PERFORMANCE OF NEW AND CONVENTIONAL INSECTICIDES IN B.t. COTTON

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Abstract

In 2000, supplemental insecticide applications to the B.t. cotton variety, Deltapine 451B/RR (contains a single gene for the production of CryIA(c) toxin), were evaluated to determine if improved Heliothine control could be demonstrated compared to untreated Deltapine 451B/RR. Insecticides evaluated were Steward 1.25SC, Tracer 4SC, Karate Z 2.09E, Asana XL 0.66EC, Vydate C-LV 3.77SL + Asana XL 0.66EC, Decis 1.5EC, and Baythroid 2EC. Under predominantly bollworm pressure in early July, all supplemental insecticide treatments reduced square damage. Under predominantly budworm pressure, during the remainder of the test, no differences among treatments were observed. Differences in live Heliothine larvae counts were not observed among treatments at any time. Supplemental applications of Tracer and Vydate + Asana significantly out yielded the untreated B.t. cotton control. This study suggests that benefits through increased yield can be obtained when appropriate supplemental insecticide applications, targeted at pests not adequately controlled by the CryIA(c) toxin, are utilized.

Introduction

The bollworm, *Helicoverpa zea* (Boddie), and the tobacco budworm, *Heliothis virescens* (Fab.), are perennial pests of cotton in Arkansas and growers must utilize control measures to prevent economic damage each year. The commercialization of transgenic cotton cultivars containing the insecticidal endotoxin of *Bacillus thurengiensis* introduced a new approach in managing the Heliothine complex in cotton (Deaton 1995). This new management tactic for Heliothine control, the utilization of transgenic *B.t.* cotton varieties, is gaining acceptance in Arkansas with approximately 35% of the 950,000 cotton acres in 2000 being planted to transgenic B.t. varieties. Research is needed in Arkansas to help understand how best to integrate this new tactic with traditional methods of Heliothine control. *B.t.* cotton alone has been shown to provide excellent mortality of the tobacco budworm but is less efficacious on the bollworm (Leonard et al. 1997). In instances where bollworm pressure is high, the reliance on *B.t.* cotton alone to provide control has been less than satisfactory. Improved Heliothine control in *B.t.* cotton has been documented through the use of supplemental insecticide applications (Burd et al. 1999; Johnson et al. 2000). Resistance management is also a concern when deciding how best to employ B.t. cotton. A selected colony of the bollworm exhibited 50-fold resistance to the CryIA(c) toxin after 6 generations of selection and nearly 100-fold resistance after 10 generations of selection (Burd et al. 2000). The use of supplemental insecticides when needed in B.t. cotton can help reduce the potential for loss of B.t. efficacy through resistance. The objective of this study was to document, under Arkansas conditions, the benefits of supplemental applications of traditional and new insecticides in *B.t.* cotton to enhance Heliothine control.

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 greatly reduced boll weevil and plant bug pressure. A combination of new and traditional chemistry was selected for evaluation. 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 Deltapine 451B/RR and was planted on 1 May 2000. The crop was furrow-irrigated on an as needed basis. 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 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 evaluated were:

Steward 1.25SC	0.065 lb (AI)/A or 6.66 floz/A
Steward 1.25SC	0.075 lb (AI)/A or 7.68 floz/A
Steward 1.25SC	0.09 lb (AI)/A or 9.22 floz/A
Tracer 4SC	0.067 lb (AI)/A or 2.14 floz/A
Karate Z 2.09E	0.028 lb (AI)/A or 1.7 floz/A
Karate Z 2.09E	0.033 lb (AI)/A or 2.0 floz/A
Asana XL 0.66EC	0.036 lb (AI)/A or 7.0 floz/A
Vydate C-LV 3.77SL + Asana XL 0.66EC	0.25 + 0.033 lb (AI)/A or 8.5 + 6.4 floz/A
Decis 1.5EC	0.025 lb (AI)/A or 2.13 floz/A
Decis 1.5EC	0.03 lb (AI)/A or 2.56 floz/A
Baythroid 2EC	0.03 lb (AI)/A or 1.9 floz/A
UTC	

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, 50 terminals, and 50 blooms at random from the center of each plot for the presence of live larvae (<1/4 + >1/4") and square damage. 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 run 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

