Spotted Wing Drosophila: A New Pest of Berry Crops

Celeste Welty
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February 2015
• Looks like common vinegar flies on overripe, fallen, decaying fruit

• The new species attacks healthy ripening fruit
Hosts

- **Early:** cherries
- **Mid:** raspberries, blueberries, blackberries
- **Late:** grapes
- strawberry, peach, plum
- cherry tomato, kiwi, pear, apple
Injury

- Egg laying & larval feeding
- Starts as tiny scar on skin of fruit
- Larvae feed inside fruit
- Skin collapses in 2-3 days; molds
Eggs

Egg being deposited by female fly

Egg left on surface of berry

Egg laid below surface of berry
When talking to customers about worms in fruit...

• Say “Larvae”!

• Do not say “Maggots”!
Fruit injury in raspberry

Fruit is susceptible to injury once it has started to turn color.
Fruit injury in blueberry

Photo by R. DeJong, OMAFRA

Photo by Bev Gerdeman, Washington State Univ.
Fruit injury in strawberry
Fruit injury in grape

- Likely >7.5% brix
- Most 17-22 brix
Fruit injury in cherries
Fruit injury in peach
Origin

- From Asia
- In Hawaii since 1980
- Detected in California in 2008
- 2009: Florida, Washington, Oregon
- 2010: Michigan, Carolinas, Utah
Ohio

• First report:
  – Raspberries
  – September 2011
  – VanWert County

• 2012:
  – First catch 7/12/2012
  – Blackberries, raspberries, grapes

• Many reports July-August 2013
  – Also blueberry, peach, HT strawberry
Range in Ohio

• 37 counties positive for SWD in 2013
Ohio: SWD reports

• Most reports
  – Blackberries
  – Raspberries
  – Blueberries

• Some reports
  – Peaches
  – Grapes
Ohio: news

• Bad news
  – Widespread
  – Severe damage

• Good news
  – Under control if insecticide program used
**SWD Life Cycle**

8-16 days per 1 generation

- Adult: Female lays 1-3 eggs/site, ≈350 eggs
- 1st Instar Larva
- Pupate inside or outside of fruit
- 2nd Instar Larva: 5-7d
- 3rd Instar Larvae: 4-15d
Monitoring spotted wing Drosophila

- Critical to determine if this new pest is present on each farm
- Use vinegar bait traps to monitor adult flies
- Use salt test to monitor larvae in fruit
Traps to monitor adult SWD flies

• Make your own trap

• Option 1:
  – Use 1 quart clear deli container
  – Make ¼” holes around 1 side

• Option 2:
  – 24 oz peanut butter jar
  – Make 5 holes @1”, cover with mesh
  – Add red tape
Bait for traps

• Apple cider vinegar (1 inch) + a drop of dish soap

• Alternative: fermenting bait
  ➢ Mix: Yeast (1/4 tsp active dry)
  ➢ Sugar (1/2 tsp)
  ➢ Flour (2 Tbsp)
  ➢ Water (4 tsp)
  ➢ Put in 4-oz cup with mesh cover
  ➢ Float cup on apple cider vinegar in jar trap
Traps: other options

• Add yellow sticky card inside jar
Trap options:
Commercial trap by ConTech

- Great Lakes IPM
  - $9.45 for 2 traps
- Red color adds attraction
- 2 small holes
- Advantages:
  - Ready-made, easy to use
  - Catches fewer non-targets
- Disadvantage: catches significantly fewer SWD than other traps
- Can modify by making more holes
Using traps in fruit crops

• Hang in canopy
• On north side
• Do not dump spent vinegar in field
Bait trap maintenance

• Once per week:
  – Remove trapped insects
  – Replace vinegar

• If heavy rain:
  – Replace vinegar
Supplies

- Strainer
- Funnel
- Jug to hold spent vinegar
- Vial to hold insects
- Small paintbrush
- 75% ethanol or preservative
- Fresh bait
Ready to identify?

• **Threshold:** a single SWD adult

• **Need to separate:**
  – Suspected SWD
  – All others

• **Equipment:**
  – Minimal: 30x magnifying lens
  – Better: Dissecting microscope
What insects are trapped?

