UF UNIVERSITY of FLORIDA
IFAS Extension
Tropical Research and Education Center, Homestead, FL

Redbay ambrosia beetle - Laurel wilt pathogen control

May 27, 2014

Jonathan H. Crane, Tropical Fruit Crop Specialist
UF/IFAS, TREC, Homestead, FL

Research on the control of laurel wilt and the redbay ambrosia beetle vector is on-going; therefore the recommendations for mitigation and control periodically change. Currently, the industry has implemented an early detection and suppression program with the goal of depressing the ambrosia beetle population and the incidence of laurel wilt (LW) infected avocado trees in the commercial groves. A major component of this strategy is that grove owners/operators remove and destroy LW infected and ambrosia beetle infested trees as soon as it is apparent the avocado tree has laurel wilt. This is because the laurel wilt pathogen is capable of moving from an infected avocado tree to adjacent healthy avocado trees through their root-grafted root systems. In addition, the time from when a tree is infested with the ambrosia beetles (LW vectors) to the time of emergence of new beetles may be as short as 50-60 days. In addition, wood and stumps of declining trees have been observed to be attacked by ambrosia beetles, some of which may be contaminated with the laurel wilt pathogen. Thus to control laurel wilt control of the laurel wilt pathogen (fungus) and the ambrosia beetle vectors is necessary.

This document describes the current recommendations for control of ambrosia beetles and prevention of the spread of the laurel wilt pathogen among root grafted avocado trees. The first step in limiting the spread of laurel wilt is detecting diseased and declining trees as quickly as possible. Currently, the Avocado Administrative Committee and University of Florida/TREC has implemented an aerial helicopter survey of the avocado production area to locate avocado trees symptomatic for laurel wilt (LW). Once the LW Coordinator identifies suspect trees from the air this information is passed on to producers and grove-care companies to ground truth. If the grove has not had any LW infected trees in the past a sample of wood should be taken to verify the presence of the disease. If the grove has had laurel wilt in the past sampling may not be necessary. If you have trees symptomatic for laurel wilt please contact Don Pybas, LW Coordinator (305-247-0848).

Visual symptoms that suggest some symptoms of laurel wilt are similar to trees infected with *Phytophthora cinamomi* (phytophthora root rot), flooding, lightning strike, and freeze damage (Table 1). However, some pre-existing environmental factors may help separate the cause of the tree decline and provide growers/operators some guidance in ascertaining whether their tree or trees are infected with LW. If in doubt take a LW sample or have someone take a proper sample (see enclosed instructions).

Definitions

1. When is a tree positive for LW? A tree is positive for LW when a proper xylem wood sample has been taken and submitted to either UF/IFAS TREC Diagnostic Lab (Homestead) or FDACS-Div. of Plant Industry Lab (Gainesville) and determined through laboratory testing to be positive for the pathogen (*Raffealea lauricola*)

that causes laurel wilt. Local growers may want to use the Diagnostic Lab located at TREC in Homestead since it is close by and results are obtained within 10 working days. Note: False negatives may occur because: (a) the titer (amount) of LW pathogen in a tree may be very small and unevenly distributed within the tree; (b) symptoms for LW may be caused by the presence of very little LW pathogen; (c) the wood sample may be taken improperly and; (d) the wood sample may miss the location where the pathogen is present.

