We have been invaded by SWD

Damage reported in:

- Blackberry
- Raspberry
- Elderberry
- Strawberry
- Blueberry
- Peach
- Cherry

As of Oct. 31, 2013

Map made by Michael Tarka, Lincoln University
Spotted Wing Drosophila
(a vinegar fruit fly)
How to Identify SWD

Flies with no dots on wings could be:

- SWD females
- Native Drosophila species

Need to detect presence of ovipositor

Serrated egg-laying structure (ovipositor)
Life Cycle of the Spotted Wing Drosophila

*Drosophila suzukii* (Matsumura)

- **Eggs**: 12-72 hours, 350+ eggs in a lifetime
- **Three Larval Instars**: 5-7 days
- **Pupation**: 4-15 days
  - *Inside or outside of fruit*
- **Adults**: 20-30 days

Source: Washington State Univ.
1 female = 300 eggs
150 females = 45,000 eggs
22,500 females = almost 7 million eggs
Host Plants

**Tree fruits, small fruits, some vegetable fruits** such as tomatoes

**Highest risk crops** = Raspberries, blackberries, blueberries, cherries, strawberries, nectarines

**Lower risk crops** = Grapes, pears, peaches

**CROPS ARE MORE SUSCEPTIBLE WHEN:**

- Softer fruit (skin)
- Later season
Significance

• Unlike other fruit flies, SWD attacks sound ripening fruit, also attacks some vegetables
• Once eggs laid in fruit, no longer able to control with pesticides
• Short lifecycle and overlapping generations make spray timing difficult
• Requires sprays near harvest time
• Requires multiple sprays which can lead to pesticide resistance
Significance

Cherry Damage

Oviposition marks

Feeding damage and exit hole
What does it look like when SWD lay eggs on fruit?

A small hole and breathing tubes appear where eggs are laid.

Courtesy of ARS Corvallis
Significance

What does damage look like 3-4 days after SWD lays egg on fruit?

- **Blueberries**: start to show visible damage specific to SWD ~3 days following infestation. Larval holes allow fruit juice to escape berry and soft areas become pronounced.

- **Raspberries**: show damage quickly. The skin wrinkles and fruit becomes juicy. Scarring and collapse of berry may occur as soon as 1-2 days following infestation.

- **Strawberries**: deteriorate quickly. The skin wrinkles and fruit softens; mold may appear ~3 days after infestation.

(Observations made with fruit kept at room temperature.)

Courtesy of ARS Corvallis
Significance

...after 5 days?

Soft areas collapse due to larval feeding

Dark scarring apparent

Increased mold and juice

Courtesy of ARS Corvallis
Risk posed to vegetables

- Cherry and grape tomatoes, which tend to have more unharvested, overmature fruit represent higher risk

- Heirlooms, which are often marketed with cracks, are also higher risk than tomatoes with intact skin

- Any tomato with cracks is at higher risk for SWD
Cultural Management
Canopy management

• For brambles, thin the plant row to 3-4 strong canes per square foot, eliminating weaker shoots and **opening the canopy**
• Consider a trellising system that similarly **opens the canopy**
• This may make plantings less attractive to SWD and will improve insecticide spray coverage
Sanitation

- Removing over-ripe fruit from production areas can minimize SWD egg laying and larval development
- Growers in other regions of the country have sent pickers through fields with one container to collect good fruit and another container to collect over-ripe fruit
- In the case of strawberries, sanitation also helps reduce incidence of fungal diseases such as Rhizopus rot and Botrytis grey mold
- Place bad fruit in plastic bags and seal before disposal.
- Cooling fruit assists in slowing SWD development, so place in refrigerator after harvesting.
- Freezing kills the SWD.
Management Options for SWD in Tomatoes

- If possible, locate tomatoes away from soft fruits such as blueberries or brambles

- Harvest tomatoes thoroughly and remove all ripe fruit regularly

- Manage irrigation water to reduce cracks

- Consider high tunnels / greenhouses to increase fruit quality

- If the market allows, shift to thicker skinned, less crack prone varieties
Monitoring

- Simply determine SWD presence or absence
- Helps time insecticide sprays (if needed)
- Confirm efficacy of control measures
How to make a trap to monitor for SWD

14 gauge solid core wire

Melt 3/16” diameter holes in side of cup using a soldering iron

1 quart deli-type container

Yellow sticky card cut down to fit diameter of container

Yeast bait recipe:
½ tablespoon active dry yeast
2 tablespoons sugar
6 oz. water
Monitoring for SWD

