# Managing Spotted Wing Drosophila in Michigan Cherry

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## KEY POINTS:

- Each SWD female is capable of laying 300+ eggs, developing into adults in as little as 8 days.
- SWD produce multiple over-lapping 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 sugar 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., and was first detected in Michigan 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 know that SWD flies are found in all cherry producing counties. As SWD 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 and in large crop years. The presence of non-crop host plants in woodland edges is thought to heighten activity of SWD 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 later harvested blocks, 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, this pest is not easily controlled, and the there is a higher potential to have larvae in the fruit at harvest, which can lead to load rejections. Controlling this pest that has tremendous capacity for reproducing is especially difficult and will require implementing a robust pest management program. Because larvae feed inside the fruit, control actions should primarily target adults before eggs are laid. Excellent coverage is required when adults are active. Post-infestation treatments will not eradicate larvae.

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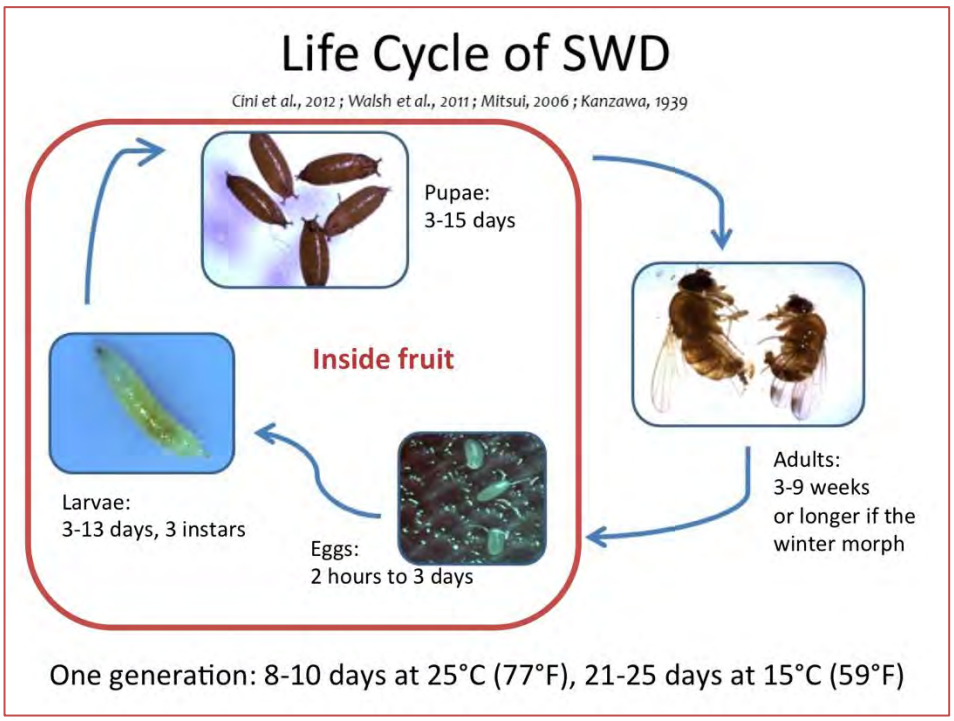


## *SWD lifecycle.*

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 an overwintering phase (i.e. diapause) 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 from other flies: 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**

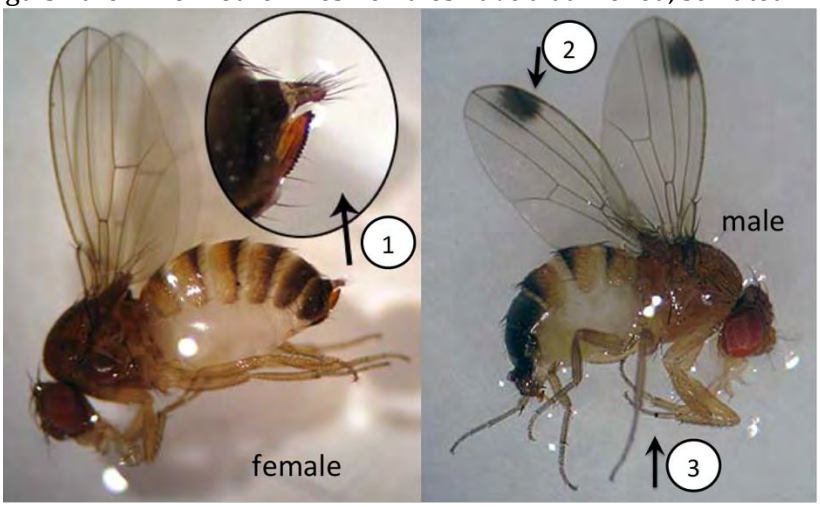


**Fig. 2.** Key identifying features of female and male spotted wing drosophila. Female SWD (image on the left) have a darkened, serrated ovipositor (labeled as 1); male SWD (image on the right) have a dark spot on the margin of each wing (labeled as 2) and a dark ring of bristles on each foreleg (labeled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

## TRAPPING FOR ADULTS

The first step toward 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 in helping growers make reliable management decisions. 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. The trap contains 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.

