UF IFAS Extension UNIVERSITY of FLORIDA

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Recommendations for the Detection and Mitigation of Laurel Wilt Disease in Avocado and Related Tree Species in the Home Landscape[1]

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Background

Dooryard (homegrown) avocado fruit are enjoyed by hundreds of thousands of Florida residents. In addition to providing fruit, they offer habitat for wildlife and canopy cover in urban areas. There are over 600,000 avocado trees in Florida home landscapes (Evans and Crane 2019). Most dooryard trees are in Miami-Dade, Broward, Palm Beach, and Lee Counties in southern Florida, but they are also planted in many central Florida counties.

Laurel wilt disease (LW) is caused by *Raffaelea lauricola*, a fungal mutualistic symbiont (two or more organisms mutually benefiting from living together) of the redbay ambrosia beetle (*Xyleborus glabratus*) (Figure 1). The redbay ambrosia beetle and *R. lauricola* are native to India, Japan, Myanmar, and Taiwan (Carrillo et al. 2014). A few years after the beetle and its symbiont were inadvertently introduced into the United States, other ambrosia beetle (AB) species already in Florida have been contaminated with *Raffaelea lauricola*, and some of them (*X. bispinatus* and *X. volvulus*) can transmit the disease (Carrillo et al. 2012; Carrillo et al. 2014). The beetles use the fungus directly as a food source, cultivating fungal gardens within their galleries. The fungus uses the tree's tissue as a source of nutrients.

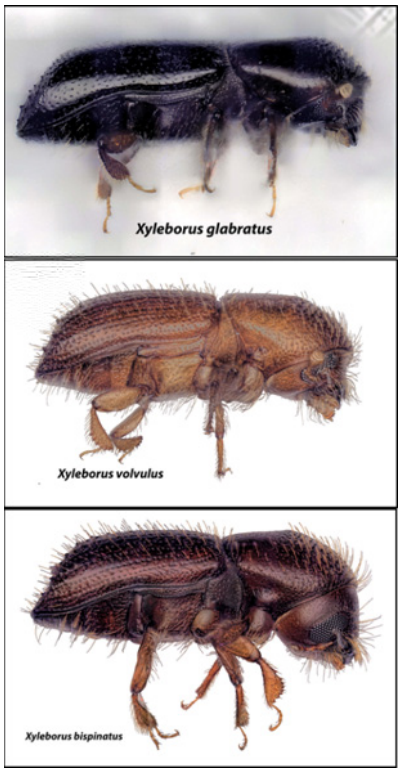

Figure 1. (A) The redbay ambrosia beetle (*Xyleborus glabratus*), the primary vector of the laurel wilt pathogen, and secondary vectors, (B) *X. volvulus* and (C) *X. bispinatus*.
Credits: D. Carrillo, UF/IFAS

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Trees become infected with the LW pathogen when a contaminated ambrosia beetle bores into the tree's xylem (water-conducting tissue) to form galleries and inoculates these galleries with *R. lauricola*. The infection triggers the tree's natural defense mechanism designed to wall off the pathogen through the production of tyloses (outgrowths of xylem cells that detach from the cell wall and dam up the vascular tissue) and gums (Inch et al. 2012; Inch and Ploetz 2012). Unfortunately, before the tree can successfully wall off the fungus, the fungus repeatedly spreads to new sections of the tree, which keeps triggering the tree's defense system. After a relatively short period of time, the water-conducting tissue (xylem) becomes plugged with tyloses and gums, and water can no longer flow to the leaves and stems, causing the tree to wilt, die back, and die. Time from infection to tree death depends on several factors but can range from three weeks up to three months.

In the United States, native trees in the Lauraceae (Laurel plant family) and non-native trees in this family, such as avocado, are susceptible to LW (Table 1). In addition, at least 32 avocado cultivars have been documented to succumb to LW (Table 2).

Timeline on the Spread of Laurel Wilt in Florida

Laurel wilt was inadvertently introduced into the United States in 2002 at Port Wentworth, Georgia, when wooden packing material, infested with the redbay ambrosia beetle carrying the LW pathogen, was imported from Asia (Mayfield and Thomas 2006) (Figure 2). The redbay ambrosia beetle–fungal pathogen complex was detected in north Florida in 2005 and central Florida in 2006 due to movement of beetle-infested wood. In 2007, the first confirmed avocado tree death in a home landscape occurred in Jacksonville (Duval County), Florida (Mayfield et al. 2008). In February 2010, the redbay ambrosia beetle was detected in a natural area 21 miles (33.7 km) north of the south Florida avocado production area in Miami-Dade County (Okins 2010; Ploetz et al. 2011). By 2011 the first confirmed swampbay (*Persea borbonia*) tree to succumb to LW was documented in this natural area, and by 2012, LW was detected in a commercial avocado grove (J. Crane, personal communication). Since that time, LW has been detected in all of Florida's 67 counties (Figure 2).