- Minimum of 3 traps per farm
- Best efficiency at 1 trap/5 acres
- Locate traps at high risk sites
  - Problem areas last year
  - Near woods, in shaded area, next to wild host plants
- Deploy before fruit ripening.
- Check for SWD weekly and change weekly.
- Look for females on sticky cards under a microscope.
- Once SWD are found in a trap, assume all fruit is vulnerable.
- As soon as fruit is ripe start monitoring for larvae using salt (sale of fresh fruit) or boil test (sale for processing fruit).
How to monitor for SWD

- Check trap and replace bait at least weekly (more often is better)
- Do NOT dump old bait in the field
- As fruit ripens, visually scout areas with ripe and overripe fruit for adults

- Additional native host plants in Missouri are: mulberries, pokeweed, autumn olive, crabapple, nightshade, Amur honeysuckle and wild fruits of grapes, blackberries, etc.
In Field Sampling

Gather harvestable berries (1#) into ziplock bag

Pour salt solution (1C/gallon) over berries

Wait 20 minutes and count SWD larvae.
Effective Insecticides

- Based on presence/absence of SWD in monitoring traps
Applying sprays without knowing whether SWD is present is not recommended, as many beneficial predatory insects and pollinators may be killed.
Insecticidal options

## Insecticidal options

### Strawberry

<table>
<thead>
<tr>
<th>Drosophila (also known as fruit flies and vinegar flies), including spotted wing Drosophila</th>
<th>Brigade WSB (10WP)</th>
<th>5.3-16 oz</th>
<th>Danitol 2.4EC</th>
<th>10.7-21.3 fl oz</th>
<th>Entrust 80WP</th>
<th>1.25-2 oz</th>
<th>Malathion 8F</th>
<th>2.5 pt</th>
<th>Radiant 1SC</th>
<th>6-10 fl. oz</th>
</tr>
</thead>
</table>

See Special Insect Pest Problems on page 63.

### Raspberry & Blackberry

<table>
<thead>
<tr>
<th>Drosophila (also known as fruit flies and vinegar flies), including spotted wing Drosophila</th>
<th>Brigade WSB (10WP)</th>
<th>5.3-16 oz</th>
<th>Danitol 2.4EC</th>
<th>10.7-16 fl oz</th>
<th>Delegate 25WG</th>
<th>3-6 oz</th>
<th>Entrust 2SC</th>
<th>4-6 fl oz</th>
<th>Entrust 80WP</th>
<th>1.25-2 oz</th>
<th>Malathion 8F</th>
<th>2.5 pt</th>
<th>Mustang Max 0.8EC</th>
<th>4.0 fl. oz</th>
</tr>
</thead>
</table>

See Special Insect Pest Problems on page 63.

Treatment options continued on next page.
### ACTIVE INGREDIENTS:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azadirachtin</td>
<td>1.20%</td>
</tr>
<tr>
<td>Pyrethrins, a botanical insecticide</td>
<td>1.40%</td>
</tr>
<tr>
<td>OTHER INGREDIENTS</td>
<td>97.40%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.00%</strong></td>
</tr>
</tbody>
</table>

Contains: 0.10 lb of azadirachtin and 0.11 lb of pyrethrins per gallon.

- Quick knock-down and kill
- Kills listed pests on contact or by ingestion
- Contains Pyrethrins, a botanical insecticide derived from chrysanthemums
- Kills a broad spectrum of listed insects including aphids, whiteflies, leafminers and caterpillars
- Kills larval, pupae and adult stages of listed insects
## To Kill the Following Listed Insects:

