Soil-applied neonicotinoids

• Foundation of young tree psyllid control programs
  – Admire Pro (imidacloprid)
  – Platinum 75 SG (thiamethoxam)
  – Belay 2.13 SC (clothianidin)
# Season-long ACP control

(foliar applications to prevent pesticide resistance to neonics shown in orange)

<table>
<thead>
<tr>
<th>Tree size</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>Reset (&lt;3’)</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td>P</td>
</tr>
<tr>
<td>1-2 yr (3-5’)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P</td>
</tr>
<tr>
<td>3-5 yr bearing (5-9’)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P</td>
</tr>
</tbody>
</table>

A= Admire (imidaclorpid); B=Belay (clothianidin); P=Platinum (thiamethoxam)
Soil-applied neonics can prevent phloem feeding by psyllids!
## Duration of feeding disruption (lab)

<table>
<thead>
<tr>
<th>Product evaluated</th>
<th>Active ingredient</th>
<th>Application method</th>
<th>Duration of psyllid feeding disruption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admire Pro 4.6F</td>
<td>imidaclorpid</td>
<td>Soil drench</td>
<td>At least 6 weeks*</td>
</tr>
<tr>
<td>Platinum 75 SG</td>
<td>thiamethoxam</td>
<td>Soil drench</td>
<td>At least 6 weeks*</td>
</tr>
<tr>
<td>Belay 50 WDG</td>
<td>clothianidin</td>
<td>Soil drench</td>
<td>At least 6 weeks*</td>
</tr>
</tbody>
</table>

*no evaluations of the soil-applied neonicotinoids have been made beyond 6 weeks.
Lab vs. Field Results

- Lab studies show what’s possible; need to evaluate under field conditions
Research Objectives

• What is the level of neonic (insecticide) needed in leaf to prevent (protect) psyllid phloem feeding?

• How long will neonics provide protection under field conditions?

• Rate per tree needed based on tree size?
Initial experiments

- Trees of different size classes treated with Admire Pro at recommended rates
- Determine imidacloprid levels in leaf tissue over time
## Preliminary Results
(Admire Pro – imidacloprid)

<table>
<thead>
<tr>
<th></th>
<th>Amount of imidacloprid in leaf tissue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 weeks</td>
</tr>
<tr>
<td></td>
<td>12.3 PPM (12,300 PPB)</td>
</tr>
<tr>
<td></td>
<td>7.7 PPM (7,700 PPB)</td>
</tr>
<tr>
<td></td>
<td>6.7 PPM (6,700 PPB)</td>
</tr>
</tbody>
</table>

LC/MS/MS analysis
Field Studies

• Observed psyllid adults and nymphs on some treated plants 2-3 weeks after application

• Collected psyllids and leaf tissue
  – Tested ACP for resistance to imidacloprid
    • Not resistant
  – Measured imidacloprid concentration in leaf
    • 2-3 PPM (2,000 - 3,000 PPB)
    • Sufficient for ACP control
Lab Studies

• How much imidacloprid is needed to disrupt psyllid feeding...or kill outright?

• 2010 paper from TX suggested 200-250 PPB was sufficient to control ACP

– Used ELISA methods, not the more reliable LC/MS/MS
Lab Studies

• Developed methods to obtain specified levels of imidacloprid in leaf tissue
  – 0, 6, 12, 60, 120, 600 PPM imidacloprid
  – Results were inconsistent; up to 50% survival at 600 PPM! WHY????
    • Some repellency – ACP on sides of cages
    • Some ACP were observed feeding normally

• Location of imidacloprid within a leaf and feeding location of ACP probably plays a role
Imidacloprid distribution within a leaf

• Mendel et al. 2000
  - Imidacloprid accumulates away from vascular bundles
Re-examine leaf sampling methods

- **PhD student – Kevin Langdon**
  - Conducting in-depth analysis of neonic movement within leaf over time
  - Initial findings show significant differences in imidacloprid distribution within a leaf
  - Also examining whether differences in distribution occur among neonics
    - Due to water solubility
Re-examine leaf sampling methods

- **Within-leaf distribution** probably determines how long protection lasts.
- **Whole-leaf sampling** may not provide reliable results:
  - Higher concentrations may exist on leaf edges versus center portion of leaf.
  - More to come soon!
What do these results mean for growers now?

• **Sending leaves off for analysis probably won’t tell you anything…currently**
  – Whole leaf analyses may not accurately predict effectiveness
  – False sense of security…at a high cost
  – Better sampling protocols needed first
What do these results mean for growers now?

- **Utilize soil-applied neonics to the full maximum allowed**
  - Protection will begin to fade over time, probably beginning in the leaf midvein area
  - Keep interval between applications as short as possible (per label directions)
What do these results mean for growers now?

• **Utilize foliar sprays between neonic applications**
  – Kaolin works well in the dry season….but not very effective in rainy season

• **CHMA participation**
  – It’s a numbers game!
## HLB infection rates in new plantings

### Groves ~2 years of age

<table>
<thead>
<tr>
<th>Psyllid pressure</th>
<th>HLB infection range</th>
<th>Average infection rate</th>
<th># of groves</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - low</td>
<td>0 – 4.05%</td>
<td>1.02%</td>
<td>20</td>
</tr>
<tr>
<td>2 – medium</td>
<td>1.73 – 65.6%</td>
<td>17.7%</td>
<td>20</td>
</tr>
<tr>
<td>3 - high</td>
<td>0 – 36.9%</td>
<td>20.96%</td>
<td>21</td>
</tr>
</tbody>
</table>
Acknowledgements

• **Funding provided by the Citrus Research & Development Foundation**

• **Lab Members:**
  – Tim Ebert, Post-doctoral assoc.
  – Rhonda Schumann, Sr. Chemist
  – Kevin Langdon, Ph.D. Student
  – Holly Shugart, Ph.D. Student
  – Goupang Liu, OPS
  – Percibia Mariner, OPS
  – Emily Collins, OPS
Questions?