Western Cherry Fruit Fly Research Update

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Cherry Fruit Fly (CFF)

• Primary source of CFF infestations in managed orchards - immigration of mature females

• Must kill mature females within ~2 hr of exposure to fruit to prevent oviposition (Yee & Alston 2011, J. Pest. Sci.)
  • Adults active in orchards Jun – Jul (hard frost)

• Key management strategies:
  • prevent egg-laying
  • kill eggs & larvae inside fruits with systemics
Three Methods to Time CFF Treatments

1. Fruit maturity
   • Straw-salmon color (fruit soft enough to penetrate)

2. Adult trapping
   • Yellow sticky trap + ammonium carbonate (AC) bait
   • Treat within 5-7 days (190 DD_{41})

3. Degree-day model
   • 1060 DD_{41} ~3% fly emergence, first reproductively mature female
Are Cherries Over-treated for CFF?

• Insecticides are an insurance policy
• Lessons-learned from moth mating disruption:
  • lower pest numbers
  • allow for more flexibility in mgmt.
• Key CFF attractants:
  • visual: color – bright yellow
  • food: sugars, yeasts, proteins
  • ammonium carbonate > ammonium acetate
Key CFF Management Strategies

• Maintain rapid adult mortality (5-7 days)
  • Prevent build-up of reproductively mature females
    • Consistent insecticide coverage; orchard borders are more at risk for immigrating flies

• Ways to achieve this:
  • Insecticides that quickly knock-down adults (e.g., pyrethroid, spinosyn)
  • Systemic insecticides that kill CFF/SWD within fruit (e.g., neonicotinoid, diamide)
  • Constant CFF/SWD population suppression
    • attract-and-kill (attractants + insecticide)
Insecticide Rotations
Activity on CFF Life Stages
Fruit Protection
Timing
CFF Population Management Research Results
Insecticide Rotation Trial - CFF Tart Cherry: 2012 & 2013

- USU research farm, Kaysville
- Plot size: 4 rows × 6 trees (0.12 ac)
- RCB design, 4 reps
- Different insecticide chemistries
  - spinosyns, pyrethroids, carbamates
    - kill adult flies, fast acting, contact & ingestion on fruit surface, fly grooming behavior
  - neonicotinoids & diamides
    - penetrate fruit flesh (systemic), kill eggs & larvae inside fruits, adult ingestion on fruit surface, longer residuals
### Insecticide Rotation Treatments

<table>
<thead>
<tr>
<th>Treatment No.</th>
<th>Jun 4 or 10^</th>
<th>Jun 19 or 22</th>
<th>Jul 2 or 5 (9 or 12-Success)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Delegate 6 oz (Spinosyn, 5*)</td>
<td>Assail 30SG 6 oz (Neonic, 4A)</td>
<td>Sevin 4F 2.5 qt (Carbamate, 1A)</td>
</tr>
<tr>
<td>2</td>
<td>Warrior 3 oz (Pyrethroid, 3A)</td>
<td>Altacor 4 oz (Diamide, 28)</td>
<td>Success 6 oz X 2 app. (Spinosyn, 5)</td>
</tr>
<tr>
<td>3</td>
<td>Admire Pro 2.5 oz (Neonic, 4A)</td>
<td>Warrior 3 oz (Pyrethroid, 3A)</td>
<td>Delegate 6 oz (Spinosyn, 5)</td>
</tr>
<tr>
<td>4</td>
<td>Altacor 4 oz (Diamide, 28)</td>
<td>Assail 30SG 6 oz (Neonic, 4A)</td>
<td>Warrior 3 oz (Pyrethroid, 3A)</td>
</tr>
<tr>
<td>5</td>
<td>Untreated</td>
<td>Untreated</td>
<td>Untreated</td>
</tr>
</tbody>
</table>

^Application dates for 2012 and 2013

*Insecticide resistance action committee (IRAC) classification

PHIs – 3 d: Sevin; 7 d: Admire, Assail, Delegate, Success; 10 d: Altacor; 14 d: Warrior
CFF Adult Pressure: 2012 and 2013

CFF Trap Catch - 2012

- Mean no. CFF adults per trap
- Insecticides
- Fruit samples

CFF Trap Catch - 2013

- Mean no. CFF adults per trap
- Insecticides
- Fruit samples

1. Del-Ass-Sev
2. War-Alt-Suc
3. Adm-War-Del
4. Alt-Ass-War
5. Untrt

Fruit samples
Fruit Infestation

**2012**
- **Mean no. CFF pupae per 100 fruit**
- **Success only**
  - Del-Ass-Car
  - War-Alt-Suc
  - Adm-War-Del
  - Alt-Ass-War
  - Untrt

