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EVALUATION OF IMIDACLOPRID AND CYANTRANILIPROLE FOR SUITABILITY IN CONSERVATION BIOLOGICAL CONTROL PROGRAM FOR *ORIUS INSIDIOSUS* (HEMIPTERA: ANTHOCORIDAE) IN FIELD PEPPER

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A biologically based integrated pest management program is fundamental in preventing the development of insecticide resistance, resurgence of populations of western flower thrips, *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae), and replacement with nontarget pest damage (Demirozer et al. 2012). The conservation biological control component of the integrated pest management program is the most effective way to manage thrips in pepper (*Capsicum* spp.; Solanales: Solanaceae) (Reitz et al. 2003). Species of Anthocoridae are the most important worldwide predators of thrips. Within this family are minute pirate bugs with 2 species in Florida, *Orius insidiosus* (Say) and *O. pumilio* (Champion) (Hemiptera: Anthocoridae). The minute pirate bugs are a valuable tool for controlling thrips as they prey preferentially on the adults of the western flower thrips over the adults of the non-damaging native thrips species, *F. tritici* (Fitch) and *F. bispinosa* (Morgan) (Baez et al. 2004). The damaging thrips larvae also are preferred prey (Baez et al. 2004). About 1 minute pirate bug for every 180 thrips is sufficient for suppression of the populations of thrips, and at a ratio of about 1 predator to 40 thrips, thrips populations are controlled (Funderburk et al. 2000). Natural populations of minute pirate bug adults rapidly invade pepper fields in sufficient numbers to control western flower thrips adults and larvae, but they must be conserved with judicious insecticide use (Funderburk et al. 2000, Demirozer et al. 2012).

An integrated pest management program for peppers that encompasses the simultaneous management of multiple pests is being developed and implemented (Demirozer et al. 2012). To further enhance the effectiveness of the conservation biological control component of this program, updated information on insecticides labeled for fruiting vegetables against thrips or other pests that have little impact on populations of minute pirate bugs was reported (Funderburk et al. 2011). In the present report, imidacloprid 4.6SC (Bayer Crop Protection, Research Triangle Park, North Carolina) and cyantraniliprole 10SE and 20SC (DuPont Crop Protection, Newark, Delaware) were evaluated against populations of thrips and minute pirate bugs. Spinetoram SC (Dow AgroSciences, Indianapolis, Indiana) was included as a standard foliar treatment.

Experimental procedures to evaluate the treatment effects on adult and immature *O. insidiosus* and flower thrips were similar to those established for pepper by Funderburk et al. (2000) and Reitz et al. (2003). Experimental design was a randomized complete block, with 4 replications. Plot size was 1 raised, plastic mulched bed 9 m long on which there were 2 linear rows of pepper with a 13.8-cm plant spacing between and within rows for a total of 48 plants per plot. Beds were irrigated with a single trickle tube with emitters spaced every 30 cm at a rate of 20,000 L/ha/day. Dates and rates of insecticide applications and of insect sampling are included in Table 1. Foliar insecticides were applied with a CO_2-powered backpack sprayer equipped with 4 D7 nozzles with the amount of spray 430 L/ha. Drench treatments were applied in a water solution of 200 mL/plant. Trickle tube treatments were applied in a water solution of 5.7 L/plot with a CO_2-powered injector pressurized to 103 kPa, followed by 8 L of clean water rinse. Inline connectors with shut-off valves were used to isolate the plots. Ten flowers per plot (whenever possible) were collected on each of 6 sample dates and preserved in 70% alcohol with the number of thrips and *O. insidiosus* determined using 7 to 100 X magnification. The data for each sample was converted to number per flower, pooled over date, and transformed to $\log_{10}(x + 0.5)$ for analysis of variance. When the overall treatment effect was significant at the $P = 0.05$ level, orthogonal comparisons were used to separate treatment differences. Untransformed means per 10 flowers are reported in Table 1.

The adults of *F. occidentalis* and *F. tritici* accounted for 6 and 19% of the total thrips in the untreated controls and there were no significant treatment differences (data not shown). The numbers of thrips were well below the economic thresholds established by Demirozer et al. (2012), with the ratio of predators in relation to prey sufficient in the untreated plots to result in thrips suppression. There were treatment differences in the number of *F. bispinosa* females, thrips larvae, and *O. insidiosus* nymphs (Table 1). When compared to the untreated control, 2 applications of cyantraniliprole 20SC in the trickle tube did not reduce the numbers of thrips or *O. insidiosus* in the flowers. However, the 2 applications of cyantraniliprole 20SC combined with a transplant treatment of imidacloprid 4.6SC resulted in 94, 82, and 88% reductions in numbers of *F. bispinosa* adults, thrips larvae, and *O. insidiosus* nymphs, respectively. Unless there are unexpected synergistic effects, this result showed that the residual effect of a transplant application of imidacloprid lasted through pepper flowering and

