Insecticidal Control: Considerations

- **When to spray**
  - Dormant vs growing season
  - “On demand” vs Calendar
    - Thresholds, risk/benefit
- **How to spray**
  - Low Volume vs High Volume
  - Air vs Ground
- **What to spray**
  - **Efficacy**
    - Adults/nymphs
  - Resistance management
    - Frequency of use
    - Rotation MOAs
  - Secondary pests
    - Leafminers, mites, scales
  - Conservation beneficials
    - Broad-spectrum vs Selectiv
Insecticide Efficacy Trials: Methods
http://www.imok.ufl.edu/entomology/

- Location: UF-Southwest Florida Research and Education Center, Immokalee, FL
- 'Valencia' orange trees planted 1998
- Trees pruned with a hand-held hedger to induce new growth and encourage ACP infestation
- Both bed and swale sides of the trees were sprayed using a Durand Wayland 3P-10C-32 air blast speed sprayer @ 120 gpa or Proptec™ rotary atomizer sprayer @ 10 gpa
- RCBD design, 4 replicates
- 5 trees per plot, 3 central trees included in post treatment evaluations
Evaluation Methods

✓ **Estimation of ACP adults**
  - “Tap Sample”:
    - 22 x 28 cm laminated white paper sheet or clipboard
    - Tap branches three times
    - Four tap samples per tree

✓ **Estimation of immature densities**
  - Ten randomly selected shoots per plot collected and examined under a stereomicroscope in the laboratory to count **ACP nymphs**
Insecticide Efficacy: Published Trials
23 Reports, Ca. 250 Treatments: Available on this Website

Foliar Insecticides Against ACP Nymphs
Ranked by Average number of days counts were significantly less than the check

Average Days of Activity
Foliar Insecticides: Reduction of ACP Adults
Ranked by average number of days counts were significantly less than the check. Does not imply that adults were controlled directly.
## Example Insecticide Programs for ACP and other pests

<table>
<thead>
<tr>
<th></th>
<th>Insecticide Sprays per year (excluding oil alone)</th>
<th>Other pests Controlled</th>
<th>MOA**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One</td>
<td>Two</td>
<td>Four</td>
</tr>
<tr>
<td>Jan</td>
<td>Pyrethroid</td>
<td>Pyrethroid</td>
<td>Pyrethroid</td>
</tr>
<tr>
<td>Feb</td>
<td>Movento*^</td>
<td>Movento*^</td>
<td>Movento *^</td>
</tr>
<tr>
<td>Mar</td>
<td>Oil</td>
<td>Oil</td>
<td>Oil</td>
</tr>
<tr>
<td>Apr</td>
<td>Oil</td>
<td>Oil</td>
<td>Oil</td>
</tr>
<tr>
<td>May</td>
<td>Abamectin* or Delegate*</td>
<td>Abamectin* or Delegate*</td>
<td>Abamectin*^</td>
</tr>
<tr>
<td>Jun</td>
<td>Oil</td>
<td>Oil</td>
<td>Oil</td>
</tr>
<tr>
<td>Jul</td>
<td>Oil</td>
<td>Oil</td>
<td>Oil</td>
</tr>
<tr>
<td>Aug</td>
<td>OP</td>
<td>OP</td>
<td>OP</td>
</tr>
</tbody>
</table>

*Generally applied with oil or another surfactant  † May not be necessary due to low populations  ^ Primarily for control of nymphs  ** [www.irac-online.org](http://www.irac-online.org)
Program for Resets

• THE GOOD NEWS: Using drenches of imidacloroprid, thiamethoxam (Platinum) and clothianidin (Belay) you should be able to get 3 or more years control in solid sets, longer in resets. Cyazapyr (MOA 28) coming soon (hopefully).

THE BAD NEWS: All 3 products available today are

• Neonicotinoids with the same mode of action (MOA – 4)

• Alternate soil applications of these products with sprays of insecticides with different MOAs.

