1998 BOLLWORM AND TOBACCO BUDWORM CONTROL STUDIES

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Abstract

Five separate tests were conducted in 1998 at the Southeast Research and Experiment Station near Rohwer, AR to test the efficacy of traditional and new insecticides against cotton bollworm and tobacco budworm. Terminal, square and boll inspection was used to assess the efficacy of insecticides as indexed by worm count and damage. Our data show that Baythroid and Tracer effectively controlled cotton bollworm. Steward also showed some activity against bollworm. Tobacco budworm was well controlled by Tracer and Pirate. Tobacco budworm survival trends after treatment strongly indicate that Steward may effectively control tobacco budworm and reduce damage. Baythroid did not control tobacco budworm indicating the presence of a resistant population in southeast Arkansas. Increased lint yield was obtained with some chemicals such as Tracer, Baythroid, and Decis (bollworm tests) and Steward (bollworm and tobacco budworm tests). Increased yield in plots treated with Steward was probably due, in part, to Steward's broad spectrum activity and not entirely due to worm control.

Introduction

The cotton bollworm, *Helicoverpa zea* (Boddie) and the tobacco budworm, *Heliothis virescens* (F.) are multivoltine pest species of cultivated crops. Both species are well established as two of the most important cotton pests in the U. S. (Luttrell 1994). During the 1997 growing season, the corn earworm together with tobacco budworm infested nearly 79% of all U.S. cotton causing an estimated loss of more than $250 million in total cotton losses and costs of control (Williams 1998). Insecticide resistance is a major factor responsible for our inability to manage these two insects (Sparks et al. 1993). Insect resistance management is central to cotton insect control and especially tobacco budworm control. Fundamental to this is the availability of safe and effective insect control agents. Although insecticides such as the pyrethroids are effective against cotton bollworm, tobacco budworm has developed resistance to all the major classes of insecticides which have been widely used against them. Bt technology has provided farmers with an effective mean of controlling tobacco budworm, but Bt cotton has been shown to be less effective against bollworm (Macintosh et al. 1990). In addition, there are concerns about the development of resistance in bollworm and tobacco budworm to Bt cotton (Phillips 1995, Lambert et al. 1998). Thus, there is a continual need for the development of new insecticides with new modes of action. In recent years, several new products with good efficacy, some degree of selectivity, and novel modes of action have been introduced. Research is vital to learn how these compounds can best be used. The purpose of this study was to examine the efficacy of new insecticides with novel modes of action as compared to traditional insecticides against cotton bollworm and tobacco budworm.

Materials and Methods

Five separate tests were carried out in 1998 on the Southeast Branch Experiment Station near Rohwer, AR to evaluate the efficacy of several chemicals on cotton bollworm and tobacco budworm. Plots were 40 feet long and four rows wide. We used a planting pattern of 4 x 2 skip row so that each plot was bordered on each side by a 2 row fallow strip. In all tests we used a Randomized Complete Block Design with four replications. Efficacy tests were initiated when eggs or small worm densities were at or approaching threshold levels. All research plots were maintained using standard production practices to produce the crop. Lint yields were determined by machine harvesting the middle 2 rows of the plots on dates specified below. Data were processed using the Pesticide Research Manager 5 (PRM) and CoStat (CoStat Statistical Software). Analysis of Variance was run and the Least Significant Difference (LSD) was used to separate the means.

Test I

The primary worm pest in this test was cotton bollworm. In addition to traditional insecticides, new chemistries with novel modes of action were used in this test. Suregrow 125 was planted on 6-9-98. Treatments were applied on 7-17 and 7-27-98 using a two row back pack sprayer with 2 Tx4 hollow cone nozzles/row. The sprays were applied at 40 PSI and10 gallons of finished spray per acre. Appropriate rates of surfactants were used. Post treatment counts were made 3 days after treatment by examining 25 terminals, 25 squares, and 25 bolls per plot and recording number of eggs, worms, and damaged parts. Cotton was harvested on 9-30-1998.

