NEW CHERRY FRUIT FLY CONTROLS IN TART CHERRY

Diane Alston
Entomologist, Utah State University
NW Michigan Orchard and Vineyard Show, Traverse City, MI January 15-17, 2008

WCFF MANAGEMENT – TART CHERRY

- Primary insect pest
- Zero tolerance for larvae in fruit
- Growers struggle with control timing
  - Low populations – difficult to set biofix
  - Large orchards (10+ acres) - If minimal outside influx, does entire interior need to be treated?
  - Excessive spraying
- Growers use a low trap density (1-2 traps per 5-10 acres) & most are placed on borders

1. EFFICACY OF NEW INSECTICIDES

- 2004-07: 19 orchard trials
  - 15 trials on commercial farms
  - 4 trials on university research farm
- Objectives:
  - Evaluate, demonstrate, & encourage adoption of non-OP insecticides for CCFF management
  - Test & refine strategies, technologies, & timing for alternative products
  - Develop and validate predictions of fruit injury from trap catch

WESTERN CHERRY FRUIT FLY IN UTAH RHAGOLETIS INDIFFERENS

- Native hosts don’t play a role
- Tart & sweet cherry
- Unmanaged trees
  - Home yard trees
  - Neglected orchards
- Hostile environment & ecosystem outside of orchard & urban areas

UTAH CCFF RESEARCH

- Field-based
- Efficacy of new insecticides
  - Neonicotinoid (imidacloprid, Provado®)
  - Microbial (spinosad, GF-120®)
  - Adult & larval suppression
  - Non-target effects on mites
- Monitoring (Pherocon AM® trap)
  - Additional attractants
  - Trap placement (border & interior)
  - Trap density
  - Insecticide influences on dispersal of males & females (immature & gravid)

GF-120 APPLICATION

- Photo of home orchard with GF-120 sprayer
- Electric pump sprayer mounted on 4-wheeler applies a strip of spray along the mid-and upper-line of each tree row
**Efficacy of New Insecticides**

#### Commercial Orchard Trials

<table>
<thead>
<tr>
<th>Year</th>
<th>Orch #</th>
<th>Treatment*</th>
<th># Off Larvae</th>
<th>Year</th>
<th>Orch #</th>
<th>Treatment*</th>
<th># Off Larvae</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>1</td>
<td>Guthion</td>
<td>0</td>
<td>2005</td>
<td>6</td>
<td>Guthion</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Dimethoate</td>
<td>0</td>
<td></td>
<td>7</td>
<td>Guthion</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Guthion</td>
<td>0</td>
<td>2006</td>
<td>8</td>
<td>Provado/Guthion</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Provado</td>
<td>0</td>
<td></td>
<td>10</td>
<td>Provado/GF-120</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>GF-120</td>
<td>0.8 b</td>
<td></td>
<td>13</td>
<td>Provado/Guthion</td>
<td>0.0002</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td>Provado/GF-120</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Provado/GF-120</td>
<td>0.0004</td>
</tr>
</tbody>
</table>

*Total of 2-6 applications per season. *Cumulative # Off larvae per 100 fruit (2,000-5,000 fruit sampled per plot)

#### Research Orchard Trials

<table>
<thead>
<tr>
<th>Year</th>
<th>Orch #</th>
<th>Treatment*</th>
<th># Off Larvae</th>
<th>Year</th>
<th>Orch #</th>
<th>Treatment*</th>
<th># Off Larvae</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>16</td>
<td>Untreated</td>
<td>44.7 a</td>
<td>2007</td>
<td>19</td>
<td>Untreated</td>
<td>9.1 a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Guthion</td>
<td>1.1 b</td>
<td></td>
<td></td>
<td>Guthion</td>
<td>1.9 b</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GF-120</td>
<td>0.3 c</td>
<td></td>
<td></td>
<td>GF-120+AA</td>
<td>0.8 b</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GF-120+AA</td>
<td>0.1 c</td>
<td></td>
<td></td>
<td>GF-120+U</td>
<td>1.4 b</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GF-120+U</td>
<td>0.5 b</td>
<td></td>
<td></td>
<td>GF-120+TY</td>
<td>0.9 b</td>
</tr>
</tbody>
</table>

