Spotted Wing Drosophila

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WHAT YOU SHOULD KNOW

- Spotted Wing Drosophila (SWD) is a new Utah pest (first found August, 2010) that can infest un-ripened (pre-harvest), ripe, over-ripe, and spoiled fruits.
- SWD attacks a broad range of fruits, including tree fruits, berry fruits, and vegetable fruits.
- SWD can be easily controlled using standard insecticides, and by expanding the spray program to pre- and post-ripe fruit stages.
- Suspect SWD flies should be sent to the Utah Plant Pest Diagnostic Lab (UPPDL) for identification.

BACKGROUND

Spotted Wing Drosophila (SWD) (Drosophila suzukii) is a new fruit pest recently discovered in Davis County, Utah (August, 2010). Because this pest is widespread in the western and southeastern United States, it is considered “non-actionable,” meaning no import or export restrictions, or quarantines will be implemented. SWD is similar to other vinegar flies (genus Drosophila), except they can infest unripe fruit. SWD can be easily controlled using insecticides common in fruit integrated pest management plans. If SWD is caught in monitoring traps, insecticide applications must be used during the unripe fruit stage to prevent damage.

This fact sheet describes SWD biology and current monitoring and control strategies for growers and homeowners. Any suspect SWD should be sent to the UPPDL for identification. Many flies have spots on their wings. Small flies with only 1 spot per wing (Fig. 1) should be considered suspect.

BIOLOGY

Scientific Name: Drosophila suzukii (Drosophilidae)

Range in U.S.: Davis County, Utah; California; Oregon; Washington, Florida, Louisiana, North Carolina, and South Carolina.

Hosts: Detected in a raspberry and blackberry field in Kaysville, Utah (trap survey). Hosts include: tree fruits (apple, apricot, cherry, mulberry, nectarine, peach, persimmons, plum, pluot); small fruits (blackberry, blueberry, grapes, raspberry, strawberry); vegetable fruits (melons, tomato). Any soft-skinned fruit may be susceptible to SWD.

Damaging Stage: Larvae and adults. Larvae feed inside fruit causing abscesses; secondary fungal and pest infection may occur. Adults cause superficial scarring by sawing into fruit to lay eggs.

Overwintering Stage: Unknown if SWD will survive winter in northern Utah; survival in southern Utah is likely. Adults and pupae may overwinter.

Egg: Small, white, inserted into fruit. Two thin filaments used for breathing are visible protruding out of fruit. Over 350 eggs may be laid by a single female (Fig. 2).

Immature: Small (0.067-3.5mm or 0.003-.01in) cream-colored maggot with black mouthparts (Fig. 3).

Adult: Typical vinegar fly appearance: 2-3 mm (0.1 in) long, red eyes, pale brown body, featherlike antennae. Males have one circular black spot per wing (Fig. 1); females have no spots on wings and a sawlike ovipositor (Fig. 2). They are most active at 68°F; egg laying decreases above 86°F.

Pupae: Small (2-3 mm or 0.1 in) brown, cylindrical capsules with two extensions on one end (Fig. 4). Found in fruit or just below leaf litter in soil.

Generations per year: Unknown for Utah. Three to eight gen/yr have been observed in Oregon, and 10-13 gen/yr in California.
Seasonal Emergence: Unknown for Utah. Washington State University estimates SWD emergence between late May and early June (514 degree days °F, base temp. 48°F).

Important Behaviors: Can lay eggs in unripe, ripe, overripe, shriveled, or spoiled fruit. Adults prefer to feed on damaged or fermenting fruit.

MONITORING METHODS

Control is not recommended unless SWD is caught in monitoring traps, fruit injury is detected, or a high-value crop needs protecting. The following traps can be used for monitoring:

Clear Cup Trap: For homeowners or low-budget growers, simple traps can be made from a 16 to 32 oz clear plastic cup and lid, hanger, bait solution, twist-tie or paper clip, and a yellow sticky card.

- On one side of the cup, drill four to six, 3/16" holes in the upper portion of the cup.
- Drill two holes on opposite sides of the cup to put hanger through (to hang trap).
- Put yellow sticky card in cup by attaching to a twist-tie put through two small holes in the top of the lid. Optional, but may make monitoring easier.

