Insecticide Efficacy for Pecan Aphids

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Western Pecan Aphids

Western Pecan Aphid Species

Black Pecan Aphid

Yellow Pecan Aphid Complex

Blackmargined Aphid

Yellow Pecan Aphid
Aphid Lifecycle

**Eggs**
Over-winter in tree bark

**Winged Adults**
Male and female
Sexual reproduction
Lay eggs in late Fall

**Nymphs**
Emerge in Spring
Feed on leaves
4 instars

**Stem Mothers**
Wingless adult
Clones
Produces winged adults in Fall

10-14 Day Egg => Egg
100+ Nymphs
Black Pecan Aphids

- Reduction of photosynthetic area
- Can cause affected leaves to defoliate
- Impacts nut quality and flower set for next year
Blackmargined Aphid Biology

• Fecundity
  • Average 18 reproductive days
  • Average 125 nymphs/adult

• Abundant Predators

• Inefficient feeder
  • 400% more honeydew

• Crop Damage
  • Large amount of phloem lost (sink)

https://mrec.ifas.ufl.edu/iso/Aphids.htm
Impact of Blackmarginated Aphid on In-Shell Pecan Yield (Whiteaker, 2001)

(On Year)

Bowie, Arizona

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Grade 1</th>
<th>Grade 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Control</td>
<td>1500</td>
<td>1500</td>
</tr>
<tr>
<td>Spring Only Control</td>
<td>1500</td>
<td>2000</td>
</tr>
<tr>
<td>Season-long Control</td>
<td>1500</td>
<td>2000</td>
</tr>
</tbody>
</table>
Percent Flowering-Terminals Following Specific Aphid Treatments the Previous Year (Whiteaker, 2001).

(Off Year)

Bowie, AZ

http://northernpecans.blogspot.com/2013/05/
In-Shell Pecan Yields Following Specific Aphid Treatments the Previous Year (Whiteaker, 2001) (Off-Year)

Bowie, AZ

- **No Control**
  - Grade 1: Approximately 200 Pounds/Acre
  - Grade 2: Approximately 100 Pounds/Acre

- **Spring Only Control**
  - Grade 1: Approximately 700 Pounds/Acre
  - Grade 2: Approximately 150 Pounds/Acre

- **Season-long Control**
  - Grade 1: Approximately 800 Pounds/Acre
  - Grade 2: Approximately 100 Pounds/Acre
Blackmargined Aphid Damage

(Summary)

• Decrease in nut quality during an On-Year
  – Increase likelihood of #2 nut meats
• Significant reduction in blooming terminals and yield in the next growing season

https://nuts.com/nuts/pecans/
Changes in Blackmargined Aphid Population Dynamics (Off Years)

- **2002 - 2011 Aphids**
- **2012 - 2017 Aphids**

- **RECENT**
- **HISTORIC**

**Aphids per Compound Leaf**

- 2002 - 2011: Peaks at 23 and 12
- 2012 - 2017: Peaks at 27 and 6
Changes in Blackmargined Aphid Population Dynamics (On Years)

- **2002 - 2011 Aphids**
  - 1-15 May: 0
  - 16-31 May: 41
  - 1-15 June: 73
  - 16-30 June: 0
  - 1-15 July: 0
  - 16-31 July: 0
  - 1-15 Aug: 0
  - 16-31 Aug: 0
  - 1-15 Sept: 0
  - 16-30 Sept: 0
  - 1-15 Oct: 0
  - 16-31 Oct: 0
  - 1-15 Nov: 0
  - 16-30 Nov: 0

- **2012 - 2017 Aphids**
  - 1-15 May: 0
  - 16-31 May: 0
  - 1-15 June: 29
  - 16-30 June: 0
  - 1-15 July: 0
  - 16-31 July: 0
  - 1-15 Aug: 0
  - 16-31 Aug: 0
  - 1-15 Sept: 0
  - 16-30 Sept: 0
  - 1-15 Oct: 0
  - 16-31 Oct: 0
  - 1-15 Nov: 0
  - 16-30 Nov: 0

**Comparison**
- **Recent**
  - Peak: 96
  - Time: 16-30 Sept
- **Historic**
  - Peak: 73
  - Time: 1-15 July

**Graph Notes**
- **Aphids per Compound Leaf**
- **Date Categories**
  - 1-15 May
  - 16-31 May
  - 1-15 June
  - 16-30 June
  - 1-15 July
  - 16-31 July
  - 1-15 Aug
  - 16-31 Aug
  - 1-15 Sept
  - 16-30 Sept
  - 1-15 Oct
  - 16-31 Oct
  - 1-15 Nov
  - 16-30 Nov
Trends in Aphid Populations

• Higher densities

• Populations are lasting longer

http://northernpecans.blogspot.com/2015/08/late-season-aphids.html
Dynamics of Insecticide Chemistries

• Over the decades, previous aphid insecticide classes have included primarily contact and several with contact plus translaminar activity

