Reducing psyllids improves tree health even when trees have HLB; important do's and don'ts

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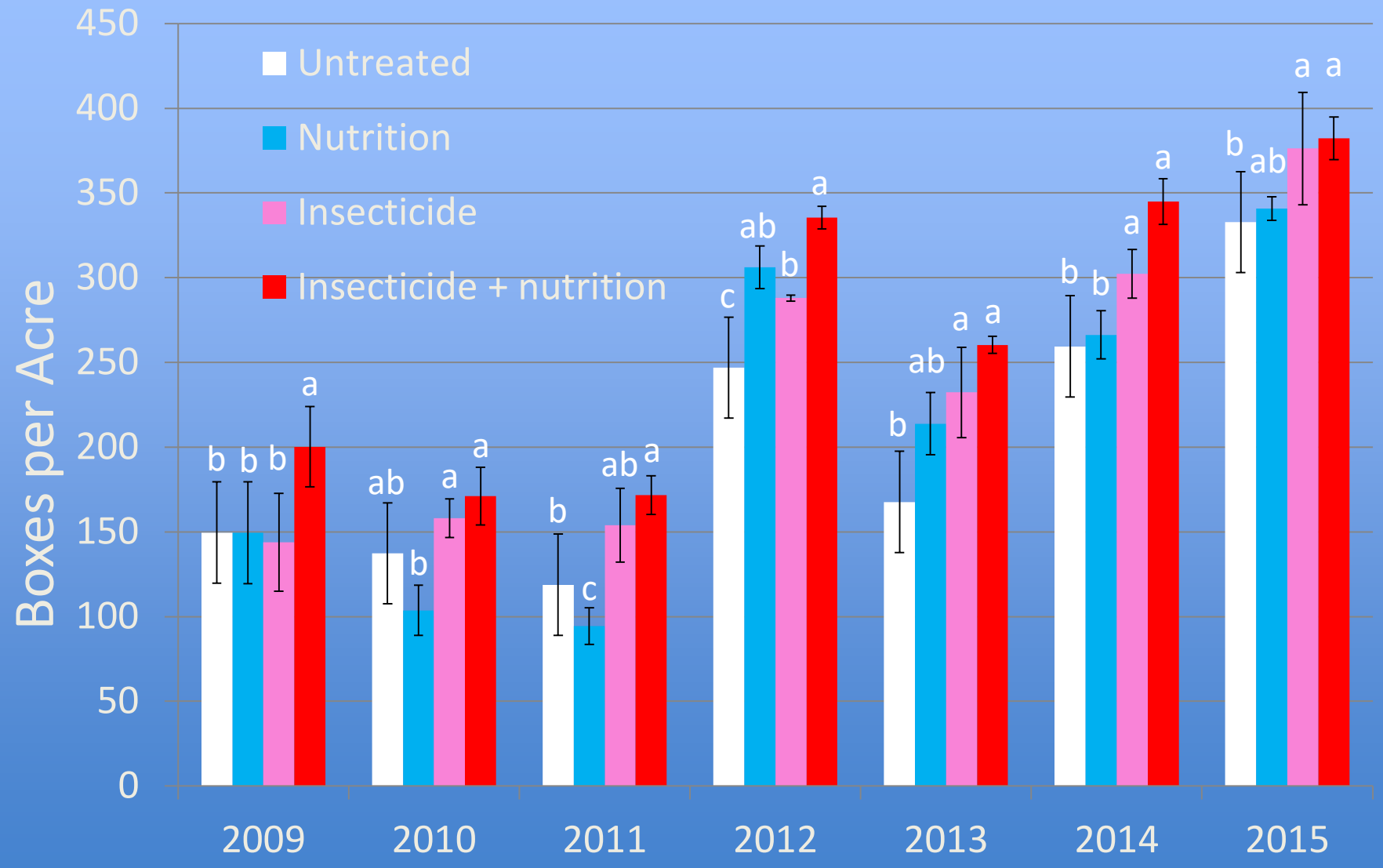
Keeping ACP down seems to help yield



Hypothesis: Plant health is affected by pathogen inoculation frequency

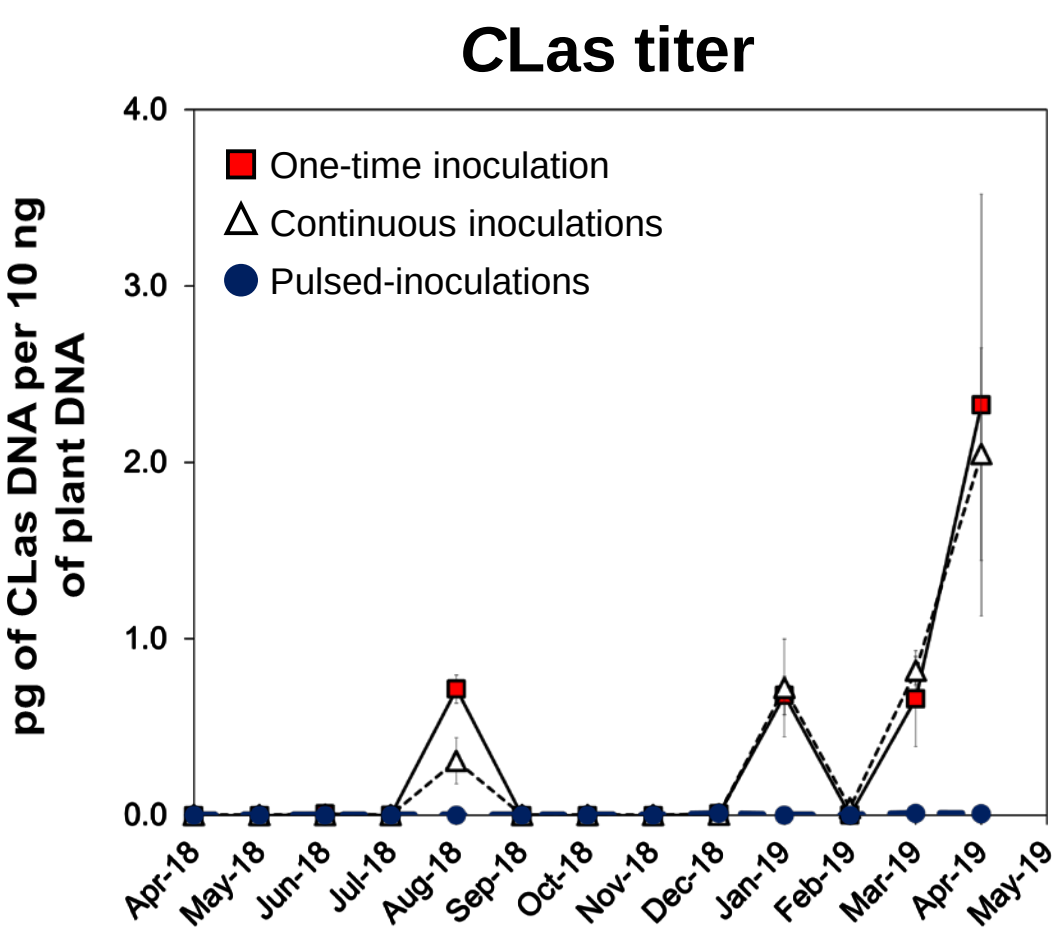
Citrus sinensis
cv Valencia

Challenged with:

