

Spotted wing drosophila (*Drosophila suzukii*) is a fruit fly native to Japan and Southeast Asia. First discovered in the United States in 2008, it has spread throughout North America and was detected in Kansas in 2013. This insect pest attacks a wide range of berry crops including blackberries, blueberries, boysenberries, raspberries, strawberries, and grapes. Raspberries appear to be more susceptible than blackberries, blueberries, and strawberries. The pest may not bother June-bearing strawberries. Wild berry crops, mulberries, and elderberries are also affected. In addition to berries, this pest attacks tree fruits such as apples, cherries, figs, nectarines, peaches, persimmons, and plums. Adult populations increase in mid-to-late summer and remain high through early fall as berries and fruits ripen. Late-season crops are particularly vulnerable.

Spotted wing drosophila has been detected in high-tunnel production systems, possibly attracted by the warmer temperatures and wind protection provided throughout the growing season. This pest has been known to attack tomatoes in high tunnels, but tomatoes do not appear to be a preferred host crop. Because spotted wing drosophila



Figure 1. Spotted wing drosophila female (left) and male (right). Males have a black spot near the tip of the forewings, which is absent on females.

is not a quarantined or regulated pest, it may have spread rapidly by means of human transportation. This publication addresses identification, biology, monitoring, and management of this emerging pest.

## Identification and Biology

The spotted wing drosophila resembles other native vinegar and fruit flies. Adults are 2 to 3 mm long with red eyes, a yellow-brown thorax, and black stripes on the abdomen. Active during the day, they prefer moist conditions and temperatures between 68 and 70°F. Activity decreases at temperatures above 85°F. Adults are susceptible to moisture loss and may die within 24 hours without water. Spotted wing drosophila males can be distinguished from native vinegar and fruit flies by a

spot near the tip (outer edge) of each wing and two dark bands on the front legs (Figure 1). The spot may take 8 to 10 hours to appear after emergence. The female does not have a wing spot but can be distinguished from other vinegar and fruit flies by the large, saw-like ovipositor used for laying eggs. Two rows of serrations (Figures 2–4) allow the female to pierce the skin of unripened, immature fruit to deposit eggs. More than one egg may be laid in each berry or fruit (Figure 5). A 10x or higher magnifying lens is needed to observe egg-laying sites, which may allow soft rots and fungal diseases to enter.

## Life Cycle

Adult females live approximately 2 weeks and deposit between 100 and 300 eggs from spring through fall. The number of eggs depends on the temperature and the host plant. Life stages are egg, larva, pupa, and adult. Time required to complete the life cycle varies with temperature; warmer temperatures tend to reduce the time required to complete the life cycle. Studies have shown that the spotted



Figure 2. Female serrated ovipositor.



Figure 3. Close-up of female ovipositor.



Figure 4. Ovipositor exiting the abdomen.



Figure 5. Eggs in peach fruit.



Figure 6. Larva in fruit.

wing drosophila life cycle may take 23 days at 59°F and 10 days at 77°F. Eggs hatch into white larvae (Figure 6) that feed inside berries or fruit for 5 to 7 days. Typically, larvae pupate inside fruit, but they also may pupate outside the fruit unlike other vinegar and native fruit flies. Females are capable of laying eggs almost immediately after emerging.

A key difference between spotted wing drosophila and other fruit flies is that most native fruit flies lay eggs into damaged or rotting fruit. Spotted wing drosophila females attack healthy, ripening berries or fruit as well as damaged or split fruit. In general, darker colored fruit is more susceptible. Females prefer to lay eggs in thin-skinned berries or fruits. Thick-skinned varieties may be less susceptible.

Spotted wing drosophila may attack berries and fruits throughout the growing season. They continue to lay eggs in fallen fruit after harvest, and offspring develop in fallen or rotting berries or fruit. As a result, this insect pest reproduces rapidly generating multiple generations per year. Spotted wing drosophila overwinters as an adult, and winter severity may influence survival.

