CITRUS ADVANCED TECHNOLOGY PROGRAM

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

▶ INSTRUCTIONS

○ *Quarterly Report* ◉ *Annual Report* ○ *Final*

Required: What is the "headline" for this report (e.g. a one-sentence "newspaper headline" describing what you accomplished)

Alternative antimicrobial agent for citrus protection

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)
10/23/14	Citrus Research and Development Foundation	Pathogen/Disease Detection

REPORT UPDATE (500 words; summarize your accomplishments)

In agriculture, Copper (Cu) has been and is continuing to be used extensively to protect multiple crop species from a wide variety of infectious diseases. While its low cost and potent protection make it useful, there are many downsides involved. Protracted usage of copper based biocides has led to an increased risk of copper toxicity in fertile soil from accumulation and the development of copper resistance among infectious organisms threatens its effectiveness. The goal of this project is to develop an attractive, environmentally safe, industrially feasible alternative to Cu biocides. The use of Quaternary Ammonium Compounds (Quat) as an antimicrobial agent is extensive within medical and industrial fields as a disinfectant. Quat compounds have not been used in agriculture due to their potential to cause plant tissue damage (Phytotoxicity). Combining Quat with a silica delivery system to produce Fixed-Quat can reduce its potential phytotoxicity and allow it to be used in agricultural applications.

For the 2013-2014 period, we have successfully synthesized a variety of Fixed-Quat nanomaterials with Quat immobilized within a silica matrix either covalently or electrostatically. Fixed-Quat nanomaterials were synthesized using EPA approved compounds and followed modified Stober protocols by hydrolyzing a silica precursor under either acidic (nanogel) or basic (nanoparticle) conditions. The large series of nanomaterials were originally developed to determine the best Quat to Silica ratio for generating Fixed-Quat systems. The various Fixed-Quat nanomaterials were characterized for Quat presence, particle size and morphology using Fourier transform infrared spectroscopy (FTIR), Dynamic Light Scattering (DLS) and Scanning Electron Microscopy (SEM). Fixed-Quat nanoparticles conjugated covalently or electrostatically polydispersed exhibited sizes in the sub-micron range of 300-600nm. Fixed-Quat nanogels exhibited a large size distribution from sub-micron to micron. Fixed-Quat nanomaterials were found to be stable at concentrations exceeding 10,000 ppm Quat content, indicating potential large scale production. Potential plant tissue damage (Phytotoxicity) of Fixed-Quat nanomaterials was tested on a variety of plants, including Vinca sp (Ornamental plant highly susceptible to phytotoxicity), Hamlin Orange and Pink Grapefruit. Fixed-Quat Nanogels were found to be completely safe to plants at rates as high as 900ppm. Antibacterial studies have been conducted using in-vitro microplate alamar blue assay, bacterial viability expressed as colony forming units (CFU/mL), growth curves and the determination of the Minimum Inhibitory Concentration (MIC). Antimicrobial efficacy was tested using gram-negative model bacterial system, E. coli and X. alfalfae (a citrus canker surrogate), with Kocide 3000 (commercial product from DuPont) as a control. Studies indicated Fixed-Quat nanomaterials were effective at MICs as low as 2ppm. One of the Fixed-Quat nanogel materials has been delivered for 2014 field trials. Field efficacy will be evaluated at two different foliar spray rates. Trial data is being collected in October 2014 and will be analyzed and presented in the next progress report.

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Total Funds (current year) $85,495.00

SUBMIT REPORT

CITRUS RESEARCH AND DEVELOPMENT FOUNDATION, INC.