Integrated Management of Asian Citrus Psyllid in Florida

Phil Stansly, Jawwad Qureshi, Moneen Jones and Barry Kostyk: SWFREC Immokalee Florida
“IPM is pest management employing biological, chemical, and cultural controls, and utilizing monitoring techniques to determine if treatments are necessary”
Biological Control

Conservation of Natural Enemies
• Limit broad-spectrum insecticides to dormant season
• Selective insecticides in growing season

Augmentation of Tamarixia radiata
• Pilot studies under way
• DPI Facility in Dundee – Dr. Robin Stuart
Life Cycle of *Tamarixia radiata*
Production of Tamarixia Radiata at SWFREC
José Castillo

Production of clean Murraya
Psyllid colony

Emergence Cages

Ovoposition cage
Oviposition and Emergence cages for *T. radiata*
Over 160,000 wasps released 2011
Parasitism observed during Jul-Aug of feral nymphs at SWFREC in blocks with and without *T. radiata* releases, 2011: J. Qureshi

![Graph showing parasitism percentages]

- **Parasitism (%)**
- **Blocks with releases**
- **Blocks without releases**

<table>
<thead>
<tr>
<th>No. Released</th>
<th>July</th>
<th>August</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17200</td>
<td>15300</td>
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</table>
Field production of T. radiata: J. Qurehsi
Insecticidal Control: Considerations

- **When to spray**
  - Dormant vs growing season
  - “On demand” vs Calendar
    - Thresholds, risk-cost/benefit
- **How to spray**
  - Low Volume vs High Volume
  - Air vs Ground
- **What to spray**
  - Label restrictions
  - Efficacy
    - Adults/nymphs
  - Resistance management
    - Frequency of use
    - Rotation MOAs
  - Secondary pests
    - Leafminers, mites, scales
  - Conservation beneficiais
    - Broad-spectrum vs Selective
<table>
<thead>
<tr>
<th>Month</th>
<th>One</th>
<th>Two</th>
<th>Four</th>
<th>Five</th>
<th>Seven</th>
<th>Other pests Controlled</th>
<th>MOA**</th>
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<tbody>
<tr>
<td>Jan</td>
<td>Pyrethroid</td>
<td>Pyrethroid</td>
<td>Pyrethroid</td>
<td>Pyrethroid</td>
<td>Pyrethroid</td>
<td>rustmite, scales</td>
<td>3</td>
</tr>
<tr>
<td>Feb</td>
<td>Movento*^</td>
<td>Movento*^</td>
<td>Movento *^</td>
<td>Portal^</td>
<td></td>
<td>spidermites rustmites</td>
<td>23</td>
</tr>
<tr>
<td>Mar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>Apr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>May</td>
<td>Oil</td>
<td>Oil</td>
<td>Oil</td>
<td>Oil</td>
<td></td>
<td>Leafminer</td>
<td>5</td>
</tr>
<tr>
<td>Jun</td>
<td>Abamectin* or Delegate*</td>
<td>Abamectin* or Delegate*</td>
<td>Abamectin*^</td>
<td></td>
<td>leafminer rustmite</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Jul</td>
<td>Oil</td>
<td>Oil</td>
<td>Oil</td>
<td>Oil</td>
<td>OIL</td>
<td>leafminer rustmite</td>
<td>5</td>
</tr>
<tr>
<td>Aug</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep</td>
<td></td>
<td>Micromite*^</td>
<td>Micromite*^</td>
<td></td>
<td>leafminer rustmite weevils</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Oct</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov-Dec</td>
<td>OP</td>
<td>OP</td>
<td>OP</td>
<td>OP</td>
<td>OP</td>
<td></td>
<td>1B</td>
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*Generally applied with oil or another surfactant   ♯ May not be necessary due to low populations
^ Primarily for control of nymphs   ** www.irac-online.org
Young Tree Programs

• Drenches of neonicotinoids (MOA = 4): imidacloprid, thiamethoxam (Platinum) and clothianidin (Belay) may provide up to 3 or more years control in solid sets, longer in resets. Need to be alternated with sprays with different MOA.

• Cyazapyr (cyantraniliprol MOA 28) and possibly other chemistry hopefully available for soil application soon.

• Best of 4 treatments rotating cyazapyr with neonicontinoids still zero HLB after 21 months compared to 30% in untreated check.