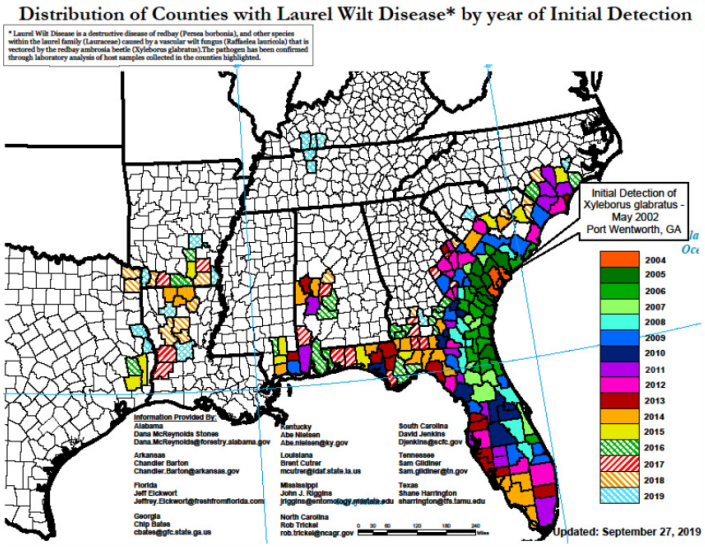

Figure 2. Distribution of laurel wilt disease in the United States as of 2019. The redbay ambrosia beetle (*Xyleborus glabratus*) was first detected in 2002 and the link to the fungal pathogen it carries (*Raffaelea lauricola*) was made in 2004. Laurel wilt has been detected in all of Florida's 67 counties.
Credits: USDA Forest Service

Update

At present, LW has been detected in 11 southeastern US states, including Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Texas (USDA Forest Service 2019) (Figure 2). The spread of LW by the redbay ambrosia beetle in natural areas has been estimated to be 15 to 34 miles per year, but the rate of movement through urban areas of Florida with native and avocado trees is unknown (Koch and Smith 2008). Over half a billion native trees in the Lauraceae family have been killed by the disease (Hughes et al. 2017; Snyder 2014; Spence et al. 2013; Rodgers et al. 2014). The potential for human-assisted spread of LW through the movement of ambrosia-beetle-infested wood or plant material is a major concern. Currently, LW has spread as far west as eastern Texas but has not yet reached California. These states have dooryard and commercial avocado trees and along with Mexico and Central and South America are at risk of LW (Crane 2015).

At least nine native and four non-native tree species in the Lauraceae family are susceptible to LW (Table 1). This includes redbay (*Persea borbonia*), a common understory tree found throughout the natural areas of the Florida peninsula and southeastern United States, and swampbay (*P. palustris*), which is common in some areas of southern Florida. The native California bay (*Umbellularia californica*) has been shown to be susceptible to attack by the redbay ambrosia beetle and the LW pathogen (Fraedrich 2008).

In addition to the redbay ambrosia beetle, two other native AB species (*Xyleborus volvulus* and *X. bispinatus*) have been documented to carry the LW pathogen and transmit the disease (Atkinson et al. 2013; Carrillo et al. 2012; Carrillo et al. 2014) (Figure 1). These beetles bore into host trees (e.g., avocado and redbay) and reproduce in the galleries (tunnels) they form, thus spending most of their lifecycle protected from predators. The development time from egg to adult is between one and two months, depending upon temperatures and tree host species. Logs, limbs, sections of limbs, and stumps may all be infested. Research has demonstrated that chipping wood significantly reduces the number of AB that emerge from the chipped wood (Spence et al. 2011). Furthermore, the laurel wilt pathogen is not able to survive in chipped wood. The time from initial beetle contact with a host tree to tree damage or death varies with the host species, tree health, and tree size, and ranges from about 21 days to about three months or more.

In addition to natural spread of LW by AB through natural areas, LW can be moved by infested wood products (e.g., firewood and logs moved by entrepreneurs, residents, landscape companies, pruning companies, and wood-turners); movement of wood products to landfills that don't burn or bury materials; and illegal dumping of wood products (logs, brush, limbs, etc.).

