Importance of Controlling ACP In HLB Infected Groves

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The ACP Juggernaut: Challenge and Response

- Why control ACP?
  - Increase yield: make more money
  - Bring new plantings into rapid and profitable production
- Efficient and sustainable ACP control in mature blocks
  - Yield benefits of ACP management
  - Using economic thresholds
  - Spray timing
  - Border vs whole block sprays
  - Value and use of beneficials
  - Economical and effective pest management plan

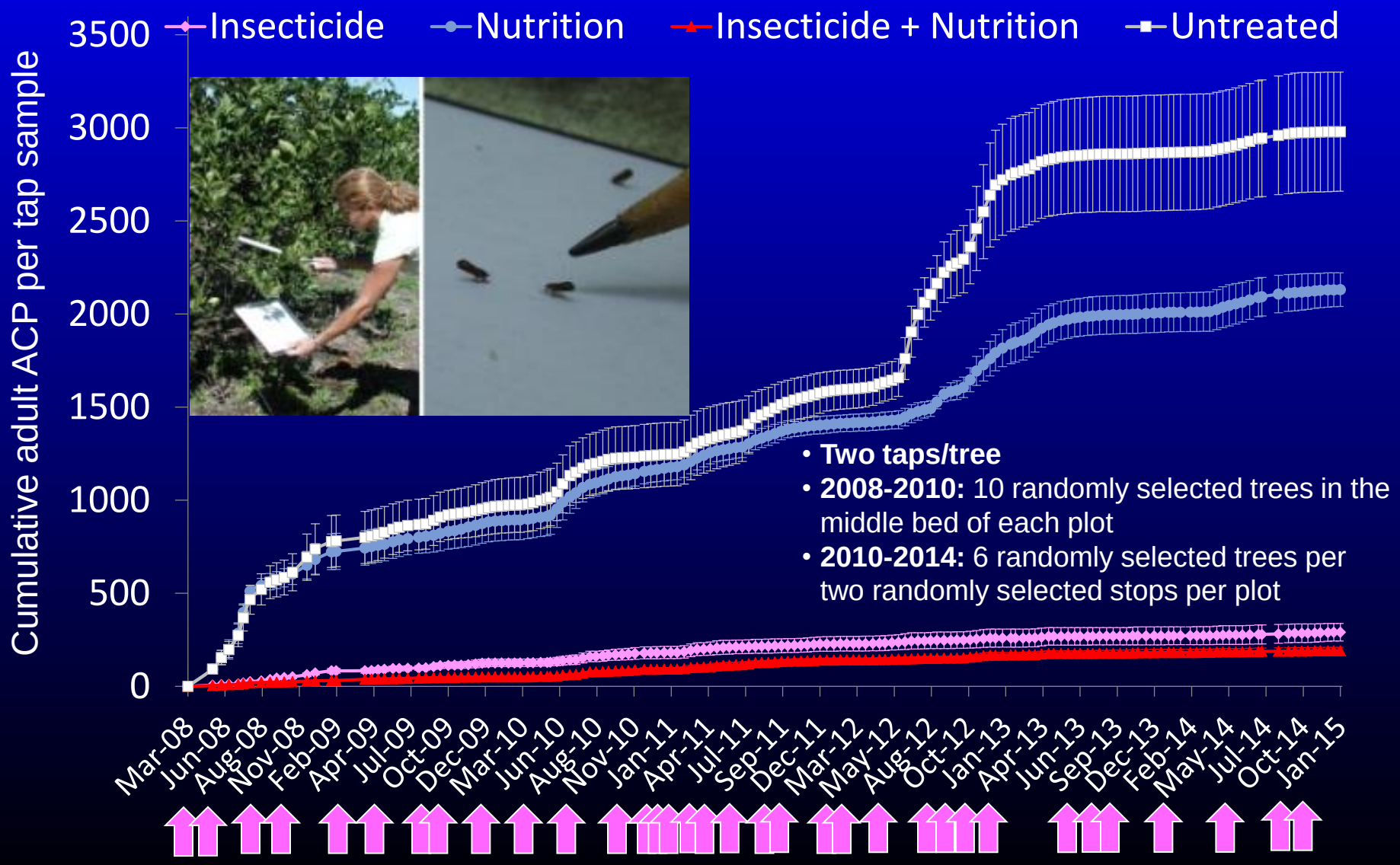
Why spray if my trees are already infected with HLB?

Objective: Evaluate effect of insecticidal control and foliar nutritional on ACP populations HLB incidence, yield and quality

- 13 acres 'Valencia' on 'Swingle'
- Planted June 2001
- Defoliated 2005 and 2006 for canker control
- HLB detected spring 2006
- 2 x 2 factorial (RCBD 4 reps)
  - 16 plots
  - Average 108 trees per plot
  - Treatments began Feb 2008

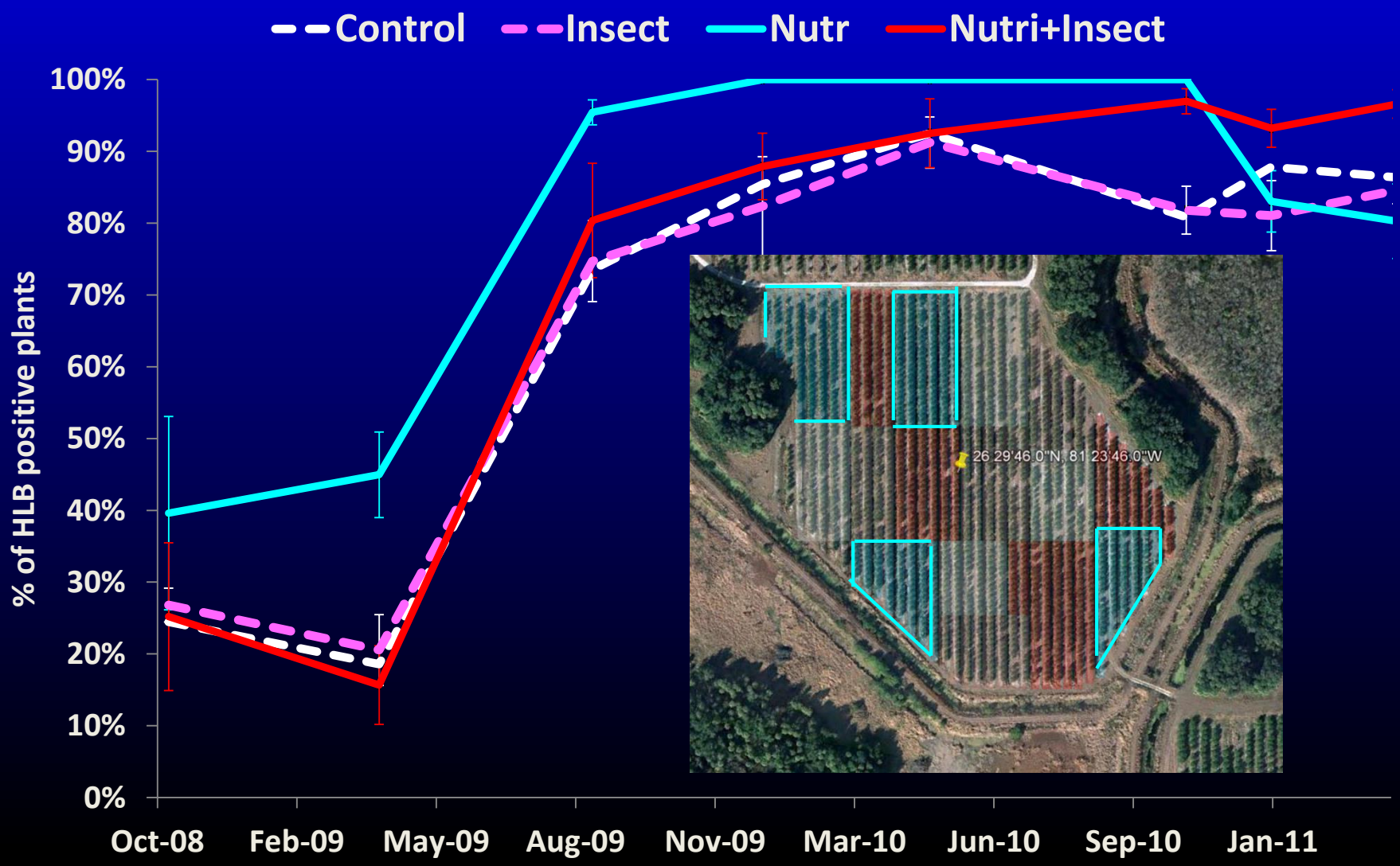
	No-Insecticide	Insecticide
No-Nutritional	Control	Insecticide
Nutritional	Nutritional	Nutritional + Insecticide

Cumulative of ACP adults per tap sample taken at two week intervals:



Sprays (Avg 5/year) dormant + threshold based on 0.5,0.2 and finally 0.1 APC/TAP

Incidence of HLB:
Assessed by PCR from most infective branch on 20% of trees
Rose from 30% to > 90% in 18 months
Highest initially in Nutrient Only plots
If treatments will help, it will be by reducing intensity of HLB