Many!

• Spotted wing Drosophila
• Common vinegar flies
  – Same size, shape as SWD
• Other flies, wasps, moths
  – Some obviously not SWD
  – Some same size, shape as SWD
  – Some with spots on wings
i.d. of adult male

• Spots on wings
• Spots can be absent on young (newly emerged) males
• 2 dark bands of combs on front leg
i.d. of adult female

- No spots on wings
- Saw-like ovipositor
  - Large, dark, more obvious

Photo by Eric LaGasa
Trap network 2013 & 2014

• 26 traps in 14 counties

• trap counts on MyTraps website

http://mytraps.com/share/?key=1929238414752663616
Identifiers with microscopes

Curtis Young

Tim Malinich

Rory Lewandowski, Ron Becker, Dave Scurlock

Jim Jasinski

Celeste Welty

Thom Harker, Gary Gao, & Brad Bergefurd
Need to ship specimens to clinic for species confirmation?

• Via personal courier
  – In alcohol is good

• Via US Mail or FedEx, UPS, etc.
  – Do NOT send in alcohol (hazardous!)
  – Use apple cider vinegar instead
Seasonal trends in traps

• In most of Pacific NW:
  – First catch March - May
  – Negligible catch until August
  – Peak in October
  – Higher when cool & wet
  – Lower when hot & dry

• Michigan & Ohio:
  – 1st catch mid-June at few sites
  – 1st catch mid-July at most sites
Number of trapping sites, 2014

Red:  +
Green: -
Spotted wing Drosophila in Ohio: results of trapping, 2014
First detect of SWD adults in traps, 2014

ACV = vinegar
Y = yeast
First detect of SWD adults in traps, 2014: comparison of baits
ACV = vinegar
Y = yeast
Test fruit for SWD larvae with salt test

• Put fruit in zip-top bag
• 4 cups warm water + 1/4 cup salt
• Examine for floaters in 15 minutes
• To find smallest larvae, pour through coffee filter
Salt test: proportions

<table>
<thead>
<tr>
<th>Salt</th>
<th>Warm water</th>
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<tbody>
<tr>
<td>1 Tablespoon</td>
<td>1 cup</td>
</tr>
<tr>
<td>¼ cup</td>
<td>1 quart (4 cups)</td>
</tr>
<tr>
<td>1 cup</td>
<td>1 gallon</td>
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</table>
Salt test
salt test results: fruit lots inspected for SWD larvae at Holmes County produce auction

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Auction lots SWD positive</th>
<th>Auction lots SWD negative</th>
<th>% Positive</th>
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<tbody>
<tr>
<td>mulberry</td>
<td>0</td>
<td>2</td>
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<tr>
<td>elderberry</td>
<td>0</td>
<td>8</td>
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<tr>
<td>plums</td>
<td>0</td>
<td>1</td>
<td>0</td>
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<tr>
<td>garden huckleberry</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>ground cherry</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>grapes</td>
<td>3</td>
<td>32</td>
<td>9</td>
</tr>
<tr>
<td>blackberry</td>
<td>3</td>
<td>8</td>
<td>27</td>
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<tr>
<td>red raspberry</td>
<td>12</td>
<td>14</td>
<td>46</td>
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salt test results, Holmes County, 2014: red raspberries, by week

<table>
<thead>
<tr>
<th>Date</th>
<th>+ (infested)</th>
<th>- (clean)</th>
<th>√</th>
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<tbody>
<tr>
<td>6/25 to 8/5</td>
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</tr>
<tr>
<td>5-Aug</td>
<td>1</td>
<td>0</td>
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</tr>
<tr>
<td>7-Aug</td>
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<td>0</td>
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<tr>
<td>14-Aug</td>
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</tr>
<tr>
<td>19-Aug</td>
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<td>1</td>
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</tr>
<tr>
<td>21-Aug</td>
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</tr>
<tr>
<td>26-Aug</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>28-Aug</td>
<td>4</td>
<td>0</td>
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</tr>
<tr>
<td>2-Sep</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4-Sep</td>
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<td>2</td>
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<tr>
<td>9-Sep</td>
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<td>1</td>
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<td>11-Sep</td>
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<td>16-Sep</td>
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<td>9-Oct</td>
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</tr>
<tr>
<td>sum</td>
<td>12</td>
<td>14</td>
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</table>
Non-chemical management

