HELIOTHINE CONTROL IN COTTON WITH NEW CHEMISTRY

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Abstract

The development and evaluation of new insecticides is necessary to maintain acceptable control levels of the Heliothine species in cotton. Performances of new and traditional insecticides were evaluated with three field experiments in Jefferson Co., AR, in 2000. The objective of these experiments was to compare new and traditional insecticides in addition to determining efficacy of combinations of each for Heliothine control in cotton. Tracer provided the best seasonal Heliothine control across all experiments. Performance of S-1812 was comparable to Tracer; however, control with S-1812 was not enhanced by the addition of Orthene or Asana XL. Tracer, Intrepid, Denim, and S-1812 provided better Heliothine control than traditional pyrethroid insecticides. The addition of Karate Z to Tracer (0.033 lb ai/ac) provided Heliothine control equal to that of Tracer alone (0.067 lb ai/ac). The addition of Karate Z increased the control level of Denim. The selective use of both new and traditional insectides can decrease development of Heliothine resistance and result in more effective IPM programs in cotton.

Introduction

Resistance of the tobacco budworm (*Heliothis virescens*) to currently available insecticides has demanded the development of new chemistry for effective Heliothine control in cotton. Some recently developed compounds for use in cotton include Tracer (spinosad) by Dow AgroSciences, Intrepid (RH-2485) by Rohm & Haas, Denim (emamectin benzoate) by Novartis, and S-1812 by Valent. Of these compounds, only Tracer is recommended for Heliothine control in Arkansas cotton. Evaluation of these insecticides is necessary to determine performance and implementation in pest management programs.

Tracer is a biologically based insect control product with many favorable characteristics. The organism *Saccharopolyspora spinosa*, a bacterium, produces the secondary metabolite spinosad, which is the active ingredient in Tracer (Thompson et al., 1996a). Tracer has a high efficacy on target insects, including Heliothine species, while maintaining little effect on beneficial insects (Salgado et al., 1997; Ruberson and Tillman, 1999). Tracer also decreases ovicidal activity of the Heliothine species; however, predacious insects and sucking pests are not affected (Peterson et al., 1998). Previous research reported Tracer to be effective in controlling pyrethroid-resistant tobacco budworm (Johnson et al., 1997).

Intrepid is a molt-accelerating compound that mimics an insect molting hormone when ingested. Like Tracer, Intrepid has little effect on beneficial insects. Intrepid has provided excellent control of foliage feeding insects, such as cotton bollworm and loopers, while demonstrating activity on tobacco budworm as well (Harrison et al., 1997).

Denim contains emamectin benzoate, a second-generation avermectin insecticide that provides control of many Lepidopteran species including tobacco budworm, cotton bollworm, armyworms, and loopers (Dunbar et al., 1998). While emamectin benzoate is susceptible to photodegradation, reservoirs of the compound develop in cotton leaf tissue, resulting in long residual activity under field conditions (Denim Technical Bulletin). Low use rates (0.0075-0.015 lb ai/ac) have been shown to effectively control Heliothine species (Dunbar et al., 1998).

S-1812 is new compound currently in the developmental stages. While its mode of action is not completely understood, previous research has shown efficient control of Heliothine species at the 0.15 lb ai/ac rate (Johnson et al., 2000). S-1812 has also exhibited good levels of selectivity, indicating little effect on beneficial insects (Ruberson and Tillman, 1999).

Three field experiments were conducted to compare these compounds to traditional insecticides and determine the effects of combinations of new and traditional insecticides for Heliothine control in cotton.