• Legacy products:
  – Zolone
  – Cygon
  – Pyrethroids
  – Metasystox-R
  – Malathion
  – Supricide
Legacy vs Current Generation Products

**Legacy**
- Primarily contact
- Little or no residual
- Some translaminar
- Broad-spectrum
- Effective on black pecan aphid or yellow pecan aphid complex, but not on both

**Current Generation**
- Systemic – mobile in xylem, phloem or both
- Translaminar
- Narrower spectrum – largely preserves beneficial insects
- Longer residual
- Effective on both black pecan aphid and the yellow pecan aphid complex
Systemic Mobility

Xylem and Phloem Mobility

Translaminar Mobility

Leaf Cross Section

- stoma (opening for gas exchange)
- guard cells
- upper epidermis
- palisade mesophyll
- spongy mesophyll
- vein (vascular bundle)
- lower epidermis
- waxy cuticle
- air space
- mesophyll (photosynthetic cells)
- guard cell
- carbon dioxide
- oxygen
## Translaminar Systemic Insecticides

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Common Name</th>
<th>Mode of Action</th>
<th>Plant Movement</th>
<th>Max No. Apps per Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beleaf/Carbine</td>
<td>Flonicamid</td>
<td>9C</td>
<td>Translaminar/Xylem</td>
<td>3</td>
</tr>
<tr>
<td>Closer</td>
<td>Sulfoxaflor</td>
<td>4C</td>
<td>Translaminar/Xylem</td>
<td>6</td>
</tr>
<tr>
<td>Movento</td>
<td>Spirotetramat</td>
<td>23</td>
<td>Translaminar/Xylem/limited Phloem</td>
<td>2</td>
</tr>
<tr>
<td>Sivanto</td>
<td>Flupyradifurone</td>
<td>4 D</td>
<td>Translaminar/Xylem</td>
<td>2</td>
</tr>
</tbody>
</table>
Blackmargined Results 2013 – 2016

### BELEAF/CARBINE

- **1 to 3 Days**
  - 2013: 57%
  - 2014: 71%
  - 2015: 38%
  - 2016: 45%
- **5 to 10 Days**
  - 2013: 85%
  - 2014: 94%
  - 2015: 100%
  - 2016: 78%
- **12 to 14 Days**
  - 2013: 83%
  - 2014: 92%
  - 2015: 99%
  - 2016: 88%
- **21+ Days**
  - 2013: 89%
  - 2014: 88%
  - 2015: 45%

### CLOSER

- **1 to 3 Days**
  - 2013: 44%
  - 2014: 61%
  - 2015: 77%
  - 2016: 37%
- **5 to 10 Days**
  - 2013: 64%
  - 2014: 93%
  - 2015: 99%
  - 2016: 84%
- **12 to 14 Days**
  - 2013: 71%
  - 2014: 88%
  - 2015: 100%
  - 2016: 92%
- **21+ Days**
  - 2013: 65%
  - 2014: 2%
  - 2015: 37%

### MOVENTO

- **1 to 3 Days**
  - 2013: 12%
  - 2014: 53%
  - 2015: 26%
  - 2016: 31%
- **5 to 10 Days**
  - 2013: 67%
  - 2014: 79%
  - 2015: 96%
  - 2016: 63%
- **12 to 14 Days**
  - 2013: 61%
  - 2014: 70%
  - 2015: 99%
  - 2016: 81%
- **21+ Days**
  - 2013: 60%
  - 2014: 23%

### SIVANTO

- **1 to 3 Days**
  - 2013: 22%
  - 2014: 69%
  - 2015: 47%
  - 2016: 13%
- **5 to 10 Days**
  - 2013: 67%
  - 2014: 68%
  - 2015: 97%
  - 2016: 50%
- **12 to 14 Days**
  - 2013: 32%
  - 2014: 68%
  - 2015: 99%
  - 2016: 71%
- **21+ Days**
  - 2013: 69%

### DAYS AFTER APPLICATION

- 1 to 3
- 5 to 10
- 12 to 14
- 21+
2017 Efficacy Trial

Mesilla Valley, NM

Aphids per Leaf

Days After Application

- Carbine
- Sivanto
- Movento
- Closer
- Untreated

PRE 1 POST 1 POST 7 POST 11 POST 14 POST 21
Performance Inconsistencies

• Environmental Factors
  – Temperature
  – Rain and Humidity
  – Wind

• Plant and Pest Factors
  – Leaf physiology
  – Resistance

• Application Factors
  – Timing
  – Mixing
  – Speed
  – Spray Volume
  – Surfactants
Application Timing

• Primary control from translaminar, mobile insecticides is from INGESTION
• Aphid populations increase exponentially
• Early application generally results in better control
Rotation and Resistance

All four chemistries are from different IRAC Classes

- Beleaf/Carbine: 9C
- Closer: 4C
- Movento: 23
- Sivanto: 4D

Rotation is **KEY** to resistance **MANAGEMENT**

Failing to rotate **WILL** lead to resistance which reduces the number of tools in our toolbox.
Spray Volume

- Coverage needed depends on tree architecture and canopy.
- Evidence that a more concentrated solution can produce better results.

