Cherry Fruit Fly Management with Reduced Risk Insecticides

and Recent Advances in Codling Moth Management

Diane Alston
Utah State University
2006 Utah State Horticultural Association Convention
## Insecticides Registered for WCFF in Utah

<table>
<thead>
<tr>
<th>Product</th>
<th>REI</th>
<th>PHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imidan*</td>
<td>24 h</td>
<td>7 d</td>
</tr>
<tr>
<td>Lorsban*</td>
<td>4 d</td>
<td>14 d</td>
</tr>
<tr>
<td>Asana</td>
<td>12 h</td>
<td>14 d</td>
</tr>
<tr>
<td>Warrior</td>
<td>24 h</td>
<td>14 d</td>
</tr>
<tr>
<td>Guthion</td>
<td>15 d</td>
<td>15 d</td>
</tr>
<tr>
<td>Diazinon</td>
<td>24 h</td>
<td>21 d</td>
</tr>
<tr>
<td>Dimethoate</td>
<td>Post-harvest</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Product</th>
<th>REI</th>
<th>PHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sevin</td>
<td>12 h</td>
<td>3 d</td>
</tr>
<tr>
<td>Malathion</td>
<td>12 h</td>
<td>1/3 d</td>
</tr>
<tr>
<td>Diatect</td>
<td>12 h</td>
<td>12 h</td>
</tr>
<tr>
<td>Provado</td>
<td>12 h</td>
<td>7 d</td>
</tr>
<tr>
<td>Actara</td>
<td>12 h</td>
<td>14 d</td>
</tr>
<tr>
<td>Spinosad</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Success</td>
<td>4 h</td>
<td>7 d</td>
</tr>
<tr>
<td>Entrust</td>
<td>4 h</td>
<td>7 d</td>
</tr>
<tr>
<td>GF-120</td>
<td>4 h</td>
<td>4 h</td>
</tr>
</tbody>
</table>

*for tarts only
Efficacy of GF-120 & Provado Field Sites - 2004 & 2005

- 9 study sites
  - 2 were the same research orchard replicated in '04 & '05 (tart cherry)
  - 7 were commercial orchards (2 sweets, 5 tarts)
  - GF-120 applied every 4-7 days; 5-7 applications
  - Provado applied every 14 days; 2-3 applications

Photo courtesy of Tim Smith, WSU Ext.
Fruit Protection
### GF-120 Research Trials, Kaysville (Tart Cherry)

<table>
<thead>
<tr>
<th>Trt.</th>
<th>2004 Mean Cum. # Adults per Trap</th>
<th>2004 Mean Cum. # Larvae per 100 Fruit</th>
<th>2005 Mean Cum. # Adults per Trap</th>
<th>2005 Mean Cum. # Larvae per 100 Fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1211 a</td>
<td>44.7 a</td>
<td>474 a</td>
<td>9.3 a</td>
</tr>
<tr>
<td>Guthion</td>
<td>249 b</td>
<td>1.1 b</td>
<td>69 b</td>
<td>1.3 b</td>
</tr>
<tr>
<td>GF-120</td>
<td>187 b</td>
<td>0.3 b</td>
<td>48 b</td>
<td>0.1 b</td>
</tr>
</tbody>
</table>

6 or 8 reps.; 0.2 acre plots; 12 or 16 traps; 3,000 or 4,000 fruits x 3 dates; High WCFF population!
### GF-120 On-Farm Trials, 2005

#### Sweet 1

<table>
<thead>
<tr>
<th>Trt.</th>
<th>Mean Cum. # Adults per Trap</th>
<th>Mean Cum. # Larvae per 100 Fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guthion</td>
<td>3.4</td>
<td>0</td>
</tr>
<tr>
<td>Provado</td>
<td>3.6</td>
<td>2.4</td>
</tr>
<tr>
<td>GF-120</td>
<td>4.2</td>
<td>0.8</td>
</tr>
</tbody>
</table>

#### Sweet 2

<table>
<thead>
<tr>
<th>Trt.</th>
<th>Mean Cum. # Adults per Trap</th>
<th>Mean Cum. # Larvae per 100 Fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guthion</td>
<td>1.1</td>
<td>0</td>
</tr>
<tr>
<td>GF-120</td>
<td>1.4</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Tart 1

<table>
<thead>
<tr>
<th>Trt.</th>
<th>Mean Cum. # Adults per Trap</th>
<th>Mean Cum. # Larvae per 100 Fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guthion</td>
<td>0.4</td>
<td>0</td>
</tr>
<tr>
<td>GF-120</td>
<td>0.6</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Tart 2

