Best Use of Insecticides to Control Asian Citrus Psyllid
Phil Stansly, SWFREC Immokalee Florida
Reasons to use insecticides for ACP Control

- They work

Reasons to limit insecticide use

- Cost
- Secondary pest outbreaks caused by loss of beneficials
- Insecticide Resistance

How to make them work better and reduce negative impacts?
Getting the most out of insecticides

• **When** to spray
  - Dormant season
  - “On demand”
    • Thresholds, risk/benefit
  - Calendar

• **What** to spray
  - Broad spectrum vs selective
  - Controlling secondary pests
    • Leafminers, mites, scales
  - Rotating Modes of action

• **How** to spray
  - Low Volume vs High Volume
  - Air vs Ground
## Management “Program”

<table>
<thead>
<tr>
<th>Season</th>
<th>Spring flush and bloom</th>
<th>Summer flush</th>
<th>Post-bloom</th>
<th>Summer</th>
<th>Fall flush</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dormant</td>
<td>Broad-spectrum insecticide to target adults</td>
<td>Movento (pre bloom) Portal, Micromite if needed</td>
<td>Various possibilities if needed</td>
<td>Movento, Delegate if needed</td>
<td>Systemic insecticide if needed</td>
</tr>
<tr>
<td>OP</td>
<td>Pyrethroid</td>
<td></td>
<td>Neonicotinoid drench for young trees</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Month</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
</tr>
</thead>
</table>

**Oil Option**

- **OP (Pyrethroid)**
ACP Monitoring System
http://swfrec.ifas.ufl.edu/entlab/

- Tap Sample
  10 trees per stop

- Visual inspection
  10 flush per stop
Sample Location

- 1 Block
- 10 Stops
  - 5 border
  - 5 inside
- 10 trees

Border areas usually get greening first and often have higher psyllid counts than interior portions of the grove, justifying more frequent border sprays.
Every time you use a Pesticide
You are Selecting for Resistance:
A droplet of 0.2 µL of technical grade insecticide in acetone was applied on the dorsal side of the adult thorax. Acetone alone served as control. At each conc. 120 adults treated. Mortality counts taken 24 h after treatment. LD$_{50}$ values (95% confidence intervals) calculated by probit analysis.
Insecticide susceptibility of Fort Pierce population

RR = LD$_{50}$ of field pop./LD$_{50}$ of lab pop.

Insecticide susceptibility of Vero Beach population

RR = LD$_{50}$ of field pop./LD$_{50}$ of lab pop.

Insecticide susceptibility of La Belle population

RR = LD$_{50}$ of field pop./LD$_{50}$ of lab pop.

Evidence of Cross Resistance

Insecticide Resistance Management
IRM = IPM + Pesticide Rotation
Important to rotate modes of actions!

Insecticide Mode of Action Classification:
Diversity is a key to successful resistance management

IRAC website: www.plantprotection.org/irac

Introduction
IRAC promotes the use of a Mode of Action (MoA) classification of insecticides as the basis for effective and sustainable insecticide resistance management (IRM). Insecticides are allocated to specific groups based on their target site. Reviewed and re-issued annually, the IRAC MoA classification list provides farmers, growers, advisors, extension staff, consultants and crop protection professionals with a guide to the selection of insecticides or acaricides in IRM programs. Effective IRM of this type preserves the utility and diversity of available insecticides and acaricides.

Effective IRM strategies: Alternations or sequences of MoA
All effective insecticide (and acaricide) resistance management (IRM) strategies seek to minimise the selection for resistance from any one type of insecticide or acaricide. In practice, alternations, sequences or rotations of compounds from different MoA groups provide sustainable and effective IRM. This ensures that selection from compounds in the same MoA group is minimised. Applications are often arranged into MoA spray windows or blocks that are defined by the stage of crop development and the biology of the pest(s) of concern. Local expert advice should always be followed with regard to spray windows and timings. Several sprays of a compound may be possible within each spray window but it is generally essential to ensure that successive generations of the pest are not treated with compounds from the same MoA group.

