

SWD Management Recommendations for Michigan Blueberry Growers

Rufus Isaacs¹, Steve Van Timmeren¹, John Wise^{1,2}, Carlos Garcia-Salazar³, and Mark Longstroth⁴

1. Department of Entomology, 2. Trevor Nichols Research Complex, 3. Ottawa County MSU Extension, 4. Van Buren County MSU Extension

BACKGROUND

The spotted wing drosophila (SWD) is an invasive pest of berries, stone fruit, grapes, and some pome fruit crops. It is native to Asia but was detected in North America for the first time in California during 2008. Since then, it has spread throughout many of the primary fruit production regions of the United States. In Michigan, the first SWD were found after blueberry harvest in 2010. So far, it has been detected in 22 counties across the state (Figure 1), and additional detections are expected as time progresses. For detailed fact sheets, identification guides, and how-to videos on monitoring for this pest, see the online resources at www.ipm.msu.edu/SWD.htm

SWD flies look similar to the many species of small vinegar flies that typically infest fruits and some vegetables in late summer. Unlike other vinegar flies, female SWD have a serrated ovipositor, or egg-laying device, used to cut a slit into the skin of intact fruit to lay their eggs. This makes SWD a more significant pest than the native vinegar flies that require damaged fruit to lay eggs. Soft skinned fruit such as blueberries, raspberries, and blackberries are at the greatest risk.

Larval feeding by SWD causes fruit to collapse and increases the risk of the small white larvae being found at harvest time. Because this insect has already been found in major blueberry production regions of Michigan, it will be important to incorporate the control of the SWD into our current blueberry IPM programs to ensure that the impact of this new pest is minimized. Effective management of SWD consists of these key components:

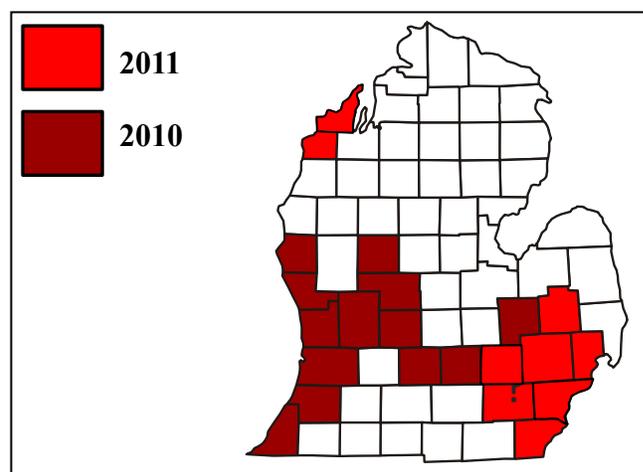


Figure 1. Michigan counties where SWD were first detected in 2010 or 2011.

1. Monitor fields with traps and check them regularly – this is an essential first step!
2. Check trapped flies to determine presence and number of male and female SWD.
3. If SWD is found, apply effective insecticides registered for blueberries to protect the fruit (see MSU Fruit Management Guide, MSU Extension publication E154).
4. Continue monitoring to evaluate your management program, and respond quickly if needed.
5. If possible, remove leftover fruit on the bush or in waste piles to reduce SWD food resources.
6. Stay informed. These recommendations are subject to change based upon new information. Find the latest information at our SWD website: www.ipm.msu.edu/SWD.htm

MONITORING

The most important step in managing SWD is to determine whether they are present in your fields, and when they may become active. Monitor for SWD from fruit set until the end of harvest. This will help identify the start of fly activity, although the most important monitoring period is from fruit coloring until the crop is harvested, when the fruit are susceptible to SWD infestation.

These flies can be trapped using a simple monitoring trap consisting of a plastic 32oz cup with ten 3/16"-3/8" holes around the upper side of the cup, leaving a 3-4 inch section without holes to facilitate pouring out of the liquid attractant, or bait (Figure 2). The holes can be drilled in sturdy containers or burned with a hot wire or soldering iron. The small holes allow access to vinegar flies, but keep out larger flies, moths, etc. The traps can be baited with one inch of apple cider vinegar. To help ensure that trapped flies do not escape, a small yellow sticky trap can be placed inside, hung on a paper clip. This can be attached with hot glue to the inside of the lid. The traps will also work without the yellow sticky insert, but then a drop of unscented dish soap should be added to the vinegar to ensure flies remain trapped in the liquid.



