UF IFAS Extension UNIVERSITY of FLORIDA

PP326

Frequently Asked Questions About Huanglongbing (HLB; citrus greening) for Homeowners[1]

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Huanglongbing (HLB), also known as citrus greening, is a serious bacterial disease that affects citrus in Florida, as well as many citrus production areas worldwide. Media outreach has made it commonly known that the disease is a primary concern for the citrus industry. Florida residents enjoy growing citrus for a variety of reasons, but growing citrus in today's disease climate is not an easy task. This document is designed to help Master Gardeners and homeowners answer commonly asked questions about HLB.

Disease and Vector Biology

1. What is citrus greening?

Huanglongbing (HLB), also referred to as citrus greening, is a systemic bacterial disease that affects all citrus varieties and other plants in the Rutaceae family. Ornamental plants can also be infected, including boxwood and orange jasmine. See the resources at the end of the document for a complete list of plants that can harbor the bacterium.

2. What causes citrus greening?

HLB is caused by the bacterium, *Candidatus* Liberibacter asiaticus. The bacteria are located in the part of the tree vascular system known as the phloem and are harmless to humans. The Asian citrus psyllid can also acquire the bacteria from an infected tree and is the vector of the disease. The bacterium reproduces in the plant and in the psyllid.

3. Why is greening so bad?

In a plant, water moves through the xylem, and sugar and minerals move through the phloem.

The bacterium that causes citrus greening resides in and damages the phloem, causing the tree to be unhealthy. You can relate this concept to the movement of blood throughout a human's veins and arteries. The effects of citrus greening are comparable to what happens when the human vascular system is damaged and blood flow is restricted. In the case of citrus greening, the flow of sugar and minerals to the rest of the plant is restricted.

The tree roots are also affected by the bacteria. Even before leaf symptoms are visible, the bacteria is already damaging the tree roots; therefore, the tree cannot function as if it were a healthy tree. Once the root damage has occurred, the tree tries to grow new roots to replace the damaged ones, but at that point the damage has already occurred and the overall tree health will only continue to decline.

There is no cure for greening at this time. Ultimately, an infected tree will become unproductive over time. A smaller

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tree will succumb to the infection more quickly than a larger tree. As tree health declines, it should be removed.

4. How does citrus greening spread?

HLB is spread by two methods, the Asian citrus psyllid (ACP) and grafting. The most frequent method is the ACP. The insect has piercing, sucking mouthparts that allow it to acquire and transmit the bacteria to and from the plant phloem, part of the tree's vascular system.

Budding (grafting), the other method for disease spread, is illegal for Florida homeowners to perform. This regulation is in place to prevent unintentional disease spread. Only certified nurseries may graft/bud citrus trees from certified mother trees determined to be clean stock. The disease is not seed transmissible.

5. What does the ACP look like?

The adult psyllid (Figure 1) is approximately 3–4 millimeters (0.12–0.16 inch) long and stands at a 30 degree angle. The adult psyllid is approximately the size of an aphid. Psyllids can fly at least 1.25 miles, can be carried by the wind, and move quickly when disturbed. They prefer to feed and lay eggs on new flush.

Figure 1. Adult Asian citrus psyllid.
Credit: Michael Rogers, UF/IFAS CREC

The ACP nymphs (Figure 2) (immature stage) have five stages, or instars, before maturing to an adult. The nymphs are small and light yellow to orange in color. They are not as mobile as the adults.

Psyllid eggs (Figure 3) appear as small orange dots found on feather stage leaf flush (small leaves that have not fully expanded). ACP populations are highest during spring and fall due to the new flush. ACP can overwinter on the underside of mature leaves.

Figure 2. Asian citrus psyllid nymphs.
Credit: Michael Rogers, UF/IFAS CREC

Figure 3. Asian citrus psyllid eggs.
Credit: Michael Rogers, UF/IFAS CREC

Disease Identification

1. How can I diagnose citrus greening?

Fruit and leaves have different symptoms. Fruit symptoms include lopsided, misshapen, and small green fruit (Figure 4). As the fruit begins to mature (ripen), it may display a color inversion. Healthy fruit colors from the blossom end (bottom) toward the calyx button (where the fruit attaches to the stem); whereas, in HLB infected fruit the color begins to change from the top end (calyx button) downward toward the blossom end (Figure 5).

