

## Detecting Larval Infestations and Insecticidal Options for Spotted Wing Drosophila, a Significant Pest of Small Fruit Crops in Missouri

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The Spotted Wing Drosophila (SWD) is a very serious new invasive pest. It attacks small fruit crops and some stone fruits (cherries, nectarines, peaches). It also attacks high tunnel tomatoes and wild hosts (including pokeweed, autumn olive, crabapple, nightshade, Amur honeysuckle and wild grape). Raspberries, blackberries, blueberries and grapes are at the greatest risk. SWD flies look similar to the small vinegar flies that are typically found around or on fermenting fruits and vegetables. However, unlike those native vinegar flies, a SWD female has a serrated egg-laying device (called an ovipositor). The ovipositor cuts a slit into the skin of intact fruit when the female lays its eggs. This makes the SWD a more harmful pest. An identification and monitoring guide was developed by the Lincoln University (LU) Integrated Pest Management (IPM) program. It is available at <http://www.lincolnu.edu/web/programs-and-projects/ipm>.

This article discusses how to detect larval infestations. It also details how to manage the SWD using the key IPM components listed below. A SWD control program starts with monitoring. If the SWD is detected, chemical control is needed so that fruit can remain marketable. Some chemicals already used by commercial growers to control similar pests should effectively control SWD.

1. Monitor fields with traps; check them regularly.
2. Check trapped flies to determine the presence and number of SWD.
3. If SWD are found and fruit are ripening or ripe, apply effective insecticides that are registered for that crop; this will protect the fruit until harvest is completed.
4. Continue monitoring to evaluate your management program; this time check traps twice per week. Respond quickly if needed.
5. Use cultural controls where possible by removing old, infested or damaged fruit from the field; this will reduce SWD food supplies.
6. Stay informed. These recommendations are subject to change based upon new information.

*Use of effective insecticides that are well timed and have good coverage can control SWD through harvest. However, there is a potential for rapid population increase by SWD, especially during fall red raspberry season. Therefore, active management, by monitoring flies and fruit infestation, is critical.*

**Always follow the specific label restrictions for raspberry/blackberry crops. The level of control achieved will depend on the SWD population, timeliness of application, coverage of fruit and product effectiveness.**

## DETECTING LARVAL INFESTATIONS IN FRUIT

The following recommendations are largely based on guidelines provided by Michigan State University (MSU) and Oregon State University (OSU). A first sign of SWD infestation in raspberries might be that red patches are seen on the container when the berries are picked. The fruit of raspberries and blackberries might also begin to collapse in areas where the larvae are feeding inside. Opening the berries might reveal the larvae within the fruit; however, it is time consuming to check individual berries. Fruit can be selected in two ways: (1) by collecting fruit at random, or (2) by collecting only fruit suspected to be infested. Fruit might be suspected if they have soft spots and/or if oviposition scars are present.

**(i) Sugar-water method:** Place fruit in a plastic Ziploc® bag. Crush lightly to break the skin. Then, add a sugar-water mixture (four cups water to every one-fourth cup sugar). SWD larvae will float in the liquid, and the fruit will sink. Detection of small larvae might require the use of a hand lens. This works well with a light behind the bag to create backlighting

**(ii) Salt-water method:** A salt solution will irritate the larvae, causing them to wiggle out of holes in the fruit. To prepare a salt-water solution, dissolve one-fourth cup plain salt in four cups warm water. Place fruit in a shallow white pan, and cover with salt solution. Observe the fruit closely for at least 10-15 minutes to see if larvae exit the fruit out of egg-laying holes. Detection of small larvae might require the use of a hand lens and good lighting. Count as quickly as possible while they are still alive and moving.

## INSECTICIDAL CONTROL

Because this pest is so new to Missouri, there has been no research on insecticidal treatments to manage SWD. Therefore, recommendations are based on findings from other states. Before you spray, confirm that you have SWD in your area by hanging out traps or checking fruit. Sprays must be timed to kill adults before they lay eggs; sprays will not control larvae already in the fruit. Always read product labels to make sure pesticides are registered for use on the fruit or berry being treated.

If monitoring indicates a need to spray, the application should be made about two to three weeks before berry harvest. Depending on the residual effectiveness of the insecticide, a second application might be needed five to 10 days later. In the case of indeterminate fruiting berries, such as raspberries or strawberries, sprays might need to be repeated to keep populations low during summer and fall. You can use monitoring traps to help you decide if and when more spraying might be needed. Be sure to wait the interval specified on the pesticide label before harvesting fruit. Thus far, an economic threshold for SWD has not been developed. MSU recommends a conservative approach in which fly capture on your farm triggers protection of fields if berries are at a susceptible stage.

