EVALUATION OF *BACILLUS THURINGIENSIS* AND OVICIDE COMBINATIONS FOR BOLLWORM AND TOBACCO BUDWORM

C. D. Klein, Assistant Specialist - Entomology
D. R. Johnson, Extension Entomologist
H. B. Myers, Assistant Specialist - Entomology
L. M. Page, Agricultural Technician - Entomology
University of Arkansas
Cooperative Extension Service
Little Rock, AR

Abstract

Two tests were conducted to determine the efficacy of *Bacillus thuringiensis*/ovicide combinations against tobacco budworm and bollworm larvae. Bt + ovicides significantly reduced larval populations below the untreated check early season. No differences were observed later in the season. The combinations appear to have a greater reduction of larvae than Bt alone. Larvin in combination with Bt provided the best control of all ovicides tested.

Introduction

Tobacco budworm, *Heliothis virescens* Boddie, resistance to several insecticide classes has increased in most of the mid-South. Resistance to four insecticide classes (pyrethroids, carbamates, organochlorines and organophosphates) has been recorded in Louisiana and Arkansas recently (Graves et al. 1994, Wall 1994). Resistance management programs have been implemented in most of the Cotton Belt states in an effort to delay the onset of higher resistance levels.

The use of *Bacillus thuringiensis* (Bt) had been advocated in the mid-South as part of the tobacco budworm resistance management program. One advantage of Bt is the conservation of the beneficial arthropod population which allows for supplemental control of the Heliothine complex. Ideally, Bt should be applied alone to conserve beneficial arthropods but low efficacies are observed when used in this manner. Due to this low efficacy, Bt must be applied in combination with low to moderate rates of traditional insecticides such as sulprofos, profenofos, methomyl, amitraz or thiodicarb (Johnson & Studebaker 1992). The Bt/ovicide combinations are most effective against low to moderate Heliothine populations. Application timing of the Bt/ovicide is crucial for maximum efficacy and the application should occur within 24 hr of egg hatch with thorough crop coverage.

Tobacco budworm and bollworm moth populations are monitored in Arkansas with pheromone traps to determine species composition as part of the resistance management program. Moth trap and resistance vial testing data are provided to the public and extension personnel. This information is invaluable in determining the appropriate insecticide to apply such as a Bt/ovicide combination.

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Materials and Methods

The test plots were located in Jefferson county, Arkansas. Two tests were conducted with ten and eleven treatments. Plots consisted of 8 rows by 50 feet arranged in a randomized complete block design with four replications. Treatments were applied with a high clearance sprayer equipped with a CO_2 powered system designed for spraying small plots. Total volume was 9.91 gallons per acre at 25 psi using Teejet TSX-6 nozzles on 20 inch spacing. Treatments were applied within 24 hours of egg hatch on both tests on 14 and 27 July, and on the eleven treatment test on 11 August. Evaluations were conducted four days after treatment by whole plant search of 14 row feet for the 14 and 27 July applications and 50 squares and terminals for the 11 August application. The center two rows of each plot were evaluated. Tobacco budworm and bollworm moth traps were monitored throughout the county to determine species composition.

Results and Discussion

Tobacco budworm pheromone trap catches in 1995 averaged less than five moths per day from late May until mid-July (Table 1). In late July, trap catches increased to over 17 moths per day and remained high for the remainder of the season except for one week in mid-August. The tobacco budworm moth population peaked in late August. The bollworm moth population remained relatively low until late June (Table 1). In early July, the population increased to over 20 moths per day with the peak occurring in mid-July. Bollworm trap catches remained relatively high until late August. Bollworm was the predominant species at the time of the first application and tobacco budworm was predominant on the second and third applications.

Various Bt/ovicide combinations were evaluated for activity on tobacco budworm and bollworm in the first test. All treatments with the exception of Dipel ES alone had significantly lower larvae than the untreated check on the first evaluation date (Table 2). Both rates of Larvin and the low rates of MVP II + Larvin provided the best control. No treatments significantly reduced the number of larvae below the untreated check on the last two evaluation dates. The high rates of MVP II + Larvin and Larvin alone were the only treatments that produced yields significantly higher than the untreated check. The yields for these two treatments were almost 200 lbs higher than the untreated check.

