Citrus tree health and HLB incidence

By Timothy M. Spann, Kirandeep Mann and Arnold W. Schumann

A lot of attention has been paid to the apparent beneficial effects of foliar nutrition programs on maintaining the health of HLB-infected trees. Recently, observations have indicated that overall tree health influenced by soil physical and chemical properties as well as mineral nutrition may be related to the incidence of HLB. This article summarizes these initial results and discusses how tree health may affect HLB.

In a study on the effects of HLB on fruit size, yield and quality, we observed that the HLB-infected trees tended to be smaller compared to the uninfected control trees. The question arose whether the HLB-infected trees were smaller because they were infected and had been growing more slowly for some time, or were they smaller prior to infection? About the same time, we began to notice what appeared to be a correlation between areas of a grove with poor soils and weak trees and the incidence of HLB. These observations led us to begin investigating whether there is a link between general tree health, water/fertilizer uptake and HLB incidence.

For baseline information on how tree health, growth and production is affected by various soil characteristics, we used data from the recently completed Ph.D. dissertation of author Kirandeep Mann, "Characterization and amelioration of yield-limiting soil variability in Florida citrus production." This study looked in detail at the relationship between soil variability within a grove and tree yield and canopy volume. The study grove is shown in Figure 1. It is clear from looking at this aerial view of the grove that there is a direct relationship between the very white sand-soak area in the middle of the grove and tree size. The trees were all the same age. Prior to this, a detailed study of the specific soil characteristics causing these differences had never been done.

Not unexpectedly, there was a strong positive correlation between tree size and yield in this grove. Larger trees yielded more than smaller trees. Tree size and yield were highly correlated with soil organic matter (SOM) content, which was lowest (0.2 percent) in the central section of the grove and increased (2.0 percent) toward the perimeter. SOM content was inversely related to sand content of the soil. That is, sand content was highest (99 percent) in the center of the grove where SOM was lowest and decreased (96 percent) where SOM was highest.

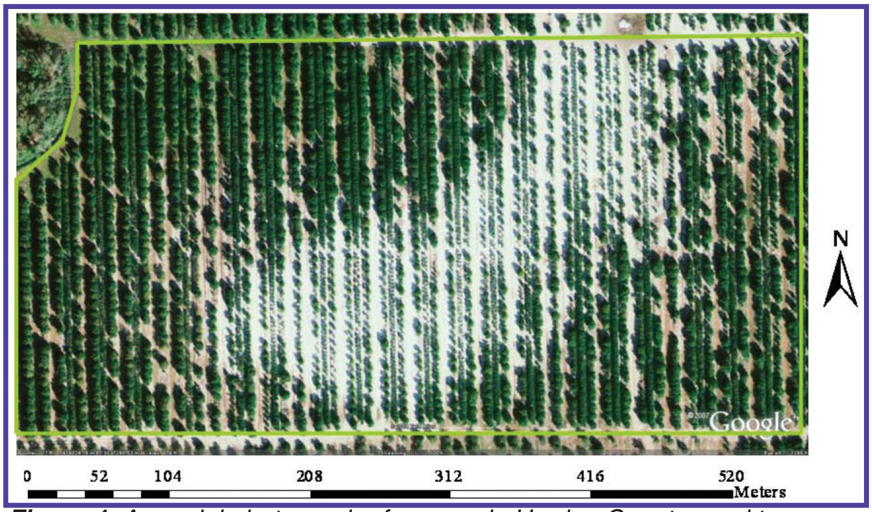

Figure 1. An aerial photograph of a grove in Hardee County used to assess the relationships between soil physical and chemical properties and tree canopy volume and yield.

These two factors, SOM and sand content, were related to soil water-holding capacity and plant available water content. The amount of water in the soil at field capacity was much higher in the highly productive areas of the grove where SOM was high and sand content was low, compared to the less productive areas (low SOM, high sand).

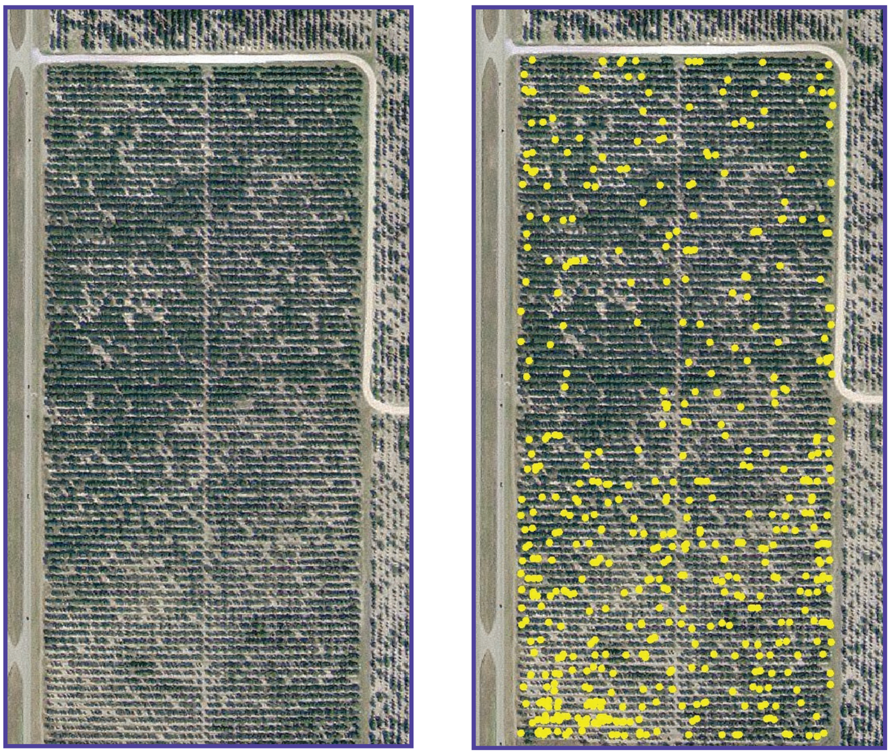

Figure 2. An aerial photograph of a Ben Hill Griffin grove south of Lake Placid showing soil and tree canopy variability in 2004 prior to HLB being found (left). The same grove showing the cumulative HLB finds through late 2009 (right).