Moulting & Metamorphosis
Group 18 Ecdysone agonist / disruptor
Tebufenozide
Group 7 Juvenile hormone mimics
Fenoxycarb, Methoprene, etc

Midgut
Group 11 Microbial disruptors of insect midgut membranes
Toxins produced by the bacterium Bacillus thuringiensis (Bt): Bt sprays and Cry proteins expressed in transgenic Bt crop varieties (specific cross-resistance sub-groups)

Nervous System
Group 1 Acetylcholinesterase (AChE) inhibitors
Carbamates and Organophosphates
Group 2 GABA-gated chloride channel antagonists
Cyclodiene and Fiproles
Group 3 Sodium channel modulators
DDT, pyrethrins, pyrethroids
Group 4 Acetylcholine receptor agonists
Neonicotinoids
Group 5 Acetylcholine receptor modulators
Spinosyns
Group 6 Chloride channel activators
Avermectin, Emamectin Benzoate and Milbemycin
Group 22 Voltage dependent sodium channel blocker
Indoxacarb

Metabolic Processes
Acting on a wide range of metabolic processes including:
- Group 12 Inhibitors of oxidative phosphorylation, disruptors of ATP
- Difenofuran & Organotin miticides
- Group 12 Uncoupler of oxidative phosphorylation via disruption of H proton gradient – Chlorfenapyr

Non-specific MoA
Group 10 Compounds of non-specific mode of action (mitigrowth inhibitors)
Clorfenapyr, Hexythiazox, Etoxazole

Non-specific MoA
Group 9 Compounds of non-specific mode of action
(Clear cell transport inhibitors)
Cyfluthrin, Pyrethroids

Non-specific MoA
Group 20 Site II electron transport inhibitors
Hydramethylnon and Dicofol
Group 21 Site I electron transport inhibitors
Rotenone, METI acaricides

Cuticle Synthesis
Groups 15, 16 and 17
Inhibitors of chitin biosynthesis
- Benzoylureas (Lepidoptera and other species), Euprenezim (Homoptera) and Cyanazine (Diptera)

Metabolic processes
Group 20 Site II electron transport inhibitors
Hydramethylnon and Dicofol
Group 21 Site I electron transport inhibitors
Rotenone, METI acaricides
### Chemical class (MOA) | Active ingredient | Product | Rate/A | Application methods | REI | PHI | Comments
--- | --- | --- | --- | --- | --- | --- | ---
**Carbamates (1A)**<br>Carbaryl<br>Oxamyl<br>Aldicarb | Sevin XLR<br>Vydate<br>Temik 15 G | 1.5 qts<br>2 qts<br>33 lbs | Air, lv, ss<br>ss<br>Soil | 12 hrs<br>48 hrs<br>48 hrs | 5 days<br>7 days<br>0; 30 days (lemons) | 21 days<br>12 hrs<br>0 day | Short residual; fresh fruit should avoid use due to European MRL issues.<br>Short residual; fresh fruit should avoid use due to European MRL issues.<br>Slow acting on adult psyllids; product scheduled to be cancelled Dec 31, 2011.

**Organophosphate (1B)**<br>chlorpyrifos<br>dimethoate<br>malathion<br>phosmet | Lorsban<br>Dimethoate 4E<br>Malathion 5<br>Imidan | 5 pts<br>1 pt<br>2 pts<br>1.0 lb | Air, lv, ss<br>ss<br>ss<br>ss | 5 days<br>10 days<br>12 hrs<br>24 hrs | 21 days<br>15-45 days<br>7 days<br>7 days | Consult label for buffering instructions when pH is greater than 7.

**Pyrethroids (3)**<br>fenpropathrin<br>zeta-cypermethrin | Danitol 2.4EC<br>Mustang | 1 pt<br>4.3 fl oz | Air, lv, ss<br>ss | 24 hrs<br>12 hrs | 1 day<br>1 day | Important to minimize use of foliar applications to prevent insecticide resistance development to maintain use for young tree care.

**Neonicotinoids (4)**<br>imidacloprid<br>thiamethoxam | Admire Pro 4.6F<br>Actara 25 WG<br>Platinum 75 SG | 7-14 fl oz<br>4.0-5.5 fl oz<br>1.83-3.67 fl oz | Soil drench<br>ss<br>Soil drench | 12 hrs<br>12 hrs<br>12 hrs | 0 day<br>0 day<br>0 day | Apply with 2% oil v/v. Also provides control of leafminer.<br>Applies to be cancelled Dec 31, 2011.<br>Slow acting on adult psyllids.<br>Apply with 2% oil v/v. Also applies to be cancelled Dec 31, 2011.

