



Managing Spotted Wing *Drosophila* in Michigan Cherry

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KEY POINTS:

- SWD is well established in all cherry-producing counties.
- Each SWD female is capable of laying 300+ eggs, developing into adults in as little as 8 days.
- SWD produce multiple overlapping generations within a single season.
- SWD populations typically surge in July, often coinciding with cherry harvest.
- Cherries are at risk of infestation when they first start to color all the way through harvest.
- Use on-farm monitoring to assess SWD adult populations and to determine when to begin management.
- Protect ripening cherries through harvest using effective, registered insecticides.
- Use high spray volumes and apply full covers.
- Tighten spray intervals and follow up with another insecticide after rainfall.
- Use the salt test to determine whether your management program is effective.
- Do not delay harvesting ripe fruit – the longer fruit stays on trees, the more likely it is to be infested.

BIOLOGY, DISTRIBUTION, KEY CHARACTERISTICS

Distribution of SWD in Michigan. Spotted wing drosophila (SWD), *Drosophila suzukii*, was first detected in the U.S. mainland in California sweet cherries in 2008. From the west coast, this invasive pest rapidly spread to the rest of the U.S. with the first Michigan detection in 2010. SWD is now well established in Michigan and has become a major pest of thin-skinned fruit crops that ripen in mid- to late summer including berries, grapes, cherries, and some softer pome fruit. Based on four years of the MSU SWD monitoring network, we now know that SWD flies are found in all cherry producing counties. As populations have continued to increase, cherries have become vulnerable to infestation close to harvest, particularly in seasons where harvest overlaps with the summer surge in SWD populations. Recent observations indicate that non-crop hosts may be used as a predictor of heightened activity in adjacent cherry orchards. A list of recorded non-crop host plants is posted online at: <http://www.ipm.msu.edu/uploads/files/SWD/em9113.pdf>

Pest biology as it relates to cherry infestation. Female SWD will lay eggs in a wide range of thin-skinned fruit, both cultivated and wild. Unlike other drosophila species (e.g. the common vinegar or fruit fly), SWD can infest fruit that is just beginning to turn color and ripen. In the past two years, the initial surge of SWD trap captures in cherry orchards occurred in mid-July. In many parts of Michigan cherry harvest can be completed prior to the exponential increase in SWD populations. However in 2015, growers experienced SWD-infested fruit in the northwest, and as a result of these infestations, orchards were not harvested or loads of fruit were rejected at the processor. When the risk of infestation is high, and the pest is not controlled, fruit may be harvested with the white larvae inside, potentially leading to load rejections. Controlling this rapidly reproducing pest is especially difficult and will require implementing an excellent pest management program. Because larvae feed inside the fruit, adults must be controlled before eggs are laid. Excellent coverage is required when adults are active. Post-infestation treatments will not eradicate larvae.

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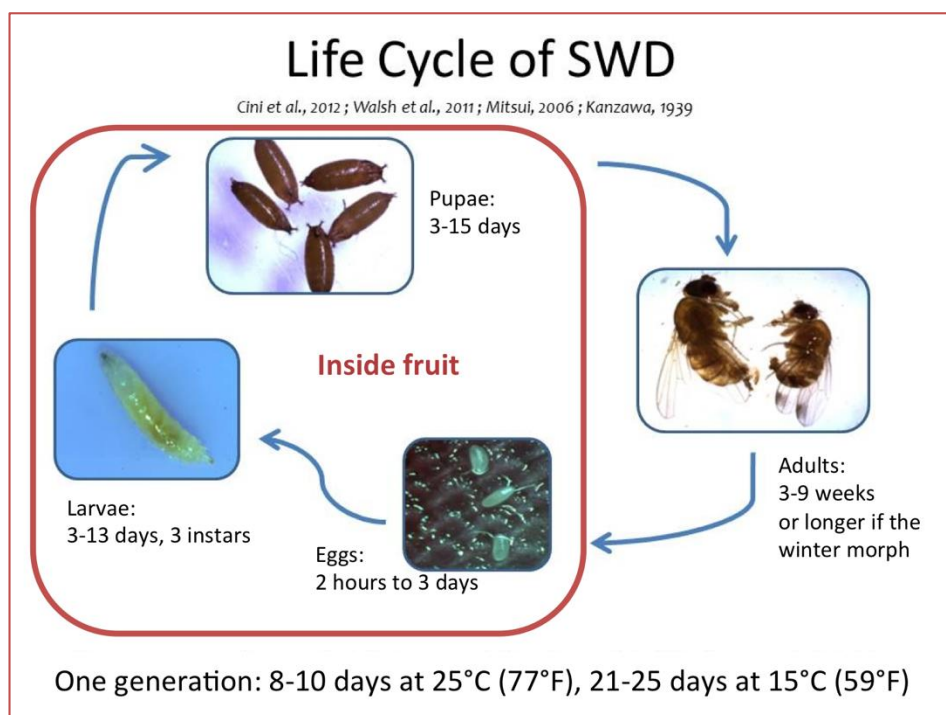


