CITRUS ADVANCED TECHNOLOGY PROGRAM

QUARTERLY & FINAL REPORTS: Control of Citrus Greening, Canker & Emerging Diseases of Citrus

SELECT PERIOD June 2016

Quarterly Report ◉ Final

Proposal Title

Calcium carbonate may reduce root health and exacerbate HLB expression

Today's Date: 5/12/2016

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

Category (drop down): Infection Consequences

REPORT UPDATE (500 words-It is not necessary in this public report to disclose your institution's proprietary information or intellectual property.)

We hypothesized that groves suffering most from HLB were exhibiting stress associated with high soil concentrations of bicarbonate since they support lower fibrous root density compared to groves with lower bicarbonates (< 100 ppm) in irrigation water and/or soil pH (< 6.5). To confirm this relationship, we surveyed 41 grove locations in Highlands and Desoto Counties with varying liming history and deep vs. shallow wells mostly on Swingle and Carrizo. Lower root density was significantly related to well water pH > 6.5 and to soil pH > 6.2. Records from these blocks revealed that yields from groves under high bicarbonate stress declined 20% from 2011 to 2013, in contrast to ridge groves with low bicarbonate stress that increased 6% in production even though HLB incidence had accelerated.

Yield losses were correlated with less fibrous root density which reduces root system capacity for water and nutrient uptake. Evidence from research on other crops indicated that bicarbonate impairs the root's ability to take up important nutritional cations including Ca, Mg and K as well as micronutrients, especially Mn and Fe. Similar data for citrus were lacking; hence there was a need for more specific information for the effects of HLB, bicarbonates and their interaction for trees on the commonly grown rootstocks in Florida (i.e. Swingle and Carrizo) under field conditions.

For evaluation in replicated plot trials, acidification of irrigation water and soil treatments that reduce bicarbonate were applied to quantify their effects on root health. Irrigation water acidification was targeted to soil pHs of 7.5, 6.0, 5.0 and 4.0 without or without sulfur application to soil to maintain the pH targets. In response to acidification leaf nutrient concentrations have been maintained in the optimum or high range. Greater leaf concentrations of Mg, Ca, Fe, Mn and Zn in plots were measured at target soil pH of 4.0 and 5.0, but no differences were found with or without sulfur amendment. Lower irrigation applications and few fertigation applications resulted in reduced soil acidification in the irrigated zone. Survey for root density, tree nutrient status and yields was implemented in groves that received water/soil acidification treatments to reduce soil pH and bicarbonate concentrations in comparison to unmanaged groves that were either untreated or experienced little or no bicarbonate stress based on the status of irrigation water and/or liming history. Acidification of irrigation water in central ridge and south central flatwoods Valencia orange groves on Swingle rootstock maintained soil pH below 6.5 on the flatwoods and 6.0 on ridge. Over the last 2.5 seasons of survey, root density as an index of root heath was sustained. Phytophthora populations remained below the damaging level in ridge groves and in flatwoods increases to damaging levels were coincident with the fall root flush dropped back to non-damaging levels for remainder of the season. Compared to 2014-15, yields in the ridge blocks have increased up to 4% and on the flatwoods increased up to 20%. Soil and tree responses to acidification required several seasons to become completely manifested. The final goal is to perform an economic analysis of bicarbonate management in terms of irrigation water and soil acidification costs versus benefit from gains in tree health and productivity so that growers may prioritize their expenditure on practices that mitigate losses of tree productivity due to HLB. With a complete sets of 2015-2016 yield data from acidified grove blocks, a cost benefit analysis will be performed.

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