During the initial portion of this trial, the Heliothine population mix was approximately 75% cotton bollworm / 25% tobacco budworm. By the time the second treatment application was made, the population had shifted to 20% cotton bollworm / 80% tobacco budworm and averaged 27% cotton bollworm / 73% tobacco budworm during the remainder of the test period (Figure 1). Heliothine pressure was high in the test area as indicated in the untreated control of an adjacent non-B.t. test plot (cotton variety: Deltapine 5415RR) that had an identical 1 May planting date. Over the same evaluation period as mentioned above, the non-B.t. plots averaged 18% square damage, 4.2 live larvae per 50 squares and 50 terminals, and yielded 562 pounds of lint per acre. Peak Heliothine pressure occurred at the test site around 31 July.

At four days after the first application (4DAT#1), when the Heliothine population was predominantly cotton bollworm, all treatments had significantly less Heliothine damaged squares than the untreated control (B.t. cotton alone). During the remaining three ratings (4DAT#2, 4DAT#3, and 4DAT#4), when the Heliothine population was predominantly tobacco budworm, there were no significant differences among treatments with respect to square damage (Table 1). When looking at the treatment seasonal averages for square damage (<1%), no significant differences among treatments were observed (Figure 2).

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There were no significant differences among treatments for total live Heliothine larvae / 50 squares, 50 terminals, & 50 blooms at any of the rating dates (Table 2). When looking at the treatment seasonal averages for live Heliothine larvae count, all treatments remained below 0.5 larvae / 50 sq., 50 term., & 50 blm. And again, treatment differences were non-significant (Figure 3).

Tracer at 0.067 lb (AI)/A and Vydate + Asana XL at 0.25 + 0.033 lb (AI)/A significantly out yielded the B.t. cotton untreated control by 182 and 158 lbs. lint/A, respectively. All other treatments failed to significantly out yield the B.t. cotton untreated control. On a numerical basis only, all other treatments except Asana XL at 0.036 lb (AI)/A out yielded the control by an average of 75 lbs. lint/A (Figure 4).

Summary

This study was conducted to evaluate potential benefits from supplemental applications of insecticides for Heliothine control in *B.t.* cotton. The results obtained in this study suggest that the appropriate use of selected supplemental insecticides, targeted at pests not adequately controlled by the CryIA(c) toxin in single gene B.t. cotton can be beneficial. The benefits derived from this improved bollworm control and increased yield can result in a substantial economic benefit to the producer.

References

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Acknowledgments

Tracer is a registered trademark of Dow AgroSciences LLC.

Steward, Asana, and Vydate are registered trademarks of E.I. duPont de Nemours & Co., Inc.

Karate is a registered trademark of Zeneca Company.

Decis is a registered trademark of Hoechst Schering AgrEvo S.A. de C.V.

Baythroid is a registered trademark of Bayer Corporation.

Table 1. % Heliothine damaged squares: Heliothine control with supplemental insecticide applications in B.t. Cotton. AR. 2000.

	Rate lb	% Heliothine Damaged Squares			
Treatment	(AI)/A	4DAT#1	4DAT#2	4DAT#3	4DAT#4
Steward	0.065	0b	0.5a	1.5a	2a
Steward	0.075	0.5b	1a	1.5a	0a
Steward	0.09	0.5b	1a	2a	0a
Tracer	0.067	0b	0.5a	1.5a	0a
Karate Z	0.028	0b	0a	3a	0a
Karate Z	0.033	0.5b	0a	3a	0a
Asana XL	0.036	0b	0.5a	1.5a	0a
Vydate +	0.25 +				
Asana XL	0.033	0b	0a	0.5a	0a
Decis	0.025	0b	1.5a	0.5a	0a
Decis	0.03	0b	0.5a	1.5a	0a
Baythroid	0.03	0.5b	1a	0.5a	0a
UTC		2a	0a	1a	0.5a

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Table 2. Live Heliothine Larvae Count: Heliothine control with supplemental insecticide applications in B.t. Cotton. AR. 2000.

