EFFICACY OF NEW AND TRADITIONAL INSECTICIDES AGAINST THE HELIOTHINE COMPLEX IN SOUTHEAST ARKANSAS COTTON FIELDS

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Abstract

Three separate tests were conducted during the 2000 cotton growing season at the Southeast Branch Experiment Station near Rohwer, AR to evaluate the efficacy of several new and traditional insecticides against cotton bollworm and tobacco budworm. Efficacy of insecticides was rated 3 days after treatment by examining 25 terminals, 25 squares, and 25 small bolls per plot and recording the number of worms and damaged parts. Tobacco budworm was the predominant heliothine species (> 90%) in all three tests. Thus, worm count and damage in plots treated with pyrethroids tended to be greater than in plots that received other treatments. Tobacco budworm was effectively controlled by the new insecticides Steward (0.11 lb ai/acre), Tracer (0.063 lb ai/ac), and Denim (0.01 lb ai/acre). Tracer (0.063 lb ai/acre) was as effective in reducing worm count and damage as a tank mix of Lorsban (0.5 lb ai/acre) + Tracer (0.031 lb ai/acre). Steward, Tracer, and Denim (all rates) provided a significant increase in lint yield compared to the check treatment. Lint yields in plots treated with pyrethroids, when used alone, were similar to those of the untreated check plots.

Introduction

The cotton bollworm, *Helicoverpa zea* (Boddie) and the tobacco budworm, *Heliothis virescens* (F.) are key insect pests of cotton in the U.S. During the 1999 growing season, the corn earworm together with tobacco budworm infested nearly 79% of the U.S. cotton acreage causing an estimated loss of about 275,524 bales (Williams 2000). Tobacco budworm is an especially troubling pest due to its ability to develop resistance to insecticides (Bagwell et al. 1998, Payne et al.1999). The tobacco budworm and cotton bollworm have developed (or are developing) resistance to all classes of insecticides to which they have been repeatedly exposed. The development of resistance to insecticides has been a major factor responsible for our inability to manage these two pests (Sparks et al. 1993). Insect resistance management is central to cotton insect control, and it is critical in the management of the tobacco budworm. Fundamental to this is the availability of safe and effective insect control agents. Since it became commercially available in 1996, Bt technology has provided farmers with an effective mean to control tobacco budworm, but Bt cotton has been shown to be less effective on bollworm (Macintosh et al. 1990, Sumerford et al.1999). In addition, there are concerns about the development of resistance in bollworm and tobacco budworm to Bt cotton. Alternating the usage of available insecticides and introducing new chemistries with new and novel modes of action is an important step toward slowing down the development of resistance to insecticides and lengthening their effective usage period. Several new products have been introduced in recent years for the control of noctuid pests in cotton. Information about the performance of these new insecticides against noctuids is needed. The purpose of this study was to evaluate and compare the efficacy of several new and traditional insecticides against the cotton bollworm and tobacco budworm.

Materials and Methods

Three separate tests were carried out in 2000 on the Southeast Branch Experiment Station near Rohwer, AR to evaluate the efficacy of several chemicals on cotton bollworm and tobacco budworm. A Randomized Complete Block Design with four replications was used in all tests. Plots were 40 ft x 4 rows wide. A planting pattern of 4 x 2 skip row was used in all three tests so that each plot was bordered on each side by a 2 row fallow strip. Cottonseed 'Stoneville 474' were planted on 5-23 in Tests I and II but planted on 6-7 in Test III. Research plots in all three tests were maintained using standard production practices. Efficacy tests were initiated when eggs or small worm densities were at or approaching threshold levels. In all three tests, treatments were applied to test plots using a high clearance sprayer at 40 PSI and 10 gallons of finished spray per acre. In Tests I and II, treatments were applied on 7-21, 7-25, and 7-31-2000. Treatments in Test III were applied on 8-14, 8-18, 8-22, and 8-28-2000. Post treatment counts in all tests were made 3 days after treatment by examining 25 terminals, 25 squares, and 25 small bolls per plot and recording the number of eggs, worms (small, medium, and large), and damaged parts. Heliothine larvae were collected for species identification on each sampling date of all three tests. A microscopic examination using a dissecting microscope was made to identify larvae. Lint yields were determined by machine harvesting the middle 2 rows of the plots and applying the farm average percent lint turn-out of 36%. Cotton in Tests I and II was harvested on 10-10 while Test III was harvested on 10-30-2000. Data were processed using the Agriculture Research Manager (ARM) and CoStat (CoStat Statistical Software). An Analysis of Variance was run and the Least Significant Difference (LSD) was used to separate the means.