- Prepare bait and add to cup: mix 0.25 oz yeast (one package) + 4 teaspoons sugar + 12 fl oz water, or 2-3" of apple cider vinegar as a substitute for the yeast mixture.
- Add 1 to 2 drops of dish soap (optional, but will improve fly capture).
- Attach lid.
- Hang traps at fruit level. In low-growing fruits such as strawberries, sink traps 2-3" in the ground.

Commercially Available Traps: Easy-to-use commercial traps are available from Contech (Fruit Fly Trap) for about $10 for a two-pack (Fig. 6). McPhail traps from ISCA Tech. are more complex to use and cost about $14 per trap (available in bulk order rates at $11 each). There are many other similar traps on the market that work on the same principles. Homemade and commercial traps are equally effective at catching SWD. See “Trap Sources” at end of publication for contact information.

Liquid Baits: The two best bait solutions to use in traps are apple cider vinegar, or a sugar-water-yeast solution. The yeast solution is likely a better attractant when SWD populations are low. If you are trapping to detect the presence of SWD, you may want to use the yeast solution. The downside of the yeast solution is that it needs to be changed at least every 2 weeks, is messy, and has a bad odor. Once a SWD population is confirmed, you can switch to the vinegar solution for monitoring. All liquid baits should be changed weekly for optimal performance.
**CHEMICAL CONTROL**

A SWD control program starts with monitoring. If SWD is detected, chemical control is necessary to preserve the marketability of fruit. For commercial growers, some chemicals already used in your IPM program for similar pests should give effective control of SWD. To protect fruit, an additional insecticide application will be needed at the pre-ripe (straw color) stage, with additional applications as per the label directions through harvest, and post-harvest if a high volume of fruit remains on trees or plants.

Select insecticide products based on the fruit type you want to protect. Products that are effective against tephritid fruit flies will be effective against SWD. Products for commercial and homeowner (\(\^{+}\) use, including organically certified (\(\circ\)) products, listed in Table 1, have shown good to excellent control of SWD in preliminary tests. Do not apply insecticides while pollinators are active.

**Table 1. Insecticides for SWD control.** Products are not complete listings of all available options. \(\^{+}\)Signifies that the product is registered for homeowner use, \(\circ\) signifies an organically compatible insecticide. Not all products are labeled on all fruits; read label to ensure that your product matches the site. Alternate the MoA (mode of action) of the product you choose on a yearly basis to minimize resistance build-up.

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Active Ingredient</th>
<th>MoA</th>
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<tbody>
<tr>
<td>Asana</td>
<td>esfenvalerate</td>
<td>3A</td>
</tr>
<tr>
<td>Assail(^{1})</td>
<td>acetamiprid</td>
<td>4A</td>
</tr>
<tr>
<td>Baythroid(^{1})</td>
<td>beta-cyfluthrin</td>
<td>3A</td>
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<td>Delegate(^{1})</td>
<td>spinetoram</td>
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<tr>
<td>Diazinon</td>
<td>diazinon</td>
<td>1B</td>
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<tr>
<td>Dimethoate</td>
<td>dimethoate</td>
<td>1B</td>
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<tr>
<td>Entrust(^{\circ})</td>
<td>spinosad</td>
<td>5</td>
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<tr>
<td>Guthion</td>
<td>azinphos-methyl</td>
<td>1B</td>
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<tr>
<td>Malathion(^{1})</td>
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<tr>
<td>Pounce</td>
<td>permethrin</td>
<td>3A</td>
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<tr>
<td>Proaxis</td>
<td>gamma-cyhalothrin</td>
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<tr>
<td>Provado(^{1})</td>
<td>imidacloprid</td>
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<tr>
<td>Pyganic(^{\circ})</td>
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<tr>
<td>Warrior</td>
<td>lambda-cyhalothrin</td>
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**USEFUL SWD REFERENCES**


Google page on SWD: http://sites.google.com/site/spottedwingastrophi/a


Oregon Department of Agriculture: http://www.oregon.gov/ODA/PLANT/IPPM/

Oregon State University: http://swd.hort.oregonstate.edu/

University of California: http://www.ipm.ucdavis.edu/EXOTIC/drosophila.html

University of California SWD blog: http://ucanr.org/blogs/strawberries_caneberries/

Washington State University: http://jenny.tfrec.wsu.edu/opm/displaySpecies.php?pn=165

**TRAP SOURCES**

Contech Enterprises Inc.
Unit 115 - 19 Dallas Road
Victoria, BC V8V 5A6
Canada
tel: 1-800-767-8658
fax: 1-800-876-1666
e-mail: na
website: www.contech-inc.com/

ISCA Technologies Inc.
P.O. Box 5266
Riveride, CA 92517

United States of America
tel: (951) 686-5008
fax: (815) 346-1722
e-mail: info@iscatech.com
website: www.iscatech.com

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Males: a part of the hatched SWD in Oct. and Nov. overwintered.

