IPM Updates:
Walnut Scale & Navel Orangeworm

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Sacramento-Solano-Yolo Walnut Production Meeting
March 1st, 2017
Scale Pests of Walnut

Walnut scale

San Jose Scale

Italian Pear Scale
Walnut Scale Damage

• Suck plant juices
• Infested trees can appear water stressed
• Heavy populations may cause dieback of inside fruiting wood on lateral bearing cultivars, cracking of bark, reduced terminal growth & vigor leading to smaller nuts & poor kernel quality
• Economic damage rare unless populations very heavy, but…
• Feeding can provide entry point for pathogens  
  - Ex: Bot-walnut scale association
Association with *Botryosphaeria*
Walnut Scale Life Cycle

- Two generations/year
- Overwinter as 2\textsuperscript{nd} instar nymphs
- Resume development late winter – spring
- 1\textsuperscript{st} generation crawler emergence late April – early May
- 2\textsuperscript{nd} generation crawlers late summer – fall
Walnut Scale Management Options & Timing

- **Pre-Bot:** Biological control provided adequate suppression of low to moderate populations

- **Bot-era:** Insecticide treatment timings
  - Delayed-dormant (March)
  - Crawler stage
Biological Control: Walnut Scale Parasitoids
Walnut Scale Monitoring – Dormant Period

• Examine scaffolds, limbs, branches, and prunings for scales & evidence of parasitism

• Historical treatment thresholds: pests + parasitization
  – If high degree of parasitization observed, consider delaying treatments until after crawler emergence

• Current thresholds – must consider Botryosphaeria

  If treatments were applied previous season, confirm whether scales are still alive
Walnut Scale Monitoring – Dormant Period

Live walnut scale nymphs (above)
Live walnut scale adult females (below)

Dead adult female walnut scale
Walnut Scale Dormant Monitoring and Decision Support

Examine scaffolds, branches, limbs, prunings

High proportion parasitized

Botryosphaeria incidence low

No treatment warranted

Low proportion parasitized

Botryosphaeria incidence med-high

Consider treatment

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Walnut Scale Dormant Monitoring and Decision Support

1. Examine scaffolds, branches, limbs, prunings
   - High proportion parasitized
     - Botryosphaeria incidence low → No treatment warranted
     - Botryosphaeria incidence med-high → Consider treatment
   - Low proportion parasitized
Walnut Scale Dormant Monitoring and Decision Support

Examine scaffolds, branches, limbs, prunings

High proportion parasitized

Botryosphaeria incidence low
No treatment warranted

Low proportion parasitized
Botryosphaeria incidence med-high
Consider treatment

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Walnut Scale Monitoring – Crawlers

- Place tapes by mid-April
- Monitor weekly
- Aid in treatment timing
- Confirm live populations
- Assess population densities

Double-sided sticky tape

Photos: D.M. Lightle, R.P. Buchner
Walnut Scale Monitoring – Crawlers

Appr. 100X magnification

Often high densities at margins of tape (low magnification)

Photos: E. J. Symmes (L) and D. M. Lightle (R)
### 2014-2016 Insecticide Evaluations

<table>
<thead>
<tr>
<th>Generally performed better than untreated:</th>
<th>Mixed results (relative to controls):</th>
<th>Did not perform well (relative to controls):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seize DD</td>
<td>Assail C</td>
<td>Sivanto C</td>
</tr>
<tr>
<td>Centaur DD</td>
<td>Brigadier C</td>
<td>Sequoia C</td>
</tr>
<tr>
<td>Centaur C</td>
<td>Movento C*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Movento + Assail C*</td>
<td></td>
</tr>
</tbody>
</table>

Data based on R. Van Steenwyk field trials

- Spring evaluations showed continued population suppression in previous year treatments
  - Possible every 2-3 year treatment for scale

- Numerical treatment thresholds based on Bot pressure?

- Frosted scale???
Navel Orangeworm in Walnuts
NOW Management – Points to Remember

• Consider all varieties important for NOW IPM activities
  – Earlier-than-typical, and spread out husk split and maturation led to many later varieties experiencing higher damage in 2016

• High NOW damage at harvest = possibility of large overwintering populations
NOW Management – Key Elements

• Sanitation

• Minimize damage caused by other sources
  – CM, blight, sunburn, hail
  – Sound nuts most vulnerable to NOW damage after husk split

• Timely harvest

• Insecticide treatments
NOW Management – Sanitation

• Key to NOW management
  – Reduce overwintering populations
  – Reduce early generation oviposition/development sites

• Increasing destruction = greater reduction in emerging NOW
  – Shredded vs. bare berm = 100% & 97% reduction
  – Double-disked vs. bare berm = 95% & 68% reduction
  – Left in weeds vs. bare berm = 85% & 24% reduction

Sibbett & Van Steenwyk 1992
NOW Management – Sanitation

• Remove & destroy mummies by early March
  – Orchard – trees, floor
  – Bins, hulling, drying equipment, buildings
  – Maintaining ground cover during winter may aid in decomposing trash nuts
    • Do not rely solely on this, especially in dry years

• Wet weather helps **IF NUTS ARE ON THE GROUND**
  – BUT less natural mortality expected in walnuts compared to almonds (thicker shell)
NOW Management – Reduce In-Season Damage

• NOW is “secondary” pest – intact nuts not vulnerable until husk split
  – Good codling moth, blight, sunburn management to reduce earlier season access & development sites

