Economic Returns to Coordinated Actions to Control HLB

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Year 2 of 2 (90% Complete)

Objectives

1. Define appropriate/useful measures of the net benefits of coordinated action against ACP and HLB.
2. Estimate the current net benefits of coordinated ACP and HLB control efforts.
3. Estimate the dynamic path of net benefits under alternative degrees of coordination levels to determine when coordination is no longer cost effective.
4. Study fairness issues regarding fees collected and subsequent control of ACP and HLB that may hinder willingness to undertake coordinated action.

Problem and Significance

Uncertainty about the net benefits of coordinated actions to control Asian citrus psyllid (ACP) and huanglongbing (HLB) in California hinders the decision-making ability of the California citrus industry. Although the majority of the citrus community agrees that a regional approach is required to limit the spread of this insect-vectored disease, participation in area-wide management (AWM) for ACP has varied across Southern California, and considering the current limited distribution of HLB-positive trees, it is hard to estimate the impact that coordinated efforts could have on the HLB epidemic. The objective of this project was to increase understanding of the magnitude of net benefits from coordinated action against HLB and ACP in order to inform efforts to promote coordination while it remains useful.

Benefit to Industry

This project has used an agent-based model developed in Florida to estimate the present value of net benefits of coordinated control efforts against ACP and HLB, compared to uncoordinated efforts. Through a close collaboration with the model developers, we have adapted the agent-based model to California conditions, populated it with available data, and run simulations of disease spread in three different citrus-producing areas in Ventura County under different coordination levels in the insecticide AWM treatments against ACP. The model has also been used to estimate the future time when net benefits might become negative. Additionally, we have analyzed different dimensions of equity and fairness associated with the management practices recommended for ACP and HLB, in order to design strategies to improve grower acceptance of the recommended practices. We have conducted a thorough review of institutional approaches to promote coordination for HLB and other insect-vectored diseases, and we have conducted surveys and interviews to improve understanding of the citrus industry's perception of the benefits of coordinated efforts.

Progress Summary

During the fiscal year 2019-2020, we have collaborated closely with the modelling team in Florida to improve the agent-based model to the point where it simulates the AWM insecticide treatments used by growers in California much more realistically, providing robust results. After a trip to Florida in November of 2019, we set up biweekly meetings through Zoom to calibrate the impact of different initial conditions and parameters on the simulations, to examine results of model runs, and to improve model output and analysis.

After many iterations, we have selected three scenarios that reflect the current coordinated efforts adopted by citrus growers in Ventura County and can be simulated by the model with confidence. These scenarios consist of three coordinated insecticide treatments for ACP between January and February, July and August, and September and October, with a coordination window of 21 days (the current recommendation), 60 days, or no

control at all, assuming that the insecticide treatments have an efficacy of 50%, based on available data. We have run 100 simulations of these scenarios for a period of 10 years under different initial disease pressures. The results suggest that three coordinated treatments applied every year within a 21-day window can delay the onset of the HLB epidemic and significantly reduce the number of infected trees after 10 years. We discovered that the initial locations of HLB-infected trees can have a considerable impact on disease progress (Figure 1). Treatments coordinated within a period of 60 days do not alter disease progress compared to no control, and they do not provide a benefit in terms of a reduction in the number of diseased trees after 10 years (Figure 2). In fact, because insecticide treatments trigger the ACP to disperse, uncoordinated treatments may favor disease spread to nearby commercial groves and residential properties.

