SUBLETHAL EFFECTS OF NEW INSECTICIDES ON INSIDIOUS FLOWER BUG

Glenn E. Studebaker and Timothy J. Kring[1]

RESEARCH PROBLEM

Integration of chemical and biological controls is an important aspect of IPM. Insecticides may not always cause mortality in non-target species, but may affect other aspects such as fecundity, longevity, etc. Knowledge of these effects on beneficial insects is essential to a cotton IPM program in which conservation of natural populations of beneficial insects is a goal.

BACKGROUND INFORMATION

Many of the insecticides used in cotton have a broad range of activity, affecting both target as well as non-target arthropods. However, many of the newer chemistries are more specific and as a result may have less dramatic effects on non-target organisms. However, lack of simple mortality may not indicate the lack of negative effects. More subtle effects may occur affecting fecundity, longevity, searching behavior, predation, or general movement within the field or plant canopy. Such sublethal effects have been observed in several pest species after exposure to imidacloprid (Drinkwater, 1994; Chaisuekul and Riley, 2001; Elzen, 2001).

RESEARCH DESCRIPTION

A colony of *Orius insidiosus* was maintained at the Northeast Research and Extension Center, Keiser, Arkansas. Insects in the colony were fed bollworm eggs and green bean pods daily. Green bean pods also served as a substrate for oviposition. Plots of cotton cultivar SureGrow 125 were planted at the University of Arkansas Northeast Research and Extension Center, Keiser. No insecticides were applied to plots with the exception of the insecticide treatments outlined in this study. Also, no in-

[1] Entomologist, Northeast Research and Extension Center, Keiser; and professor, Department of Entomology, Fayetteville.

furrow insecticides were applied at planting to insure insecticide-free plants. Plots were 4 rows by 7.6 m long arranged in a randomized complete block design with 4 replications. Insecticides were applied using a CO_2-powered backpack sprayer. The sprayer was calibrated to deliver 10 gallons per acre at a pressure of 40 psi through 2-TX8 hollowcone nozzles per row. Water alone was applied to the untreated control plots. Only the center 2 rows of each plot were treated to give a buffer of 2 rows between each pair of treated rows. Treatments were applied early in the morning, just after sunrise, when wind conditions were negligible to avoid spray drift. The spray boom was cleaned between each treatment by rinsing with a water and bleach solution, followed by pure water.

O. insidiosus individuals were caged on plants as soon as sprays had dried. Cages were placed on the fourth leaf down from the plant's terminal. Cages were constructed from 6-cm diameter polystyrene petri dishes held together and on the plant by 11.5-cm hair clips that were bent to fit around the dish. Each cage was constructed of either 2 petri dish bases or 2 petri dish tops so that the edges would meet forming an enclosure. Strips of foam were glued to the edges of each dish so that a seal would form when the cage was closed. A hole 3.2-cm in diameter was cut in each side of the cage and a piece of organdy cloth was glued over the opening to allow for air flow through the cage. Insects were caged on the plants for 24 hours and then removed. Only adults that were 7 to 10 days old were used to insure females had mated and were beyond their preoviposition period (Ruberson et al., 1991). Survivors were evaluated for sublethal effects by placing them individually in 1-oz plastic cups with a single piece of green bean pod and 10 *Helicoverpa zea* eggs. Each day green bean pods and *H. zea* eggs were removed and replaced with fresh bean pods and eggs. The number of *H. zea* eggs consumed each day was recorded, as well as the number of eggs deposited in green bean pods by *O. insidiosus* females. Insects were caged individually on treated plants (20 per replicate). Males, females and third-instar nymphs were evaluated separately to determine the variation in effects on gender and insect stage. Means were subjected to analysis of variance and separated by least significant difference test (LSD, $P< 0.05$).

RESULTS AND DISCUSSION

Survival of third-instar nymphs and males was significantly reduced by imidacloprid and indoxacarb, while none of the compounds tested had any effect on females (Table 1). Both imidacloprid and indoxacarb significantly reduced feeding activity in third instars, females and males (Table 2). However, females were not as severely affected as the others. Imidacloprid also had a more dramatic effect on males than did indoxacarb. Fecundity was also significantly reduced by indoxacarb and imidacloprid (Table 3). Spinosad, methoxyfenozide and tebufenozide had no apparent adverse effects on survival, feeding activity, or fecundity (Tables 1-3).

Imidacloprid and indoxacarb had the most far-reaching sublethal effects in all three of the areas measured in this study. Exposure to spinosad, methoxyfenozide and tebufenozide resulted in no measurable sublethal effects, making them more appropriate for use in beneficial insect conservation.

PRACTICAL APPLICATION

Integrating chemical and biological controls is difficult with insecticides. Although imidacloprid and indoxacarb may not have a broad spectrum of activity, they do have far-reaching sublethal effects on *O. insidiosus,* making them less likely to be of use in conserving this important predator. However, spinosad, methoxyfenozide and tebufenozide all show no lethal or sublethal effects on this predator and should be the insecticides of choice when trying to conserve this and other related predators.

