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Spotted Wing Drosophila

A detrimental invasive pest of soft-skinned fruit

Spotted wing drosophila (SWD, *Drosophila suzukii*) is an invasive pest of many of Wisconsin's soft-skinned fruit crops. Since it was first detected in Wisconsin in 2010, SWD has rapidly expanded its range and increased in population density. Unlike many of the closely related "vinegar flies" which only affect damaged or overripe fruit, SWD females can lay eggs directly into economically viable fruit, potentially causing a large portion of a crop to be unmarketable. Left uncontrolled, SWD can cause significant economic damage to raspberry, blackberry, strawberry, blueberry, cherry, and other Wisconsin fruit crops. In addition to fruit crops, SWD has been observed developing inside over 40 wild hosts such as buckthorn, honeysuckle, dogwood, and mulberry.

Wisconsin phenology

In Wisconsin, SWD adults begin to appear in traps from late June to early July, although earlier emergence has been the trend every year since the first detection of SWD. Because SWD is known to develop on several wild berries in Wisconsin woodlands, populations may build up in the spring outside of agricultural landscapes before spilling over onto cultivated crops in midsummer. SWD adults are thought to overwinter in Wisconsin as distinct winter morphs. Winter morphs are able to withstand colder temperatures for extended periods of time, and are found in the fall in Wisconsin.

Damage symptoms

Unlike other drosophilid flies that rely on damaged or rotten fruit to lay eggs (oviposit), SWD females have a distinctly hardened, serrated egg-laying structure called a sclerotized ovipositor. The sclerotized ovipositor allows adult females to cut a slit into the skin of healthy, intact fruit. Crop damage occurs as the eggs and larvae develop inside the fruit.

SWD damage to cherries.

SWD damage to raspberries. Larval feeding causes the structure of the fruit to collapse and become droopy and watery.

Initially, visible damage is limited to soft, slightly discolored spots on the surface of the fruit. Wrinkling and eventual collapse follow as larvae feed entirely inside the fruit. Aside from physical fruit damage, customers are largely averse to eating maggots, especially at later stages of development when the white larvae are visible inside the fruit. Additionally, the opening created during SWD oviposition provides access for pathogens to enter the fruit, greatly increasing the likelihood of disease. When left uncontrolled, up to 100% of fruit in a planting may be affected by SWD.

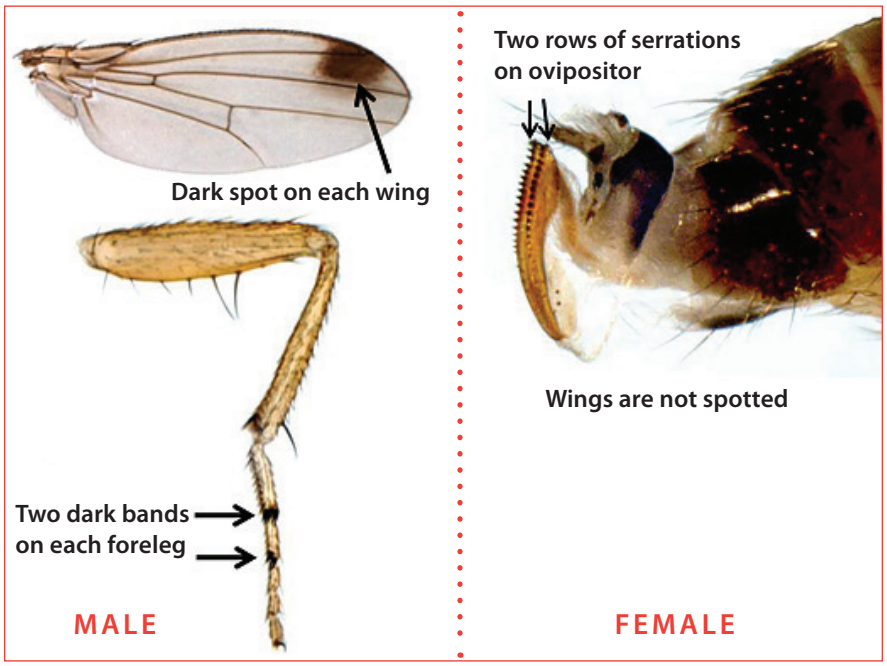
Life cycle and identification

SWD eggs and larvae are less than ⅛ inch long and indistinguishable from other drosophilid flies. An adult female typically lays one to three eggs in each fruit, and during her lifespan will lay up to several hundred eggs. Eggs hatch after 12 to 72 hours, and larvae feed within the fruit for 5 to 7 days. Pupation (the transformation from larva to adult) generally takes place outside of the fruit, with the majority of larvae dropping to the ground to pupate in or under leaf litter.