Test II

In this test, we examined the efficacy of four pyrethroid insecticides on cotton bollworm. Stoneville 474 was planted on 5-5-98. Treatments were applied on 7-17 and 7-27-98 using a two row back pack sprayer with 2 Tx4 hollow cone nozzles/row. The sprays were applied at 40 PSI and10 gallons of finished spray per acre. Appropriate rates of surfactants were used. Post treatment counts were made 3 days after treatment by examining 25 terminals, 25 squares, and 25 bolls per plot and recording number of eggs, worms, and damaged parts. Cotton was harvested on 9-30-1998.

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Test III and Test IV
The main worm pest in these tests was tobacco budworm. Traditional and new chemistries were used in these tests. In both tests, Suregow 125 was planted on 6-9-98. Treatments in test III were applied on 8-10, 8-17, and 8-24-98 while in test IV treatments were applied on 8-15, 8-21, and 8-29-98. Insecticides were applied using a high clearance sprayer in10 gallons of total spray solution/acre. Appropriate rates of surfactants were used in both tests. Post treatment counts were made 3 days after treatment by examining 25 terminals, 25 squares, and 25 bolls per plot and recording counts of eggs, worms, and damaged parts. Cotton in both tests was harvested on 11-6-98.

Test V
The efficacy of different rates of Confirm 2F and in combination with Karate 2SC was examined on tobacco budworm which was the predominant worm pest in this test. Suregow 125 was planted on 6-9-98. Treatments in this test were applied on 8-11, 8-17, and 8-22-98. Insecticides were applied using a high clearance sprayer in10 gallons of total spray solution/acre. Appropriate rates of surfactants were used in both tests. Post treatment counts were made 3 days after treatment by examining 25 terminals, 25 squares, and 25 bolls per plot and recording counts of eggs, worms, and damaged parts. Cotton was harvested on 11-6-98.

Results and Discussion

Bollworm Control
Using worm count and square damage as the standard for comparison, all treatments in Test I significantly reduced bollworm count and damage compared to the check treatment (Table 1). Similar efficacy trends were seen in data gathered from terminals and bolls. New compounds such as Tracer and Steward were as effective on bollworms as Baythroid in reducing worm count and damage. Reports by Bierman (1998) indicated Steward gave excellent square protection against bollworm and tobacco budworm. In Test II, although most treatments significantly reduced worm count and damage compared to the check, Baythroid at .037 lb ai/ac appeared to be quite effective against the bollworm. Similar efficacy trends can be seen from terminal and boll data as those obtained from squares. Those trends indicate that some of the insecticides used in this test could be the products of choice against bollworms in southeast Arkansas. However, worm densities in these two tests were much below the treatment threshold which would renders any comparative analysis of the results relatively weak. Low worm pressure did not allow insecticides to fully express their potential for bollworm control and yield protection. In light of that, it is not possible to draw strong conclusions regarding the efficacy of insecticides used in these test against bollworm. More work is needed.

Tobacco Budworm Control
Tracer and Pirate were very effective in Test III against tobacco budworm. Worm count and damage on squares, as well as those from terminals and bolls, tended to be numerically lower in plots treated with Tracer or Pirate than in plots treated with other insecticides (Table 3). Similar results were shown by Johnson et al. (1997) who reported Pirate and Tracer to provide excellent control of pyrethroid resistant tobacco budworm. Steward, a new insecticide with a novel mode of action, also appeared to be an effective compound against tobacco budworm. Tobacco budworm counts and damage in plots treated with Steward were not significantly different from those in the check plot but tended to be numerically lower (Table 3). Worm counts and damage in plots treated with Baythroid were relatively high indicating the presence of a resistant population of tobacco budworm. The high effectiveness of Tracer against tobacco budworm is again displayed in Test IV. Worm counts and worm damage in plots treated with Tracer were consistently low (Table 4). Steward at .09 and .11 lb ai/ac was also effective and also showed a consistent tendency to give low worm count and damage. Efficacy of Steward on tobacco budworm in Test IV was similar to that of Tracer and plots treated with the two compounds had similar counts of worm and plant damage (Table 4). In both tests (III and IV), Tracer and Steward exhibited a trend of suppressing tobacco budworm populations and subsequent damage. Confirm, in Test V, tended to be more effective than Karate on tobacco budworm, although significant differences in worm count and damage between plots treated with the two compounds were infrequently seen (Table 5). Increasing the Confirm rate did not result in an increased measure of control. The poor performance of Karate in this test indicates the presence of insecticide resistant population of tobacco budworm.

