Spotted wing drosophila management recommendations for Wisconsin cherry growers

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Spotted wing drosophila is a vinegar fly that was first detected in Racine County, Wisconsin in 2010 and in 2012 populations were confirmed in Bayfield, Washburn, Brown, Dane, Door, Fond du Lac, Marinette, Monroe, Pierce, Vernon, Winnebago, and Wood Counties. SWD prefers soft skinned fruit such as raspberry, blueberry, strawberry, cherry, and blackberry. In 2012, raspberry growers experienced severe crop losses due to SWD in Wisconsin.

SWD females lay their eggs under the skin of the fruit after cutting a slit in the skin of intact ripening fruit. Larvae feed on the flesh of the fruit, causing soft spots on the surface of the fruit (Figure 1, white arrows) and brown sunken areas (Figure 2). The fruit will subsequently collapse. Cherries become susceptible to SWD damage around blush or pink stage and susceptibility increases as harvest approaches.

Figure 1. Oviposition holes on sweet (left) and tart (right) cherry. Photos: Martin Hauser, CDFA (left) and Michigan State University Extension (right).

Figure 2. Damage from SWD larvae feeding on sweet cherry. Photo: UC Statewide IPM Program.

Due to the high susceptibility of cherries to SWD, it is important to implement IPM programs in cherry orchards to minimize the impact of SWD in 2013.

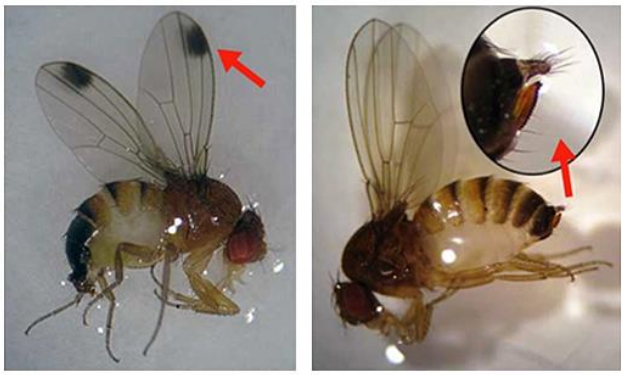
Based on the experience of neighboring states and others on the West Coast, management recommendations have been developed and consist of the following components:

1. Monitor orchards with traps and check traps at least once a week. This step is essential as we are not sure yet whether SWD overwinters in WI.
2. Record trap catches to determine the presence and number of male and female SWD.
3. When SWD is detected in traps, apply effective insecticides registered for cherry to protect the fruit.

4. Continue monitoring to assess fly distribution, to evaluate your management program and to respond quickly if needed.
5. Schedule timely harvest and if possible, remove leftover ripe fruit to reduce breeding and food resources.
6. Stay informed by visiting http://labs.russell.wisc.edu/swd/ where updates are available throughout the season.

Identification

SWD are very similar in size, shape and appearance to other vinegar flies (i.e. our common "fruit flies"). Adult SWD are small, 1/16 to 1/8" long (2-3 mm) with red eyes and a light brown thorax and abdomen (Figure 3). Larvae are small, legless, up to 1/8" long, cream colored and round in shape.



SWD Male – note the characteristic dark spot near the tip of each wing.

SWD Female – note the saw-like egg-laying structure (insert); lacks wing spots.

Figure 3 - SWD Male vs. Female. Photos: Sheila Fitzpatrick, Agriculture & Agri-Food Canada, Pacific Agri-Food Research Center, Agassiz

SWD adults have certain characteristic features that help with identification (Figure 4). Males have a single dark colored spot at the tip of each wing and two dark colored bands on each foreleg. Females lack the wing spots. Females possess a unique, serrated ovipositor (egg laying device), which distinguishes them from other vinegar flies. The serrated ovipositor is only visible with magnification.