Results and Discussion

Worm Count and Damage

Tobacco budworm was the predominant heliothine species (> 90%) in all three tests. Steward (0.11 lb ai/acre) and the high rate of Denim (0.01 lb ai/acre) were the only treatments in Test I to significantly reduce worm count on squares compared with the check treatment (Table 1). Plots treated with the low rate of Denim (0.0075 lb ai/acre), however, had similar worm count on squares to the untreated check plots. Worm count on small bolls in plots treated with Steward were not significantly different from those in the check plots but tended to be numerically lower. All treatments significantly reduced worm damage to squares compared with the untreated check except for Provado and the pyrethroids, a reflection of the high percentage of tobacco budworm in the worm populations. New compounds such as Steward, Tracer, and Denim were quite effective in reducing worm damage to squares. In Test II, all treatments significantly reduced worm count on squares compared with the untreated check except for Karate Z (0.03 lb ai/acre) (Table 2). Tracer (0.063 lb ai/acre), however, appeared to be the most effective worm treatment in this test. Both Tracer (0.063 lb ai/acre) and Lorsban (1.0 lb ai/acre) significantly reduced worm counts on small bolls compared with the check treatment. Tracer (0.063 lb ai/acre) and a tank mix of Lorsban (0.5 lb ai/acre) + Tracer (0.031 lb ai/acre) significantly reduced worm damage on squares and, simultaneously, on bolls compared with the check treatment. In Test III, all treatments significantly reduced worm counts and damage on squares and bolls compared with the untreated check except for the pyrethroid treatments (Table 3), indicative of the 90% tobacco budworm population in this test. As in Test I, new compounds such as Denim, Tracer, and Steward were very effective treatments in reducing worm count and damage on all plant parts that were examined.

Lint Yield

Steward, Tracer, and Denim (all rates) provided a significant increase in lint yield in Test I compared to the check treatment (Table 1). Although statistically similar, lint yields in plots treated with Steward were numerically higher than those treated with Denim or Tracer. This numerical increase in yield in Steward treated plots is probably not entirely due to worm suppression but rather to Steward's broad spectrum activity. Beside its activity on bollworm and tobacco budworm, Steward has good efficacy on plant bugs and beet armyworm (Kharboutli et al. 1999), which may have contributed to the numerically higher yield in the Steward plots.

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In Test II, lint yields were similar among all treatments including the untreated check except for Tracer (0.063 lb ai/acre) which yielded significantly more cotton than any other treatment (Table 2). All treatments in Test III provided a significant increase in lint yield compared to the untreated check except for the pyrethroid treatments when used lone (Table 3).

Conclusions

Tracer, Denim, and Steward seem to be the chemicals of choice against noctuid caterpillars. In addition to having good worm activity, Steward is a broad-spectrum insecticide with activity on insects such as plant bugs and beet armyworm. Consequently, if such pests were present at sufficient numbers, increases in lint yields were obtained in plots treated with Steward compared to treatments with a narrower spectrum of activity. The availability of Tracer, Denim, and Steward for cotton pest control would be greatly beneficial to cotton farmers. These are new insecticides with novel modes of action and will help in the management of resistance in insect pests to insecticides. These insecticides are quite effective on noctuid pests but are, at the same time, fairly soft on beneficials.

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Table 1 (Test I). Efficacy of insecticides on Heliothines as indexed by insect count, damage, and lint yield[1]. Rohwer, AR, 2000.

		Worm Count[2]			Worm Damage[2]			
Treatment	Rate lb ai/ ac	Term.	Squrs.	Bolls	Term.	Squrs.	Bolls	Lint Yield lb/ac
Decis 1.5EC	.01	1.1 a	2.3 ab	1.6 a	4.0 ab	5.5 abc	2.8 ab	978 c-f
Karate Z 2.09CS	.025	.75 ab	1.5 bcd	.33 d	3.9 ab	7.3 a	2.3 bc	898 ef
Provado 1.6SC	.0469	.75 ab	2.7 a	1.3 ab	3.4 ab	7.4 a	2.1 bc	811 f
Check	-	.5 ab	1.9 abc	1.7 a	4.9 a	7.3 a	4.2 a	843 f
Denim 0.16EC	.01	.50 ab	.67 d	.58 bcd	3.5 ab	4.4 bc	1.8 bc	1151 abc
Leverage 2.7SE	.0634	.50 ab	2.2 ab	.75 bcd	4.2 ab	5.9 ab	2.6 bc	933 def
Tracer 4SC	.063	.42 b	.92 cd	.50 cd	3.0 ab	3.8 c	1.1 c	1189 ab
Denim 0.16EC	.0075	.42 b	1.3 bcd	1.2 abc	3.2 b	4.4 bc	2.2 bc	1117 a-d
Denim 0.16EC+ NIS L	.01+.25%[3]	.42 b	.92 cd	.75 bcd	2.8 b	4.8 bc	1.8 bc	1080 a-e
Baythroid 2EC	.0329	.33 b	1.6 bcd	.83 bcd	3.3 b	6.2 ab	2.7 ab	1003 b-f
Steward 1.25SC	.11	.25 b	.75 d	1.0 a-d	3.6 ab	3.7 c	1.8 bc	1211 a
Capture 2EC	.05	.17 b	1.6 bcd	1.6 a	4.0 ab	6.3 ab	2.7 ab	967 c-f

[1]Means in columns followed by the same letter(s) are not significantly different (*P* = 0.05, LSD).
[2]Worm count and damage are seasonal means of counts 3 days after treatment (3 applications). Data reported per 25 terminals, 25 squares, and 25 small bolls per plot.
[3]V/V.

