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Regular leaf nutrient analysis improves HLB-affected trees

By Tripti Vashisth and Davie Kadyampakeni

Nutrition management is complex! Multiple factors affect the nutrient uptake and availability in trees. For example, high soil pH can limit the uptake of soil-applied micronutrients such as zinc (Zn) and manganese (Mn). Oxide forms of nutrients might be less available than nitrate or sulfur forms. Moreover, the time and method of nutrient application can affect the availability of nutrients to the trees.

University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) researchers have gained a significant amount of information about citrus nutrition in the last decade. There is "no one size fits all" when it comes to fertilizer programs. Each grove is unique. Therefore, fertilizer programs need to be carefully formulated to fully reach the tree's yield potential.

In a field trial aimed at evaluating the impact of controlled-release fertilizer (CRF) along with elevated levels of Tiger-Sul micronutrients on the yield of Valencia oranges, the best-performing treatment combination of CRF and micronutrients in one site was the worst-performing treatment in another site. For example, a treatment combination of CRF + Tiger micronutrient mix + Tiger iron (Fe) produced more than 1,200 boxes per acre in three years in Arcadia, Florida. However, the same treatment produced about 900 boxes per acre in three years in Fort Meade, Florida.

Dry fertilizer with foliar micronutrients was the worst performer at both locations and produced about 900 boxes per acre for three years. A closer look at soil results revealed that Arcadia soil was significantly deficient in Fe as compared to Fort Meade soil. Thus, supplemental Fe (around 8.5 pounds per acre per year) performed better than the control.

In 2019, the UF/IFAS Citrus Nutrition Box Program was initiated as a demonstration project for growers to apply regular leaf and soil nutrient analysis to custom fertilizer programs. All the participants in this program received free leaf (quarterly) and soil (annually) sampling kits and a quarterly customized fertilizer program based on nutrient analysis results. The customized fertilizer programs were developed by UF/IFAS researchers and citrus Extension agents at no cost to the growers.

In the first year of the Citrus

Figure 1. Manganese and zinc concentration (in parts per million) throughout the year in groves participating in the Citrus Nutrition Box Program. The top row shows results sorted by scion variety, and the bottom row is by rootstock.

Nutrition Box Program, 144 boxes were requested by growers; about 60 growers participated in all four quarters. The program emphasizes doing a leaf nutrient analysis multiple times per year in contrast to the historical recommendation of one analysis of 4- to 6-month-old spring flush in late summer.

Growers recently have begun applying fertilizer multiple times per year to compensate for the small and weak root systems of HLB-affected trees. Therefore, each application is an opportunity to ensure that the nutrient requirements of the trees are being addressed.

Not all scions and rootstocks have the same nutrient profile.

This program has given researchers a snapshot of Florida citrus nutrition trends. The pockets of low soil pH (Hardee, DeSoto and Charlotte counties) and low leaf Fe concentration (Hardee, Manatee, DeSoto and Charlotte counties) have been identified and need more focused management strategies.

Another interesting observation is that Hamlin and Swingle seem to undergo a sudden dip in leaf Mn and Zn concentration from fall to spring, in contrast to other varieties and rootstocks (Figure 1). This may contribute to the poor performance of Hamlin and Swingle under HLB conditions compared to other scions and rootstocks. A customized nutrition program addressing such nutrition requirements may enhance the performance of Hamlin and Swingle.

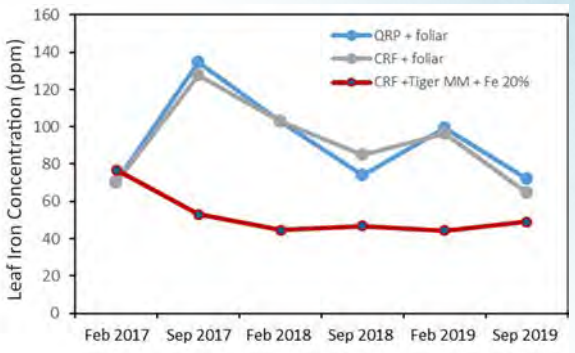

Figure 2. Leaf iron concentration in a field trial. The red line is the best-performing treatment in Southwest Florida. The blue line is the control.