## Monitoring

Traps can be used to monitor spotted wing drosophila populations and help time insecticide applications. Historically, fermentation-based traps containing apple cider vinegar or yeast/sugar solutions were used to monitor pest populations. However, because spotted wing drosophila is attracted to ripe, not overripe, berries or fruit, traps should be placed in fields when fruit starts coloring. Once berries or fruit ripen, they become less attractive, and native fruit flies may be captured instead. Research has shown that traps with red and black banding tend to be more attractive to adults. One trap, called CAPtiva, is available for use in orchards and is sold by Marginal Design, Oakland, Calif. ([marginaldesign.com](http://marginaldesign.com)). Traps should be positioned in the shady, humid interior

of plants where the pest prefers to reside. Females are typically present earlier in the season than males, so more females will be captured at first. Colored sticky cards are not effective for trapping adults. Mass trapping may not suppress adult spotted wing drosophila populations.

## Management

### Cultural Controls and Sanitation

Spotted wing drosophila can be managed with cultural controls throughout the growing season. These include harvesting berry and fruit crops early and removing and destroying overripe, infested, or culled fruit. It is also recommended that potentially infected berries and fruits are buried 2 feet deep to kill adults, larvae, and pupae. To kill eggs and larvae, collect fruit, place in sealed plastic bags, and expose bags to full sunlight for a week. Prevent infestations by removing wild host plants such as grapes, blackberries, raspberries, American pokeweed, crabapples, dogwood, and Japanese yew from nearby locations to keep the fruit of these plants from serving as reservoirs for spotted wing drosophila populations during the growing season. Growers also may want to place protective netting over berry crops. It should be installed after pollinators (bumble bees and honey bees) have finished pollination but before fruit ripens to keep flies from becoming trapped inside. Because warm temperatures associated with compost piles may enhance spotted wing drosophila development, growers should avoid composting infested or culled fruit.

### Insecticides

Insecticides can be used to suppress spotted wing drosophila populations during the growing season. Those effective against the pest include malathion, carbaryl (Sevin), spinosad (Spintor and Success), spinetoram (Delegate and Radiant), and a number of pyrethroid-based insecticides with the active ingredients: beta-cyfluthrin, bifenthrin, esfenvalerate, fenpropathrin, and zeta-cypermethrin. The neonicotinoid insecticides (acetamiprid, imidacloprid, and thiamethoxam) tend to be less effective than other insecticides against adults. Check the label to determine if an insecticide is registered for use against the pest. Because spotted wing drosophila is a relatively new insect pest, reliable treatment thresholds have not been established.

Insecticides should be applied from the time fruit begins to color until harvest. Because this pest prefers to live within the plant, it may be difficult to suppress populations with insecticide spray applications. Application timing and coverage are critical. Insecticides must be applied in time to kill adults before egg-laying because spraying will not kill larvae already inside the berry or fruit. For better fruit coverage, growers may need to increase water volume or

use a surfactant such as a spreader-sticker. Pruning fruit trees to open up the canopy may improve effectiveness. Rains can reduce longevity of insecticide residues, so repeat applications may be required. The interval and frequency of insecticide spray applications also can influence the effectiveness of spotted wing drosophila suppression programs. Because of the number of generations per year, spraying once or twice a week may be warranted.

Application frequency varies depending on the environment (e.g., rainfall and temperature) and growing conditions. Frequent applications needed to treat multiple generations per year may result in intense selection pressure and lead to insecticide resistance. Consequently, it is critical to use insecticides with different modes of action and to rotate them to reduce the development of insecticide resistance.

Insecticide applications may harm beneficial insects and mites that regulate populations of pest mites, leafminers,

and scales. Two insecticides available to organic producers are spinosad (Entrust) and pyrethrins (Pyganic). Both have short residual activity (1 to 3 days), and spotted wing drosophila females exposed to Pyganic may recover to lay fertile eggs. In addition, certain spotted wing drosophila populations in California have developed resistance to Pyganic.

### **Biological Control**

Although a number of predators may feed on spotted wing drosophila pupae and adults, typically they do not consume enough of either life stage to substantially diminish populations. Growers should understand the biology and life cycle of spotted wing drosophila to effectively manage this insect pest in berry and fruit crop production systems. Management requires a holistic approach, which includes cultural controls, sanitation, monitoring, and appropriate application of insecticides.

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