SWD IPM: Are we there yet?

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USDA defines integrated pest management (IPM) as "a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks." Although current management of the spotted wing drosophila (SWD) is highly reliant on spraying insecticides, the degree to which insecticides are relied upon varies with each crop.

IPM Components Currently in Use

Monitoring. A key provision of IPM is to continuously monitor pest populations. Management measures (sprays, clean harvesting, etc…) are then based on the judgment of the likelihood that a pest's population is great enough (or soon will be) to justify the treatment costs. For every crop, monitoring of SWD populations is essential. Over the past two years, we have proceeded from having ineffective traps that were not competitive with surrounding ripe fruit, to having traps that are so competitive with ripe fruit that some farmers and researchers are trying to directly protect crops by mass trapping SWD (more on this later). Although groups around the world have been striving to find ever more attractive baits and traps, the current leader for both attractant and traps are easily made. Our best trap is a 16 fl. oz. (470 ml) red cup with a tightly fitting lid, a single stripe of black electrical tape approximately one inch (2.5 cm) from the top rim, punctured with 40 one-eighth inch (3.2 mm) holes (use a hobby punch to do this) and placed in the fruit crop or surrounding vegetation with a wire hanger. The attractant bait consists of 50 – 75 ml per trap of the following recipe: water (12 fl. oz. [350 ml]), whole wheat (1 cup [240 ml]), apple cider vinegar (1 Tbsp [15 ml]), active dry yeast (1 Tbsp) and a few drops of an agricultural surfactant. For those not wishing to make traps or baits, products from a company in Spain, BioIberica, are nearly as effective as the homemade trap and bait, are more selective in trapping SWD, the bait does not spoil, and should be available on the market soon.

Use of selective insecticides. For all crops, there is a great need for selective insecticides. Selective insecticides kill SWD and have minimal effect on beneficial predatory or parasitic insects. Among the products available and registered for use in fruit crops, the most effective against SWD have been pyrethroids, organophosphates, and neonicotinoids, and spinosyns (listed by increasing selectivity). Pyrethroids and OPs have a long history of being problematic for being disruptive to crop ecology. Unfortunately, the limit on the number of applications per crop and per farm of spinosyns (Entrust, Radiant, or Delegate) means that these highly effective and selective products have to be used sparingly. Neonicotinoids have been used to a limited extent, partly because early reports from the Pacific Northwest rated them as being inferior insecticides. However, neonicotinoids work best through ingestion, and west coast researchers did not include a feeding stimulant with this class of insecticide. I have suggested combining several SWD insecticides with sucrose (table sugar) at a concentration of 2 lb per 100 gallons can enhance insecticide ingestion by SWD. Of the neonicotinoids, acetamiprid (Assail) deserves special consideration because it has much lower toxicity to honey bees than other neonicotinoids

(Belay, Venom, or imidacloprid products), and so is safer to pollinators when applied post-bloom in the crop. Furthermore, acetamiprid is highly systemic – a property not shared with other classes of insecticides available to target SWD. I observed ~80% mortality in larvae fed upon diet experimentally spiked with the amount of acetamiprid absorbed into fruit (based on IR-4 data).

Sanitation. Removal and destruction of infested fruit appears to be a practical (and perhaps essential) measure in raspberries and day-neutral strawberries. In raspberries, a two container picking system (one for overripe fruit to be discarded, one for sound fruit) has worked well. For strawberries, mashing soft berries between the rows appears to help. In all fruit crops, keeping the fruit picked cleanly, and picking when the fruit are approaching ripeness are key to preventing SWD outbreaks. PYO growers with exceptional customer traffic may not even have to spray blueberries to protect them from SWD. The acreage of some crops (especially raspberry and day neutral strawberries) needs to be adjusted to a manageable size so that fields can be kept picked. At the end of blueberry season, bird netting should be removed to allow any remaining fruit to be consumed by birds rather than to allow continued SWD breeding.