Lint Yield
In Test I against bollworms, non of the insecticides tested, with the exception of a combination treatment of Baythroid plus Tracer, provided a significant increase in lint yield compared to the check (Table 1). The treatment combination of Baythroid plus Tracer, Baythroid plus Pirate, in addition to the Steward treatments produced the highest numerical yields in this test. Steward yielded 798 and 817 lb lint per acre in plots treated with 0.09 and 0.11 lb ai/ac, respectively (Table 1). Plots treated with Steward yielded numerically about 150 lb more cotton lint than the check plot. This numerical increase in yield in Steward treated plots is probably not entirely due to suppression of bollworm populations. The high efficacy of Steward on plant bugs and beet armyworm (Kharboutli and Allen 1999, in press) may have contributed to this numerically higher yield. Bollworm pressure in this test was low, therefore, Steward and the other insecticides tested did not fully express their efficacy on bollworm with significant increases in yield. All the pyrethroids used in Test II tended to produce more cotton than did the check plots with Decis producing numerically the highest yield (Table 2).

In Test III, where tobacco budworm was the predominant worm pest, lint yield in plots treated with Steward were numerically higher than the other treatments (Table 3). Plots treated with Steward at 0.09 and 0.11 lb ai/ac produced 1011 and 1041 lb lint /ac, respectively, a significant increase compared to 708 lb lint/ac produced in the check plots (Table 3). It is interesting that plots treated with Tracer had the lowest worm count and damage, yet did not rank high in terms of lint yield. This is most probably due to the presence of other yield influencing insects such as tarnished plant bug in our plots beside tobacco budworm. The compounds that produced the highest yields such as Steward must have effectively controlled those insects while Tracer did not. A similar trend occurred in Test IV against tobacco budworm where plots treated with Steward at 0.09 and 0.11 lb ai/ac produced 781 and 996 lb lint /ac, respectively compared to 648 lb lint produced in the check plots. Although plots treated with Tracer and Steward yielded similarly, plots treated with Steward (.11 lb ai/ac) yielded over 170 lb of lint more than plots treated with Tracer. Again, this was probably due to Steward=s broad spectrum activity. Plots treated with Confirm at.125 lb ai/ac produced more cotton than did the check plots in Test V (Table 5). However, no significant differences in yield were seen between Confirm and Karate or between the different rates of Confirm used.

Conclusions

Our data showed that Baythroid is an effective control agent against cotton bollworm. Among the new insecticides, Tracer and Pirate are also highly efficacious against bollworm. Steward may also play a role as a good control agent against the bollworm. Pirate, Tracer, and Steward seem to be the chemicals of choice against tobacco budworm. Steward is a broad-spectrum insecticide with activity on insects such as plant bug and beet armyworm. Consequently, significant increases in lint yields were obtained in plots treated with Steward compared to other treatments used in this study. More work need to be done to document the efficacy of Steward on bollworm and tobacco budworm. Tracer, Pirate and Steward availability for cotton pest control would be greatly beneficial to cotton farmers. These new insecticides with novel modes of action could aid in the management of resistance in insect pests to insecticides.

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Table 1 (Test I). Cotton bollworm survival following insecticidal sprays as indexed by insect count, damage, and lint yield[1]. Rohwer, AR

Treatment	Rate	Bollworm Count[2]		
	lb ai/ac	Term.	Squrs.	Bolls
Check		1.4 a	.88 a	1.4 a
Steward 1.25SC	.11	.38 ab	.13 b	0 b
Tracer 4SC	.067	.13 ab	.13 b	0 b
Baythroid 2EC	.033	.13 ab	0 b	.63 b
Pirate 3SC + Baythroid 2EC	.2 + .028	.13 ab	0 b	.13 b
Steward 1.25SC	.09	0 b	.25 b	.13 b
Pirate 3SC + Baythroid 2EC	.25 + .028	0 b	0 b	0 b
Tracer 4SC + Baythroid 2EC	.031 + .028	0 b	0 b	.25 b

