EPPO Datasheet: *Harringtonia lauricola*

Last updated: 2025-08-07

IDENTITY

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Preferred name: *Harringtonia lauricola*
Authority: (T.C. Harr., Fraedrich & Aghayeva) Z.W. de Beer & M. Procter
Taxonomic position: Fungi: Ascomycota: Pezizomycotina: Sordariomycetes: Sordariomycetidae: Ophiostomatales: Ophiostomataceae
Other scientific names: *Raffaelea lauricola* Harrington, Fraedrich & Aghayeva
Common names: laurel wilt (US)
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EPPO Categorization: Alert list
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EPPO Code: RAFFLA

Notes on taxonomy and nomenclature

Harringtonia lauricola was initially described in the genus *Raffaelea* (Harrington *et al.*, 2008), which has long been used to group many ambrosia beetle symbionts of uncertain taxonomic placement within the order Ophiostomatales. In 2022, a major taxonomic revision of this group moved this species and several relatives into their own genus *Harringtonia* based on molecular data (de Beer *et al.*).

HOSTS

Harringtonia lauricola is an ambrosia beetle-transmitted pathogen affecting woody plants within the family Lauraceae. There are no records of laurel wilt disease in non-Lauraceae, and the records of the primary vector *Xyleborus glabratus* on other hosts are considered dubious (Hulcr & Lou, 2013). In its native range, the fungus is a mild pathogen on lauraceous trees but primarily damages only previously injured or weakened hosts (Hulcr *et al.* 2017, Shih *et al.*, 2018).

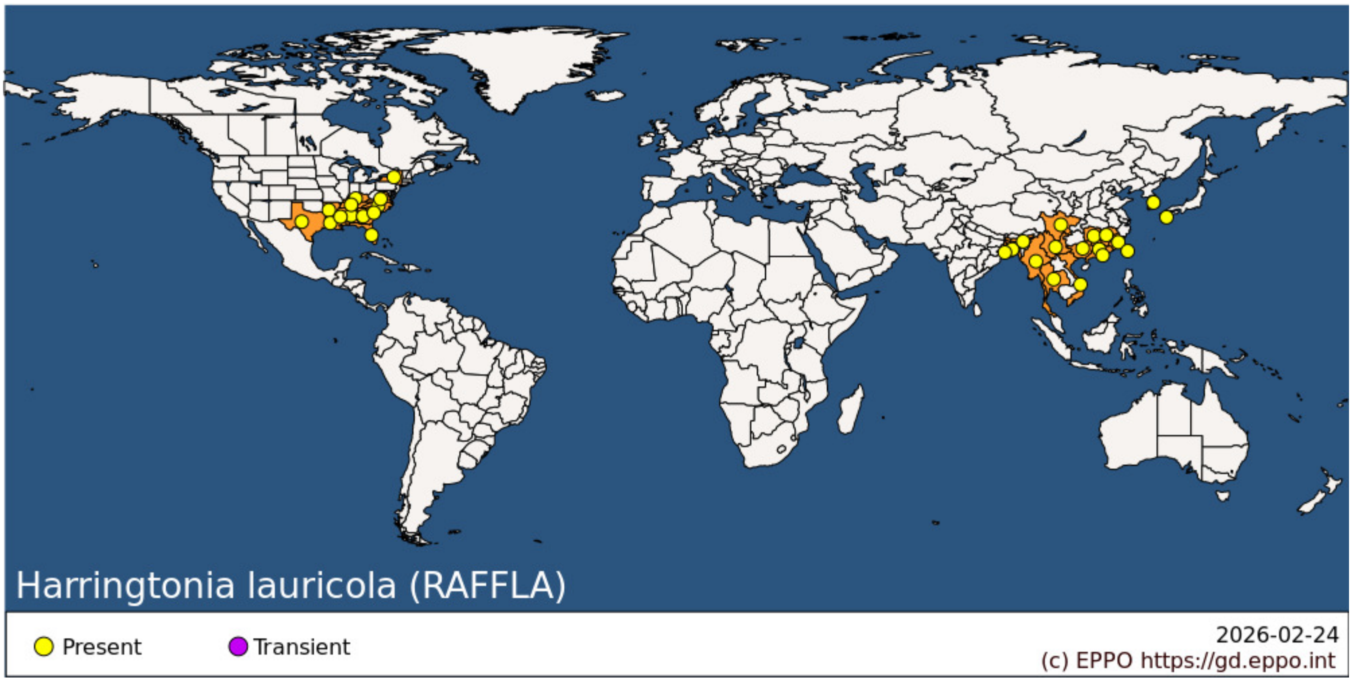
However, in areas where Lauraceae do not share a long coevolutionary history with *H. lauricola*, this pathogen poses a major threat, hence its impact on forest plants such as redbay (*Persea borbonia*), swampbay (*Persea palustris*), and sassafras (*Sassafras albidum*) and commercial crops such as avocado (*Persea americana*) in its invasive range in North America (Fraedrich *et al.*, 2008). Other as-yet untested Lauraceae may prove to be susceptible when/if the beetle-pathogen complex continues to expand its range. Amongst hosts known to be vulnerable to severe *H. lauricola* infection, *Laurus nobilis* and *Persea americana* occur most frequently in the EPPO region