1) *C*Las-infected
or
2) Non-infected
ACP

1. One-time inoculation
2. Pulsed inoculation
   (Periodic invasions)
3. Continuous inoculation
   (Constantly reproducing
   resident population)

Pathogen titer not related to inoculation frequency



Plant health

	CLas-infected ACP	Non-infected ACP
→	Intermediate	Good
→	Poor	Poor
→	Good	Good

Temporal Dynamics of *Candidatus* Liberibacter asiaticus Titer in Mature Leaves from *Citrus sinensis* cv Valencia are Associated with Vegetative Growth. Journal of Economic Entomology. *In Press*

Larger cage experiment in Texas (Mamoudou Setamou, Texas A&M)-same results

HLB +; No ACP

HLB +; Pulsed (monthly) ACP

HLB +; Continuous ACP

HLB -; No ACP

HLB -; Pulsed (monthly) ACP

HLB -; Continuous ACP

General observations

- CLas titer in leaf tissues is not affected by inoculum load imparted by the vector

- Plants respond to pulses of ACP feeding with boost to plant defense--against *C*Las? HLB symptoms?—Open questions

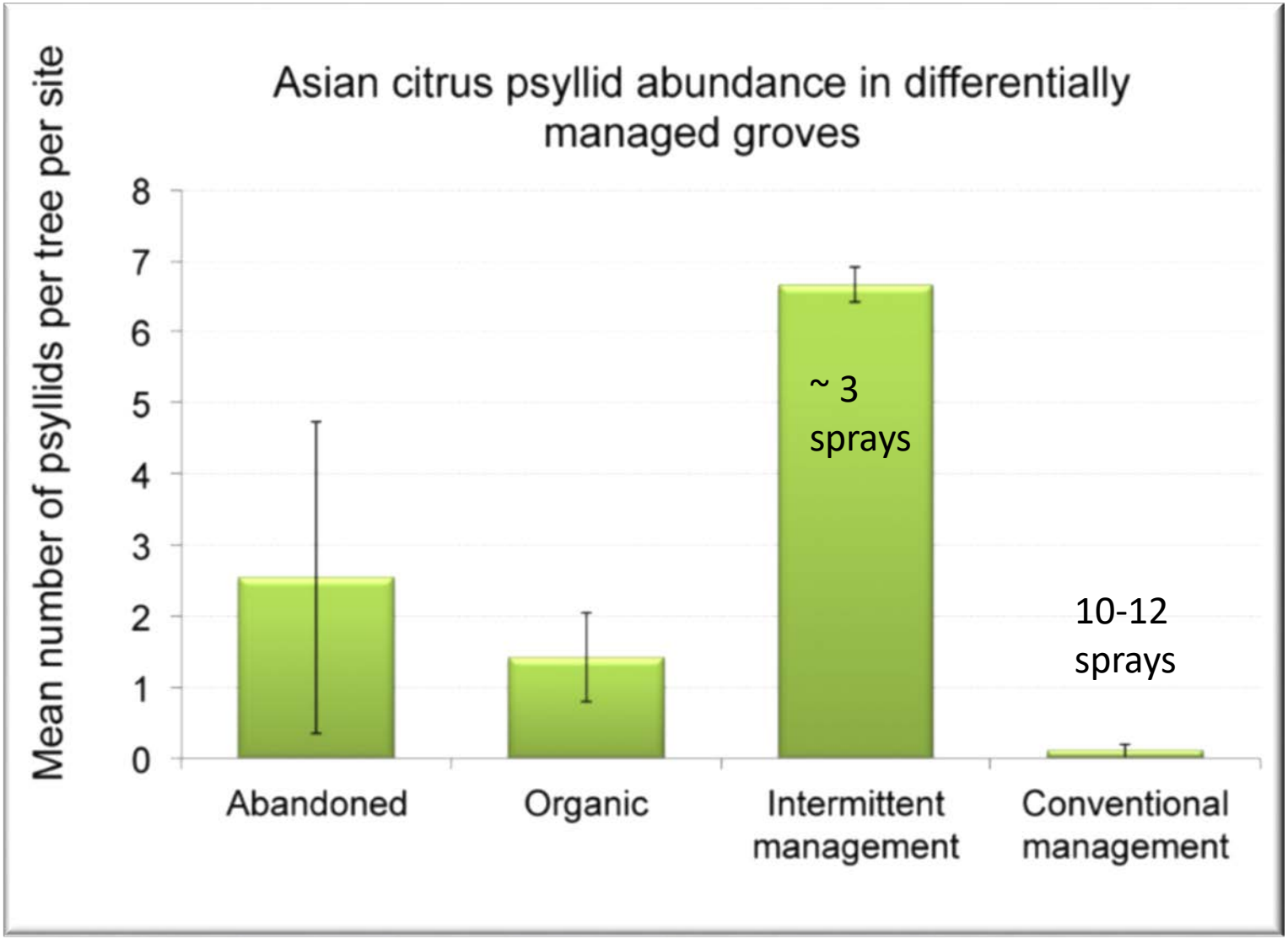
- Long-term ACP feeding suppresses plant immunity and inhibits growth, which explains the importance of vector suppression as part of HLB management

Brainstorming

- Keeping ACP out of the equation seems important for maintaining productivity

- What can be done?

