s.* are provided in Wellso and Manley (2007) and Steed and Burton (2015). Many members of the *femorata* complex have a broadly similar size and appearance.

Eggs

Eggs are disk-like, pale yellow, flattened and wrinkled, and measure approximately 1.5?mm in diameter (Steed & Burton, 2015).

Larvae

Larvae are cream-coloured with a brown head, with greatly enlarged and flattened thoracic segments. Mature larvae measure 18–25?mm long (Steed & Burton, 2015).

Pupae
Pupae are pale yellow, sometimes becoming brown, and measure 7–19?mm long (Steed & Burton, 2015).

Adults

Adults are typical buprestids, with a broad oval shape, metallic colours and large compound eyes (EPPO, 2021). Overall, adults are metallic olive-grey to brown. The elytra are blackish grey with coppery-bronze reflections, with several irregular greyish to brassy spots. Beneath the wings, the abdomen is metallic purple to greenish blue, and the ventral surface metallic bronze. Antennae are dark reddish. The male face is often bright green. Adults measure 7–16?mm long and up to 5–7?mm wide (Hansen, 2010; Hansen *et al.*, 2009; Steed & Burton, 2015; Wellso & Manley, 2007). Considerable variation exists between individuals of *C. femorata s.s.* (Wellso & Manley, 2007).

Detection methods

Detection in the field relies mostly on visual examination of vulnerable trees for symptoms (Beddes & Caron, 2014). 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. Attacks are normally not detected until the autumn, and are even more visible the following spring (Oliver *et al*., 2010, 2019a). First emergence (and the appearance of exit holes) can be observed at the earliest one year after the first infestation. Trapping is possible, for example using purple sticky traps (Hansen *et al*., 2015; Petrice *et al*., 2013, citing others), but there is no specific attractant available. Such traps also capture other Buprestidae and identification is required.

Morphological identification of *Chrysobothris* species should be done by a specialist of the genus *Chrysobothris*. For a reliable identification, adults should be available. *C. femorata* can be distinguished from *C. mali*. Within the *femorata* complex, the geographical distribution and host range of species overlap and cannot be used to identify to species. Identification keys within the *femorata* complex rely on adult characters such as integument colour, elytra pattern and, especially, the form of the male genitalia (Hansen *et al*., 2011; Wellso & Manley, 2007). However, the morphological characters used in the existing keys are not easy to observe, and intermediate character forms and intraspecific variations complicate identification (Klingeman *et al*., 2015). Identification of the female in some taxa/species within the *C. femorata* complex requires specimens in a good condition, and a very good reference collection consisting of specimens from across the species range. Genitalia removal is required to identify males of some taxa in the *C. femorata* complex. At the time of the EPPO PRA, *C. femorata* could not be reliably distinguished from other species in the *femorata* complex by molecular methods, but research was ongoing (EPPO, 2021).

PATHWAYS FOR MOVEMENT

Chrysobothris femorata adults can fly, but no specific data was found on their flight capacity (EPPO, 2021). As with other Buprestidae, it is expected that when host trees are abundant, spread is minimal. *C. femorata* 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. femorata* will have more potential corridors for spread (EPPO, 2021).

Over long distances, *C. femorata* 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 (Coyle *et al*., 2005; Oliver *et al.*, 2010). In young trees, galleries may girdle the trunk and lead to tree death (Krischik & Davidson, 2013; Solomon & Payne, 1986). A single larva can girdle a young tree within one season (Hansen *et al*., 2009). Nursery trees that survive attacks are often scarred and unmarketable (Hansen *et al*., 2009). On mature trees, attacks by *C. femorata* usually do not kill trees, but can weaken them or contribute to their death (Beddes & Caron, 2014; Solomon & Payne, 1986). In older trees with thick bark, galleries may be confined to a circular area, and wounds may be enlarged by attacks during succeeding generations, creating scars and loss of large patches of bark on trunks (Steed & Burton, 2015). Branches of mature trees may also be girdled.

Chrysobothris femorata has had economic impact in the USA. Higher damage by *C. femorata* has been reported in warm and humid climates of South-Eastern USA. In other areas of the USA, the pest may emerge in suitable conditions (e.g. extensive planting of trees at a sensitive stage or a tree species not suited to a particular area). Currently, *C. femorata* has impacts especially on commercial nurseries and landscapes trees (including urban trees), due to the mortality of young newly transplanted or weakened trees, or loss of value/unmarketability of trees attacked (Hansen *et al*., 2009; Oliver *et al*., 2010, 2019a, 2019b; Potter *et al*., 1988). In Tennessee, the pest is currently under control in nurseries, relying on wide use of imidacloprid soil drenches, and serious damage is avoided for most hosts (Oliver *et al*., 2019b).