Table 2 (Test II). Efficacy of insecticides on Heliothines as indexed by insect count, damage, and lint yield[1]. Rohwer, AR, 2000.

		Worm Count[2]			Worm Damage[2]			
Treatment/ formulation	Rate lb (AI) /acre	Term.	Squrs.	Bolls	Term.	Squrs.	Bolls	Lint Yield lb/acre
Karate Z 2.09CS	0.03	0.67 a	1.8 ab	0.92 abc	3.7 ab	4.7 bc	2.2 ab	1049 b
Lorsban 4EC + Karate Z 2.09CS	0.5 + 0.015	0.67 a	1.3 bc	1.6 a	3.2 ab	5.4 ab	2.1 ab	978 b
Check	-	0.58 a	2.3 a	1.3 ab	3.9 a	7.6 a	3.2 a	1024 b
Lorsban 4EC + Tracer 4SC	0.5 + 0.031	0.58 a	1.3 bc	0.67 bc	2.1 b	4.5 bc	1.8 b	1081 b
Tracer 4SC + Karate Z 2.09CS	0.031 + 0.015	0.42 a	1.4 bc	0.75 bc	2.3 ab	5.0 abc	1.7 b	1067 b
Lorsban 4EC	1.0	0.42 a	1.0 bc	0.50 c	2.7 ab	4.4 bc	2.1 ab	969 b
Tracer 4SC	0.063	0.42 a	0.75 c	0.25 c	2.5 ab	2.6 c	0.33 c	1340 a

[1]Means in columns followed by the same letter(s) are not significantly different (*P* = 0.05, LSD).
[2]Worm count and damage are seasonal means of counts 3 days after treatment (3 applications). Data reported per 25 terminals, 25 squares, and 25 small bolls per plot.

Table 3 (Test III). Efficacy of insecticides on Heliothines as indexed by insect count, damage, and lint yield[1]. Rohwer, AR, 2000.

		Worm Count[2]			Worm Damage[2]			
Treatment	Rate lb ai/ac	Term.	Squrs.	Bolls	Term.	Squrs.	Bolls	Lint Yield lb/ac
Leverage 2.7SE	.0634	2.3 a	3.7 a	3.6 a	8.5 a	10.3 a	6.9 a	305 d
Check	-	1.9 ab	3.4 a	3.2 ab	7.7 ab	9.0 a	5.6 ab	359 d
Decis 1.5EC	.01	1.7 ab	3.7 a	2.8 abc	7.3 abc	8.4 a	4.8 bc	348 d
Leverage 2.7SE + Tracer 4SC	.0634 + .033	1.5 abc	2.7 a	1.8 cd	5.9 a-d	6.3 b	3.8 cd	1026 a
Baythroid 2EC	.0329	1.3 bcd	3.4 a	2.4 bc	7.9 ab	8.6 a	4.9 bc	333 d
RH-2485 2F + Tracer 4SC + Penetrator Plus	.12 + .033 + .5[3]	1.3 b-e	1.3 b	.63 e	5.4 b-e	4.3 bc	2.8 de	936 ab
Tracer 4SC + Penetrator Plus	.033+ .5[3]	1.1 b-e	1.1 b	.31 e	4.9 cde	3.3 cd	1.3 efg	843 bc
Steward 1.25SC	.11	1.1 b-e	.56 b	.56 e	5.4 b-e	2.8 cd	1.2 efg	710 c
Tracer 4SC	.063	.69 cde	.31 b	.19 e	3.1 e	1.7 d	.31 g	975 ab
Denim 0.16EC + NIS L	.01 + .25%[4]	.63 de	.63 b	.63 e	3.8 de	2.0 d	.75 fg	935 ab
Baythroid 2EC + Tracer 4SC	.0329 + .033	.50 de	.81 b	.63 e	3.1 e	2.2 d	2.1 def	932 ab
Denim 0.16EC	.01	.44 e	.38 b	.81 de	4.2 de	1.8 d	.63 fg	930 ab

[1]Means in columns followed by the same letter(s) are not significantly different (*P* = 0.05, LSD).
[2]Worm count and damage are seasonal means of counts 3 days after treatment (4 applications). Data reported per 25 terminals, 25 squares, and 25 small bolls per plot.
[3]Pint/Acre.
[4]V/V.