Figure 2. Trap for capturing SWD adult flies.

In 2011, we found that SWD traps were more attractive to SWD when they were baited with a yeast-sugar mix compared with the apple cider vinegar. This mix is made by combining 1 Tablespoon of active dry yeast (we use Red Star brand) with 4 tablespoons of sugar and 12 oz of water. This ratio produces a solution that ferments and the flies are attracted to the odors. Using this mix, SWD were trapped earlier, more of the traps caught SWD, and SWD was trapped in greater numbers than with the apple cider vinegar. Although these traps are harder and messier to service, the yeast bait is less expensive than the apple cider vinegar traps, and the benefits of earlier detection are obvious when needing to protect crops from infestation. Traps baited with yeast will collect many flies, so sorting through these traps will take more time. For blueberry growers in Michigan, we recommend a minimum of one yeast-baited trap for SWD every 5-10 acres.

Any traps for SWD should be hung in a shaded area of the bush canopy in the fruit zone, using a wire attached to the top of the trap. Make sure the trap is clear of vegetation with the holes exposed so that SWD can easily fly in.

Traps should be checked for SWD flies once a week at a minimum, by looking on the yellow sticky trap and in the liquid. If you use a yeast trap, checking only the sticky trap can be used as a way to reduce the amount of time needed to service the trap. However, checking the trap insert and liquid will provide the best ability to detect early fly activity. At each check, fresh bait should be swapped out and disposed of, away from the trap location. Spotted wing drosophila captures should be recorded each week in a log book.

Identification of flies

Vinegar flies are small (2-3 mm) with rounded abdomens. Traps catch both male and female SWD flies and native species of vinegar flies. This means that SWD need to be distinguished from the others when checking the traps. Identification of SWD flies becomes easier with practice, especially when using a hand lens to examine the wings of trapped flies. Some native flies have dark patches on the wings, but will not have the distinctive dark dot that is present on the wings of SWD males (Figure 3).

Female SWD do not have dots on the wing, so their ovipositor needs to be examined closely in search of its serrated characteristics. Use of a 30 X magnification hand lens or microscope is needed to detect the distinctive saw-toothed ovipositor on female SWD. This is challenging to detect, so we recommend that growers and scouts focus on checking more traps for males than be spending lots of time identifying females.

If you check a trap that has flies matching these descriptions but you are unsure of their identification, contact your local MSU Extension office or a trained scout or crop consultant for assistance.

For flies suspected of being SWD that are trapped in counties where this insect has not yet been reported (Figure 1), we encourage growers, scouts, and consultants to place flies trapped on the sticky traps into another container (or pull those floating in the vinegar out of the liquid and place in a small vial) then send them for identification to: Howard Russell, SWD Monitoring, Diagnostic Services, 101 CIPS, Michigan State University, East Lansing, MI 48824-1311. *Include the location and date of collection along with your contact information.*

A photographic guide to identifying SWD is provided at the MSU SWD website.

Further aid with identification can be gained from the online key provided by Oregon Department of Agriculture at swd.hort.oregonstate.edu/files/webfm/editor/ID_D_suzukii_060210_sm.pdf



Figure 3. Male spotted wing *Drosophila* fly with distinctive wing markings. (3 mm long).

Sampling fruit for larvae

If fruit are suspected of being infested, larvae can be sampled using a fruit dunk flotation method. Either collect a standard sample of fruit, or only suspicious (oviposition scars and soft spots) fruits. If you are sampling in fields, place fruit in a plastic “ziplock” bag and crush lightly to break the skin. Add a salt-water mixture (4 cups water to every 1/4 cup salt). Leave the fruit in the mixture for an hour, then check it. *Drosophila* larvae will float in the liquid making them easier to see, plus they should be visible as small white larvae against the blue colored liquid.

Detection of small larvae may require the use of a hand lens, and this works well with a light behind the bag to shine through onto the larvae. If this is being done indoors, place suspect berries on a tray and pour the salt solution over the lightly crushed fruit. Observe the fruit after an hour to see if larvae are present. Note that this method doesn’t allow for differentiating between SWD larvae and other similar species. The only way to be sure larvae in the fruit are SWD is to rear them until they are adult flies.



Figure 4. Relative size of blueberry maggot larva (top) and SWD larva (bottom).