Symptoms of LW and AB Infestation

1. Leaf and green stem wilt

2. Leaf color change from green or light green to dark purplish green or bluish green to greenish brown to brown

3. Dead, desiccated leaves hanging on the tree branches

4. Stem and limb dieback

5. Inspection of the trunk and major limbs may show dried sap (white, crystalline powder-like material) or sawdust tubes protruding from the bark.

6. The sapwood below the bark will have dark blue-brown, brown, or black streaks. Normally this sapwood should be white to yellowish with no dark staining or streaking. The staining might not appear evenly along the tree.

7. In addition, small, dark holes in the sapwood indicate wood-boring beetles are present.

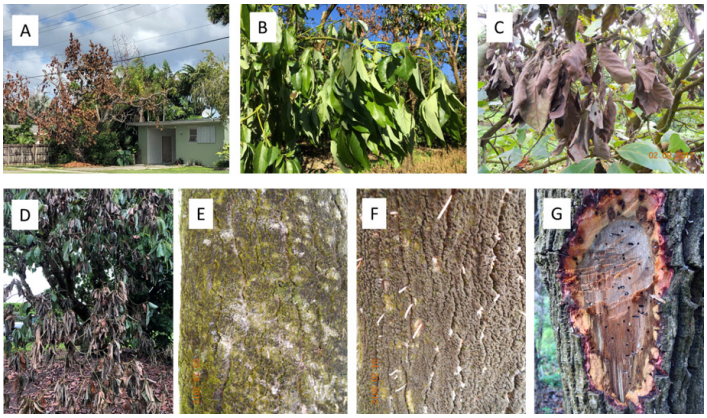

Figure 3. (A) Dooryard avocado tree with symptoms of laurel wilt; (B) wilting of green leaves; (C) desiccation (browning) of leaves; (D) dieback of stems and limbs; (E) powdery sawdust and (F) frass (sawdust) tubes from ambrosia beetle boring; and (G) blackish or brown streaking of the sapwood under the bark showing holes made by ambrosia beetles boring.
Credits: J. H. Crane, UF/IFAS

Current Control Recommendations for Dooryard Avocado Trees

1. Report any suspicious redbay, swampbay, camphor, sassafras, and avocado trees to the **Division of Plant Industry (DPI) at 1-888-397-1517** or your local county UF/IFAS Extension office. These trees are all in the laurel family. Laurel wilt has not been documented in plants outside the laurel family. Trees in other families such as oaks, maples, mangoes, sapodilla, and citrus are not susceptible to the fungus that causes LW.

2. A sample of sapwood from trees suspected of having LW may be collected and submitted to DPI or a UF/IFAS Plant Diagnostic Center (https://plantpath.ifas.ufl.edu/extension/plant-diagnostic-services/diagnostic-labs/).

3. Avocado, redbay, and other woody LW host trees should not be moved or sold as firewood, tree trimmings, BBQ smoke-wood, mulch, or wood-turning material. For more information, visit https://www.dontmovefirewood.org/.

4. At this time, there are no approved fungicide treatments to prevent or cure laurel-wilt-affected avocado trees in the home landscape.

5. The issue of disposal of dead or dying trees is complicated by numerous state, county, and local regulations. Current recommendations for urban and rural residents with redbay, swampbay, or avocado trees that have LW vary, but these trees should be destroyed because of their potential as AB habitat and reproduction sites that will increase the beetle population and further spread the disease. Chipping and tarping infested wood material

has been shown to be an effective sanitation procedure to reduce the potential for AB to survive and reproduce (Spence et al. 2011).

6. Potential options for tree disposal vary by county and local regulations and may include cutting the tree down and placing the wood into the urban debris stream (i.e., the wood is taken to the local landfill and destroyed or buried); cutting the tree into sections, chipping or grinding the entire tree, then covering the debris with a tarp for at least seven days; or composting the tree by cutting it to the ground, placing all wood (or chips) on top of the stump, and covering it with a tarp all the way to the ground. However, composting is not allowed in some urban areas, so please contact your local county government for guidance. Burning is *not* recommended because of the necessity to obtain state, county, and/or municipal burn permits and the danger of uncontrolled burning by residents.

7. Extreme caution should be used when moving live host trees (e.g., redbay and avocado) and wood products into counties, states, and areas outside the United States where LW is not yet found. Insect- and disease-free containerized host trees should only be purchased from registered nurseries, and trees showing any signs of wilt or dieback should be destroyed immediately.

