CITRUS ADVANCED TECHNOLOGY PROGRAM

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

▶ SELECT PERIOD December 2015

(●) *Quarterly Report* ( ) *Final*

Proposal Title

Fixed-Quat: A novel alternative to Cu fungicide/bactericide for preventing citrus canker

Today's Date	Sponsoring Organization (drop-down)	Category (drop down)
1/17/16	Citrus Research and Development Foundation	Pathogen/Disease Detection

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

This research project aims at developing an alternative to Cu biocides. Fixed-Quat is a non-phytotoxic highly potent antimicrobial formulation which are being evaluated in this project.

In the previous reporting period, Fixed-Quat A-II and AP-II nanogels were studied for their antimicrobial and plant safety properties. These formulations demonstrated strong potential for further development on which study is being continued. In this reporting period, a new environmentally-friendly, minimally processed silica core material (EPA approved for food use; cost effective) was used to create a new version of Fixed-Quat, referred to as Fixed-Quat-E. Fixed-Quat E nanogel was synthesized with a quat concentration of 9,000 ppm (the quat active is cleared for EPA "for food use"). The composition and interactions between the active and inert components were confirmed using Fourier Transform Infra-Red (FTIR) spectroscopy, with Si-O stretching, SiO-H stretching and Si-H bending confirming the presence of silica. FTIR confirmed the presence of quat with N-H stretching and bending. The morphology of Fixed-Quat E materiall was examined using Scanning Electron Microscopy (SEM) which revealed sub-micron to micron composites with irregular shapes in multiple layers. X-ray Diffraction (XRD) was used to study the crystallinity of the new silica core material and results indicated that the material is primarily amorphous in nature. Phytotoxicity study of the Fixed-Quat E material was carried out in a Panasonic Environmental Test Chamber (Model MLR- 352H) which allowed for controlled day/night cycling temperatures, light intensity and humidity to simulate summer weather conditions (biocide application season). Studies conducted on Tomato sp, an ornamental plant revealed no sign of plant injury even as high as 1000 ppm Quat. It is noted that EPA maximum allowed concentration for industrial use of Quat is 200 ppm), indicating a large therapeutic window. Antimicrobial studies of Fixed-Quat E material was conducted against Xanthomonas alfalfae subsp. citrumelonis (Citrus Canker Surrogate), Pseudomonas syringae pv syringae, a gram negative causative agent of bacterial speck in citrus and tomato sp and Clavibacter michiganensis subsp michiganensis, a gram positive causative agent of canker and systemic infections in tomato. Studies were conducted to determine the Minimum Inhibitory Concentration (MIC) and compared against Kocide 3000 and copper sulfate. MICs of Fixed-Quat E were found to be ≤ 2.0 µg/mL for X. alfalfae, ≤ 2.0 µg/mL for P. syringae and ≤ 2.0 µg/mL for C. michiganensis. Future studies will involve rainfastness evaluation and preparation of formulations for 2016 citrus canker field trials.

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Form PR-12 Quarterly Reports **SUBMIT REPORT**

CITRUS RESEARCH AND DEVELOPMENT FOUNDATION, INC.