<table>
<thead>
<tr>
<th>Trt.</th>
<th>Mean Cum. # Adults per Trap</th>
<th>Mean Cum. # Larvae per 100 Fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guthion</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>GF-120</td>
<td>0.2</td>
<td>0</td>
</tr>
</tbody>
</table>

*Very low crop load*

5 reps.; 0.4 to 1.2 acre plots; 16 traps; 2,500 fruits x 3 dates
GF-120 Fruit Protection

- Injury in GF-120 plots in 3 out of 6 field trials, but it was low (0.1-0.8 cum. larvae per 100 fruit)

- Detectable injury occurred when:
  - High WCFF adult pop. (48 & 187 mean cum. adults per trap)
  - Low crop load & mod. adult pop. (4.2 mean cum. adults per trap)

- Sites with <1.4 cum. adults per trap had no detectable injury

- Large enough sources of mature adults caused “small failures” in fruit protection
# Table: Provado On-Farm Trials, 2004

## Tart 1

<table>
<thead>
<tr>
<th>Trt.</th>
<th>Mean Cum. # Adults per Trap</th>
<th>Mean Cum. # Larvae per 100 Fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guthion</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>Provado</td>
<td>0.8</td>
<td>0</td>
</tr>
</tbody>
</table>

## Tart 2

<table>
<thead>
<tr>
<th>Trt.</th>
<th>Mean Cum. # Adults per Trap</th>
<th>Mean Cum. # Larvae per 100 Fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimethoate</td>
<td>4.6</td>
<td>0</td>
</tr>
<tr>
<td>Provado</td>
<td>4.5</td>
<td>0</td>
</tr>
</tbody>
</table>

## Tart 3

<table>
<thead>
<tr>
<th>Trt.</th>
<th>Mean Cum. # Adults per Trap</th>
<th>Mean Cum. # Larvae per 100 Fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guthion</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Imidan</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Provado</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

5 reps.; 0.4 to 2.4 acre plots; 16 traps; 2,500 fruits x 3 dates
Provado Fruit Protection

- Injury in Provado plots in 1 out of 4 field trials (sweet; low crop load; 2.4 cum. larvae per 100 fruit; 3.6 cum. adults per trap)
- No injury in tarts (0-4.8 cum. adults per trap)
- Source of adults:
  - Interior traps
  - Border traps
- Risk of fruit injury when adult pops exceeded 3.6 cum. adults per trap
How do new, reduced risk insecticides kill fruit flies?

**Adults**

**Eggs & Larvae**
Neonicotinoid insecticides are only moderate adulticides

Cumulative # adults per trap

Solid arrows indicate insecticide spray timings; broken arrow indicates cherry harvest date
Spinosad is a good adulticide

GF-120 Bait and Guthion dramatically suppressed WCFF pops. Guthion: 76% flies caught next to Untreated. GF-120 Bait & Guthion suppressed populations post-harvest.
GF-120 Mode of Action

- Bait in GF-120 is a weak attractant, but a strong arrestant.
- 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

- **Systemic** - uptake by fruit kills eggs & small larvae
- **Contact** - weak to moderate adulticide
- Under high populations in Kaysville research orchard - 14 d of fruit protection
How do new insecticides affect mites?

Two spotted spider mites

Mite burn on cherry leaves

Predaceous mite eating spider mite
Spider Mite Population Stimulation with Multiple Applications of Neonicotinoid Insecticides

Provado, Actara, Calypso

2004 Tart Cherry On-Farm Trial

Provado increased spider mite densities vs. Guthion
Pred mites increased in mid July - too late
Take Home Points on New WCFF Insecticides

- New insecticides offer greater flexibility in REIs & PHIs
- GF-120 offers an alternative application method
- Differ in target stage efficacy
  - Provado – larvicide, kill eggs/larvae inside fruit
  - Success / GF-120 – adulticide
- Cannot protect fruit against migrating, mature adults – in Utah, ff sources are within & outside orchards
- Rotate neonicotinoid insecticide applications – mite stimulation
Codling Moth Management

**Critical factors:**

- Reduce population size to manageable level
  - Mating disruption
- Time sprays for peak egg hatch (and peak egg laying) periods
- Use a diverse management program
  - Avoid insecticide resistance
  - Target eggs & hatching larvae
Advantages of Mating Disruption (MD)

