College of Tropical Agriculture and Human Resources
University of Hawai'i at Manoa

Laurel Wilt

A Potential Threat to Hawai'i Avocado Production

Laurel wilt is a fungal disease that is currently impacting avocado orchards in the Southeastern U.S. and poses a threat to Hawai'i Hawai'i an avocado production. The pathogen, Harringtonia lauricola (previously Raffaelea lauricola) originates from Southern Asia and was first found in the continental U.S. in Port Wentworth, Georgia, in 2002.

Hawai'i is the third largest producer of avocados in the nation, growing an estimated 1.2 million pounds during the 2020-2021 growing season. The market price of avocados averaging $1.19 per pound makes Hawai'i an avocados an approximately 1.4 million dollar industry. Laurel wilt has not yet been reported in Hawai'i, but its presence could severely impact commercial and homeowner avocado trees.

Avocados growing wild on Hawai'i Island

The laurel wilt fungus is capable of being vectored by multiple ambrosia beetles. Multiple ambrosia beetles have been observed in Hawai'i and are Xyleborus bispinatus, Xyleborus volvulus, Xyleborus affinis, Xyleborinus saxesenii, Xylosandrus crassiusculus. However, H. lauricola forms a symbiotic relationship with the redbay ambrosia beetle, Xyleborus glabratus. The beetle has been documented in Japan, Taiwan, China, India, and Myanmar.

The avocado species widely produced in Hawai'i, Persea americana, is especially susceptible to infection. It favors tropical, warm, wet conditions to spread, with vectoring from ambrosia beetles. After the disease has been established at a site, it is possible for root-to-root transmission to occur, not necessarily requiring further ambrosia beetles.

Symptoms

The external symptoms of laurel wilt on avocado will first appear as petiole wilting on a random section of canopy leaves. This may be confused with wilting as a drought, but will progress much faster than any abiotic cause. The fungus will spread through the avocado tree xylem, causing a defense response within the plant. This can result in the production of tyloses and gums, clogging the vessels.

Wilting will progress, causing leaves to appear whitish-gray, then completely brown. Desiccated leaves will not drop from branches and can persist for extended periods. Wilting may be localized and even allow for the development of apparently healthy shoots after infection.

The internal symptoms (streaking) are the result of the plant's response to the pathogen infection.

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Figure 1. Early wilting symptoms of laurel wilt on avocado. Photo courtesy of Mónica Navia-Urrutia, PhD, Tropical Research and Education Center, University of Florida, Institute of Food and Agricultural Sciences (UF/IFAS)

Figure 2. Complete wilting and desiccation of infected avocado tree. Photo courtesy by Jeff Wasielewski, Commercial Tropical Fruit Extension Agent, UF/IFAS Extension.

Figure 3. Streaking symptoms of avocado sapwood from laurel wilt. Photo courtesy of Mónica Navia-Urrutia.

This symptom can be deceptive, and one must remove tree bark in multiple sections to ensure its presence. A wilting branch can be pruned to reveal staining in the sapwood. As laurel wilt is a systemic pathogen, staining can be observed throughout the avocado tree, rapidly progressing in days to a week.

Redbay ambrosia beetle (RAB) forms a symbiotic relationship with the laurel wilt pathogen. This symbiosis causes the RAB to vector H. lauricola between trees in the Lauracea family, but notably not avocado. This beetle is extremely small in size (1-2 mm) and will bore into the trunk and branches of its host. Small, string-like frass tubes will emit from boring sites, indicating the presence of an ambrosia beetle or RAB. A cross-section of a boring site will reveal a gallery or opening where the beetles will reproduce and deposit laurel wilt inoculum.

Injury to the tree trunk by beetles can result in secondary infections, as wounding sites offer an easy route for new pathogens. Sugar volcanoes may appear at boring sites, exuding a white, sticky mass. The RAB is not present in Hawai'i, although multiple other species of ambrosia beetles have been reported.