**Spinosyns (5)**<br>spinetoram | Delegate WG | 4 oz | lv, ss | 4 hrs | 1 day | Apply with 2% oil v/v. Also provides control of leafminer.<br>Provides suppression of leafminer and rust mites.<br>Provides suppression of leafminer and rust mites.

**Avermectins (6)**<br>abamectin | Agri-mek 0.15 EC | 10 fl oz | lv, ss | 12 hrs | 7 days | Apply with oil as directed. Also provides control of leafminer and rust mites.<br>Apply with 2% oil v/v. Also provides control of leafminer and rust mites.

**Benzoylureas (Chitinase inhibitors) (15)**<br>diflubenzuron | Micromite 80 WGS | 6.25 oz | lv, ss | 12 hrs | 21 days | Applies to be cancelled Dec 31, 2011.<br>Provides suppression of leafminer and rust mites.<br>Provides suppression of leafminer and rust mites.

**METI insecticides (21A)**<br>fenpyroximate | Portal | 4.0 pts | ss | 12 hrs | 14 days | Provides suppression of rust mites.

**Petroleum distillates**<br>petroleum oil | numerous | 2% v/v | ss | 12 hrs | 0 days | Provides suppression of leafminer and rust mites.<br>Systemic activity provides extended residual control of nymphal populations. Must use 3% oil v/v or other approved surfactant.

**Tetramic acid derivatives (23)**<br>spirotetramat | Movento 240 SC | 10 fl oz | ss | 24 hrs | 1 day | Provides suppression of leafminer and rust mites.<br>Provides suppression of leafminer and rust mites.<br>Provides suppression of leafminer and rust mites.
## Insecticides used by SW Florida Growers (%) at Least Once

<table>
<thead>
<tr>
<th>Product</th>
<th>MOA</th>
<th><a href="http://www.irac-online.org">www.irac-online.org</a></th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mustang</td>
<td>3A - Pyrethroid)</td>
<td>67%</td>
<td>63%</td>
<td></td>
</tr>
<tr>
<td>Abamectin</td>
<td>6 - Avermectin</td>
<td>62%</td>
<td>63%</td>
<td></td>
</tr>
<tr>
<td>Danitol</td>
<td>3A - Pyrethroid)</td>
<td>46%</td>
<td>31%</td>
<td></td>
</tr>
<tr>
<td>dimethoate</td>
<td>1B - Organophosphate</td>
<td>42%</td>
<td>38%</td>
<td></td>
</tr>
<tr>
<td>chlorpyrifos</td>
<td>1B - Organophosphate</td>
<td>42%</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>Temik</td>
<td>1A - Carbamate</td>
<td>38%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>carbaryl</td>
<td>1A - Carbamate</td>
<td>29%</td>
<td>19%</td>
<td></td>
</tr>
<tr>
<td>Delegate</td>
<td>5 - Spinosyn</td>
<td>29%</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>imidaclorpid</td>
<td>4A - Neonicotinoid</td>
<td>25%</td>
<td>19%</td>
<td></td>
</tr>
<tr>
<td>oil</td>
<td>Unclassified</td>
<td>25%</td>
<td>19%</td>
<td></td>
</tr>
<tr>
<td>Micromite</td>
<td>15 - Benzoylurea</td>
<td>17%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Imidan</td>
<td>1B - Organophosphate</td>
<td>17%</td>
<td>56%</td>
<td></td>
</tr>
<tr>
<td>Movento</td>
<td>23 – Tetronic acid</td>
<td>8%</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>malathion</td>
<td>1B - Organophosphate</td>
<td>8%</td>
<td>19%</td>
<td></td>
</tr>
<tr>
<td>Actara</td>
<td>4A - Neonicotinoid</td>
<td>4%</td>
<td>19%</td>
<td></td>
</tr>
</tbody>
</table>

**Important to rotate modes of actions!**
## Quick Reference Guide to Citrus Insecticides and Miticides

**M.E. Rogers, P. A. Stansly, L. L. Stelinski and J. D. Yates**

**ENY-854**  Products recommended in the Florida Citrus Pest Management Guide and their effects on selected pests and their natural enemies.