**2013**
- **Mean no. CFF pupae per 100 fruit**
- **Success only**
  - 1. Del-Ass-Sev
  - 2. War-Alt-Suc
  - 3. Adm-War-Del
  - 4. Alt-Ass-War
  - 5. Untrt Con
Insecticide Rotation Study Conclusions

• High CFF pressure in both years, especially 2012
  • much higher than typical commercial tart cherry orchards
• Systemics applied first (Admire & Altacor) performed best
  • systemics killed early CFF eggs & larvae within fruit
  • Admire-Warrior-Delegate: 0%
  • Altacor-Assail-Warrior: \(<0.25\%
• Pyrethroid or spinosyn applied first: some early infestation
  • Warrior-Altacor-Success: 7% in 2012 & 0.5% in 2013
  • Delegate-Assail-Sevin: 9% in 2012 & 1.5% in 2013
• Under high CFF pressure, killing CFF adults and eggs/larvae within fruit are both important strategies
Food Baits + Insecticide

GF-120 (spinosad + ammonia acetate + sugar) – attract and kill
Corn sugars – Nu Lure, Monterey Insect Bait
Sugar (sucrose)

Sugar Baits can Enhance Insecticides – CFF Kill

• Sugar (sucrose) - stimulate CFF feeding, enhance speed of kill, & reduce oviposition
  • lab studies
    • best: Actara, Provado, Success/GF-120
    • moderate: Assail, Avaunt, Guthion
  • field studies
    • Actara, Success/GF-120
Two Goals:
1) Kill CFF adults quickly with sugar bait sprays
2) Evaluate insecticides also effective for SWD
Insecticide + Sugar Experimental Design
Tart Cherry, Kaysville, UT

2012 and 2013
9 treatments (4 reps; RCBD):

1. untreated control
2. zeta-cypermethrin (4 oz Mustang Max)
3. zeta-cypermethrin + 1% sugar (by wt)
4. lambda-cyhalothrin (2.56 oz Warrior)
5. lambda-cyhalothrin + 1% sugar
6. thiamethoxam (5.5 oz Actara)
7. thiamethoxam + 1% sugar
8. spinetoram (7 oz Delegate)
9. spinetoram + 1% sugar

- label rates & allowable limits not exceeded
- first sprays within 7 days of first fly capture
- pyrethroids applied 3 or 4 times (weekly)
- thiamethoxam applied twice (biweekly)
- spinetoram applied three times (weekly)

High CFF pressure
Low spray volume (100 gpa)
WCFF Trap Catch

2012

Mean no. adults per trap

Insecticides

4 fruit sample dates

2013

Mean no. adults per trap

Insecticides

3 fruit sample dates

Mean of 8 traps placed in bordering, untreated trees in 2012; 4 traps in 2013
## Fruit Infestation: 2012

### Sample Dates Combined

<table>
<thead>
<tr>
<th>Insecticide treatment</th>
<th>Mean no. pupae/100 fruit*</th>
<th>% less than control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untrt control</td>
<td>15.7 a</td>
<td>--</td>
</tr>
<tr>
<td>Zeta-cyper</td>
<td>10.4 ab</td>
<td>33.8%</td>
</tr>
<tr>
<td>Zeta-cyper + sugar</td>
<td>7.5 bcd</td>
<td>52.2%</td>
</tr>
<tr>
<td>Lambda-cyhal</td>
<td>9.7 bc</td>
<td>38.2%</td>
</tr>
<tr>
<td>Lambda-cyh + sugar</td>
<td>9.6 bc</td>
<td>38.8%</td>
</tr>
<tr>
<td>Thiamethoxam</td>
<td>5.8 cd</td>
<td>63.1%</td>
</tr>
<tr>
<td>Thiamethox + sugar</td>
<td>2.4 e</td>
<td>84.7%</td>
</tr>
<tr>
<td>Spinetoram</td>
<td>11.4 ab</td>
<td>27.4%</td>
</tr>
<tr>
<td>Spinetoram + sugar</td>
<td>5.2 de</td>
<td>66.9%</td>
</tr>
</tbody>
</table>

*Data square-root transformed; ANOVA & lsd tests; p<0.0001. Comparisons within insecticides: sugar reduced infestation for thiamethoxam & spinetoram.
## Fruit Infestation: 2013