IPM Methods requiring more research

Mass trapping. Mass trapping is a method that removes insects by physically capturing them. Successful mass trapping depends on the following variables: effectiveness of chemical and visual attractants for bringing the target insect to the trap, the efficiency of the trap for capturing the insect, the number of traps placed per unit area, the population density of the insect, and our economic threshold. Some guesswork is needed to estimate the distance SWD are attracted to our best traps, but based upon my field trapping experience, this distance is approximately 10 m, and most responses are probably even closer. If we were to place traps 10 m apart, this translates to 40 traps per acre (100 traps per hectare). This number would be modified as various factors warrant. We could decrease the trap density if (1) the chemical and visual attractants draw flies to the trap from greater distances, (2) the efficiency of capturing the flies per trap visit is increased, (3) fly mobility (diffusivity) increases, (4) the population density is lower, or (5) the economic threshold (tolerance for damage) is increased. Historically, mass trapping has worked in the 1930s to protect sweet cherries from damage by SWD. As early season crops, sweet cherries, June bearing strawberries, and early ripening blueberries all are appropriate crops to consider mass trapping.

How well do our traps work? One measure is competitiveness of our traps when they are placed among highly competitive fruits. If the traps catch large numbers of flies, it indicates that there is the possibility that mass trapping could work, if sufficient numbers of traps are placed in the crop. In 2013, we observed excellent ability of our traps to capture flies when surrounded with ripe blueberries, raspberries, and tree fruits (apples and pears).

Unfortunately, catching many flies doesn't necessarily translate into significant reductions in the fly population or protection of fruit. High trap catches certainly signify that there is a large population that threatens the crop. The conundrum is, to know whether we may be protecting fruit requires that we have some measure of the population of flies not being captured in traps, because these flies continue to jeopardize the fruit. To get an idea of how many flies are

attracted to the trap, versus the number that are actually captured and drown in the bait, I hung pairs of cup traps directly over 5 gallon [20 liter] buckets. For only one trap in the pair, I sprayed the exterior of the trap with an insecticide combination likely to cause nearly immediate knock-down and mortality of visiting insects. From this preliminary test, only about one-fifth of the SWD were captured by drowning in the bait when compared with the number recovered from the buckets. This is a sobering value, because it implies that about 14 visits of flies to traps would be required before we would see a 95% reduction in the fly population in the field. If flies have an opportunity to mate and lay eggs between visits to traps, then protection of fruit through mass trapping is unlikely. What may we do to improve upon this situation? One option is to expand the concept of the "trap" to include the surrounding vegetation and the outer surface of the trap itself. Rather than trying to achieve a 5-fold improvement in retention of flies in the trap, if we can guarantee that flies will succumb once they contact the trap or nearby surrounding vegetation, we will have achieved the same goal in reducing the fly population. There are a great number of insecticides that could be suitable for application to the surface of traps. Rapid fly response to the insecticide would be acceptable, rather than the immediate knock needed for my experiment. A broad choice of insecticides can be considered, because the limited quantity of insecticide applied to traps could make even expensive active ingredients economically practical. Furthermore, limiting insecticide application to the trap will limit the environmental impact of their use to a great degree and facilitate U.S. EPA registration.

Exclusion. Raspberries are so extremely susceptible to SWD that it may be economical to use high tunnels to produce and protect fruit. The research needed is not to determine whether fruit can be protected with screening – it is known that 1 mm screening (e.g., ProtekNet from DuBois, 80 g per square meter) will exclude flies from access to fruit. However, the use of insect exclusion screening along the sides of high tunnels has not been tested with respect to horticultural properties in growing the crop. Side benefits can include exclusion of birds, excluding rain to reduce fruit rot, and a prolonged growing season. Some growers are building high tunnels for cane fruit, so we shall soon learn how well they perform. Caging bumblebees inside these enclosures may be necessary for pollination, as there are open blossoms at the same time that there are ripe fruit.

Disclaimer: Use of trade names for pesticides does not constitute an endorsement for that product. Always read and follow pesticide label directions.