Host list: *Cinnamomum camphora*, *Cinnamomum jensenianum*, *Cinnamomum osmophloeum*, *Laurus nobilis*, *Licaria triandra*, *Lindera benzoin*, *Lindera melissifolia*, *Litsea aestivalis*, *Persea americana*, *Persea borbonia*, *Persea humilis*, *Persea palustris*, *Sassafras albidum*

GEOGRAPHICAL DISTRIBUTION

The native range of *Harringtonia lauricola* extends across eastern and southern Asia (Harrington *et al.*, 2011). In North America, *Xyleborus glabratus* was first detected in Georgia in 2002, the pathogen in 2003, and both have been spreading rapidly through the southeastern United States ever since (Fraedrich *et al.*, 2008).

H. lauricola does not produce severe disease in Asian Lauraceae and therefore has not been extensively studied there (Most records for Asia only relate to *X. glabratus*, and this is indicated in the comments of the detailed distribution for the concerned country in the EPPO Global Database). Other fungi in the Ophiostomatales are occasionally isolated from the fungus-carrying organs (mycangia) of *X. glabratus*, but *H. lauricola* is its main fungal symbiont (Harrington *et al.*, 2010). Because ambrosia beetles depend on their fungal partners for survival, it is most prudent for quarantine purposes to use the distribution of *Xyleborus glabratus* to infer the full current range of *H. lauricola*.



Asia: Bangladesh, China (Fujian, Guangdong, Guangxi, Hunan, Jiangxi, Sichuan, Xianggang (Hong Kong), Yunnan), India (Assam, West Bengal), Japan (Kyushu), Korea, Republic of, Myanmar, Taiwan, Thailand, Vietnam
North America: United States of America (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, New York, North Carolina, South Carolina, Tennessee, Texas, Virginia)

BIOLOGY

The redbay ambrosia beetle *Xyleborus glabratus* is the primary vector of *Harringtonia lauricola* between host Lauraceae (Fraedrich *et al*., 2008). Like all ambrosia beetles, *X. glabratus* inoculates the wood it colonizes with fungus to help feed developing offspring in the otherwise nutritionally poor xylem of trees. However, *H. lauricola* is unusual among fungi cultivated by ambrosia beetles in being a systemic pathogen capable of affecting otherwise healthy trees outside of its native range. Several bark beetles in the same subfamily (Scolytinae) may incidentally spread fungal pathogens between plants (e.g. *Ophiostoma novo-ulmi'* causing Dutch elm disease) (Jacobi *et al*., 2013), but most true nutritional symbionts of ambrosia beetles have little to no impact on tree health, particularly in the absence of their beetles (i.e., *Neocosmospora euwallaceae* induces symptoms only during heavy infestations by its beetle vector *Euwallacea fornicatus*) (Freeman *et al*., 2019). Even other species in the genus *Harringtonia* do not cause disease in otherwise healthy redbay (Araújo *et al*., 2022).

