Thresholds for Asian citrus psyllid in two high-HLB incidence groves

By César Monzó and Phil Stansly

Almost 10 years have passed since the first detection of greening (HLB) in Florida.

How have we done against the world's most devastating citrus disease? Clearly, the impact has been great, with costs of $4.54 billion and more than 8,000 jobs in the first six years, according to one estimate.

Another casualty was the former integrated pest management (IPM) system for processed orange production in Florida. Post-bloom and summer oil sprays were usually all that was needed back in the day. Now, 12 or more insecticide sprays to control the HLB-spreading Asian citrus psyllid (ACP) are common, with all their attendant costs and risks of secondary pest outbreaks and insecticide resistance.

On the other hand, growers have been successful in bringing ACP populations lower every year, in part by synchronizing sprays in regional Citrus Health Management Areas (CHMAs). Effective ACP control, better tree care programs and higher prices have allowed many operations to remain profitable in spite of HLB.

Table 1. Number of insecticide sprays, average ACP per tap, insecticide cost, marginal income and marginal profit estimated for the 2014 harvest of a 15-year-old Valencia orange grove with high HLB incidence in replicated plots subjected to the following treatments: (1) 10 preplanned sprays, (2) three sprays during the growing season based on a 0.2 per tap threshold plus two during the dormant season, (3) two sprays at a threshold of 0.7 adults per tap plus one during the dormant season, and 4) no ACP insecticide management. Calculations based on two juice price scenarios: $1.37 and $1.76 per pound solids. Monitoring costs of $57/year/acre were added to treatments 2 and 3.

At $1.37 per pound solids

Program	Insecticide Sprays	Average ACP per tap	Pest management cost ($/acre)	Marginal income ($/acre)	Marginal profit ($/acre)
1) Calendar	10	0.03	490	894	**404**
2) 0.2 thsld	5	0.04	251	748	**497**
3) 0.7 thsld	3	0.10	156	383	**227**
4) Check	0	0.67	0	0	**0**

At $1.76 per pound solids

Program	Insecticide Sprays	Average ACP per tap	Pest management cost ($/acre)	Marginal income ($/acre)	Marginal profit ($/acre)
1) Calendar	10	0.03	490	1149	**659**
2) 0.2 thsld	5	0.04	251	961	**710**
3) 0.7 thsld	3	0.10	156	492	**336**
4) Check	0	0.67	0	0	**0**

Still, it may be timely to ask, how many sprays can be added to a program before it reaches the point of diminishing returns? More specifically, what criteria can we use to decide whether or not another spray is warranted?

The traditional answer to this question in many crops has been to apply the concept of economic injury level, defined as the pest density at which yield losses balance the cost of control. At first, it was impossible to determine this with ACP due to uncertainty regarding risk of infection and consequent losses due to HLB. Now, however, many groves are completely infected, leading many to wonder if there is still value in controlling ACP. The answer is a definitive yes! Our research reported below and in earlier trials makes it clear that the fewer the psyllids the better the yield, even with 100 percent HLB incidence. Still, spraying has its costs as well as benefits, so the question should be, "What level of ACP control will earn greatest profits?"

To help answer this question and with support from the Citrus Research and Development Foundation (CRDF), we ran replicated trials for four years in two highly infected commercial citrus blocks to test four levels of ACP control: (1) "calendar" insecticide sprays (10–11 per year), (2) sprays based on a threshold of 0.7 and (3) 0.2 ACP per tap, and (4) an untreated check (no sprays). See Figure 1. Treatments (2) and (3) also received one or two dormant sprays, respectively, regardless of counts. ACP numbers were monitored by stem taps every other week, and yields and fruit quality per treatment were assessed every harvest. Trees also received three foliar nutrient sprays and other standard inputs (Figure 2).

Not surprisingly, the fewest ACP were seen in trees receiving calendar sprays and the most were seen in the

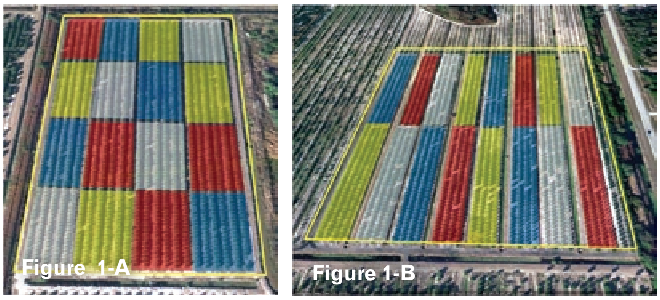
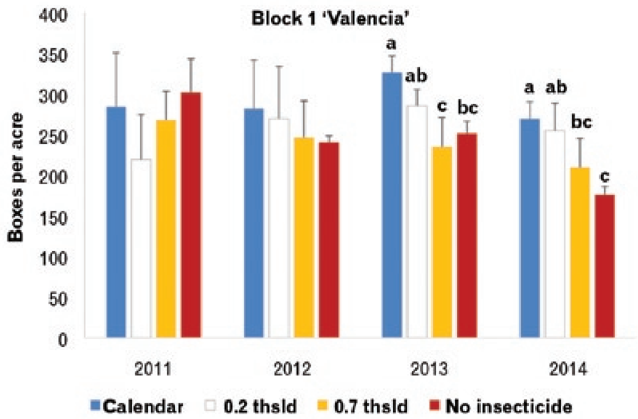


Figure 1. Experimental design for the two blocks where four ACP insecticide management treatments were tested: 1) calendar (10-11) insecticide applications (blue), 2) insecticide applications during the growing season at 0.2 ACP adults per stem-tap threshold plus two dormant sprays (white), 3) insecticide applications at a 0.7-ACP-adults-per-stem-tap threshold plus one dormant spray (yellow), and 4) no insecticide applications for ACP control (red). A) Block 1: Valencia oranges, and B) Block 2: Earlygold oranges.