Methods

This trial was conducted on the Robert Fratesi Farm in Jefferson Co., Arkansas, in 2000. This farm was located within the boll weevil eradication zone and received programmed sprays of ULV malathion that virtually eliminated boll weevil and plant bug pressure. A combination of new and conventional chemistry was selected for evaluation. The treatments observed in the three experiments can be found in Tables 1, 2, and 3 in the results section. Treatments were evaluated in small plots (8-40" rows x 50 ft) arranged in a randomized complete block design with 4 replications. The cotton variety used was Delta Pine 5415RR and was planted on 1 May 2000. Insecticide treatments were initiated based on state recommendations of one Heliothine damaged square per row foot with eggs and small larvae present. Applications were made with a John Deere 6000 hi-cycle sprayer equipped with a compressed air delivery system. The boom was equipped with conejet TXVS 6 nozzles on a 20" spacing. Operating pressure was 45 psi with a final spray volume of 8.6 gpa. Treatments were applied as foliar sprays on 6 July, 20 July, 27 July, and 3 August. Insect counts and damage ratings were made on 10 July 4DAT#1, 24 July 4DAT#2, 31 July 4DAT#3, and 7 August 4DAT#4. Data were collected by examining 50 squares and 50 terminals selected at random from the center of each plot for the presence of live larvae and square damage. Seasonal averages of percentage square damage and total number of live larvae were calculated from the rating dates. The center two rows of each plot were machine harvested with a commercial two-row John Deere cotton picker on 13 October (165DAP) and lint yields were determined based on a 36% gin turnout. Data were processed using Agriculture Research Manager Ver. 6.0.1. Analysis of variance was conducted and Duncan's New Multiple Range Test (P=0.05) was used to separate means only when AOV Treatment P(F) was significant at the 5% level.

Results and Discussion

In Arkansas, the tobacco budworm populations are greatest the last of July and the first part of August. Based upon phermone trap catches, this trend held true for the year 2000. (Table 1). Heliothine pressure was highest around 31 July or around the third insecticide application.

Heliothine control in cotton using new products S-1812 and Tracer was compared to and used in combination with traditional insecticides Orthene, Asana XL, Baythroid, Leverage, and Capture. Results are displayed in Table 2. All treatments resulted in less seasonal percentage square damage than the untreated check. Tracer provided the least amount of seasonal average square damage (3.9%) and live larvae (0.3); however, these figures were not significantly different from all other treatments. Leverage plus Tracer did not significantly increase Heliothine control or lint yield when compared to Tracer alone (Table 5). The lint yield of the Leverage plus Tracer treatment was greater than all other treatments. S-1812 at the 0.15

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lb ai/ac rate did not differ from the Tracer treatment with respect to seasonal Heliothine control and lint yield. This agrees with results of others (Johnson et al., 2000) in that a rate of 0.15 lb ai/ac provided the best Heliothine control. The addition of Orthene and Asana XL did not enhance performance of S-1812 .

New insecticides Tracer, Intrepid, Denim, and S-1812 were compared to pyrethroid insecticides Karate Z, Decis, Fury, Leverage, and Baythroid. Only Tracer (0.67 lb ai/ac), Denim (0.01 lb ai/ac), and Decis (0.02 lb ai/ac) provided increased Heliothine control and lint yield over the untreated check for the parameters displayed in Tables 3 and 6. All treatments with the exception of Decis (0.01 lb ai/ac) had significantly greater yields than the untreated check. Although Heliothine control was greater for Tracer when compared to all other treatments, no yield difference was observed between it and S-1812. This similarity in yield agrees with the results displayed in Table 5. In general, new products Tracer, Intrepid, Denim, and S-1812 provided greater seasonal Heliothine control and yield when compared to the pyrethroid insecticides.

The efficacy of Tracer and Denim used in combination with Lorsban and Karate was also evaluated. Results can be found in Tables 4 and 7. In general, combinations of the new products with old resulted in better Heliothine control than using the older products alone. For example, all treatments provided less seasonal square damage when compared to the control except for the Karate and Lorsban treatments. Tracer (0.033 lb ai/ac) combined with Karate and with Lorsban provided greater Heliothine control and yield. However, Tracer used alone (0.67 lb ai/ac) had the same level of control as the Tracer (0.033 lb ai/ac) + Karate combination. The activity of Denim was not enhanced by the addition of a wetting agent alone. Heliothine control and yield was increased, however, by adding Karate (0.03 lb ai/ac) and Latron CS-7 (0.25% v/v) to Denim (0.0075 lb ai/ac). The results of this combination was comparable to the Tracer (0.067 lb ai/ac) and the Tracer (0.033 lb ai/ac) + Karate treatments. Denim used alone did not provide Heliothine control comparable to the Tracer treatments.