Spread and mortality can occur even in the absence of the primary beetle vector *X. glabratus*. That is because other ambrosia beetles can pick up *H. lauricola* in infected Lauraceae and introduce it into new trees. These include beetles such as *Xyleborus affinis*, *Xyleborus volvulus*, *Xyleborus bispinatus*, *Xyleborus ferrugineus*, *Xyleborinus gracilis*, *Xyleborinus saxesenii*, and *Xylosandrus crassiusculus*, allowing the pathogen to persist in environments that seem to be suboptimal for *X. glabratus*, such as avocado orchards. However, the efficiency of transmission and concentration of propagules of *H. lauricola* is extremely variable across potential vectors. Ambrosia beetle clades are typically highly specific to their fungal mutualists, so genera that are coevolved with fungi other than *Raffaelea* or *Harringtonia*, such as *Xyleborinus* or *Xylosandrus*, are less likely to be effective vectors of *H. lauricola* than other *Xyleborus* (Carrillo *et al*. 2014). Furthermore, many of them are polyphagous and feed on plants outside of the Lauraceae; however, the impact that colonizing non-susceptible hosts might have on the transmission of *H. lauricola* across multiple generations of these “non-primary” beetle vectors and the implications for overall pathogen epidemiology have not been investigated in detail.

Even so, experience from Florida (Hulcr, unpublished) suggests that persistent infection of *H. lauricola* in natural environments (i.e., where susceptible trees are not distributed homogenously within a small area, as in avocado orchards) is only maintained by *X. glabratus*. Thus, although it is hypothetically possible that the pathogen could be introduced to new places via other ambrosia beetles, it seems unlikely that it would spread widely in the absence of its main beetle host.

As a beetle-vectored fungus, *H. lauricola* enters live Lauraceae through entrance holes made by *X. glabratus* females. The first foundresses generally fail to establish full galleries in healthy trees, but even an unsuccessful attempt introduces the pathogen into the xylem of its new host (Martini *et al*., 2015). Naïve Lauraceae react to the fungus's presence via gel production and the swelling of parenchyma cells into xylem vessels. These tyloses block the flow of water and nutrients to the leaves, killing the top of the tree, but they do not effectively prevent pathogen spread: conidia and mycelia of the fungus soon become detectable throughout the plant's water transport system (Inch *et al*., 2012). At this stage, additional *X. glabratus* arriving on the tree can establish successful galleries. *H. lauricola* produces nutritional conidia on the gallery walls, feeding developing larvae. When offspring of these broods emerge, the dispersing adult females accumulate conidia in fungus-carrying cavities (mycangia) at the internal base of the mandibles. These asexual spores replicate in a yeast-like phase (i.e., unicellularly rather than in the multicellular filamentous form seen in tree tissues) within the mycangia, increasing the amount of inoculum available upon arrival at the next plant host (Harrington & Fraedrich, 2010).

Population genetic analyses suggest that *H. lauricola* is heterothallic (i.e., two separate mating types are required for sexual reproduction) and reproduces sexually within its native range. However, only one mating type of the fungus seems to be present in the United States (Wuest *et al*., 2017).

DETECTION AND IDENTIFICATION

Symptoms

The most obvious diagnostic symptom of *H. lauricola* infection is rapid canopy wilt. In studies on avocado, plants remain asymptomatic for 1.5 - 2 weeks, at which point leaves above the inoculation point begin to die, changing from green to grey to brown. Dead leaves may remain on the tree for months (in avocado) to over a year (in redbay) (Ploetz *et al*., 2012). The second most visible symptom is blue-grey streaking throughout the sapwood of affected trees, and tissue may even turn brown or black where beetles have bored (Kendra *et al*., 2014). The presence of the vector, *Xyleborus glabratus,* or its entrance hole are not reliable symptoms - not only is it a challenge to locate the inoculation site, but additional ambrosia beetles typically arrive at the infected tree as it deteriorates (Fraedrich *et al*., 2008). In some cases, the tree will regenerate by putting up epicormic sprouts from the base even after the top has been killed (Kendra *et al*., 2013).

Morphology

Cultures of *Harringtonia lauricola* grown on common culture media have a noticeably yeasty consistency, more so than most other *Harringtonia* and *Raffaelea* species. Colonies are initally off-white and gradually darken to light yellow-brown. They also develop feathery edges as they mature. Translucent spore-producing structures can be found at the tips of hyphae or on branches extending out from hyphae. The asexual spores (conidia) arise from the tips of these cells, with new spores clustering together like bunches of grapes. They tend to be longer than they are wide, assume oval or rod-like shapes, and give the surface of the culture a mucilaginous consistency as it ages. There are few septa dividing cells except where tissues branch (Harrington et al., 2008).

Detection and inspection methods

The optimal initial monitoring method is visual inspection and detection of rapid terminal wilt in the canopy of trees within the Lauraceae family. Culturing and identification of the pathogen can then confirm the diagnosis.

