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—Scientific Note—

Evaluation of Varied Fertilization Rates on Root Growth and Distribution of HLB-affected 'Valencia' Orange Trees

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Candidatus Liberibacter asiaticus (*C*Las), which causes Huanglongbing (HLB) in citrus trees, has a great impact on tree root health, fruit development, and juice quality. HLB-affected trees have a fibrous root density loss of about 30 to 80%. *C*Las blocks the phloem, disrupting the functionality of phloem in the transportation of sugars from sources to sinks. The leaves act as sources due to production of sugars in the photosynthetic process while roots are the sinks due to a higher demand of sugars for growth and nutrient uptake. Thus, the flow of sugars in phloem tubes of HLB-affected trees transports *C*Las to the roots resulting in loss of fibrous roots. Loss of fibrous root loss subsequently interferes with water and nutrient uptake, which negatively affects tree overall performance and productivity. There are no current fertilization guidelines to determine optimal nutrient concentrations in citrus roots that can lead to a better understanding of the relationship between root growth, distribution and HLB-affected trees for improved management strategies. Therefore, a two-year study was conducted to evaluate the effect of varied soil fertilization rates on root growth and distribution of 5- to 8-year-old HLB-affected 'Valencia' (*Citrus sinensis*) oranges on 'Swingle' citrumelo rootstock on the Florida Ridge and Flatwoods soils. The Ridge soils at Citrus Research and Education Center (CREC) site are excessively drained Entisols formed from eolian deposits and sandy marine deposits. Soils at the southwest Flatwoods site are poorly drained and rapidly permeable soils that are formed in sandy marine sediment underlain by limestone. The Ridge soils have a high density of trees of about 450 trees/acre while the Flatwoods soils of southwest Florida have a lower tree density of about 300 trees/acre.

The experimental design for the orange trees was a randomized complete-block factorial design with an evaluation of macronutrients K and Ca at 220 lb/acre K and 40 lb/acre Ca (1× macronutrients) and 440 lb/acre K and 80 lb/acre Ca (2x macronutrients); and micronutrients (Zn and Fe) at a) 5 lb/acre (1× micronutrients), b)10 lb/acre (2× micronutrients) and c) 20 lb/acre (4× of micronutrients) of the current UF/IFAS fertilization guidelines. Root scans were done using minirhizotrons at 0–19.1 cm, 19.1–40.7 cm, 38.2–59.8 cm, and 57.3–78.9 cm soil depths. Root growth and dieback were estimated using the CID-600 root imager. Results obtained from the study showed that root growth and distribution were greater in 0-19.1-cm than 19.1–40.7 cm to 57.3–78.9-cm soil depths. Thus, root growth decreased ($P < 0.0004$) with increasing soil depth due to variation in nutrient availability for tree uptake. Root growth and dieback was also influenced by season. At Flatwoods site, root growth increased from Nov. 2019 till Feb. 2020 (fall/winter season), however sharp decreases in root growth were observed by July 2020 and at the end of winter season. Root dieback was reduced during the fall and spring season. Sharp increases in root dieback were observed throughout Summer 2020. However, root dieback decreased from mid-Fall 2020 until the end of the study. Similarly, at Ridge site, root growth decreased sharply from Nov. 2019 to Jan. 2020. Root growth increased during winter season until toward the end of the spring season (Apr. 2020) when a decrease in root growth was observed. Root dieback increased from Nov. 2019 to Dec. 2019, however during the winter season, root dieback decreased sharply. This was followed by an increase in root dieback once the spring season began and another decrease in root dieback at the beginning of Fall 2020.

In conclusion, nutrient availability affects root distribution and growth in the soil. With increased nutrient availability in the topmost layer, there is more root growth while root growth is decreased with depth. Additionally, increased nutrient availability at occurrence of physiological processes in citrus trees results in root growth flushes. Processes such as fruit formation, growth of shoots, and flower formation affect root growth. When these processes are occurring, nutrient expenditure is mostly on the vegetative growth instead of root growth. Therefore, at higher fertilization rates, nutrient availability was increased, thus promoting root growth and distribution in HLB-affected orange trees.

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