Summary

The continuing occurrence of Heliothine resistance to recommended insecticides will increase the demand for the development and implementation of new products for future Heliothine control. The performance of Tracer, S-1812, Intrepid, and Denim provided improved Heliothine control compared to traditional insecticides. Selective use of these products with traditional insecticides can minimize Heliothine resistance, thus resulting in an effective pest management program and profitable cotton crop.

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Table 1. Species Composition for Jefferson County, AR, 2000*.

Date	% Cotton Bollworm	% Tobacco Budworm
3-Jul	78	22
10-Jul	77	23
17-Jul	69	31
24-Jul	20	80
31-Jul	20	80
7-Aug	37	63
14-Aug	31	69

* Numbers based upon 7-day averages.

Table 2. Seasonal Average Heliothine Control in Cotton with S-1812, Leverage, Tracer, and Capture.

	Treatment	Rate	Heliothine Damaged Squares[1](%)	Total Live Heliothine Larvae[1]
1	S-1812 35WP	0.075 lb ai/ac	10.6 b[2]	2.1 cde
2	S-1812 35WP	0.15 lb ai/ac	8.5 bcd	1.6 c-f
3	S-1812 35WP	0.075 lb ai/ac	8.1 bcd	1.3 def
	Orthene 90S	0.5 lb ai/ac		
4	S-1812 35WP	0.075 lb ai/ac	9.1 bc	2.0 cde
	Asana XL 0.66EC	0.02 lb ai/ac		
5	Asana XL 0.66EC	0.02 lb ai/ac	11.9 b	3.3 abc
6	Orthene 90S	0.5 lb ai/ac	8.9 bc	1.4 def
7	Tracer 4SC	0.067 lb ai/ac	3.9 d	0.3 f
8	Baythroid 2EC	0.033 lb ai/ac	7.8 bcd	1.9 c-f
9	Leverage 2.7SE	3 fl oz/ac	11.8 b	3.8 ab
10	Leverage 2.7SE	3 fl oz/ac	5.1 cd	1.0 ef
	Tracer 4SC	0.033 lb ai/ac		
11	Capture 2EC	0.05 lb ai/ac	10.9 b	2.7 bcd
12	Untreated Check		18.0 a	4.4 a

[1]Damage based upon samples of 50 squares and 50 terminals per plot.
[2]Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT).

Table 3. Comparison of New Chemistry and Pyrethroids for Seasonal Average Heliothine Control in Cotton.

Treatment	Rate (lb ai/ac)	Heliothine Damaged Squares[1](%)	Total Live Heliothine Larvae[1]
1 Untreated Check			17.8 a[2]
2 Tracer 4SC	0.067	4.3 d	0.6 e
3 Intrepid 2SC	0.15	14.0 ab	4.1 a
4 Denim 0.16EC	0.01	9.8 bc	1.6 cde
5 Karate Z 2.09CS	0.025	13.5 ab	3.3 ab
6 Decis 1.5EC	0.01	14.0 ab	4.0 ab
7 Decis 1.5EC	0.02	11.8 bc	2.4 bcd
8 Fury 1.5EC	0.0375	10.8 bc	3.6 ab
9 Leverage 2.7SE	0.079	12.8 abc	3.1 abc
10 Baythroid 2EC	0.03	13.0 ab	3.3 ab
11 S-1812 35WP	0.15	10.0 bc	2.6 a-d

[1]Damage based upon samples of 50 squares and 50 terminals per plot.
[2]Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT).

Table 4. Efficacy of Tracer and Denim Combinations with Traditional Insecticides for Seasonal Average Heliothine Control in Cotton.