Recent literature often relates to *C. femorata s. s.* as a pest of *Acer*, especially *A. rubrum* (Oliver *et al.*, 2010, 2019b; Potter *et al*., 1988; Seagraves *et al*., 2013). *Acer* crops in middle Tennessee nurseries commonly sustain 25%–40% losses by the 3rd to 4th production year because of this pest (Oliver *et al*., 2010). In Kentucky and neighbouring states, infestation rates over 30% were observed during a period of intermittent drought on young *Acer* trees, particularly *A. rubrum*, in nurseries (Potter *et al*., 1988). In intensively managed hardwood forest systems using *A. saccharinum* in the North-Central USA, *C. femorata* caused over 40% mortality of first-year trees (Coyle *et al*., 2005, citing others). Hosts in the genera *Carpinus*, *Cercis*, *Cornus*, *Malus*, *Populus* and *Prunus* are also reported as being especially attacked (Fulcher, 2012; Oliver *et al*., 2019b; Steed & Burton, 2015). There are limited data on the impact to fruit hosts. *C. femorata* has been reported as a pest in apple orchards (*Malus domestica*), occasionally becoming a problem on trees of pre-bearing age and in organic orchards (Ames, 2018; Eaton, 2011). It has also been recorded as a pest of pecan (*Carya illinoinensis*) (Acebes-Doria *et al*., 2019; Thompson & Conner, 2012).

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

Control

Management is complicated by the wide host range (Hansen, 2010) 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. Management measures are applied mostly to newly planted trees and young trees. Although recommendations appear to differ slightly for nurseries, landscape trees, orchards and gardens, they are based on the same control methods. Extensive research is ongoing in the USA to develop control methods, avoid heavy reliance on a single active substance, reduce the potential for insecticide resistance development and provide alternatives to insecticides (Addesso *et al*., 2018; Dawadi *et al*., 2019; Oliver *et al*., 2019a).

Systemic neonicotinoid drenches are the main control method used in nurseries where *C. femorata* damage is prevalent in South-Eastern USA (Oliver *et al.,* 2019b). They provided 2-4?years (imidacloprid) or 1?year (dinotefuran, clothianidin) of protection in trials with young *Acer* trees (Oliver *et al*., 2010). For landscape trees, Baker (2019) mentions that imidacloprid soil drenches can be combined with insecticide sprays on trunks and larger branches.

Trunk sprays using active substances such as bifenthrin, carbaryl, chlorpyrifos, imidacloprid and permethrin have been widely used and are part of control recommendations, especially for young trees (Addesso *et al*., 2018 citing Oliver *et al*., 2014; Baker, 2019; Beddes & Caron, 2014; Krischik & Davidson, 2013). However, such treatments require multiple applications per year, and an appropriate monitoring for timing of applications (LeBude, 2019; Oliver *et al*., 2019a).

Cultural control methods are applied to maintain tree health, avoid stress and control *C. femorata* 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 (Baker, 2019; Beddes & Caron, 2014; Hansen *et al.*, 2009; Krischik & Davidson, 2013; Oliver *et al*., 2019b). The use of cover crops sown within tree rows in nurseries was recently investigated as a viable alternative to insecticides (Addesso *et al*., 2019; Dawadi *et al*., 2019). 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; Solomon & Payne, 1986). Firewood should not be piled near susceptible host productions because adults may emerge in the summer after an infested tree was cut down (Eaton, 2011). Finally, predators and parasitoids can reduce populations under natural conditions but their role in ornamental nurseries and landscapes is not known (Frank *et al.*, 2013). There are no commercial biological control agents available against *C. femorata* (EPPO, 2021).

Phytosanitary risk

Most host genera and species of *C. femorata* 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. femorata* 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, with the highest impact in areas that are climatically similar to southeastern USA. 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, and the pest may also extend its life cycle to 2–3?years.

Chrysobothris femorata 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. femorata* is likely to affect primarily newly planted trees and weakened/stressed trees, especially in the landscape, nurseries, orchards and forest plantations. 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. *Carpinus betulus*) 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. femorata* s.s., 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. 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. Although the establishment of pest free areas was identified as a possible option for most pathways, it was not considered possible in Southern Canada and continental USA except Alaska, and therefore limits its applicability in the current distribution of the pest (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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