### Sample Dates Combined

<table>
<thead>
<tr>
<th>Insecticide treatment</th>
<th>Mean no. pupae/100 fruit*</th>
<th>% less than control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untrt control</td>
<td>4.1 a</td>
<td>--</td>
</tr>
<tr>
<td>Zeta-cyper</td>
<td>0.1 b</td>
<td>97.6%</td>
</tr>
<tr>
<td>Zeta-cyper + sugar</td>
<td>0 b</td>
<td>100%</td>
</tr>
<tr>
<td>Lambda-cyhal</td>
<td>0.2 b</td>
<td>95.1%</td>
</tr>
<tr>
<td>Lambda-cyhal + sugar</td>
<td>0.1 b</td>
<td>97.6%</td>
</tr>
<tr>
<td>Thiamethoxam</td>
<td>0 b</td>
<td>100%</td>
</tr>
<tr>
<td>Thiamethox + sugar</td>
<td>0 b</td>
<td>100%</td>
</tr>
<tr>
<td>Spinetoram</td>
<td>0.1 b</td>
<td>97.6%</td>
</tr>
<tr>
<td>Spinetoram + sugar</td>
<td>0 b</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Data square-root transformed; Friedman rank & lsd tests; $p=0.005$.
No differences within insecticide comparisons.
Sugar Bait Trial Conclusions

• 2012: Very high WCFF pressure (early & late)
  • thiamethoxam & spinetoram + 1% sugar reduced fruit infestation the most; thiamethox + sugar was the best (85%)
  • control was poorer with 2 pyrethroids; sugar did not enhance
  • thiamethoxam may have had an advantage from systemic activity in killing eggs & larvae within fruit

• 2013: Lower WCFF pressure (peaked early June)
  • all insecticides + & - sugar were effective
  • only thiamethoxam (+,-), spinetoram (+), & zeta-cypermethrin (+) eliminated infestation (100%)
CFF Killing Station Trial - 2013

Placed KS on border row trees
Target immigrating mature female flies
Treated with GF-120

Commercial tart cherry orchards:
- Insecticide program/CFF pressure low
- No difference in adult fly capture on traps (trees with and without KS)
- Very low fruit damage (no difference)

Research tart cherry orchard:
- No insecticides applied/CFF pressure moderate

Fruit Infestation by Sample Date

![Graph showing fruit infestation by sample date.](image)
Apple Maggot in Utah - 2013

Home Yard Plum Fruits

Quarantine Pest

Apple maggot adult fly on domestic plum fruit, Salt Lake City, 2013

AM larva inside plum fruit

Breakdown of plum flesh from AM feeding
Apple Maggot Life History

Apple Maggot Life History in Utah

- **Monitor with Traps**
- **Adults**
- **Eggs in Fruit**
- **Larvae in Fruit**
- **Pupae in Soil**

Jun    Jul    Aug    Sep    Oct

Native hawthorn shrub: River hawthorn

Broad host range: hawthorn, apple, crabapple, pear, plum, cherry, apricot, wild rose, mountain ash, cotoneaster, firethorn (*Pyracantha*)
New Fact Sheet
www.utahpests.usu.edu

- Educate home gardeners
- Master Gardener Program
- IPM Tree Fruit Advisory
- Online resources
- County Extension Offices
New Project – 2014 & 2015
Tree Fruit Leafroller Study
Species Complex & Biology
Phenology – Degree-Day Model
TRAPs Online Tools for Management
Survey Orchard Insecticide Management Programs

Obliquebanded Leafroller
Looking for Orchards with Leafrollers

Cherry, Apple, Other Fruits
New Project - 2014
Evaluate New Insecticide for CFF & SWD

• **Exirel** (cyantraniliprole; diamide; IRAC group 28; DuPont)
• With and without corn sugar (Monterey Insect Bait) and yeast baits
• USU Farm, Kaysville
• 2014 registration
Pesticide Updates

• **Lannate** (carbamate; DuPont): 2(ee) label
  • allows use of a registered product in a manner for which it isn’t currently registered
  • **Brown Marmorated Stink Bug**
    • UT tree fruit crops: apple & peach
    • 1.5 to 3 pints per acre, ground application only
    • Apple: 14 d PHI, 15 pints per acre/5 apps per season limit
    • Peach: 4 d PHI, 18 pints per acre/6 apps per season limit

• **New bee protection icons on labels**
  • commercially pollinated crops & those attractive to bees
  • Bee Advisory Box on the label
  • on all neonicotinoid insecticide labels for sure
Pesticide Updates

• New insecticide/fungicide for stone fruits:
  • Bexar (tolfenpyrad; Nichino America)
    • METI (IRAC group 21A; energy metabolism); fungicidal activity (FRAC group 29)
    • contact activity, quick knock-down, anti-feedant
    • 2 apps/season; 14-27 oz/acre
  • Target insect pests:
    • western cherry fruit fly, obliquebanded leafroller, spotted wing drosophila (suppressant)
  • Target fungus disease:
    • cherry powdery mildew

• Available in 2014