Because other conditions can produce similar symptoms additional circumstantial evidence can either support or rule out a laurel wilt diagnosis. Firstly, laurel wilt does not attack trees outside of the Lauraceae, so symptoms in nonlaurels can be attributed to other causes (Fraedrich *et al*., 2008). Secondly, if there are signs of ambrosia beetle activity – in particular, noodle-like extrusions of frass from insect entry holes - it may be possible to collect and identify beetles morphologically to confirm the presence of *X. glabratus*. (It should be noted that the so-called 'noodles' may be produced by multiple ambrosia beetle species). If the beetle is present, its ambrosial symbiont probably is as well, though its absence does not exclude a laurel wilt diagnosis because *X. glabratus* may be relatively uncommon compared to other ambrosia beetles capitalizing on the weakened defenses of a dead or dying tree (Dong *et al*., 2024). If no *X. glabratus* are positively identified, dark streaks through the sapwood of the affected individual are also strong indications of *H. lauricola* infection (Fraedrich *et al*., 2015).

A combination of these conditions provides strong evidence for the presence of laurel wilt, but definitive diagnosis requires identification of the pathogen. Diagnostic tools have grown more advanced with the progression of the current outbreak in the United States. Early methods for detection required that *H. lauricola* be cultured from infected wood on cycloheximide-streptomycin malt agar before DNA extraction, which meant that confirmation could be delayed for over a week to account for fungal growth. Although this remains the gold standard for identification, Parra *et al*. shortened this time frame to a day by extracting DNA directly from wood, with PCR amplification using microsatellite primers (Parra *et al*. 2020), and loop-mediated isothermal amplification in the field may accelerate the process even further (Hamilton *et al*., 2021).

Several organisms can cause confusingly similar symptoms. First, dark streaking and rapid wilt of laurel twigs could also indicate the fungus *Thyridium lauri*, vectored by another ambrosia beetle, *Xylosandrus compactus*. However, *X. compactus* colonizes only individual thinner twigs of the tree, and the disease does not progress systemically (Leonardi *et al*., 2024). In contrast, *X. glabratus* attacks trunks and branches, and *H. lauricola* kills the entire tree. In avocado, *Phytophthora cinnamomi* can cause similar external symptoms and tree death, but the disease typically occurs in excessively wet situations and progresses slowly compared to the short timeline for disease and long retention of leaves in true laurel wilt (Dong *et al*., 2024).

PATHWAYS FOR MOVEMENT

Harringtonia lauricola primarily depends on beetle vectors to transmit it from tree to tree. In the US, the spread of this disease has thus far followed the range expansion of *Xyleborus glabratus*. In the early stages of the US outbreak, the infection front advanced about 15 to 20 km a year, probably approximating the natural rate of dispersal of *X. glabratus*, with much larger jumps facilitated by human transport of infested firewood, cut trees, and possibly wood chips (Cameron *et al*., 2008).

Within avocado orchards, *H. lauricola* may also move through root grafts (Ploetz *et al*., 2012) or be vectored by other ambrosia beetles – in fact, they are likely to play a more substantial role in within-stand transmission than *X. glabratus* does (Carrillo *et al*., 2014). That said, the extent to which non-*X. glabratus* ambrosia beetles transmit *H. lauricola* strongly depends on the phylogenetic closeness of the putative alternative vector to *Xyleborus*, and they are not believed to be a major factor in transmission in natural settings.

International transport of infested wood packing material (WPM) likely introduced the beetle and its fungus to the U.S., and this continues to be a potential pathway for movement (Hughes *et al*., 2015). While the current population in the US may act as a bridgehead for future invasions, introduction of the beetle from Asia is more likely because of the abundance of large-diameter trees (e.g. *Machilus*, *Cinamommum*; whereas American laurels are usually small trees and not used for industrial purposes).

Scolytine beetles are often intercepted in crates, dunnage, and pallets associated with a variety of shipped goods (Haack, 2001), and although implementation of the International Standards for Phytosanitary Measures No. 15 (ISPM 15) has reduced the frequency of these reports, factors such as insufficient heat treatment, poor penetration of some fumigants, and accidental or intentional failure to meet WPM treatment criteria may permit some insects to circumvent controls (Haack *et al*., 2014). Secondary colonization of material after treatment is unlikely to impossible when WPM treatment criteria are satisfied, given that *X. glabratus* infests live trees or those that have recently died. Intercontinental transport of raw products (including live plants, plants for planting, and untreated wood commodities like round and sawn wood, neither of which are covered by IPSM 15) may provide *X. glabratus*, and by extension, *H. lauricola*, an additional pathway for introduction.