Fig. 1. Life cycle and development times for spotted wing drosophila associated different temperatures. Generation time is 8-10 days at 25°C (77°F) and 21-25 days as 15°C (59°F). Eggs develop into first instars in 2 hours to 3 days. There are three larval stages lasting a total of 3-13 days. The pupal stage lasts between 3-15 days. Adults last 3-9 weeks or longer if it is the winter morph.

SWD lifecycle.

SWD development is largely driven by temperature and day length (Fig. 1). Under warm weather conditions (77°F), SWD will develop from egg to adult rapidly – in as little as 8 days – with multiple overlapping generations typical. Under cooler conditions (~59°F), development will be slower. Adults are active for 3-9 weeks, and each female is capable of laying as many as 300 eggs. Eggs hatch into larvae between 2 hours to 3 days after they are deposited under the fruit skin. Three larval instars feed on the fruit for 3-13 days, pupate within the same fruit, and emerge as adults 3-15 days later. In fall with shorter day length and cooler temperatures, the last adults, enter overwintering and are slightly larger and darker in color; these insects are known as the “winter morphs”.

Key characteristics for identification.

Adult SWD have several key features to help distinguish them: females have a darkened, serrated (toothed) ovipositor that allows them to saw into intact, ripening fruit; mature males have a dark spot on each wing near the margin, and a dark ring of bristles on each foreleg (Fig. 2). For detailed fact sheets, identification guides and weekly reports on this pest during the growing season, see the online resource page at:

www.ipm.msu.edu/SWD.htm

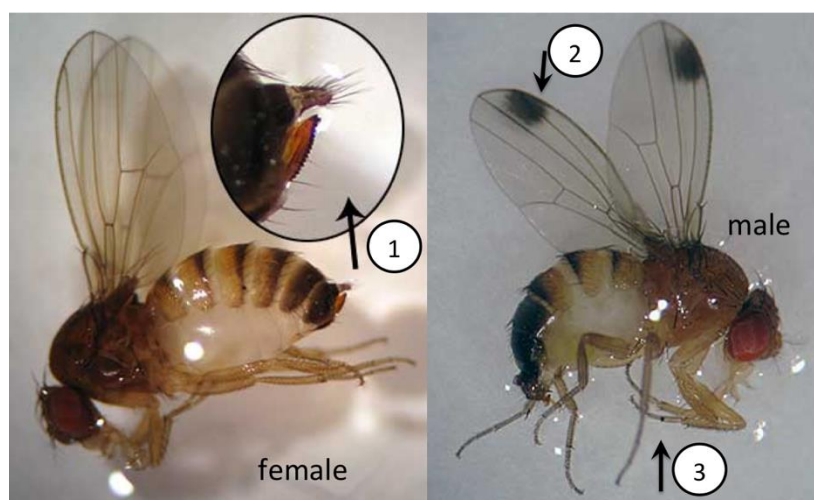


Fig. 2. Key identifying features of female and male spotted wing drosophila. Female SWD (image on the left) have a darkened, serrated ovipositor (labeled as 1); male SWD (image on the right) have a dark spot on the margin of each wing (labeled as 2) and a dark ring of bristles on each foreleg (labeled as 3).

