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	7/20/10

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

TITLE and CONTACT INFORMATION

Proposal Title Epidemiology and disease control of huanglongbing

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Phone 772-462-5883	*Project Duration (years)* 3 *Year of Project* 1
Organization USDA, ARS	*Total Direct Funds (current year)*

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

The objective of this study is to develop a series of flexible stochastic models to predict the temporal increase and spatial spread of diseases. The models were initially characterized for citrus canker but have subsequently been extended to HLB . The models can be used in a number of ways: to predict spread and to analyze the effectiveness of control strategies. Most attention has been given to spread within plantations, including allowance for proliferation of infection along boundaries in response to vector behavior but can readily be extended to consider spread at larger scales including spread State-wide. We also considered the effects of uncertainties in the distribution of host crops for example the effects of small areas of citrus that may not be recorded but which can act as 'bridges' in transmitting disease. The effects of uncertainty in parameter estimates for dispersal parameters and transmission rates have also been included. Additional computer-friendly formulations of the models have also been developed to aid in education of stake-holders to illustrate the effects of uncertainty in predicting future disease spread and the effectiveness of alternative methods of control. Estimation of parameters for dispersal of HLB poses considerable statistical challenges, especially where trees may become infectious before they are symptomatic/detected. Here we use an SEIDR model (Susceptible, Exposed (latently infected but not yet infectious), Infectious but not yet symptomatic/detected, Detected and infectious and Removed trees). Using MCMC methods, and extensive data from Southern Gardens (SG) for successive snapshots of the occurrence of symptomatic detected trees in known populations of susceptible trees, we are able to estimate model parameters for the transmission rates and dispersal kernel for the disease. Current work is focused on the differential effects of host age on epidemiological parameters as well as variability across the plantation. From these it is possible to allow for uncertainty in the parameters as well as variability over time and through space. We are using Baysian methods to infer posterior densities on the model parameters. The uncertainty is then incorporated in models to predict spread and to allow for uncertainty in the efficiency and comparison of control methods. A front-end, a web based version of the model that users can easily access and use is under final development has now been nearly finalized. Via this web tool, both residential and commercial citrus scenarios can be tested. A wide variety of epidemiological and climate/weather variables have been included and are user selectable and changeable via sliding controls. The simulator generates epidemics that progress through time and can be visualized on the screen. Various disease control/mitigation parameters can be selected and simulations can been visualized to see the effect of these various control strategies. This web tool runs simulations one at a time and is highly instructive to growers and regulators. It is based on a more formal analytical model that can run thousands of simulations based on the same parameters and make more statistically valid predictions for regulatory intervention strategy building and regulatory/industry decision making. Currently the spread of HLB is being modeled in 10 contiguous blocks in SG, chosen to encompass both young and mature trees, since host age is likely to be an important consideration for HLB. The blocks are also relatively isolated from the surrounding outbreak. The outbreak is noticeably clustered with only a small number of isolated cases. The model continues to be improved upon to capture more and more of the true features of the data and the disease. The model is being extended to estimate spread should HLB be introduced into new areas such as TX, CA or AZ.