Spotted wing drosophila management recommendations for Wisconsin raspberry 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 berry (Figure 1) and a wrinkling of the fruit skin. The fruit will subsequently collapse and scarring of the tissue will appear (Figure 2).

Figure 1. Damage from SWD larvae feeding on raspberry, 3-4 days after egg laying. Photo: Parent, Whitney, Shearer, Reitmajer, Dalton and Walton; USDA-ARS Corvallis and Oregon State University

Figure 2. Damage from SWD larvae feeding on raspberry, 5 days after egg laying. Photo: Parent, Whitney, Shearer, Reitmajer, Dalton and Walton; USDA-ARS Corvallis and Oregon State University

Due to the high infestation levels found in 2012 in raspberry in Wisconsin, it is important to implement IPM programs in raspberry fields and high tunnels to minimize the impact of SWD in 2013.

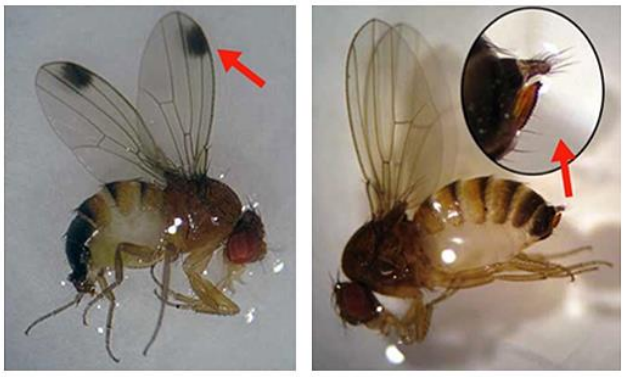
Based on the experience of neighboring states and others on the West coast, management recommendations have been developed and consist of the following components:

1. Monitor fields 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 raspberry 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.

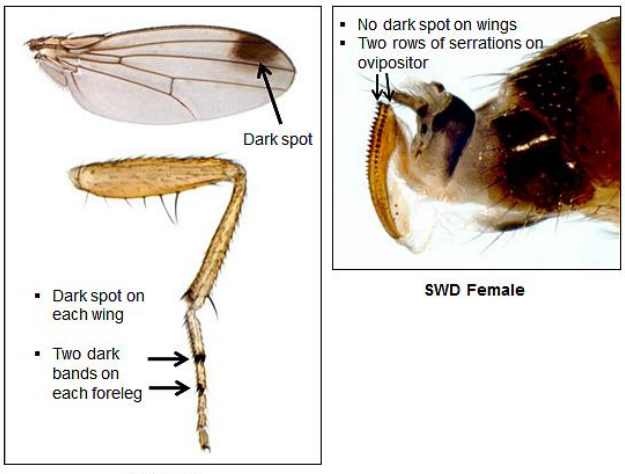


Figure 4 - SWD Male vs. Female. Photo: M. Hauser, CDFA

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.

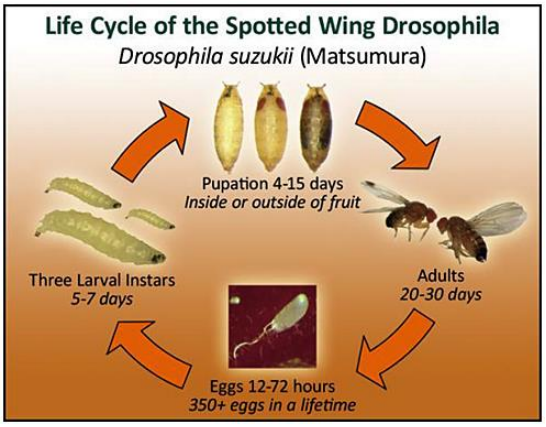
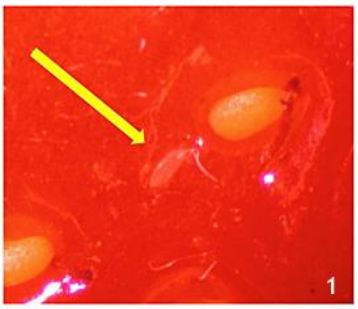