Please contact your local UF/IFAS Extension office for more information (http://sfyl.ifas.ufl.edu/find-your-local-office/**).**

Frequently Asked Questions

1. *Are leaf wilt and stem dieback symptoms indicative of an ambrosia beetle–laurel wilt disease attack?* Not necessarily. Wilting of leaves and young stems, dead leaves hanging onto the stems, and stem and limb dieback may be due to a lightning strike, flooding, severe drought events, or an infestation of one or more of the many AB already in Florida. However, these symptoms are similar to those caused by LW infection, and therefore the tree should be tested to determine if the LW pathogen is present.

2. *Can the laurel wilt pathogen live in soil?* No, the LW pathogen needs a living host and does not survive in the soil.

3. *Can I replace my dead avocado tree with a new avocado tree?* Yes. In general, AB are not attracted to young avocado trees with small stem diameter. This is thought to be because a small trunk and limbs are not a suitable site for AB to make galleries in which they can grow the LW pathogen and reproduce. Furthermore, the LW pathogen cannot survive in the soil, so newly planted avocado trees are not in danger of contracting the pathogen through the soil.

4. *Are there any LW pathogen-resistant avocado varieties?* There do not appear to be any resistant avocado varieties, although testing continues.

5. *Should I apply insecticides to try to control ambrosia beetles?* There are contact insecticides that can kill ambrosia beetles, but most of them are not available for homeowner use, and ambrosia beetles spend most (~90%) of their time inside the tree, where contact insecticides will not reach them.

More information about LW and AB may be found at:

- UF/IFAS (https://sfyl.ifas.ufl.edu)
- UF/IFAS Electronic Digital Information System (free publications) (https://edis.ifas.ufl.edu/)
- UF/IFAS Tropical Research and Education Center (https://trec.ifas.ufl.edu/RAB-LW-2/index.shtml)
- FDACS Division of Plant Industry (DPI) (https://www.fdacs.gov/Divisions-Offices/Plant-Industry)
- DPI—Laurel Wilt (https://www.fdacs.gov/Divisions-Offices/Plant-Industry/Pests-Diseases/Laurel-Wilt-Disease)
- DPI—Save the Guac (https://www.fdacs.gov/Consumer-Resources/Protect-Our-Environment/Save-the-Guac)
- Southern Forest Health (USDA Forest Service) (http://southernforesthealth.net/diseases)

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Acknowledgments

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Table 1. Known hosts of the redbay ambrosia beetle–laurel wilt pathogen in Florida.

Background	Common name	Scientific name	Literature cited
Native	Redbay	*Persea borbonia*	Fraedrich et al. 2008
	Swampbay	*Persea palustris*	Fraedrich et al. 2008
	Pondberry[y]	*Lindera melissafolia*	Fraedrich et al. 2008, 2011
	Northern spicebush[z]	*Lindera benzoin*	Fraedrich et al. 2008
	Lancewood[z]	*Nectandra coriacea*	Hughes and Ploetz, unpublished
	Sassafras	*Sassafras albidum*	Fraedrich et al. 2008
	Pondspice	*Litsea aestivalis*	Fraedrich et al. 2008, 2011
	Silk bay	*Persea humilis*	Hughes et al. 2012
	Gulf licaria[z]	*Licaria trianda*	Ploetz and Konkol 2013
Non-native	Camphor	*Cinnamomum camphora*	Fraedrich et al. 2015
	Avocado	*Persea americana*	Mayfield et al. 2008; Hansen and Davison 2012
	Bay laurel	*Laurus noblis*	Hughes et al. 2014
	Persea indica[z]	*Persea indica*	Hughes et al. 2013

[y] Reported extirpated (now extinct) in Florida.
[z] Experimentally shown to be susceptible to the laurel wilt pathogen.

Table 2. Mature avocado tree cultivars and their genetic background that have succumbed to the laurel wilt pathogen.

Cultivar name	Background[z]
Arue	WI
Bernecker	WI
Day	WI
Donnie	WI
Dupuis	WI
Hardee	WI
Peterson	WI
Pollock	WI
Russell	WI
Simmonds	WI
Waldin	WI
Beta	G-WI
Booth 7	G-WI
Booth 8	G-WI
Brooks Late	G-WI
Buck II	G-WI

Cultivar name	Background[z]
Choquette	G-WI
Hall	G-WI
Loretta	G-WI
Lula	G-WI
Miguel	G-WI
Monroe	G-WI
Nadir	G-WI
Nesbitt	G-WI
Tonnage	G-WI
Tower-2	G-WI
Wheeling	G-WI
Brogdon	G-M-WI
Marcus Pumpkin	G
Winter Mexican	G-M
Toni	Nd
Jim Lapeck	Nd

[z] WI = West Indian; G = Guatemalan; M = Mexican; G-WI, G-M, and G-M-WI = hybrids; Nd = not determined.