• Netting
• Prompt harvest as soon as ripe
• Chill fruit as soon as harvested
• Sanitation
  – Strongly recommended!
  – Destroy ALL leftover fruit
  – Do every 2 days
  – Culls in clear plastic bags in sun, 1 week
Non-chemical management

Removal of nearby wild hosts
• Wild blackberry
• Pokeweed
• Bush honeysuckle
• Silky dogwood
• buckthorn
Biocontrol??

• Natives: ~2% parasitism
• Exploration in Korea
  • 4 parasitoid species
  • In quarantine @ Berkeley
Insecticide strategy for SWD control

- Decisions
  - When to start spraying?
  - What product(s) to spray?
  - How often to spray?

- Factors
  - How often crop is harvested
  - Pre-harvest interval
  - How long residue is active
When to start?

- If the adult flies are detected
- Fruit is susceptible to injury once it has started to turn color
<table>
<thead>
<tr>
<th>Efficacy</th>
<th>Group</th>
<th>Product</th>
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<tbody>
<tr>
<td>Most effective</td>
<td>spinosyns</td>
<td>Delegate</td>
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<tr>
<td></td>
<td>diamides</td>
<td>Exirel</td>
</tr>
<tr>
<td></td>
<td>organo-phosphates</td>
<td>Imidan, Diazinon</td>
</tr>
<tr>
<td></td>
<td>pyrethroids</td>
<td>Mustang Max, Brigade, Pounce, Hero, Danitol, Baythroid, Asana, Warrior</td>
</tr>
<tr>
<td></td>
<td>carbamates</td>
<td>Lannate</td>
</tr>
<tr>
<td>Effective</td>
<td>organo-phosphates</td>
<td>Malathion</td>
</tr>
<tr>
<td></td>
<td>spinosyns</td>
<td>Entrust [OMRI]</td>
</tr>
<tr>
<td>Moderately effective</td>
<td>neonicotinoid</td>
<td>Assail</td>
</tr>
<tr>
<td></td>
<td>carbamates</td>
<td>Sevin</td>
</tr>
<tr>
<td>Slightly</td>
<td>pyrethrins</td>
<td>Pyganic [OMRI]</td>
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</tbody>
</table>
Insecticides for SWD for gardeners

• Most effective:
  – pyrethroids:
    • bifenthrin, permethrin, esfenvalerate, gamma-cyhalothrin
• Effective:
  – spinosyns:
    • Captain Jack’s Deadbug Brew (spinosad)
  – organophosphates: malathion
• Moderately effective:
  – carbaryl: Sevin
  – acetamiprid: Ortho Flower Fruit & Veg Insect Killer
# How often to spray?

When residues no longer active

<table>
<thead>
<tr>
<th>Product</th>
<th>Residual activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exirel</td>
<td>5 days</td>
</tr>
<tr>
<td>Delegate</td>
<td>5-7 days</td>
</tr>
<tr>
<td>Imdan, Diazinon</td>
<td>7 days</td>
</tr>
<tr>
<td>Pyrethroids:</td>
<td>7-10 days</td>
</tr>
<tr>
<td>Asana</td>
<td></td>
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<tr>
<td>Brigade</td>
<td></td>
</tr>
<tr>
<td>Danitol</td>
<td></td>
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<tr>
<td>Hero</td>
<td></td>
</tr>
<tr>
<td>Mustang Max</td>
<td></td>
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<tr>
<td>Warrior</td>
<td></td>
</tr>
<tr>
<td>Malathion</td>
<td>5-7 days</td>
</tr>
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<td>Lannate</td>
<td>3-6 days</td>
</tr>
<tr>
<td>Entrust</td>
<td>3-5 days</td>
</tr>
<tr>
<td>Pyganic</td>
<td>1-3 days</td>
</tr>
<tr>
<td><strong>Product</strong></td>
<td><strong>Pre-harvest interval</strong></td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Delegate</td>
<td>1 day</td>
</tr>
<tr>
<td>Mustang Max</td>
<td>1 day</td>
</tr>
<tr>
<td>Malathion</td>
<td>1 day</td>
</tr>
<tr>
<td>Entrust [OMRI]</td>
<td>1 day</td>
</tr>
<tr>
<td>Danitol</td>
<td>3 days</td>
</tr>
<tr>
<td>Brigade</td>
<td>3 days</td>
</tr>
<tr>
<td>Hero</td>
<td>3 days</td>
</tr>
<tr>
<td>Pyganic [OMRI]</td>
<td>0 days</td>
</tr>
</tbody>
</table>
News: sucrose adjuvant to increase efficacy