SWD adults can be distinguished from other drosophilid flies under at least 10x hand lens magnification. Adults are 1/16 to ⅛ inch long with red eyes and a striped abdomen. Males have a single dark spot near the tip of each wing. Females do not have wing spots, however, they can be distinguished from other flies based on the two rows of dark, blade-like serrations of the ovipositor, which can best be seen under at least 30x magnification.

At optimal temperatures (68 to 77°F), SWD can complete a generation in 8 to 12 days. Populations build up very quickly given this rapid generational turnover, providing only a short time span from first detection to economically significant damage. For this reason, monitoring and implementation of immediate control measures at the first sign of adult activity is critical.

Male and female SWD anatomy.



Larval SWD in a raspberry.

Monitoring for SWD

Larvae

The presence of adults in a fruit crop block is a good indication that larvae may be present in the fruit. However, the most accurate way to measure crop loss due to SWD is to monitor for larvae in the fruit. To do so, place the fruit in a sealable bag, slightly crush the fruit, and add 4 cups of water and ¼ cup of salt. This will draw the larvae out of the fruit, causing them to die and eventually float in the saltwater solution. Not all larvae will necessarily be SWD, so you may want to leave some fresh, intact fruit in a sealed container and wait for up to 10 days for adults to emerge. Thereafter, you can then accurately identify the adults.

Adults

Monitoring for SWD adult flies during the growing season is crucial for early detection and rapid response. The easiest way to monitor for SWD adults is to use a trap. Commercial traps are available, and simple, inexpensive traps can be easily made at home.

To make a trap, obtain a 32-ounce clear plastic deli cup with a lid. Drill or melt ten 3⁄16 inch holes around the top of the cup to allow adults to enter. Larger holes will allow other larger insects to enter and will make counting SWD specimens difficult. Leave a few inches without holes to allow easy pouring of the liquid bait. Traps can be baited with approximately one inch of a yeast-sugar mix (1 tablespoon of active dry yeast mixed with 4 tablespoons of sugar and 12 ounces of water), with a couple drops of unscented soap. Soap breaks the surface tension of the liquid to ensure that flies drown instead of escaping. Commercial traps and lures can be easier and less messy to use, and generally attract few non-SWD flies, simplifying the identification process.

Hang one trap per acre in the shaded plant canopy when green fruit emerges. When using a homemade trap, replace the liquid bait weekly and dispose of the bait in a bucket or on the ground a measurable distance away from the monitored crop. Replace commercial lures according to instructions. Some flies in the trap may not be SWD, therefore you will need to closely inspect them under magnification for identification.

Management

Cultural control

Some cultural control methods have been shown to effectively decrease the probability of SWD infestation, such as: (1) the timely harvest of berries to prevent larval development; (2) sanitation, including the removal of damaged or overripe fruits from the field; and (3) the removal of wild host plants in the surrounding landscape.

When disposing of infested or potentially infested fruit, place it inside a sealed bag and leave it in direct sunlight or a freezer to kill SWD eggs and larvae. Do not compost infested fruit. Refrigeration slows the development of SWD, and it is recommended to keep fruit as cool as possible post-harvest to prevent further development of remaining eggs and larvae. Additionally, SWD prefers a humid, shady environment. Adequate canopy pruning and the use of drip instead of overhead irrigation will lower humidity levels and decrease the prevalence of SWD.

SWD infestation can be minimized or avoided in some small fruit varieties. Planting summer-bearing raspberry varieties, for example, will dramatically reduce the risk of infestation by avoiding the peak of SWD populations before harvest is completed.


Commercial SWD trap.


Homemade SWD trap.

