GETTING THE MOST OUT OF SWD CONTROL MEASURES

Cesar Rodriguez-Saona
Marucci Center for Blueberry/Cranberry Research & Extension, Rutgers University, NJ

In 2011, the first adults of the spotted wing drosophila (SWD) were found in the Northeastern United States. Since then, this insect has become a serious pest of blueberries, strawberries, raspberries, and blackberries in our region. To control this pest, we are currently evaluating various insecticides with different modes of action. In 2013, we conducted studies to: a) determine the efficacy of various insecticides with and without a phagostimulant against adult SWD, and b) determine the efficacy of these insecticides against SWD larvae inside the fruit (curative control).

Efficacy of insecticides with and without a phagostimulant against adult SWD

An experiment was conducted to compare the efficacy of Exirel (a diamide), Danitol (a pyrethroid), Delegate (a spinosyn), Assail 30SG (a neonicotinoid), Bifenture (a pyrethroid), Movento (a tetramic acid derivative), Malathion (an organophosphate), and Imidan (an organophosphate) against SWD in highbush blueberries in New Jersey. Insecticides were applied with and without sugar as a phagostimulant at 2 lbs. per 100 gallons. The experiment was conducted in the mid-season cultivar 'Bluecrop,' located at the P.E. Marucci Blueberry/Cranberry Center in Chatsworth, New Jersey. Treatments were applied to single bushes and were replicated four times. Applications were made with an R&D CO2 backpack sprayer, using a 0.5 liter plastic bottle. The sprayer was calibrated to deliver 50 gallons of volume per acre at 35 psi, using a single ConeJet TXVS 4 nozzle, yielding 5.29 fl oz per bush. Treatments were applied on 30 June. A single cluster of ripe blueberries with an 8-10 cm stem attached was taken from each treated bush 1 and 3 DAT on 1 July and 3 July. The clusters were placed in a 32 oz deli container with a hole cut in the bottom in which a florists water pick fit tightly, with stems watered, and the number of ripe/ripening berries counted. A total of ten spotted wing drosophila adults (5 females and 5 males) were removed from a laboratory colony and kept in rearing tubes in a 25°C incubator for 2-3 h before being released into the containers. Flies were 1-3 days old at the time of use to ensure sexual maturity and were anesthetized with small puffs of CO2 injected into the tubes prior to placing them in the containers. The containers were then placed on a light bench in the laboratory under a 14:10 L:D photoperiod, and were kept at 25-28°C during the 7 days of observation. Adult fly mortality data were collected on day 1 and 3. Data on fruit infestation were collected 5-9 days after the last adult mortality observation via a salt water extraction method and then counting larvae and/or pupal cases that exited the fruit. The salt water extraction method consisted of submerging fruit samples in warm salt water approx 1000 ml of salt to 5 gal water. Number of larvae per 100 berries was calculated from the number of larvae and ripe/ripening fruit in the cluster. Data were analyzed using ANOVA and means separation by Tukey tests at $P = 0.05$. Percent mortality data were arcsine square-root transformed. Count data were natural log (x+0.5) transformed prior to analysis. Exirel, Assail, Imidan, Malathion, Bifenture, and Delegate provided the best control 1 DAT (see Figure 1). The efficacy of Exirel, Assail, Imidan, Bifenture, Danitol, and Delegate increased when sugar was added. All treatments, except for Movento, reduced the number of larvae in fruit (see Figure 2).

Figure 1. Effect of various insecticides with and without sugar (sucrose) on SWD mortality

Figure 2. Effect of various insecticides with and without sugar (sucrose) on SWD larvae in fruit

Efficacy of various insecticides against SWD larvae inside the fruit (curative control)

This experiment tested the efficacy of Exirel, Assail, Imidan, Malathion, Bifenture, Danitol, Delegate, and Movento for curing existing SWD infestation in blueberries. On 6 July, 3600 ripe undamaged berries were obtained from an untreated field of the mid-season blueberry cv. 'Bluecrop' located at the Rutgers P.E. Marucci Center in Chatsworth, New Jersey. Picked berries were divided up into eight groups of 450 berries each and each group was spread in a single layer on each of eight clear polypropylene trays. Four of the trays were placed in a 15°C incubator for later exposure. The remaining four trays were placed in 1 ft cube cages and exposed to >500 spotted wing drosophila