2. When is an avocado grove positive for LW? A grove is positive for LW when one or more avocado trees have tested (by either or both labs mentioned above) positive for the pathogen causing LW.
3. Does every tree in a grove that shows symptoms of LW have to be laboratory tested to be assumed positive for LW? No, not every symptomatic tree must be laboratory tested for it to be assumed infected with the LW pathogen. This is because: (a) the LW pathogen is capable of moving from a LW infected avocado tree to adjacent avocado trees via root grafting and; (b) groves where a laboratory verified LW positive avocado tree has been detected previously and where little to no history of phytophthora root rot or other pathogen induced decline has occurred in the grove, trees adjacent to (1 to 2 rows or plant spaces away) the LW positive tree and now with LW symptoms probably have LW. However, we'd suggest that a newly LW symptomatic tree (e.g., wilting) 5, 6 or more rows away from a documented LW positive tree may warrant LW testing and documentation.
4. A tree cut to the ground: An avocado tree has been cut to or close to the ground level.
5. Stump: That portion of the tree remaining above ground after cutting down to the ground.
6. Pushed or pulled trees: Trees that are pushed with a tractor or machinery out of the ground roots and all and pulled trees, trees that are pulled out of the ground roots and all.
6. Chipped: That portion of a tree that can be cut up into chips (small pieces of wood) with a conventional chipper. A wood splitter may be employed to reduce large wood to a size that can be chipped.
7. Burned: Wood too large for chipping that is exposed to fire to such an extent that the outer bark is burned off and the outer 2" to 3" of sapwood is significantly charred or reduced to ashes. Usually, large wood needs to be burned at least twice: the wood from the first burning may not be charred on all sides or deeply enough and therefore should be re-stacked in order to expose sides of the wood not sufficiently burned to intense fire. Call FDACS-Div. of Forestry at 305-257-0875 or 954-475-4120 for permission to burn (burn permit).

Immediate Control Recommendations for Laurel Wilt

Before tree destruction

In groves without a previous LW positive avocado tree or where a new LW suspect tree is many rows from a previously infected tree, a sample of the sapwood of the declining or symptomatic tree or trees should be taken (see enclosed sampling directions) for laboratory analysis. The laboratory analysis should be completed within 10 business days. However, trees in severe decline should be taken removed and destroyed immediately anyway to limit the spread of the disease and reproduction of ambrosia beetles. Ambrosia beetles are generally attracted to declining trees. Growers may opt to take LW samples and immediately destroy the tree prior to completion of the LW laboratory analysis.

Recommendations for laurel wilt infected avocado tree destruction and groves with laurel wilt infested trees

1. Remove the entire tree by pulling or pushing, cut into pieces and chip. Pushing trees over before cutting is easier than trying to uproot stumps from the ground. Preferably wood too large to chip should be split and then chipped or burned. Removing the entire tree immediately upon detection may reduce root-graft

movement of the laurel wilt pathogen to adjacent trees. If removal is delayed the disease will move to adjacent trees.

2. Wood too large to chip or difficult to chip should be burned.
   a. Wood cut into smaller pieces will burn faster and more completely.
   b. The large wood may need to be burned more than one time (restack to expose non-burned wood) in order to severely char all sides of the wood to at least a 2" to 3" depth.
   c. Treating the tree stump (or stumps) with insecticides **does not** prevent emergence of ambrosia beetles which are already inside the tree and after a few days does not prevent further ambrosia beetle infestation.
3. The wood chips should be spread out not mounded and thoroughly sprayed with an insecticide (e.g., Malathion or Danitol) plus adjuvant (i.e., Vapor Gard or Pentrabark prolongs the insecticide activity) or piled and burned.
   a. Chipped wood is attractive to ambrosia beetles for about 7-10 days and so it may be important that the wood chips be sprayed twice in order to prevent beetle infestation.
   b. Avocado groves under organic production should chip and burn all wood (i.e., burn the chips and all wood that cannot be chipped). This is because the chipped wood is attractive to ambrosia beetles.
4. It is not recommended to leave stumps of LW infested trees. Furthermore, leaving the root system in the ground may increase movement of the laurel wilt pathogen to adjacent trees.
5. Monitor (scout) trees in the grove frequently for LW development (watch for wilting of adjacent tree which may indicate root-graft movement of the pathogen). Early detection and destruction improves the potential for control.

Insecticide applications in the immediate area surrounding LW positive avocado trees

Ambrosia beetles may be found in basically three locations in a grove: (a) inside an infested tree; (b) on tree surfaces or; (c) in the air. Contact insecticides have not been shown to prevent ambrosia beetle emergence from already infested trees or wood and only a few contact insecticides have been found to provide good control of ambrosia beetles on wood surfaces (Table 2). Chipping and burning wood can eliminate ambrosia beetles inside tree stumps and wood. However, to kill ambrosia beetles in an area of the grove positive for laurel wilt, applications of contact insecticides may help control or prevent further beetle movement in the grove. Please note though, besides being costly, spraying a large area and/or spraying an area on a regular basis may not be efficacious (i.e., may not work), be economically sustainable, or cause other insect problems. Perhaps two aerial applications at a 15 day interval should be made. To reduce the chances of beetle resistance insecticides should be rotated (Table 2). Use an adjuvant such as NuFilm to prolong the efficacy of the insecticide. We do not recommend using Vapor Gard and Pentrabark for foliar applications because of potential phytotoxicity.