TRAPPING FOR ADULTS

The first step to controlling SWD is to determine whether they are present in the orchard. Monitoring for SWD from fruit set until the end of harvest will help identify the start of fly activity and determine when populations are increasing. Traps provide valuable information, particularly when the crop is most vulnerable to infestation. Traps and lures can be made at home or they can be purchased from commercial suppliers.

The most commonly used trap.

A simple monitoring trap consists of a plastic 32oz cup perforated with ten 3/16"-3/8" holes near the lip of the cup, containing an inch of liquid bait or a lure hung above a soapy water drowning solution to attract flies (Fig. 3). The small holes allow access to vinegar flies, but keep out larger insects. A small yellow sticky card can be placed inside, hung on a paper clip, to facilitate the capture of flies.

Making the yeast-sugar bait.

The best homemade bait is a yeast-sugar mix, which ferments and attracts the flies. The mixture is made by combining 1 tablespoon of active dry yeast, 4 tablespoons of sugar, and 12 oz of water. If using the yeast-sugar bait, the solution needs to be changed at least weekly, and the fermented liquid should be disposed of away from the trapping area.

Effective commercial lures.

Several commercial lures are available, but in our 2015 trials, only two were as effective as the yeast-sugar mix. These are the Scentry gel packet lure and the Alpha Scents lure. Each lure has its own requirement as far as when it needs to be changed, generally on a 3-4 week interval. The lure is hung over an inch of soapy water, and the liquid can be checked each week for SWD adults. As mentioned above, a sticky insert can be used to facilitate fly capture and checking.

Trap density and placement.

Traps should be hung in a shaded area of the tree near fruit using a wire attached to the top of the trap. At least one trap should be placed per orchard block along the perimeter near a wooded edge. However, our recent experience suggests that SWD traps are fairly inefficient and trapping area may only cover a few acres. Therefore, we encourage deploying more than a single trap per block. Place some traps along the edge and some within the orchard block. Traps should be checked at a minimum of once per week and the number of males and females recorded.



Fig. 3. Examples of SWD traps baited with yeast-sugar solution (left) or with a commercial lure suspended above a soapy water drowning solution (right).



Fig. 4. Contents of an SWD trap, strained over a mesh screen (left); examining the sample with a dissecting microscope (right).

SAMPLING FRUIT FOR LARVAE

In addition to trapping for SWD adults at a particular site, a salt test is an excellent back-up method to determine if fruit is infested. If cherries are suspected of SWD infestation, fruit can be sampled using the following technique:

- Place about 1-2 cups of fruit in a one gallon Ziplock (or similar) bag and very lightly crush the fruit, just enough to break the skins.
- Mix up a saltwater solution that is 1 part salt to 16 parts water (e.g. 1 cup salt in 1 gallon of water) and add enough saltwater solution to the bag to cover the cherries.
- Seal the bag, removing as much air from the bag as possible.
- Let the bag sit for at least 30 minutes, then place the bag against a dark surface in good lighting to look for larvae that may have emerged from the fruit.
- Detection of small larvae may require the use of a hand lens.



Fig. 5. SWD larva emerging from a lightly crushed cherry.

SWD CONTROL



Fig. 6. Cherries are susceptible to SWD infestation as soon as they start turn from green to straw color and all the way through harvest.

Given the potential for rapid SWD population increase, ripening cherries require targeted management of adult flies to prevent fruit infestation from the time the fruit loses its green color until the end of harvest. Pesticide registrations and recommendations will change as we learn how to better manage this pest, and growers can remain informed through the MSU SWD website, local Extension Educators, and the MSU Extension News for Agriculture (www.msue.anr.msu.edu/topic/info/fruit).