![Graph showing the effect of spray volume on leaf concentration of imidacloprid over time in parts per million (PPM) for Untreated, 50 GPA, 75 GPA, and 100 GPA solutions. The graph includes data points for Day 1, Day 5, Day 9, Day 14, Day 21, and Day 28.](image)
Impact of Spray Volume

- Legacy products required high spray volumes to achieve coverage of both sides of the leaves.
- Current generation products may benefit from a higher concentration application.
# Pesticide Label Volume Recommendations

<table>
<thead>
<tr>
<th>Product</th>
<th>Spray Volume (Gallons/Acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admire Pro Systemic</td>
<td>50+</td>
</tr>
<tr>
<td>Beleaf 50 SG</td>
<td>50+</td>
</tr>
<tr>
<td>Closer 2 SC</td>
<td>No recommendation made</td>
</tr>
<tr>
<td>Movento 240 SC</td>
<td>50+</td>
</tr>
<tr>
<td>Sivanto 200 SL</td>
<td>25+</td>
</tr>
</tbody>
</table>
Volume Study

• Objective
  – Compare leaf concentration of imidacloprid at three spray volumes

• Treatments
  – Admire Pro Systemic at 1.2 fl oz/A in
    • 50 gallons per acre
    • 75 gallons per acre
    • 100 gallons per acre

• Methodology
  – Small airblast sprayer
    • Changed flow rate NOT speed to vary spray volume
Spray Volume Results

0.125% organosilicone surfactant by volume

Post Application Evaluations
Spray Volume Results

• Highest leaf concentration in the 50 GPA treatment
• Significantly more imidacloprid at 28 days in the 50 GPA treatment
Surfactants

- Typical labels allow between 0.0625% and 0.375%
- Most commonly stickers, spreaders, and penetrants
- Improved insecticide performance with increased concentration
Characteristics of Common Surfactants Used in Pecan

• Spreaders – decrease water surface tension, improving the cover of water droplets
• Penetrants – improve product penetration of leaf
• Stickers – Increase adhesion of the pesticide to the leaf
• URAN – Used as a carrier for herbicides, insecticides and other fertilizers
# Pesticide Label Surfactant Recommendations

<table>
<thead>
<tr>
<th><strong>Product</strong></th>
<th><strong>Recommendations</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Admire Pro</td>
<td>Organosilicone when spraying for aphids</td>
</tr>
<tr>
<td>Systemic</td>
<td></td>
</tr>
<tr>
<td>Beleaf 50 SG</td>
<td>No mention on label</td>
</tr>
<tr>
<td>Closer 2 SC</td>
<td>May improve initial spray deposits, redistribution and weatherability.</td>
</tr>
<tr>
<td>Movento 240 SC</td>
<td>Spreader/Penetrator required; Sticker forbidden.</td>
</tr>
<tr>
<td>Sivanto 200 SL</td>
<td>No mention on label</td>
</tr>
</tbody>
</table>
Surfactant Study

• Objective
  – Compare common surfactants used in the pecan industry to using no surfactant at all

• Treatments
  – Untreated Check
  – Imidacloprid without a surfactant
  – URAN
  – Crop Oil Concentrate (COC), a common inexpensive Spreader
  – Sticker
  – 100 % Organosilicone Spreader
  – Methylated Vegetable Oil Spreader/Penetrant designed for use with neonicotinoid insecticides
Surfactant Results

Application made by airblast sprayer at 75 gallons per acre.
Surfactant Results

• Very little statistically significant differences between surfactants

• Any surfactant was better than none
Summary of Both Studies

• Surfactant
  – Any better than none

• Volume
  – Highest leaf concentration in 50 GPA
  – Significantly more imidaclorpid at 28 days in 50 GPA

Take Home Message

Always use a surfactant
Try lowering spray volume to improve results
Imidacloprid

• Sold under Admire, Provado, Trimax and 20+ other labels
• Very popular until widespread resistance developed
• Lab trialed 2013 through 2016
• Resistance the Mesilla Valley is still high
Pecan Nut Casebearer

- Overwinter as larvae
- Emerge in Late May
- Second generation about 6 weeks after the first
- Third and (sometimes) Forth generation
Casebearer Populations
Mesilla Valley

Moths per Trap

2017
2014
2011
2016 Pecan Nut Casebearer Degree Days (DD) for Mesilla Valley

Predicted Dates for Insecticide Applications

Estimated Cumulative DD for Larvae Control

Estimated Cumulative DD for Moths Control

2016 Cumulative DD

2016 Predicted

2016 Predicted larvae spray date

2016 Predicted moth spray

Spray date range for moths

Spray date range for larvae

2006 DD (warm spring)

1998 DD (cold spring)

MAY 19 2016 YEAR TO DATE
Conclusion

• Translaminar systemic insecticides provide long lasting, effective control
  – Performance may be improved with surfactants and lower spray volumes

• Pecan nut casebearer populations have returned to pre-2011 freeze levels
Questions?

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