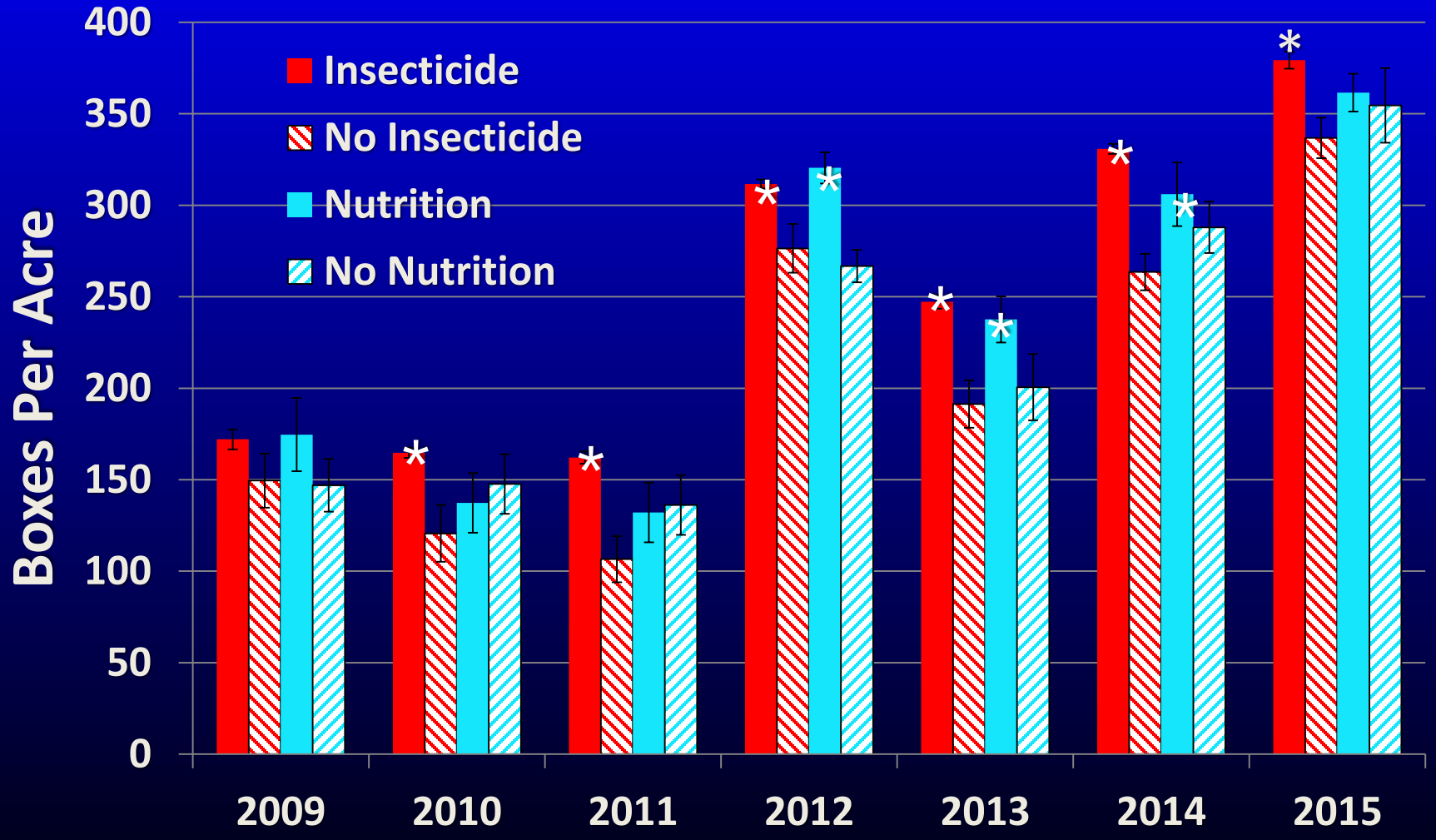


Yield and Quality Evaluation

Oranges hand picked into 10-box tubs by supervised crews. Tared weight of oranges in each tub was recorded in the field using a Gator Deck Scale 500 ± 1 lb.

A 10 lb composite fruit sample was taken from each plot and evaluated at the CREC fruit quality laboratory.

Separate Contributions of Insecticides and Foliar Nutrients to Yield



Bottom Line: Both insecticides an foliar nutrients reduced intensity of HLB. Insecticides contributed to yield every year but the first, whereas nutrients contributed only 3 out of 7 years

HLB Infection Process: Latency and Symptom Expression
Transmission cycle explains what we see.

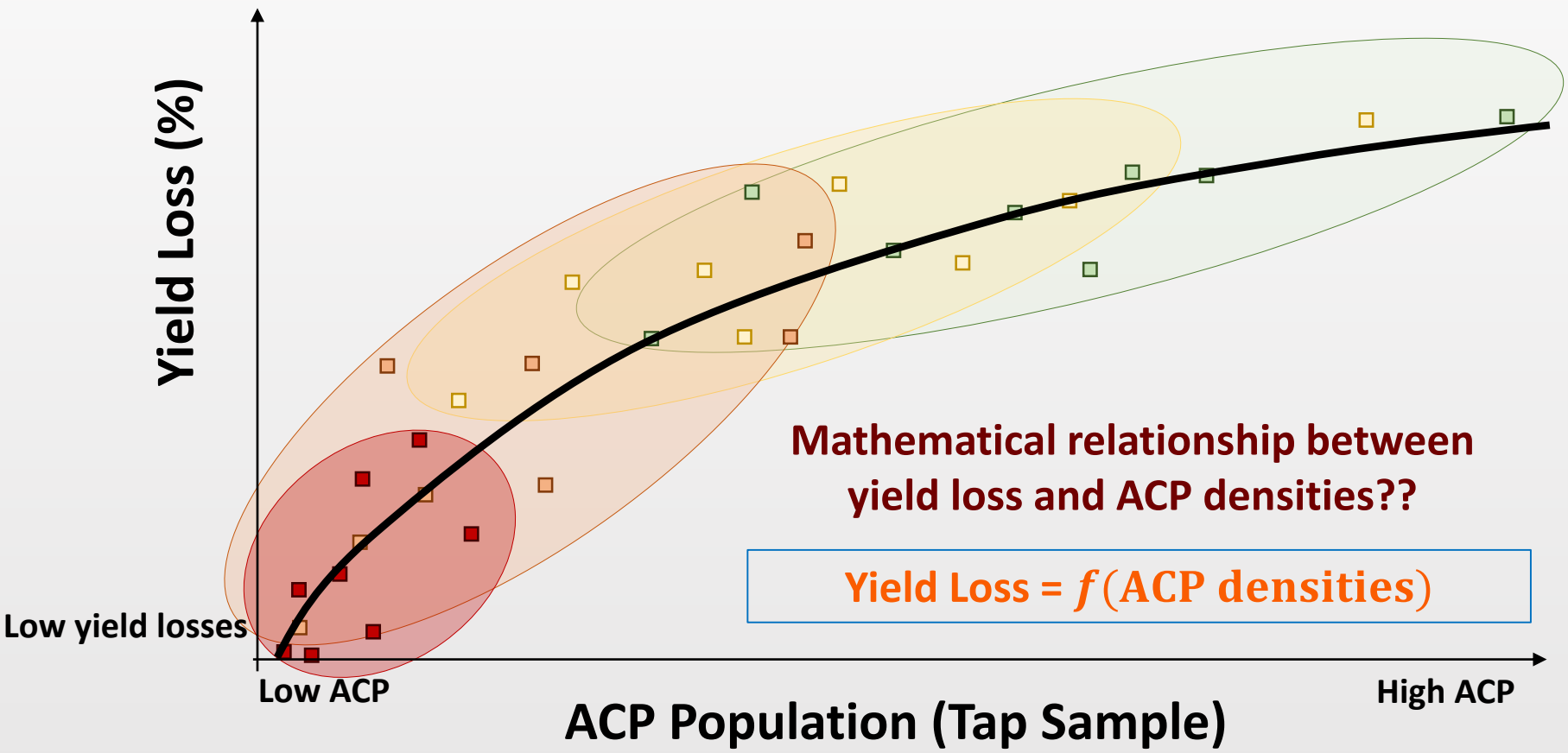
Time	Stage	Event
1 day	1	Transmission of Clas to the shoot by adult
15 days	2	Acquisition & amplification of CLAS by nymphs
30 days	3	Emergence of infected adults
3 months‡	4	Incapacitation of phloem
6 months‡	5	Dysfunction of root system
6 months‡	6	Appearance of foliar symptoms

‡ Depends on tree age

Protecting HLB+ trees from ACP allows formation of healthy new flush reversing the downward spiral

* Lee, J.A., Halbert, S.E., Dawson, W.O., Robertson, C.J., Keesling, J.E., Singer, B.H. (2015) Asymptomatic spread of huanglongbing and implications for disease control. *Proceedings of the National Academy of Sciences of the United States of America,* (14) 24, 7605–7610, doi: 10.1073/pnas.1508253112.