An effective management program entails: 1) Protecting ripening cherries through harvest using effective, registered insecticides, 2) Using on-farm monitoring to assess fly distribution (via multiple traps throughout the farm for helping to indicate hot spots), 3) Using the salt test to determine whether the current management program is effective, and 4) Not delaying harvest – the longer ripe fruit stay on trees, the more likely they are to be infested.

When to begin your management program.

Because of the mandated zero tolerance for larvae in cherries at harvest, a conservative management approach is currently suggested. If you are trapping on your own farm, management programs should begin when fruit starts to turn color *and* you have captured an SWD adult in one of your traps. In our regional trapping in the past, we have often caught single flies in traps for several weeks prior to the fruit being vulnerable or the summer population surge. If using the regional trapping reports to guide management decisions, some growers may opt to similarly treat vulnerable orchards soon after the first SWD flies are captured. However, our experience suggests that management can be initiated when 5-10% of the traps in the region are reporting SWD catches without risking infestation.

Chemical Control.

SWD presents a new challenge to our current cherry pest management program. The potential for cherries to be infested begins as soon as the cherries turn yellow or lose that green background until the end of harvest. As SWD populations rise, which they can do quickly under warm summer conditions, management can be challenging, especially with frequent rain events. Many of the insecticides that are effective against cherry fruit fly will also provide good protection against SWD, but only if coverage and timing are excellent. Based on laboratory and field efficacy trials, we have found insecticides in the pyrethroid, organophosphate, diamide, and spinosyn chemical classes to be effective materials for SWD control.

Because SWD can complete a single generation in 8-10 days at 77°F, it is crucial to maintain excellent coverage with effective insecticides *and* alternate insecticides with different modes of action to reduce the risk of creating insecticide-resistant SWD populations. Excellent coverage requires tighter spray intervals, particularly in rainy conditions, applying full covers rather than alternate row middles, reducing tractor speeds, accurately calibrating sprayers, and using adequate spray volumes (see Table 1). Growers should **not** stretch spray intervals, even with materials that are rated as excellent against SWD. ***Based on our experiences in Michigan cherries and in other crops, SWD control will likely require a 7-day spray interval under dry conditions, with another application following a rain event.***



Fig. 7. Good coverage is essential to protecting cherries from SWD infestation. Expect to use high spray volumes, full cover applications, tight spray intervals, and returning with an application of another effective insecticide after a rainfall event.

A number of registered insecticides have been shown to be effective against SWD in recent MSU trials. These materials include Danitol, Exirel, Delegate, Imidan, Mustang Max, and Warrior (see Table 1 of registered materials for control of SWD in cherry). Always follow the specific label restrictions for cherry. With more frequent spraying, it is also important to understand the seasonal limits for each product and the minimum time between reapplication (minimum days between sprays, Table 1). Growers should also be aware of insecticide pre-harvest interval (PHI) restrictions, re-entry interval (REI) restrictions, other pests that may be present, and potential impacts on existing IPM programs (see the Michigan Fruit Management Guide E-154 for more details).

Another consideration in applying pesticides close to harvest is their potential for leaving residues that exceed the tolerances of export markets. If used according to label, detectable residues for most of the materials listed in Table 1 should not exceed export tolerances for Michigan cherry markets. However, there are some important exceptions. Exirel has a 3-day PHI, but there is a risk of exceeding the maximum residue limits (MRLs) for China and Taiwan if used within 1 month of harvest. Danitol also has a 3-day PHI, but is likely to exceed the MRL for EU markets if used within a month of harvest. Delegate and Imidan each have a 7-day PHI, but both would exceed the MRLs for China and Israel if used within a month of harvest. For more information, please refer to the most current Tart Cherry MRL Charts available as a separate PDF or consult the free online decision support tool for selecting pesticides close to harvest (<http://mrl.msu.edu/>).