*Total of 2-6 applications per season; AC=ammonium carbonate, AA=ammonium acetate, U=urea, Thionyl chloride, & CO-concentrate cherry juice (10% w/v)

**Imidacloprid (Provado®)**

- Prevented WCFF fruit injury in 13 of 15 commercial orchard trials
- In Orchard 4 (2.4% fruit injury), crop load was small and external, home yard sources of fruit flies compromised Provado’s performance
- In Orchard 13 (0.0002% fruit injury), fruit maturity was advanced

15% of fruit was rosy in color on June 12 (collection date of infested fruit)

**Spinosad (GF-120 NF®)**

- Similar to Provado, GF-120 prevented WCFF fruit injury in 13 of 15 commercial orchard trials
- GF-120 did not completely protect fruit in any of the 4 research orchard trials
- Fruit fly densities were 2-100× times higher in research orchards (21-121 cumulative adults per trap) than in commercial orchards (0-12 cumulative adults per trap)
- Despite high OF densities & influx of gravid females, GF-120 kept fruit injury ≤ 4.0 larvae per 100 fruit
- 10% AA (w/v) improved performance of GF-120 in 2006 trial, but no added attractiveness enhanced GF-120 in 2007 trial

**Life Stage Suppression – Neonicotinoid insecticides are moderate adulticides**

**Life Stage Suppression – Spinosad is a good adulticide**
**GF-120 MODE OF ACTION**

- Bait in GF-120 must be arresting adults reasonably well, but it doesn’t appear to be attractive
- Bait droplets encountered during routine adult foraging
- Adult fruit flies that feed on GF-120 are killed quickly
- 0.02% a.i. spinosad is highly toxic to adults when ingested
- Need to keep enough GF-120 available for adult population size
- Not rain-fast
- Reapply every 5-7 d & after rain

**PROVADO MODE OF ACTION**

- Contact – only moderate adulticide
- Systemic – kills larvae (eggs) inside fruit
- Under high populations in research orchard trials – 14 d of fruit protection
TRAP ATTRACTANT TRIAL

- 2007
- 5 'Montmorency' tart cherry orchards (4 commercial, 1 research)
- 13 potential attractants:
  - Ammonium acetate (AA) – volatile powder
  - Ammonium carbonate (AC) – volatile powder
  - Ammonium hydroxide (AH) – volatile liquid
  - Unea (U) – volatile granular
  - Sour cherry essence (SWCE) – volatile liquid
  - Sour cherry essence (SOCE) – volatile liquid
  - Single strength cherry juice (SSCJ) – liquid
  - Concentrate cherry juice (65 brix) (CCJ) – liquid
  - Torula yeast (TY) – powder dissolved in water
  - Mulasses (M) – 10 drops per trap
  - Sucrose (S) – crystals dissolved in water, 10 drops per trap
  - No bait

TRAP ATTRACTANT TRIAL DESIGN

CUMULATIVE ADULTS FOR FOUR FRUIT MATURITY PERIODS – ALL 5 ORCHARDS

TRAP ATTRACTANTS SUMMARY

- AH & AC increased adult trap catch by 1.5-2× over NB traps
- AH releases the most ammonia, AC also releases CO₂
- BY enhanced catch over NB on dates when fruits were mature or nearly mature
- Overall, more adults were caught when fruits were mostly red in color (June 27 – July 12), but more were caught in commercial orchards during June (fruits mostly yellow and rose in color)
- More work needed on release rates & formulations, & enhancement of compound volatility

TRAP ATTRACTANT RECOMMENDATIONS

- Use of commercial AC bait recommended (~2× increase in trap catch over no bait)
- "Sphere of influence" of trap small
- Greater accuracy in CFF detection depends on higher trap densities
- Further work on CFF attractants is needed!