Reducing costs (1): Economic thresholds for mature trees with high incidence of HLB



Mathematical relationship between yield loss and ACP densities??

$$\text{Yield Loss} = f(\text{ACP densities})$$

Economic Injury Level (EIL):

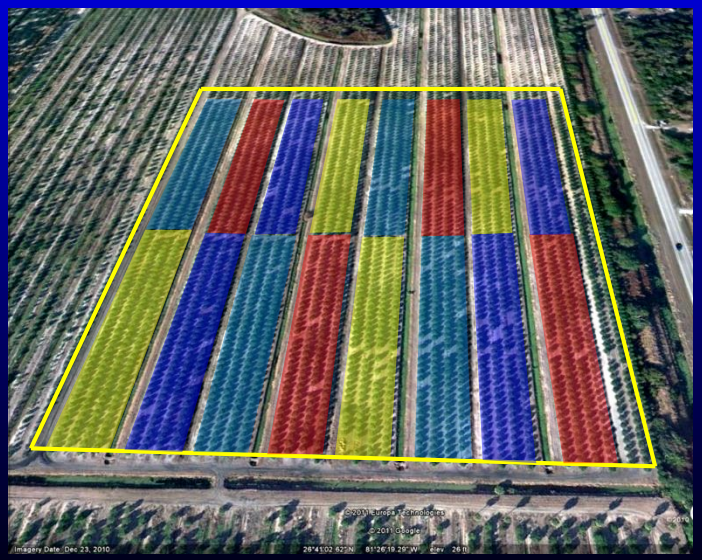
Balance point where pest damage equals management costs.

Two 4-year studies:

Dr. César Monzó

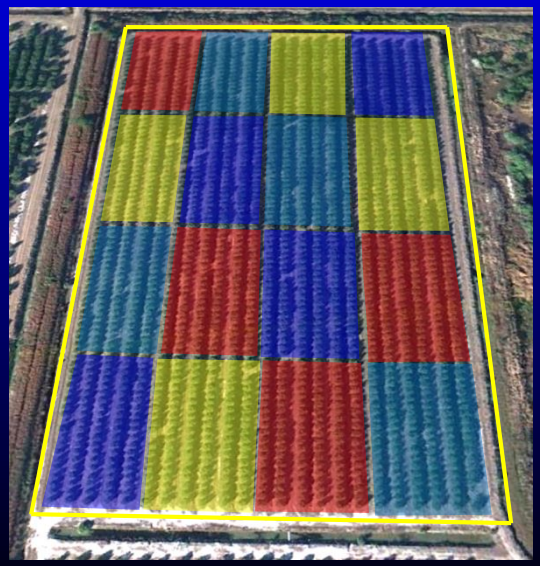
Randomized Complete Block Design w/ 4 reps and 4 Treatments:

Bob Paul (Block 1):



- No insecticide
- Monthly sprays
- 0.2 ACP threshold + 2 dormant sprays
- 0.7 ACP threshold + 1 dormant spray

Moreno Farms (Block 2):



30 acres

Early Gold (10 years old)

Estimated HLB infection: 98%

12 acres

Valencia (10 years old)

Estimated HLB infection: 80%

Materials and Methods

Insecticide treatments → Air-O-Fan airblast sprayer

ACP monitoring → Stem-tap sampling

HLB incidence → qPCR from leaf petiole tissue

Harvest evaluations → Volume of marketable fruit

Juice quality measures

ACP Management.

Calendar of applications 2012:

Dates	Insecticide	Aim	Treatment sprayed	Cost per acre ($)
January 19, 2012	Zeta-cypermethrin (Mustang)	ACP control	●○●	28.7
March 13, 2012	Spirotetramat (Movento MPC)	ACP control	●	62.6
March 13, 2012	Chlorpyrifos (Lorsban 4EC)	Overspray	●○●●	48.0
April16, 2012	Diflubenzuron (Micromite 80WGS)	ACP control	●	62.3
May 24, 2012	Spinetoram (Delegate WG)	ACP control	●	61.8
June 22, 2012	Abamectine (Agri-Mek SC)	ACP control	●	39.2
August 3, 2012	Imidacloprid (Admire Pro)	ACP control	●	55.4
August 30, 2012	Dimethoate (Dimethoate 4E)	ACP control	●○	29.6
October 12, 2012	Fenpyroximate (Portal)	ACP control	●	39.3
December 14, 2012	Zeta-cypermethrin (Mustang)	ACP control	●○	28.7

Valencia only

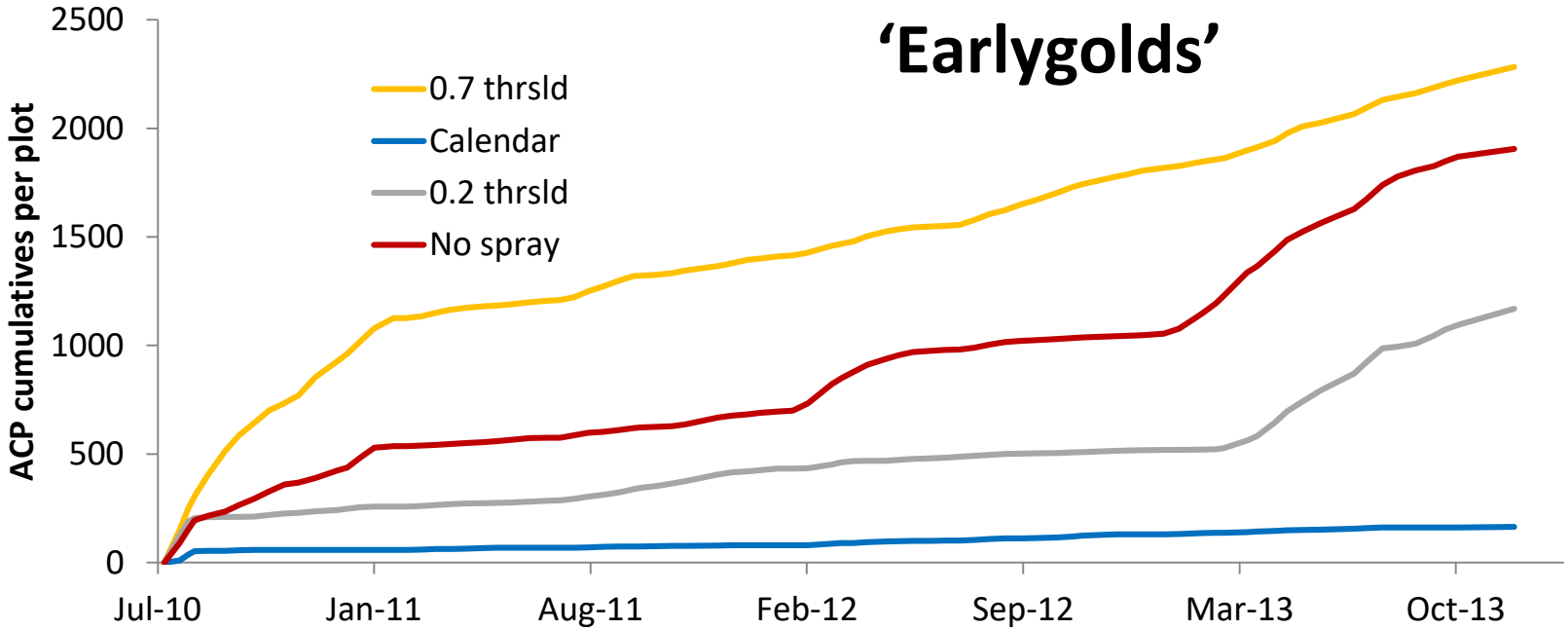
of insecticide sprays:

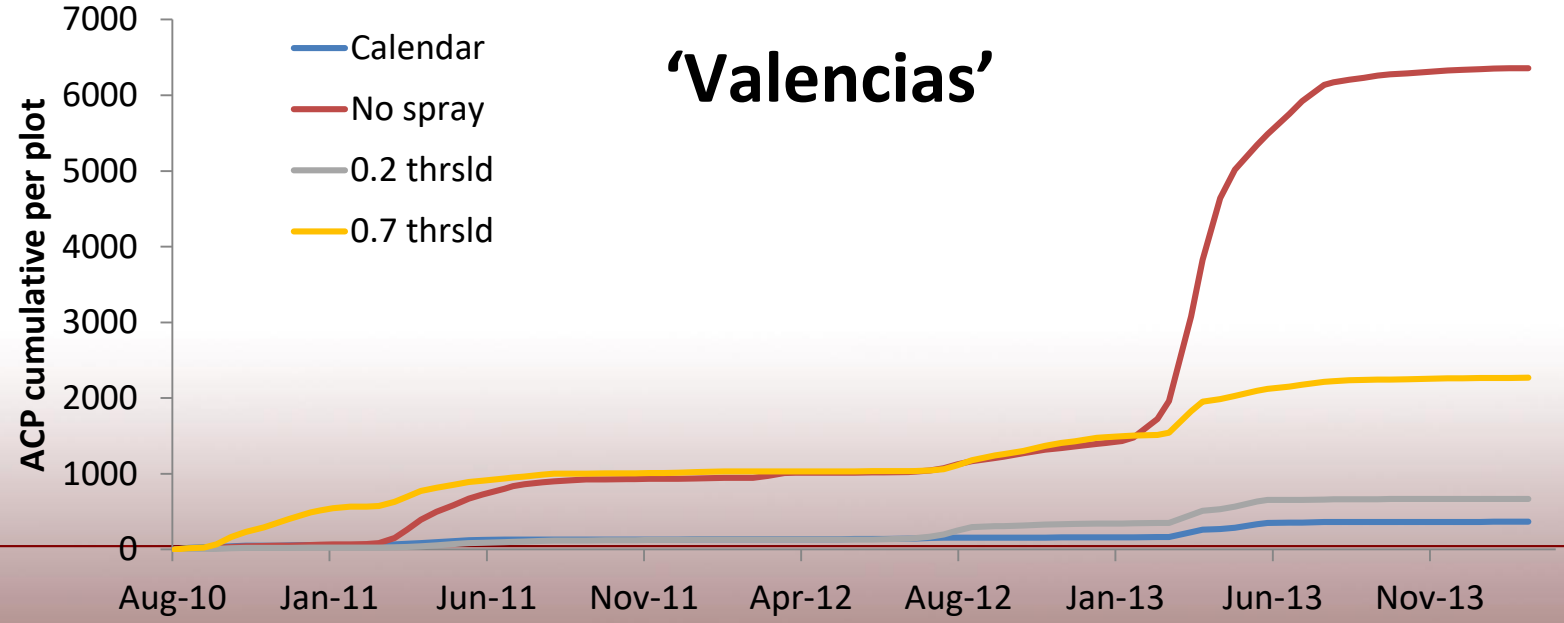
Calendar applications: 10
0.2 ACP threshold: 4
0.7 ACP threshold: 2
No insecticide: 1

Nutritional program:

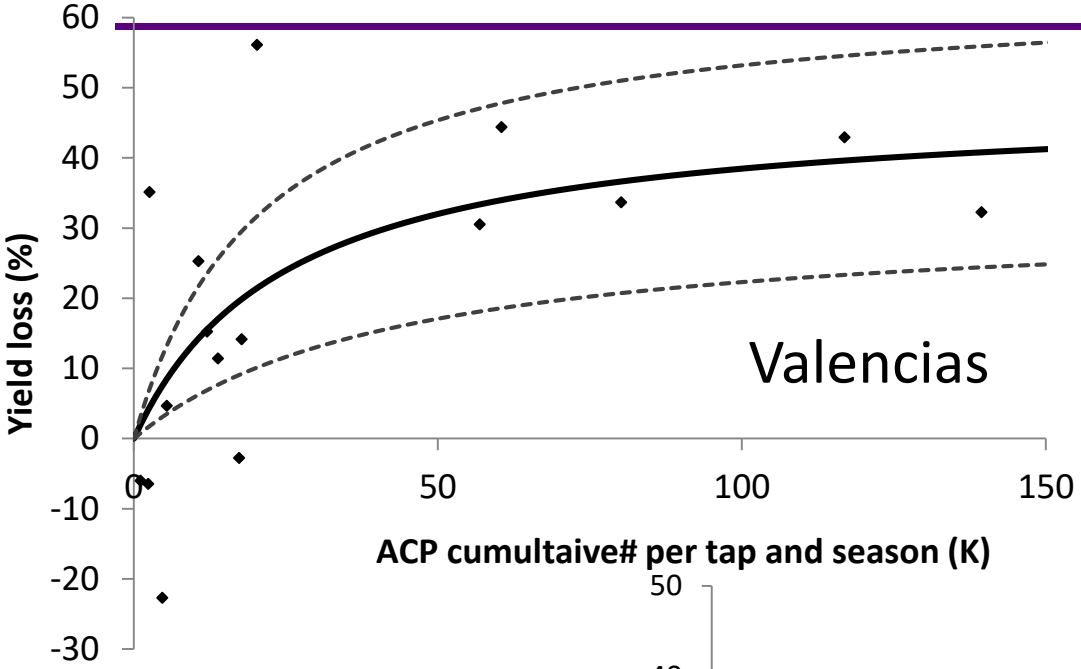
Nutrients	Rate/ac
K-Phite	1 gal
13-0-44 fertilizer	12 lb
Techmangan ($MnS0_4$)	8.5 lb
Zinc Sulfate	2.8 lb
Sodium Molybdate	0.85 oz
Epsom Salts	8.5 lb

Cumulative ACP Adults in Stem Tap Samples

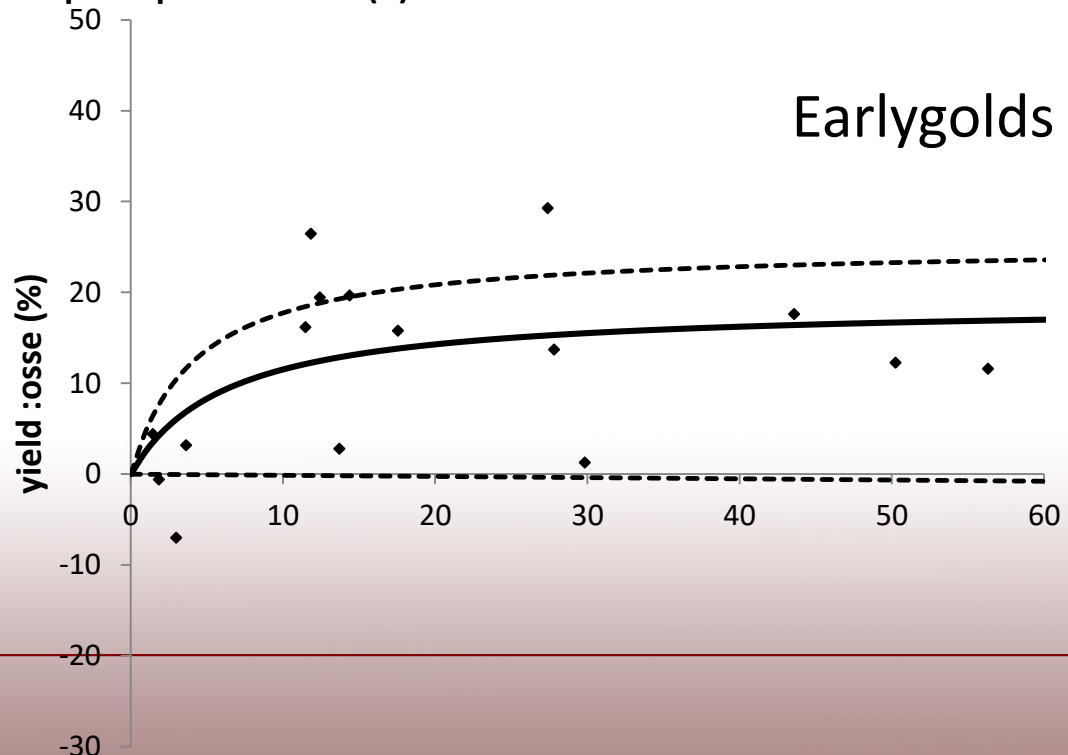




Relationship between cumulative ACP counts and Yield Loss



100% with Calendar Spray



Results

EIL implementation

- Simulation:

2 dormant season sprays

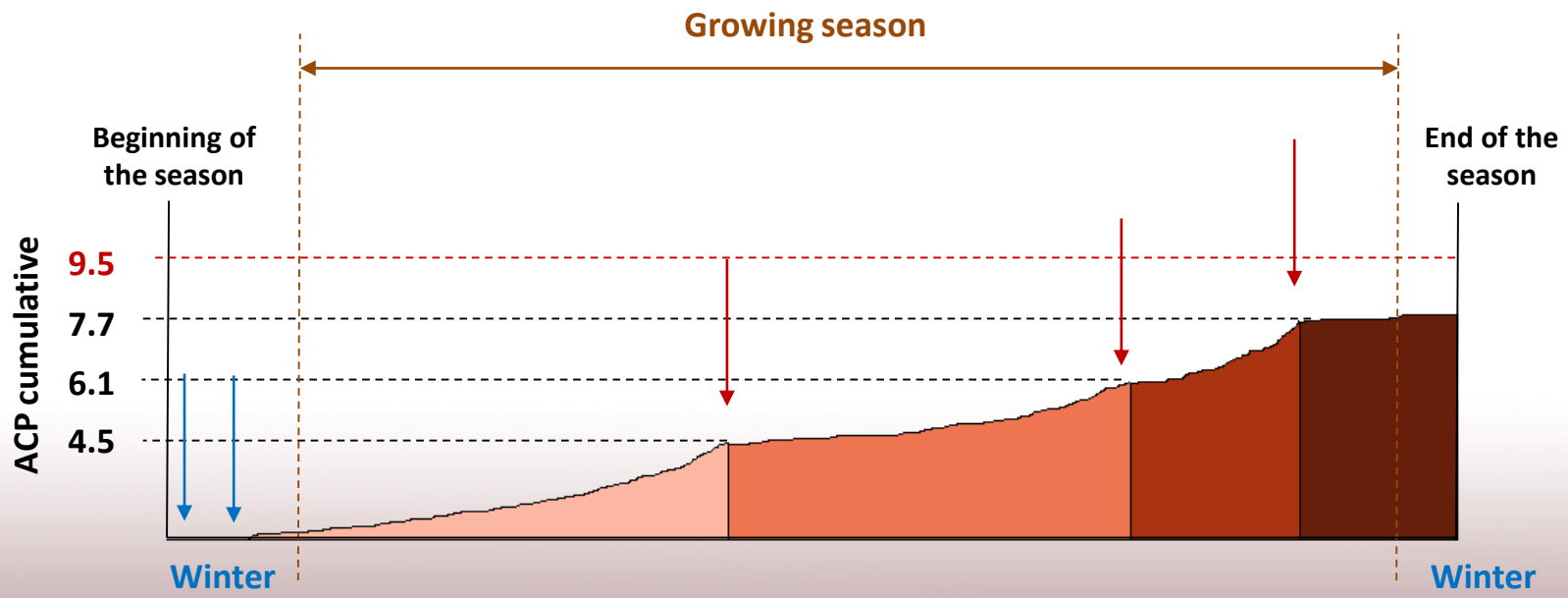
1st growing season spray (at 4.5 cumulative ACP adults)