LITERATURE CITED

Chaisuekul, C. and D.G. Riley. 2001. Thrips (Thysanoptera: Thripidae) feeding response to concentration of imidacloprid in tomato leaf tissue. J. Entomol. Sci. 36:315-317.

Drinkwater, T.W. 1994. Comparison of imidacloprid with carbamate insecticides, and the role of planting depth in the control of false wireworms, *Somaticus* species, in maize. Crop Prot. 13:341-345.

Elzen, G.W. 2001. Lethal and sublethal effects of insecticide residues on *Orius insidiosus* (Hemiptera: Anthocoridae) and *Geocoris punctipes* (Hemiptera: Lygaeidae). J. Econ. Entomol. 94:55-59.

Ruberson, J.R., L. Bush, and T.J. Kring. 1991. Photoperiodic effect on diapause induction and development in the predator *Orius insidiosus* (Heteroptera: Anthocoridae). Environ. Entomol. 20:786-789.

Table 1. Survival of 7 to 10 day old *Orius insidiosus* after exposure to treated cotton leaves.

Treatment	Rate	Survival		
		Third instars	Females	Males
	(kg ai/hectare)	---------- (days) ----------		
Untreated control		18.2 a[z] (69)[y]	6.1 a (75)	6.9 a (70)
spinosad	0.09	17.9 a (67)	5.9 a (70)	7.9 a (69)
spinosad	0.199	17.5 a (68)	5.8 a (71)	5.5 ab (58)
indoxacarb	0.078	4.7 b (59)	5.7 a (45)	3.4 b (38)
indoxacarb	0.123	5.2 b (58)	4.2 a (65)	2.6 b (42)
imidacloprid	0.027	7.2 b (31)	4.2 a (42)	5.0 ab (41)
imidacloprid	0.053	4.4 b (18)	4.4 a (33)	3.2 b (39)
methoxyfenozide	0.28	16.0 a (62)	6.0 a (64)	7.6 a (74)
methoxyfenozide	0.84	15.7 a (65)	5.9 a (66)	7.8 a (66)
tebufenozide	0.14	15.9 a (66)	5.4 a (64)	5.6 ab (73)
tebufenozide	0.28	16.1 a (66)	6.3 a (62)	6.7 a (65)

[z] Means within a column followed by same letter do not significantly differ (P<0.05, LSD).
[y] Number in parentheses is number of individuals evaluated.

Table 2. Percent of *Orius insidiosus* resuming feeding on *H. zea* eggs after exposure to treated cotton leaves.

Insecticide	Rate	Third instars	Females	Males
	(kg ai/hectare)	---------- (%) ----------		
untreated control		98.8 a[z] (69)[y]	98.8 a (75)	98.8 a (70)
spinosad	0.09	100.0 a (67)	97.5 a (70)	95.0 a (69)
spinosad	0.199	98.8 a (68)	92.5 ab (71)	87.5 a (58)
indoxacarb	0.078	10.0 b (59)	73.8 b (45)	27.5 b (38)
indoxacarb	0.123	2.5 b (58)	68.3 b (65)	45.0 b (42)
imidacloprid	0.027	7.5 b (31)	82.5 ab (42)	2.5 c (41)
imidacloprid	0.053	0.0 b (18)	65.0 c (33)	7.5 c (39)
methoxyfenozide	0.28	97.5 a (62)	92.5 ab (64)	97.5 a (74)
methoxyfenozide	0.84	97.5 a (65)	90.0 ab (66)	96.2 a (66)
tebufenozide	0.14	98.8 a (66)	88.8 ab (64)	93.8 a (73)
tebufenozide	0.28	100.0 a (66)	87.5 ab (62)	93.8 a (65)

[z] Means within a column followed by same letter do not significantly differ (P<0.05, LSD).
[y] Number in parentheses is number of individuals evaluated.

Table 3. Fecundity of *Orius insidiosus* after exposure to treated cotton leaves in 2001.

Treatment	Rate	Eggs/female/day
	(kg ai/hectare)	
untreated control		3.9 a[z] (75)[y]
spinosad	0.09	4.2 a (70)
spinosad	0.199	4.5 a (71)
indoxacarb	0.078	1.3 b (45)
indoxacarb	0.123	0.6 b (65)
imidacloprid	0.027	1.3 b (42)
imidacloprid	0.053	1.9 b (33)
methoxyfenozide	0.28	4.1 a (64)
methoxyfenozide	0.84	4.2 a (66)
tebufenozide	0.14	4.8 a (64)
tebufenozide	0.28	4.1 a (62)

[z] Means within a column followed by same letter do not significantly differ (P<0.05, LSD).
[y] Number in parentheses is number of individuals evaluated.