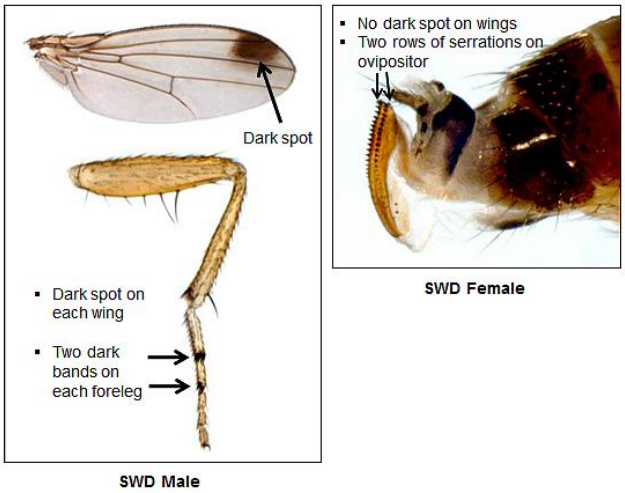


Figure 4 - SWD Male vs. Female. Photo: M. Hauser, CDFA

Life Cycle (Figure 5)

SWD adults prefer moderate temperatures and can complete a generation in as little as 8-12 days. Adult females use their serrated ovipositor to cut a slit into healthy fruit to deposit from one to three eggs. Several females may lay eggs on a single fruit. Eggs hatch in as little as 1-3 days and the larvae can complete feeding within several days depending on temperature (Figure 6). Adults may live for several weeks and females can lay several hundred eggs in their lifetime. Because of this short generation time, buildup of large number of adults may be possible.

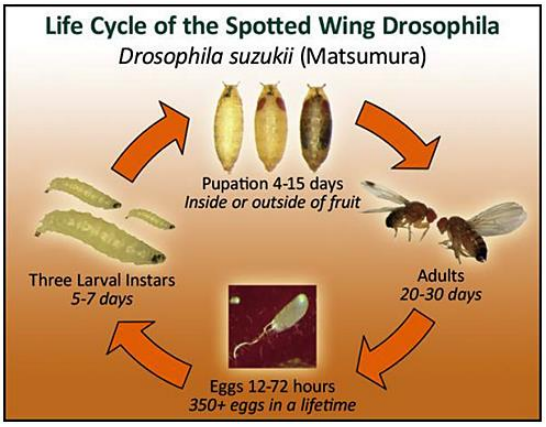
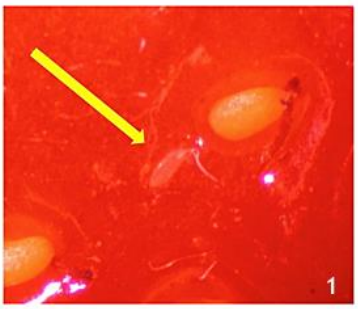


Figure 5 – SWD life cycle. Photo: Beverly Gerdeman, WSU NWREC



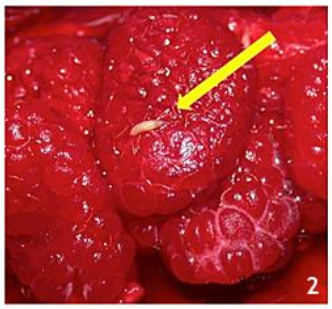


Figure 6 - 1 - SWD egg on Strawberry-pale, indicated by arrow. The two yellow objects are achenes ("seeds").
Figure 6 - 2 - SWD Larva on Raspberry-whitish, indicated by arrow.
Photos: Phil Pellitteri, UW-Madison Insect Diagnostic Lab

Egg Detection and Larval Sampling

Eggs and larvae of SWD may be detected in fruit. To see the presence of eggs on the fruit surface, look for breathing tubes (Figure 7) and pits on the outside of the fruit.

Figure 7. Egg breathing tubes at the surface of the berry. Photo: Michigan State University.

For larval detection, place suspected fruit in a Ziploc-type bag, slightly crush the fruit and add a salt water solution (1/4 cup salt and 4 cups water). Leave the fruit in the mixture for one hour. Dislodged larvae will float. Backlighting the bag should facilitate detection. Another method is to boil suspected cherries in 150 milliliters (approx. 5-6 ounces) of water for one minute then gently crushing the cherries over a 4 mesh screen with a spoon and then rinsing the fruit under cold water with a dark tray underneath to collect the juice and larvae. The dark tray should facilitate detection of larvae.