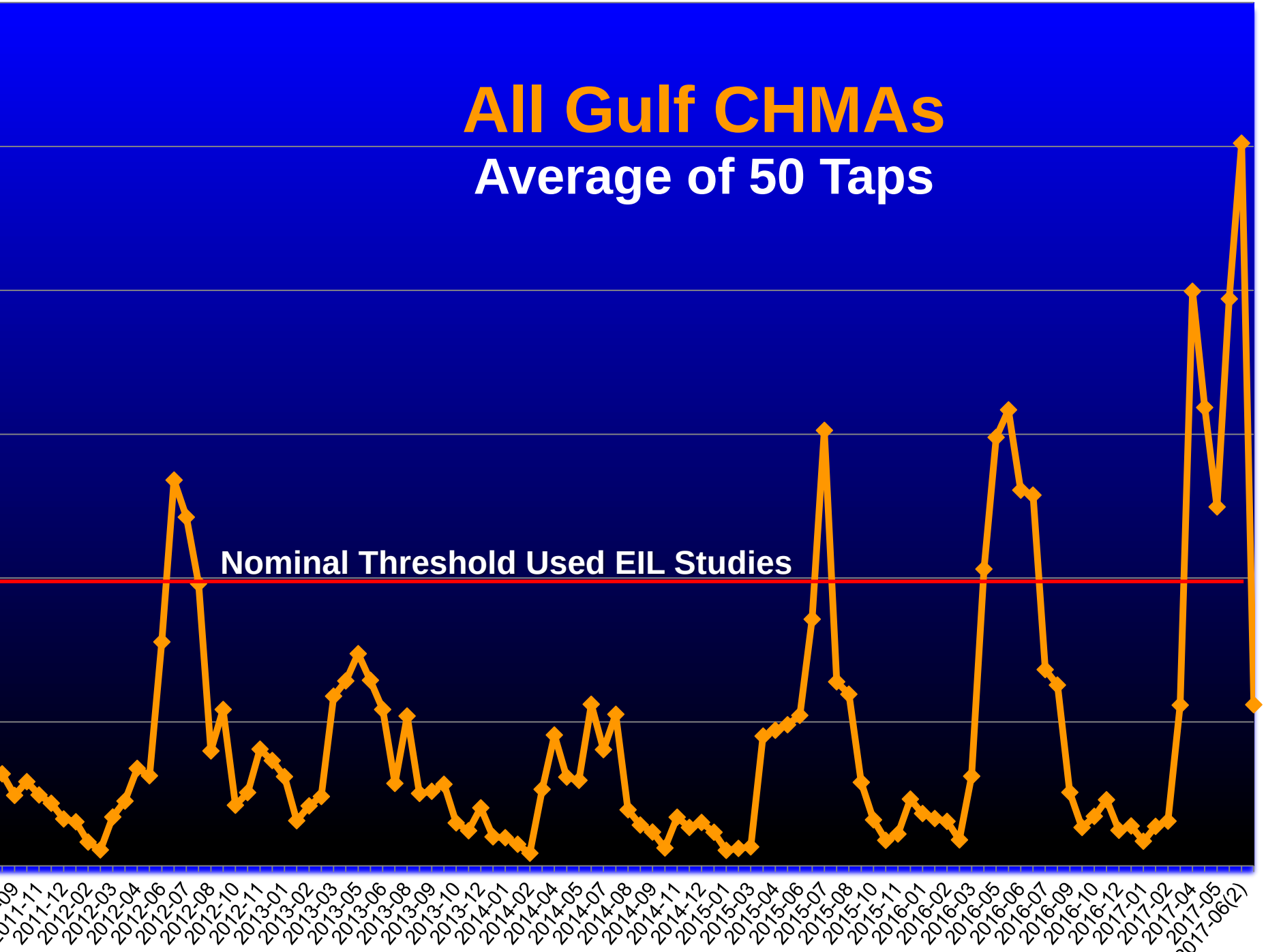
2nd growing season spray (at 6.1 cumulative ACP adults)

3rd growing season spray (at 7.7 cumulative ACP adults)

~~4rd growing season spray (at 9.5 cumulative ACP adults)~~

(Threshold not reached in that season)




All Gulf CHMAs
Average of 50 Taps
Nominal Threshold Used EIL Studies
2011-11
2011-12
2012-02
2012-03
2012-04
2012-06
2012-07
2012-08
2012-10
2012-11
2013-01
2013-02
2013-03
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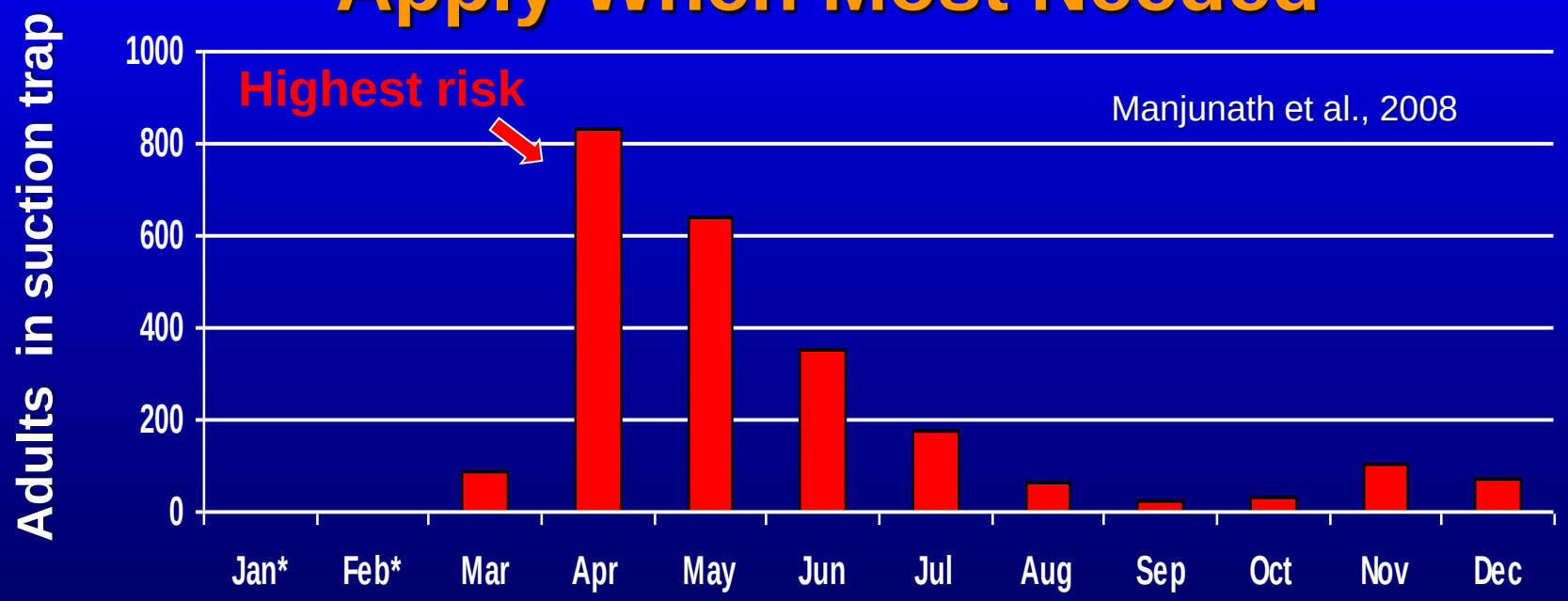
2016-02
2016-03
2016-05
2016-06
2016-07
2016-09
2016-10
2016-12
2017-01
2017-02
2017-04
2017-05
2017-06(2)

