Photo by Tonya Weeks

Determining Asian citrus psyllid sprays based on economic thresholds can help growers reduce control costs and increase beneficial insects.

Putting IPM back in citrus

By Lukasz L. Stelinski, Jawwad A. Qureshi and L. Gene Albrigo

Florida citrus production has a long and trailblazing history of implementing integrated pest management (IPM). In 1950, the director of the Florida Citrus Experiment Station, A.F. Camp, proposed an "Ecological Survey of Citrus Pests and Disorders" to provide a comprehensive survey of the ecology of citrus groves throughout Florida (Simanton, 1996).

Important discoveries were also made concerning the existence and impact of biological control agents regulating pest populations. It was realized, for example, that excessive sulfur use had a negative impact on natural enemies of the purple scale. Advising growers to use less sulfur allowed populations of these parasitoids to rebound, which decreased the purple scale populations below economic thresholds.

THE GREENING INVASION

From the 1970s to the 2000s, the pesticides applied to Florida citrus were restricted to a few fungicides, herbicides and horticultural oil sprays with notable reduction of contact insecticide or miticide use. This changed dramatically with the arrival of citrus greening around 2005.

Despite efforts to control the disease, greening spread in Florida due to the mobility of the Asian citrus psyllid (ACP), favorable environmental conditions for both vector and pathogen, and the long latent period, during which initial indications of infection went undetected. In the first decade of greening management in Florida, vector suppression with insecticides played a prominent role. Calendar spraying became commonplace, and coordinated spraying among neighboring growers took place at times to reduce psyllid populations on a regional scale. Despite improvements in management outcomes as measured by reduced psyllid numbers in many cases, the disease has spread to all parts of the state and is now endemic infecting virtually all trees.

Currently, there is renewed interest among growers to return management practices to a more balanced IPM approach rather than heavy reliance on insecticides alone. Is such an IPM approach possible under conditions of endemic greening? We believe the necessary information and tools are indeed available to begin putting such a management paradigm into practice.

APPLICATION THRESHOLDS

The foundation of IPM is the economic injury level, which is also referred to as the economic threshold. This is the pest population level at which the resulting damage it causes justifies the economic investment of implementing a control measure. If the pest population (and resulting damage) is below this point, it does not pay to take a control measure.

Economic thresholds are developed by monitoring pest populations, implementing control measures at varying population densities and then measuring yield at the various levels of input. Comparing investment versus yield at varying levels of input will shed light on the action threshold density under various crop scenarios. Such thresholds

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may take a few seasons to perfect, but they often work reliably to maximize return on investment, particularly when more variables can be added such as crop price.

Initially, application thresholds were not considered practical for ACP, given that even one psyllid can spread the pathogen. However, the situation has changed since the goal of psyllid management in Florida is no longer prevention of disease spread. The new objective is reducing severity for economically viable production of citrus under the conditions of endemic greening.

An investigation by Cesar Monzo and Phil Stansly in 2017 demonstrated that economic thresholds for ACP are possible and can be beneficial. Specifically, by using a threshold of 0.2 psyllids per tap to trigger the need for a spray, the investigators reduced the number of annual treatments per calendar year from 10 to only 4 sprays. Using the threshold system, they achieved returns that were either equivalent or better than those attained using the calendar-based program.

These results show that the investment made in psyllid control costs using calendar-based programs were not justified. The 0.2 psyllids per tap threshold used in this investigation is currently not optimized for every situation in Florida, but it was a useful starting point to illustrate the potential utility of thresholds for guiding spray decisions under greening. Although it can be further optimized and should not be considered a general rule that will fit every situation, it is a good starting point to consider for those who wonder when they should spray.

MONITORING PSYLLIDS

Regular scouting for pests is important for making need-based decisions regarding insecticide applications and to minimize unnecessary investment in control measures and potential collateral damage to beneficial insects and mites. Implementation of an economic threshold for psyllid management depends on monitoring the pest's density in a grove.

Stem tap sampling is probably the easiest method to collect instant data for making management decisions. A tap sample is made by using a white clipboard or laminated white paper sheet held horizontally under randomly chosen branches. Strike the branch three times with a length of PVC pipe for one tap sample (see https://edis.ifas.ufl.edu/pdffiles/IN/IN111600.pdf).

Psyllids can be counted as they fall onto the clipboard. Scouting 10 trees

in a particular block at 10 random locations and taking an average of the number of psyllids from those 10 trees on a per tap basis should give a reliable estimate similar to what Stansly and Monzo did. If your average count is less than 0.2 psyllids/tap, consider not spraying. However, when the count goes above that threshold, consider spraying. Again, more work is needed to determine how effective this threshold is industrywide.

TIMING MATTERS

Although the decision to spray for psyllid management may be guided by economic thresholds, which could use more research-based optimization, there is consensus that well-timed, dormant-season sprays prior to the appearance of flush are critical for reducing psyllid numbers. The goal is to kill adult psyllids before new feather flush is available for them to lay eggs and produce offspring.

If a large area is treated in this manner, then subsequent generations can be greatly reduced. Also, movement of psyllids and population re-establishment can be reduced. If treatments continue prior to each new major flush, ACP suppression can be improved as compared with spraying in a fashion that is not coordinated with flushing.

Photo by Tonya Weeks

The previous tendency has been to spray on a schedule with intervals somewhat determined by length of efficacy of an insecticide with additional rotation of chemistries to prevent development of resistance. After a dormant winter spray, the first spring spray has often been timed to when the flush became evident using a pyrethroid or organophosphate for adult ACP. Unfortunately, that allows ACP time to lay eggs and begin a new population for the growing season.

Spray timing can be significantly improved by closely following a budbreak phenology model. This strategy times sprays for adults to bud break or the beginning of each new flush before there is feather flush on which the adults can lay eggs. A second spray is then timed on the flush as ACP begins to reappear.

With this technique, we measured more than 60 days of low ACP populations in 2018. Results showed that one to two sprays starting at initial budbreak or shortly thereafter appear to provide a good initial protection period past bloom and bee activity.

For the spring flush, the vegetative development is fairly coincident with flowering. The initiation of growth of the flower buds is identified by the online Citrus Flowering Monitor model (see http://disc.ifas.ufl.edu/bloom/). The model outputs include the date of bud growth initiation and the predicted date of full bloom. The first summer flush usually starts about

the time of the summer rainy season in Florida.

RETURNING TO IPM

Florida citrus is a trailblazer for incorporation of IPM in U.S. agriculture. A return to IPM in citrus is not only possible; it could be very beneficial. Returning to a more sustainable paradigm could bring economic reward.

Implementation of thresholds and timing sprays to flushing should maximize the impact of spraying. The above example from Stansly and Monzo indicates that one well-timed dormant spray followed by three additional sprays triggered by a 0.2 psyllids per tap action threshold can provide equal or greater economic return than 10 calendar sprays in the same grove.

Reducing sprays allows buildup of the biological control agents already present in Florida and allows them to work for you. Diversifying selection forces complicates development of resistance for the insect population. Resistance to one tactic can be compensated for by the others. Therefore, the IPM system can be further improved by not only allowing biological control to do its work by reducing insecticide input, but also by incorporating cultural controls.

Psyllid-exclusion technologies, such as protective screening and kaolin clay, are proving effective. Protecting grove borders with targeted sprays can reduce costs of whole-grove sprays. Significant progress has also been made toward reducing psyllid access to young citrus by planting on UV reflective mulches. Finally, IPM-based management will likely benefit from area-wide implementation. Many of the tools for practicing IPM in Florida citrus are already here; however, it takes integration to assemble the puzzle in practice.

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