### Aphids Including:
- Bagworms
- Beet Armyworms
- Black Cutworms
- Budworms
- Cabbage Loopers
- Cankerworms
- Carpenterworms
- Citrus Cankerworms
- Corn Earworms
- Cross-striped Cabbageworms
- Cutworms
- Diamondback Moths
- Eastern Tent Caterpillars
- Fall Armyworms
- Fall Cankerworms
- Fall Webworms
- Filbert Worms
- Filbert Plume Moths
- Fireworms
- Forest Tent Caterpillars
- Garden Webworms
- Grapefruit Moths
- Grape Leaf Skeletonizers
- Green Leaf Moths
- Hickory Shockworms
- Homeworms
- Imported Cabbageworms
- Lawn Armyworms
- Lesser Webworm Looper
- Melonworms
- Navel Orangeworms
- Oriental Fruit Moths
- Pecan Nut Case Bearer
- Rindworms
- Sod Webworms
- Southern Armyworms
- Soybean Loopers
- Saltmarsh Caterpillars
- Tent Caterpillars
- Tobacco Budworms
- Tomato Hornworms
- Tomato Fruitworms
- Tomato Pinworms
- Yellow-striped Armyworms
- Walnut Caterpillars
- Wespores
- Western Yellow-striped Armyworms
- Western Grapeleaf skeletonizers
- **Beetles and Weevils Including:**
  - Altaifa Weevils
  - Asparagus Beetles
  - Bean Beetles
  - Bean Leaf Beetles
  - Black Vine Weevils
  - Blister Beetles
  - Boll Weevils
  - Carrot Weevils
  - Chestnut Weevils
  - Clover Weevil
  - Colorado Potato Beetle
  - 12-Spotted Cucumber Beetle
  - Cucumber Beetles
  - Darkling Beetles (jisser meal worms)
  - Egyptian Altaifa Weevils
  - Elm Leaf Beetles
  - Flea Beetles
  - Fuller Rose Beetles
  - Grape Bud Beetles
  - Japanese Beetles
  - June Beetles
  - Mexican Bean Beetles
  - Navel Orangeworms (NOW)
  - Pecan Weevils
  - Pink Bollworms
  - Potato Flea Beetles
  - Rice Weevils
  - Rose Chafer
  - Saw-Toothed Grain Beetles
  - Strawberry Beetles
  - Twg Girders
  - All other beetles and weevils
- **Leafrollers:**
  - Blueberry Leaf Rollers
  - Filbert Leaf Rollers
  - Fruit Tree Leaf Rollers
  - Grape Leaf Rollers
  - Oblique Banded Leaf Rollers
  - Omphalosoma Leaf Rollers
  - Orange Tortrix
  - Western Avocado Leaf Rollers
  - Variegated Leaf Rollers
- **Leaffoppers & Sharpshooters:**
  - Aster Leaffoppers
  - Beettle Leaffoppers
  - Glassy-winged Sharpshooters
  - Grape Leaffoppers
  - Potato Leaffoppers
  - Western Boxelder Bugs
- **Borers such as:**
  - European Corn Borer
  - Pacific Flatheaded Borers
  - Peach Tree Borer
  - Peach Twig Borers
  - Squash Vine Borers
  - Shothole Borers
  - Branch and Twig Borers
- **Flies:**
  - Australian Sod Flies
  - Caribbean Fruit Flies
  - Crane Flies
  - Fruit Flies
  - Fungus Gnats
  - Hasselin Flies
  - Mediterranean Fruit Flies
  - Melon Flies
  - Mushroom Flies
  - Oriental Fruit Flies
  - Olive Fruit Flies
  - Sawflies
  - Shore Flies
  - VINEGAR FLIES
  - Walnut Husk Flies

### Moths:
- **Leaffoppers & Sharpshooters:**
  - Artichoke Plume Moths
  - Codling Moths
  - Diamondback Moths
  - European Pine Tip Moths
  - Grape Berry Moths
  - Gypsy Moths (adult & larvae)
  - Indian Meal Moths
  - Mediterranean Flour Moths
  - Pine Tip Moths
  - Tussock Moths

### Midges (plant pests):
- Millipedes
- Onion Maggots
- Proba Bugs
- Scale Insects
- Silverfish
- Skippers
- Soft Scales
- Spider Mites
- Squash Bugs
- Spiders (except Black Widow and Brown Recluse Spiders)
- Springtails