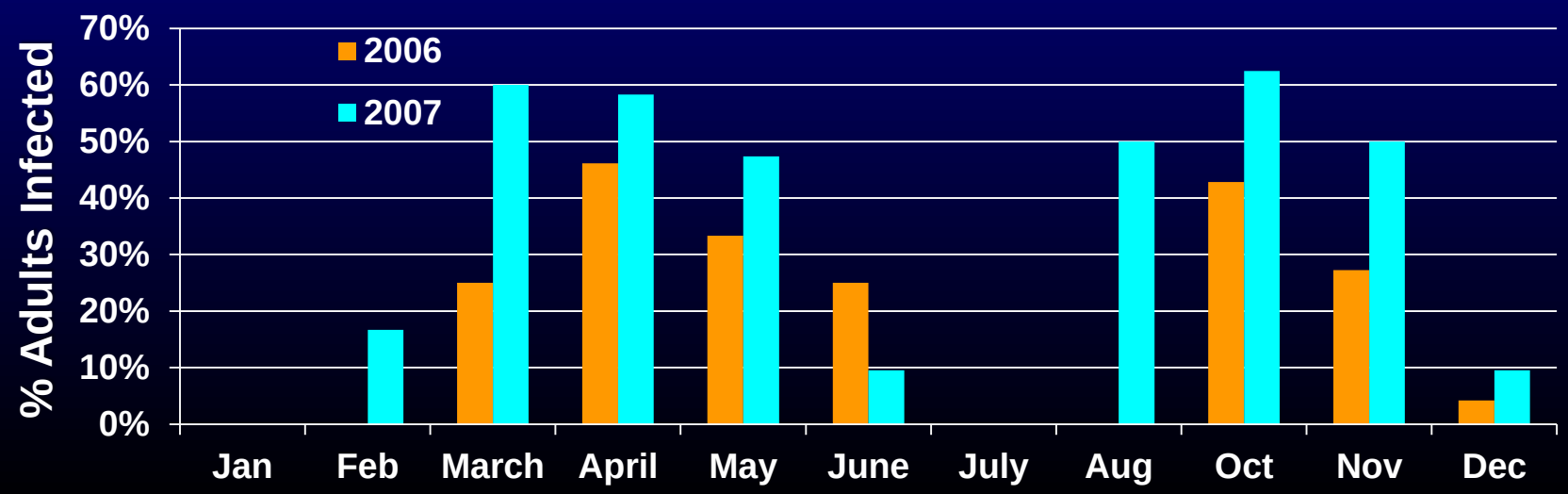
Conclusions

- An Economic Injury Level (EIL) Model is proposed to help decide when to spray bearing trees under high HLB incidence during the growing season
- The model does not provide pre-fixed densities of the pest that trigger the sprays because management costs and juice prices are variable
- The number of applications per season would vary depending on expected price, cost and efficacy of the insecticide treatments and pest pressure during the season
- More research is needed to calibrate model to different varieties and growing conditions

Reducing Insecticide Costs (2): Apply When Most Needed



2006



Reducing Insecticide Costs (3): Use the Right Stuff!

Efficacy
Adults/nymphs
Secondary pests

Resistance management
Frequency of use
Rotation MoAs

Conservation of beneficials
Frequency of use
Selectivity

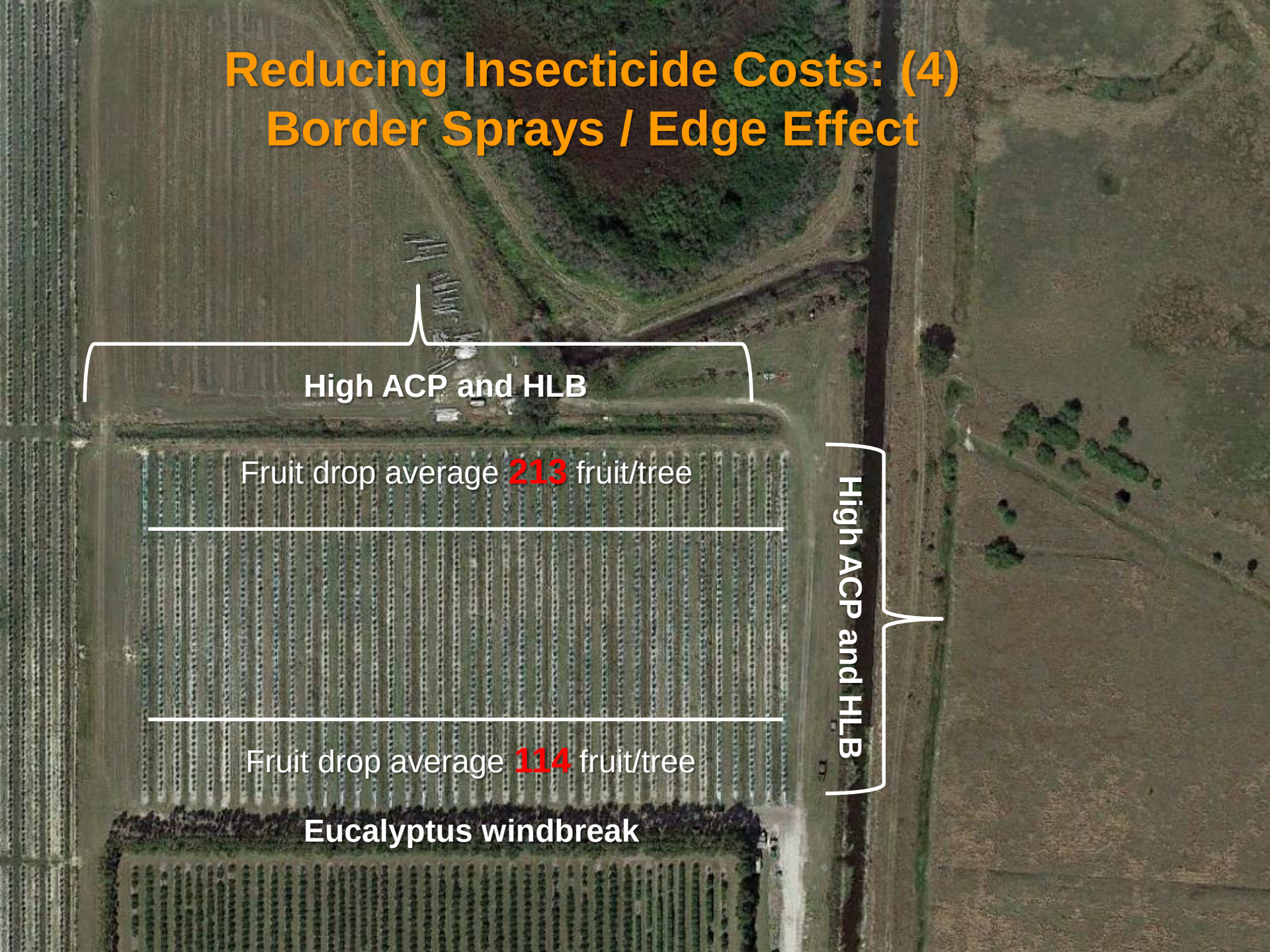
Cost!