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NOW Management – Harvest Timing

• The longer nuts stay in the orchard after husk split = more time vulnerable to NOW
• Time harvest to avoid late generation NOW flights
• Consider possibility of increased damage in $2^{nd}$ shake
• Ethephon to advance husk split
  – Especially in high NOW population years & prolonged dry falls
  – Based on in-orchard monitoring, potential for immigration
NOW Management – Insecticides

- Best current guideline - focus protection husk split through harvest
NOW Monitoring/Treatment Decisions

- Monitoring options
  - Egg traps
  - Pheromone traps
  - Kairomone traps
  - Crop phenology and egg detection

- Historical pressure/damage

- Immigration potential (risk assessment)

- Treatment thresholds?
NOW Seasonal Cycle

Almonds

Walnuts

Based on development **IN ALMONDS**

Based on development **IN WALNUTS**

BUT...resident versus immigrant populations???
NOW Monitoring Pheromone Traps 2016

NOW Pheromone Trapping Walnuts 2016

- 'Hartley'/'Vina'
- 'Chandler'
- 'Chandler'/Howard'
- 'Tehama'
- 'Howard'
- 'Serr'

<table>
<thead>
<tr>
<th>Date</th>
<th>Almond DD from local biofix (4/13/16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>29-June</td>
<td>1055 (1056)</td>
</tr>
<tr>
<td>7-August</td>
<td>1800 (1806)</td>
</tr>
<tr>
<td>20-September</td>
<td>2562 (2556)</td>
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</table>
Synthetic Lures vs. Females
Walnuts (2016)

Sacramento Valley
Northern San Joaquin Valley
Southern San Joaquin Valley
Synthetic Lures vs. Females
Walnuts (2016)

Five traps/set

Females (wing)
• Trece L2L (delta)
• Trece L2H (delta)
• Suterra Biolure (delta)
• AlphaScents AMYTRA (delta)

Walnut n = 21
### Regional Cumulative Trap Catches
**Walnuts (2016)**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Southern San Joaquin Valley</th>
<th>Northern San Joaquin Valley</th>
<th>Sacramento Valley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>283 ± 94a</td>
<td>201 ± 45</td>
<td>74 ± 27a</td>
</tr>
<tr>
<td>NBL</td>
<td>132 ± 25b</td>
<td>216 ± 46</td>
<td>186 ± 48b</td>
</tr>
<tr>
<td>L2L</td>
<td>184 ± 22ab</td>
<td>196 ± 43</td>
<td>277 ± 59c</td>
</tr>
<tr>
<td>L2H</td>
<td>168 ± 31ab</td>
<td>166 ± 22</td>
<td>315 ± 57c</td>
</tr>
<tr>
<td>AMYTRA</td>
<td>235 ± 54ab</td>
<td>256 ± 54</td>
<td>359 ± 32c</td>
</tr>
<tr>
<td>$F_{4,24}$</td>
<td>2.87</td>
<td>2.00</td>
<td>31.16</td>
</tr>
<tr>
<td>$P$</td>
<td>0.0448</td>
<td>0.1262</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

#### Regional variability in performance
Effect of Synthetic Lure Age on Trap Catch Walnuts (2016)

<table>
<thead>
<tr>
<th>Lure</th>
<th>n</th>
<th>Spearman $\rho$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>AlphaScents AMYTRA</td>
<td>386</td>
<td>-0.14</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Suterra NOW Biolure (NBL)</td>
<td>391</td>
<td>-0.02</td>
<td>0.678</td>
</tr>
<tr>
<td>Trécé NOW L2 low (L2L)</td>
<td>388</td>
<td>-0.01</td>
<td>0.829</td>
</tr>
<tr>
<td>Trécé NOW L2 high (L2H)</td>
<td>391</td>
<td>0.04</td>
<td>0.376</td>
</tr>
</tbody>
</table>

Correlation analysis:
Number of males captured decreased between lure change intervals for AMYTRA only
Females outperformed lures
Alphascents lures more variable
Suterra performed poorly
• Less activity between May and August
• All lures performed more similarly

Lures vs. Females: Walnuts
Northern San Joaquin Valley, CA (2016)
• Less activity between May and August
• Poor female performance
• Alphascents performed inconsistently

Lures vs. Females: Walnuts
Sacramento Valley, CA (2016)
Overall Conclusions

• **Female-lure anomaly:**
  – Evident in pistachio
  – Not evident in almonds
  – Walnut more intermediate and variable

• **Variable performance of commercial lures**
  – AMYTRA was least suitable
  – L2 lures were similar and most consistent

• **More evidence of mid-summer populations in walnuts in SSJV than NSJV or Sacramento Valley**
NOW in Walnuts – Risk Model Assessment

- Things to consider:
  - Proximity to external sources of infestation
    - Native habitats, almond orchards, pistachio orchards
  - Previous season’s harvest damage
  - Orchard sanitation
  - Carry-over populations in mummy nuts
  - Degree-day accumulation and populations cycles in walnuts and surrounding crops
  - Harvest timing
    - Harvest timing of external sources
  - In-season damage caused by other sources
    - Codling moth, sunburn, blight, etc.
  - Environmental conditions
    - Temperature, precipitation, etc.
Acknowledgements

California Walnut Board
Survey Feedback Request 😊

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