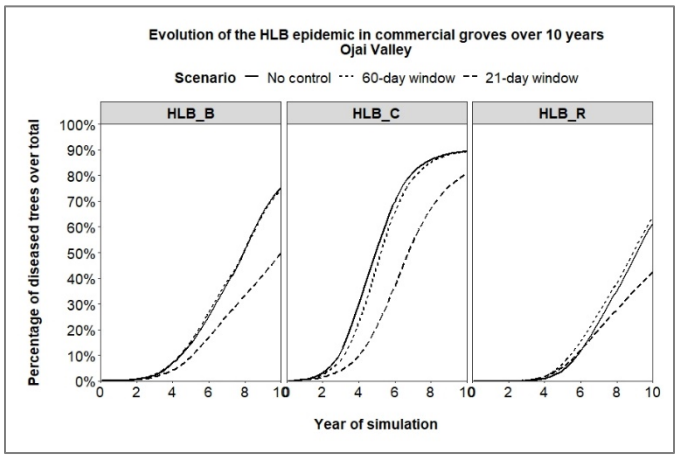

Figure 1: Evolution of the HLB epidemic in commercial groves in Ojai Valley over 10 years. The curves show the average percentage of diseased trees (exposed, cryptically infected or symptomatic) across 100 simulations. The line types correspond to three different scenarios: no control (solid), insecticide treatments 3 times a year within a 60-day period (short dash) and within a 21-day period (long dash). These scenarios were evaluated under three different initial conditions: HLB-infected trees in both commercial and residential properties (HLB_B), only in commercial (HLB_C) or only in residential (HLB_R).

In addition, we have explored the potential of the model to evaluate the impact that alternative control measures, such as surveys, infected tree removal and delimitation responses could have on the HLB epidemic when applied to residential and commercial properties. Results from 100 replicates of selected scenarios suggest that infected tree removal and delimitation responses are very effective in preventing HLB spread when combined with close coordination in AWM treatments, but similar effects might be obtained with different combinations of survey intensities and coordination levels.

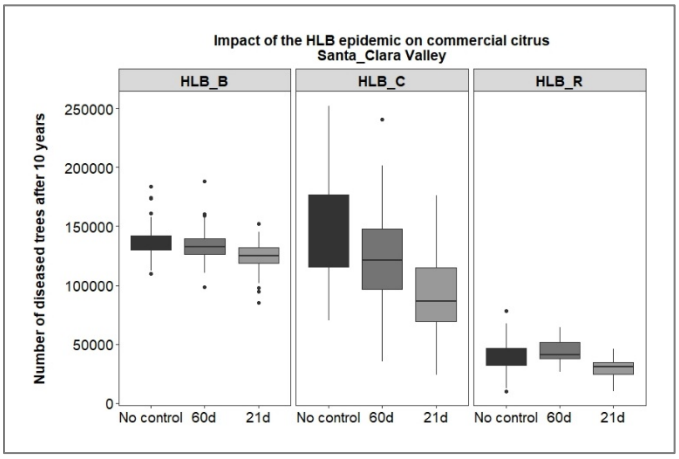

Figure 2: Impact of the HLB epidemic in commercial groves in Santa Clara River Valley over 10 years. The boxplots represent the distribution of the number of diseased trees across the 100 simulations of each scenario. The lower hinge of the boxplot represents the first quartile, the middle represents the median and the upper hinge is the third quartile. The colors correspond to the scenarios: no control (dark grey), insecticide treatments 3 times a year within a 60-day period (medium grey) and within a 21-day period (light grey). These scenarios were evaluated under three different initial conditions: HLB-infected trees in both commercial and residential properties (HLB_B), only in commercial (HLB_C) or only in residential (HLB_R).

Finally, the observations and recollections of fairness issues gathered through the attendance of numerous grower meetings over the last three years have been used to identify and categorize fairness issues regarding actual and proposed actions to HLB and ACP management. We submitted a manuscript about the institutional structures that lead to effective provision of public goods in plant disease management that we are using to guide us in identifying the fairness issues

that, if not resolved, pose the biggest threats to effective provision of HLB-free growing conditions.

During the no-cost extension of this project, we would like to randomize the locations of HLB-infected trees at the beginning of the simulations to finalize the estimation of the current net benefits of coordination; to possibly extend the duration of the simulations beyond 10 years to be able to determine the time when coordination is no longer beneficial in all three landscapes under different initial conditions; and to collaborate with DATOC to better understand the impact of coordinated insecticide treatments against ACP in combination with other control measures in residential properties.

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Publications and Presentations

García Figuera S, Grafton-Cardwell E, Babcock B, Lubell M, McRoberts N (2020). “Institutional approaches for plant health provision as a collective action problem”. *Food Security* (*accepted for publication*)

García Figuera S. “Studying plant diseases from a social-ecological systems perspective”. Keynote presentation at UC Davis Plant Pathology Virtual Retreat 2020. September 2020.

García Figuera S, McRoberts N. “The dilemma of coordination for huanglongbing management in California”. Oral presentation at Plant Health 2020 Online. August 2020.

García Figuera S, McRoberts N. “Differences in the institutional response to an invasive plant disease in different countries and potential links to social-ecological outcomes”. Oral presentation at the Virtual Sunbelt 2020 Conference. July 2020.