<table>
<thead>
<tr>
<th>Pesticide active ingredient</th>
<th>Product Brand Name Examples</th>
<th>Restricted entry interval (REI)</th>
<th>Pre-harvest interval (PHI)</th>
<th>Mode of Action</th>
<th>Pyllid</th>
<th>Leafminer</th>
<th>Rust Mites</th>
<th>Spider Mites</th>
<th>Root Weevil Adults</th>
<th>Scale Insects</th>
<th>Mealybugs</th>
<th>Effects on natural enemies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abamectin + oil</td>
<td>Agri-mek 0.15EC</td>
<td>12 hours</td>
<td>7 days</td>
<td>6</td>
<td>++</td>
<td>+++-R</td>
<td>+++-R</td>
<td>+</td>
<td>+ (oil)</td>
<td>+ (oil)</td>
<td>medium</td>
<td></td>
</tr>
<tr>
<td>Aldicarb</td>
<td>Temik 15G</td>
<td>48 hours</td>
<td>0; 30 days (lemons)</td>
<td>1A</td>
<td>+++-R</td>
<td>-</td>
<td>+++-R</td>
<td>+++</td>
<td>-</td>
<td>-</td>
<td>low</td>
<td></td>
</tr>
<tr>
<td>Carbaryl</td>
<td>Sevin XLR Plus</td>
<td>12 hours</td>
<td>5 days</td>
<td>1A</td>
<td>++</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+++-R</td>
<td>+++-R</td>
<td>high</td>
<td></td>
</tr>
<tr>
<td>Chlorpyrifos</td>
<td>Lorsban 4E</td>
<td>5 days</td>
<td>21 days</td>
<td>1B</td>
<td>+++-R</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+++-R</td>
<td>high</td>
<td></td>
</tr>
<tr>
<td>Diflubenzuron</td>
<td>Micromite 80WG</td>
<td>12 hours</td>
<td>21 days</td>
<td>15</td>
<td>++</td>
<td>+</td>
<td>+++-R</td>
<td>+</td>
<td>+++-R</td>
<td>-</td>
<td>low</td>
<td></td>
</tr>
<tr>
<td>Dimethoate</td>
<td>Dimethoate 4E</td>
<td>10 days</td>
<td>15-45 days</td>
<td>1B</td>
<td>+++</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>?</td>
<td>+++-R</td>
<td>high</td>
<td></td>
</tr>
<tr>
<td>Fenbutatin oxide</td>
<td>Vendex 50WP</td>
<td>48 hours</td>
<td>7 days</td>
<td>12</td>
<td>-</td>
<td>-</td>
<td>+++-R</td>
<td>+++-R</td>
<td>-</td>
<td>-</td>
<td>low</td>
<td></td>
</tr>
<tr>
<td>Fenpropathrin</td>
<td>Danitol 2.4EC</td>
<td>24 hours</td>
<td>1 day</td>
<td>3</td>
<td>+++-R</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+++-R</td>
<td>-</td>
<td>+</td>
<td>high</td>
</tr>
<tr>
<td>Imidacloprid (soil)</td>
<td>Admire Pro</td>
<td>12 hours</td>
<td>0</td>
<td>4</td>
<td>+++-R</td>
<td>+++-R</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td>low</td>
</tr>
<tr>
<td>Imidacloprid (foliar)</td>
<td>Provado 1.6F</td>
<td>12 hours</td>
<td>0</td>
<td>4</td>
<td>+++-R</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>medium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methoxyfenozide</td>
<td>Intrepid 2F</td>
<td>4 hours</td>
<td>1 day</td>
<td>18</td>
<td>-</td>
<td>+++-R</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>low</td>
<td></td>
</tr>
<tr>
<td>Petroleum oil</td>
<td>numerous</td>
<td>12 hours</td>
<td>0</td>
<td>NR</td>
<td>+</td>
<td>++-R</td>
<td>++-R</td>
<td>++</td>
<td>+(eggs)</td>
<td>++-R</td>
<td>low</td>
<td></td>
</tr>
<tr>
<td>Phosmet</td>
<td>Imidan 70W</td>
<td>24 hours</td>
<td>7 days</td>
<td>1B</td>
<td>+++-R</td>
<td>-</td>
<td>+</td>
<td>?</td>
<td>+++-R</td>
<td>?</td>
<td>?</td>
<td>medium/high</td>
</tr>
<tr>
<td>Pyridaben</td>
<td>Nexter Miticide</td>
<td>12 hours</td>
<td>7 days</td>
<td>21</td>
<td>-</td>
<td>?</td>
<td>+++-R</td>
<td>+++-R</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>high</td>
</tr>
<tr>
<td>Spinosad</td>
<td>Spintor 2SC</td>
<td>4 hours</td>
<td>1 day</td>
<td>5</td>
<td>-</td>
<td>+++-R</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>low</td>
<td></td>
</tr>
<tr>
<td>Spinetoram</td>
<td>Delegate WG</td>
<td>4 hours</td>
<td>1 day</td>
<td>5</td>
<td>+++-R</td>
<td>+++-R</td>
<td>-</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Spirodiclofen</td>
<td>Envidor 2SC</td>
<td>12 hours</td>
<td>7 days</td>
<td>23</td>
<td>-</td>
<td>-</td>
<td>+++-R</td>
<td>+++-R</td>
<td>?</td>
<td>-</td>
<td>-</td>
<td>low</td>
</tr>
<tr>
<td>Spirotetramat</td>
<td>Movento 240SC</td>
<td>24 hours</td>
<td>1 day</td>
<td>23</td>
<td>+++-R</td>
<td>?</td>
<td>+++-R</td>
<td>?</td>
<td>?</td>
<td>+++-?</td>
<td>low</td>
<td></td>
</tr>
<tr>
<td>Sulfur</td>
<td>numerous</td>
<td>12 hours</td>
<td>0</td>
<td>NR</td>
<td>-</td>
<td>-</td>
<td>+++-R</td>
<td>+++</td>
<td>-</td>
<td>?</td>
<td>?</td>
<td>high (short term)</td>
</tr>
<tr>
<td>Thiamethoxam</td>
<td>Actara 25 WG</td>
<td>12 hours</td>
<td>0</td>
<td>4</td>
<td>+++-R</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>++</td>
<td>+</td>
<td>medium</td>
<td></td>
</tr>
<tr>
<td>Thiamethoxam</td>
<td>Platinum 75 SG</td>
<td>12 hours</td>
<td>0</td>
<td>4</td>
<td>+++-R</td>
<td>+++-R</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td>low</td>
</tr>
<tr>
<td>Zeta-cypermethrin</td>
<td>Mustang Insecticide</td>
<td>12 hours</td>
<td>1 day</td>
<td>3</td>
<td>+++-R</td>
<td>-</td>
<td>-</td>
<td>?</td>
<td>+++-?</td>
<td>?</td>
<td>?</td>
<td>high</td>
</tr>
</tbody>
</table>