Live plants in particular have received increasing attention as potential pathway for insect pests such as *X. glabratus*, although the proportion of introductions attributed to live plants among woodboring pests is substantially lower than for other insect guilds (Liebhold *et al.*, 2012). Some known hosts are used as ornamentals in the EPPO region and may be traded, such as *Laurus nobilis* and *Cinnamomum camphora* (EPPO, 2017).

PEST SIGNIFICANCE

Economic impact

To date, the most significant impacts of *Harringtonia lauricola* have been restricted to the United States, as Lauraceae native to its original range are unaffected by laurel wilt (although there has been at least one outbreak in avocadoes introduced into Myanmar as an agricultural commodity) (Ploetz *et al.*, 2016). Damage in North America takes two primary forms: 1) loss of native laurels in south-eastern forests and 2) tree death in avocado orchards. There are also major indirect costs incurred from laurel wilt-associated tree removal on public and private property, nursery losses, public education efforts, attempts to regulate untreated wood, etc. (Hughes *et al.*, 2015).

Early in the outbreak, the potential impact to the Florida avocado industry was predicted to range from 183 million USD to 356 million USD (Evans *et al.*, 2010). Avocado production in Florida did indeed suffer, but with the disease-induced population decline of wild tree hosts, removal of abandoned groves, and the adoption of phytosanitary measues in managed groves, local laurel wilt pressure has decreased. Many farmers continue to replant avocado trees lost to the disease (Carrillo, 2023).

Should *H. lauricola* be introduced to a new location, its primary threat would be to naïve Lauraceae. In the EPPO region, the native laurel is the bay laurel (*Laurus nobilis*), which, though uncommon in the United States, has been shown to be an effective host of both *H. lauricola* and *X. glabratus* there (Hughes *et al*, 2014). *Laurus nobilis* is grown ornamentally and commercially for seasoning and cosmetics in Algeria, France, Greece, Morocco, Portugal, Spain, and Türkiye (Ciesla, 2002) and can be found in natural environments around the Mediterranean Basin and southern Black Sea. Other *Laurus* species have been described in other parts of the EPPO region, although not all taxonomists agree that they should be treated separately from *L. nobilis* (Rodríguez-Sánchez et al., 2009). *L. azorica* is endemic to Macaronesia and southern Morocco, and *L. novocanariensis* occurs in Madeira (PT) and the Canary Islands (ES) (Rodríguez-Sánchez *et al*., 2009; Ettaqy *et al*. 2023). Lauraceae forests of high patrimonial value (including genera such as *Apollonias, Laurus, Ocotea,* and *Persea*) are found in the Azores (PT), Madeira and the Canary Islands. The susceptibility of most of these native Lauraceae species remains untested but seems probable given that none have had an opportunity to coevolve with the fungus or its beetle vector.

Laurel wilt would also threaten avocado, which is grown commercially in the EPPO region in Israel and Spain and to a lesser extent in Türkiye, Morocco, Portugal, Cyprus, and France, amounting to a collective production of 400 000 tonnes in 2021 (FAO). The impact of laurel wilt would be even greater if introduced to EPPO economic partners in Central and South America. Massive economic impacts would be expected for avocado production in this region along with significant environmental impacts on forest ecosystems (Lauraceae comprise a significant proportion of the tree flora and have a high diversity).

Control

There are no cost-effective options for treating plants infected with laurel wilt. Individual trees of special historical, aesthetic, or educational interest have been protected prophylactically through regular administration of propiconazole in the United States (Mayfield *et al.*, 2008), although propiconazole is not presently approved for this use in some EPPO countries e.g. the European Union. Other chemical control measures targeting both the fungus and beetles have been investigated, but an efficacious, inexpensive, and long-lasting treatment remains elusive (Hughes *et al*., 2015). Efforts to develop biological control methods (primarily entomopathogenic fungi) have similarly failed. These strategies are limited by the low threshold of inoculation (one beetle) required for successful infection and by the challenge of penetrating the bark and wood of the host tree to reach the beetles and fungi within (Ploetz *et al.*, 2017).