Common questions

1. Why do you need to treat with insecticide or burn the chips if most beetles cannot survive in it? Because we now know the avocado wood chips are highly attractive to ambrosia beetles and leaving them untreated or not burned results in bringing large numbers of additional ambrosia beetles to the grove.
2. Is treating the stumps or large wood with insecticide effective in preventing further infestation or emerging of beetles already in the trees? Some preliminary testing suggested that periodic spray treatment of stumps and large wood with insecticide prevented additional beetle infestation and beetle emergence. However, upon further observation and testing this does not appear to be the case – at least not with the current products that are being sprayed. Also incomplete coverage of the wood (e.g., underside of logs) allows further beetle infestation on those surfaces not covered with insecticide. Thus the best method to prevent

beetle emergence from this wood and new boring into the wood is to dispose of the wood by chipping and/or burning.

Spot treat with systemic fungicide two healthy avocado trees on all sides of the infected tree(s)

Three methodologies are used to stop the spread of the laurel wilt fungus from moving from a diseased tree to healthy trees, these include uprooting and destruction of infected trees, insecticide spraying for beetles and infusing healthy trees with Tilt® adjacent to diseased trees; called spot treatment. The key to all of these working is early detection of trees with symptoms of laurel wilt and immediate action. The earliest visual symptom of laurel wilt is wilting. That means scouting your groves frequently.

Currently there are two forms of infusing avocado trees with Tilt® (propiconazole) fungicide; passive and pressure. Injection of Tilt® is being used by some producers and investigations are underway to determine if that method is as efficacious. At this time we recommend two adjacent trees in all directions be infused to stop the spread of laurel wilt through root grafting of adjacent trees (Fig. 1). You must follow the Tilt® label instructions and suggest you see additional handout information on how to construct and use passive and pressure infusion.

H	H	H	H	H
H	H	H	H	H
H	H	LW	H	H
H	H	H	H	H
H	H	H	H	H

Fig. 1. Example of infected tree (LW) and the adjacent trees that should be infused (H=healthy)

Infusion with Tilt® has been shown to protect avocado trees from laurel wilt for at least 18 months. Additional research is underway to test new fungicides and alternative application methods and strategies. Note: If and when infusion and/or injection are determined to be efficacious and economically feasible for treating all trees in a grove, then treating every tree prophylactically will be recommended.

Table 1. Environmental conditions and symptom descriptions for trees infected with the pathogens causing laurel wilt and phytophthora root rot or affected by lightning, flooding, and freezing weather conditions.

Potential cause of tree decline	**Environmental conditions[z]**	**Symptoms**	**Comments**
Raffaelea lauricola (laurel wilt)	Not known if environmental conditions affect the prevalence of pathogen or rate of progress of LW symptoms. Appears the activity of the ambrosia beetles is affected by environmental conditions.	• Leaf wilting (tends to be sudden) • Leaves may remain on the shoots for up to about 6 months or more • Leaf desiccation/ browning (to dark bluish green) • Stem dieback • Progressive tree dieback • Dark brown, black or bluish-black streaks in sapwood • Tree decline and death	From the available data, peak activity of the ambrosia beetles in south Miami-Dade County occurs during the spring/summer. Trees attacked by wood boring beetles[y]
Phytophthora	Flooding or frequent	• Leaf wilting (may or may not	Some groves have