1Mode of action class for citrus pesticides from the Insecticide Resistance Action Committee; 
NR = no resistance potential (R) = product recommended for control of pest in Florida Citrus Pest Management Guide 
(+++) = good control of pest  (+++) = short-term control of pest  (+) = low levels of pest suppression  (-) = no observed control of pest  (?) = insufficient data available

Revised August 2010
## Example Insecticide Programs for ACP and other pests

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insecticide Sprays per year (excluding oil alone)</strong></td>
<td>One</td>
<td>Two</td>
<td>Four</td>
<td>Five</td>
<td>Seven</td>
<td>Eleven</td>
<td>Other pests Controlled</td>
<td>MOA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>One</strong></td>
<td>Pyrethroid</td>
<td>Pyrethroid</td>
<td>Pyrethroid</td>
<td>Pyrethroid</td>
<td>Pyrethroid</td>
<td>Pyrethroid</td>
<td>weevils</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Two</strong></td>
<td>Movento*^</td>
<td>Movento*^</td>
<td>Movento*^</td>
<td>Movento*^</td>
<td>Movento*^</td>
<td>rustmite, scales</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Four</strong></td>
<td>Micromite*^</td>
<td>Micromite*^</td>
<td>leafminer rustmite weevils</td>
<td>Carbaryl</td>
<td>leafminer</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Five</strong></td>
<td>Oil</td>
<td>Oil</td>
<td>Oil</td>
<td>Oil</td>
<td>Delegate*</td>
<td>Delegate*</td>
<td>weevils</td>
<td>1A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Seven</strong></td>
<td>Agriflex*^ or Delegate*</td>
<td>Agriflex*^ or Delegate*</td>
<td>Agriflex*^</td>
<td>Neonic</td>
<td>Leafminer rustmite</td>
<td>(6,4) 4, 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Eleven</strong></td>
<td>Oil</td>
<td>Oil</td>
<td>Oil</td>
<td>OIL</td>
<td>Abamectin*</td>
<td>Leafminer rustmite</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Generally applied with oil or another surfactant