	Rate lb	Total Live Heliothine Larvae / 50 Sq, 50 Term, & 50 Blm			
Treatment	(AI)/A	4DAT#1	4DAT#2	4DAT#3	4DAT#4
Steward	0.065	0a	0a	0a	0a
Steward	0.075	1a	0a	0a	0a
Steward	0.09	0a	0a	0a	0a
Tracer	0.067	0a	0a	1a	0a
Karate Z	0.028	0a	0a	0a	0a
Karate Z	0.033	0a	0a	1a	0a
Asana XL	0.036	0a	0a	1a	1a
Vydate +	0.25 +				
Asana XL	0.033	0a	0a	0a	0a
Decis	0.025	0a	0a	0a	1a
Decis	0.03	0a	0a	1a	0a
Baythroid	0.03	0a	0a	0a	0a
UTC		1a	0a	0a	1a

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

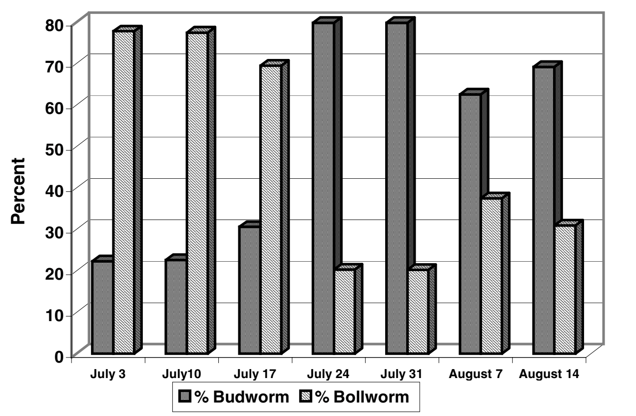

Figure 1. Heliothine Population Density Based on Phermone Trap Catches-July through Mid-August: Jefferson Co,. AR. 2000.

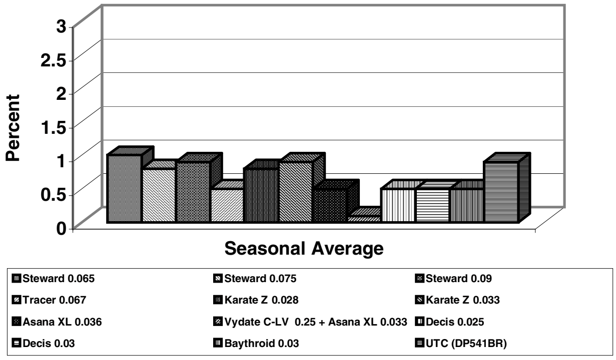

Figure 2. Seasonal Average % Heliothine Damaged Squares: Heliothine Control in Bt Cotton. AR. 2000.

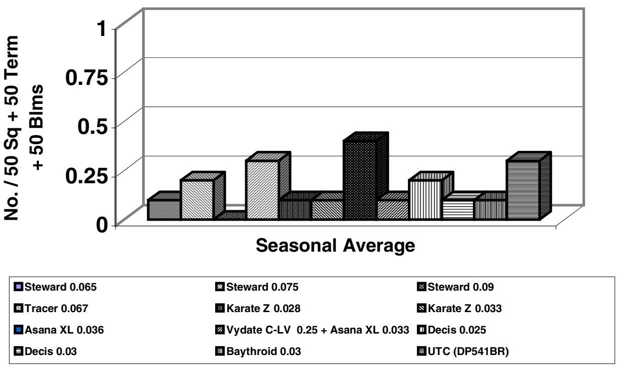

Figure 3. Seasonal Average Live Heliothine Larvae Count: Heliothine Control in Bt Cotton. AR. 2000.

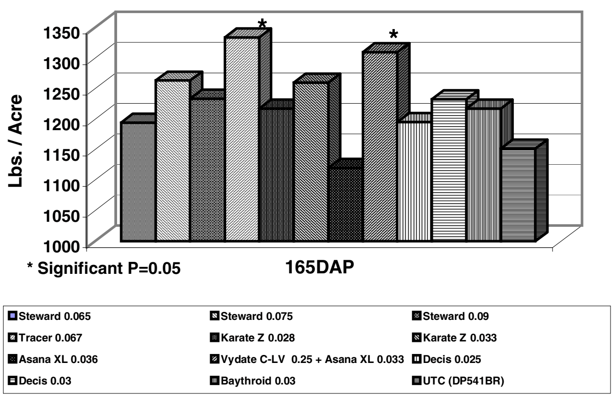

Figure 4. Lint Yield: Heliothine Control in Bt Cotton. AR. 2000.