EFFECT OF SPINOSAD ON *ORIUS INSIDIOSUS* (HEMIPTERA: ANTHOCORIDAE) WHEN USED FOR *FRANKLINIELLA OCCIDENTALIS* (THYSANOPTERA: THRIPIDAE) CONTROL ON GREENHOUSE POT CHRYSANTHEMUMS

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Western flower thrips, *Frankliniella occidentalis* (Pergande), is a major pest of greenhouse vegetables and ornamentals. This is a result of both feeding damage and the thrips ability to transmit tospoviruses (Tommasini & Maini 1995; van de Wetering et al. 1996). Control of this thrips species has been difficult because it has developed resistance to the major classes of insecticides used for its control (Brødsgaard 1994; Zhao et al. 1995). *Orius insidiosus* (Say) is capable of reducing thrips populations on greenhouse vegetables (van den Meiracker & Ramakers 1991) and ornamentals (Fransen et al. 1993).

Spinosad (Dow AgroSciences, Indianapolis, IN) is a new insecticide derived from the fermentation of *Saccharpolyspora spinosa*. Spinosad effectively controls western flower thrips under laboratory conditions (Eger et al. 1998). Funderburk et al. (2000) demonstrated that spinosad was more effective than broad-spectrum insecticides in suppressing *F. occidentalis* populations in field peppers. This suppression was partially due to the spinosad applications not reducing *O. insidiosus* populations compared to the standard insecticide treatment. Our objective was to evaluate the impact of spinosad on *O. insidiosus* when used in combination to control *F. occidentalis* on greenhouse grown pot chrysanthemums.

Three rooted chrysanthemum 'Charm', *Dendranthema* × *grandiflora* (Ramat.) Kitamura, (Yoder Brothers Inc., Barberton, OH) cuttings were planted per 15 cm plastic pot containing Pro-Gro Professional Growing Medium® 300 (Pro-Gro Products Inc., McCormick, SC). Plant terminals were removed to promote branching two weeks after the plants were potted. A foliar application of 5,000 ppm daminozide (B-Nine®, Uniroyal, Middlebury, CT) was applied four weeks after potting. The western flower thrips population was a natural infestation which occurred prior to the plants being placed into the cages. Screen cages measuring 105 × 57 × 57 cm (L × W × H) were placed over groups of eight plants on cloth covered greenhouse benches. The cages were constructed using PVC pipe frames covered with mesh screen (25 threads per cm). Cages were lifted off of the plants to apply treatments and collect samples. Plants were watered daily with 200 ppm N [20-10-20 Peter's Peatlite Special® (Scotts, Marysville, OH)] using a spaghetti drip watering system that entered each cage through a hole in the fabric under the pots.

The cages were arranged in a randomized complete block design with four treatments and six replicates in the first trial and five replicates in the second trial. The four treatments investigated were *O. insidiosus* (four females and two males per cage), spinosad (0.5 ml / liter), *O. insidiosus* + spinosad, and a control. Spinosad was applied to runoff using a hand sprayer at 241 kPa. Sampling for thrips and *O. insidiosus* was conducted weekly by collecting ten flowers per cage and placing them into a jar containing 200 ml of 50% ethyl alcohol. The flowers were then rinsed, removed from the jars and discarded. The number of adult and immature thrips and *O. insidiosus* were determined by microscopic evaluation.

In the first trial, *O. insidiosus* adults were released at bud break and again 14 days later. Spinosad was applied approximately 24 h after each *O. insidiosus* release. In the second trial, an attempt was made to establish *O. insidiosus* before the plants set bud, but poor establishment occurred. A second *O. insidiosus* release was made one week after bud formation and spinosad was applied 14 and 28 days after the second *O. insidiosus* release. Sampling in both trials was conducted every seven days.

A logarithmic transformation [log10 (x + 1)] of the data was used to make the variance independent of the means (Sokal & Rohlf 1995). Data were subjected to Analysis of Variance (GLM procedure). The means were separated using the least significant difference test (LSD) at the $P < 0.05$ level (SAS Institute 1985). The effects of the treatments were determined by comparing thrips populations in each of the four treatments. The effects of spinosad on *O. insidiosus* was determined by comparing the *O. insidiosus* present in the *O. insidiosus* treatment and the *O. insidiosus* + spinosad treatment.

In the first trial *O. insidiosus*, spinosad, and the combination treatments resulted in lower thrips populations (adults + larvae) than the control (Table 1). Both treatments containing spi-

TABLE 1. MEAN DENSITIES ±SD OF *ORIUS INSIDIOSUS* (A) AND *FRANKLINIELLA OCCIDENTALIS* (B) PER 10 CHRYSANTHEMUM FLOWERS IN THE FIRST *O. INSIDIOSUS* AND SPINOSAD COMPATIBILITY TRIAL.

