USDA TART CHERRY ORCHARD MANAGEMENT (RAMP I) FOUR-YEAR SUMMARY FOR UTAH: “MONITORING AND MANAGEMENT ALTERNATIVES FOR CHERRY FRUIT FLY AND PLUM CURCULIO”

Diane Alston, Entomologist, Utah State University
2008 NW MI Orchard and Vineyard Show, Traverse City, MI

RAMP Objectives:

1. Develop alternative insect management options for on-farm use (reduce dependency on organophosphate insecticides)
2. Evaluate monitoring and trapping systems
3. Optimize management strategies, tactics, and tools
4. Impacts on ecosystem quality and non-target effects
5. Extension and outreach

Develop alternative insect management options for on-farm use (reduce dependency on OP insecticides)

A. Western cherry fruit fly
   i. Imidacloprid (Provado®)
   ii. Spinosad formulated as a bait (GF-120®)

Efficacy of new insecticides

<table>
<thead>
<tr>
<th>Year</th>
<th>Orch #</th>
<th>Treatment*</th>
<th># CFF larvae^</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>1</td>
<td>Guthion</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Provado</td>
<td>0</td>
</tr>
<tr>
<td>2005</td>
<td>3</td>
<td>Guthion</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Provado</td>
<td>2.4 a</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>GF-120</td>
<td>0.8 b</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Guthion</td>
<td>0.0002</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Guthion</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Provado/Guthion</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Provado/Imidan</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Provado/GF-120</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Provado/GF-120</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>GF-120</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Provado/GF-120</td>
<td>0.0002</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Provado/GF-120</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>Provado/GF-120</td>
<td>0</td>
</tr>
</tbody>
</table>

*Total of 2-6 applications per season; ^Cumulative # CFF larvae per 100 fruit (2,000-5,000 fruit sampled per orchard)

Efficacy of new insecticides

Commercial orchard trials

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<tr>
<td>2004</td>
<td>1</td>
<td>Guthion</td>
<td>1.1 b</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>GF-120</td>
<td>0.3 c</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Guthion</td>
<td>1.3 b</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>GF-120</td>
<td>0.1 x</td>
</tr>
<tr>
<td>2005</td>
<td>5</td>
<td>Guthion</td>
<td>1.9 b</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>GF-120</td>
<td>0.8 b</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>GF-120+AA</td>
<td>1.4 b</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>GF-120+YY</td>
<td>0.5 b</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>GF-120+CC</td>
<td>0.9 b</td>
</tr>
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Insecticide efficacy summary

- Spinosad (GF-120 and Success) and imidacloprid (Provado) offer greater flexibility in REIs and PHIIs than OP insecticides
- GF-120 offers an alternative application method
- The two products differ in pest target stage
  - Provado: larvicide (ovicide), & adulticide
  - Spinosad: adulticide
- GF-120 cannot protect fruit against migrating females that contain mature eggs
  - Prevented fruit injury for orchards ≤ 20 cumulative CFF on traps
- Important to rotate applications of neonicotinoid (Provado) with other insecticide classes
  - Stimulation of spider mites
Develop alternative insect management options for on-farm use (reduce dependency on OP insecticides)

- **B. Plum curculio**
  - i. Influence of temperature and concentration on the performance of two entomopathogenic nematodes (EPNs)
    - Laboratory – Wax worm larvae
  - ii. Influence of EPN species and concentration on mortality of plum curculia (PC) life stages
    - Laboratory – PC Colony
  - iii. Suppression of PC by EPNs in home yard fruit trees in northern Utah
    - Field – Brigham City, UT

<table>
<thead>
<tr>
<th>Source</th>
<th>Mean mortality of <em>G. mellonella</em> (%) ± SE</th>
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<tr>
<td>Temperature</td>
<td></td>
</tr>
<tr>
<td>10 °C</td>
<td>14.3 ± 2.3 a</td>
</tr>
<tr>
<td>20 °C</td>
<td>3.2 ± 0.3 b</td>
</tr>
<tr>
<td>30 °C</td>
<td>3.9 ± 0.5 b</td>
</tr>
</tbody>
</table>

**Nematode Species**

- *H. bacteriophora* | 8.0 ± 2.2 a
- *S. feltiae* | 5.3 ± 0.7 a

**Nematode concentration**

- 20 IJs / larva | 6.7 ± 1.6 a
- 50 IJs / larva | 6.5 ± 1.8 a

**Mean number of days required to kill 50% of wax worm last-instar larvae by EPNs**

<table>
<thead>
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<th>Source</th>
<th>Total cumulative nematode reproduction (± SE)</th>
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<tr>
<td>Temperature</td>
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<tr>
<td>10 °C</td>
<td>11,150.8 ± 1,720.8 b</td>
</tr>
<tr>
<td>20 °C</td>
<td>143,002.6 ± 1,071.3 a</td>
</tr>
<tr>
<td>30 °C</td>
<td>113,541.2 ± 1,388.3 a</td>
</tr>
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**Nematode Species**

- *H. bacteriophora* | 173,943.5 ± 1,340.3 a
- *S. feltiae* | 65,187.6 ± 5,680.8 b

**Susceptibility of PC life stages to EPNs**

**EPN virulence to PC**

- *Heterorhabditis*-infected larvae
- *Steinernema*-infected larvae

Mean maximum corrected percent mortality of wax worm larvae caused by EPNs

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<tr>
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<td>72.8 ± 20.0</td>
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<tr>
<td>20 °C</td>
<td>99.9 ± 1.1</td>
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<td>30 °C</td>
<td>78.2 ± 9.8</td>
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**Nematode Concentration**

- 20 IJs / larva | 100.0 ± 0.0 |
- 50 IJs / larva | 93.9 ± 6.1 |

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**Nematode Species**

- *H. bacteriophora* | 100.0 ± 0.0 |
- *S. feltiae* | 93.9 ± 6.1 |

Hb* = *H. bacteriophora* and Sf* = *S. feltiae
**Field suppression of PC with EPNs**

- EPNs applied with backpack sprayer
- Trunk screen traps monitored PC adults

**Recycling (self-perpetuation) of EPNs in the field**

05/20/2005 (Before EPN applications)
06/02/2006 (1 wks. before EPN applications)
07/19/2006 (At final EPN application)
08/24/06 (1 mo. after EPN applications)
10/11/06 (3 mo. after EPN applications)

**Evaluate monitoring and trapping systems**

- A. Western cherry fruit fly
  - Trap placement / position
  - Trap density
  - Adult attractants
    - Traps
    - GF-120 droplets
    - Insecticide effects on adult dispersal

**Summary Points on Trap Density and Placement**

- Higher trap density increased adult trap catch
  - 3 traps per acre > 1 trap per acre > 4 traps per orchard
- Adult catch on border vs. interior traps varied
  - More adults caught on border than interior traps in some years and orchards
  - Varied with primary source of fruit fly population
  - In one study, greater proportion on border traps were males
  - Males may disperse differently than females
  - Percentage of adults caught was greater in orchards with traps on both borders and within interiors
  - First catch was an average of 2.4 days earlier
  - Adults were caught earlier in orchards with higher fruit fly densities

**Adult attractants on traps**

- Most lymph of GF-120 adults on traps
  - Mostly green
  - Yellow and rose
  - Mostly red
  - Post-harvest

**Insecticide effects on adult dispersal**

- Significant Effect:
  - Mature Ovaries: GF-120>Standard
  - Females: 30-34% of Adults
  - Mature Ovaries: 12-20% of Adults

*For 16 traps in each treatment of 8 cherry orchards from late May to mid Aug, 2004 & 2005
Optimize management strategies, tactics, and tools

- **Western cherry fruit fly**
  - Provado
    - Larvicide (within fruit), adulticide (moderate)
    - Minimize application number, rotate with non-neonicotinoids (avoid mite stimulation)
  - GF-120 (& other spinosad formulations)
    - Suppress CFF when adult numbers ≤ 20 cumulative per trap
    - Good adulticide, no non-target effects, alternative application method
- **Plum curculio**
  - EPNs for population suppression
    - Not stand-alone control; 2-3 years of use substantially reduced PC densities, target summer generation
    - A fit with diverse, multi-pronged IPM strategies
    - Potential for recycling (self-perpetuation)

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Extension and Outreach

- **2004-07**
  - 13 meetings & field days
  - Over 640 face-to-face contacts
- **Utah Pests web page**
  - [www.utahpests.usu.edu](http://www.utahpests.usu.edu)
    - Pest advisory service
    - Orchard spray timing advisories
    - Photo gallery (pests & natural enemies)
    - Research reports, slideshows, other resources
    - Extension publications / fact sheets

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**Tree Fruit IPM Advisory**

Example of weekly Tree Fruit IPM Advisory

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**Western Cherry Fruit Fly**

- **Description:**
  - Adult: small, brown, and active in spring
  - Larva: creamy white, oval, and compact

- **Hosts:**
  - Various deciduous trees

- **Control:**
  - Cultural methods
  - Chemical control

**Plum Curculio**

- **Description:**
  - Adult: small, brown, and active in spring
  - Larva: creamy white, oval, and compact

- **Hosts:**
  - Various deciduous trees

- **Control:**
  - Cultural methods
  - Chemical control

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**Prussian Woolly Bear**

- **Description:**
  - Adult: small, brown, and active in spring
  - Larva: creamy white, oval, and compact

- **Hosts:**
  - Various deciduous trees

- **Control:**
  - Cultural methods
  - Chemical control
Research publication
on neonicotinoid and spinosad efficacy on cherry fruit fly

Acknowledgements

- Research assistance: Sadie Enright, Helen Darrow, Doug Anderson, Guy Banner, Britney Hunter, Tyrell Simkins, Adam Thompson, Paul Bingham, Camille Rowley, John Woertendyke, & others
- Graduate student: Hong-Geun Kim
- Funding:
  - USDA CSREES IPM RAMP Tart Cherry Grant
  - Utah State Horticultural Association
  - Agricultural Chemical Industry