^ Primarily for control of nymphs
Program for Resets

- THE GOOD NEWS: Using drenches of imidacloprid, thiamethoxam (Platinum) and clothianidin (Belay) you should be able to get 2 years control in solid sets, longer in resets. Cyazapyr (MOA 28) coming soon (hopefully).

- THE BAD NEWS: All 3 products available today are neonicotinoids (MOA 4) with the same MOA.

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

- Limit sprays of imidacloprid, Actara or Agriflex in older blocks to at most one per year.
Aerial vs. Ground 2008

• 150 ac., 16 treatments
• 20 trees/plot

• Aerial Applications: 10 gpa
  – 10 treatments
  – 12 acres per plot

• Ground Applications: 125 gpa
  – 5 treatments
  – 3.8 acres per plot
Imidan good by air and speed sprayer, Delegate and Provado only by speed sprayer for this summer application
Aerial vs. Ground July 2009

- 576 Acres, 8 treatments
- 50 trees/plot

- Aerial Applications: 125 gal/ac.
  - 3 treatments
  - 48 acres per plot

- Ground Applications: 10 gal/ac.
  - 3 treatments
  - 12 acres per plot

- Controls
  - 2 controls
  - 6 acres per plot
Aerial vs. Ground 2009

Mean No. of Adult ACP per 10 trees

All treatments better by speed sprayer for this summer application
### DPI-CHRP Field Survey Results:
**Average ACP Adults per 10 Tap Samples Before and After Dormant Sprays**

<table>
<thead>
<tr>
<th>Year</th>
<th>Pre-Treatment</th>
<th>Post-Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>0.4</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>Pre-Treatment (Oct-Dec 08)</td>
<td>Post-Treatment (May 09)</td>
</tr>
<tr>
<td>2009</td>
<td>0.21</td>
<td>0.19</td>
</tr>
<tr>
<td></td>
<td>Pre-Treatment (Oct 09)</td>
<td>Post-Treatment (May 10)</td>
</tr>
<tr>
<td>2010</td>
<td>0.9</td>
<td>15.1</td>
</tr>
<tr>
<td></td>
<td>Pre-Treatment</td>
<td>Post-Treatment</td>
</tr>
</tbody>
</table>

Aerial sprays worked as well as ground applications during dormant season
• Prices range between $13-15K
• Limited to low volume applications.
• Spray at night (wind 0-5 mph)
Mini sprayers

- Price ranges between 28-40K
- Have the ability to go low or high volumes which increases flexibility of machine
- Can handle a little wind
- Needs a good operator.

Ryan Attwood
**Products labeled for application at reduced volume either by ground or aerial application**

