

2019–2020 Florida Citrus Production Guide: Huanglongbing (Citrus Greening)¹

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Huanglongbing (HLB; citrus greening) is caused by the bacterium *Candidatus Liberibacter asiaticus*. The name huanglongbing means “yellow shoot disease,” and derives from the bright yellow shoot symptom that commonly occurs on a sector of an infected tree. HLB is a serious citrus disease because it causes tree decline and affects all citrus cultivars. The HLB-causing bacterium found in Florida is the Asian species, which occurs in warm low-altitude areas and is transmitted by the Asian citrus psyllid (*Diaphorina citri* Kuwayama). The Asian citrus psyllid was discovered in Florida in 1998 and is now found throughout the state wherever citrus is grown.

Early HLB symptoms on leaves include vein yellowing and an asymmetrical chlorosis referred to as “blotchy mottle.” The blotchy mottle of the leaf is the most diagnostic symptom of the disease, especially on sweet orange. The blotchy mottle symptom also may be confused with other diseases or damage such as severe forms of citrus tristeza virus (CTV), Phytophthora root rot, waterlogging, citrus blight, leafminer tunnels, or citrus stubborn disease (an exotic disease to Florida). Leaves may be small and upright with a variety of chlorotic patterns that often resemble mineral deficiencies such as those of zinc, iron, and manganese. Some leaves may be totally devoid of green or exhibit green islands. Young trees decline quickly and rarely become productive if they are infected shortly after planting. As mentioned above, early symptoms of yellowing may appear

on a single shoot or branch. The yellowing usually spreads throughout the tree canopy over several years. It is common for affected trees to show twig dieback. Fruit are often few in number and small, may be lopsided with a curved central core, and fail to color properly, remaining green at the stylar (flower) end. Many fruit drop prematurely from afflicted trees in the month prior to harvest. A yellow stain may be present just beneath the peduncle (stem) on a cut fruit. The affected fruit often contain aborted seeds and have a salty, bitter taste reminiscent of unripe fruit. Root systems are heavily damaged by HLB, with 30%–50% root loss occurring in the early phases of the disease. More than 70% root loss has occurred by the time canopy decline is visible. Current information about the effects of HLB on root systems is available in the Root Health chapter.

The causal bacterium present in Florida, *Ca. Liberibacter asiaticus*, has not been cultured, and formal diagnosis is done by PCR. Detection of the bacterium is usually only possible from blotchy mottle symptomatic tissues. The host range of the *Ca. Liberibacter* spp. that cause HLB includes all citrus species regardless of rootstock. Normally symptoms are severe on sweet orange, mandarins, and mandarin hybrids and moderate on lemon and sour orange. Grapefruit symptoms are moderate initially but become suddenly severe after several years. Lime, pummelo, and trifoliolate orange are listed as more tolerant, but this does not mean that the bacterium is unable to infect and multiply in

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those cultivars. Severe symptoms have been observed on pummelo and lime.

The consequences of unmanaged HLB can be grave. Mature trees start to decline slowly and eventually become non-productive after infection. Consequences are worse for young trees. In most cases, the trees never reach full production, and in the worst case, the trees die within 1–2 years of planting. Because HLB also can be transmitted with infected budwood, the use of certified disease-free planting materials is essential to maximize planting success.

Psyllids are the primary vector for HLB spread and are present in Florida year-round, so their management is a necessary part of an integrated management program. Peak activity and movement occur in the spring and summer with the development of new flush. Because of high HLB presence in Florida, psyllids are likely to carry the bacterium between plants when they move, increasing the disease pressure in plants that are already infected and establishing the bacteria in young plants. Despite the high pest and disease pressure, citrus can still be productive thanks to nutritional inputs to maintain the health of trees. New tools are also under evaluation to determine the best way to protect young trees from HLB. In addition to management within the field, non-crop hosts for psyllids require attention because they can be a source of this pest. The Asian citrus psyllid feeds on many rutaceous plant species. Of these plants, orange jessamine (*Murraya paniculata*) and orange boxwood (*Severinia buxifolia*) serve as hosts for both the psyllid and *Ca. Liberibacter* spp. Movement of these ornamentals is restricted under state compliance agreements, and they should not be moved from areas where the disease occurs.

Recommended Practices

Overall, integrated pest management strategies should focus on the following: use of disease-free nursery trees, an optimal nutritional regime, reduction of the inoculum by frequent disease surveys, removal of symptomatic trees, and focused management of Asian citrus psyllid populations. Specific recommendations based on tree age are listed below.

A. Young Trees/New Plantings

1. The use of clean budwood and certified healthy trees is essential for successful replanting. It is now mandatory in Florida that budwood sources and nursery production be carried out under psyllid-proof enclosures and certified HLB-free.