Internally, the fruit may have aborted seeds (seeds that have not fully developed), a yellow stain beneath the calyx button (some yellowing naturally occurs, but it will be more prominent with HLB infected fruit), and/or a curved central core (Figure 6).

The most characteristic symptom of HLB is the blotchy mottle pattern on leaves (Figures 7–9). This blotchy mottle pattern presents as an asymmetrical pattern across the midvein on both sides of the leaf. Other leaf symptoms

include yellow veins or corky veins (Figure 10). Broken or girdled limbs and another disease called *Phytophthora* may also cause yellow veins. Corky veins are also a symptom of Boron (B) deficiency.

Overall, the tree will not look healthy. Twig dieback, sparse foliation (see-through canopy), fruit drop, and off-season bloom are commonly seen as infected trees begin to decline from the disease (Figure 11).

Figure 4. Lopsided grapefruit due to HLB infection.
Credit: Jamie D. Burrow, UF/IFAS CREC

Figure 5. Color inversion and oblong fruit shape caused by HLB infection.
Credit: Megan M. Dewdney, UF/IFAS CREC

Figure 6. Internal fruit symptoms of HLB.
Credit: Brooke L. Moffis, UF/IFAS Extension Lake County

Figure 7. Blotchy mottle leaf pattern on sweet orange.
Credit: UF/IFAS CREC

Figure 8. Blotchy mottle leaf pattern on sweet orange.
Credit: Jamie D. Burrow, UF/IFAS CREC

Figure 9. Blotchy mottle leaf pattern on lemon trees.
Credit: Jamie D. Burrow, UF/IFAS CREC

Figure 10. Vein corking on leaf.
Credit: Jamie D. Burrow, UF/IFAS CREC

Figure 11. HLB infected trees.
Credit: Jamie D. Burrow, UF/IFAS CREC

2. How do I tell the difference between citrus greening and symptoms caused by plant nutrient deficiencies?

HLB leaf symptoms have an asymmetrical pattern; the blotchy mottle pattern will not be the same when comparing both sides of the leaf from across the midrib. Whereas nutrient deficiencies have a symmetrical pattern, chlorosis (yellowing) patterns will be the same when comparing both sides of the leaf across the midrib (Figures 12 and 13).

Figure 12. Nutrient deficiency.
Credit: Jamie D. Burrow, UF/IFAS CREC

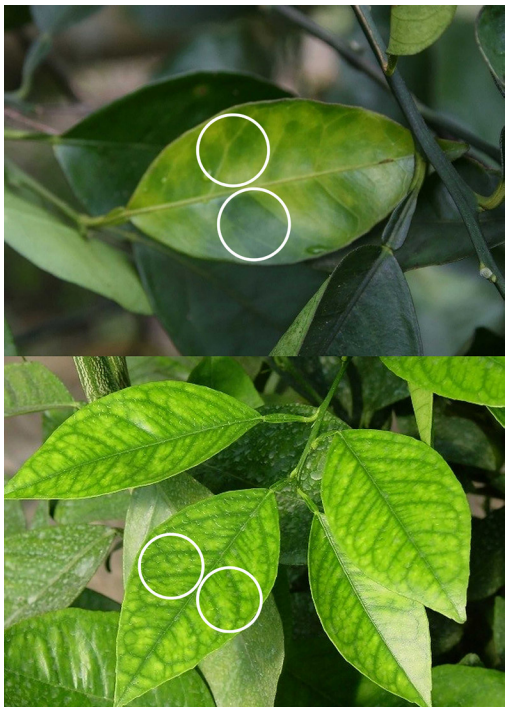

Figure 13. Comparison of citrus greening (top) (blotchy mottle pattern) with nutrient deficiency (bottom). If the pattern inside of the circles does not match, it is possibly greening. If the pattern inside of the circles matches, it is possibly nutrient deficiency.
Credits: Jamie D. Burrow, UF/IFAS CREC and Mongi Zekri, UF/IFAS Extension Hendry County