Treatment	Rate	Bollworm Damage[2]			Lint Yield
	lb ai/ac	Term.	Squrs.	Bolls	lb/ac
Check		2.8 a	4.4 a	3.3 a	648 b
Steward 1.25SC	.11	1.1 ab	.63 b	.25 b	817 ab
Tracer 4SC	.067	.5 b	.75 b	.5 b	800 ab
Baythroid 2EC	.033	.38 b	.50 b	.75 b	742 ab
Pirate 3SC + Baythroid 2EC	.2 + .028	.63 b	0 b	.25 b	713 ab
Steward 1.25SC	.09	.25 b	.38 b	.88 b	798 ab
Pirate 3SC + Baythroid 2EC	.25 + .028	.5 b	.63 b	0 b	834 ab
Tracer 4SC + Baythroid 2EC	.031 + .028	0 b	0 b	.25 b	847 a

[1]Means in columns followed by the same letter(s) are not significantly different at the 5% level of significance.
[2]Worm count and damage are seasonal means of counts 3 days after treatment (2 applications).

Table 2 (Test II). Cotton bollworm survival following insecticidal sprays as indexed by insect count, damage, and lint yield[1]. Rohwer, AR

Treatment	Ratelb	Bollworm Count[2]		
	ai/ac	Term.	Squrs.	Bolls
Check		1.9 a	0.38 a	.38 a
Karate Z 2.08EC	.033	.25 b	0.5 a	0 a
Fury 1.5EC	.039	.13 b	0 a	0 a
Decis 1.5EC	.025	.13 b	0 a	.13 a
Baythroid 2EC	.037	0 b	0 a	0 a

Treatment	Rate	Bollworm Damage[2]			Lint Yield
	lb ai/ac	Term.	Squrs.	Bolls	lb/ac
Check		1.9 a	2.5 a	2.8 a	649 b
Karate Z 2.08EC	.033	.5 a	.75 b	.38 b	860 ab
Fury 1.5EC	.039	.75 a	0.5 b	.5 b	834 ab
Decis 1.5EC	.025	.75 a	0.75 b	.63 b	912 a
Baythroid 2EC	.037	.38 a	0 b	.75 b	851 ab

[1]Means in columns followed by the same letter(s) are not significantly different at the 5% level of significance.
[2]Worm count and damage are seasonal means of counts 3 days after treatment (2 applications).

Table 3 (Test III). Tobacco budworm (TBW) survival following insecticidal sprays as indexed by insect count, damage, and lint yield[1]. Rohwer, AR

Treatment	Rate	TBW Count[2]		
	lb ai/ac	Term.	Squrs.	Bolls
Baythroid 2EC	.03	3.0 a	1.8 abc	1.3 abc
Check		2.1ab	2.3 a	1.7 ab
Steward 1.25SC	.11	1.8 bc	.84 abc	.92 a-d
Baythroid 2EC + Orthene 90S	.03 + .5	1.7 bcd	2.1 ab	1.8 a
Pirate 3SC + Curacron 8L	.25 + .5	1.6 bcd	1.2 abc	1.2 a-d
Pirate 3SC	.35	1.5 bcd	.58 bc	.58 bcd
Baythroid 2EC +Pirate 3SC	.03 + .35	1.4 bcd	1.6 abc	.66 a-d
Steward 1.25SC	.09	1.2 bcd	1.0 abc	1.1 a-d
Pirate 3SC + Curacron 8L	.2 + .5	.75 cd	1.75 abc	1.3 abc
Baythroid 2EC +Steward 1.25SC	.03 + .09	.67 cd	1.2 abc	1.0 a-d
Baythroid 2EC +Tracer 4SC	.03 + .031	.59 cd	.33 c	.42 cd
Tracer 4SC	.063	0.42 d	.33 c	.1 d