### Whiteflies:
- Greenhouse Whiteflies
- Silverleaf Whiteflies
- Sweetpotato Whiteflies

### Other:
- Ants (except Pharaoh, Harvester, Carpenter and Fire Ants)
- Apple Maggots
- Bilbug
- Brown Marmorated Stinkbug
- Cabbage Maggots
- Clover Mites
- Cutworms
- Crickets
- Dichondra Flea Beetles
- Earwigs
- Firebrats
- False Cichlid Bugs
- Garden Symphytum
- Garden Tortrix
- Glassy-winged Sharpshooters
- Grasshoppers
- Hairpin Bugs
- Grape Phylloxera
- Katydidks
- Leaf-footed Plant Bug
- Lace Bugs
- Leaf Hoppers
- Leaf Lice
- Lice
- Lygus
- Lace bug
- Mealybugs (all)
- **Psyllids:**
  - Pear Psylla
  - Thrip:
    - Avocado thrips
    - Citrus Thrips
    - Flower Thrips
    - Greenhouse Thrips
    - Thrips Palmi
    - Northern Masked Chafers
    - Southern Masked Chafers
    - Western Flower Thrips
    - Western Flower Thrips
<table>
<thead>
<tr>
<th>Useful resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Michigan State University</strong></td>
</tr>
<tr>
<td><a href="http://www.ipm.msu.edu/invasive_species/spotted_wing_drosophila">http://www.ipm.msu.edu/invasive_species/spotted_wing_drosophila</a></td>
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<tr>
<td><strong>Oregon State University</strong></td>
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<td><a href="http://spottedwing.org">http://spottedwing.org</a></td>
</tr>
<tr>
<td><strong>Cornell University</strong></td>
</tr>
<tr>
<td><a href="http://www.fruit.cornell.edu/spottedwing/">http://www.fruit.cornell.edu/spottedwing/</a></td>
</tr>
<tr>
<td><strong>PennState University</strong></td>
</tr>
<tr>
<td><a href="http://extension.psu.edu/plants/vegetable-fruit">http://extension.psu.edu/plants/vegetable-fruit</a></td>
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</table>
The Spotted Wing Drosophila (SWD) is a very serious new invasive pest. It attacks small fruit crops and some stone fruits (cherries, nectarines, peaches). It also attacks high tunnel tomatoes and melons including watermelon, cantaloupe, honeydew, and cantaloupe. The pest was first reported in the U.S. in 2008. SWD flies look similar to the small vinegar flies that are typically found around or on fermenting fruits and vegetables. Moreover, unlike those native vinegar flies, SWD females have a second egg laying device called an ovipositor, which is used to inject the eggs directly into the skin of intact fruit to lay their eggs. This makes SWD a more serious pest than the other vinegar flies, and the eggs can be found in the summer when the fruit population increases, further increasing the risk.

This article discusses IPM options to minimize larval infestations by SWD in high tunnel spinach. It is very important that farmers also learn how to identify and monitor for SWD, and how to detect and control larval infestations. An identification and monitoring guide is available at: http://www.ipmcenters.org/sites/default/files/ITD_2013 Finals spin IPM guide.pdf. Because SWD can have two generations a year, and because some SWD control methods will require planning and implementation of programs that incorporate multiple components.

**Female Spotted Wing Drosophila**

**Exclusion:** In high tunnels, screening might protect individual plants or crops. In Japan, extremely fine mesh with openings less than 0.06 mm (0.0025 inch) wide is used to protect blueberries. If screening is used, proper venting can be problematic, thus some means of increasing air flow will be required. Ventilation at the roof and sides, or venting at the sides, will be required. Each season will also require additional ventilating boxes, and pest control procedures will be needed if the crop is in bloom. Exclusion in high tunnels and netting over a long period of time, especially with the presence of a high tunnel, is reasonable to be practiced to ensure the crop is not damaged by introducing insects into the tunnel. One option would be to use successfully screens with sticky traps affixed to stakes within the high tunnel, allowing for attachment at face and neck and during early development. If SWD are found, trapping inside the high tunnel, an insecticide application might provide SWD suppression for the rest of the season if evisceration is implemented.

**Use of effective insecticides that are well timed and have good coverage can control SWD through harvest. However, there is a potential for rapid population increase by SWD, especially during fall red raspberry season. Therefore, active monitoring, by monitoring flies and fruit infestations, is critical.** Always follow the specific label instructions for registered use on high tunnel crops. The level of control achieved will depend on the SWD population, timing of application, coverage of fruit, and product effectiveness. Monitoring for Spotted Wing Drosophila

A recommendation for use on high tunnel crops is that the level of control achieved will depend on the SWD population, timing of application, coverage of fruit, and product effectiveness.
Sticky Cards

Great Lakes IPM (VESTABURG MI)
989-268-5693
989-268-5911
800-235-0285
glipm@greatlakesipm.com
www.greatlakesipm.com

Yellow sticky cards (3” x 5”), code: 010-MS-35, 1000 Case for $ 253.45
http://www.greatlakesipm.com/stickystrips.html

Gempler’s (Janesville WI)
800-382-8473
customerservice@gemplers.com
www.gemplers.com

Olson Yellow Sticky Traps – 3”x5” (package of 25)
1-9 for $10.25
10+ for $9.20
What’s Next?

Brown Marmorated Stink Bug
Monitoring Update

- **LU**
  - [http://www.LU-IPM.net](http://www.LU-IPM.net)

- **MU**
  - [http://ipm.Missouri.edu](http://ipm.Missouri.edu)
  - [http://ipm.Missouri.edu/pestmonitoring/subscribe.htm](http://ipm.Missouri.edu/pestmonitoring/subscribe.htm)
Questions?