Preventative Options

1. How can I prevent my tree from getting citrus greening?

The Asian citrus psyllid (ACP) is the insect responsible for spreading citrus greening; therefore, managing psyllid populations is the best way to prevent your tree from becoming infected. Foliar- and soil-applied chemicals reduce psyllid populations when applied properly. However, no chemical will provide complete protection. Even with chemical control methods, it is not possible to keep all ACP

from gaining access to trees. Ultimately, all infected trees will eventually succumb to HLB.

2. What is available for homeowners to apply to their trees to manage psyllids?

There are limited chemicals available for homeowners. Foliar-applied chemicals available for homeowner ACP management include horticultural oil, malathion, and carbaryl (these are product ingredients not brand names). Imidacloprid (product ingredient) is a soil-applied chemical. Organic options include horticultural mineral oil, neem oil, and kaolin clay. When applying any chemical, follow the label instructions.

3. Can I do anything to prevent my tree from spreading citrus greening?

Once your tree has HLB, it becomes a source of the bacterium that causes the disease and spreads via the ACP, which acquires and transmits the bacteria. You should remove the infected tree, as it is a source of greening, to reduce further spread.

Management Options

1. If my tree has greening, what can I do to treat the symptoms?

There is no cure or treatment for HLB. Once a tree has greening, it will become unproductive over time. Fertilizer will make the tree appear healthier for a short period of time but will not improve productivity or fruit flavor.

2. If my tree has greening, can nutrition and watering improve the health of my tree or extend the life of the tree?

Fertilizing and watering will only extend the life of the tree. The tree will not be cured of citrus greening and as time progresses, it will become even less appealing to the eye. Tree removal should be strongly considered.

3. If my tree is infected with greening bacteria, why can't I treat it with an antibiotic?

Antibiotics have not been proven to be an effective source of treatment nor are antibiotics approved by government regulatory agencies for homeowner applications.

4. My tree has citrus greening, what should I do to remove it?

Two options for tree removal include cutting the tree off at the soil line or removing the tree in its entirety (including roots). You can put the tree in your yard waste or burn the tree remains, if allowed in your area. ACP will not feed on a dead tree; therefore, once the tree is removed, the psyllid will no longer remain on the tree. It is advised that you treat for psyllids prior to tree removal with a foliar-applied chemical (horticultural oil, malathion, carbaryl).

5. Can I replant a citrus tree in the same spot where I have a diseased tree?

If you are going to replant a citrus tree or another plant in the same location, be sure to remove and kill the infected tree's stump with a herbicide to kill all the roots. It is best to wait for a period of time to make sure the herbicide's active ingredient is no longer available to be taken up by the roots of a new plant.

6. If my neighbor refuses to remove an infected tree, what can I do about it?

There are no laws that enforce the removal of infected trees. You can inform your neighbor of the effects of citrus greening on their tree and how it may affect commercial groves and other citrus trees in the area. Resources are available at your local Extension office.

7. Why can't greening be eliminated by removing all the infected citrus trees in a location and spraying to kill the psyllids?

Theoretically this could work to eliminate the disease; however, the removal of all infected citrus greening trees would be nearly an impossible task. The bacterium can reside in a tree for months or years before visible symptoms occur. Citrus trees can also be found growing in wooded areas; therefore, locating all the infected citrus trees would not be practical. In addition, there would need to be 100% cooperation from all citrus tree owners for removal of their trees. To completely remove all plant sources of the HLB bacterium, all susceptible plant species would need to be removed, not just citrus, but landscape ornamentals like boxwood and orange jasmine as well.