Figure 5 – SWD life cycle. Photo: Beverly Gerdeman, WSU NWREC



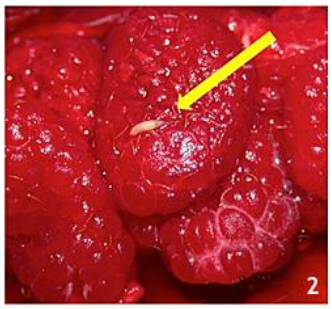


Figure 6 - 1 - SWD egg on Strawberry-pale, indicated by arrow. The two yellow objects are achenes ("seeds").
Figure 6 - 2 - SWD Larva on Raspberry-whitish, indicated by arrow.
Photos: Phil Pellitteri, UW-Madison Insect Diagnostic Lab

Egg Detection and Larval Sampling

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

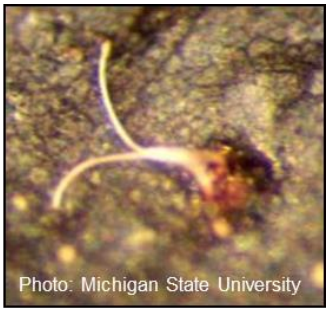


Figure 7. Egg breathing tubes at the surface of the berry. Photo: Michigan State University.

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 berries in 150 milliliters (approx. 5-6 ounces) of water for one minute then gently crushing the berries 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 field as soon as possible to prevent the development of eggs and larvae. When collecting fruit, one suggestion is to have two buckets with you, one to collect good fruit and another to collect over-ripe and infested fruit.

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 berries will kill SWD and refrigerating berries will stop further development of larvae inside the fruit and may kill larvae after longer refrigeration periods. It is thus recommended to keep berries 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 raspberry 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. Spray in short intervals (4-5 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 bush where flies like to hide in the shade.

List of insecticides effective against SWD and registered on raspberry.

Class (IRAC)	Trade name	Active ingredient	REI	PHI (days)	Rate (per acre)	Efficacy against SWD	Comments
Carbamates (1A)	Sevin XLR Plus	Carbaryl	12 hrs	7	1-2 quarts	Good HT to bees	No more than 10 quarts/acre/year Max of 5 application/year 7 day interval between applications
Organo-phosphates (1B)	Malathion	Malathion	12 hrs	1	Check label for specific formulations	Good HT to bees	No more than 2 lb a.i./acre No more than 3 applications/year 7 day interval between applications
Pyrethroids and Pyrethrins (3A)	Brigade	Bifenthrin	12 hrs	3	3.2-6.4 fl. oz.	Excellent HT to bees	Max of 12.8 fl. oz./acre/year One application may be made pre-bloom and a 2nd application may be made post-bloom
	Asana	Esfenvalerate	12 hrs	7	4.8 – 9.6 fl. oz.	Excellent HT to bees	Max of 28.8 fl. oz./acre/year
	Danitol 2.4EC	Fen-propathrin	24 hrs	3	10-⅔ – 16 fl. oz.	Good/ Excellent HT to bees	Max of 32 fl. oz./acre/year 14 day interval between applications
	Mustang Max	zeta-Cypermethrin	12 hrs	1	4 oz.	Excellent HT to bees	Max of 24 oz./acre/season 7 day interval between applications
	Pyganic **OMRI**	Pyrethrum	12 hrs	12hrs	16 – 64 oz.	Fair MT to bees	Recommended that final spray mix be buffered to pH of 5.5 - 7.0
Spinosyns (5)	Delegate WG	Spinetoram	4 hrs	1	3 – 6 oz.	Excellent HT to bees	Max of 19.5 oz./acre/season Max of 6 applications/year 4 day interval between application
	Entrust **OMRI**	Spinosad	4 hrs	1	1.25 – 2 oz.	Good HT to bees	Max of 9 oz./acre/season Max of 6 applications/year 5 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.

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.