Efficacy of Biopesticides for Management of Spotted Wing Drosophila, *Drosophila suzukii* (Matsumura) in Fall Red Raspberries, *Rubus idaeus* L.

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Introduction

Drosophila suzukii (Matsumura) is an invasive vinegar fly and a significant pest infesting small fruits and cherries, in the majority of fruit growing regions globally (Walsh et al. 2011). The management of the species is challenging due its ability infest ripening fruit, due to the serrated ovipositor of the females (Figure 1).

Since the introduction of the pest, traditional pest management programs have been replaced by calendar spray programs dominated by use of broad-spectrum insecticides (VanTimmeren & Isaacs 2013).

The ability of *D. suzukii* to infest ripening fruit means growers are restricted to using insecticides with short pre harvest intervals (PHI's).

The selection of additional effective insecticides to be included in a rotation is also important for resistance management. Conventional berry growers have a number of chemical classes to incorporate into spray programs, however organically certified growers have a limited number of choices.

Objective

The objective of this study was to determine the efficacy of biopesticides for management of Spotted Wing Drosophila (SWD) in Raspberries.

Methods

This experiment was conducted during August and September 2016 in fall red raspberries, *Rubus idaeus*, located in Clarksville Research Center in Clarksville, Michigan. The experiment was laid out in a randomized block design with 10 treatments, and four replicates per treatment.

Each plot consisted of three rows of raspberries, each 18 meters in length and spaced 3 meters apart, giving a total plot size of 162m^2. Insecticides were applied alone, in rotation with other and some had corn syrup added (Table 1). The spray solution was applied both sides of rows separately and all three rows in plots were treated with their assigned treatment.

Adults of *D. suzukii* were sampled in week 1, 3 and 5 of the trial. Traps were baited with 150 ml of yeast-sugar-water mixture.

Fruit infestation was sampled weekly, and 4-8 oz. of randomly selected fruit were sampled from each plot, and infestation was determined using a modified salt test. The number of eggs, larvae, and pupae of drosophila were counted using a stereomicroscope.

Figure 1. Male (top-right) and female, with serrated ovipositor (top-right) of *D. suzukii.* Larva of *D. suzukii* feeding on the raspberries (bottom)

Table 1. List of insecticide treatments tested for the control of *Drosophila suzukii* in raspberries, with trade name, active ingredient, application rate

Trt.	Insecticide Treatment	Active Ingredient	Rate
1	Untreated	--	--
2	Entrust SC	Spinosad	4-6 fl oz/acre
3	Grandevo WP	Chromobacterium subtsugae	3 lb/acre
4	Veratran D	Sabadilla alkaloids	15 lb/acre
5	Entrust SC	Spinosad	4-6 fl oz/acre
	Grandevo	Chromobacterium subtsugae	3 lb/acre
6	Entrust SC	Spinosad	4-6 fl oz/acre
	Veratran D	Sabadilla alkaloids	15 lb/acre
7*	Entrust SC	Spinosad	4-6 fl oz/acre
	Grandevo	Chromobacterium subtsugae	3 lb/acre
8*	Entrust SC	Spinosad	4-6 fl oz/acre
	Veratran D	Sabadilla alkaloids	15 lb/acre
9*	Azera	Pryethrins + Azadirachtin	2.5 pints/acre
10*	VST -006330 EP	GS-omega/kappa-Hxtx-Hv1a	4 lb/acre

*Treatment included corn syrup at a rate of 12.5% by volume.

Results

The number of *D. suzukii* captured in traps were not significantly different over time.

Results of the drosophila larva infestation assessments in fruit revealed significant differences among treatments ($F_{(45,135)}$ = 1.82, P <0.01). In week 4 ($F_{(9, 30)}$ =3.31, P<0.01) and week 5 ($F_{(9, 30)}$=2.34, P<0.01) there was significant differences between treatments. In both weeks, the rotation of Entrust SC and Grandevo WP had significantly lower (P<0.05) infestation than untreated plots (Figure 2).

Insecticide treatments which included and excluded corn syrup as a phagostimulant (Treatments 5, 6, 7, & 8, Table 1) varied significantly in infestation of drosophila. However in week 5, only the Entrust/Grandevo treatment in the absence of corn syrup had significantly lower (P <0.05) levels of infestation than other treatments.