Dormant or Border | Growing season/whole block

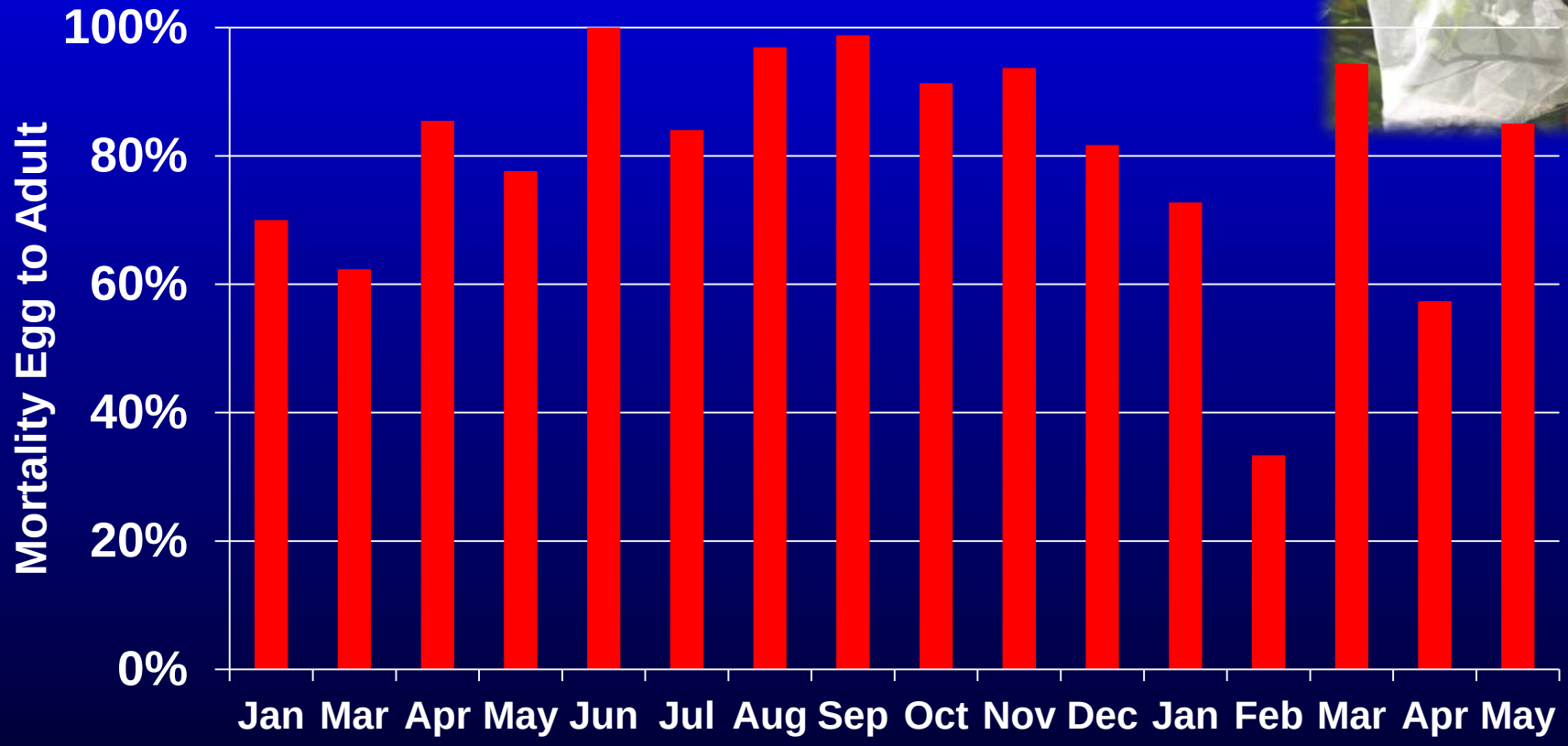
Months	Nov-Dec	Jan	Feb-Mar	Apr	May - June	July - Aug	Sep-Oct
Products	OP[13] (e.g. Imidan, Dimethoate, chlorpyrifos)	Pyrethroid[14] (Mustang Danitol Baythroid)	*Sivanto[9] *Movento[1] *Portal[2] *Micromite[4] *Intrepid[5] Exirel[6]	Portal[2] Micromite[4] Exirel[6] Apta[8] Sivanto[9]	Movento[1] Delegate[10] Abamectin[11] Knack[12] Exirel[6] Apta[8] Sivanto[9]	Oil[7] Sivanto[9] Apta[8] OP[13]	Movento[1] Delegate[10] Apta[8] Sivanto[9]
Pests	ACP Weevils	ACP Weevils	ACP, Mites Leafminer Weevils Scales Aphids	ACP Mites Leafminer Weevils Aphids	ACP Rustmite Leafminer Scales	ACP	ACP Rustmite Leafminer

ACP[+++1,6.8,9,13,14] ACP[++2,10] ACP[+4,7,11] Leafminer[4,5,6,10] Rustmite[1,4,7,8,11] Scales[1,12] Aphids[9] Mealybugs[1]

Reducing Insecticide Costs: (4) Border Sprays / Edge Effect



Reducing Insecticide Costs:5 Take Advantage of Biocontrol

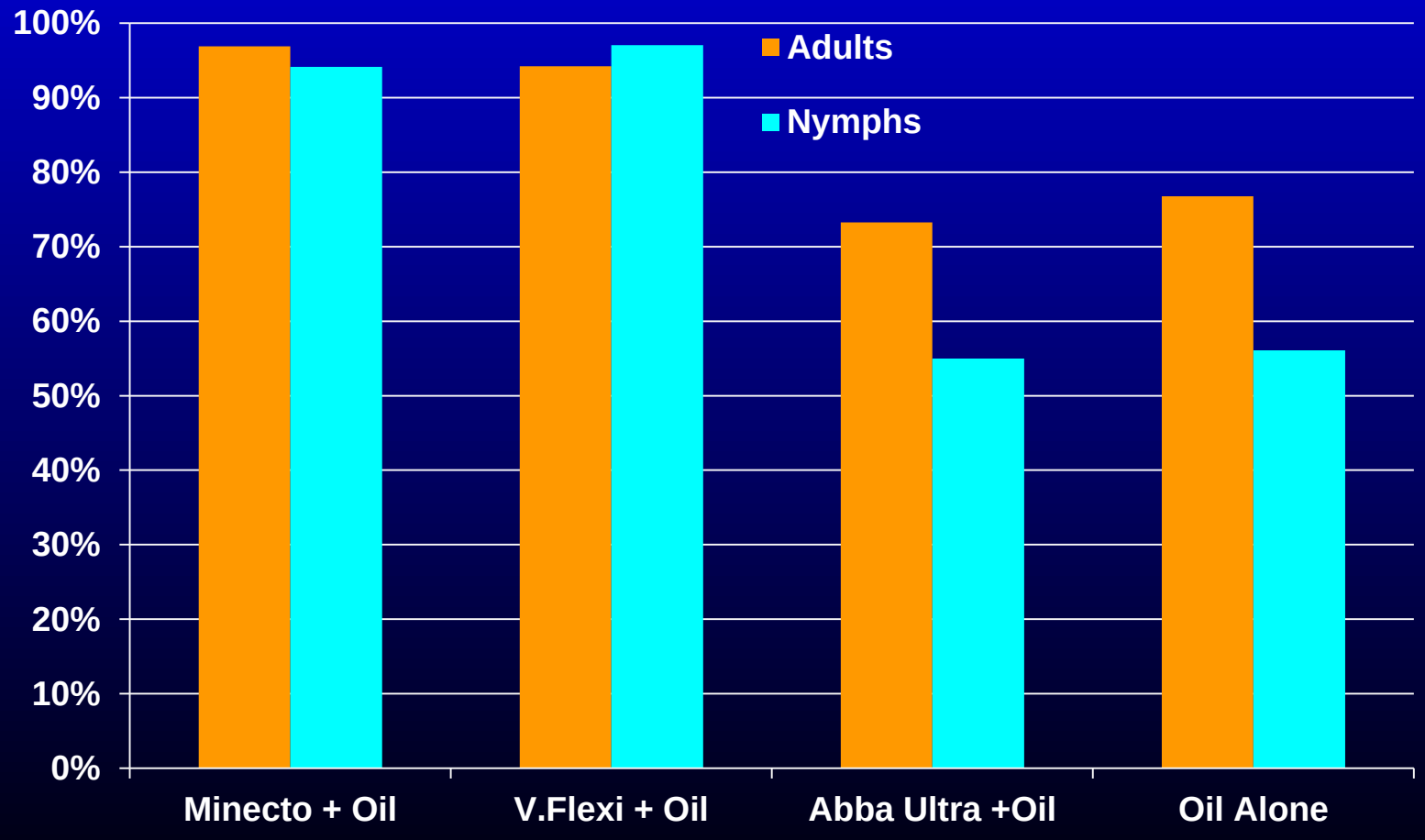


Working everywhere every day!

Qureshi and Stansly Biological Control 50: 129-136.

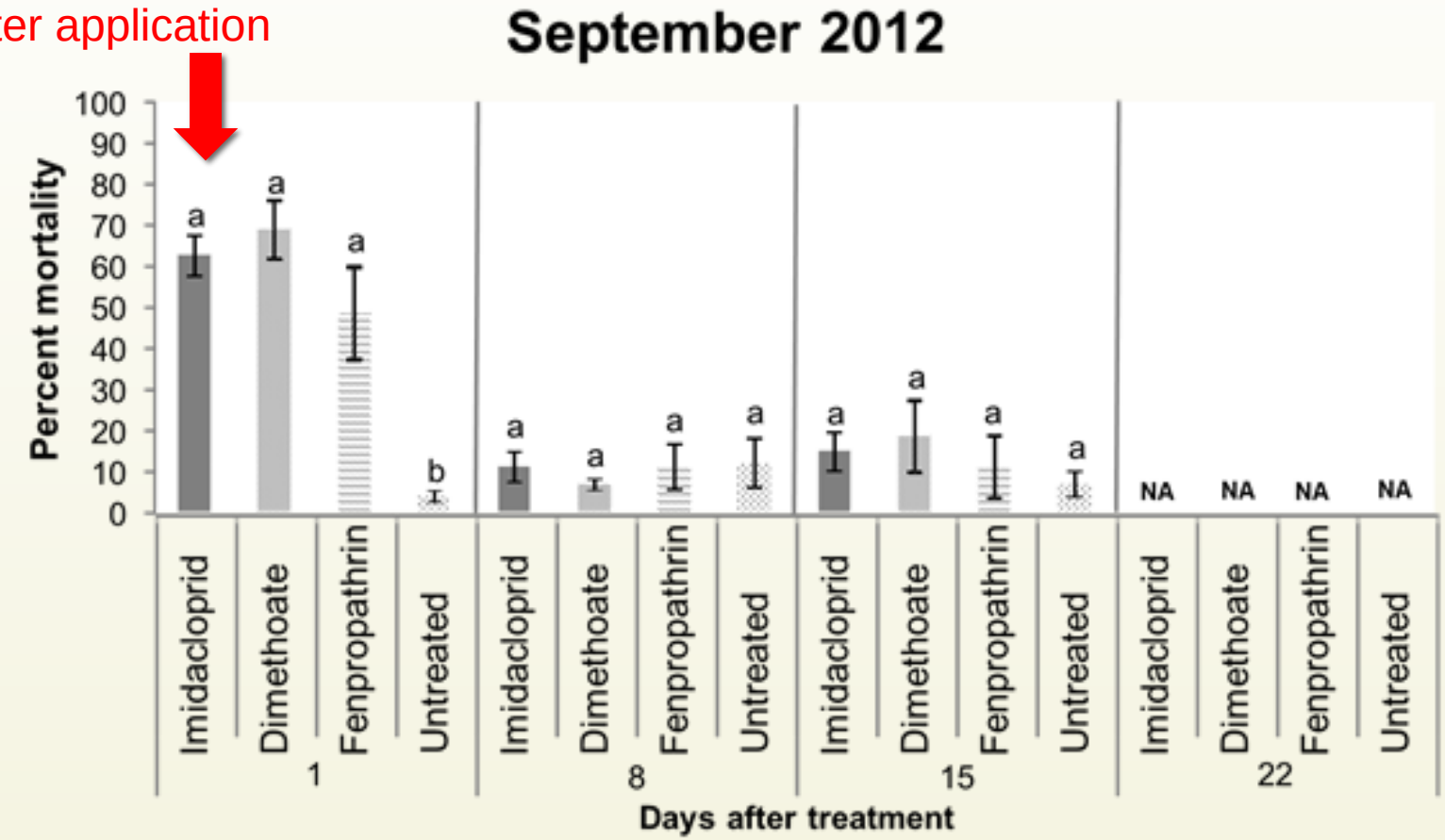
How Good is Insecticidal Control?