Most psyllids found where management is intermittent (2016-17) – Average from 4-13 groves



Measuring contribution of biological control

Two ACP management practices were compared: i) Organic and ii) Low input (2-4 annual sprays) conventional. Trees were 10-12 year old sweet orange 'Valencia'. The study was conducted in 2019 form March to June and July to September

4 days

Uncaged

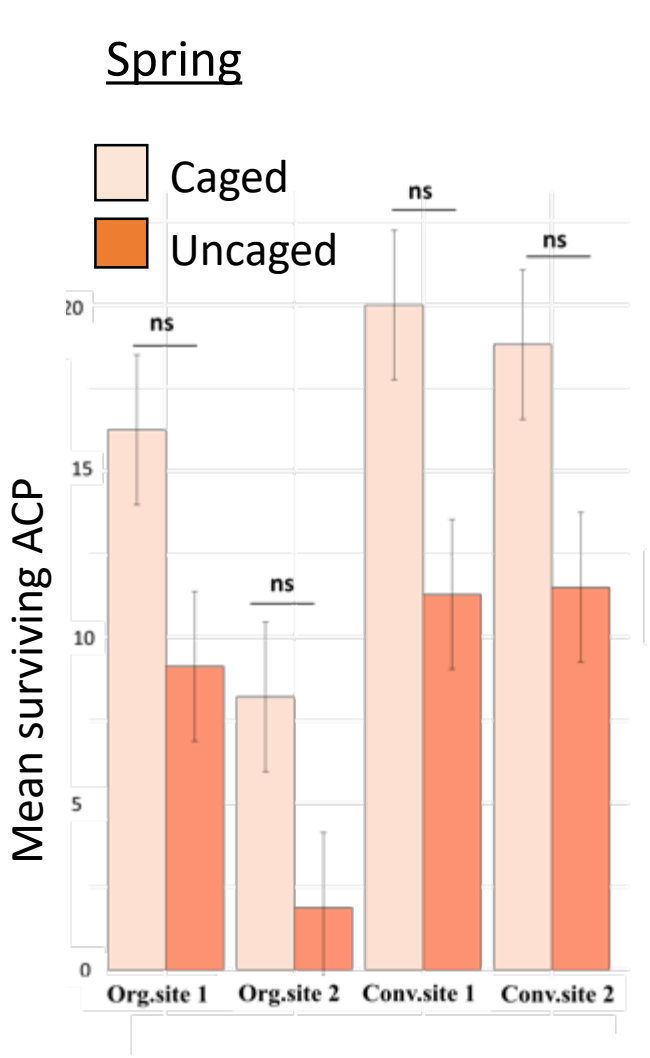
Caged

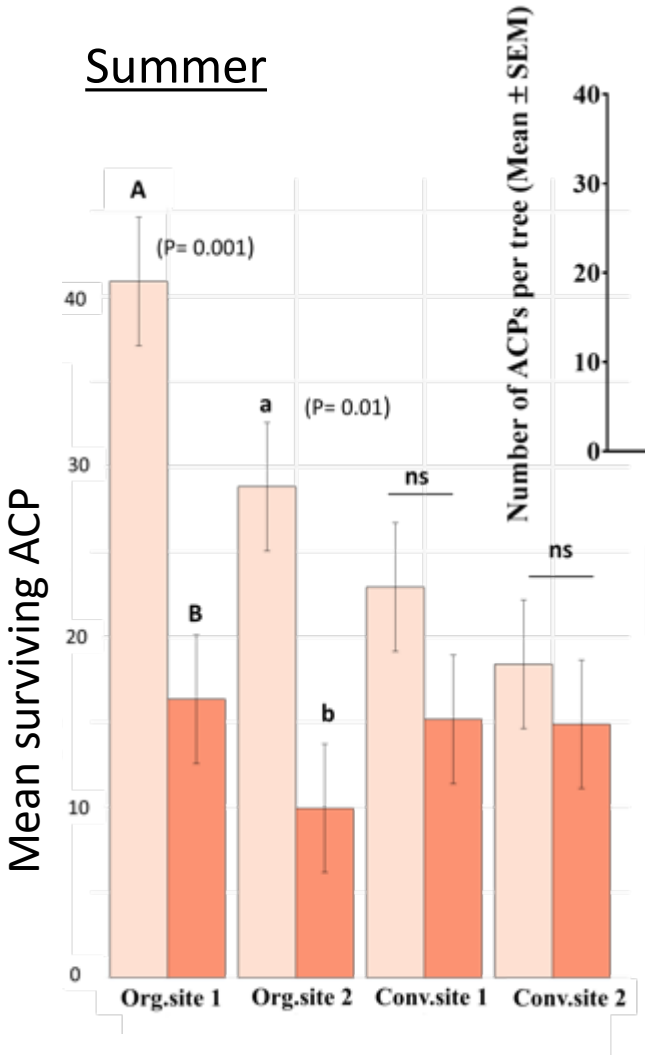
Released two pairs of ACP sentinels with and without exclusion cages

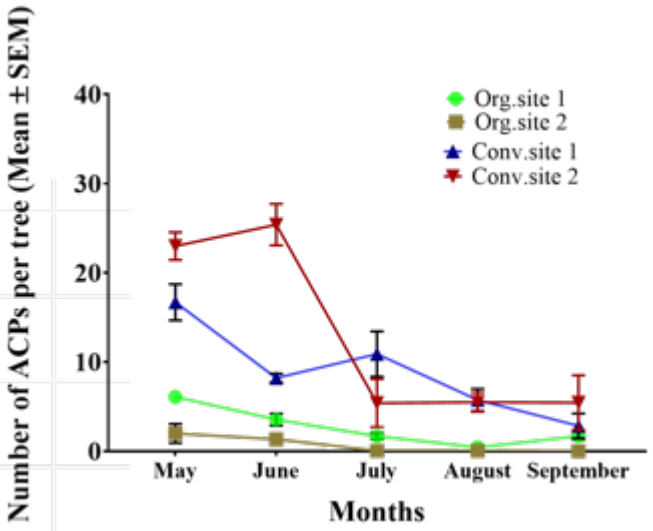
- Natural enemies were recorded during 2-minute visual inspections.
- Tap samples were used to monitor the abundance of ACP.

Number of ACP were counted for three weeks after deployment

Mortality of uncaged ACP significantly higher than caged ACP in organic; not so in conventional (~ 3 sprays) groves during summer.







ACP densities lower in both organic groves than in groves treated intermittently with conventional insecticides

Grove management type

Typical recent model for ACP sprays:

- After harvest, a dormant spray has been usually timed before major spring flush using pyrethroid or organophosphate.

- Sprays made on a schedule with intervals somewhat determined by length of efficacy of a particular insecticide.