2. MONITORING CFF WITH TRAPS

B. TRAP PLACEMENT

- Most Utah tart cherry growers place 1.2 traps per orchard (10+ acres), on border trees
- Growers most concerned about detection of external sources of flies
- Objective:
  - To compare adult catch on borders vs. interiors of orchards
    - 2005 & 06: 11 orchards (compared border (B) vs. interior (I) trap catch within orchards)
    - 2003 & 04: 32 orchards (compared orchards with B & I traps vs. B only)
### Influence of Trap Placement on Wcff Catch - 2006

Influence of trap placement on Wcff catch for 2006. The graph shows the cumulative number of adults per trap for border and interior orchards. The cumulative catch from early June to early August is indicated. The graph highlights the difference in catch between border and interior orchards.

**Legend:**
- **Border**
- **Interior**

*Cumulative catch from early June to early August*

### Influence of Trap Placement on Wcff Catch - 2003 & 2004

Influence of trap placement on Wcff catch for 2003 and 2004. The graph shows the percentage of adults caught in border and interior traps vs. border only traps. The first adult catch was an average of 2.4 days earlier in orchards with both border and interior traps vs. border traps only. The catch from 2003 & 2004 is indicated. The graph highlights the statistical significance of the difference. The *caught on traps from biofix to Jul 31*

**Legend:**
- **Border & Interior**
- **Border only**

*Caught on traps from biofix to Jul 31*

### Influence of Trap Placement on Trap Catch - 2004 & 2005

Influence of trap placement on trap catch for 2004 & 2005. The graph shows the percentage of adults caught on traps from biofix to Jul 31. The factorials design is shown with treatments: Borders only, Borders & Interior. The graph highlights the significant effect of trap placement on trap catch.

**Legend:**
- **Border**
- **Interior**

*For 8 border & 8 interior traps in each treatment of 6 cherry orchards from late May to Mid Aug, 2004 & 2005*

### 2. Monitoring Cff with Traps

#### C. Trap Density

2003:
- 6 Treatments
- Factorial design
- Reps.: 3X (18 orchards)
- Orchard size: 10-14 acres
- 4 traps/orch. 1 trap/acre 3 traps/acre

2004:
- 2 Treatments
- 1 trap/acre 7X (14 orchards)
- 10-14 acres
- 4 traps/orch. 1 trap/acre

**Trece® Pherocon AM + Ammonium carbonate**

#### Trap Density

- **Borders only**
- **Borders & Interior**

### Influence of Trap Density on Wcff Catch

Influence of trap density on Wcff catch. The graph shows the mean cumulative number of adults per trap for different trap densities: 4, 1, and 3 traps per orchard. The adults were caught in 19/32 orchards (59%). The mean number per orchard: 3 per acre > 1 per acre > 4 traps per orch. (p<0.05)

**Legend:**
- **4 traps per orch.**
- **1 per acre**
- **3 per acre**

*From biofix to Jul 31*

### Influence of Cff Density on Date of First Trap Catch - 2003 & 2004

Influence of Cff density on date of first trap catch for 2003 & 2004. The graph shows the negative relationship between trap density and date of first adult catch. The first adult catch was an average of 2.4 days earlier in orchards with both border and interior traps vs. border traps only.

**Legend:**
- **Border & Interior**
- **Border only**

*Biofix to Jul 31; missing data point: JD 151, 1600 adults*
**SUMMARY OF TRAP DENSITY AND PLACEMENT**

- Adult trap catch was markedly increased by increasing trap density
  - 3 traps per acre > 1 trap per acre > 4 traps per orchard
- Adult catch on border vs. interior traps varied between years
  - 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

**INSECTICIDE EFFECTS ON TRAP CATCH**

**GF-120 EFFECTS ON TRAP CATCH**

- GF-120 plots retained more females with mature ovaries
  - Ammonium acetate bait in GF-120 influenced gravid and non-gravid adults differently
- Evaluation of how attract-and-kill products and insecticides influence adult activity / movement should sort out effects on gravid females

**2. MONITORING CFF WITH TRAPS**

**D. UNDERSTANDING MALE & FEMALE DISPERAL**

- Objective:
  - To assess the influence of different insecticides on dispersal of male & female flies in orchards

**EXTENSION / OUTREACH PRODUCTS**

**UTAH PESTS WEB PAGE**