Dipel ES in combination with different ovicides was evaluated for control of tobacco budworm and bollworm in the second test. All treatments except Dipel alone significantly reduced total larvae below the untreated check on the first evaluation date (Table 3). Dipel + Larvin provided the best control. No treatments significantly reduced the number of larvae below the untreated check on the last evaluation date. No differences in yields were observed.

Conclusions

Combinations of *Bacillus thuringiensis* and ovicides provided better control of the tobacco budworm/bollworm complex than Bt alone. Similar results were reported in 1993 and 1994 (Johnson et al. 1994, Klein et al. 1995). Tank mixes of Bt + Larvin appear to provide the most effective control. These combinations appeared to provide better control under low tobacco budworm/bollworm pressure that normally occurs early season in Arkansas.

References

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Table 1. Daily pheromone trap averages by week for tobacco budworm, *Heliothis virescens*, and bollworm, *Helicoverpa zea*, in Jefferson county, 1995.

Week of	Tobacco Budworm	Bollworm
31 May	1.3	8.4
7 June	1.9	10.8
14	3.7	5.8
21	4.4	1.6
28	4.7	2.0
5 July	3.6	21.8
12	1.1	58.2
19	4.0	10.4
26	17.5	33.5
2 August	17.9	14.1
9	22.1	24.6
16	3.4	22.3
21	37.0	10.1
28	33.5	4.7

Table 2. Mean number of bollworm and tobacco budworm larvae per plot for various Bt/ovicide combinations, Jefferson county, AR; 1995

Treatment	Rate lb (AI/Ac)	Mean no. bollworm/budworm Per 14 ft 18 Jul	1 Aug	Per 50 Squares & Terminals 15 Aug	Lint (lb/Ac)
UTC		16.00 a	15.25 ab	1.75 ab	561.8 b
Design +	0.25	6.50 b	20.00 a	2.75 ab	639.8 ab
Curacron 8 E	0.125				
Design +	0.25	6.75 b	10.75 b	1.50 ab	681.0 ab
Larvin 3.2 EC	0.125				
MVP II +	0.75 pt	2.25 b	8.75 b	1.75 ab	759.5 a
Larvin 3.2 EC	0.25				
MVP II +	1.50 pt	4.75 b	8.50 b	3.00 a	608.3 b
Larvin 3.2 EC	0.25				
Larvin 3.2 EC	0.25	2.75 b	10.75 b	1.25 ab	644.8 ab
Larvin 3.2 EC	0.60	1.75 b	9.25 b	0.50 b	743.8 a
Dipel ES	2.0 pt	13.50 a	6.25 b	0.50 b	577.0 b
Dipel ES +	2.0 pt	4.00 b	9.75 b	1.50 ab	686.8 ab
Larvin 3.2 EC	0.25				
Dipel ES +	2.0 pt	5.75 b	9.50 b	0.75 ab	634.5 ab
Lannate 2.4 LV	0.225				
Lannate 2.4 LV	0.225	5.00 b	12.25 ab	2.25 ab	566.8 b

Means followed by same letter in the same column do not significantly differ (P=.05, Duncan's MRT)

Table 3. Mean number of bollworm and tobacco budworm larvae per plot for Dipel/ovicide combinations, Jefferson county, AR; 1995.

Treatment	Rate lb(AI)/ acre	Mean no./14 ft. Bollworm/budworm complex 18 Jul	1 Aug	Yield (1b lint/Ac)
Untreated		14.75 a	8.75 a	692.0 a
Dipel ES	2.0 pt	12.00 ab	8.25 a	775.3 a
Larvin 3.2 EC	0.25	3.25 de	7.75 a	749.0 a
Lannate 2.4 LV	0.25	3.50 cde	12.75 a	686.8 a
Ovasyn 1.5 EC	0.25	8.75 bc	7.75 a	738.8 a
Dipel ES +	2.0 pt	1.00 e	8.50 a	738.8 a
Larvin 3.2 EC	0.25			
Dipel ES +	2.0 pt	7.00 bcd	9.50 a	801.3 a
Lannate 2.4 LV	0.225			
Dipel ES +	2.0 pt	8.00 bcd	9.75 a	749.3 a
Ovasyn 1.5 EC	0.25			
Dipel ES +	2.0 pt	7.00 bcd	8.75 a	780.3 a
Curacron 8.0 E	0.25			
Curacron 8.0 E	0.25	6.00 cde	11.25 a	749.3 a

Means followed by same letter in the same column do not significantly differ (P=.05, Duncan's MRT)