There are only two OMRI approved products that show some activity against SWD, Entrust and Grandevo. Entrust has a 7-day PHI and Grandevo has a 0-day PHI. Both may be used without MRL concerns.

Post-harvest considerations.

Post-harvest treatments against SWD in cherry are limited. However, for other susceptible fruit (e.g. blueberries) refrigeration for 72 hours at 35°F has been found to slow the development of eggs and larvae, and freezing will halt development all together. These techniques are presumed to be effective for cherries with otherwise undetectable infestation at harvest. Processing tart cherries either for juice or dried markets will also effectively halt development.

Table 1. Insecticides registered for use against spotted wing drosophila in Michigan cherries, their properties and restrictions.

Trade Name	Active Ingredient	Class (Group)	PHI (days)	REI (hrs)	Minimum days bet. Sprays	Relative efficacy against SWD	Rate per acre	Season Limit (no. of applications)	Spray Volume (gals/A, ground application only)
Grandevo*	<i>Chromobacterium subtsugae</i>	biological	0	4	7 days	fair	3 lbs	n/a	minimum 100
Danitol 2.4 EC	fenpropathrin	pyrethroid (3)	3	24	10 days	good	21.3 fl oz	2	minimum 100
Pounce 25 WP	permethrin	pyrethroid (3)	3	12	10 days	fair	12.8 oz	3	minimum 25 up to 400
Exirel 10SE	cyantraniliprole	diamide (28)	3	12	7 days	excellent	13.5-20.5 fl oz	3	minimum 30; best results 100-150
Delegate WG	spinetoram	spinosyn (5)	7	4	7 days	excellent	6-7 oz	4	sufficient to obtain full coverage of the foliage or target area
Entrust SC*	spinosad	spinosyn (5)	7	4	7 days	good	1.25-2.5 oz	3	minimum 300
Imidan 70-W	phosmet	OP (1B)	7	72	7 days	excellent	2.125 lbs	3	sufficient to obtain full coverage of the foliage or target area
Baythroid XL	beta-cyfluthrin	pyrethroid (3)	7	12	14 days	good	2.4-2.8 oz	2	minimum 50
Movento	spirotetramat	lipid biosynthesis inhibitor (23)	7	24	14 days	suppression	6-9 fl oz	1.5	minimum 50
Rimon 0.83EC	novaluron	benzoylurea (15)	8	12	7 days	fair	20-40 fl oz	3	minimum 100
Mustang Max 8EC	zeta-cypermethrin	pyrethroid (3)	14	12	7 days	excellent	4 fl oz	6	minimum 20 for concentrate spray or 100 for dilute spray
Warrior II 2CS	lambda-cyhalothrin	pyrethroid (3)	14	24	5 days	excellent	2.56 fl oz	5	sufficient to obtain full coverage of the foliage or target area
Apta 15SC	tolfenpyrad	METI (21A)	14	12	10 days	suppression	21-27 fl oz	2	minimum 50

For more information, please refer to the specimen label for each material (<http://www.cdms.net/Label-Database>). See also the 2016 Michigan Fruit Management Guide E-0154. * OMRI registered product. ** Grandevo requires an even shorter spray interval: no more than 5 days before re-treatment.

For more information

MSU Integrated Pest Management SWD Resource page:
http://www.ipm.msu.edu/invasive_species/spotted_wing_drosophila

MSU Extension News for Agriculture Fruit & Nut page:
<http://msue.anr.msu.edu/topic/info/fruit>

Michigan Fruit Management Guide: Bulletin E0154
http://shop.msu.edu/product_p/bulletin-e0154.htm

Pesticide Label Database:
<http://www.cdms.net/Label-Database>

Tart Cherry MRL Charts in Poster Form (under Key Resources):
http://msue.anr.msu.edu/topic/cherries/pest_management

Michigan Apple & Cherry MRL Tool:
<http://mrl.msu.edu/>

List of SWD non-crop host plants:
<http://www.ipm.msu.edu/uploads/files/SWD/em9113.pdf>