Spotted wing drosophila

adding cost to fruit production

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Spotted wing drosophila (SWD), *Drosophila suzukii* (Matsumura), was first detected in California in 2008. The pest continues to catch growers by surprise as it spreads across North America and has now been confirmed in 41 U.S. states (Fig. 1) and seven Canadian provinces (Alberta, British Columbia, New Brunswick, Newfoundland, Nova Scotia, Ontario, and Quebec). In 2008, infestations in California and the Pacific Northwest were estimated to cause $511 million in losses to the blueberry, cane berry, cherry, and strawberry industry.

These softer fruits, including plums, grapes, and figs, are particularly susceptible to egg deposition. Larvae developing in fruit make it unmarketable. Apples, pears, peaches, and nectarines are potentially susceptible but are typically harvested before fruit are soft enough for egg laying. All commercially produced fruits are managed for SWD in such a way to meet a zero tolerance for infested fruit in the fresh market. Management has been a challenge because of difficulties detecting and predicting infestations as well as the very short lifecycle of the pest. Under ideal temperatures, eggs deposited one day can become new adults in as little as 10 days.

"SWD has significantly changed the model of small-fruit production," according to Vaughn Walton, research entomologist at Oregon State University and director of a team of scientists working on SWD. "There are growers now spending $250 to $350 per acre on materials just to manage SWD, and this does not include labor or fuel to make the applications." Growers in eastern states have reported insecticide costs up to $400 per acre.

The affected small-fruit industries in Oregon have an annual farm-gate value of around $200 million. Before SWD, less than $1 million was spent on pest management, primarily on fungicides, but last year, the costs to these industries to manage SWD were estimated to be $15 million.

Key biology

The SWD is native to Southeast Asia, first detected in Japan in 1916, and has been established in Hawaii since the 1980s. SWD surfaced in Spain in 2008 and is now established in many countries in western Europe. Its ability to be transported in infested fruit speeds its spread.

Typically, *Drosophila* species infesting fruit deposit eggs in only overripe or damaged fruit. SWD females however, have a serrated ovipositor (Fig. 2a), allowing them to lay eggs under the skin of ripening fruit. Freshly injured fruit may be marred by oviposition scars, but these are difficult to detect without magnification.

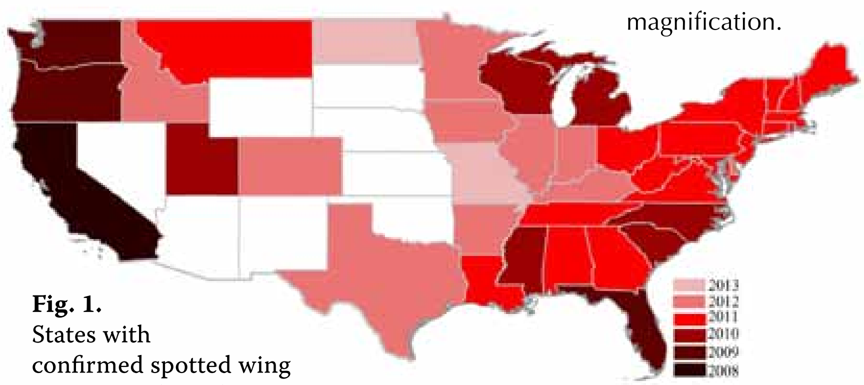

Fig. 1. States with confirmed spotted wing drosophila (SWD) detections by year. Source: Hannah Burrackand and colleagues.

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Fig. 2a, left: On female SWD, the serrated ovipositor is a distinctive morphological feature, longer than other Drosophila species and with two rows of serration. Photo by Martin Hauser. **Fig. 2b, center:** Males have distinct dots on tips of wings; females do not. Photo by Gevork Arkelian. **Fig. 2c, right:** Males also have two dark bands on the forelegs. Photo by Martin Hauser.

Rot spots may develop within a day or two as secondary pathogens infect the oviposition site. Fruit begin to collapse as developing larvae feed on the flesh, and fruit typically drop if not harvested.

SWD adults are 2 to 3 mm long. Males have one distinctive spot on the leading edge of each wing (Fig. 2b) and two dark bands on each foreleg (Fig. 2c). Females do not have these characteristics but have the distinctive ovipositor. A 10 to 30x hand lens is sufficient to identify males; females are typically identified using a microscope.

Adults emerge and mate when ambient temperatures are above 50°F, and they survive for 20 to 30 days. Females lay in excess of 350 eggs, which hatch within 12 to 72 hours. Larval feeding lasts five to seven days. Pupation occurs either inside or outside of the fruit. Adults emerge from pupae in 4 to 15 days, for a total egg to adult lifecycle of 10 to 25 days.

SWD overwinter as mature adults and have been found harboring in moss, tree bark, and other protected sites in and around fruit plantings. Peak activity occurs when ambient temperatures are around 68°F; activity drops below 50°F and above 86°F.

