Maintaining productivity in the presence of HLB

By Arnold Schumann, Tim Spann and Bob Rouse

In June 2011, an article was published in *Citrus Industry* explaining why managing huanglongbing (HLB) in Florida with a foliar nutrition approach was viable. In summary, seven years of minimal Asian citrus psyllid (ACP) control (1998-2005), a climate conducive to abundant flush production, about 136,500 acres of abandoned groves, and geographic restrictions have appeared to create a "perfect storm" of HLB in Florida.

In this article we will restate and expand some of the important integrated management principles required to manage citrus production in endemic HLB groves using horticultural methods, including foliar nutrition.

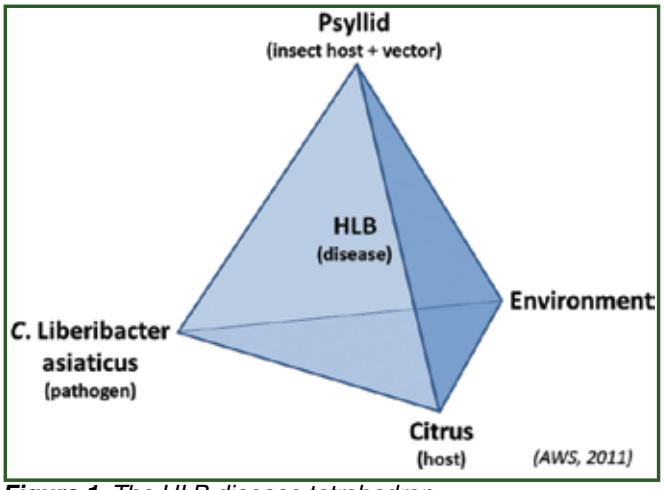

Figure 1. *The HLB disease tetrahedron*

INTERACTING COMPONENTS OF HLB DISEASE

As in other crops where cultural methods like crop rotation are used to manage diseases or pests, special attention should be paid to the potential synergistic interactions of all horticultural components used in citrus production. An example is nutritional sprays, used in part to create a favorable response in the citrus trees for an effective integrated pest management (IPM) solution. Without aggressive psyllid control, the benefits of nutrient sprays will be greatly diminished; both are required. HLB inoculum reduction by removal of infected trees is a fundamental component of the IPM strategy, and is particularly emphasized when infection levels are still low and it is practical and economical to destroy infected trees.

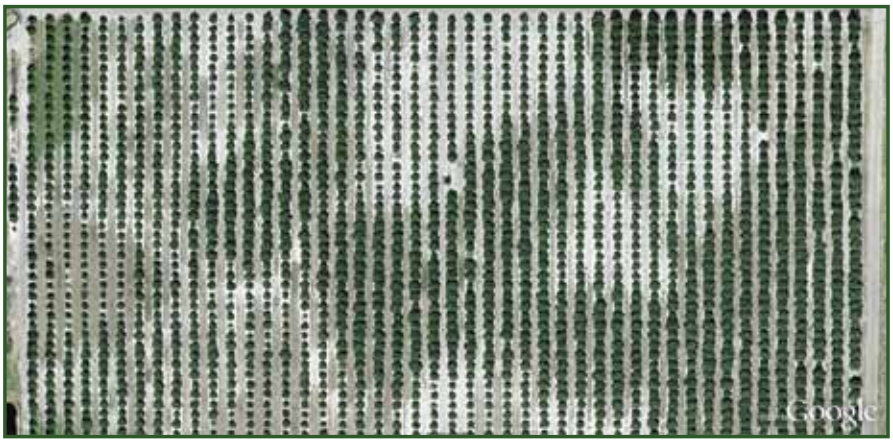

Figure 2. *Spatially variable soils produce variable trees and fruit yields in a typical Florida grove (Google® 2011)*

The four principal interacting components comprising the HLB disease complex in citrus can be simplified in Figure 1 as the ACP, the Candidatus Liberibacter asiaticus bacterium, the citrus tree and the environment. Until recently, the HLB disease diagram was represented as a triangle (host, vector, pathogen), but we now recognize the importance of the environment — both natural and artificial — which interacts with the host, vector and pathogen. An example of a natural environment component would be soil quality (Figure 2), and an artificial environment component would be fertilizer inputs (e.g. foliar nutrient sprays) or pesticide sprays. The soil quality differences illustrated in Figure 2 can cause more than 100 percent variation in canopy size and yield of the trees. Those differences will also impact the ACP and the pathogen by influencing leaf flushes, and by imposing water and nutrient stresses in host trees growing on patches of weaker soils. Thus, all cultural methods which influence the tree, pathogen or vector fall into the "environment" category in Figure 1.