Reduction in ACP compared to check
4 days after application 12 June 2017



Determination of True Insecticide Residual Control at different times of the year (Seasonality)

1.2 inches of rainfall 12 hrs after application



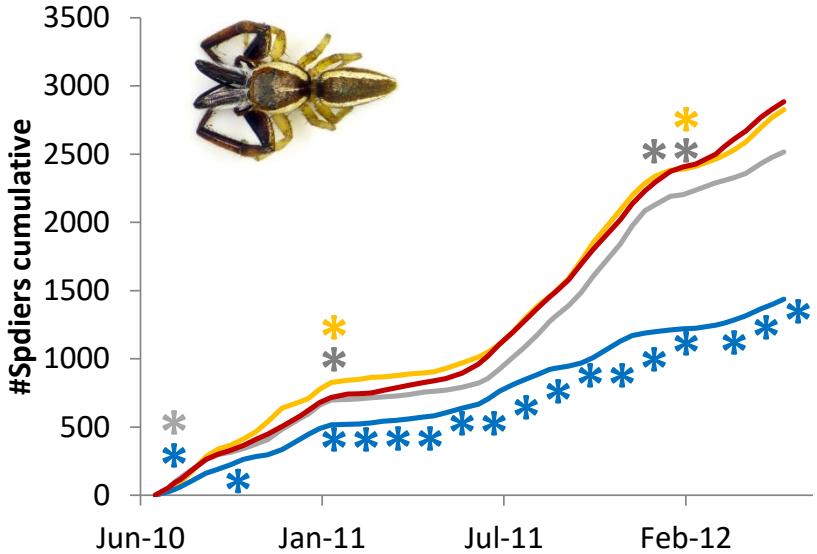
Applications made during the day had time to dry, but overnight there was 1.2 inches of rainfall. As a result, control of psyllids caged the following day was less than 70%.

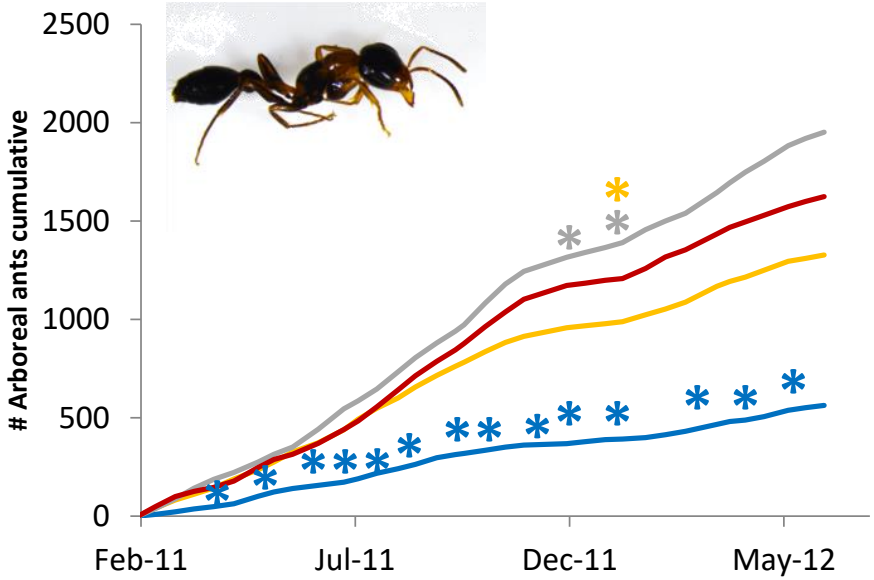
(Christine Weaver, M.S. Student, Rogers' lab)

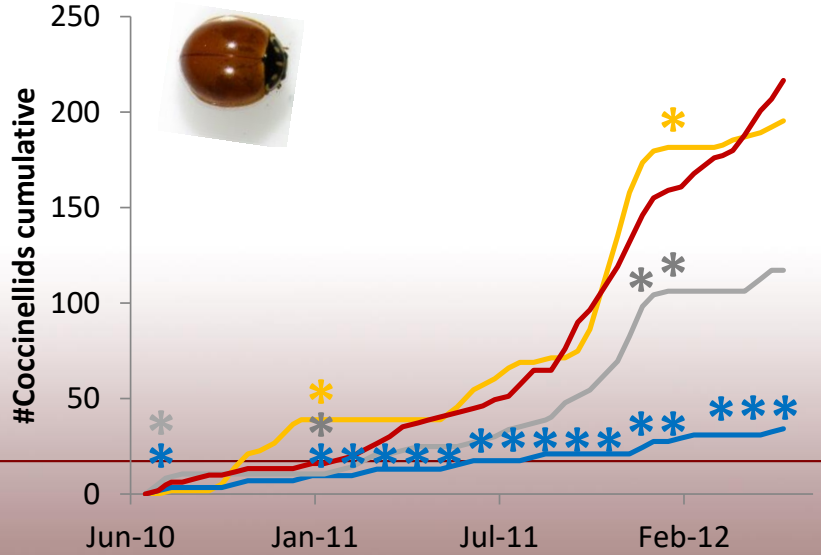
UF UNIVERSITY of FLORIDA

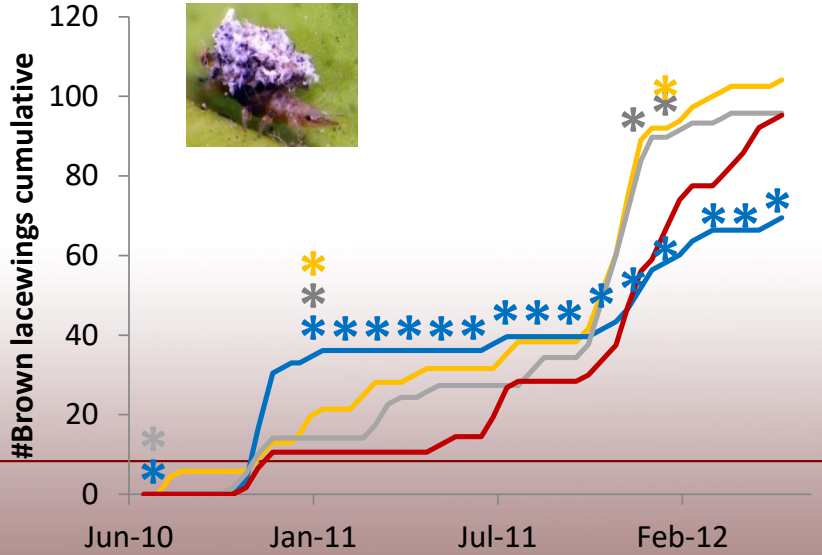
The threshold approach permits inclusion of biological control as a supportive tool to reduce pest pressure and consequently the frequency of applications

Beneficial arthropods (#cumulative stem taps).









Summary: Ways to Lower ACP Control Costs

1. Use thresholds to guide spray frequency.
2. Target control to reduce ACP in flush
   - Preemptive sprays may be best.
   - Damage potential of ACP least in summer
3. Choose the best product for the job at hand.
4. 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
5. Conserve beneficials by eliminating unnecessary sprays and using selective insecticides to treat whole blocks during the growing season

An ACP Management Plan

- Make sure of at least 2 good dormant sprays
  - Use pyrethroids or OPs
  - Try and avoid rain and spray again if it does rain
- Mop up with bloom sprays using any of the 4 registered products
- Don’t use pyrethroids or OPs again except for perimeter sprays
- Use selective chemistries on whole block sprays during rest of the growing season
  - Base when and what to spray on pest pressure (thresholds)
  - Create reservoirs for beneficials in block interiors
- Make every effort to protect new blocks and resets
  - Insecticides as needed
  - Reflective mulch

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