Leaf nutrient concentration is intricate.

Focusing on leaf nutrient concentration is important, but many factors can influence the numbers. When interpreting the leaf nutrient concentration, it is important to not only look at nutrient values but also consider the tree age, time of year, leaf age, etc.

Leaf nutrient value tells how much nutrition has accumulated in the leaf. However, considering that most nutrients are utilized in growth processes, an actively growing tree may metabolize nutrients in supporting growth and may not be able to accumulate a significant portion of it in leaves. For example, in the same CRF and micronutrient trial mentioned above, CRF + Tiger micronutrient + Tiger Fe was significantly better than the control in terms of yield. Over three years, the Fe treatment produced about 300 boxes per acre more than the control treatments.

However, when looking at leaf nutrient concentration (Figure 2), the

Photos by Chris Oswalt

Leaf Sampling Dates	N	P	K	Ca	Mg	S	Mn	Zn	Cu	Fe	B
Dec. 2019	3.2	0.16	1.4	4	0.46	0.23	14	20	10	26	113
April 2020	2.9	0.14	1.5	3.4	0.44	0.33	16	112	3	31	121
Aug. 2020	3	0.15	1.9	2.8	0.37	0.23	13	47	5	47	98
Dec. 2020	2.7	0.14	2	2.9	0.4	0.29	13	25	5	39	107

Figure 3. Leaf nutrient analysis of a grapefruit grove participating in the Citrus Nutrition Box Program

better-performing treatment shows lower Fe concentration in leaves than the poor-performing treatment. The Tiger micronutrients are soil-applied, whereas the control treatments are foliar applied. Soil-applied micronutrients have a better distribution of nutrients within the trees as they can readily move within the tree, including to the fruit, and are not stuck at the uptake site. Therefore, even though the better-performing treatment included application of approximately 25% more Fe than the control treatment, the leaf nutrient results do not show it. The added Fe supported the increased fruit and canopy growth.

Similarly, in the Citrus Nutrition Box Program, the leaf nutrient number often does not seem to have changed dramatically even with added nutrients. However, a tree may be producing more foliage or fruit with added nutrients. Therefore, the leaf nutrient concentration should be interpreted in respect to canopy and fruit yield.

Figure 3 shows pictures from a grower participating in the Citrus Nutrition Box Program. The photos show severely HLB-symptomatic grapefruit in March 2020 (at the start of the program) and in March 2021. Significant foliage can be observed on the tree upon implementation of the fertilizer program, though the leaf nutrient concentration does not seem to have changed significantly. It is rational to conclude that the added nutrients are being utilized in growth.

HLB-affected trees need more secondary nutrients and micronutrients than healthy trees.

HLB-affected trees seem to have higher nutrient needs than healthy trees. When nutrients are supplied in an adequate amount and available throughout the growing period, the trees tend to perform well. New findings suggest that to maintain the productivity of HLB-affected trees, it is critical to be at the higher end of the optimal nutrient range. For example, optimal leaf nutrient concentration for Mn is 25 to 100 parts per million (ppm). However, HLB-affected trees are more productive when their leaf nutrient concentration is above 60 ppm. With the Citrus Nutrition Box

Program, trees are responding to a higher than recommended rate of nutrients when applied during the growing season.

The bottom line is that it is possible to customize fertilizer based on leaf nutrient analysis to improve the growth and productivity of trees. However, a fertilizer program should be site, scion and rootstock specific. A steady availability of secondary nutrients and micronutrients throughout the year can help trees, especially Hamlin and Swingle. Leaf nutrient concentration, canopy growth and fruit yield are all interconnected, and a fertilizer program necessitates thoughtful formulation to maximize the yield potential of HLB-affected trees.

A fertilizer program should be site, scion and rootstock specific.

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