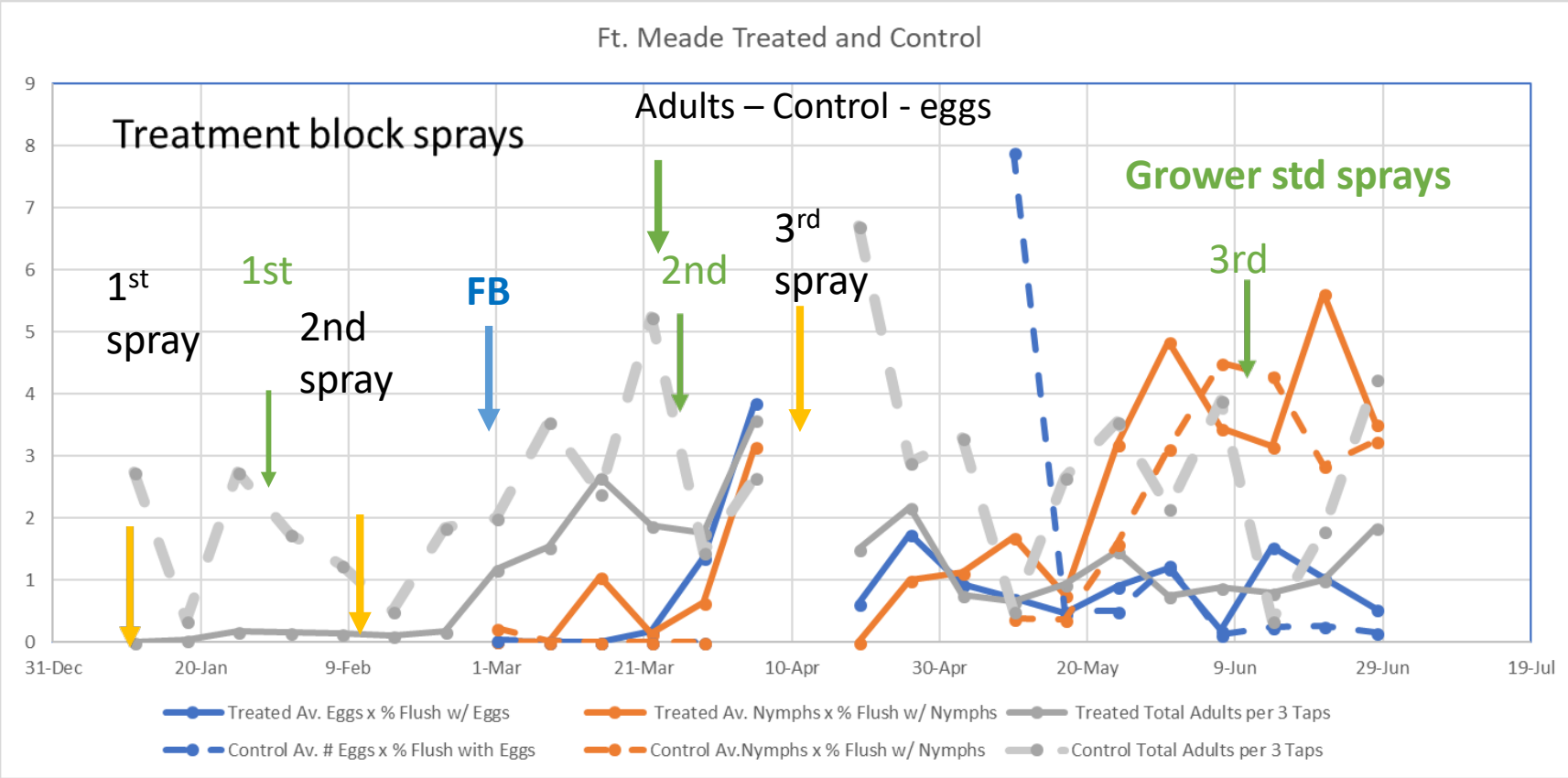
Possible better alternative:

- Spray for adults at bud break at the beginning of each new flush before there is feather flush on which adults can lay eggs.

- Apply second spray on the flush as ACP begin to reappear. This seems to achieve more than 60 days of low ACP

- Hold off spraying until ACP reach threshold (0.2—0.7 per tap)

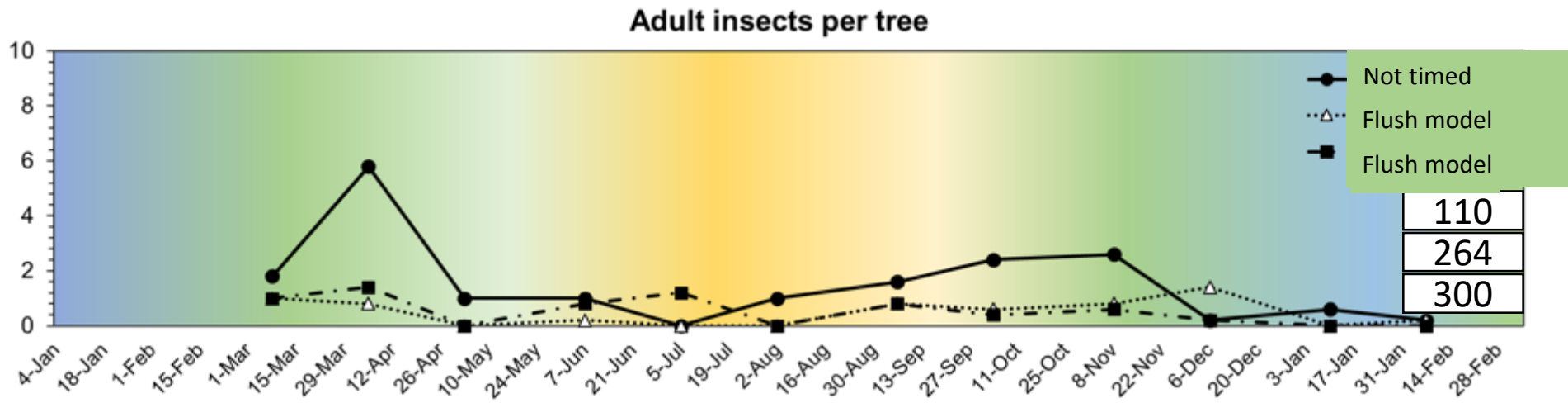
Chemical Control: Dormant Winter Sprays Timed prior to Flush (2018)