Preventing introduction along with the use of cultural controls in infected groves remain the most viable options for slowing further spread of infection within natural and commercial stands. Infected trees should be removed quickly where possible; dead individuals can harbor both *H. lauricola* and *X. glabratus* for many months. Dispersal of *X. glabratus* and *H. lauricola* from infested wood can be greatly reduced through chipping. However, because this may not completely eradicate the vector, chips should be covered or buried locally rather than transported to new sites (Spence *et al*., 2013). Some publications also recommend pruning to increase light exposure in avocado orchards. Although the mechanism is not clear, thinning and pruning in general tend to lead to lower populations of ambrosia beetles (Crane *et al*., 2020).

Phytosanitary risk

Although it has been suggested that invasive ambrosia beetles change their behavior in newly colonized areas (e.g. Hulcr & Dunn, 2011), recent research indicates that such rapid adaptation is unlikely. Adventive populations of haplodiploid Xyleborine species are genetically homogeneous, greatly limiting natural selection. Indeed, *Xyleborus glabratus* populations in the USA are essentially genetically homogeneous, in contrast to the high variability present in the native Asian range (Cognato *et al.*, 2019). Instead, what may appear to be a change in beetle behavior is more accurately a consequence of the presence of susceptible hosts. In the case of *X. glabratus*, the American laurel hosts emit atypical volatile profiles that attract the beetle to living trees, and are susceptible to its fungal symbiont, the pathogenic *H. lauricola* (Martini *et al*., 2015).

The exact risks posed by laurel wilt in the EPPO region have yet to be quantified, but several factors may influence its capacity to become established. *X. glabratus* has a haplodiploid sex determination system and typically mates with its siblings or beetles in neighboring galleries before dispersing, meaning that a single foundress could hypothetically start an entire outbreak. Fortunately, there is relatively limited movement of common host material into the region, as redbay, swampbay, and most other afflicted Lauraceae are not traded extensively internationally or used in packing material. Even if it remains relatively unaffected by laurel wilt, camphor tree (*Cinnamomum camphora*) may pose the most risk for further transport since it is traded as cut wood and as a live ornamental (EPPO, 2020). Alternatively, because *X. glabratus* occasionally attacks plants outside of the Lauraceae, trade of other types of wood could (more rarely) provide additional opportunities for introduction (Hulcr & Lou, 2013). The possibility for transmission through trade of avocado seedlings or grafts should also be considered (Carrillo *et al*., 2014).

Should it arrive in the EPPO region, the climate around the Black Sea, the Balkans, and northern Italy most closely matches the humid, subtropical zone in which the beetle and fungus have become invasive in the US (EPPO, 2020). Although *X. glabratus* is unlikely to become established in areas prone to sustained hard freezes (Formby *et al*., 2018), this may not have practical importance, as its cold tolerance exceeds that of most lauraceous hosts.

PHYTOSANITARY MEASURES

As is the case for other bark and ambrosia beetles (EPPO, 2020), phytosanitary measures for wood or isolated bark at import may include heat treatment and fumigation. Wood could also be treated with ionizing radiation according to EPPO Standard PM 10/8 (EPPO, 2008). Phytosanitary measures for Lauraceae host plants may include production in a pest-free area, in a pest-free place/site of production for *H. lauricola* and its vector(s) established according to EPPO Standard PM 5/8 *Guidelines on the phytosanitary measure 'Plants grown under physical isolation*', or import under post-entry quarantine.

Inspection of trees for suspected infections remains the simplest and most cost-effective monitoring method. Trapping for the vector beetle is also an option. If traps are used, they can be baited with the commercial lures for *X. glabratus*, particularly those based on alpha-copaene (Kendra *et al*. 2014 Kendra *et al*. 2018). Unlike many other ambrosia beetles, *Xyleborus glabratus* is not attracted to ethanol (Kendra *et al*., 2012). Prospective laurel wilt cases in previously *Harringtonia lauricola*-free regions should be confirmed with molecular tests as described above.

If *X. glabratus* and *H. lauricola* become established in a new location, movement of unprocessed wood from this area should be restricted immediately. This is the only effective method to suppress the human-mediated "jumps" seen in the US outbreak.

Introduction and establishment of this disease in the EPPO region could be prevented by pre-invasion regulation, surveillance, and systematic public outreach efforts to discourage people from unknowingly importing beetle-infested materials (Hughes *et al*., 2015). In addition, every precaution should be taken to avoid introducing the pathogen to Central and South America, where the potential damage could be devastating.

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