



## 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.



Fig. 1. Adult male spotted wing drosophila (*Drosophila suzukii*). Photo by G. Arakelian.

### 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.



Figs. 2, 3, and 4. Left to right: Spotted wing drosophila (SWD) serrated ovipositor and egg (photo insert by Steve Valley); SWD larva; SWD pupa. Photos by E. Beers.

**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.



Fig. 5. Homemade SWD cup trap. Flies attracted to the bait enter through the holes and land on the yellow sticky card or in the bait solution. Photos by BC Ministry of Agriculture and Lands.

- 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.



Fig. 6. Contech fruit fly trap (left), and McPhail trap (right).

**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.

**Fruit Dunk:** Developed at Oregon State University, this method of larva detection works best with smaller fruits, e.g., berries and cherries. Collect 50 to 75 randomly selected fruits (depending on the fruit size), and place them in a 1 gallon ziplock bag. Lightly crush fruit to expose larvae. Add 1 cup of a salt solution (1 tblsp. salt to 1 cup water) and wait a few minutes. If present, larvae will float to the surface, while fruit will sink. The presence of larvae may indicate SWD in your fruit crop. There are other species of fruit-infesting insect larvae, such as cherry fruit fly, currant maggot and sap beetle. The UPPDL can assist with insect larva identification.

## NON-CHEMICAL CONTROL

Non-chemical control begins with monitoring for SWD. The methods below are possible for both the homeowner and fruit grower, but are more feasible on a small scale.

**Baits/Traps:** Use traps throughout and around fruit production areas to capture and kill adult flies.

**Sanitize:** Damaged or fallen fruit should be removed from the property, buried, solarized, crushed, or stored in a sealed container to exclude flies. Remove neglected fruit orchards.

**Exclusion:** Fine-mesh floating row covers can protect low growing fruits.

**Timeliness:** Pick ripe fruits frequently to minimize potential SWD host material where populations may build.

**Freezing:** Infested harvested fruit may be stored at 35°F or lower for at least 96 hours to kill developing eggs, larvae, pupae, and adults.

## 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

## USEFUL SWD REFERENCES

BC Ministry of Agriculture and Lands: <http://www.al.gov.bc.ca/cropprot/swd.htm>

Google page on SWD: <http://sites.google.com/site/spottedwingdrosophila/>

Kanzawa, T. 1939. Spotted Wing Drosophila Report.

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/](http://ucanr.org/blogs/strawberries_caneberries/)

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

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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 (H) use, including organically certified (O) products, listed in Table 1, have shown good to excellent control of SWD in preliminary tests. Do not apply insecticides while pollinators are active.

Product Name	Active Ingredient	MoA
Asana	esfenvalerate	3A
Assail <sup>H</sup>	acetamiprid	4A
Baythroid <sup>H</sup>	beta-cyfluthrin	3A
Delegate <sup>H</sup>	spinetoram	5
Diazinon	diazinon	1B
Dimethoate	dimethoate	1B
Entrust <sup>H, O</sup>	spinosad	5
Guthion	azinphos-methyl	1B
Malathion <sup>H</sup>	malathion	1B
Pounce	permethrin	3A
Proaxis	gamma-cyhalothrin	3A
Provado <sup>H</sup>	imidacloprid	4A
Pyganic <sup>H, O</sup>	pyrethrin	3A
Sevin <sup>H</sup>	carbaryl	1A
Success <sup>H</sup>	spinosad	5
Warrior	lambda-cyhalothrin	3A

Table 1. Insecticides for SWD control. Products are not complete listings of all available options; <sup>H</sup> signifies that the product is registered for homeowner use, <sup>O</sup> 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.

## 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  
email: na  
website: [www.contech-inc.com/](http://www.contech-inc.com/)

### ISCA Technologies Inc.

P.O. Box 5266  
Riverside, CA 92517  
United States of America  
tel: (951) 686-5008  
fax: (815) 346-1722  
email: [info@iscatech.com](mailto:info@iscatech.com)  
website: [www.iscatech.com](http://www.iscatech.com)

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 gluelike 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.