To assess the effects of different insecticide treatments on the different life stages of drosophila infesting fruit in the field the number of eggs, 1st, 2nd and 3rd instar larva was assessed for week 4 for the trial (Figure 3). Significant differences in the number of 2nd (P>0.001) and 3rd (P>0.01) instars.

Conclusions

In addition to spinosad (Entrust SC), sabadilla alkaloids (Veratran D) and *Chromobacterium subtsugae* (Grandevo WP) both reduced the number of drosophila larvae in raspberry fruit.

Plots treated with a rotation of Entrust and Grandevo WP had the lowest infestation of all treatment.

The inclusion of a nutritional source such as sucrose has previously been shown to increase the uptake of insecticides (Cowles et al. 2015), however in the current study no effect of corn syrup was observed on the numbers of *D. suzukii* captured in traps or reduction in the number of drosophila larva in fruit.

Treatments which incorporated Entrust, Grandevo alone and in rotation were able to reduce the numbers of later instar larva which results in the greatest damage and loss of fruit.

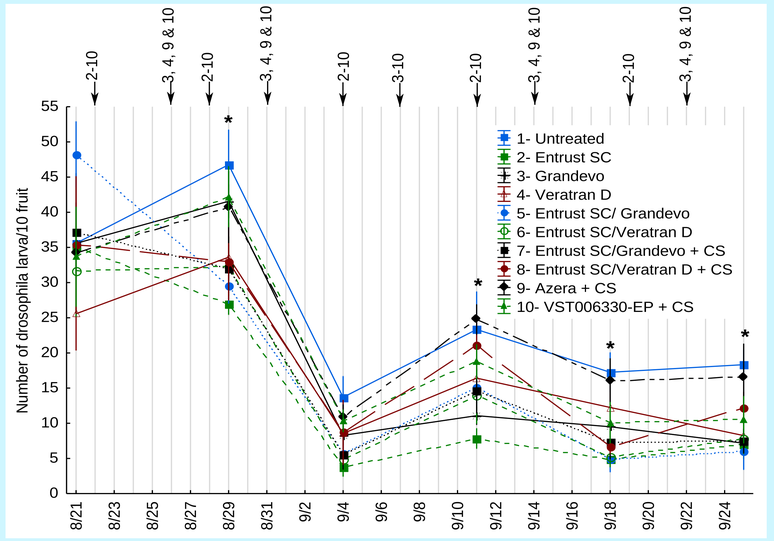

Figure 2. Mean (± S.E.) number of *Drosophila* larvae per 10 fruit in raspberries treated with 10 different biopesticide treatments, assessed using a modified salt test. Black arrows and numbers denote spray application timing and number of the treatments applied at that time, respectively. Asterisk (*) indicates significant differences among treatments for that week.

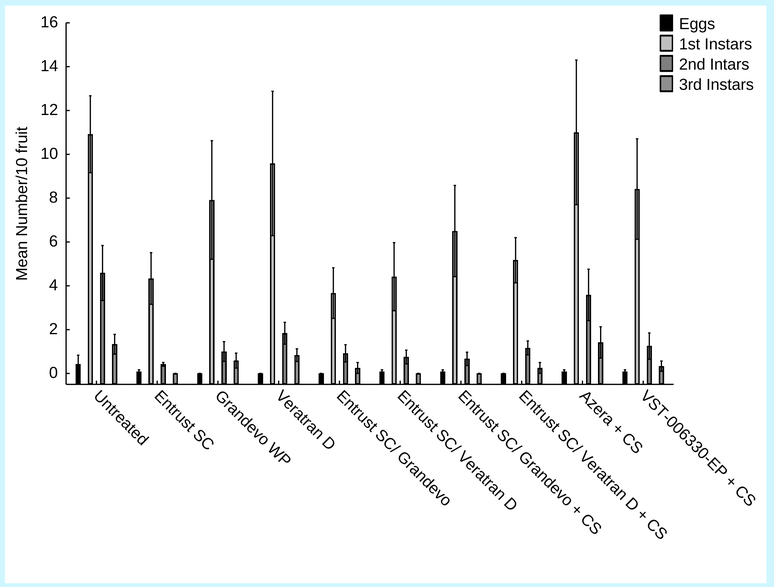

Figure 3. Mean (± S.E.) number of eggs and larval instars of *Drosophila* per 10 fruit in raspberries treated with 10 different biopesticides treatments, assessed using a modified salt test. Asterisk (*) indicates significant differences among treatments for that week.

Acknowledgement

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