**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).

### *Making the yeast-sugar bait.*

The best homemade bait is a yeast-sugar mix, which ferments and attracts the flies. To make the yeast-sugar bait, combine 1 tablespoon of active dry yeast, 4 tablespoons of sugar, a drop of dish soap, 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.

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

### *Commercial lures.*

Several commercial lures are available and work about as well as the yeast-sugar mix. 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 may only cover a few acres. Therefore, we encourage deploying more than a single trap per orchard. 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 SWD recorded.

## SAMPLING FRUIT FOR LARVAE

In addition to trapping for SWD adults at a particular site, a sugar test is an excellent back-up method to determine if fruit is infested. The sugar method allows for detection of living larvae as they emerge from the fruit. Instructions for how to complete a sugar test follow:

- Dissolve 7 lbs brown sugar in 5 gallons of warm water. Warm water helps the sugar dissolve and reduces the time it takes for the larvae to exit the fruit; cold water will reduce larval activity.
- Lightly squeeze about 1-2 cups of fruit in a plastic bag to disturb the larvae, taking care not to break the skins as the flesh of Montmorency cherry has whitish colored veins that can be mistaken for SWD larvae (Figure 5).
- Place fruit in a shallow pan and cover with the sugar solution. Stir the fruit every few minutes to thoroughly mix the fruit in the sugar solution and further disturb the larvae.
- After 10-15 minutes, inspect the mixture for larvae exiting fruit.
- Detection of small larvae will require good lighting and the use of a hand lens (15-20x will work, but 30x is better). If a quantitative sample is necessary, count the number of larvae quickly while they are still alive and moving.

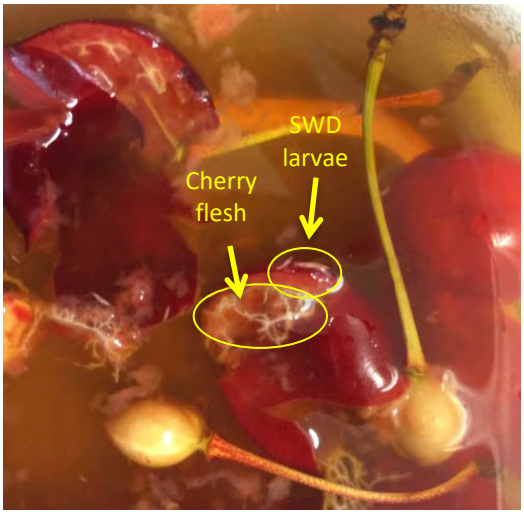


**Fig. 5.** Tart cherries in brown sugar solution used to detect larvae emerging from fruit. Apparent in this image are different larval instars as well as the white veins of the crushed fruit.

soon as they start turning from green to straw color and all the way through harvest.

## SWD CONTROL

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**).

### *Keys to Success.*

An effective management program entails the following: 1) Protecting ripening cherries through harvest using effective, registered insecticides, 2) Using on-farm monitoring to assess fly distribution and population size (via multiple traps throughout the farm for helping to indicate hot spots), 3) Using the sugar test on ripening fruit to determine whether the current management program is effective, and 4) Minimizing delay in harvest – the longer ripe fruit remain on trees, the more likely they are to be infested and SWD populations rise quickly later in the season.

### *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 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 their green color and continues until the end of harvest. As SWD populations rise, which occurs 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.

**Fig. 7.** Good coverage is essential for 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.

## *Maintain Coverage, Tighten Spray Intervals.*

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 middle sprays, reducing tractor speeds, accurately calibrating sprayers, and using adequate spray volumes. Growers should **not** stretch spray intervals, even with materials that are rated as excellent against SWD. ***Based on our experience in Michigan cherries and in other crops, SWD control will likely require a minimum 7-day spray interval under dry conditions with tighter intervals following a rain or other wetting event.***

## *Effective Materials Against SWD in Cherry.*

Based on laboratory and field efficacy trials, we have found insecticides in the pyrethroid, organophosphate, diamide, and spinosyn chemical classes to be effective for SWD control. The most effective products against SWD in recent MSU trials include Danitol, Exirel, Imidan, Mustang Maxx, and Warrior (see Table 1). Always follow the specific label restrictions for cherry. With more frequent spraying, it is also important to understand the seasonal limits for each product, re-entry interval (REI) restrictions, and their re-treatment intervals or minimum number of days between applications (please refer to the product label). Growers should also consider best options for controlling other pests that may be present and potential impacts on existing IPM programs (see the Michigan Fruit Management Guide E-154 for more details).