To confirm that the larvae in the fruit are SWD, first collect coloring damaged fruit and place them in a Ziploc bag and let the adults emerge (less than 10 days, depending on the size of the larvae). When the adults emerge, place the bag in the freezer to stun the flies. The flies can then be identified or transferred to a container with rubbing alcohol and shipped to:

Phil Pellitteri
Insect Diagnostic Lab
240 Russell Labs
1630 Linden Drive
Madison, WI 53706

Adult Monitoring

Monitoring of SWD adults during the growing season will ensure early detection and rapid response. Trapping is a valuable technique that should be used for detection and to monitor adult population trends. Traps are available commercially but are also simple and inexpensive to make (Figure 8). Simply use a 32 oz. clear plastic deli cup with a lid. Drill or melt 10 3/16"-3/8" inch holes (preferably 3/16") around the top of the cup to allow adults to enter. Larger holes will allow larger insects to enter and will make counting SWD more difficult. Leave ~3-4 inches without holes to allow easy pouring of the liquid bait. Traps can be baited with either ~1 inch of apple cider vinegar, or ~1 inch of a yeast-sugar mix (1 Tbsp. active dry yeast: 4 Tbsp. sugar: 12 oz water). Add either a couple drops of unscented soap or a yellow sticky card (hung from the inside of the lid using a paperclip) to prevent flies from escaping. The soap acts as a surfactant, breaking the surface tension of the liquid bait, which allows the flies to drown. **Based on our recent observations, our recommendation is to use the yeast-sugar bait as it seems more effective than apple cider vinegar at detecting flies early.** The yellow sticky card is more cumbersome to work with than the unscented soap, so we recommend using the soap to prevent flies from escaping the trap.

Figure 8. Monitoring trap and entry hole with fly. Photo: Hannah Burrack, NC State University, Bugwood.org.

Hang traps in the shaded plant canopy where fruit are present. Place about 1 trap/acre. Check traps weekly, record catches, and replace liquid bait on a weekly schedule. Do not pour bait out at the base of the trap as it will confuse the adults and reduce the effectiveness of the trap. You can dispose of the bait either in a bucket or on the ground away from the monitored crop. A hand-lens (at least 30x magnification) or a microscope will be useful for identifying male SWD and required for identifying female SWD. The best detection is expected as the fruit begin to ripen.

There is no economic threshold for SWD, so if fruit is ripening and SWD flies are trapped:

1) check traps at least twice per week to assess fly distribution and population levels;
2) use cultural controls when possible;
3) use registered insecticides from detection until harvest is completed (taking pre-harvest intervals into account).

Note that later-harvested cultivars and areas where harvesting happens later will be at greater risk from SWD than earlier-harvesting areas, as populations increase throughout the summer and into the fall.

Cultural Control

1. Minimize the buildup of SWD

Minimize the buildup of SWD by removing native wild hosts such as blackberries, plums, dogwoods, and honeysuckle. Schedule timely harvests and remove over-ripe or infested fruit from the orchard as soon as possible to prevent the development of eggs and larvae.

2. Dispose of infested fruit

You can place infested fruit inside a plastic bag, seal the bag, and solarize the bag. If you have a lot of infested fruit, you can lay them on the ground in a sunny area, cover all the fruit with a piece of clear plastic, and seal the plastic with soil around the edges. You can also bury the fruit, at least 2 feet deep. Important note: DO NOT compost fruit, it might actually speed up SWD development in warm areas of the compost piles! Freezing cherries will kill SWD and refrigerating cherries will stop further development of larvae inside the fruit and may kill larvae after longer refrigeration periods. It is thus recommended to keep cherries cool as much as possible, from processor to market to consumer as it will minimize the chance that larvae will continue developing in fruit.

Chemical Control

A list of insecticides that have been shown to be effective against SWD in cherry is provided below. There are no registered insecticides that will control larvae within fruit. The insecticides listed below target adults with the intent to eliminate flies before they mate and lay eggs. Use traps to determine when adults are present and treat with insecticides if the crop is at a susceptible stage (blush or pink stage). Spray in short intervals (7-10 days depending on product used) to prevent crop infestation from when the fruit is beginning to ripen until harvest is completed (taking pre-harvest intervals into account). Make sure to calibrate your sprayers to provide thorough coverage, especially in the center of the canopy where flies like to hide in the shade.

List of insecticides effective against SWD and registered on cherry.

