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MEETING HOST:



2009 Florida Citrus Pest Management Guide: Huanglongbing (Citrus Greening)¹

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Huanglongbing (HLB), commonly called citrus greening, is caused by the bacterium, *Candidatus Liberibacter asiaticus*. The name huanglongbing means "yellow shoot disease" which describes the symptom of a bright yellow shoot that commonly occurs on a sector of an infected tree. HLB is a serious disease of citrus because it affects all citrus cultivars and causes tree decline. HLB has seriously affected citrus production in a number of countries in Asia, Africa, the Indian subcontinent and the Arabian Peninsula, and was discovered in July 2004 in Brazil. Wherever the disease has appeared, citrus production has been compromised with the loss of millions of trees. HLB has not been reported in Australia or in the Mediterranean Basin. In August 2005, the disease was found in the south Florida region of Homestead and Florida City. Since that time, HLB has been found in commercial and residential sites in nearly all counties with citrus. The HLB species 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 now occurs throughout the state wherever citrus is grown.

The early symptoms of HLB on leaves are vein yellowing and asymmetrical chlorosis referred to as 'blotchy mottle.' The blotchy mottle symptom is the most diagnostic symptom of the disease especially on sweet orange. Leaves might 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 with only islands of green spots. The blotchy mottle symptom also may be confused with other diseases or damage such as stubborn, severe forms of citrus tristeza virus (CTV), Phytophthora root rot, water logging, citrus blight, or leafminer tunnels. Root systems of infected trees are often poorly developed and new root growth may be suppressed. As mentioned above, early symptoms of yellowing may appear on a single shoot or branch. The yellowing usually spreads throughout the tree over a year and affected trees may show twig dieback causing the productivity to decline in a few years. Fruit are often few in number, small, may be lopsided

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with a curved central core and fail to color properly remaining green at the stylar end. Many fruit drop prematurely from afflicted trees. A yellow stain may be present just beneath the peduncle on a cut fruit. The affected fruit often contain aborted seeds and have a salty bitter taste. Symptoms may be enhanced by the presence of other pathogens such as CTV.

The causal bacterium, *Ca. Liberibacter asiaticus* has not been cultured and diagnosis is by PCR. Detection of the bacterium is usually only possible from symptomatic tissues. Four different species of *Ca. Liberibacter* exist. There are three species that cause HLB in citrus; *Ca. L. asiaticus*, *Ca. L. africanus* found in Africa and *Ca. L. americanus* discovered in Brazil in 2004. There is also *Ca. L. africanus* sp. *capensis* that causes a disease in cape chestnut and the most recently discovered, *Ca. L. psyllauros*, that is responsible for Zebra chip of potato. 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; moderate on grapefruit, lemon and sour orange; lime, pummelo and trifoliate orange are listed as more tolerant. However in south Florida, the symptoms were severe on pummelo, lime and grapefruit.

When psyllids are abundant and conditions are favorable, HLB can spread, destroying existing groves and preventing the commercial production of oranges and other citrus cultivars. Infected mature trees may decline and become non-productive and young trees that become infected never come into full production. In China, the disease was reported to kill young trees in 1-2 years. HLB also can be transmitted with infected budwood. Therefore, use of certified disease-free planting materials is essential to minimize further spread.

Recommended Practices

1. HLB is difficult to manage and continued production of citrus has proven difficult and expensive in areas where it is widespread. Since HLB is transmitted by the Asian citrus psyllid, which is well established in Florida, there is clearly a potential for the continued spread of HLB throughout Florida citrus. The use of clean budwood and certified healthy trees is essential.

It is now mandatory in Florida that budwood sources and nursery production is carried out under psyllid-proof enclosures and are certified HLB free. Systemic insecticides such as imidacloprid are an important part of psyllid control (see ENY-734 Asian Citrus Psyllid and Citrus Leafminer). Some biological control of the psyllid is available but the amount of psyllid control provided by introduced parasitoids has not been sufficient to limit disease spread.

