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—Scientific Note—

Effect of HLB on Leaves and its Implication on Nutrient Profile

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Huanglongbing [(HLB); *Candidatus* Liberibacter asiaticus] is a bacterial citrus disease that has resulted in more than 70% decline of Florida sweet orange (*Citrus sinensis*) production. HLB symptoms are quite evident, ranging from blotchy mottled leaves, nutrient deficiencies, starch accumulation and reduced leaf size. HLB affected trees undergo significant root and shoot dieback, which affects nutrient uptake, assimilation, and translocation. Based on newly developing research, it is recommended that citrus growers regularly perform leaf nutrient analysis to assess the nutritional status of the HLB-affected sweet orange trees and hence accordingly tailor their fertilizer program to address the nutritional needs of the trees. However, due to the changes in the morphology and composition of leaves on HLB-affected trees, it is critical to understand if there is any effect on leaf nutrient profile. Therefore, the goals of this study were to assess the effect of HLB on mineral nutrient content in different plant parts, HLB effects on leaf size, leaf weight, and starch accumulation on nutrient accumulation in sweet orange.

HLB-affected leaves were about 20% smaller than healthy leaves. On fresh weight basis, HLB affected leaves were about 20% lighter (Fig. 1) and had 10 times more starch than healthy leaves. Interestingly, when dry weight was measured there was no difference in leaf weight between healthy and HLB affected leaves, and the starch content was 2.5% in HLB-affected trees as compared to 1.5% in healthy trees. During the drying process, healthy trees lost significantly more water as compared to those that were HLB affected, indicating water deficit in HLB-affected leaves. HLB-affected trees are known to be under water deficit; therefore, it is likely that water accumulation is lower in HLB-affected leaves thereby resulting in smaller leaf area.

In regard to leaf nutrient analysis, usually measured on dry weight basis, in HLB affected trees calcium (Ca), sulfur (S), zinc (Zn), manganese (Mn), and iron (Fe) values were lower, but nitrogen (N) was higher in leaves of HLB-affected trees compared to leaves on healthy trees. However, N, potassium (K), B, copper (Cu) and Mn values were lower in roots of HLB affected trees. Most of nutrients were found to be deficient in HLB affected trees as compared to healthy trees. Out of all the nutrients, B and Cu had significant positive relation with starch content in HLB affected trees, but not in healthy trees. When biomass of leaves, stem and roots were taken into consideration separately, no significant difference was seen in total nutrient values between healthy and HLB-affected trees; N along with Ca, B, and Cu values were found to be higher in stem tissue of healthy trees and Mg, B, and Zn found to be deficient in the roots of HLB-affected trees, respectively. When total nutrients present in a tree were taken into consideration, N, Ca and Mn were significantly lower in HLB-affected trees than in healthy trees. Macronutrients like Ca, Mg, and S along with micronutrients such as B, Zn, Mn, and Cu showed a significant relation for the parameters of plant growth. A significant variation of nutrient content in plant parts was seen when total biomass of trees was taken and most of nutrients were deficient in HLB-affected trees.

Our preliminary results suggest that the leaf nutrient profile is not affected by excessive starch buildup or differences in leaf morphology. The observed deficiencies of most the nutrients in the leaves of HLB-affected trees is possibly due to higher nutrient requirements.

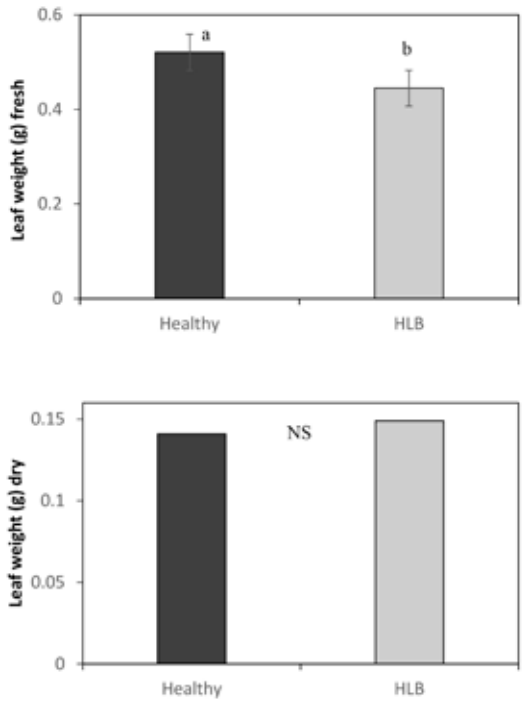

Fig. 1. Average weight of healthy and huanglongbing-affected sweet orange (*Citrus sinensis*) leaves, grown under greenhouse conditions. Different letters indicate significant differences ($P < 0.05$) among treatments. NS = not significantly different.

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