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)

HLB models developed and currently being validated

Proposal Title

Epidemiology and disease control of huanglongbing

Today's Date	Sponsoring Organization (drop-down)	Category (drop down)
7/21/13	Citrus Research and Development Foundation	Epidemiology and Cultural Control

REPORT UPDATE (500 words; summarize your accomplishments)

1. Development and testing of efficient methods of statistical inference to estimate epidemiological parameters from maps of emerging epidemic.)
Using citrus canker as a test system, we are developing and testing quantitative models to link weather variables to the rate of disease spread. We are also analysing models for anisotropic dispersal of the pathogen, in order to correlate the direction and extent of pathogen dispersal with wind direction/strength during extreme weather events (rainstorms). The outcome will be a set of epidemiological parameters that can be used as inputs for predictive modelling, with (at least) two different final goals: i. To produce risk maps for disease spread for large (state-wide) geographical areas and long time scales (several years), under different "what if" scenarios for favorable and unfavorable weather conditions; and ii. To produce a risk map on a smaller (county-wide) scale in response to a local storm. With knowledge of the distribution of disease prior to the storm, it should be possible to estimate the new distribution of disease using the strength and direction of wind, and other relevant weather parameters. This would help directing a post-storm sampling procedure (e.g. which areas surveyors should target for new symptoms).
We have developed and tested a set of advanced spatial statistical methods for goodness of fit. The methods are based on the comparison of simulated and observed spatial patterns of infection. They have been successfully tested using model estimates for the Miami outbreak, and they were able to discriminate between good and less good dispersal models. Such methods are also a fundamental ingredient, hence a significant step forward, for the ABC (simulation-based) estimation algorithms that are currently being developed. The methodology being tested with citrus canker can be generalized to HLB. A paper on Markov chain Monte Carlo for estimation of epidemiological parameters in the Miami area has been submitted.
2. Develop a generic epidemiological model that can be used to compare control scenarios and to optimize the probability of controlling and managing high-risk pathogens of agricultural significance.
We have built a model that represents the spread of HLB within an individual tree. Successful spread of the pathogen depends on transmission both within the vascular system of the tree and between leaves via psyllid vectors. The relative importance of these transmission routes is being explored, with the speed of spread of the pathogen dependent on whether transmission via psyllid vectors is frequency- or density- dependent: this depends on the population density of psyllids relative to the number of leaves. A novel feature of our modelling approach is that it explicitly incorporates the ability of Las bacteria to survive in the vascular system of the plant.
Control: We are using this model for a variety of purposes. Firstly, we are investigating and comparing the efficacy of roguing, application of insecticide and the use of nutritional products and thermotherapy for disease control and mitigation. Secondly, we are using it to inform grove scale models for the spread of HLB. Grove scale models typically assume that each citrus plant is either entirely infected or not (instead of considering the proportion of the tree that is infected). This model is being used to inform the force of infection of each infected citrus tree in grove scale models.
3. Develop user friendly model 'front ends' that can be used by researchers and regulatory agencies. We are finalising the publication on Webidemics (http://www.webidemics.com/), the user-friendly front-end for control of citrus disease.

PI First Name Tim

PI Last Name Gottwald

Email tim.gottwald@ars.usda.gov

Phone 772-462-5883

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SUBMIT REPORT

CITRUS RESEARCH AND DEVELOPMENT FOUNDATION, INC.