## *MRL Considerations.*

Another consideration for 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/**).

## *OMRI Approved Materials.*

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. Preliminary data suggest that Entrust has improved activity against SWD compared with Grandevo.

**Table 1.** Insecticides registered for use in Michigan CHERRIES and their expected efficacy against SWD. [1]

| Trade Name | Active Ingredient | Class (Group) | PHI (days) | Re-treatment Interval (days) | Relative efficacy against SWD | Rate per acre |
|---|---|---|---|---|---|---|
| **Grandevo** [2] | *Chromobacterium subtsugae* | biological | 0 | NS | G | 3 lbs |
| **Danitol 2.4 EC** | fenpropathrin | pyrethroid (3) | 3 | 10 | E | 21.3 fl oz |
| **Exirel 10SE** | cyantraniliprole | diamide (28) | 3 | 7 | E | 13.5-20.5 fl oz |
| **Pounce 25 WP** [3] | permethrin | pyrethroid (3) | 3 | 10 | F | 12.8 oz |
| **Baythroid XL** | beta-cyfluthrin | pyrethroid (3) | 7 | 14 | G | 2.4-2.8 oz |
| **Delegate WG** [3] | spinetoram | spinosyn (5) | 7 | 7 | G | 6-7 oz |
| **Entrust SC** [2] | spinosad | spinosyn (5) | 7 | 7 | E | 4-8 oz |
| **Imidan 70-W** | phosmet | OP (1B) | 7 | NS | E | 2.125 lbs |
| **Movento 2F** | spirotetramat | LBI (23) | 7 | 14 | G, S | 6-9 fl oz |
| **Rimon 0.83EC** | novaluron | benzoylurea (15) | 8 | 7 | G/P [4] | 20-40 fl oz |
| **Apta 15SC** | tolfenpyrad | METI (21A) | 14 | 10 | E, S | 21-27 fl oz |
| **Mustang Maxx 8EC** | zeta-cypermethrin | pyrethroid (3) | 14 | 7 | E | 4 fl oz |
| **Warrior II 2CS** [3] | lambda-cyhalothrin | pyrethroid (3) | 14 | 5 | E | 2.56 fl oz |

**KEY:** NS = not specified on product label; S = specimen label lists this material as suppressive only; P = Poor, F = Fair, G = Good, E = Excellent, based on MSU field/lab bioassays. For more information about efficacy ratings, please refer to the current Michigan Fruit Management Guide, MSU Extension Bulletin E-0154.

[1] For more information, please refer to the specimen label for each material. [2] This material is OMRI approved. [3] SWD is not listed as a target pest on the label for stone fruit, but relative efficacy against SWD has been evaluated through field and/or lab bioassays at MSU. [4] Considered to be poor against adults; this material is meant to target the egg stage.

## *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 for juice will also effectively halt development.

At the end of harvest, cherries, especially tart cherries (Figure 8), should not be left on the tree as SWD readily infest them leading to increasing pest densities. Additionally, there is evidence that flailing or otherwise crushing dropped fruit will help reduce post-harvest opportunities for SWD infestation, build-up and movement to adjacent orchards.

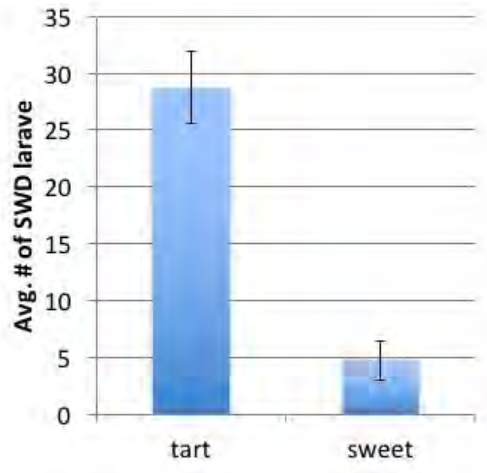


**Fig. 8.** This graph shows that on average nearly 6x the number of SWD larvae were found in tart versus sweet cherries during a choice test. Given these results, it appears that SWD reproduce very well on tart cherry compared with sweet cherry.

## NOTES

## 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**