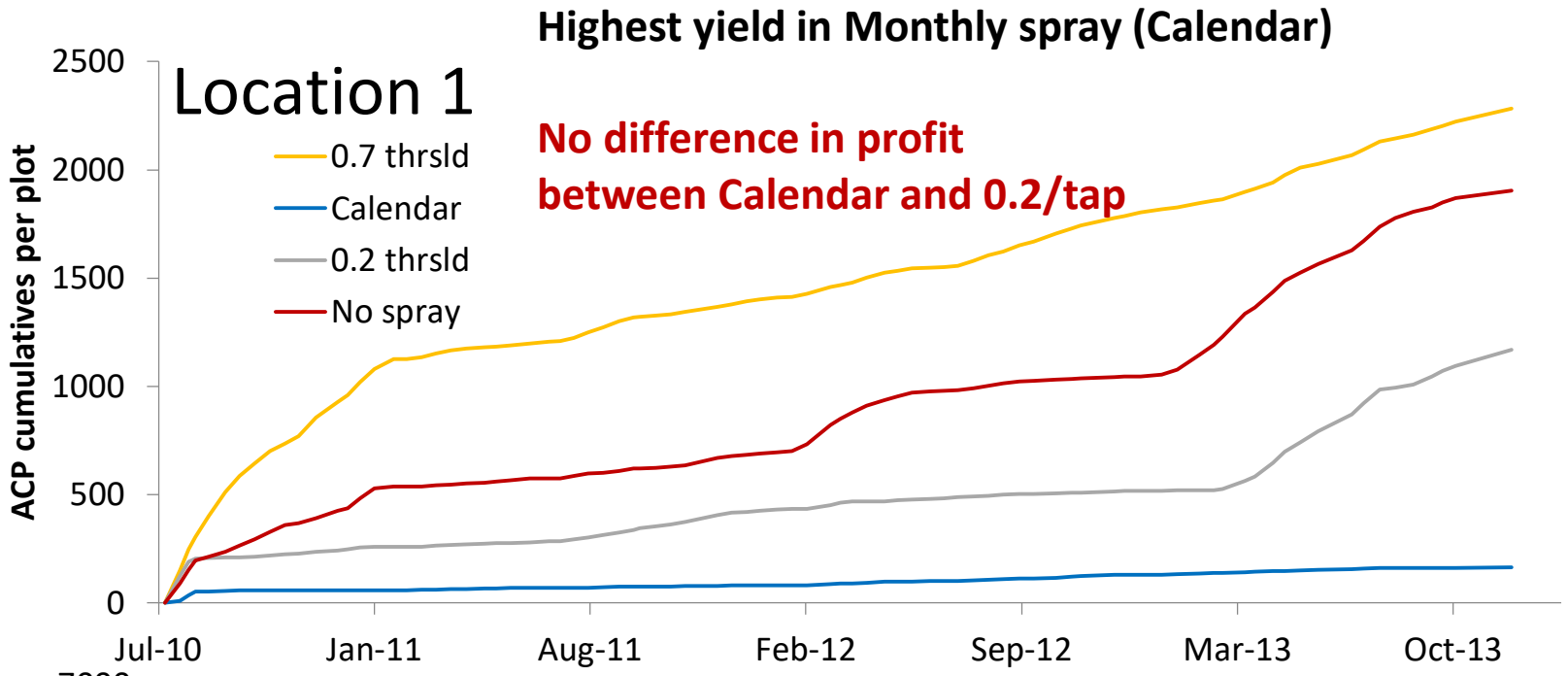
-Solid lines indicate results obtained using the bud break model (lower ACP)

-Dashed lines indicate results when simply applying near flushing periods (higher ACP)

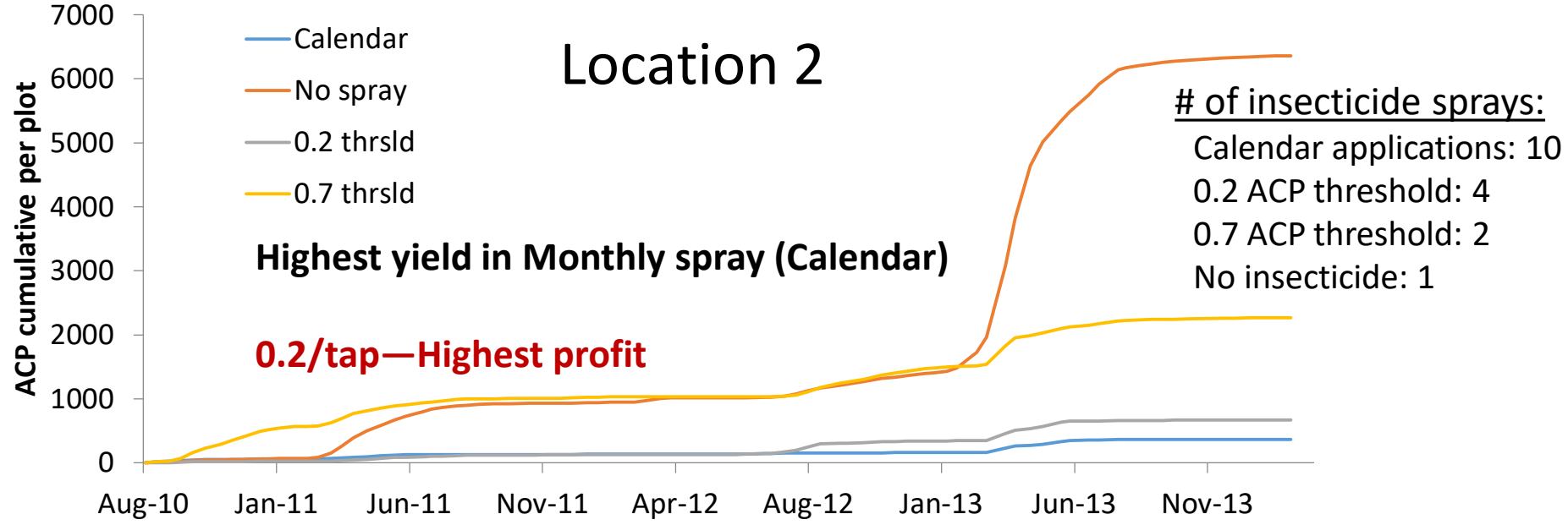
2018 Nonreplicated trial: Fewest fruit per tree where psyllid numbers were highest



Reduce spray frequency by incorporating economic threshold



How many is too many?