2. The Asian citrus psyllid feeds on many rutaceous plant species. The psyllid has a preference for the landscape ornamental, orange jessamine (*Murraya paniculata*). It has been found to be a host of *Ca. Liberibacter* spp. and can serve as a potential source of inoculum. Another rutaceous ornamental, *Severinia buxifolia* or orange boxwood, is also a host for the bacterium as well as the psyllid. Movement of these ornamentals is restricted under state compliance agreements and should not be moved from areas where the disease occurs.
3. Scouting for greening infected trees should be done routinely so that infected trees can be removed. It has been suggested that scouting be conducted four or more times per year. The frequency of scouting may be higher in areas previously determined to have HLB positive trees. Symptoms are the easiest to find from October to March. However, symptoms may be present at other times of the year. The current methods used to scout are walking, using all-terrain vehicles and on platforms mounted on vehicles. Symptomatic tree numbers and the rows in which they are found should be marked with colored flagging tape and GPS coordinates 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).
4. Diagnosis of HLB may be difficult since some nutrient deficiency symptoms and other problems are often confused with some of the symptoms associated with HLB. HLB affected leaves accumulate starch. An iodine based starch test can be used to assist in determining what

leaves should be sent for PCR diagnosis. The iodine test alone is not used for HLB diagnosis; however, it is a useful indication that the tree likely has HLB. The procedure for the test can be found on the Citrus Research and Education Center HLB Web site at the address listed below.

Samples of suspected HLB infected trees may be sent for PCR diagnosis to the Southern Gardens Diagnostic Laboratory or to the Southwest Florida REC in Immokalee. The procedures for submission of suspect samples for PCR testing is available at the following Web sites:

http://www.flcitrusmutual.com/content/docs/issues/canker/sg_samplingform.pdf or
<http://www.imok.ufl.edu/hlb/index.htm>

Additional Information:

Links to websites on citrus greening disease can be accessed through the Citrus Research and Education Center Web site at the following addresses:

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

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

<http://edis.ifas.ufl.edu/HS375>

5. Removal of infected trees is the only way to ensure that they will not serve as a source of the bacteria for psyllid acquisition and subsequent transmission. Prior to removal, the infected tree should be treated with a foliar insecticide (such as Danitol, fenpropathrin) to kill all adult psyllids feeding on that tree. Failure to control these psyllids will result in the infected psyllids dispersing to new plants once the diseased tree is removed. Pruning of symptomatic limbs has been attempted in many countries to reduce the inoculum available to the psyllids. However, because the disease is systemic, pruning has not been successful since other parts of the tree may already be infected but not yet symptomatic. Additionally, if a tree is still infected after pruning, the new flush produced will serve as a feeding site for adult psyllids to acquire *Ca. Liberibacter* spp. The infected psyllids may then disperse to uninfected trees once the new flush hardens off.
6. Integrated pest management strategies should focus on the following: use of disease-free nursery trees, reduction of the inoculum by frequent disease surveys, removal of symptomatic trees, and suppression of Asian citrus psyllid populations. Refer to ENY-734, Asian Citrus Psyllid and Citrus Leafminer, in the Florida Citrus Pest Management Guide for more information on management of Asian citrus psyllid.



Figure1. Yellow shoot symptom (indicated by arrowhead) on sweet orange tree affected by greening.



Figure 2. Leaf mottle symptom (left) caused by greening and healthy leaves (right).

Source: K.-R. Chung and R. H. Brlansky PP-210: Citrus Diseases Exotic to Florida: Huanglongbing (Citrus Greening). Citrus REC, Lake Alfred, Florida; Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 32611.



Figure 3. Small fruit with poor juice quality and leaves showing mineral deficiency symptoms (left) caused by greening.



Figure 4. The Asian citrus psyllid, *Diaphorina citri* that transmits citrus greening. Note: wings held rooflike.

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