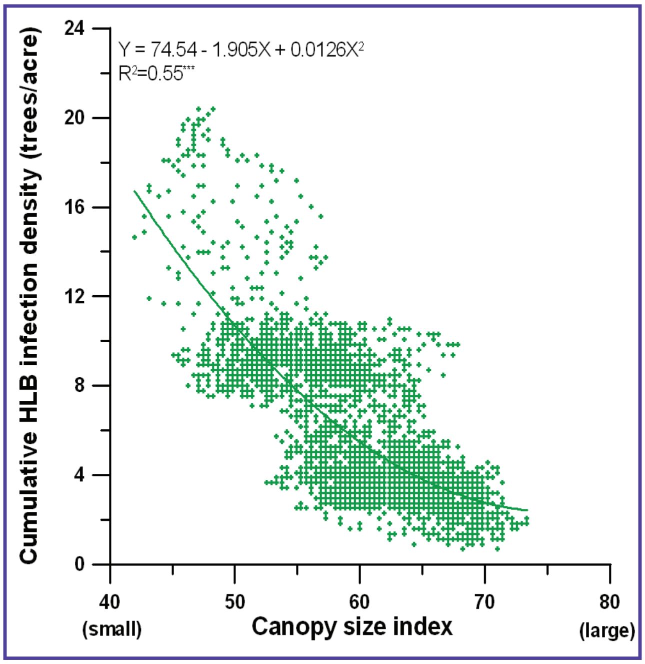

Figure 3. *A graph showing the results of a correlation analysis between canopy size index and the cumulative HLB infection density. The data show a strong negative relationship between HLB incidence and canopy size.*

Areas with higher SOM had improved water-holding capacity that grew larger, better yielding trees than sandy areas. The amount of water available for plant use between field capacity and the permanent wilting point (the point at which the tree cannot extract water from the soil) was much greater in the highly productive zones. In other words, if the entire grove was irrigated on the same schedule, the central section of the grove would run out of available water sooner than the more productive zones around the outside. Thus, the trees in the low productivity area in the center of the grove would become stressed sooner, and growth would be inhibited.

The soil properties mentioned above were also correlated with soil phosphorus, potassium, calcium, magnesium, manganese and aluminum content, suggesting that plant nutrient deficiency was also limiting tree growth in the weak parts of the grove.

Recently, a Ben Hill Griffin grove with a similar appearance in an aerial view to the one used in the above study was identified south of Lake Placid. The aerial image from 2004 shows how this 70-acre grove appeared before HLB was found (Figure 2). This grove was originally planted in the late 1980s, and routine resetting occurred until recently so trees in the block range from +20 years old to <5 years old. From the aerial image, areas of thin canopy associated with very white sand-soak areas can be seen. Observations on the ground indicate these thinner canopies and smaller trees follow variation in soil characteristics, independent of tree age. HLB was found in this grove in 2007, and the cumulative number of infected trees as of late 2009 is represented by the yellow dots in Figure 2.

Visually comparing these two images, it appears that there is a relationship between the areas of smaller, weaker trees and HLB incidence. When a detailed statistical analysis was performed comparing HLB incidence with canopy size, these visual observations proved correct (Figure 3). A detailed sampling and analysis of the soil in this block is currently under way to confirm that the visual soil and tree variability seen in the aerial photo are similar to the block used in Kirandeep's study.

While the correlations discussed in this article are generally strong and are scientifically valid, it must be remembered that not all correlations are causal. Our greatest limitation in this type of study is that we are looking at things after the fact. We know that there is currently a higher incidence of HLB in the areas of smaller trees on poorer soils, but we do not know that those trees were actually infected with HLB via the psyllid vector at a higher rate compared with the larger trees on better soils. Scouting efficiency may also have been higher in areas of the grove with smaller trees.

One possible explanation for what we are seeing is that all of the trees may have been infected at the same rate, but the smaller, presumably less healthy trees are simply developing symptoms more quickly and being identified earlier. The other possible explanation is that the smaller trees on the poorer soils are actually weaker and more susceptible to HLB because they are more attractive to psyllids and/or because they are less tolerant of the bacterium.

Regardless of the ultimate explanation for what we are seeing, the data are supportive of the general concept that tree health is important in the fight against HLB. Improving tree health through foliar nutrition programs and/or amelioration of poor soil conditions may compensate for some root decline and enhance tree tolerance to HLB. However, if it does not, improved tree health will still be beneficial by increasing the productivity and quality of trees and improving the economics of citrus production in the presence of HLB.

Timothy Spann (assistant professor), Kirandeep Mann (post-doctoral researcher) and Arnold Schumann (associate professor) are at the University of Florida-IFAS Citrus Research and Education Center in Lake Alfred. *Thanks are due for the help and support from the Mosaic Company, Ben Hill Griffin, Inc., and FCPRAC.* *Email spann@ufl.edu for more information.*