Class (IRAC)	Trade name	Active ingredient	REI	PHI (days)	Rate (per acre)	Efficacy against SWD	Comments
Carbamates (1A)	Sevin XLR Plus	Carbaryl	12hrs	3	2 – 3 quarts	HT to bees	No more than 14 quarts/acre/year Max of 3 application/year 7 day interval between applications No more than 5 quarts at dormant or delayed dormant timing and no more than 9 quarts during production season
Organo-phosphates (1B)	Malathion 5EC	Malathion	12hrs	3	4 – 6 pints	HT to bees	Max of 8 lbs/acre **Caution:** Injury may occur on certain sweet cherry varieties
	Diazinon 50W	Diazinon	4 days	21	½ - 1 lb/100 gals water	HT to bees	Max of 4 lbs./acre/application Max of 2 applications/year (max of 1 as dormant application and max of 1 as in-season foliar application). **Caution:** Closed cab required
	Imidan 70W	Phosmet	3* days	7	2 ⅛ lbs	Excellent HT to bees	TART CHERRIES ONLY! Max of 7 ½ lb/acre/year *"Pick your own", REI = 14 days
Pyrethroids and Pyrethrins (3A)	Asana XL	Esfenvalerate	12hrs	14	4.8 – 14.5 fl. oz.	HT to bees	Max of 72 fl. oz./acre/year, with no more than 57.6 fl. oz./acre/season between bloom and harvest
	Danitol 2.4EC	Fen-propathrin	24hrs	3	10 ⅔ – 21 ⅓ fl. oz.	Excellent/Good HT to bees	Max of 42 ⅔ fl. oz./acre/year 10 day interval between applications **Caution:** Do not apply as ULV spray. Do not allow livestock to graze on cover crops from treated orchards.
	Mustang Max EC	zeta-Cypermethrin	12hrs	14	1.28 – 4 oz.	Excellent HT to bees	Max of 24 oz./acre/season 7 day interval between applications **Caution:** Do not apply as ULV spray. Do not allow livestock to graze on cover crops from treated orchards.
	Warrior II	Lambda-cyhalothrin	24hrs	14	1.28 – 2.56 fl. oz.	HT to bees	Max of 12.8 fl. oz./acre/year Max of 10.24 fl. oz./acre/year post-bloom 5 day interval between applications
	Pyganic **OMRI**	Pyrethrum	12hrs	12 hrs	16 – 64 oz.	RS to bees	Recommended that final spray mix be buffered to pH of 5.5 - 7.0 0 day interval between applications
Spinosyns (5)	Delegate	Spinetoram	4hrs	7	4.5 – 7	Excellent	Max of 28 oz./acre/season

	WG				oz.	HT to bees	Max of 4 applications/year 7 day interval between application
	Entrust **OMRI**	Spinosad	4hrs	7	1.25 – 2.5 oz.	Excellent MT to bees	Max of 9 oz./acre/season No more than 2-3 consecutive applications of group 5 insecticides/season. Rotate with Pyganic for resistance management in organic production. 7 day interval between application

This is not a comprehensive list. Trade names are provided as examples of specific active ingredients. Other products may be registered with the same active ingredient and no endorsement or recommendation of a particular trade name is implied. Research is ongoing and recommendations for SWD are constantly changing as research results become available. Please, make sure to always read and follow label instructions carefully. Human error happens, so please double check rates and other information on the label! Experience from other states suggests using the full label rate for each product against SWD, until we have more information on pesticide efficacy.

MRL Issues. Cherries for export have to follow the MRLs guidelines on pesticide residues set by the country of destination. Check with your packinghouse when choosing your SWD spray program to comply with the MRL requirements of the country of destination.

Neonicotinoids are not recommended for control of SWD as they are considered to be weakly active against SWD. Michigan State noted that while Assail may have some potential for post-infestation control of eggs and larvae, it still has limited contact activity and thus is not recommended to use against SWD.

Biological Control

No biological control is available yet for SWD. Research is on the way to identify biological control agents against SWD. Hopefully, natural enemies of other drosophila species will soon have a taste for SWD!

Organic Production

Two insecticides, Pyganic and Entrust, are OMRI approved (see table above). Rotate Entrust (5-7 day residual) with Pyganic (2-3 day residual) to achieve some resistance management.

Organic insecticides are less effective than conventional insecticides. Organic production requires more intensive monitoring, more timely application, and shorter intervals between sprays. Cultural controls are even more important to help reduce overall SWD population levels. Using these recommendations, experience from some West Coast states suggests that SWD populations can be successfully managed in organic production.

If you have any question, please contact Christelle at guedot@wisc.edu or by phone at 608-262-0899.