# CITRUS ADVANCED TECHNOLOGY PROGRAM

**QUARTERLY & FINAL PROGRESS REPORT FORM:** Control of Citrus Greening, Canker & Emerging Diseases of Citrus

▶PROJECT QUARTER END October 2021 ◯ *Quarterly Report* ◉ *Final*

Proposal Title

Development of Root Nutrient and Fertilization Guidelines for Huanglongbing (HLB)-Affected Orange and Grapefruit

Today's Date 11/30/2021

Sponsoring Organization (drop-down) Citrus Research and Development Foundation

Category (drop down) Horticultural & Management


**ABSTRACT** (Executive Summary-public report-do not disclose proprietary information or intellectual property)

Project Objectives:
The purpose of the project was to develop new guidelines for restoring root health and improving overall tree nutrition for Florida oranges and grapefruits. The objectives of the project were to: 1. Determine optimal nutrient concentrations in roots and leaves for multiple grapefruit and orange varieties. 2. Compare and contrast fertigation, soil, and foliar fertilization to identify best application method for uptake of nutrients into both underground and aboveground components. 3. Investigate the relationship between root and leaf nutrient contents to tree health, yield, and fruit quality as well as bacteria titer. 4. Generate updated and new guidelines for optimal nutrient contents for roots and leaves for HLB-affected trees.

Summary Description of the Project:
The project was conducted at three sites: Citrus Research and Education Center (CREC), Southern Gardens Citrus near Clewiston, FL and Indian River Research and Education Center (IRREC). Data collection on root, leaf and soil nutrient evaluations, root scanning, canopy size determinations and soil sampling on the central Ridge and southwest Flatwoods along with fertilizer treatment applications were done throughout the project. Mini-rhizotrons were installed at the beginning of the experiment and root images were taken monthly and root density data were measured half-yearly. Fruit yield and juice quality and bacteria titer data were measured yearly. We compared standard fertilization with elevated (1x and 2x of current recommendations) macronutrients (potassium, magnesium and calcium) along with elevated (1x, 2x and 4x of current recommendations) micronutrient blends (iron, zinc, boron and manganese). At the UF/IFAS IRREC in Fort Pierce, FL the research was conducted on flatwoods soils in a randomized complete block design field study on ‘Ruby Red’ grapefruit. Micronutrients (B, Fe, Mn and Zn) were applied using three different concentrations (1x, 2x, and 4x current UF/IFAS guidelines) in the form of either dry granular water-soluble fertilizer, controlled-release fertilizer, or liquid fertilizer. A total of 600 trees divided in 40 experimental units were employed. We collected leaf and root nutrient concentrations, canopy volume and tree height twice a year. Mini-rhizotrons were installed at the beginning of the experiment and root images were taken four times a year.

Major accomplishments of the project:
One key finding in HLB-affected oranges is that it is not beneficial to double macronutrients such as Ca, Mg and K, but rather increasing micronutrients such as Fe, Mn, B and Zn by 1x to 4x because fruit yield, root health and canopy volume were optimized where micronutrients were elevated compared to current guidelines. For HLB-affected grapefruit, the results of this study may show evidence that rehabilitation of HLB-affected trees may be limited by the age of the tree and number of years it has been HLB-affected and should start early at the establishment of a grove. Two graduate students completed graduate degrees in Soil and Water Sciences and Horticultural Sciences. We made 8 grower presentations, published two MS theses, 5 citrus industry articles and 3 refereed journal articles. Next steps Additional 5 articles will be published in refereed journals in the next few months upon completion of data analysis. This will also be followed by extension bulletins based on our current results and follow-up studies to follow on the inconsistent results on yield, canopy size, root growth and root density patterns and bacteria titers. In the next phase of the research, we plan to use other tools we have learned from growers and other projects such as using real-time artificial intelligence to measure nutrient deficiency, soil amendments and using variable rate fertilization tools, besides fertigation and controlled release fertilizers.



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Sponsor Project Number CRDF18-042C

Project Duration (years) 3 *Year of Project* 3

% Completion of Objectives (FDACS requirement) 100.00%




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