CODLING MOTH: 
“Area-Wide” Mating Disruption Using Puffers

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San Joaquin County

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W. Bentley, S. Wulfert, C. DeBuse,
S. Goldman Smith
Growers and PCAs
“Been there, done that”

- Sprayables
- Puffers
- Wax emulsion
- Hand applied
- Flakes, tubes
STATUS OF PUFFERS IN WALNUTS

- Few to no mechanical failures (<1%)
- Large areas (40 acre min.) appear to lower populations better
- Supplemental sprays important
- Population suppression achievable in 2-3 years
- Monitor: Use COMBO traps (hung high)
- Still need actionable treatment thresholds
  - Traps
  - Mid-season damage??
- Orchard edges may need extra efforts
- Can lose “incidental control” of other pests, esp. WHF
- “Good Neighbor” approach: Inform neighbors about puffer use
CM Puffer Transition Strategy

• **Year 1** - Puffers + supplemental sprays to reduce population and control damage

• **Year 2** – Continued population reduction; reduce/eliminate sprays or use softer materials according to “Combo” trap catches and in-season damage

• **Year 3-5** – With above, need for CM sprays eliminated over time
CM Pheromone puffer implementation sites

- **San Joaquin County**
  - 5th year: 600 acres (22 blocks)
  - 2nd year: 540 acres (10 blocks)

- **Glenn County**
  - 5th year
  - 180 acres (3 blocks)

- **Butte County**
  - 3rd year
  - 205 acres (2 blocks)

- **Yolo County**
  - 2nd year
  - 180 acres (4 blocks)

- **Tehama County**
  - 2nd year
  - 2 blocks: 120, 160 acres

- **Kings County**
  - 2nd year
  - 160 acres (2 blocks)

- **Advise cooperators on CM management**
- **Population monitoring**
  - 1x traps low
  - Combo traps high
- **In-season damage counts**
  - End 1st and 2nd generation
  - 600 nuts / block
- **Harvest damage**
  - 500 nuts / block
San Joaquin County Puffer Trial
Locke Ranch
600 acres
San Joaquin County Puffer Trial
Locke Ranch
600 acres

Puffers added in 2006-2008
Downwind pheromone movement from puffer

1000 Sterile Marked Codling Moths Released at Each Black Dot

Wind Direction

# Moths

<table>
<thead>
<tr>
<th>0</th>
<th>20</th>
<th>40</th>
<th>60</th>
<th>80</th>
<th>100</th>
</tr>
</thead>
</table>

Trap Location

P Puffer Location

Souza 3a-on/5day
‘08 & ‘09: **0% CM** all blocks except at edges of some blocks

Locke Ranch Puffer Trial  
San Joaquin County  
T4N R7E

Harvest % CM damage  
**2008**  
**2009**

NO CM SPRAYS  
Either year

1.2

0.2

0.8

0.0

0.2

0.0

1.3

0.2

0.2

0.2

0.2

0.2(SERR)

0.2(SERR)
Codling moth damage at harvest

Locke Ranch Puffer Trial

<table>
<thead>
<tr>
<th>Variety</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1 Tulear</td>
<td>0.20</td>
<td>1.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>F2 Serr</td>
<td>2.0</td>
<td>0.89</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>F4 Chandler</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
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<tr>
<td>F6 Tulear</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>F7 Howard</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>F8 Serr</td>
<td>0.8</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>F9 Chandler</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>F10 Vina/Serr</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>F12 Serr</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>F13 &amp; F22 Chandler</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>F14 &amp; 15 Serr</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>F18 Serr</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
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<tr>
<td>F19 Hartley</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>F23 Howard</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>F24 Vina</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
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<tr>
<td>F25 Serr</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
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<tr>
<td>F25 Chandler</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
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</tbody>
</table>
Locke Ranch Puffer Trial, Seasonal Trap Captures, CM-DA Lure
Population decline over time
Locke Ranch, 2005-2009

Total COMBO captures - all farm

<table>
<thead>
<tr>
<th>Year</th>
<th>Total moths/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>1262</td>
</tr>
<tr>
<td>2006</td>
<td>1245</td>
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<tr>
<td>2007</td>
<td>377</td>
</tr>
<tr>
<td>2008</td>
<td>139</td>
</tr>
<tr>
<td>2009</td>
<td>42</td>
</tr>
</tbody>
</table>
Need for supplemental sprays declines over time
Butte 2007-2009
% CM Damage at Harvest
No CM Insecticides for 3 years!
San Joaquin County “Expansion” Puffer Trial

Locke Ranch
2005-2008
600 A

2008 Expansion Area
540 A
Glenn County Puffer Trial
180 acres

Vina 110 ac

Tehama 37ac

Chandler 30ac

Sacramento River

Glenn County Puffer Trial
180 acres
Glenn puffers 2005-2009
% CM Damage at Harvest