HLB DISEASE AND COMPETITION FOR RESOURCES IN THE GROVE

HLB affects most trees by causing an advanced state of decline, similar to that found when trees are abandoned. On a macroscopic scale, the trees and

Figure 3. *Prolific weed growth, including vines, on an HLB-infected tree (foreground)*

the groves with HLB infection develop visible symptoms (sparse canopy, die-back, root decline, nutrient deficiencies, irregular flushing and flowering) similar to those found in abandoned groves. In an uninfected, well-managed grove, the trees are grown and maintained with constant artificial inputs of agrochemicals, cultivation and irrigation (all requiring energy) to prevent natural succession or return of the land to native vegetation. When those artificial energy inputs are discontinued or insufficient, natural succession advances again and the ecological balance shifts to favor pioneer species such as annual weeds, combined with increased pressure from pests and pathogens. Over a short time, the pioneers will invade and outcompete the citrus trees as they do in abandoned groves.

HLB appears to raise the need for energy inputs (such as grove care) required to favor and sustain citrus trees in a competitive environment, which is why use of more artificial inputs helps to keep infected trees productive.

An example of increased weed pressure under and on an HLB-infected tree in the grove is illustrated in Figure 3. If additional weed control methods are not applied, the infected tree will not compete favorably and may not survive. The surrounding uninfected trees need less intensive weed control because they are at a competitive advantage.

Similar principles apply to the observed nutrient deficiencies developing in HLB-infected trees and their correction through foliar nutrient sprays. Evidence collected to date shows that the additional foliar nutrient inputs do not modify the bacterial titer of the HLB disease in the trees. This artificial "balancing" situation exists in every monoculture cropping system, and is different from natural ecosystems where species diversity and complex food webs balance nutrient and energy flows, and usually the only external energy input required is sunlight.

BALANCED NUTRITION FOR MAINTAINING PRODUCTIVITY

Long before HLB was discovered in Florida citrus, the importance of comprehensive fertilization programs to maintain fruit production and tree health was recognized, but not always practiced. Annual fertilizer inputs of nitrogen, potassium and phosphorus were generally routine and adequate, but secondary- and micro-nutrient fertilization was often lacking, being driven primarily by the discovery of and response to visible deficiencies. The resulting unbalanced nutrition largely remained a "hidden hunger" but

often compromised yields and wasted fertilizer. Since the widespread adoption of frequent foliar nutrient sprays to help maintain fruit production on HLB-infected trees, growers have noticed a large increase in fruit production from the remaining uninfected trees, which now receive more optimal balanced nutrition. The increased fruit production from healthy trees has compensated for much of the lost production from HLB-infected trees for the time being, and confirms the existence of often invisible nutrient deficiencies and imbalances in Florida citrus groves.

The concept of nutrient balance stems from the fact that plants need different nutrients in specific amounts relative to other nutrients, equivalent to fairly constant nutrient ratios. Justus von Liebig, generally credited as the "father of the fertilizer industry," formulated the law of the minimum: "If one crop nutrient is missing or deficient, plant growth will be poor, even if the other elements are abundant." Liebig likened the potential of a crop to a barrel with staves of unequal length (Figure 4). The capacity of this barrel is limited by the length of the shortest stave (in this case, phosphorus) and can only be increased by lengthening that stave. When that stave is lengthened, another one becomes the limiting factor. The spilled pool of water next to the barrel represents the lost yield potential and wasted non-limiting nutrients. For example, if a citrus tree is limited by a manganese deficiency, then adding more N-P-K fertilizer will not correct the problem, but instead the additional N-P-K will likely be wasted and could contaminate the environment and constitute a revenue loss.

Figure 4. *Poorly constructed overflowing barrel illustrating Liebig's Law of Minimum*

MAINTAINING PRODUCTIVITY WITH BALANCED NUTRITION IN HLB-ENDEMIC GROVES

A citrus nutrition program aiming to maintain the productivity of HLB-infected trees as well as maximizing productivity of uninfected trees should follow an integrated approach for achieving the best nutrient balance, which also eliminates wasted nutrients. Recent research in semi-abandoned HLB-infected groves has demonstrated that a foliar nutrient spray program alone will not rejuvenate the trees and maintain productivity at economically viable levels. Foliar nutrient sprays targeting the main foliage flushes when they are half to two-thirds grown must be balanced with a good ground-applied dry or liquid fertilizer.

Typically the most important foliage-applied nutrients will include magnesium, manganese, zinc and boron. The ground-applied fertilizer will include nitrogen, potassium, phosphorus, calcium, magnesium, iron and boron.