cinamomi (phytophthora root rot)	(continual) soil saturation Poor soil drainage Low-lying area prone to wet/saturated soil conditions Recent tropical storm weather conditions (i.e., high rainfall)	be sudden) • Leaves may remain on the shoots although in some cases there is leaf drop • Leaf desiccation/ browning • Stem dieback • Progressive tree dieback • Necrotic fibrous root system • Tree decline and death	areas within the grove with a known history of phytphthora root rot problems. May spread to adjacent trees with similar soil conditions Trees attacked by wood boring beetles
Lightning	Most common during spring/ summer and early fall (i.e., the rainy season)	• Leaf wilting • Leaf desiccation/ browning • Leaves may remain on the shoots although in some cases there is a sudden pronounce leaf drop • Sudden stem, limb and/or trunk dieback • Scorching of limbs and/or trunk • Tree decline and death	Typically trees adjacent to the affected tree have terminal shoots in the tops of the trees that are dead (with desiccated brown leaves). Trees attacked by wood boring beetles
Freezing	Historically, may occur from mid-Nov. through first week of March	• Water soaking of leaves (mottled, dark green color) • Leaf desiccation/ browning • Leaves may remain on the stems but eventually fall off • Sudden stem, limb and/or trunk dieback • Tree decline and death	Typically entire areas within the agricultural area are affected similarly although there are micro-climates (e.g., low lying areas, “cold spots”) that may experience more frequent or severe cold temperatures than others. Trees may be attacked by wood boring beetles

y, Recently determined up to nine different ambrosia beetles may be contaminated with laurel wilt spores; two species of ambrosia beetles have been found experimentally they can inoculate avocado plants under controlled conditions; not known if they can successfully inoculate avocado trees under grove conditions.
z, Environmental conditions with respect to south Miami-Dade County.

Table 2. Contact insecticides for RAB. It is recommended that pesticides products are rotated to prevent insect resistance. Mix the insecticides with an adjuvant (e.g., NuFilm) to prolong its efficacy.

Product	Rate per acre	Spray interval	Potential # of applications allowed per year per acre[z]	Comments – estimated days of efficacy[y]
Danitol 2.4 EC, foliar	21.3 oz	14	1	14-21
Malathion 5EC, foliar	72 oz	7-10	Open	10-14

y, The estimated days of efficacy is influenced by numerous factors including weather conditions (e.g., rainfall, temperature, and UV light intensity).

z, The potential number of applications per year is based on applying the product to an entire acre. Technically the amount allowed to be sprayed onto an acre is more correctly calculated based on the allowable amount of a.i. (active ingredient) allowed per acre per year.

(c://ext/2014/RAB-LW programs/recommendations 2014/Tree destruct and LW control recommendations 5-27-14.docx)

Sampling for Laurel Wilt (LW)
Please take a good sample

Jonathan H. Crane, Tropical Fruit Crop Specialist
Jan., 23, 2013

Sampling declining trees

1. Equipment: pruning hand saw or hatchet, plastic zip-lock bags, permanent marker, gloves, disinfectant (Pine-Sol, 1 oz in 8 oz water), flagging tape and latex paint.
2. Information on the plastic sampling bag:
    a. **Date**
    b. **Your name**
    c. **Name of grove**
    d. **Location of the tree (row, tree number, GPS coordinates)**
    e. **Cultivar (variety) of avocado.**
    f. **Write the words "Laurel Wilt sample"**
3. Take a sapwood sample. The sapwood is the first 2-4 inches of wood just under the bark. Healthy sapwood is white to off-white in color. Unhealthy sapwood has dark brown to bluish to black streaks in the sapwood. **Bark is not a good sample for LW.**

a. Where on the tree to sample? First look to see where the canopy is showing signs of decline and then look for evidence of beetle holes – try to sample in these areas.

b. Sampling options
- Sample by hatchet. The bark of avocado trees can be thick (1/2 to 1 inch or more). The outer bark is rough and greyish colored and the color of the inner bark is pink. Remove the outer and inner bark until you see either dark-stained (streaked) wood or whitish-yellow wood. If you see only whitish-yellow wood, sample in another location that has dark-stained wood. Once sapwood is exposed take chips of the symptomatic (brown-streaked) sapwood and place in the bag for analysis. We need about ½ cup or so of this wood.
- Sample by hand-saw. Removing the bark is not necessary. Cut a wedge-shaped (<) piece of wood such that the pointed end extends several inches into the sapwood. We need 1 to 2 pieces.

c. Cover the wound made by the sampling with a thick coat of roofing tar (the ingredients should include cellulose fiber, solvent and silicate or clay; use Gardner-Fibered Roof Coating or Premier Fibered Asphalt Roof Coating-PR200) to discourage additional beetle infestation. Not all roofing tars work and paint will not inhibit beetle boring.