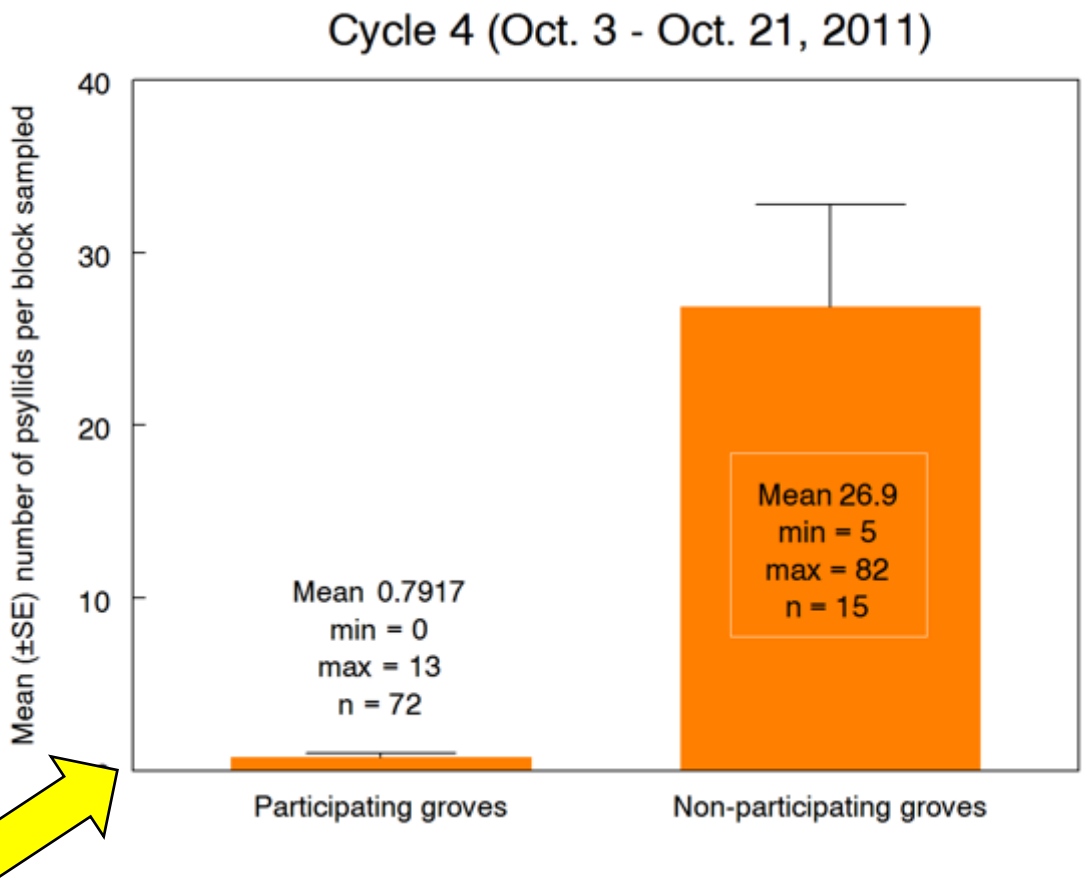


# of insecticide sprays:

Calendar applications: 10
0.2 ACP threshold: 4
0.7 ACP threshold: 2
No insecticide: 1

ACP management always more effective when coordinated on large scale

- Total blocks in CHMA = 423
  - Blocks sampled = 87
  - 20.5% of CHMA scouted
  - In 62% (54/87) of the blocks sampled, no psyllids were found
- Analysis of blocks participating vs. non-participation in CHMA



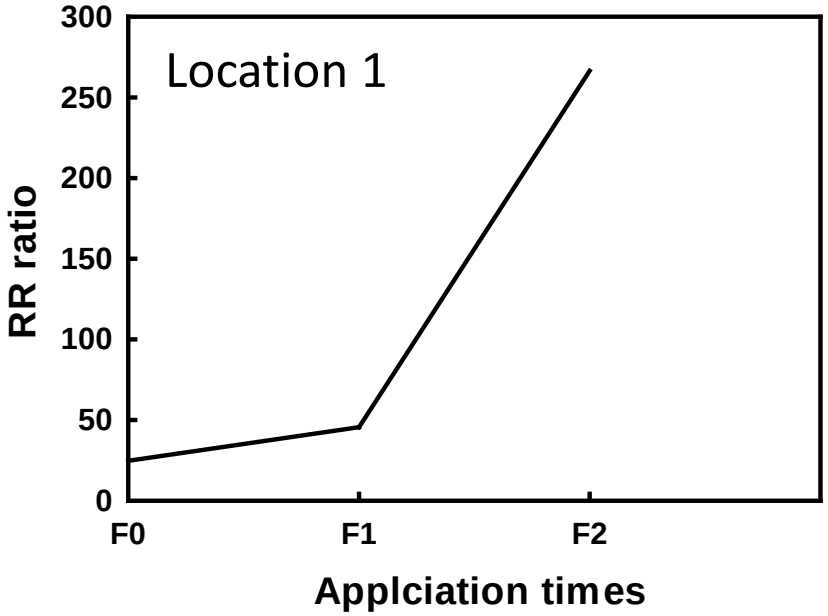
What doesn't seem to work and what are the challenges?

- Spraying intermittently without staying on top of the population. Should not allow population to rebound if you're going to be killing off the biocontrol agents anyway

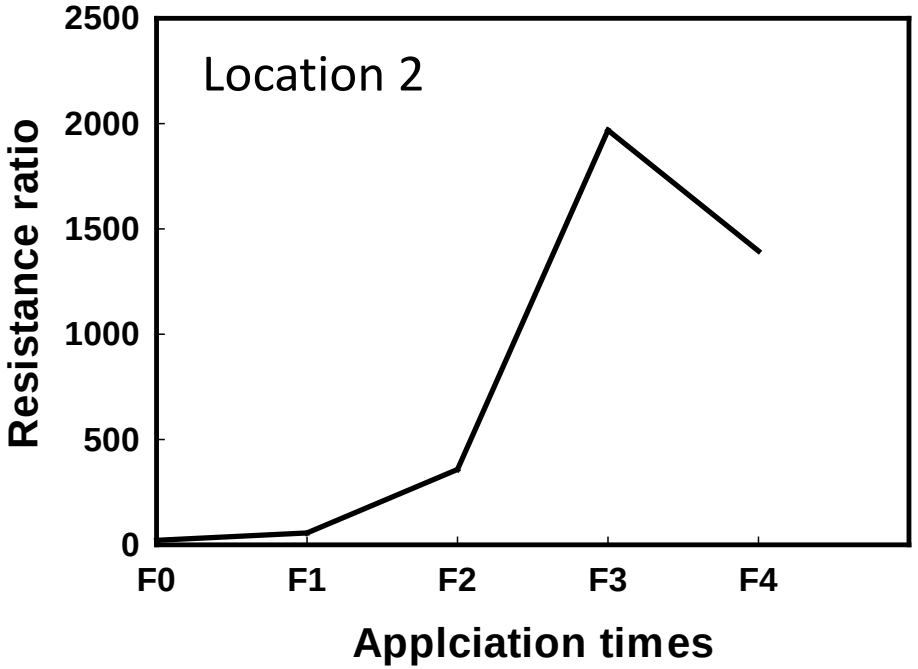
- If you're on an island of management surrounded by a sea of psyllids; the storm never ends

- Seamless integration of sprays and biological control is a challenge; This has stumped me to date.