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Figures 4 and 5. Redbay ambrosia beetle & frass tubes emitted by RAB infestation. Photo courtesy of Joseph Benzel, Screenin Aids, USDA APHIS PPQ, Bugwood.org & Mónica Navia-Urrutia, Ph.D., Tropical Research and Education Center, University of Florida, Institute of Food and Agricultural Sciences (UF/IFAS)

Look-Alike Pathogens and Pests

Multiple pathogens induce similar symptoms of avocado laurel wilt and can result in a misdiagnosis. Verticillium wilt is a disease caused by the fungus Verticillium dahliae, which invades the host plant's vascular system. Similar to laurel wilt, leaves will quickly desiccate and persist on branches for a prolonged time. Similar dark brown to black streaks can be observed underneath the bark of infected branches. Verticillium wilt will enter a tree via its roots or a wound site. The fungus is also easily identifiable by its black microsclerotia and conidia under microscopic analysis.

Phytophthora spp. is an oomycete pathogen causing root rot and wilting symptoms in avocados. An infection will begin at the roots, amplified by saturated soil or root wounds. Restricting water and nutrient movement to the upper regions of the tree, leaf, and branch dieback will occur slowly. Compared to laurel wilt, leaves will drop

Figure 6. Drilling viewing holes into an infected tree shows how black-brown streaking can present intermittently throughout sapwood. Photo courtesy of Mónica Navia-Urrutia.

Figure 7. Polyphagous shothole borer male and female. Photo courtesy of Pests and Diseases Image Library, Bugwood.org

soon after death and new growth is unlikely to occur. Streaking will not occur throughout trunk sapwood, but cankers may occur near the base of the tree. Phytophthora can be easily identified via microscopic analysis and confirmed using an immunostrip assay.

The polyphagous shothole borer (Euwallacea sp.) is a pest of avocado which can transmit fusarium fungi, resulting in fusarium dieback, and has been documented in Hawai'i. The borer is nearly identical to the RAB, being 1-2 mm large, and brown-black. As a shothole borer, they leave small holes in bark and sapwood, resulting in the ejection of small frass tubes. Sugar exudates may erupt from boring sites, described as sugar volcanoes. Symptoms of fusarium dieback and the presence of the polyphagous shothole borer are incredibly difficult to differentiate from laurel wilt and ambrosia beetles. The best method for an accurate diagnosis would be a microscopic analysis of the fungus and insect.

The avocado lace bug (Pseudacysta perseae) is a small (about 2mm) blackish insect that infests avocado leaves across the southeastern U.S. Adults and nymphs will feed on the underside of avocado leaves, causing a lesion, often originating from the center of the leaf. Feeding damage will spread throughout the infested leaf, becoming brownish in color and eventually dropping from the tree. The avocado lace bug will not feed on fruit tissue but may cause yield loss as a result of feeding damage. The life-cycle of avocado lace bugs is approximately one month, becoming a persistent issue where avocado is produced all year long. This insect is present in Hawai'i but is not to be confused with the browning of leaves caused by laurel wilt. Damaged leaves from laurel wilt will persist on the tree, compared to the early senescence that results from avocado lace bug feeding.

Disease Spread

Laurel wilt primarily relies on its vector, ambrosia beetles, to spread and infect new hosts. A multitude of ambrosia beetles and shot hole borers are also capable of vectoring laurel wilt, including the RAB. While RAB does not vector laurel wilt between avocado trees, an established disease does not require RAB for further spread. It is thought that the RAB carrying H. lauricola spores were introduced via imported wood packaging materials in afflicted areas. The trade and transport of wood material, such as timber or firewood, will cause stowaway beetle vectors to spread over great distances. The complete range of hosts of RAB and ambrosia beetles is not known but is observed in plants of the Lauraceae family. Cinnamon, kauna'oa pehu, and bay laurel could be susceptible to RAB infestation in Hawai'i. This proves a challenge for limiting the spread of laurel wilt, as it can serve as a reservoir on these Lauraceae hosts.