2. Preventing psyllid access to flush is important in managing HLB. Systemic insecticides such as imidacloprid have traditionally been used for this purpose (see chapter on Asian Citrus Psyllid). However, resistance to imidacloprid and several other commonly used insecticides has been detected in specific regions in the state. Therefore, it is recommended to contact your local UF/IFAS Extension agent or citrus entomology state specialist to assist in developing insecticide-based management plans. Some biological control for psyllids is available but the amount of control provided by introduced parasitoids has been insufficient to slow disease spread. New tools that can reduce psyllid pressure including reflective mulch and exclusion netting are available for purchase but have not been fully evaluated for efficacy.

3. Scouting for HLB-affected trees should be done routinely in young plantings so that infected trees can be removed quickly. It is recommended that scouting be conducted four or more times per year in areas where HLB is not widespread (e.g., north Florida). The frequency of scouting may be higher in areas that have high rates of HLB. Symptoms are the easiest to find from October to March although they may be present at other times of the year too. The current methods used to scout are walking or all-terrain vehicles. Symptomatic tree numbers and the rows in which they are found should be marked with colored flagging tape, and GPS coordinates should be taken or the sites marked on a map to facilitate relocation and removal of these trees. In some cases, an HLB PCR diagnostic test may be necessary to confirm the disease (see diagnosis below). Scouting resources are available on the following websites: <http://crec.ifas.ufl.edu> or <http://edis.ifas.ufl.edu/CH200>.

B. Mature Trees

1. Diagnosis of HLB by symptoms alone may be difficult because some nutrient deficiency symptoms and other problems are often confused with some of the symptoms associated with HLB. Samples of trees suspected to be infected with HLB may be sent for PCR diagnosis to the Southern Gardens Diagnostic Laboratory or the Florida Division of Plant Industry. The procedures for submission of suspect samples to labs for PCR testing are available at the following web site: <http://www.crec.ifas.ufl.edu/extension/greening/Diagnostics.shtml>.
2. In mature groves, psyllid management will vary based on growers' needs but should be based on the goal of reducing the population to minimize impacts of reinoculation and potential for spread to young plantings. Population

reduction is most often achieved using insecticides. When using insecticides, modes of action **must** be rotated for resistance management (see ENY-854, *Quick Reference Guide to Citrus Insecticides and Miticides*). Insecticide resistance has been detected in several counties; therefore, it is prudent for growers to contact their county Extension agents or state specialist for advice on which materials to use in programs.

Windbreaks in the form of trees have been evaluated and found to reduce psyllid migration into fields. Windbreaks may also provide habitat for predatory insects that can help reduce local psyllid populations. Predatory insects, including the imported parasitoid *Tamarixia radiata*, lady beetles, and lacewings, can help in reducing the young psyllid populations within a field.

C. Nutrition/Irrigation Management for All Groves

1. Plant nutrition is essential for optimum growth and yield of high-quality fruit. A fertilizer program should include all mineral nutrients. An excess or deficiency of any single nutrient can adversely affect tree performance. HLB-affected trees have smaller and weaker root systems when compared to healthy trees; therefore, it is suggested to apply fertilizer and irrigation in frequent small doses because it improves their uptake potential by the tree. Controlled-release fertilizer and fertigation can be strategic alternatives to multiple applications of conventional dry granular fertilizer. Since no single nutrient has been observed to be more beneficial for HLB-affected trees, the focus should be on all essential nutrients applied in split doses throughout the year.
2. Soil and irrigation-water pH also play an important role in nutrient availability to the plant. HLB-affected trees perform better when the soil pH is around 6.0–6.5. Intensive fertilizer and irrigation management will not cure the tree from HLB but can potentially improve the quality and productivity of HLB-affected trees. It is highly recommended that before making any changes to a fertilizer program for HLB-affected or healthy trees, leaf and soil nutrient analysis is performed and taken into consideration. The goal of the fertilization program should be to have all the leaf nutrients in the high end of the optimum range. Refer to chapters on Root Health, Irrigation, and Nutrition for more information.

D. Removal or Pruning of Infected Trees

1. Removal of infected trees is the only way to ensure that they will not serve as a source of the bacterium for psyllid acquisition and subsequent transmission. Generally, removal happens when the tree is no longer productive or is infected very early and will never be productive. In regions where HLB is not widely established, infected trees should be treated with a foliar insecticide (such as Danitol, fenprothrin) to kill all adult psyllids feeding on that tree. Failure to control psyllids will result in them dispersing to new plants once the diseased tree is removed potentially infecting new resets or plantings.
2. Pruning of trees/symptomatic limbs has been attempted; however, because HLB is systemic, pruning is not successful since tree roots are infected before canopies are symptomatic. Additionally, since the tree is still infected after pruning, the new flush produced will serve as a feeding site for adult psyllids to acquire an even higher concentration of the bacterium than before. The infected psyllids may then disperse to uninfected trees once the new flush hardens off. Moreover, pruning can stress the root system even further, resulting in an overall weak tree and reduced root system. Refer to the Canopy Management chapter of this guide.

Additional Information

Links to websites on HLB and EDIS documents can be accessed through the UF/IFAS Citrus Research and Education Center website at the following addresses:

<http://crec.ifas.ufl.edu>

<http://edis.ifas.ufl.edu/CH200>