• Meanwhile, limit sprays of imidacloprid, Actara or Agriflex in older blocks to at most one per year.
Using CHRP data: Interactive Map: M. Jones

- CHMA cycle data from [www.flchma.org](http://www.flchma.org) converted into ArcGIS shape files
- Can view data temporally and spatially
- Able to turn on and off layers to compare specific cycle data
- A ‘hot spots’ layer for last 3 cycles of data

In this example, 3 layers are selected and Hot Spots are noted
Choosing and Comparing Cycles

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- Click on the cycles you want by turning on the ‘eye’ button
- Example shows comparing Cycle 6 to Cycle 7 data
- Cycle 7 has reduced # of ACP

Cycles 6 & 7 Selected
(Cycle 6 = purple circles)
(Cycle 7 = green circles)

Clicking on a circle show its attribute data
Insecticidal Control

- Necessary for surviving HLB
- Need to control costs, limit collateral damage and resistance
- Dormant spray of pyrethroids and/or OPs most effective treatment
- Different and more selective chemical classes for growing season depending on pests
- Real time data on pest and disease incidence needed to make best decisions
- Additional insecticides needed for young tree programs that depend largely on drenches
Cultural Practices for Management of HLB

- Foliar nutrition
- UV Reflective Mulch
Role of Vector Control and Nutrition in Management of HLB

Experimental Design

Objective: Evaluate effect of a foliar nutritional program and insecticidal control of ACP on ACP number, HLB incidence and yield

- 13.75 ac. ‘Valencia’ on ‘Swingle’
- Planted April 2002
- Defoliated 2005
- HLB detected spring 2006
- 2 x 2 factorial (RCBD 4 reps)
  - 16 plots
  - Average 124 trees per plot

<table>
<thead>
<tr>
<th></th>
<th>No-Insecticide</th>
<th>Insecticide</th>
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</thead>
<tbody>
<tr>
<td>No-Nutritional</td>
<td>Control</td>
<td>Insecticide</td>
</tr>
<tr>
<td>Nutritional</td>
<td>Nutritional</td>
<td>Nutritional + Insecticide</td>
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</table>
### Nutrient Program

- **Rate/ac**
- **Serenade Max WP** 2.25 lb
- **Saver (Salicylic acid)** 1 qt
- **3-18-20 with K-Phite** 8 gal
- **13-0-44 fertilizer** 8.5 lb
- **Techmangan (MnSO₄)** 8.5 lb
- **Zinc Sulfate** 2.8 lb
- **Sodium Molybdate** 0.85 oz
- **Di-Oxy Solv Organic** 2 qt
- **Epsom Salts** 8.5 lb
- **435 oil** 5 gal

### Nutritional+Insecticide

#### 2008
1. Danitol 16 oz (May)
2. Delegate @ 4 oz (Aug)
3. Delegate @ 4 oz (Nov)

#### 2009
4. Mustang @ 4.3 oz (Jan)
5. Movento @10 oz (Apr)
6. Lorsban @ 3 pt (Sep)
7. Dimethoate @ 1 pt (Dec)

#### 2010
8. Danitol @ 12 oz (Feb)
9. Delegate @5 oz (May)
10. Lorsban @ 3 pt (Jul)
11. Imidan @ 1 lb (Nov)
Effects on ACP population

40 taps per plot every 2 weeks
Sprays at 0.2 ACP/tap

Insect × days = \int_{\text{Initial date}}^{\text{Final date}} \frac{\text{No. Adult ACP}}{\text{Tap sample}}

Cumulative ACP adult x day

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Cumulative ACP adult x day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated Control (UC)</td>
<td>1300</td>
</tr>
<tr>
<td>Nutritional (N)</td>
<td>1200</td>
</tr>
<tr>
<td>Insecticide (I)</td>
<td>200</td>
</tr>
<tr>
<td>Nutritional + Insecticide (NI)</td>
<td>100</td>
</tr>
</tbody>
</table>
Effects on HLB incidence in plants

PCR of most infective branch on 20% of trees

![Graph showing the percentage of positive HLB trees over time for different treatments. The graph includes untreated control, nutritional only, insecticide only, and nutritional + insecticide treatments. The x-axis represents sampling dates from Sep-08 to Nov-10, and the y-axis represents the percentage of positive HLB trees.]
Yield and Quality Evaluation
March 2010

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.
Yield Effects in HLB Infected Trees

Difference between untreated and Nutritional+Insecticide in 2012 = 83 boxes / acre = $994
The UV Reflective Mulch System: Scott Croxton

- ACP protection
- Weed Control
- Drip irrigation
Host Plant Resistance for Management of HLB

• Existing Rootstocks or scions
• Genetically modified
  - Anti-microbial “Spinach” genes transferred to citrus
    - Dr. Erik Mirkov, Plant Pathologist: Texas AgriLife Research
      Texas AgriLife Research and Extension Center at Weslaco
  - Encouraging greenhouse results in Florida
  - EPA permission “3-4 years” out
Summary

- Integration of all available tools required to manage HLB effectively
- Insecticides to slow spread and re-inoculation of the HLB pathogen
- Biological control to reduce need for insecticides to manage ACP and other pests
- Cultural practices to improve tree health and young tree programs
- Help hopefully coming from HPR
- Knowledge based systems for better decisions at regional and grove level
Acknowledgements

- Citrus Research and Development Foundation ($$)
- Industry partners (many)
- SWFREC Entomology Team