The ACP are easy to kill, but they reproduce quickly and in large numbers. A single female can lay up to 750–800 eggs in her life time and the ACP have nine to ten generations per year. Although chemicals (organic and non-organic) are

effective in managing ACP, they do not completely eradicate the entire population. Pesticidal sprays only maintain ACP populations at low levels.

Replanting Citrus

1. Where can I buy a citrus tree that does not have greening?

Citrus trees should be bought from a reputable nursery. Confirm the tree has been grown in a certified nursery by looking for the nursery tag. Do NOT buy a citrus tree without a tag. Furthermore ask the vendor how long the tree has been at the point of sale and if the tree has been regularly treated for psyllid control. Do not purchase plants with any visible symptoms of HLB.

2. If I purchase a citrus tree, how do I know whether it has citrus greening?

If the tree comes directly from a certified nursery, there is a very low probability that the tree has HLB. Citrus nurseries are required to be inspected for disease and pests every thirty days to ensure clean nursery stock is being sold. Trees from other vendors have the potential to be infected so consumer vigilance for symptoms and correct treatments is advised.

3. If I plant a new citrus tree, what should I expect in terms of the health, life, and production of the new tree?

The age and condition of a new tree will determine the life and production expectancy of the tree. If your tree was not infected and you have sprayed your tree regularly for ACP, then the tree may live longer than a tree that has little to no care. You will have less success in growing a healthy tree when in close proximity to infected trees. High disease pressure in Florida is limiting the life expectancy of most citrus trees.

Alternative Crops

1. What are the options for alternative crops?

Some alternative crops include, but are not limited to peaches, plums, blueberries, pomegranates, guava, chestnuts, and figs. When choosing an alternative crop, consider the USDA hardiness zone, whether you want an ornamental versus an edible plant, and the necessary maintenance.

Concerns

1. Is it safe to eat fruit from a greening infected tree?

Yes, the fruit may be eaten. The infection may cause an off flavor similar to consuming the fruit when green.

2. My neighbor has told me his tree has greening, do I need to worry?

If you do not have a citrus tree, then there is no need to worry. If you have a citrus tree, it would be best to make sure you are following preventative measures to protect your tree, but, unfortunately, it will only take one infected ACP to spread the disease to your tree, and it may already be infected.

3. I am elderly, on fixed, limited income, what should I do about my citrus tree with greening?

If possible, locate an individual or group who could assist with the removal of the tree, if infected.

4. Is there a state agency that will come to my home and inspect my citrus trees for greening, confirm whether or not my citrus trees have greening, and remove any trees that have citrus greening?

It is not likely for someone to come to your home and inspect your tree. If you would like to have a tree diagnosed, you may take a sample to your local Extension office or provide the Extension personnel with a digital photo via email. Call your local Extension office before collecting a sample. There are three other sources for having your samples tested by polymerase chain reaction (PCR; a DNA test) to confirm an HLB infection. Before sending any samples, it is best to contact the testing facility for proper sample collection and any additional information they may need for future correspondence (Table 1).

Resources

UF/IFAS Citrus Research and Education Center HLB website http://greening.ifas.ufl.edu

List of Affected Plants http://www.freshfromflorida.com/Divisions-Offices/Plant-Industry/Business-Services/Registrations-and-Certifications/Growing-Hosts-of-Citrus-Greening-In-Approved-Structures/List-of-Affected-Plants

How far do psyllids move and when? http://www.crec.ifas.ufl.edu/extension/trade_journals/2012/2012_July_Psyllids_move.pdf

Citrus Greening: A serious Threat to the Florida Citrus Industry brochure http://edis.ifas.ufl.edu/ch198

Table 1. HLB Diagnostic testing locations.

NAME	ADDRESS	PHONE NUMBER	COST
UF/IFAS Southwest Florida REC	2685 SR 29 North Immokalee, FL 34142	239-658-3400	Call for price.
Florida Division of Plant Industry	PO Box 147100 Gainesville, FL 32614	800-282-5153	$0
UF Plant Diagnostic Center	Building 1291 2570 Hull Rd. Gainesville, FL 32611	352-392-1795	Call for price.