***For conventional commercial raspberry and blackberry farmers:*** A number of registered insecticides have been very effective against SWD in laboratory trials, including some recent trials done at MSU. The most effective chemicals are organophosphate, pyrethroid and spinosyn classes of insecticides. Insecticides with fast knockdown activity have performed well at protecting berries from SWD. These include malathion, which is an organophosphate insecticide; the pyrethroids, Danitol<sup>®</sup>, Mustang Max<sup>™</sup> and Brigade<sup>®</sup>; and the spinosyns, Delegate<sup>®</sup> (spinetoram) and Entrust<sup>®</sup> (organic). Delegate 25WG<sup>®</sup> has been labeled for control of SWD in various crops in all states. Neonicotinoids, such as Provado<sup>®</sup> and Actara<sup>®</sup>, are considered weakly active on SWD flies; they are not recommended for control, according to MSU.

***For organic commercial raspberry and blackberry farmers:*** In bioassays conducted by MSU, Azera<sup>™</sup> and Pyganic<sup>®</sup> performed less effectively than Entrust<sup>®</sup>. However, pyrethrum class insecticides can still be a valuable tool for organic growers because the Entrust<sup>®</sup> label requires rotation to another product for resistance management. Pyganic<sup>®</sup> or Azera<sup>™</sup> can very well fit that need. Entrust<sup>®</sup> is the only organic product with residual activity (five to seven days of control). While it doesn't appear to provide residual control, Pyganic<sup>®</sup> applied at five-day intervals at the high labeled rate has reduced SWD populations in California. Organic growers in the Pacific Northwest have used two to three applications of Entrust<sup>®</sup> (spinosad) effectively to protect fruit in the pre-harvest period; this worked when they alternated Entrust<sup>®</sup> with Pyganic<sup>®</sup> (pyrethrum) to extend the period of control. Using two alternating applications also reduces the chance of resistance development.

***For homeowners:*** The insecticide spinosad (e.g., Monterey Garden Insect Spray) is effective and has the least negative environmental effects of currently available products. Some spinosad products are sold to be applied with a hose-end sprayer, but a compressed-air sprayer will give more reliable coverage. Fertilome<sup>®</sup> Borer, Bagworm, Tent Caterpillar and Leafminer Spray (spinosad 0.5%) and Green Light<sup>®</sup> (spinosad 0.5%) are also labeled for use in bushberries and caneberries against fruit flies. The organophosphate insecticide malathion is widely available and will also control SWD. However, malathion is very toxic to bees and natural enemies of other pests in the garden. Care must be taken to keep the application on the target plant and to avoid drift and runoff. Improper application also can result in injury to cherry trees. Because of the potential negative impact of malathion, use it only where you are certain you have or will have a SWD infestation. It would be worth using either if you had a problem last year or if you have trapped and positively identified insects this season as SWD.

**Table 1.** Insecticides for SWD control. Products are not complete listings of all available options. (H) signifies that the product is registered for homeowner use; (O) signifies an organically compatible insecticide. Not all products are labeled for all fruits; read the label to ensure that your product matches the site. To minimize resistance buildup, alternate the MoA (mode of action) of the product you choose on a yearly basis.

Product Name	Active Ingredient	Class	Mode of Action (MoA)	Pre-harvest Interval
Azera® (O)	Pyrethrins and Azadirachtin		3A (Pyrethrins) and unknown (Azadirachtin)	0 days
Danitol® 2.4 EC	Fenpropathrin	Pyrethroid	3A	3 days
Delegate® <sup>1</sup>	Spinetoram	Spinosyn	5	1 day
Entrust® <sup>1</sup> (O); Fertilome® <sup>2</sup> Borer, Bagworm, Tent Caterpillar and Leafminer Spray(H); Green Light® <sup>2</sup> (H),	Spinosad	Spinosyn	5	It varies depending on the crop
Malathion 8F (H)	Malathion	Organophosphate	1B	1 day
Mustang MAX™ <sup>3</sup>	Zeta – cypermethrin	Pyrethroid	3A	1 day
Pyganic® (H), (O)	Pyrethrins		3A	0 days
Radiant® SC <sup>4</sup>	Spinetoram	Spinosyn	5	1 day
Sevin® (H)	Carbaryl	Carbamate	1A	7 days

<sup>1</sup>For use against SWD on various crops anywhere in the U.S.

<sup>2</sup>Labeled for use against fruit flies (SWD is a “vinegar” fruit fly)

<sup>3</sup>For use against SWD in strawberries in 12 U.S. states, not including MO

<sup>4</sup>For use throughout the U.S., except in NY

*Registrations and recommendations change, so keep informed through SWD websites and your local extension educator. For all pesticides, consider re-entry intervals (REI), pre-harvest intervals (PHI), surface water and buffers, and safety to pollinators and other beneficial arthropods (insects, arachnids and crustaceans) when selecting a product. Remember to rotate classes of insecticides to delay possible development of insecticide resistance. To address pollinator safety, make early morning or late evening applications of all products.*

*As with all uses of an insecticide to control pest insects, the label is the legal document that provides the official guidance on the appropriate use pattern. Refer to the label and any supplemental labels for the full restrictions on use in your crop. A good place to locate all the most up-to-date information is through <http://www.cdms.net/labelsmsds/LMDefault.aspx>. If new supplemental labels are developed allowing expanded uses for SWD control, those will be posted at this site.*