• Limit sprays of imidacloroprid, Actara or Agriflex in older blocks to at most one per year.
Systemic Insecticides Against ACP Nymphs
Ranked by Average Days of Activity and Times Tested on young trees
Soil Applied Insecticidal Control of ACP and CLM on Young Citrus with Cyazypyr and Neonicotinoid Insecticides

- Young citrus planted May 2010
- Soil drench application: 300 ml of water per tree, then irrigated lightly to incorporate
- Products and rates tested: Verimark™ 20 SC: 10.25, 15.4 and 25 oz/ac, Admire Pro 4.6 AC: 7 oz/ac and Platinum 75 WG: 2.67 oz/ac assuming 145 trees/ac
- Only CLM found in 2010
- Adults ACP (15) into sleeve cages one branch on two trees per each plot, 4 Mar 2011. Cages were removed 21 Mar and 5 flushes per plot sampled for ACP and again for CLM on 19 Apr.
## Exp. 2: Results, CLM

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Product</th>
<th>Larvae per 3 leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(oz/acre)</td>
<td>10-Sep</td>
</tr>
<tr>
<td>Untreated</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.40 a</td>
</tr>
<tr>
<td>Admire Pro 4.6 SC</td>
<td>7.0</td>
<td>0.00 b</td>
</tr>
<tr>
<td>Platinum 75 WG</td>
<td>2.67</td>
<td>0.00 b</td>
</tr>
<tr>
<td>HGW 20 SC</td>
<td>10.25</td>
<td>0.00 b</td>
</tr>
<tr>
<td>HGW 20 SC</td>
<td>15.38</td>
<td>0.00 b</td>
</tr>
<tr>
<td>HGW 20 SC</td>
<td>24.97</td>
<td>0.00 b</td>
</tr>
</tbody>
</table>

All 3 rates cyazypyr and Platinum still showed activity against CLM 295 DAT.
### Exp. 2: Results, ACP

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Product (oz/acre)</th>
<th>Eggs (No.)</th>
<th>Nymphs (No.)</th>
<th>Eggs (No.)</th>
<th>Nymphs (No.)</th>
<th>Nymphs (No.)</th>
<th>Infested Shoots (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>21 Mar 11</td>
<td>19 Apr 11</td>
<td>11 May 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Untreated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>21.9 a</td>
<td>3.9</td>
<td>13.1 ab</td>
<td>42.4 a</td>
<td>92.1 a</td>
<td>100</td>
</tr>
<tr>
<td>Admire Pro</td>
<td>7.0</td>
<td>5.3 b</td>
<td>1.4</td>
<td>5.5 bc</td>
<td>26.1 ab</td>
<td>57.6 ab</td>
<td>100</td>
</tr>
<tr>
<td>Platinum 75 WG</td>
<td>2.67</td>
<td>1.6 b</td>
<td>0.4</td>
<td>16.6 a</td>
<td>19.3 bc</td>
<td>44.9 ab</td>
<td>100</td>
</tr>
<tr>
<td>HGW 20 SC</td>
<td>10.25</td>
<td>2.1 b</td>
<td>0.7</td>
<td>0.8 c</td>
<td>0.3 c</td>
<td>61.9 ab</td>
<td>100</td>
</tr>
<tr>
<td>HGW 20 SC</td>
<td>15.4</td>
<td>0.6 b</td>
<td>0.05</td>
<td>6.6 bc</td>
<td>9.3 bc</td>
<td>11.9 b</td>
<td>80</td>
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<tr>
<td>HGW 20 SC</td>
<td>25.0</td>
<td>4.1 b</td>
<td>2.6</td>
<td>0.3 c</td>
<td>0.3 c</td>
<td>13.0 b</td>
<td>40</td>
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</table>

Medium and high rate cyazypyr still showed activity against ACP nymphs 273 DAT
## Experiment 3: Three-Year Study

<table>
<thead>
<tr>
<th></th>
<th>Untreated</th>
<th>Rot1cy150</th>
<th>Rot2cy225</th>
<th>Rot3cy150</th>
<th>Rot4cy225</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>untreated</td>
<td>Hgw 86 20 SC</td>
<td>Admire pro</td>
<td>Platinum 75</td>
<td>Hgw 86 20 SC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.25 oz</td>
<td>7.0 oz</td>
<td>2.67 oz</td>
<td>15.38 oz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Nymphs per Flush 2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>
## Experiment 3: PCR Results