- Add sucrose (sugar)
- 1.2 gram/liter
- Assume 50 gal water/acre
- = 1 pound/acre
- With Entrust: reduced larval infestation >50% vs no sugar
Summary: Management of SWD on organic brambles

1. Use **bait traps**, check weekly
2. If any SWD in traps, start spray program when berries start to color
   - Spray **every 5 days** until final harvest
   - Alternate:
     • Entrust (1-day PHI) + sugar
     • Pyganic (0-day PHI) + sugar
3. Do a **salt test** with ripe fruit, weekly, to see if program effective
4. Increase to **3-day** schedule if need
<table>
<thead>
<tr>
<th>Efficacy</th>
<th>Mode of action group</th>
<th>Product</th>
<th>Residual activity (days)</th>
<th>Pre-harvest interval (PHI)</th>
<th>raspberry</th>
<th>blueberry</th>
<th>strawberry</th>
<th>grape</th>
<th>cherry</th>
<th>peach</th>
<th>plum</th>
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<td></td>
<td>5</td>
<td>Radiant</td>
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<tr>
<td></td>
<td>5</td>
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<td>7 days</td>
<td>X</td>
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<td>X</td>
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<td>Moderately effective</td>
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<td>X</td>
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<tr>
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<td>Assail</td>
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<td>1 day</td>
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<td>7 days</td>
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<td>Slightly eff.</td>
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<td>Pyganic (OMRI)</td>
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<td>0 days</td>
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<td>0 days</td>
<td>0 days</td>
<td>7 days</td>
<td>0 days</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

1 Restricted-Use Pesticide
§ Not allowed in greenhouses or high tunnels
x means that the product is NOT ALLOWED for use on that crop.
<table>
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1 Restricted-Use Pesticide
§§ Not allowed in greenhouses or high tunnels
X means that the product is NOT ALLOWED for use on that crop.
Insecticides for high tunnels?

For products used for SWD control:
• **Label allows** in greenhouses:
  – Malathion
• **Label prohibits** in greenhouses:
  – Delegate
  – Diazinon
• **Label ‘silent’** on greenhouses therefore ok to use:
  – pyrethroids: Asana, Baythroid, Brigade, Danitol, Hero, Mustang, Pounce, Warrior
  – Lannate
  – Imidan
  – Entrust
Observations on farms: 2013

**Figure 4.** Average SWD adult trap captures and larvae found in raspberries, blackberries and blueberries after **Entrust** and **Pyganic** treatments at a monitoring site in southwest Ohio.
Figure 3. Density of SWD in weekly samples and timing of insecticide sprays on multiple crops in Greene County. Black arrows represent Evergreen EC60 (6 oz/A) applied July 10, 15, 19, 22, and 28 on raspberry; orange arrows represent Entrust (3 oz/A) applied August 4, 9, and 18 on raspberry and blackberry. The last black arrow is Evergreen EC60 (3 oz/A) applied on raspberry and blackberry on August 24.
Additional info on SWD

On website: bugs.osu.edu/welty/

• 2-page color info sheet
  – Includes insecticides for commercial farms
• Instructions for trapping
• Instructions for salt tests
• Insecticide list for home gardens
• Slide show
Info on fruit & veg. pests
bugs.osu.edu/welty/

Questions?

e-mail: welty.1@osu.edu
office phone: 614 292 2803

cell phone: 614 746 2429