Females: most of the ones hatched SWD from late Sept. to mid Nov. overwintered. From May to Aug adults died before the end of the year after oviposition and their lifespan was between 21-66 days. Adults emerged after Sept overwintered. Many survived until June next year. The longest living fly was 301 days and latest death of imago was Jul 18. Eggs laid per day was between 1-60, and averaged 7-16. Oviposition was most active between 2-4th generations.

Egg stage 21 hrs to 3 days in May-June. Larva stage 3 days and 4 hrs to 12 days and 23 hrs. Number of moltings: 2 (so 3 instars). Pupal stage 3 days and 2 hrs to 15 days 1 hr. Average of 3rd and 5th generations was 4 days 15 hrs.

Length of stages at 15C:
Hatch-emergence: 21D7HR - 25D1HR. AVG: 22D17HR
Egg: 1D19HR - 1D22HR
Larvae: 9D7HR - 12D23HR
1st Instar: 1D23HR - 3D22HR (length 0.067mm)
2nd Instar: 2D - 3D23HR
3rd Instar: 4D9HR - 6D22HR

Length of stages at 25C:
Hatch-Emergence: 8D20HR - 10D22HR. AVG: 9D15HR
Egg: 3HR - 1D1HR
Larvae: 3D14HR - 5D5HR
1st Instar: 1D2HR - 1D4HR
2nd Instar: 18HR - 1D5HR
3rd Instar: 1D15HR - 2D21HR
Pupae: 9D9HR - 10D10HR

Overwintering stage: Imago
Sex Ratio: Slightly in favor of females in both captivity and in the field.
Emergence: begin April, peak in June and July (cherry season) and again in Sept (grape season).

SWD become mobile at 5C, and at 10C become active. Most active between 20-25C and slow down over 30C. Females can mate multiple times.

Oviposition begins when avg temps are above 10C. In autumn oviposition continued until avg temps were 5.5C. Eggs laid in fruit in hole cut by ovipositor; egg stalks hang out of holes. On Cherry the upper fruit or near the stem is preferred oviposition site. 1 to many eggs may be laid on a single fruit depending on available fruit. On tough-skinned fruits eggs can be laid on the outside skin, adhered by a glue-like excretion from the female. On Cherry oviposition takes 2-15min/egg (avg) on unripe fruit. Eggs can be laid on unripe fruit, but slightly ripe and fully ripe are preferred. Less ripe fruit, less oviposition. SWD prefers cherries 2-3 days before harvest. Oviposition is low on damaged fruit and almost non on spoiled fruit.

Imago feeds on damaged fruits, and likes to congregate on spoiled or fermented fruit on the ground or to fermented beverages utilizing fruits and melons that are spoiled or fermented. Also feed on saps from wounded (oak) trees.

overwintering: **when avg min temps reach 5C in fall flies like to hide under tree bark before dispersing to an unknown place (leaf litter, rocks) for the winter. IS THIS A POSSIBLE TREATMENT TIME??**

Larvae: .067mm long at hatch. Milky white with black mouthparts.

Emergence: Larvae will develop 100% at harvest, fully ripen and overripe stages. 90% at 2 days preharvest and shriveled, 50% for the unripe, acid and hard flesh fruit (colored but not ripe), and 10% for spoiled fruit.

Pupae: yellowish brown and hard. Pupation in the fruit is the norm, while some go into the soil, about 4mm from the surface.

Hosts: Cherries, raspberry, blackberry, strawberry, grapes, mulberries, apples, peaches, plums, persimmons, apricots, melon, tomato, watermelon. Favorites are Cherry, flowering cherries, wild rubus and grapes.

Control: Cold storage for 96 hours (1.7-2.2C) eliminated all potential damage.