<table>
<thead>
<tr>
<th></th>
<th>Rate O/zac</th>
<th>29-Jul-10</th>
<th>21-Oct-10</th>
<th>24-Jan-11</th>
<th>25-Apr-11</th>
<th>22-Jul-11</th>
<th>PCR (%) N=36</th>
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</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>--------------</td>
</tr>
<tr>
<td>Rot1cy150</td>
<td>HGW 86 20 SC</td>
<td>10.3</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>28</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>Admire pro</td>
<td>7.0</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>Platinum 75</td>
<td>2.7</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rot2cy225</td>
<td>HGW 86 20 SC</td>
<td>15.4</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>5.7</td>
</tr>
<tr>
<td></td>
<td>Admire pro</td>
<td>7.0</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Platinum 75</td>
<td>2.7</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rot3cy150</td>
<td>Admire pro</td>
<td>7.0</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HGW 86 20 SC</td>
<td>10.3</td>
<td></td>
<td>x</td>
<td>x</td>
<td>8.3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Platinum 75</td>
<td>2.67</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rot4cy225</td>
<td>Admire pro</td>
<td>7.0</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HGW 86 20 SC</td>
<td>15.4</td>
<td></td>
<td>x</td>
<td>x</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Platinum 75</td>
<td>2.7 oz</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The UV Reflective Mulch System

- ACP protection
- Weed Control
- Drip irrigation
**Psyllid Infestation**

**Trunk Diameter**
- Silver
- White
- Bare Ground
- Micro Jet

**Incidence HLB in 40 trees**
- 5-Aug-11
- 5-Dec-11

**Infested Shoots (%)**
- 0%
- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%
- 100%

**Trunk Diameter**
- (mm²)

**Infested Shoots (%)**
- 0%
- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%
- 100%
Toward an “Area Wide” IPM

- **State/National Scale**
  - Research and Extension
  - HLB Bibliographic Database (www.imok.ufl.edu/entomology)

- **Regional Scale (CHMAs)**
  - Coordinated sprays
  - Release of beneficials (Future)
  - Data sharing
    - ACP Adults (present CHRP program)
      - HLB Infection levels
      - Incidence of secondary pests and diseases
      - Populations of beneficials

- **Grove/Block**
  - Data collection
  - Pest/disease management
  - Corrective foliar nutrition
  - Flush management

**HLB is providing the need and opportunity to cooperate at different levels and upgrade citrus production technology**
## Gulf CHMA County Averages

### Average ACP For Gulf CHMA By County

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CHARLOTTE</td>
<td>5.28</td>
<td>4.90</td>
<td>2.96</td>
<td>2.96</td>
<td>5.61</td>
<td>4.41</td>
<td>5.73</td>
</tr>
<tr>
<td>COLLIER</td>
<td>3.48</td>
<td>1.65</td>
<td>0.88</td>
<td>2.45</td>
<td>1.99</td>
<td>2.08</td>
<td>2.03</td>
</tr>
<tr>
<td>GLADES</td>
<td>7.66</td>
<td>5.58</td>
<td>2.84</td>
<td>6.89</td>
<td>5.64</td>
<td>4.72</td>
<td>3.52</td>
</tr>
<tr>
<td>HENDRY</td>
<td>2.42</td>
<td>4.50</td>
<td>3.68</td>
<td>4.05</td>
<td>2.98</td>
<td>2.59</td>
<td>1.55</td>
</tr>
<tr>
<td>LEE</td>
<td>4.71</td>
<td>4.84</td>
<td>1.54</td>
<td>1.07</td>
<td>1.35</td>
<td>1.12</td>
<td>0.69</td>
</tr>
</tbody>
</table>
Average ACP for Cycles 1, 2 and 3 in Lee and Hendry Counties
Interactive Map

- CHMA cycle data from Excel file 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

- 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

Clicking on a selected cycle shows its attribute data.

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

• Spray programs need to satisfy many criteria
  – Effectiveness, Economy, Rotation, Pest Complex, Beneficials
• Soil drenches provide good protection for young trees
• UV reflective mulches add an extra level of ACP protection
• Mulch system requires drip but provides other benefits (weed control, enhanced growth)
• Effectiveness ratings, example programs, and interactive Gulf CHMA monitoring summaries available on IMOK website: www.imok.ufl.edu/Entomology
Acknowledgements

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