<table>
<thead>
<tr>
<th>Block</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vina</td>
<td>0.5</td>
<td>0.3</td>
<td>2.1</td>
<td>0.6</td>
<td>1.9</td>
</tr>
<tr>
<td>Tehama</td>
<td>0.1</td>
<td>0.1</td>
<td>1.7</td>
<td>0.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Chandler</td>
<td>0.3</td>
<td>0.0</td>
<td>0.3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Entire site</td>
<td>0.3</td>
<td>0.1</td>
<td>1.4</td>
<td>0.1</td>
<td>1.2</td>
</tr>
</tbody>
</table>
Glenn 2005-2009
Codling Moth Insecticide Applications*

*Acres in block X CM treatments per block. Only CM treatments shown.
## Long-Term, Area-wide CM Puffer Sites 2009

<table>
<thead>
<tr>
<th>LOCATION</th>
<th># YEARS</th>
<th>BLOCKS</th>
<th>VARIETIES</th>
<th>% CM</th>
<th># CM SPRAYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Joaquin</td>
<td>5</td>
<td>22</td>
<td>Chandler, Hartley, Howard, Serr, Tulare, Vina</td>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td>Glenn</td>
<td>5</td>
<td>3</td>
<td>Chandler, Tehama, Vina</td>
<td>1.2</td>
<td>spot treat</td>
</tr>
<tr>
<td>Butte</td>
<td>3</td>
<td>2</td>
<td>Vina</td>
<td>0.7</td>
<td>0</td>
</tr>
<tr>
<td>Tehama-S</td>
<td>2</td>
<td>2</td>
<td>Ashley, Tehama</td>
<td>0.1</td>
<td>0</td>
</tr>
<tr>
<td>Tehama-N</td>
<td>2</td>
<td>2</td>
<td>Vina</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>SJ expansion</td>
<td>2</td>
<td>10</td>
<td>Chandler, Hartley, Serr, Vina</td>
<td>0.4</td>
<td>spot treat</td>
</tr>
<tr>
<td>Yolo2</td>
<td>1</td>
<td>4</td>
<td>Chandler, Hartley, Tehama, Vina</td>
<td>0.5</td>
<td>1</td>
</tr>
</tbody>
</table>
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- “Good Neighbor” approach: Inform neighbors about puffer use
Walnut & Dusky-veined Aphids

CODLING MOTH
“KEY PEST”

Navel Orangeworm

Mites

Walnut Husk Fly

Fall Webworm
Downwind pheromone movement from puffer treated orchard

1000 Sterile Marked Codling Moths Released at Each Black Dot

Wind Direction

P

Puffer Location

Souza 3a-on/5day
Downwind pheromone movement from puffer treated orchard

Average number of Codling Moth

C. DeBuse, 2008
“Medium density” dispensers under test

For:

Puffer edges
Blocks too small for puffers

T. Burlando, S. Welter, 2008
## Damage at Harvest 2009

**Codling Moth & Navel Orangeworm**

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>% CM</th>
<th>% NOW</th>
<th># Nuts Examined</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Joaquin</td>
<td>0.2</td>
<td></td>
<td>11,000</td>
</tr>
<tr>
<td>Glenn</td>
<td>1.2</td>
<td>0.4</td>
<td>4,500</td>
</tr>
<tr>
<td>Butte</td>
<td>0.7</td>
<td>0.7</td>
<td>7,000</td>
</tr>
<tr>
<td>Tehama-S</td>
<td>0.1</td>
<td>0.7</td>
<td>2,000</td>
</tr>
<tr>
<td>Tehama-N</td>
<td>0.0</td>
<td>0.1</td>
<td>1,600</td>
</tr>
<tr>
<td>SJ expansion</td>
<td>0.4</td>
<td></td>
<td>5,000</td>
</tr>
<tr>
<td>Yolo2</td>
<td>0.5</td>
<td>0.1</td>
<td>1,000</td>
</tr>
</tbody>
</table>
Zero (almost) Supplemental CM Insecticide Applications in 2009

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>ACRES</th>
<th># CM SPRAYS</th>
<th>Acres Treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Joaquin</td>
<td>600</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Glenn</td>
<td>180</td>
<td>spot treat</td>
<td>&lt; 20 ac treated</td>
</tr>
<tr>
<td>Butte</td>
<td>205</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Tehama-S</td>
<td>120</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Tehama-N</td>
<td>160</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>SJ expansion</td>
<td>540</td>
<td>spot treat</td>
<td>44 ac treated</td>
</tr>
<tr>
<td>Yolo2</td>
<td>180</td>
<td>1</td>
<td>180 ac</td>
</tr>
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</table>
2010 Tehama Grower talk Varieties Final.ppt