Treatment	Rate	TBW Damage[2]			Lint Yield
	lb ai/ac	Term.	Squrs.	Bolls	lb/ac
Baythroid 2EC	.03	5.4 abc	2.8 ab	1.8 a	808 cde
Check		6.7 a	3.7 a	2.1 a	708 de
Steward 1.25SC	.11	2.9 d	1.7 ab	1.3 ab	1041 a
Baythroid 2EC+ Orthene 90S	.03 + .5	6.2 ab	3.3 a	2.0 a	920 abc
Pirate 3SC + Curacron 8L	.25 + .5	5.8 abc	3.4 a	1.4 ab	770 cde
Pirate 3SC	.35	5.3 abc	1.8 ab	1.1 ab	673 e
Baythroid 2EC+ Pirate 3SC	.03 + .35	4.4 bcd	2.6 ab	1.1 ab	894 abc
Steward 1.25SC	.09	5.3 abc	1.5 ab	1.2 ab	1011 ab
Pirate 3SC + Curacron 8L	.2 + .5	4.8 a-d	3.1 ab	2.0 a	718 de
Baythroid 2EC+ Steward 1.25SC	.03 + .09	4.1 bcd	1.8 ab	1.4 ab	1048 a
Baythroid 2EC+ Tracer 4SC	.03 + .031	3.9 cd	1.1 b	.25 b	870 bcd
Tracer 4SC	.063	2.9 d	1.5 ab	.25 b	728 de

[1]Means in columns followed by the same letter(s) are not significantly different at the 5% level of significance.
[2]Worm count and damage are seasonal means counts 3 days after treatment (3 applications).

Table 4 (Test IV). Tobacco budworm (TBW) survival following insecticidal sprays as indexed by insect count, damage, and lint yield[1]. Rohwer, AR

Treatment	Rate	TBW Count[2]		
	lb ai/ac	Term.	Squrs.	Bolls
Karate 1EC	.03	2.0 a	1.5 ab	2.5 a
Baythroid 2EC	.03	1.9 a	2.1 a	2.0 ab
Check		1.6 ab	1.5 ab	1.4 abc
Steward 1.25SC	.11	1.5 ab	0.92 ab	1.0 bc
Steward 1.25SC	.09	1.3 ab	1.2 ab	1.5 abc
Tracer 4SC	.067	.17 b	0.33 b	.42 c

Treatment	Rate	TBW Damage[2]			Lint Yield
	lb ai/ac	Term.	Squrs.	Bolls	lb/ac
Karate 1EC	.03	6.6 a	3.2 a	3.5 a	689 b
Baythroid 2EC	.03	4.6 ab	3.8 a	2.8 ab	626 b
Check		6.3 a	3.3 a	2.8 ab	648 b
Steward 1.25SC	.11	4.6 ab	2.7 a	1.9 bc	996 a
Steward 1.25SC	.09	5.3 ab	2.1 ab	2.0 bc	781 ab
Tracer 4SC	.067	3.3 b	0.67 b	.75 c	821ab

[1]Means in columns followed by the same letter(s) are not significantly different at the 5% level of significance.

[2]Worm count and damage are seasonal means counts 3 days after treatment (3 applications).

Table 5 (Test V). Tobacco budworm (TBW) survival following insecticidal sprays as indexed by insect count, damage, and lint yield[1]. Rohwer, AR

Treatment	Rate	TBW Count[2]		
	lb ai/ac	Term.	Squrs.	Bolls
Check		3.0 a	2.2 a	1.5 abc
Karate 2SC	.033	3.0 a	2.1 a	2.5 a
Confirm 2F	.0625	2.8 a	1.5 a	1.1 c
Confirm 2F	.125	2.6 a	2.0 a	1.3 bc
Confirm 2F + Karate 2SC	.125 + .033	2.4 a	2.0 a	2.3 ab

Treatment	Rate	TBW Damage[2]			Lint Yield
	lb ai/ac	Term.	Squrs.	Bolls	lb/ac
Check		5.9 a	3.2 ab	2.3 ab	694 b
Karate 2SC	.033	7.4 a	4.2 a	3.6 a	742 ab
Confirm 2F	.0625	6.5 a	2.4 b	1.5 b	785 ab
Confirm 2F	.125	5.6 a	2.7 b	1.4 b	824 a
Confirm 2F + Karate 2SC	.125 + .033	5.5 a	4.1 a	2.8 ab	768 ab

[1]Means in columns followed by the same letter(s) are not significantly different at the 5% level of significance.

[2]Worm count and damage are seasonal means counts 3 days after treatment (3 applications).