Female beetles will carry spores of Harrintonia lauricola on their mycangia and bore into a viable host. A tree afflicted by an existing abiotic or biotic stressor may compound to attract ambrosia beetles. After finding a suitable host, the mature female will bore into the sapwood and dig out a gallery for egg deposition. At the same time, spores will establish inside the gallery, growing into mycelia. This mycelium acts as a food source for the beetle, as well as the source of infection for laurel wilt. The eggs will hatch, developing from larvae to adult beetles, and repeat the vectoring process. Beetles will find hosts of a semi-random nature, being attracted to favorable hosts.

Figure 8. The entrance to a gallery, formed by a female redbay ambrosia beetle. Photo courtesy by Jeff Wasielewski

Management

Currently, there is no presence of laurel wilt or the RAB in the state of Hawai'i. If the pathogen and pest were to spread to the islands, it would likely be in a similar fashion to that of Georgia in 2002. RABs carrying the pathogen would likely stow away in an infected host material, wooden goods, or firewood. Illegal importation of agricultural material could bring the pathogen to Hawaiian shores. While general quarantine measures should prevent laurel wilt inoculum from arriving in Hawai'i, there is currently no state quarantine on avocado imports. For avocado growers to ensure that rootstock or trees are without laurel wilt (and any other disease), they should purchase certified pathogen-free material.

In the U.S. Southeast, where laurel wilt is rampant in avocado orchards, control is centered around cultural methods. There is no cure for infected trees due to the systemic nature of laurel wilt disease. If the disease is confirmed, the best method to prevent its spread is to remove infected tree material. To prevent root grafting in orchard rows, infected trees and

Figure 9. A dense avocado orchard destroyed by laurel wilt. Photo courtesy by Jeff Wasielewski

root balls must be completely dug out, not solely cutting the stump. The best method to dispose of infected trees is to finely cut the material using a wood chipper. Spray the chipped material with a general contact insecticide to ensure the complete removal of remaining ambrosia beetles. This should be performed in a safe and contained environment, respecting local laws and regulations.

Preventative measures are the only other viable option to limit laurel wilt infection. This can be done by routinely pruning upper canopy branches, as ambrosia beetles favor the shade of excess foliage. Avocado trees should be kept at 4 to 6 meters tall after pruning. Broad-spectrum insecticides can prevent ambrosia beetle populations from increasing, but are only effective when the insects are outside of a host. Therefore, it is not recommended to spray excessive insecticides to prevent the vectors of laurel wilt. Few chemical fungicide trunk injections exist, but are often cost-prohibitive and have limited-to-nonexistent preventative effects.

Diagnostic Techniques

A molecular diagnostic test must be performed to concretely identify laurel wilt as the causal agent of symptoms. To confirm its presence, a rapid PCR test can be done from extracted sample DNA. This can be done by drilling into a stained section of sapwood using a small (~3 mm) drill bit to obtain sawdust, or using a knife to cut off sections. Results can be found within 24 hours, leading to immediate action if the sample is laurel wilt-positive. Traditional agar-media culturing of infected sapwood pieces can also be done, but will take 1-2 weeks to grow. Additionally, RABs can be macerated and spread on a selective media, such as potato dextrose agar containing an antibiotic to grow the fungus and prevent bacterial contamination. Colonies will appear cream-white colored, emanating radially from the site of plating. Under a microscope, the conidia of laurel wilt will appear round-ovoid, thick-walled, and non-septate.

What To Do If I Suspect I Have Laurel Wilt

Symptoms of laurel wilt and the presence of the RAB or ambrosia beetles may vary slightly, depending on conditions and host susceptibility. Be aware of the previously listed ambrosia beetles, as they will vector laurel wilt between avocado trees once established. Some symptoms may appear as abiotic stress or due to infection by a different pathogen. Key identifiers of laurel wilt are not enough to make a definitive diagnosis. If a tree is suspected of the disease, contact your local CTAHR Extension office to get a more accurate diagnosis, or to submit a sample for testing. Timely reporting of laurel wilt on orchards and by homeowners is essential in preventing the introduction of the fungus.

The Hawai'i statewide Extension office is located on the University of Hawai'i at Manoa campus, Gilmore Hall 203. Contact at (808) 956-8139 or email extsec@hawaii.edu.

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