A practical way to do fruit extraction for detecting *drosophila* larvae is to mix a large jug of the salt solution to keep on hand, in a truck or back at the barn. Then take fruit samples into ziplock bags marked with the date and field. Once samples are taken, lightly crush the berries and add the solution and leave for at least an hour. Then the samples can all be assessed at the same time.

Berries can also be sampled using the standard boil test used by processors for blueberry maggot detection. To do this, cover a sample of berries with water and boil for one minute then pour the fruit and liquid onto a mesh-covered frame over a tray and mash the fruit with the back of a spoon. Lightly wash through with water and look in the tray for larvae. This method works very well for detecting SWD larvae, which are smaller than blueberry maggot (see photo). It should be noted that young blueberry maggot larvae are difficult to distinguish from SWD larvae, but specimens can be separated by trained entomologists. Although the boil test is used as a standard sampling method for checking fruit by processors, it would be better to detect any potential infestation in the field and control it before any infestation reaches the processor.

SWD CONTROL OPTIONS

Our 2011 trapping suggests that typical insect control programs kept this fly suppressed through the end of harvest. However, given the potential for rapid population increase by SWD, active monitoring through the ripening period is needed. This will allow rapid response to detections of SWD.

There is no economic threshold for SWD, so we are currently recommending a conservative approach in which fly capture on your farm triggers protection of fields if berries are at a susceptible stage. If fruit are ripe or are ripening and SWD flies are trapped, growers should: 1) Continue monitoring to assess fly distribution; 2) Implement cultural controls where possible; 3) Protect fruit through to harvest using registered insecticides. Female SWD are able to lay eggs into blueberries from the time of first coloring through harvest. This period is the window of susceptibility to SWD. If drosophila larvae are found, the available management options and best strategies will depend on the scale of infestation, whether the field is certified organic or not, and the timing relative to harvest date.

Laboratory tests showed no indication of blueberry varieties being more or less susceptible to infestation. But, because SWD populations tend to increase in the later part of the summer, we expect late-harvested cultivars to experience higher pressure from SWD than those that are harvested early.

Cultural controls

Cultural controls can help reduce reproduction and survival of flies and should be included in the overall plan for SWD management. Cultural controls include scheduling timely harvests and removing over-ripe fruit from fields and then disposing of them properly, to minimize host plant resources for SWD. In small fields this may be done by hand, but that is impractical in large farms. Removing wild host plants that can harbor SWD such as wild grape, pokeberry, honeysuckle, nightshade, dogwood, spicebush, autumn olive, raspberry, blackberry, etc. near crop fields is another potential strategy, but again this approach has not been tested in our region.

If infested berries are found either in the field or at the processor, there are some strategies for killing SWD before they complete development and emerge to continue infesting fields. Recent research in Oregon has shown that bagging fruit inside clear or black plastic bags works well to prevent fly escape, and placing these in the sun will kill SWD. If there is a large pile of fruit, these can also be solarized in which 1-2 ml clear plastic sheeting is placed over the fruit in a sunny location and sealed well around the edge using soil. Simply burying infested fruit is not effective as flies can survive in the cool soil and emerge, even from 2 feet depth.

Freezing berries is another way to kill SWD, and refrigerating them will stop any further development of larvae, and may kill them after long periods of refrigeration. Keeping berries cool during the supply chain from processor to market to customer kitchens will also prevent larval development.

Chemical controls

Michigan blueberry growers already use IPM programs to manage insect pests (such as the blueberry maggot fly) during the summer months. Many of the insecticides used for this pest will provide some protection against SWD, including the pyrethroid, neonicotinoid, and spinosyn chemical classes. However, members of the neonicotinoid class (e.g. Provado, Assail, Actara) are considered weakly active on SWD and are not recommended for its control.

It is important to realize that whereas blueberry maggot has only one generation a year and takes a week from emergence to egg-laying, SWD females can start laying eggs one day after emergence. This means that monitoring should be a high priority, to detect the flies quickly so that management decisions can be made. SWD will complete 5-6 generations under typical Michigan conditions and there will be continuous activity once the flies become active. For these reasons, if SWD are detected, spray intervals should be tightened to prevent crop infestation before harvest. Sprayers should be calibrated to provide thorough coverage of fruit, especially in the center of the bush where the flies like to hide in the shade. Applications that attempt to cover several rows at a time are unlikely to achieve good coverage of fruit on all the rows.