Figure 2. Orange crop during 2013 harvest in HLB-infected Earlygold trees receiving regular foliar nutrient applications plus insecticide to control the Asian citrus psyllid.



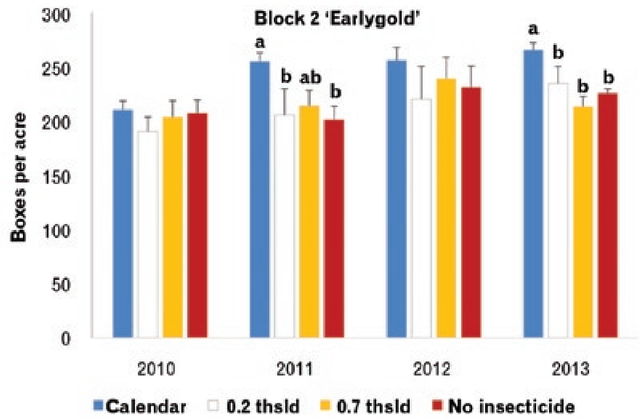


Figure 3. Yields (boxes per acre) obtained during harvest years in replicated plots receiving 1) approximately monthly insecticide applications, 2) insecticide applications during the growing season at 0.2 ACP adults per stem-tap threshold plus two dormant sprays, 3) insecticide applications at 0.7 ACP adults per stem-tap threshold plus one dormant spray, and 4) no insecticide applications for ACP control. Different letters with a particular block and harvest indicate statistical significance between treatments.

check and 0.7 threshold treatments, with intermediate numbers in the 0.2 threshold treatment. Yields varied accordingly, with the most fruit harvested from trees sprayed approximately monthly and the least fruit harvested from check and 0.7/tap threshold trees (Figure 3). However, when marginal costs from insecticides were subtracted from the marginal benefits from the harvest, the 0.2 psyllids per stem-tap threshold proved to be the most cost-effective treatment at delivered-in prices of $1.37 and $1.76 per pound solids (Table 1, page 18).

Spraying at a threshold of 0.2 ACP adults per tap may have been more cost-effective than just following scheduled applications in these trials. But is this an optimum threshold? Numerous variables go into calculation of economic threshold, including juice market price, yield, insecticide and application costs, and effectiveness of treatments. For this reason, it is not possible to define a fixed threshold for all scenarios. Nevertheless, it may be possible to estimate a threshold when the values of these variables are known or can be estimated. The critical parameter is the relationship between stem-tap results and yield (Figure 4). Once this relationship is known and given insecticide application costs, juice price and juice quality, we can estimate the cumulative number of ACP as monitored by stem taps which should trigger an insecticide application (Table 2).

These results relate to a specific variety, time and place. They should not be generalized until more such trials are run under different conditions. Also, the grower should keep in mind that possible effects of threshold-based spraying on resets or nearby young blocks have not been taken into account. Nevertheless, we are hopeful that this research will serve as a starting point toward the goal of building economically sustainable ACP management programs.

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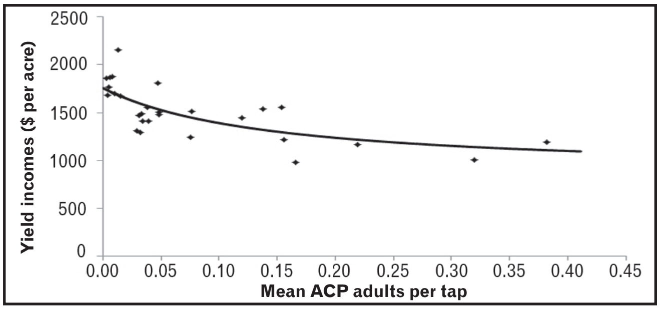

Figure 4. Estimated yield income based on a delivered-in price of $1.76 per pound solids as a function of the number of adults per tree found by stem tap in two citrus blocks where four ACP insecticide management strategies were tested.

Table 2. Estimated action threshold based on a running cumulative average number of ACP per tap sample multiplied by days in an HLB infected block of Valencia orange in Hendry County. At a greater ACP number, it would have been cost-effective to spray. Insecticide application costs for each spray during the growing season were estimated at $50 per acre for this simulation. The first insecticide application of the growing season also includes the cost of two recommended dormant sprays ($30 per acre each). Calculations are based on a juice price of $1.76 per pound solids and the empirical relationship between cumulative tap counts and yield income illustrated in Figure 4 (www.flachma.com).

Growing season sprays	Cumulative cost of the insecticide program ($/ac)	Cumulative number of ACP adults per tree and season
Spray #1	110	3.9
Spray #2	160	5.8
Spray #3	210	7.9
Spray #4	260	10.2
Spray #5	310	12.6
Spray #6	360	15.2
Spray #7	410	18.1
Spray #8	460	21.2
Spray #9	510	24.6
Spray #10	560	28.3