TABLE 1. MEAN NUMBER (SEM) AVERAGED OVER 18, 22, 25, 29 MAY AND 1, 5 JUN SAMPLE DATES OF MALE AND FEMALE *FRANKLINIELLA BISPINOSA*, *FRANKLINIELLA* SPECIES LARVAE, AND ADULT AND NYMPHAL *ORIUS INSIDIOSUS* PER 10 'ARISTOTLE' PEPPER FLOWERS IN TREATMENTS OF INSECTICIDES EACH APPLIED AS A TRANSPLANT DRENCH IN THE TRICKLE IRRIGATION WATER, OR AS A FOLIAR SPRAY IN AN EXPERIMENT CONDUCTED AT QUINCY, FLORIDA IN SPRING 2012. (*N* FOR EACH MEAN RANGED BETWEEN 200 AND 240 FLOWERS.)

			Mean number per 10 flowers (SEM)				
			Frankliniella bispinosa		*Orius insidiosus*		*Frankliniella*
Treatment	Rate (g a.i./ha)	Mode of application & date(s)	males	Females[1]	adults	Nymphs[1]	Larvae[1]
Untreated			0.6 (0.1)	3.3 a (0.5)	1.5 (0.3)	2.3 a (0.3)	4.1 a (0.9)
Cyantraniliprole 20SC	100	trickle tube (25 Apr & 9 May)	0.5 (0.2)	3.0 a (0.7)	1.2 (0.3)	2.0 a (0.4)	4.8 a (1.4)
Cyantraniliprole 20SC	150	trickle tube (25 Apr & 9 May)	0.2 (0.1)	3.2 a(0.7)	1.3 (0.2)	2.3 a (0.4)	5.5 a (1.1)
Imidacloprid 4.6SC &	423	transplant drench (24 Apr)					
Cyantraniliprole 20SC	100	trickle tube (9 May)	0.1 (0)	0.2 b (0.1)	0.1 (0)	0.5 b (0.2)	0.5 b (0.1)
Imidacloprid 4.6SC &	423	transplant drench (24 Apr)					
Cyantraniliprole 10SE[2]	100	foliar spray (9 & 16 May)	0 (0)	0.2 b (0.1)	0.1 (0)	0.4 b (0.2)	0.2 b (0.1)
Imidacloprid 4.6SC &	423	transplant drench (24 Apr)					
Cyantraniliprole 10SE[2]	123	foliar spray (9 & 16 May)	0 (0)	0.2 b (0)	0.1 (0)	0.4 b (0.2)	0.2 b (0.1)
Imidacloprid 4.6SC &	423	transplant drench (24 Apr)					
Cyantraniliprole 10SE[2]	150	foliar spray (9 & 16 May)	0 (0)	0.2 b (0)	0.1 (0)	0.6 b (0.2)	0.2 b (0.1)
Imidacloprid 4.6SC &	423	transplant drench (24 Apr)					
Spinetoram SC[2]	53	foliar spray (9 & 16 May)	0 (0)	0.1 b (0)	0.2 (0)	0.6 b (0.2)	0.1 b (0)
ANOVA F-value[3]			0.54	3.22	1.80	14.6	3.36
$P > F$ (d.f. = 7, 21)			0.79	0.02	0.15	0.0001	0.01

[1]Means in the same column followed by the same letter are not significantly ($P < 0.05$) different according to orthogonal comparisons.
[2]Folar treatments applied with vegetable oil at 0.5% volume to volume.
[3]Data was transformed to $\log_{10}(x + 0.5)$ for data analyses although means are reported for untransformed data.

4 to 6 wk thereafter. Undoubtedly, this result is the direct toxic effect of imidacloprid on predator populations rather than any indirect effects on thrips prey. Numerous studies have established that densities of *O. insidiosus* do not track densities of thrips prey, and these predators persist in sweet pepper for months in the absence of thrips prey (e.g., Funderburk et al. 2000; Reitz et al. 2003). Because of the overwhelming suppressive effect of a transplant application of imidacloprid, we were unable in this trial to evaluate the effects of foliar applications of cyantraniliprole 10SE and spinetoram SC on thrips and *O. insidiosus* populations.