Biological control

Some predators and parasitoid wasps have been shown to decrease SWD populations in other states and countries. However, at this time, the impact of these biocontrol agents is limited. Research has not yet addressed whether these biocontrol agents can be introduced or augmented in an agricultural setting to suppress SWD.

Chemical control

Consult the current *Midwest Fruit Pest Management Guide*[1] or *Michigan Fruit Management Guide*[2] for the most up-to-date chemical control recommendations for SWD. In general, carbamates, organophosphates, pyrethroids, and spinosyns have provided good control against SWD and are available for conventional production, while neonicotinoids do not perform as well. Spinosad and pyrethrum are available for organic production.

When choosing an insecticide, consider the preharvest interval, reentry restrictions, the presence of other pests, and potential effects on beneficial insects and the environment. Always read and follow the pesticide label to ensure proper use and to maximize product performance and pest control.

Sprays should be reapplied in short intervals (4 to 5 days depending on the product) when the fruit begins to ripen until harvest is completed, taking preharvest intervals into account. Calibrate sprayers to provide thorough coverage, especially toward the center of the plant where flies like to hide in the shade. Rotate chemical classes to minimize the development of pesticide resistance.

Chemical controls for SWD are only partially effective and work best when combined with intensive monitoring and cultural controls such as sanitation and timely harvesting. To preserve and protect pollinators, avoid insecticide spray applications during bloom or when bees are active. If you need to apply an insecticide when bees are present, it is recommended to spray in the evening when bees are not actively flying.

Information for home gardeners

Many fruits grown in Wisconsin home gardens can be susceptible to SWD, including raspberries, blackberries, blueberries, strawberries, and peaches. Monitoring and management recommendations for small-scale home gardens differ somewhat from those for large-scale gardens, farms, and orchards. Small-scale monitoring may still include the use of homemade or commercial traps, as well as visual observations of the fruit for the presence of small fruit flies. Similarly, home gardeners can monitor larvae by performing the saltwater test described in the **Monitoring** section or by simply inspecting ripe fruit during harvest for the presence of larvae. Even if larvae are not immediately visible, a very juicy or watery fruit that is collapsing in on itself may indicate the presence of SWD larvae.

SWD management should take place as soon as adults are found on a property in early summer and continue throughout the growing season. Some nonchemical cultural controls include:

- *Netting.* Covering all susceptible fruit crops with netting can prevent SWD adults from accessing the fruit and therefore prevent oviposition. Nets' mesh size must be no greater than 1/32 inch. It is best to position nets after early fruit set to avoid interference with pollination but before fruit begins to ripen. Additionally, it is important to ensure the mesh is adequately fastened to itself and to the ground, so SWD adults cannot sneak in through gaps.
- *Sanitation*. Fruit should be promptly picked as soon as it is ripe. All fruit that is damaged, rotten, or not harvestable should be removed from the field and either frozen or baked to kill any larvae in the fruit.
- *Refrigeration*. Fruit should be refrigerated or processed immediately after harvest to slow the development of any eggs and larvae in the fruit. Refrigeration slows development, while freezing and cooking kill larvae. There are no known health risks to consuming SWD eggs or larvae.
- *Lowered canopy humidity*. SWD thrives in a humid environment. Adequate canopy pruning and the use of drip instead of overhead irrigation lower humidity levels, and therefore can decrease the prevalence of SWD.

Chemical controls remain the most reliable, effective management strategy available. The most effective, reduced-risk active ingredient available at garden stores against SWD is spinosad. However, insecticides should not be the only management strategy, as they are most effective when combined with the previously discussed cultural control strategies. When using insecticides, always read the label prior to use and never spray insecticides during bloom or when bees are flying. For more information about insecticide choice and application, read the **Chemical control** section. Bear in mind that products labeled for commercial use are not necessarily labeled for backyard use.

References

1. The *Midwest Fruit Pest Management Guide* is available through the Purdue Extension Education Store: **https://edustore.purdue.edu/item.asp?Item_Number=ID-465#.WOQMVPyvUY**
2. The *Michigan Fruit Management Guide* is available through the MSU Extension Bookstore: **https://shop.msu.edu/product_p/bulletin-e0154.htm**

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