If boron and magnesium are included in the foliar spray, they could be omitted from the ground fertilizer and vice-versa. The nutrients chlorine and sulfur are usually supplied in sufficient quantity as salts of the other nutrients — for example, chlorine in muriate of potash or sulfur in Epsom salt. Copper and molybdenum requirements are very low and residual levels of these elements in the environment are most often adequate, but should be monitored with leaf tissue testing. Due to widespread use of copper fungicide sprays, copper deficiencies are extremely rare. Nitrogen is commonly included in foliar nutrient sprays as an adjuvant to assist with uptake of the other nutrients. Calcium nitrate is a popular source of soluble calcium for both ground and foliar fertilization, and the nitrate-nitrogen counteracts soil acidification.

In summary, since symptoms expressed on HLB-infected trees resemble those seen in abandoned groves, an integrated, intensive horticultural management program which includes foliar nutrient sprays, ground fertilization, irrigation to eliminate moisture stress, and aggressive pest and weed control can be used to prolong productivity of infected trees while boosting production in uninfected trees.

The secondary- and micro-nutrient groups of plant nutrients have so far produced the greatest benefits when

sprayed on the foliage of HLB-infected citrus trees in research plots. Studies are under way to identify the effects of individual nutrients on HLB-infected trees. Magnesium, manganese, zinc, boron and molybdenum are included in those groups.

Research is being conducted to explore the possibility of rejuvenating HLB-infected trees by severely pruning or "buck-horning" them to retain only the scaffold branches and then intensively feeding the vigorous canopy regrowth with nutrient sprays. Results to date are encouraging, with a small fruit crop being produced after only one year.

Florida growers are now realizing that intensive horticultural practices can maintain economic citrus production in endemic HLB environments in the short-term; one grower (Maury Boyd) has been maintaining production for more than six years. The bottom line is that a more intensive level of horticulture is needed in HLB-infected groves, fine-tuned by economics and individual grove requirements, and that doing nothing will likely lead to early failure.

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Citrus Pickins
Industry News

Growth Products has announced that the U.S. Department of Agriculture (USDA) recently awarded both Essential Plus 1-0-1 and Bio-Nutrients™ Soluble 8-1-9 the right to bear the Biobased Product Label. The label assures consumers that the amount of biological ingredients listed on the product label is accurate and is backed by the USDA.

Two manufacturers of specialized harvesting equipment — **Oxbo International Corp. and Ploeger Agro B.V. — have merged to create the Ploeger Oxbo Group.** The new company is headquartered in the Netherlands. Both companies will continue to conduct operations using their current names and brands. In new international markets, however, they will do business as the Ploeger Oxbo Group.

FDOC Differentiates Florida Grapefruit to Build Global Demand

By Mike Yetter
Director, International Marketing

The Florida Department of Citrus (FDOC) will drive trial and purchase for Florida grapefruit and grapefruit juice in eight countries on three continents through international marketing activities. To help maintain our global leadership position, FDOC has once again actively obtained more than $5 million from the USDA Foreign Agricultural Service to support these efforts.

FDOC will kick off the citrus season in Japan this month with a major trade event attended by U.S. Embassy officials, Florida Citrus Commissioner Mike Garavaglia, chair of the international marketing committee; myself; and other key grapefruit industry representatives.

Last year, an online study about Japanese consumption patterns conducted by the University of Florida determined that Japanese consumers would be willing to pay more for a higher quality, better looking piece of fruit. We will be working closely with the Japanese trade to conduct retail promotional activities that reach shoppers at the point of purchase. Transit ads will reach millions of Japanese commuters each day. Additional advertising will appear in newspapers and magazines, on radio broadcasts and through popular social media sites online.

Retail promotions will also be the foundation of international marketing efforts in Europe (France, the United Kingdom, Belgium, the Netherlands and Sweden) and Canada. Supermarket displays, including brochures and recipes, educate shoppers about the nutritional value and diversity of grapefruit, while sampling reinforces the delicious taste.

FDOC utilizes public relations to generate coverage in print, broadcast and online media. When reporters share health and nutrition information along with recipes, they help FDOC to increase consumer awareness and keep Florida grapefruit top of mind. Targeted culinary events and consumer shows provide the opportunity for us to interact with consumers, sample our products and create new grapefruit fans.

Last year, FDOC partnered with the Florida Department of Agriculture and Consumer Services (FDACS) to grow the market for Florida grapefruit in Korea. We'll continue to work with FDACS to expand this new market that has great potential for growth.

If you'd like to know more, you'll find our complete marketing plan at http://www.fdocgrower.com/marketing/international-marketing/. We also invite you to attend the upcoming Florida Citrus Commission meetings in Bartow to hear periodic updates about our activities in each country. Please feel free to contact me at (863) 537-3962 or myetter@citrus.state.fl.us if you have any questions.

The mission of the Florida Department of Citrus is to grow the market for the Florida citrus industry to enhance the economic well-being of the Florida citrus grower, citrus industry and the state of Florida. For more information, visit www.FDOCGrower.com

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