Monitoring and management

Key advances have been made in integrated pest management strategies. “We now know that in blueberries and raspberries, the susceptible stage does not begin until the crop starts to ripen. Earlier than that, when there is green or immature fruit, the crop is not susceptible,” Walton reports.

If growers have a susceptible crop in an area where SWD is established, they should be monitoring for the pest and be prepared to manage it, according to Hannah Burrack, researcher and coordinator of the eFly Southeast SWD monitoring network at North Carolina State University.

Growers and researchers have been monitoring with traps constructed out of lidded, one-quart clear plastic deli containers with a series of 3/16-inch holes drilled around the outside of the container. These traps are filled with an attractant, fitted with a wire hanger, and suspended in or near the crop. Traps should be located in a shady area under the crop canopy and checked at least weekly. Old attractant should be removed from the field to avoid drawing SWD to the area.

A recent multi-state trial coordinated by Burrack found that a fermented liquid made from a mix of whole-wheat flour, sugar, yeast, and apple cider vinegar was the most attractive; however, sugar, yeast, and water works adequately and improves the clarity of the mixture, making identification of captures

Drosophila trap. Source: Hannah Burrack, North Carolina State University, Bugwood.org.

easier. These traps are not selective for SWD and will catch high numbers of other non-target insects. A synthetic bait is being tested and may be available later this year.

Trapping is not a foolproof monitoring strategy and is inadequate for control. No trap-capture threshold for treatment is available as of yet. "Traps are not always as attractive as the host crop and sometimes fail as an early warning tool," Vaughn admits. Monitoring requires multiple strategies, including evaluating crop susceptibility based on ripening, which will be especially true for late-season crops, where SWD may be present weeks or months before susceptibility.

Mike Biltonen, eastern region operations manager for crop consulting firm Apple Leaf reported, "One of our farms had their first catch in June 2013 but did not have any infestations in fall raspberries until August 1."

A population model under development may provide some guidance going forward. "This fly is producing about 10 generations in the Willamette Valley, Oregon, and maybe more in North Carolina," Vaughn says. In 2013, locations in California, the southeastern U.S., and a few other regions experienced brief summertime population drops due to high temperatures. "The model is showing us that when we have very high temps, we have less pressure due to lower rates of egg laying, even though we have more generations."

Outlook for 2014

This winter has brought unseasonably cold temperatures to many U.S. fruit-growing regions. "If we see an increase in mortality, this may delay infestations in early crops," Burrack suggests. "Since SWD turns a generation in a week to a couple of weeks, by midsummer, any effects of the winter may be less relevant since SWD will have had an opportunity to reproduce."

Due to the unpredictability of populations from one year to the next, and the potential for severe crop damage, consultants are encouraged to stay on top of developments for this pest. Researchers funded by the USDA Specialty Crop Research Initiative and the Southern IPM Center have established a clearinghouse for the latest information at www.spottedwing.org and http://swd.ces.ncsu.edu. The phenology and degree day calculator for spotted wing is available at http://uspest.org/cgi-bin/ddmodel.us?spp=swd. Instructions for trapping can be found at http://ncsmallfruitsipm.blogspot.com/2013/04/spotted-wing-drosophila-monitoring.html and may be updated if the anticipated new commercial lure proves effective.

"SWD is manageable in the short term, through pretty intense use of pesticides," Burrack says. "We don't have examples of growers who have maintained larva-free fruit without pesticides." Effective active ingredients include spinosyns, some neonicotinoids, synthetic pyrethroids, malathion, and carbaryl. Products labeled for SWD can vary by state and crop. Growers who need to treat should review Extension guidelines for labeled products in their state. Due to the number of generations of SWD each year, resistance is a particular concern, and product modes of action should be rotated throughout the season.

Ontario conference

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and worked there for approximately 12 years. He then went on to establish a crop consulting venture for Cargill in 1985, and this program is still running across Ontario and western Canada. He has been responsible for hiring hundreds of university students to work as crop scouts in the crop consulting program.

Pat is currently an independent consultant working with a small group of growers. He also does numerous speaking engagements, writes in a weekly and bi-weekly newsletter for Cargill, puts on dealer training meetings as well as other meetings, has a regular column in *Better Farming* magazine, helps with the demonstrations for the Outdoor Farm Show, and is on the Ontario Soil Fertility Committee. Most recently, Pat was asked to speak in South Africa on behalf of John Deere about soybeans.

Pat is very involved with the CCA program. In fact, he was on the committee that originally introduced the program to Ontario and was part of the initial team that put together the first performance objectives and exam questions. He was also a member of the first group to write the CCA exams. One of his goals was to have the Ontario CCA program run by CCAs, and that led to the majority of seats on the Ontario Board being designated for CCAs elected by their peers. He also advocated for set term limits for board directors and establishing the program as an independent organization with its own executive director. Pat has taken his turn as the CCA chair as well as being on numerous committees within the program. We congratulate him for being selected as the recipient of this year's CCA Award of Excellence.