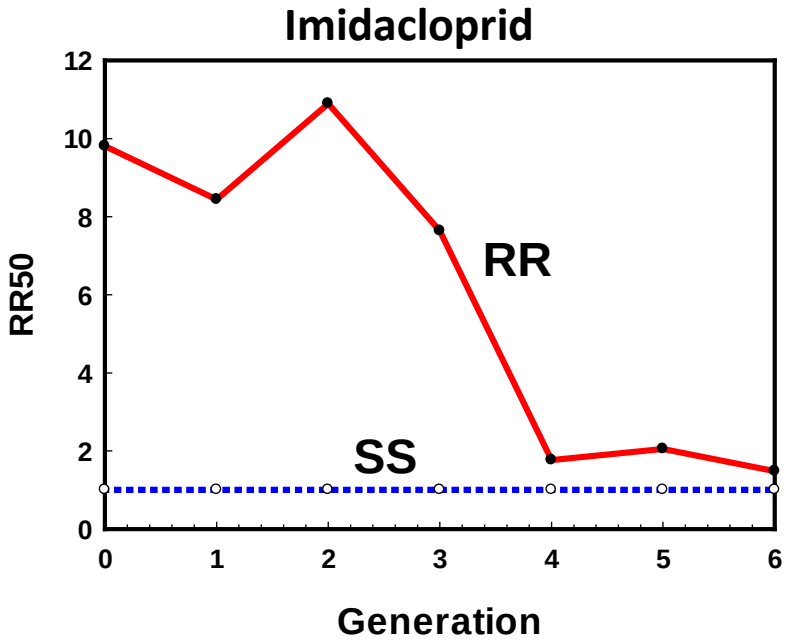
Resistance shows up fast

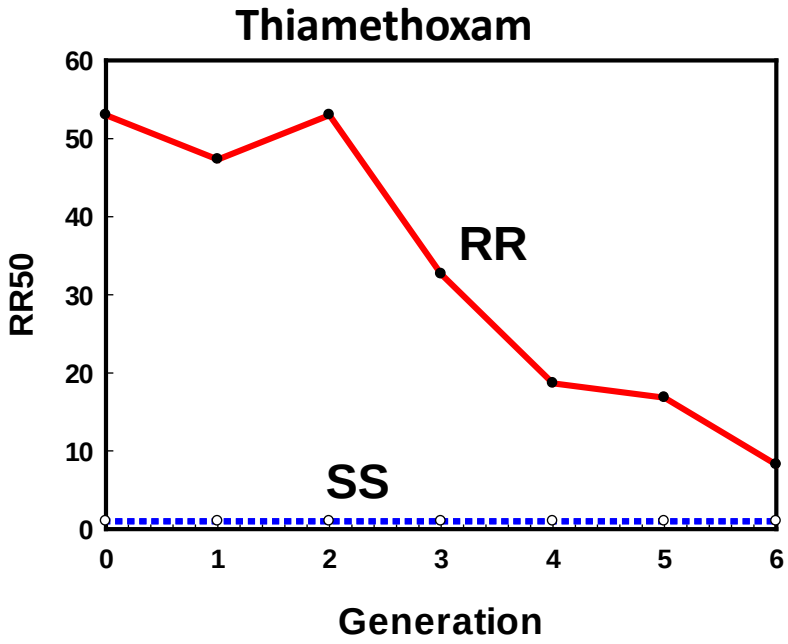


We observed 200-500 fold resistance with 2 back-to back; ~2000 fold after 3 consecutive failures to rotate