Our results show that cyantraniliprole 20SC applied as a systemic treatment had no detectable impacts 4 to 6 wk later on populations of *O. insidiosus* in the flowers. Treatments consisted of 2 rates each applied twice prior to pepper flowering, and, even at these high rates, its use in pepper appears compatible with the conservation biological control program. There was no indication of efficacy against thrips, which was consistent with earlier data showing that systemic applications are not effective against thrips in the flowers (M. S. and J. F., unpublished). Imidacloprid has a broad-spectrum of activity and our results show that it is toxic to *O. insidiosus* in the flowers even when it is applied early as a transplant drench. Imidacloprid has little activity against western flower thrips (e.g., Cloyd & Sadof 1998), and its efficacy against thrips larvae in this trial undoubtedly is because the larvae were primarily *F. tritici* or *F. bispinosa*. Overall, the results of this trial are important in our integrated pest management program for thrips and other pests in pepper (Funderburk et al. 2011).

Summary

An experiment was conducted to evaluate imidacloprid 4.6SC (Bayer Crop Protection, Research Triangle Park, North Carolina) and cyantraniliprole 10SE and 20SC (DuPont Crop Protection, Newark, Delaware) against populations of thrips and minute pirate bugs [*Orius insidiosus* (Say) and *O. pumilio* (Champion) (Hemiptera: Anthocoridae)], the key natural enemies of thrips in pepper. Cyantraniliprole 20SC applied as a systemic treatment had no detectable impacts 4 to 6 wk later on populations of minute pirate bugs in the flowers. Treatments consisted of 2 rates each applied twice prior to pepper flowering. Although there were no significant effects on thrips populations in the flowers, cyantraniliprole can be used compatibly in this manner in a conservation biological control program for thrips. Conversely, imidacloprid applied as a transplant drench greatly suppressed minute pirate bug populations in the flowers 4 to 6 wk later, and it is not compatible with the conservation biological control program.

Key Words: nontarget pest damage, insecticide resistance, pest resurgence, systemic treatment

Resumen

Se realizó un experimento para evaluar imidacloprid 4.6SC (Protección Bayer Crop, Research Triangle Park, Carolina del Norte) y Cyantraniliprole 10SE y 20SC (DuPont Protección de Cultivos, Newark, Deleaware) contra poblaciones de trips y dos especies de chinches piratas diminutos [*Orius insidiosus* (Say) y *O. pumilio* (Campeón) (Hemiptera: Anthocoridae)], que son enemigos naturales claves del trips del pimiento. El 20SC Cyantraniliprole aplicado como un tratamiento sistémico no presentó efectos detectables sobre la poblacion de los chinches piratas diminutos en las flores a las 4 a 6 semanas despues del tratamiento. Los tratamientos consistieron en 2 dosis cada uno aplicado dos veces antes de la floración de la pimienta. Aunque no hubo efectos significativos sobre la poblacion de trips en las flores, se puede usar Cyantraniliprole en manera compatible con un programa de conservación para el control biológico de trips. Al contrario, imidacloprid aplicado como un regado al suelo para las plantas trasplantadas suprimió en gran medida las poblaciones de los chinches pirata diminutos en las flores a las 4 a 6 semanas despues del tratamiento, y no es compatible con el programa de conservación de control biológico de trips.

Palablas Clave: daño por plaga no blanco, resistencia a insecticidas, resurgencia de plagas, tratamiento sistémico

References Cited

Baez, I., Reitz, S. R., and Funderburk, J. E. 2004. Predation by *Orius insidiosus* (Heteroptera: Anthocoridae) on species and life stages of *Frankliniella* flower thrips (Thysanoptera: Thripidae) in pepper flowers. Environ. Entomol. 33: 662-670.

Cloyd, R. A., and Sadof, C. S. 1998. Flower quality, flower number, and western flower thrips density on Transvaal daisy treated with granular insecticides. HortTechnology 8: 567-570.

Demirozer, O., Tyler-Julian, K., Funderburk, J., Leppla, N., and Reitz, S. 2012. *Frankliniella occidentalis* (Pergande) integrated pest management programs for fruiting vegetables in Florida. Pest Man. Sci. DOI: 10.1002/ps.3389.

Funderburk, J. E., Stavisky, J., and Olson, S. 2000. Predation of *Frankliniella occidentalis* (Thysanoptera: Thripidae) in field peppers by *Orius insidiosus* (Hemiptera: Anthocoridae). Environ. Entomol. 29: 376-382.

Funderburk, J., Reitz, S., Stansly, P., Olson, S., Sui, D., Mcavoy, G., Whidden, A., Demirozer, O., Nuessly, G., and Leppla, N. 2011. Managing thrips in pepper and eggplant. EDIS Document ENY-658, Florida Coop. Ext. Service, Univ. Florida, Gainesville. 9 pp.

Reitz, S. R., Yearby, E. L., Funderburk, J., Stavisky, J., Olson, S. M., and Momol, M. T. 2003. Integrated management tactics for *Frankliniella thrips* (Thysanoptera: Thripidae) in field-grown pepper. J. Econ. Entomol. 96: 1201-1214.