CITRUS ADVANCED TECHNOLOGY PROGRAM

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

▶PROJECT QUARTER END February 2022 ○ *Quarterly Report* ◉ *Final*

Proposal Title

Novel multi-metal systemic bactericide for HLB control

Today's Date: 03/28/2022

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

Category (drop down): Other

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

Various multi-metal formulations of Mg-hydroxide and/or Zn-hydroxide were successfully loaded with Cu-chelates using a sol-gel strategy. The average hydrodynamic radius of the MM50C50M(Mg-Cu), MM25C75Z(Zn-Cu), and MM25C75M (Mg-Cu) formulations determined by DLS were 880, 580, and 450 nm, respectively. XRD results suggested the sucessful substitution of Cu in the MM25C75M Mg-OH brucite lattice structure.

All multi-metal formulations demonstrated a superior or equivalent performance against model pathogens such as Xanthomonas alfafae relative to copper standards in vitro. Systemic movement results suggested signifcant uptake of Mg for all multi-metal formulations. XRF and AAS results suggest the systemic movement of Cu was also detected in the leaves, roots, and stems at significant levels that exceed the MIC of Cu. Approximately 24-hours post treatment, the Cu-Zn treatment was detected primarily in the stems and leaves. Within 72-hours after application signifcant increases of Zn and Cu was detected in the roots. All Zn-Cu and Zn control formulations signifcantly reduced Canker lesion sums as compared to the untreated controls in a series of greenhouse trials.

MM25C75M(Mg-Cu), MM25C75Z(Cu-Zn), and MM10C45M45Z(Mg-Cu-Zn) treated grapefruit trees in the first field trial were observed to have 0% of fruit with canker lesions present throughout this trial, which was significantly better than the untreated control (0.8%, 1.2%, 4.6%, and 8.2% at successive disease ratings). The yield of MM25C75M(Mg-Cu), MM25C75Z(Cu-Zn), and MM10C45M45Z(Mg-Cu-Zn) treated grapefruits was 50.6, 60.5, and 49 lb/tree respectively. The yield of MM25C75Z(Mg-Zn) treated grapefruits showed a statistic difference compare with untreated grapefruits (43.8 lb/tree). The mean fruit diameter for MM25C75M(Mg-Cu), MM25C75Z(Mg-Zn), and MM10C45M45Z(Mg-Cu-Zn) treated grapefruits of 86.9, 83.6, and 85 mm, respectively, was not significantly different from the untreated controls (85.8 mm). No significant differences were found in internal fruit quality based on brix acid ratio or total soluble solids.

All experimental treatments significantly improved yield with respect to the untreated control. The untreated control group was observed to yield an average of 157 lbs/tree. The Kocide copper standard control groups reported an average of 171 lbs/tree. Although not statsicallystatistically different from the Kocide control, laboratory grade Cu-ZnO, laboratory grade TMN 113-MgSOL-Cu, and Bz1.1-Cu, and Bz1.1 reported average yields of 202, 203, 189, and 207 lbs/tree, respectively. Laboratory grade ZnS-Cu did outperform all materials significantly with an observed yield of 229 lbs/tree in this years trial. All Mg:Cu ratios evaluated in the MM25C75M(Mg-Cu) subtreatment group promoted yields statistically similar to each other and the Kocide control.

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