	Days after first spinosad application[1,2]				
Treatment	7	14	21	28	35
A (*Orius insidiosus*)					
Control	0.2 ± 0.4 a	0.8 ± 0.8 b	1.2 ± 1.2 b	1.0 ± 1.0 b	1.8 ± 1.8 b
Orius	0.7 ± 1.0 a	3.2 ± 3.2 a	4.5 ± 4.5 a	3.2 ± 3.2 a	4.2 ± 4.2 a
Spinosad	0.0 a	0.0 b	0.0 b	0.0 b	0.0 b
Spinosad + *Orius*	0.2 ± 0.4 a	1.7 ± 1.7 b	0.0 b	0.2 ± 0.2 b	0.0 b
	$F_{(8,15)} = 2.1$	$F_{(8,15)} = 2.3$	$F_{(8,15)} = 6.3$	$F_{(8,15)} = 3.1$	$F_{(8,15)} = 5.1$
	P = >0.05	P > 0.05	P = 0.001	P < 0.05	P < 0.01
B (*Frankliniella occidentalis*)					
Control	124.5 ± 61.5 a	96.0 ± 25.8 a	184.2 ± 59.8 a	389.3 ± 130.9 a	614.0 ± 286.9 a
Orius	60.0 ± 24.4 b	59.8 ± 17.1 a	73.5 ± 48.4 b	159.0 ± 56.8 b	148.8 ± 51.2 b
Spinosad	20.3 ± 21.5 c	22.0 ± 25.3 b	7.0 ± 3.4 c	7.7 ± 7.4 d	68.2 ± 44.9 c
Spinosad + *Orius*	19.0 ± 17.5 c	19.8 ± 19.4 b	6.5 ± 5.4 c	24.2 ± 17.5 c	80.5 ± 57.4 c
	$F_{(8,15)} = 8.6$	$F_{(8,15)} = 7.1$	$F_{(8,15)} = 15.4$	$F_{(8,15)} = 26.7$	$F_{(8,15)} = 7.5$
	P < 0.001	P < 0.001	P < 0.0001	P < 0.0001	P < 0.001

[1]Means in each column for each species followed by the same letters are not significantly different (P > 0.05; LSD).
[2]A second treatment spinosad was made on day 14 and *Orius* release on day 13.

nosad resulted in lower populations than *O. insidiosus* alone on all five dates. A low population of *Orius* was observed in the control although none were released. This was most likely due to *Orius* eggs or nymphs on a few plants before caging. The spinosad + *O. insidiosus* treatment never resulted in significantly lower thrips populations than the spinosad treatment. This can be explained by the *O. insidiosus* population data. While the *O. insidiosus* treatment had successful predator establishment, they failed to establish in the *O. insidiosus* + spinosad treatment.

Lower thrips populations (adults + larvae) were observed in the second trial than in the first. *Orius insidiosus* suppressed thrips population on the first sample date. The thrips populations were statistically lower in the spinosad and spinosad + *O. insidiosus* treatments on the final two sample

TABLE 2. MEAN DENSITIES ±SD OF *ORIUS INSIDIOSUS* (A) AND *FRANKLINIELLA OCCIDENTALIS* (B) PER 10 CHRYSANTHEMUM FLOWERS IN THE SECOND *O. INSIDIOSUS* AND SPINOSAD COMPATIBILITY TRIAL (GRIFFIN, GA, SPRING 1999).

	Days after first spinosad application[1,2]			
Treatment	0	10	17	24
A (*Orius insidiosus*)				
Control	0.0 ± 0.0 a	0.0 ± 0.0 a	0.0 ± 0.0 a	0.0 ± 0.0 a
Orius	0.2 ± 0.4 a	0.2 ± 0.4 a	1.0 ± 1.4 a	2.0 ± 2.6 a
Spinosad	0.3 ± 0.5 a	1.2 ± 1.6 a	0.7 ± 1.2 a	0.7 ± 1.2 a
Spinosad + *Orius*	0.2 ± 0.4 a	0.3 ± 0.8 a	0.0 ± 0.0 a	0.2 ± 0.4 a
	$F_{(8,15)} = 1.0$	$F_{(8,15)} = 1.3$	$F_{(8,15)} = 1.5$	$F_{(8,15)} = 1.6$
	P > 0.5	P > 0.5	P > 0.5	P > 0.5
B (*Frankliniella occidentalis*)				
Control	4.3 ± 2.4 a	8.3 ± 10.8 ab	18.0 ± 2.6 a	30.0 ± 20.9 a
Orius	0.8 ± 1.6 c	2.5 ± 2.8 b	26.5 ± 26.2 a	52.7 ± 50.2 a
Spinosad	4.8 ± 5.7 ab	9.6 ± 10.3 a	5.0 ± 6.0 b	6.0 ± 8.7 b
Spinosad + *Orius*	1.5 ± 2.3 bc	4.3 ± 5.0 ab	3.0 ± 1.4 b	4.8 ± 4.7 b
	$F_{(8,15)} = 5.7$	$F_{(8,15))} = 6.4$	$F_{(8,15)} = 6.7$	$F_{(8,15)} = 5.3$
	P < 0.01	P < 0.01	P < 0.05	P < 0.05

[1]Means in each column for each species followed by the same letters are not significantly different (P > 0.05; LSD).
[2]A second spinosad application was made on day 17.

dates (Table 2). The *O. insidiosus* populations were not significantly different.

Funderburk et al. (2000) demonstrated *Orius* was capable of establishing and controlling thrips in field peppers. Our data obtained in the greenhouse differ from those of Funderburk et al. There may be at least two explanations for this difference. First, *O. insidiosus* was capable of moving between treated and untreated areas in the field pepper trials, while under the greenhouse cage conditions its movement was restricted. Second, although in both studies spinosad was applied at the same rate, there was a difference in the volume of insecticide applied between the two studies. Spinosad was applied at 174 liters per acre in the field studies while in the greenhouse the application rate was approximately 750 liters per acre. Additional studies need to be conducted to evaluate the timing of insecticide applications and predator releases.

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Summary

Orius insidiosus and spinosad were used in combination against *F. occidentalis* on greenhouse pot chrysanthemums to test for compatibility. *Orius insidiosus* failed to establish in the first trial when exposed to spinosad, but was more compatible in the second trial. This indicates that spinosad may have an effect on *Orius* populations when there was little free movement of the thrips and *Orius* between plants.

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