adults (mixed sexes) in each cage. Flies were approx. 4-9 days old, and were from a laboratory colony kept at the P.E. Marucci Center. Berries were left in cages for two days (from 3 July until 5 July for the 4-5 day old group and from 6 July until 8 July for the 0-2 day old group). Cages were kept on lab shelves at 25°C, under lights on a 15:9 L:D cycle. At 48 hours, trays were removed from the cages and any flies remaining on the berries were aspirated off to stop oviposition. The four exposed trays were then placed in a 22°C incubator until the treatment date. On 6 July, the remaining four trays were moved from the 15°C incubator and given an hour to warm to room temperature before being placed in the same exposure cages. Berries were left in cages for two days as was done with the first set of berries. On the day of treatment, berries from the 4-5 day old group were degraded too far to be able to handle them, and were not able to be treated. On 10 July, berries from all four trays from the 0-2 day old group were evenly divided into 36 groups (9 treatments x 4 replicates), of 50 berries each for treatment that day. On the day of treatment, 10 July, each group of berries (36) was spread out on a 12"x12" wire-mesh tray formed from 1/4"gap hardware-cloth prior to treatment. Applications were made with R&D CO2 backpack sprayer, using a 1-liter plastic bottle. The sprayer was calibrated to deliver 4.3 mL/sec at 30 psi with a single ConeJet TXVS 4 nozzle. Trays were gently shaken during application to cause berries to roll and be coated on all sides. Application took 3-4 seconds yielding 12.9-17.2 mL per group. Treated berries were left on trays for 3 hours to dry. Larvae in berries were to be allowed to develop and emerge before evaluation, so each group of treated berries were placed in a 16 oz clear plastic deli container over approx. 1 cm of clean dry playsand. All cups were capped with ventilated lids and kept on trays in a 24°C incubator on a 15:9 L:D cycle to allow any surviving larvae to develop. Samples were evaluated at 10 days post-treatment on 18 July. Fruit was allowed to incubate for 10 days to allow most surviving larvae enough time to develop and exit the berries, at which point larval data were collected using the salt water extraction method (salt water extraction method = submerging sample in warm salt water approx 1000 ml of salt to 5 gal water causing any larvae to leave fruit). Larvae and pupae floating to surface were removed and counted, and the remaining berries were then dissected to ensure no developed larvae/pupae were overlooked. The number of larvae per 50 berries was totaled for each sample. Data were analyzed using ANOVA and means separation by Tukey test at $P \leq 0.05$. Count data were ln-transformed prior to analysis [ln(x+0.5)]. All insecticides provided > 90% curative control. Exirel and delegate provided 100% control. Movento provided the weakest curative control of all insecticides tested.

Table 1. Curative control

Treatment	Rate	No. Larvae / 50 fruit (Mean ± SE)				% Curative Control
Exirel (10SE)*	20.5 floz/ac	0.00	±	0.00	d	(100.0)
Assail 30SG	5.3 oz/ac	0.75	±	0.48	cd	(99.7)
Imidan (liquid formulation)	32 floz/ac	0.25	±	0.25	cd	(99.9)
Malathion 8Aquamol	2.5 pt/ac	0.25	±	0.25	cd	(99.9)
Bifenture 10DF	16 oz/ac	4.00	±	1.41	c	(98.6)
Danitol 2.4EC*	10.7 floz/ac	2.25	±	1.03	cd	(99.2)
Delegate 30WG	6 oz/ac	0.00	±	0.00	d	(100.0)
Movento 240SC**	10 floz/ac	23.75	±	5.23	b	(92.0)
Control	-	295.75	±	25.09	a	0.0

*Adjuvant=0.25% Dynamic, **Adjuvant=0.25% MSO

Means within a column followed by different letters are significantly different (Tukey test, $P \leq 0.05$)

Count data were ln(x+0.5) transformed prior to analysis

% Curative Control = [1-(No. Larvae in insecticide-treatment / No. larvae in control)]*100

Cesar Rodriguez-Saona is the Extension Specialist in Blueberry and Cranberry Entomology at Rutgers PE Marucci Center for Blueberry & Cranberry Research & Extension, Chatsworth NJ. He conducts applied research on the development and implementation of cost-effective reduced-risk insect pest management practices and delivers educational information to growers. He received his M.S. degree in Entomology (Biological Control) from Oregon State University and his Ph.D. in Entomology (Integrated Pest Management) from the University of California, Riverside. Prior to joining Rutgers University, he worked for the USDA-ARS in Phoenix, AZ, University of Toronto in Ontario, Canada, and Michigan State University in East Lansing, MI. He is native of Lima, Peru. He and his wife Corinne have two sons Renzo and Marcello.