- Can reduce populations
- Can reduce fruit damage
- Can save money
- Can reduce worker safety concerns
- Can supplement newer, more selective insecticides
- Can allow biological control agents to increase
- No documented resistance
### CM MD Products

#### Hand-applied

<table>
<thead>
<tr>
<th>Product</th>
<th>Company</th>
<th>Load (mg)</th>
<th>Rate per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isomate C Plus</td>
<td>Pacific Biocontrol</td>
<td>110</td>
<td>400</td>
</tr>
<tr>
<td>Isomate C TT</td>
<td>Pacific Biocontrol</td>
<td>230</td>
<td>200</td>
</tr>
<tr>
<td>No Mate CM</td>
<td>Scentry Biologicals</td>
<td>120</td>
<td>400</td>
</tr>
<tr>
<td>Checkmate CM</td>
<td>Suterra</td>
<td>270</td>
<td>200</td>
</tr>
<tr>
<td>Disrupt CM Extra</td>
<td>Hercon</td>
<td>180</td>
<td>200</td>
</tr>
</tbody>
</table>

#### Aerosol Puffers
- Sprayable
- Checkmate CM-F

![Isomate-C Plus dispenser](image-url)
Supplemental Insecticides: Target Eggs & Larvae

- Larvicides, Ovicides, or Both (Intrepid, Esteem)
- Larvicides
  - Contact (most)
  - Ingestion (biologicals)
- Ovicides
  - Topical (oil, Assail, Calypso)
  - Residual (Esteem)
  - Both (Intrepid, Rimon)

1st instar larva

CM egg with dead larva
CM Integrated Insecticide Program
- Disrupt more than one stage

- **Ovicide: 50-100 DD**
  - Control first ~12% of egg hatch
  - Kill eggs before they hatch, delay larval control

- **Larvicide/Ovicide: 350 DD**
  - Optimizes residues for ~70% of egg hatch (340 – 660 DD)

For 1\(^{st}\) generation:

<table>
<thead>
<tr>
<th>#1</th>
<th>50-100 DD: Rimon, Intrepid or Esteem</th>
</tr>
</thead>
<tbody>
<tr>
<td>350 DD: Assail</td>
<td></td>
</tr>
<tr>
<td>21 d later: Calypso</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>#2</th>
<th>100 DD: Oil or IGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>350 DD: Assail or Calypso</td>
<td></td>
</tr>
<tr>
<td>+ Rimon or Intrepid</td>
<td></td>
</tr>
</tbody>
</table>
New CM Insecticides
Diverse Rotation Program

April
50 DD
Rimon
Intrepid
Esteem
Oil

350 DD
Assail
Calypso

CM egg laying periods

CM egg hatch periods
250 DD

1050 DD
1350 DD
Rimon
Intrepid
Esteem
Oil

Intrepid
CM virus
Bt

Good timing
Target different life stages
Rotate within & between CM generations
Mixtures

From Brunner et al.
Managing Apple Pests without OPs

April September
CM Adult Monitoring

- Lure options:
  - 1X, 10X, DA (pear ester), Combo

- Trap options:
  - Delta (large, orange) – catch fewer bees, more males
  - Wing – not recommended

- Trap position in tree – upper 1/3 canopy
- Trap density – 1 trap per 2-3 acres
- Trap placement – borders & interior
- Thresholds – vary with lure & time of season (2-4 moths)
Long-term, sustainable CM Mgmt. Program

- MD allows population reduction, if needed
- More options & flexibility for insecticide program
- Target both eggs & larvae
- Use only as many sprays as needed to maintain low CM population
- Monitor moths!
IR-4 Project for a New Cherry Miticide - 2006

- Michigan State U., Rutgers U., & Utah State U.
- Acequinocyl (Kanemite 15SC)
- Cherry (Tart & Sweet)
- Two spotted spider mite, European red mite
- 7 d PHI; 2 applications per season
- Suppresses respiration; mitochondrial electron transport inhibitor (METI)
- Registered on pome fruits, strawberries, ornamentals
Guthion Registration Update

- **Group 3 uses – Time limited reg.:**
  - Apple, pear
  - Sweet & tart cherry
  - Walnuts, almonds, pistachios
- **April 3, 2006 – EPA decision on continuation**
- **Group 2 uses – Phase out reg.:**
  - Peach, nectarine
  - Caneberries
- **Group 2 uses terminated in 2005**
Acknowledgements

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- Funding:
  - Utah State Horticultural Association
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  - Bayer CropScience (Ron Brenchley, Dennis Scott)
  - USDA CSREES IPM RAMP Tart Cherry Grant