A number of registered conventional insecticides have shown to be effective against SWD in recent MSU trials. These include Imidan and Malathion (see note below) which are organophosphate insecticides; the carbamate Lannate; the pyrethroids Asana, Danitol, Mustang Max, Brigade and Bifenture; and the spinosyns Delegate and Entrust (organic). Insecticides with fast knockdown activity have performed well at protecting fruit. These insecticides should be rotated among the classes to reduce the chance of resistance developing.

Note that the new malathion product available in 2012 has a reduced rate on the label of 1.25 pints per acre compared with the 2 pints per acre previously registered. We do not have any trials at this lower rate to know how effective this might be. Product with the old label can still be used at the 2 pint rate.

Organic growers can use Entrust at 2 oz/acre to protect fruit in the pre-harvest period, and this can be rotated with Pyganic to stretch the period of coverage and to reduce the chance of resistance developing. It is important to note that Entrust provides ~5 days residual control and Pyganic provides ~3 days of control. Note also that Entrust has a 9 oz/acre seasonal limit (see below for more details).

The table on the next page provides a list of insecticides registered for use in blueberries that have also shown high activity against SWD. Selection of insecticides for SWD control should take into account the other pests present, harvest date, re-entry restrictions, and potential impacts on existing IPM programs. Most of these insecticides are also active on blueberry maggot and most will have some activity on Japanese beetles that may be active at the same time of the season. Always follow the specific label restrictions for blueberry. The level of control achieved will depend on the SWD population, timeliness of application, coverage of fruit, and product effectiveness.

Insecticides for SWD control in blueberry

Class	Trade name	Active ingredient	PHI (days)	Days of activity [#]
Organophosphate	Malathion*	malathion*	1*	5-7*
	Imidan	phosmet	3	7
Pyrethroid**	Mustang Max	zeta-cypermethrin	1	7
	Danitol	fenpropathrin	3	7
	Asana	esfenvalerate	14	7
	Brigade	bifenthrin	1	7
	Hero	bifenthrin+zeta cypermethrin	1	7
Carbamate	Lannate	methomyl	3	3-5
Spinosyn	Delegate	spinetoram	3	7
	Entrust (organic)	spinosad	3	3-5
Pyrethrum	Pyganic (organic)	pyrethrum	0.5	2-3

*The new label for Malathion 8F allows only 1.25 pints per acre, and this rate has not been tested in efficacy trials. A maximum of 3 applications are allowed per season. Also check the label for your specific Malathion formulation for the correct PHI. Most are 1 day, but some may allow 0.5 day PHI.

**Residual control will be reduced during hot sunny weather.

Estimated residual activity from experience with other insect pests in Michigan and from SWD studies in Oregon.

When selecting an insecticide for SWD control in blueberry, consider the REI, PHI, and especially the MRL restrictions in the destination country if exporting fruit. See the label for restrictions on distance to surface water and safety to pollinators and other beneficial arthropods. Remember to rotate classes of insecticides to delay development of insecticide resistance. This is especially critical in organic production where there are only two classes of insecticide registered for use against SWD.

Organic blueberries: Organic fruit growers should be aware that the insecticidal control tools available to them are less effective than conventional insecticides against SWD, and will require more timely application. However, experience in the west coast states indicates that SWD can be controlled in organic production through more intensive monitoring, timely application if flies are detected, and shorter intervals between sprays. Where possible to implement, cultural controls will also be important to help reduce the overall population level.

Organic insecticide options are limited but the experience so far in California and Oregon indicates that Entrust and Pyganic are the two most effective options for SWD control in organic production. Entrust is limited to three applications in a 30 day period followed by 30 days without any Entrust application, and there is a 9 oz/acre seasonal maximum. There is a 2oz Entrust label for suppression of SWD, with a 2 oz/acre rate listed. Until there is more information available, we are recommending the 2 oz/acre rate of Entrust. Rotate Entrust with the organic pyrethrum insecticide Pyganic to achieve some resistance management. Pyganic EC 5.0 is labeled at 4.5-18 oz/acre in blueberries, and using the higher end of this rate range has provided five days of residual control in recent University of California trials.

FOLLOW FUTURE DEVELOPMENTS

Spotted wing drosophila is a new pest to North America and has only recently been detected in Michigan. There is active research and monitoring underway to minimize its impact on fruit production. As new information is available, this will be posted online at www.ipm.msu.edu/SWD.htm and will be distributed to fruit growers via MSU Extension programs.