<table>
<thead>
<tr>
<th>Product</th>
<th>EPA Reg. #</th>
<th>Restricted entry interval (REI)</th>
<th>Pre-harvest interval (PHI)</th>
<th>Product Rate / A</th>
<th>Minimum Spray Volume / A</th>
<th>Product Rate / A</th>
<th>Minimum Spray Volume / A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agri-mek 0.15 EC</td>
<td>100-898</td>
<td>12 hours</td>
<td>7 days</td>
<td>10-20 fl oz</td>
<td>Sufficient coverage</td>
<td>5 - 20 fl oz</td>
<td>10 gallons</td>
</tr>
<tr>
<td>Danitol 2.4 EC&lt;sup&gt;2&lt;/sup&gt;</td>
<td>59639-35 SLN FL-090003</td>
<td>1 day</td>
<td>1 day</td>
<td>16-21 fl oz</td>
<td>2 gallons</td>
<td>16 - 21 fl oz</td>
<td>5 gallons</td>
</tr>
<tr>
<td>Delegate WG</td>
<td>62719-541 SLN FL-090009</td>
<td>4 hours</td>
<td>1 day</td>
<td>3-6 oz</td>
<td>2 gallons</td>
<td>3 - 6 oz</td>
<td>10 gallons</td>
</tr>
<tr>
<td>Dimethoate 4E&lt;sup&gt;4&lt;/sup&gt;</td>
<td>34704-207-67760</td>
<td>2 days</td>
<td>15-45 days</td>
<td>0.5-1 pts</td>
<td>5 gallons</td>
<td>1 - 2 qts</td>
<td>5 gallons</td>
</tr>
<tr>
<td>Lorsban 4E</td>
<td>62719-220</td>
<td>5 days</td>
<td>21-35 days</td>
<td>2-12 pts</td>
<td>10 gallons</td>
<td>2 - 12 pts</td>
<td>2 gallons</td>
</tr>
<tr>
<td>Malathion 5</td>
<td>9779-5</td>
<td>12 hours</td>
<td>7 days</td>
<td>1.25 - 2 pts</td>
<td>3 gallons</td>
<td>1.25 - 2 pts</td>
<td>1 gallon</td>
</tr>
<tr>
<td>Micromite 80 WGS</td>
<td>400-487 SLN FL-090010</td>
<td>12 hours</td>
<td>21 days</td>
<td>6.25 oz</td>
<td>2 gallons</td>
<td>6.25 oz</td>
<td>5 gallons&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Mustang Insecticide</td>
<td>279-3126 SLN FL-090011</td>
<td>12 hours</td>
<td>1 day</td>
<td>4.3 fl oz</td>
<td>2 gallons</td>
<td>4.3 fl oz</td>
<td>10 gallons</td>
</tr>
<tr>
<td>Sevin XLR</td>
<td>264-333</td>
<td>12 hours</td>
<td>5 days</td>
<td>1.5 - 3 qts</td>
<td>Sufficient coverage</td>
<td>1.5 - 3 qts</td>
<td>10 gallons</td>
</tr>
</tbody>
</table>

<sup>1</sup> Aerial applications of Agri-mek 0.15EC are only labeled for citrus leafminer control.

<sup>2</sup> The use of spray adjuvants with Danitol 2.4EC is prohibited by label.

<sup>3</sup> Additional dimethoate products with similar use patterns may be available.

Additional citrus pest management information can be found in the Florida Citrus Pest Management Guide available online at [http://www.crec.ifas.ufl.edu/extension/pest/index.htm](http://www.crec.ifas.ufl.edu/extension/pest/index.htm)

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Timing: Effectiveness of the dormant spray by LV

With pre-flush application, LV equivalent to HV when pyrethroid is applied to every row

L. Stelinski
LV vs. Conventional Insecticide + Oil

- 38 acres, 5 treatments
  - Conventional 116 gal/ac.
    - Every row
    - Dimethoate 4EC @ 24 fl oz/ac
    - Delegate WG (spinetoram) @ 4 oz/ac
    - Each + 2 gal oil
  - LV (London Fogger model 18-20) 2 gal/ac.
    - Every other row
    - Dimethoate 4EC @ 24 fl oz/ac
    - Delegate WG (spinetoram) @ 4 oz/ac Control
    - Suspended in 1 qt + 1.75 gal oil
- Untreated
LV vs. Conventional Insecticide + Oil

Week After Application

Adults per 10 Taps

- Dimethoate_HV
- Delegate_HV
- Dimethoate_LV
- Delegate_LV
- Untreated
Effect of Product and Spray Volume

SWFREC: 30 Sep 2010

http://www.imok.ufl.edu/entomology/

Low volume sprays of Movento worked well
LV 435 Horticultural oil (2 gal./ac.)

- 67 ac. 3 treatments
- 20 trees / plot
- 3 treatments
  - Proptec P400D
  - London Fogger model 18-20
  - Control
- Applications every 2 to 4 weeks.
LV 435 Horticultural oil (2 gal/ac neat)

Proptec appeared to be better although populations were low

\[ CID = \sum_{day=i=1}^{x} No. ACP_i \times \Delta_{i-1}^i \]
Airblast vs LV Air and Ground

- Standard Airblast works best in many but not all applications
- LV applications more subject to environmental effects
- Some materials work better with LV than others
- Advantages of rapid application and correct timing may give advantage to LV air or ground application
- We have a lot to learn about how to use LV
Acknowledgements

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- SWFREC Entomology Team