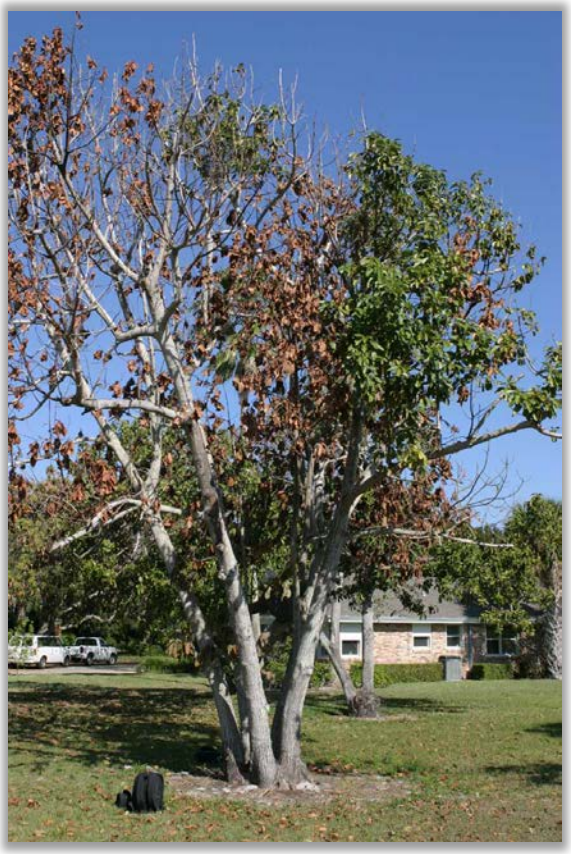
d. Sanitize the hatchet or hand-saw after each sample to prevent the spread of the disease. Examples of disinfectants include 1) 25% chlorine bleach (3 parts water and 1 part bleach; 2) 25% pine oil cleaner (3 parts water and 1 part pine oil); 3) 50% rubbing alcohol (70% isopropyl; equal parts alcohol and water); 4) 50% denatured ethanol (equal parts alcohol and water); 5) 5% quaternary ammonium salts. There are ammonium chloride based disinfectants (i.e. Green-Shield® or KleenGrow™) that are good disinfectants for cleaning tools. Do not mix quaternary ammonia products with bleach.

e. Take the labeled sample or samples to the TREC Plant Diagnostic Clinic at 18905 S.W. 280 St., Homestead, FL 33031. Please fill-in the sample form sheet at the clinic. The charge is $40.00.

f. The analysis should be completed within 10 business days of sample delivery.

(c://ext/prog/2013/extension-outreach/sampling for LW 5-1-12 update 5-24-12., 7-5-12, 1-23-13, 3-1-13; 3-18-13) (The PDF title is Sampling for laurel wilt 1-23-13.pdf)

over



1. Avocado tree with the left section showing LW symptoms.
2. Hatchet cutting through the bark.
3. Dark-stained (diseased) sapwood.
4. Chips of dark-stained sapwood.

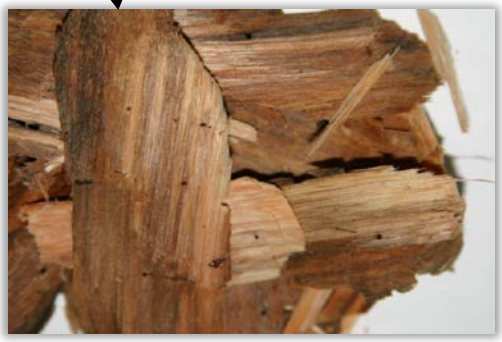
1

2

Outer bark (gray-brown)

Inner bark (reddish-brown)

Streaked sapwood (for chip sample)



3

4