Treatment	Rate	Heliothine Damaged Squares[1] (%)	Total Live Heliothine Larvae[1]
1 Untreated Check		13.3 a[2]	2.4 a
2 Lorsban 4E + Tracer 4SC	0.5 lb ai/ac 0.033 lb ai/ac	8.1 bcd	1.2 bc
3 Lorsban 4E + Karate Z 2.09CS	0.5 lb ai/ac 0.015 lb ai/ac	8.6 bc	2.0 ab
4 Tracer 4SC + Karate Z 2.09CS	0.033 lb ai/ac 0.015 lb ai/ac	4.5 d	0.6 c
5 Lorsban 4E	1.0 lb ai/ac	10.0 ab	1.6 abc
6 Karate Z 2.09CS	0.03 lb ai/ac	10.0 ab	1.3 bc
7 Tracer 4SC	0.067 lb ai/ac	4.4 d	0.8 c
8 Denim 0.16EC + Latron CS-7	0.01 lb ai/ac 0.25 % v/v	7.6 bcd	1.3 bc
9 Denim 0.16EC	0.01 lb ai/ac	5.4 cd	1.1 bc
10 Denim 0.16EC + Latron CS-7	0.0075 lb ai/ac 0.25 % v/v	6.4 bcd	0.8 c
11 Denim 0.16EC + Karate Z 2.09CS + Latron CS-7	0.0075 lb ai/ac 0.03 lb ai/ac 0.25 % v/v	4.9 cd	0.8 c

[1]Damage based upon samples of 50 squares and 50 terminals per plot.
[2]Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT).

Table 5. Cotton Lint Yield of S-1812, Leverage, Tracer, and Capture insecticide treatments.

Treatment	Rate	Lint Yield (lbs. / ac)
1 S-1812 35WP	0.075 lb ai/ac	909 cd[1]
2 S-1812 35WP	0.15 lb ai/ac	968 bc
3 S-1812 35WP Orthene 90S	0.075 lb ai/ac 0.5 lb ai/ac	888 cd
4 S-1812 35WP Asana XL 0.66EC	0.075 lb ai/ac 0.02 lb ai/ac	946 bc
5 Asana XL 0.66EC	0.02 lb ai/ac	816 cd
6 Orthene 90S	0.5 lb ai/ac	752 de
7 Tracer 4SC	0.067 lb ai/ac	1093 ab
8 Baythroid 2EC	0.033 lb ai/ac	936 bcd
9 Leverage 2.7SE	3 fl oz/ac	827 cd
10 Leverage 2.7SE Tracer 4SC	3 fl oz/ac 0.033 lb ai/ac	1168 a
11 Capture 2EC	0.05 lb ai/ac	889 cd
12 Untreated Check		633 e

[1]Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT).

Table 6. Cotton Lint Yield with New and Traditional Insecticides.

Treatment	Rate (lb ai/ac)	Lint Yield (lbs./acre)
1 Untreated Check		562 e
2 Tracer 4SC	0.067	1196 a
3 Intrepid 2SC	0.15	944 bc
4 Denim 0.16EC	0.01	966 bc
5 Karate Z 2.09CS	0.025	823 bcd
6 Decis 1.5EC	0.01	719 de
7 Decis 1.5EC	0.02	924 bcd
8 Fury 1.5EC	0.0375	777 cd
9 Leverage 2.7SE	0.079	840 bcd
10 Baythroid 2EC	0.03	892 bcd
11 S-1812 35WP	0.15	1040 ab

[1]Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)

Table 7. Cotton Lint Yield Comparing Combinations of New and Traditional Heliothine Insecticides.

Treatment	Rate	Lint Yield (lbs./acre)
1 Untreated Check		669 g[1]
2 Lorsban 4E + Tracer 4SC	0.5 lb ai/ac 0.033 lb ai/ac	976 de
3 Lorsban 4E + Karate Z 2.09CS	0.5 lb ai/ac 0.015 lb ai/ac	954 e
4 Tracer 4SC + Karate Z 2.09CS	0.033 lb ai/ac 0.015 lb ai/ac	1228 a
5 Lorsban 4E	1.0 lb ai/ac	786 f
6 Karate Z 2.09CS	0.03 lb ai/ac	1047 cde
7 Tracer 4SC	0.067 lb ai/ac	1126 abc
8 Denim 0.16EC + Latron CS-7	0.01 lb ai/ac 0.25 % v/v	1049 cde
9 Denim 0.16EC	0.01 lb ai/ac	1023 cde
10 Denim 0.16EC + Latron CS-7	0.0075 lb ai/ac 0.25 % v/v	1082 bcd
11 Denim 0.16EC + Karate Z 2.09CS + Latron CS-7	0.0075 lb ai/ac 0.03 lb ai/ac 0.25 % v/v	1184 ab

[1]Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT).