Managing the health and productivity of HLB-affected groves

By Tripti Vashisth

In 2005, huanglongbing (HLB or citrus greening disease) was first discovered in Florida. Florida orange production changed from 242 million boxes in the pre-hurricane, pre-HLB, 2003–2004 season to 81.5 million boxes in 2015–2016. This dramatic reduction in yield is attributable to multiple causes, including a reduction in citrus acreage, citrus canker and other citrus diseases. HLB is now recognized as the primary reason for declining citrus yields. Growers are urgently looking for strategies to maintain fruit production in their groves under endemic HLB conditions.

After years of extensive research from across the world, we still do not have a cure for HLB. However, we have learned a lot about this disease, the plant's response and the disease vector. Based on the scientific and observational information gathered in the last decade, a number of tools and strategies are currently available for growers to maintain the health and productivity of HLB-affected trees. This article sheds light on these currently available horticultural inputs and practices that can be implemented immediately by growers to maintain and improve citrus tree health.

FERTILIZATION

Plant nutrition is essential for optimum growth and yield of high-quality fruit. A fertilizer program should include all the mineral nutrients. Every nutrient is indispensable (see Figure 1). An excess or deficiency of any single nutrient can adversely affect tree performance. The goal with mature tree fertilization is to promote fruit set, growth and development, and at the same time, ensure maintenance of tree health and fruit-bearing surfaces to optimize yields for subsequent seasons. Fertilizer recommendations depend on a wide range of factors such as soil characteristics, age of tree, variety, rootstock and cultural practices. Refer to http://edis.ifas.ufl.edu/ss478 for more information.

HLB-affected trees have smaller and weaker root systems when compared to healthy trees. Therefore, it is suggested to apply fertilizer in frequent small doses as this maintains a constant supply of nutrients and reduces potential nutrient leaching. Controlled-release fertilizer and fertigation can be strategic alternatives to multiple applications of conventional dry granular fertilizer. With the use of controlled-release fertilizer and fertigation, the amount of nutrients

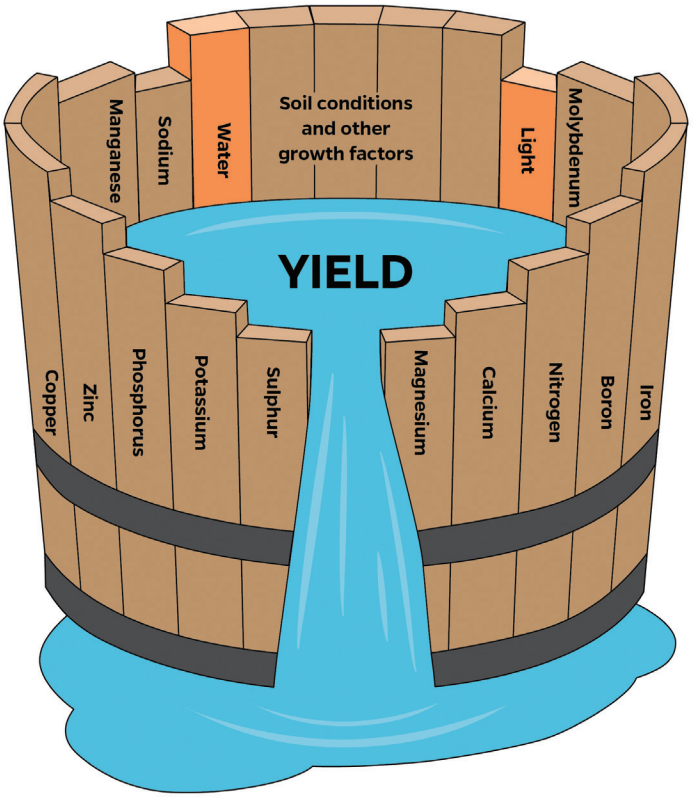

Photo credit: UF/IFAS Communications

Figure 1. A leaky water barrel depicts that the yield is dependent on a number of factors and on Liebig's Law of the Minimum, which states that "growth is controlled not by the total amount of resources available, but by the scarcest resource."

applied can be reduced by 10 to 20 percent to achieve comparable yields and quality of fruit.

In a recent greenhouse study, HLB-affected sweet orange leaves had lower concentrations of potassium, calcium, magnesium, copper, iron, zinc, manganese and boron as compared to healthy leaves. These results suggest that HLB-affected trees require higher rates of some essential mineral nutrients than healthy trees in order to circumvent any development of nutrient deficiencies.

It is highly recommended that before making any changes to a fertilizer program for HLB-affected or healthy trees, leaf and soil nutrient analysis should be performed and taken into consideration. When developing a fertilizer program, attention should be paid to all the essential mineral nutrients. In addition, the concepts of the 4Rs of plant nutrition should be implemented. The 4Rs are:

- **Right source** involves the type of source for a nutrient (dry, liquid, foliar or controlled release), ease of application of a nutrient and cost per unit of nutrient. For example, a controlled-release nitrogen source may be preferred in delivering small amounts of nutrients throughout the growing season.
- **Right rate** refers to the amount of fertilizer needed for the growing season for production of profitable crops. This right rate is dependent on the source of the nutrient.
- **Right timing** of nutrients takes into consideration the growth pattern of the crop and, therefore, natural changes in nutrient demand during the season.
- **Right placement** is the last of the 4Rs. Since most nutrient uptake occurs through the root system, placing the nutrients in the root zone maximizes the likelihood of absorption by the plant. In the case of foliar fertilizer, attention should be paid to scheduling sprays to coincide with the vegetative flush pattern of the

tree. Foliar nutrient absorption is higher in young and tender leaves as compared to mature, hardened-off leaves.

IRRIGATION

There is no doubt that water is the primary contributor to the health and productivity of citrus trees. Attention should be paid to the proper irrigation of trees throughout the year. Water stress can result in physiological changes in tree growth and fruit development. For example, drought stress in the fall can result in premature fruit drop, which can result in reduced yields. Additionally, the ending of drought stress can result in off-season flowering, which may contribute to a higher incidence of post-bloom fruit drop. Therefore, it is advised that drought stress should be avoided throughout the year.

In recent greenhouse and field studies, schedules with frequent irrigations of smaller amounts of water benefited HLB-affected trees. HLB-affected trees receiving small, frequent doses of irrigation displayed improvement in tree canopy density, greater leaf area and reduced leaf drop (See *Citrus Industry*, July 2016, pages 6–8). In light of these studies, **it is suggested to schedule frequent irrigation of smaller amounts of water to manage HLB-affected trees.**

SOIL pH, WATER QUALITY AND BICARBONATES

Soil pH of the root zone is a very critical factor that affects nutrient uptake, especially micronutrients. Irrigation water in Florida is often high in bicarbonates. Irrigating with such water over long periods of time can increase the soil pH and therefore can affect tree health and reduce yields. The effect of irrigation water quality on soil pH depends on the bicarbonate concentration in the water, irrigation timing and quantity, the buffering capacity of soil and the rootstock variety.

Field studies suggest that where soil pH is high and the irrigation water contains bicarbonates, groves exhibit increased HLB symptoms and severely declining trees. Leaf and soil nutrient analysis of such groves exhibit a reduced root uptake of calcium, magnesium, potassium and iron. In another survey, it was found that the groves which have soil pH higher than 6.5 and greater than 100 parts per million (ppm) bicarbonates in irrigation water suffered from increased fibrous root loss as well as reduced yields. A clear correlation of yield loss was observed in trees under bicarbonate stress and lower fibrous root density when compared to low-bicarbonate stress trees (see *Citrus Industry*, May 2015, pages 8–11).

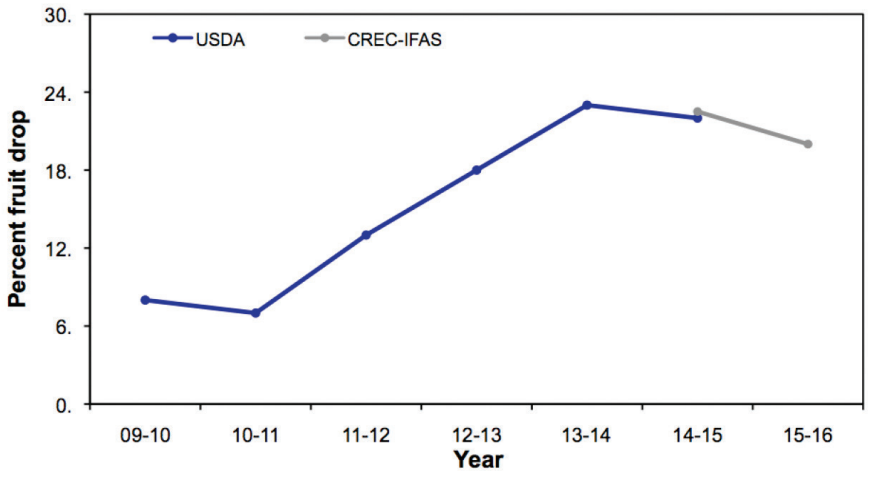

Figure 2. The U.S. Department of Agriculture reported average percent fruit drop in oranges in Florida from 2009–2015. The gray bar shows the average fruit drop data from 2014–2016 (UF/IFAS Citrus Research and Education Center).

It is advised that growers should test their soil pH and irrigation water quality (pH and bicarbonates) regularly. If the soil and irrigation water pH is greater than 6.5 and/or the bicarbonates concentration is more than 100 ppm, acidification should be done. Acid injections or combinations of acids and urea can be selected for the conditioning of irrigation water. Acid injections are usually very effective in reducing soil pH, but the major limitation is during the rainy season. An alternative to acid injections is application of elemental sulfur products to the wetted zone for acidification. The soil pH should be maintained close to 6.0 to 6.5.

PRUNING

Pruning adjusts tree shape, modifies the ratio of framework to fruit-bearing surface of the canopy, alters the shoot/root ratio and changes the carbohydrate (food storage) status of the tree.

HLB-affected trees have a smaller root system leading to an imbalanced root-to-shoot ratio. In order to correct the unbalanced ratio, some amount of pruning could be useful. Pruning also promotes rejuvenation of the citrus tree canopy. An ongoing pruning trial suggests that if trees are significantly pruned, a substantial yield decrease in year one should be expected (see *Citrus Industry*, June 2016, pages 18–23). Removal of a large portion of the canopy can also result in excessive vegetative growth at the expense of fruit set, growth and development during the first year.

After pruning, the rate of nitrogen should be adjusted corresponding to reduction in canopy volume. High rates of nitrogen may promote excessive vegetative growth and fruit with thick and puffy peels (some of the fruits produced from an 80 percent pruning treatment exhibited these symptoms). **During this regrowth period, attention should be paid to control of leafminers, psyllids and other foliar pests, since pruning will result in simultaneous emergence of new flush, which is attractive to foliar pests.**

This ongoing trial will provide conclusive results on the effect of pruning on HLB-affected trees. Meanwhile, it is suggested that growers may opt to do light pruning to rejuvenate trees, improve light interception and remove any dead wood. **Buckhorn pruning is not recommended as substantial yield loss occurs in the first four years, which may not be overcome in following years of production.**

FRUIT DROP AND QUALITY

Fruit drop can occur as a result of a number of factors, such as water stress, biotic and abiotic stress, carbohydrate shortage and physiological disorders. Since 2012–2013, HLB-induced preharvest fruit drop has become a significant issue.

Plant growth regulators (PGRs) or plant hormones such as auxins [2, 4-D (2, 4-dichlorophenoxyacetic acid), indole acetic acid and gibberellins (GA)] have been shown to reduce fruit drop in many fruit crops. In 2013, a number of trials were initiated to evaluate the use of PGRs to reduce HLB-induced preharvest fruit drop. The study showed that 2, 4-D and GA were not consistent or effective in reducing preharvest fruit drop. Therefore, **it is advised not to use PGRs to reduce preharvest fruit drop in HLB-affected trees** (see *Citrus Industry,* July 2015, pages 14–17). In 2015–2016, there was less preharvest fruit drop compared to previous seasons. Figure 2 (page 32) shows the average preharvest fruit drop data in sweet orange.

In HLB-affected trees, phloem plugging disrupts the translocation of carbohydrates in the tree. Data collected on the total soluble solids (TSS) content and size of the dropped fruit suggests that potential disruption of carbohydrate translocation to fruit results in lower fruit quality and increased preharvest fruit drop. The TSS of dropped fruit ranged from 6 to 8 degrees brix, and the average diameter of dropped fruit was less than 2.2 inches.

Dropped fruit are of low quality and should not be picked from the ground. With increase in HLB severity, fruit size has decreased considerably. In 2010–2011, more than 60 percent of the fruit measured were more than 2.5 inches in diameter, whereas in 2015–2016, less than 30 percent of the fruit measured were greater than 2.4 inches in diameter. Interestingly, the TSS does not significantly change between small, medium and large fruit from HLB-affected trees.

SUMMARY

- It is advised that growers perform regular leaf and soil nutrient testing, especially before making any changes to nutritional programs or soil amendments.
- Irrigate frequently with small doses of water.
- A complete, balanced nutritional program should be applied. The 4Rs of plant nutrition are very important.
- Maintain optimum soil pH and regularly check irrigation water quality.
- Light pruning can be beneficial for trees and should be followed by good psyllid and leafminer control.
- Minimize abiotic and biotic stress on the trees because any stress on HLB-affected trees can magnify the deleterious effects of stress.

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Tripti Vashisth is an assistant professor at the UF/IFAS Citrus Research and Education Center in Lake Alfred.