Florida Citrus Advanced Technology Program

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

Instructions Complete the fields based on your project specs. When finished, save the form to your local disk using a unique name. Then, go to **http://research.fcprac.com**, and log in with your user name and password using Researcher Login in the lower left. Find this project title and click on **Submit a Report**. Update your profile information if needed, then upload this report as directed.

2009-2010 REPORT	CATEGORY (drop-down)	TODAY'S DATE (m/d/yr)
(●) *Quarterly Report* ( ) *Annual Report* ( ) *Final*	Management	1/15/10

WHAT IS THE "HEADLINE" FOR THIS REPORT (e.g. a one-sentence "newspaper headline" describing what you accomplished)

Mobile sensor development and data collection & analysis using multiple sensing techniques for HLB detection

TITLE and CONTACT INFORMATION

Proposal Title Detecting citrus greening (HLB) using multiple sensors and sensor fusion approach.

Principal Investigator Reza Ehsani	*PI Last Name* Ehsani
Email ehsani@ufl.edu	*FDACS Contract Number* 57
Phone 1 863 956 1151 Extn. 1228	*Project Duration (years)* 3 *Year of Project* 1
Organization Citrus Research and Education Center	*Total Direct Funds (current year)* $ 290,000

REPORT UPDATE (650 words; provide details about your headline)

Five-band Sensor Development: At Citrus Research and Education Center (CREC), a passive five-band sensor was developed and integrated as a portable, relatively inexpensive, robust, mobile sensor module that can be incorporated with the sensor platform (developed in CREC) in a gator for stress-detection applications. The sensor can measure the reflectance in five spectral bands (three visible and two infrared), and has the capability of storing the GPS coordinates and for incident light intensity correction for acquiring stable spectral reflectance. The sensor is being field tested for its ability to accurately identify stressed citrus trees in different citrus varieties. This sensor will be further tested for HLB detection.

Greenhouse Experiments: The preliminary results from greenhouse experiments (CREC) for detecting HLB in early stages indicated that the spectroradiometer reflectance data could be used to identify HLB-infected trees with a classification accuracy of > 90% for Hamlin and Valencia varieties. The results are being further validated with a larger number of dataset.

Aerial Hyperspectral Imaging: A new set of aerial hyperspectral imagery has been acquired in a citrus grove with the help from Dr. Yang and his colleagues (USDA ARS, Texas). The imaging site was the 20 acres Summerland grove (Consolidated Citrus Ltd.). The grove contained some dead trees (scaffold), probably from tristeza, citrus blight and HLB. Ground truthing was conducted for diseased trees. The aerial imageries along with ground data are currently being analyzed to further develop and evaluate the HLB detection algorithms. The results will be reported in next progress report.

Differential mobility spectrometer sensor: In this quarter, we designed, manufactured and tested a volatile collection device holder that improved the reproducibility and eliminated false positives that occur when the collection device makes direct contact with the leaf surfaces. In addition, we expanded on our previous study of measuring volatile organic compounds (VOCs) of symptomatic and healthy sweet navel oranges. The sample collected in this quarter consisted of three groups: control plants in grove A (commercial grove, Lake Alfred, FL), healthy & asymptomatic plants in grove B (Experimental Station, Oakland, FL), and symptomatic plants in grove B. The VOCs were collected using polyacrylate solid phase microextraction (SPME) fibers and shipped to Dr. Davis' lab for gas chromatograph/mass spectrometer analysis to classify the disease status by the VOC profile and possibly identify chemical biomarkers. As there was a large overlap between the chemical peaks among the groups, the distinction between the groups was not very clear using linear classification techniques. However, using higher order machine learning algorithms, we were able to create a model that has > 85% classification accuracy.

Specifically, a couple of data analysis methods were applied to this data set. First, through a peak-by-peak comparison, we detected 11 peaks (potential biomarkers) where we could see a visible difference between the peak amplitude distributions of two groups: 5 healthy vs. 15 infected samples ($p<0.15$). Working on the entire chromatogram data of the samples, principal component analysis and neural network model was used for a further quantitative examination of the seperability of these two groups. Based on the leave-one-out strategy, we obtained a promising result with the specificity being 80% and the sensitivity being 87%. This diagnosis result is a promising direction for our biomarker detection and disease diagnosis research of the next step. The results of this quarter were significant because we learnt that experimental on-field conditions are very challenging because the wind mixes the VOCs and makes securing the SPME fibers difficult, and the presence of other diseases such as melanosis and leaf minor on some of the plants impact our capability of getting a clean VOC profile for HLB. We have taken these into account for our next set of studies that are currently underway.