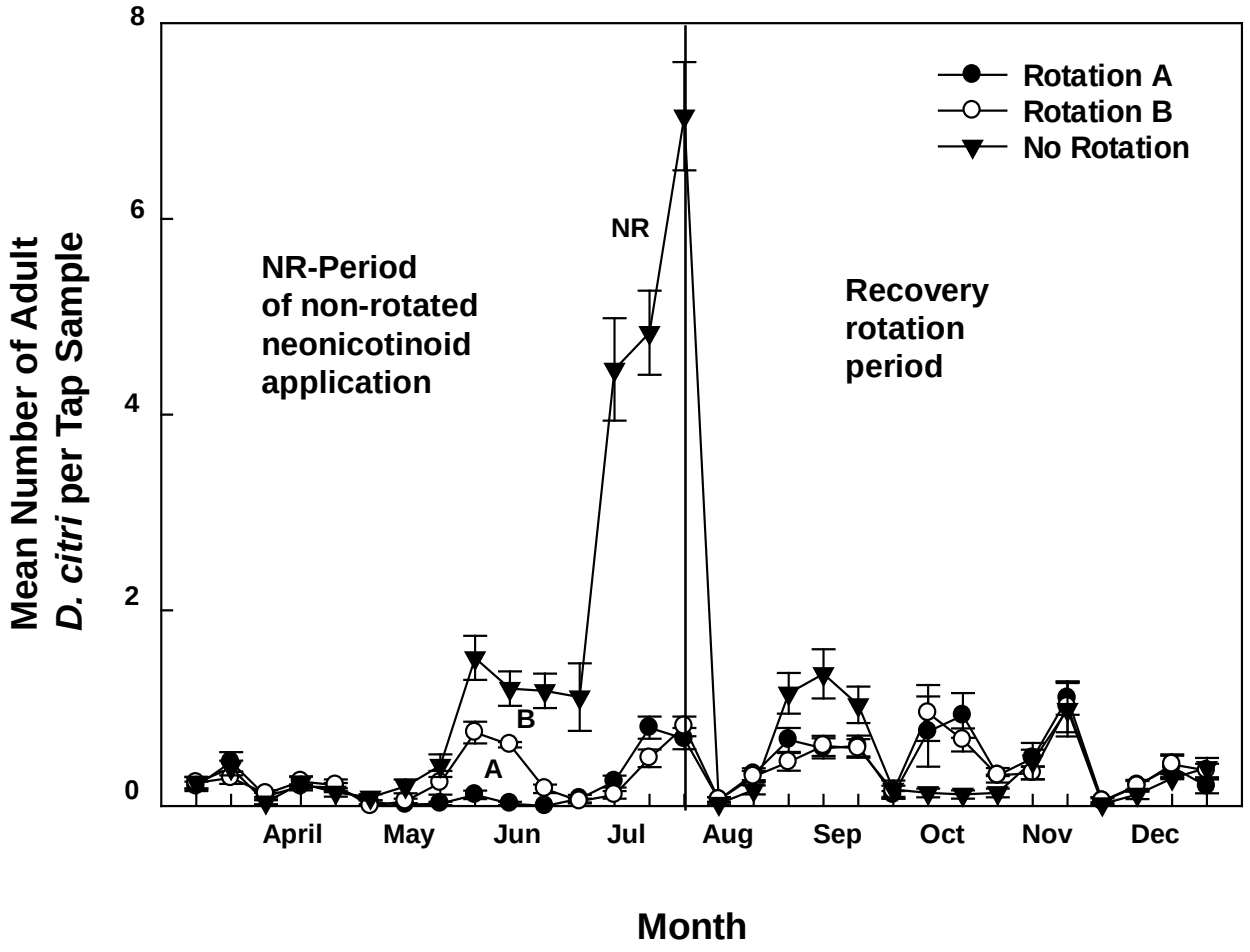


Populations recover to full susceptibility in the laboratory when reared for 5 generations without exposure to neonicotinoids.





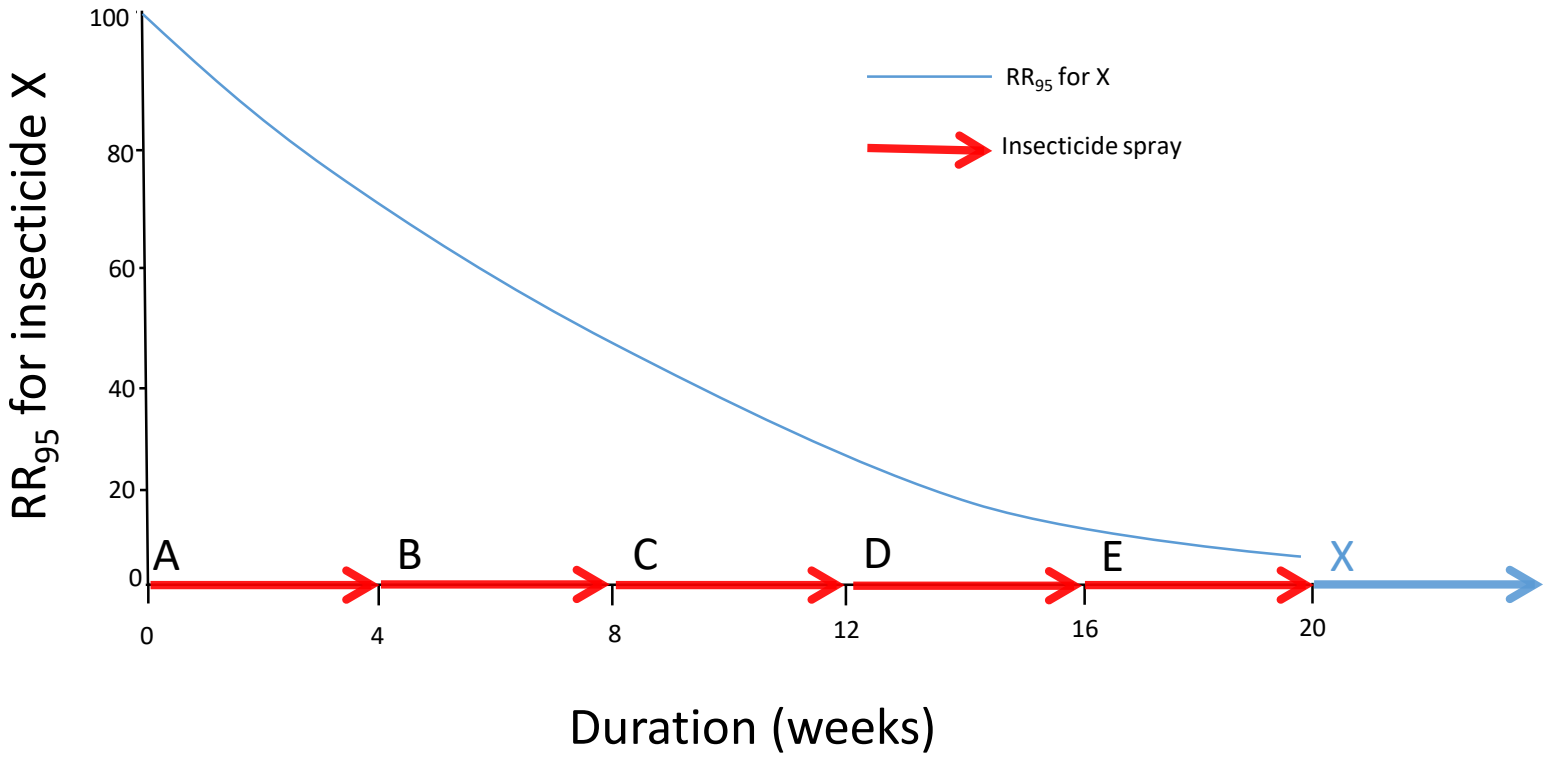
Implementation of a recovery rotation when resistance shows up in the field.



Rotating 5 modes of action in sequence cause reversal to susceptibility for over-selected MOAs

5 sequential MOAs-Protocol if known resistance to insecticide X

5 sprays every 4 weeks under ideal conditions is close to 5 ACP generations



Insecticides-What seems to work?

- Initiating sprays during the dormant period and then continuing to spray when populations begin to rise (associated with flush). A threshold can be useful

- You can hold back from spraying if there are no psyllids, but you can’t forgo spraying and allow periods of standing populations.

- Managing psyllids on a large, continuous scale

What seems to work beyond insecticides?

- Psyllid exclusion techniques to keep psyllids off, if those tactics can somehow be integrated into your practices

- Biological control under certain circumstances seems to keep ACP populations at bay; however, those groves with no other means of reducing ACP are not usually producing pre-greening yields

Summary: Ways to Lower ACP Control Costs and Resistance

1. Thresholds can guide spray frequency and reduce sprays
2. Target control to reduce ACP in flush
   - Preemptive sprays may be best
   - Don't let a standing population linger
3. Use border sprays to control psyllids where they congregate and reduce sprays to whole block
   - Selective products for whole block sprays
   - Cheap products for border sprays
4. Conserve beneficials by eliminating unnecessary sprays
5. Rotate between at least 5 modes of action
6. Other techniques (mulches, kaolin, mesh, windbreaks) either available and more coming (attract-and-kill)