CITRUS ADVANCED TECHNOLOGY PROGRAM

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

PROJECT QUARTER END June 2024 ○ *Quarterly Report* ● *Final*

Proposal Title

Organic acids compared to conventional acidification for improved nutrient uptake and root physiology

Today's Date: 08/22/2024

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)

Recent work demonstrated that irrigation and soil acidification can improve the health and productivity of huanglongbing (HLB)-affected citrus; however, the best long-term methods to achieve this response have not been investigated. This work was done on highly pH-sensitive rootstocks, so the mechanism and broader applicability to other rootstocks is not fully understood. pH adjustment with sulfuric acid or sulfur treatment does temporarily modify the pH, but other acidifiers such as organic acids could provide additional benefits while acidifying the soil. The purpose of this project was to understand the physiological response of HLB-affected roots to soil acidification and to determine if organic acids that also provide improvement in soil health can effectively acidify the root zone and improve nutrient uptake and tree productivity through two main objectives.

Objective 1. Determine effects of lowered soil pH on Candidatus Liberibacter asiaticus (CLas) populations and root physiology including internal root apoplast and vascular tissue pH. Large-scale field trials of acidification on different rootstocks would require long-term experiments with carefully laid out plantings of multiple rootstocks at multiple sites with an overlaid acidification treatment. Understanding how acidification affects HLB-affected root physiology and CLas populations in pH-sensitive and tolerant rootstocks could speed up recommendations for acidification on new rootstocks.

Objective 2. Field test multiple acidification materials including organic acids for tree response, CLas suppression, nutrient uptake, and root and vascular pH changes. Organic acids provide multiple benefits to soil and root health that sulfur-based acidification cannot provide. If these acidifiers can provide the same acidification benefit, it would increase growers' toolset of recommended acidification treatments and provide additional benefits to grove management in nutrient uptake and soil health.

This project addressed priority 2 of the RFP, specifically whether lower soil pH lowers internal root pH and subsequently lowers bacteria levels in the tree and if using organic acids for acidification can increase root nutrient uptake. Key findings from the greenhouse study were that acidic soils stimulate root growth, particularly around pH 5.5 conditions; citrus roots exhibit remarkable resilience and internal compensation mechanisms in response to pH variations. Optimizing soil pH and nutrient management can mitigate the impacts of HLB and promote the resilience of citrus trees. The field study showed a positive correlation between soil pH and soil calcium (Ca), magnesium (Mg0, zinc (Zn), manganese (Mn), and boron (B), possibly suggesting that the availability of these soil nutrients increased as pH increased. A negative correlation was observed between soil pH and soil iron (Fe), sulfur (S), potassium (K), and phosphorus (P), indicating decreased nutrients in soil solution as pH increased. There was no significant canopy difference between treatments but a difference between time points due to trees deteriorating due to the bacteria or loss caused by natural hazards, especially in hurricane-prone Florida. Results show no significant difference in fruit yield and fruit quality parameters in all treatments. In both sites, soil pH positively correlated to soluble solids and soluble solids to acid ratio but negatively to titratable acidity.

Project Outputs and Presentations

Journal manuscripts in preparation or accepted

1) Sambani, D., T. Vashisth, D. Bright, D. Kadyampakeni. In preparation. Physiological responses of huanglongbing (HLB)-affected citrus tree roots to soil acidification. Journal of Environmental Quality.

2) Sambani, D., T. Vashisth, D. Bright, H. Ghoveisi, L. Rossi, T. Ayankojo, A. Atta, D. Kadyampakeni. The impact of organic acids on soil health and acidification for enhanced nutrient uptake and tree productivity in HLB-affected citrus trees. HortScience (In review)

3) Sambani, D. and Kadyampakeni, D. Exploring the Nexus of Citrus HLB Dynamics and Interactive Influences of Soil

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Organization: University of Florida

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

% Completion of Objectives (FDACS requirement): 100.00%

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