

## Detecting larval infestations and insecticidal options for Spotted Wing Drosophila, a significant pest of small fruit crops in Missouri

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Spotted Wing Drosophila (SWD) is a very serious new invasive pest that attacks small fruit crops, some stone fruits (cherry, nectarine, peach), 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, SWD females have a serrated egg-laying device (called ovipositor) to cut a slit into the skin of intact fruit to lay their eggs. This makes SWD a more significant pest. An identification and monitoring guide has been developed by the Lincoln University (LU) IPM program. It is available at: <http://www.lincolnu.edu/web/programs-and-projects/ipm>.

This article discusses how to detect larval infestations and management of SWD based on key IPM components listed below. A SWD control program starts with monitoring. If SWD is detected, chemical control is necessary to preserve the marketability of fruit. For commercial growers, some chemicals already used in your IPM program for similar pests should give effective control of SWD.

1. Monitor fields with traps and check them regularly.
2. Check trapped flies to determine presence and number of SWD.
3. If SWD are found and fruit are ripening or ripe, apply effective insecticides registered for that crop to protect the fruit until harvest is completed.
4. Continue monitoring to evaluate your management program, this time checking traps twice a week, and respond quickly if needed.
5. Use cultural controls where possible (mainly removing old, infested, or damaged fruit from the field) to reduce SWD food resources.
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 keep SWD controlled through harvest. However, given the potential for rapid population increase by SWD, especially during fall red raspberry season, means that active management through monitoring of 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 may be noticed as red patches left on the receptacle when the berries are picked. The fruit of raspberries and blackberries may also begin to collapse in areas where the larvae are feeding inside. Opening the berries may reveal the larvae within the fruit, but it is time consuming to check individual berries. Fruit can be selected in 2 ways, either by collecting fruit at random, or by collecting only fruit you suspect is infested (i.e., the presence of oviposition scars and/or soft spots on the fruit).

**(i) Sugar-water method:** Place fruit in a plastic “ziplock” bag and crush lightly to break the skin. Then add a sugar-water mixture (4 cups water to every 1/4 cup sugar). SWD larvae will float in the liquid and the fruit will sink. Detection of small larvae may require the use of a hand lens, and 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 1/4 cup plain salt in 4 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 larvae exiting fruit out of egg-laying holes. Detection of small larvae may 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 and 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, as 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 you are treating.

If monitoring indicates a need to spray, the application should be made about 2 to 3 weeks before berry harvest. Depending on the residual effectiveness of the insecticide, a second application may be needed 5 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 additional sprays 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 commercial raspberry and blackberry farmers – conventional.*** 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. Under field conditions, insecticides with fast knockdown activity have performed well at protecting fruit. Insecticides with fast knockdown activity have performed well at protecting berries from SWD. These include Malathion which is an organophosphate insecticide; the pyrethroids Danitol, Mustang Max, and Brigade; and the spinosyns Delegate (spinetoram) and Entrust (organic). Delegate 25WG has been labeled for control of SWD in various crops in all States. Neonicotinoids such as Provado and Actara are considered weakly active on SWD flies and are not recommended for control (MSU info).

***For commercial raspberry and blackberry farmers – organic.*** In bioassays conducted by MSU with Azera and Pyganic these options performed less effectively than Entrust. However, pyrethrum class insecticides can still be a valuable tool for organic growers because the Entrust label requires rotation to another product for resistance management. Pyganic or Azera can very well fit that need. Entrust is the only organic product with residual activity (5-7 days control). While it doesn't appear to provide residual control, Pyganic® applied at 5 day intervals at the high labeled rate has shown to reduce SWD populations in California. Organic growers in the Pacific Northwest have used 2-3 applications of Entrust (spinosad) effectively to protect fruit in the pre-harvest period alternated with Pyganic (pyrethrum) to extend the period of control and also to reduce the chance of resistance development.

***For home-owners.*** 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® Borer, Bagworm, Tent caterpillar and Leafminer spray (spinosad 0.5%) and Green Light® (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, but malathion is very toxic to bees and natural enemies of other pests in the garden so care must be taken to keep the application on the target plant and avoid drift and runoff. Improper application also can result in injury to cherry trees. Because of the potential negative impact of malathion in the garden, use it only where you are certain you will have a SWD infestation, either because you had a problem last year or from trapping and positively identifying 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 on all fruits; read label to ensure that your product matches the site. Alternate the MoA (mode of action) of the product you choose on a yearly basis to minimize resistance build-up.

Product name	Active Ingredient	Class	Mode of Action (MoA)	Pre-Harvest Interval
Azera (O)	Pyrethrins + 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> ; Ferti-Lome <sup>2</sup> Borer, Bagworm, Tent caterpillar and Leafminer spray; Green Light <sup>2</sup> (H), (O)	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 in all US states

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

<sup>3</sup>For use against SWD in strawberry in 12 US states, MO is not included

<sup>4</sup>For use in all US states except NY

*Registrations and recommendations change, so keep informed through SWD websites and your local Extension educator. For all pesticides, consider REIs, PHIs, surface water and buffers, and safety to pollinators and other beneficial arthropods 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 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.*