LEPIDOPTERAN PEST MANAGEMENT IN NORTHEAST LOUISIANA DURING 1999

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Abstract

Several tests were conducted in 1999 to evaluate the efficacy of commercial and experimental insecticides against tobacco budworm, *Heliothis virescens* (F.), and bollworm, *Helicoverpa zea* (Boddie). Foliar sprays of Tracer 4SC, Denim 0.16EC, and Steward 1.25SC produced >80% mortality of tobacco budworm larvae (L3 stage). In a similar experiment, 1.0 inch of simulated rainfall applied within 1 hr post-treatment significantly reduced the activity of these same insecticides. In all field trials that included a pyrethroid as a standard treatment, numbers of damaged fruiting forms and infestations of larvae were not statistically different from those in the non-treated controls when the tobacco budworm was the predominate Heliothine species. In those same tests, Denim 0.16EC, Steward 1.25 SC and S-1812 4EC at one or more rates generally provided satisfactory tobacco budworm control comparable to that of Tracer 4SC. No insecticide demonstrated a level of efficacy against bollworm significantly greater than that provided by the pyrethroids.

Introduction

The major economic lepidopteran insect pests attacking cotton in Louisiana include the tobacco budworm, *Heliothis virescens* (F.), bollworm *Helicoverpa zea* (Boddie), beet armyworm, *Spodoptera exigua* (Hubner), and soybean looper, *Pseudoplusia includens* (Walker). This insect pest complex affects cotton profitability by reducing crop yields and by increasing the cost of control with insecticides. During 1999, population densities of these pests in Louisiana were relatively low compared to previous years (Williams 2000). Therefore, production costs for control of these insect pests were also slightly lower in 1999 compared to previous years.

Louisiana producers have implemented Bollgard technology on ca. 65% of their acreage to manage tobacco budworm. While Bollgard has not eliminated plant injury and yield losses from the other lepidopterous pests, it is an important pest management tool that significantly reduces the threat of economic injury from these pests. If high population densities of bollworm, beet armyworm or soybean looper persist for an extended duration, foliar insecticides are necessary to provide supplemental control and reduce economic injury (Mahaffey et al. 1994, Hardee and Herzog 1997, Lambert et al. 1997, Leonard et al. 1997).

Current insect resistance management (IRM) guidelines for the Bollgard technology require a refuge of non-Bollgard cotton. There are two refuge options that producers can use. The first option includes a non-Bollgard cultivar as 4% of the total acreage. This refuge must be not be treated with foliar insecticides to control Heliothine pests. The other option is to plant a non-Bollgard cultivar as 20% of the total acreage that can be treated with insecticides except for foliar Bt products. The majority of Louisiana's producers have used the 20% (treated) non-Bollgard option as their refuge choice.

Foliar insecticides to manage lepidopterous pests in cotton are still necessary for supplemental control on Bollgard cultivars and as a primary strategy on all non-Bollgard acreage. The purpose of this report is to summarize the results of several studies evaluating the performance of experimental and commercial insecticides in Louisiana. The tobacco budworm and bollworm were the most prevalent lepidopterous pests across the test areas in 1999 and this report will focus on insecticide efficacy against those species

Materials and Methods

Insecticides

Formulated samples of lambda-cyhalothrin (Karate Z 2.08SC; Zeneca Agricultural Products, Wilmington, DE), methoxyfenozide (Intrepid 80WP; Rohm & Haas, Philadelphia, PA), indoxacarb (Steward 1.25 SC; DuPont E. I. deNemours & Inc., Wilmington DE), esfenvalerate (Asana XL 0.66 EC; DuPont E. I. deNemours & Inc., Wilmington, DE), profenofos (Curacron 8EC; Novartis Crop Protection, Greensboro, NC), emamectin benzoate (Denim 0.16EC; Novartis Crop Protection, Greensboro, NC), S-1812 (S-1812 4EC; Valent USA corporation, Walnut Creek, CA), spinosad (Tracer 4SC; Dow Agrosciences, Indianapolis, IN), and thiodicarb (Larvin 3.2F; Rhone Poulenc Ag, Research Triangle Park, NC) were obtained for these tests.

Field/Laboratory Bioassays

Field-collected colonies of tobacco budworm were established by collecting eggs and/or larvae from velvetleaf, *Abutilon theophrasti* Medicus plants located on the Macon Ridge Research Station. These insects were reared in the laboratory for one generation to obtain enough insects at the proper larval stage for the bioassays. Adults were confined in one gallon cardboard cartons covered with cotton gauze as an oviposition substrate and were fed a 10% sugar water solution. Eggs were removed at least every other day and allowed to hatch at room temperature. Larvae were reared on a pinto bean and wheat germ diet according to procedures described by Leonard et al. (1987).

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:932-935 (2000)
National Cotton Council, Memphis TN

Plots of non-Bollgard (Stoneville 474) were treated using a tractor-mounted sprayer calibrated to deliver ten GPA at 32 psi during June, 1999. Steward 1.25SC, Tracer 4SC, and Intrepid 80WP were applied to pre-flowering cotton plants. The treatments were arranged in a CRD with five replications. Twenty terminal leaves were collected from a non-treated control and each treated plot at ca. two hr post-treatment and placed in nine cm plastic Petri dishes containing a piece of moistened filter paper. Tobacco budworm larvae (L3 stage) were individually placed in each dish and checked at 48, 72, and 96 hr after infestation (HAI) for mortality. After infestation, the larvae were held at 27±3˚C and 55-65% RH under a 14:10 light:dark (L:D) photoperiod. The criterion for mortality was inability of a larva to move within 15 seconds after being prodded with a blunt probe. All data were converted to percent mortality results and analyzed using microcomputer-based GLM procedures (SAS Institute 1988).

Another laboratory study was used to evaluate the effect of post-treatment rainfall on the toxicity of Steward 1.25SC, Tracer 4SC, and Denim 0.16EC compared to a non-treated control. A two factor (± rainfall and insecticides) experiment with a split plot arrangement of treatments within a RBD and four replications was used to measure insecticidal persistence. Field plots of non-Bollgard cotton (SureGrow 821) were treated using a tractor-mounted sprayer calibrated to deliver ten GPA at 32 psi during June, 1999. Within ca. 30 min to one hr post-treatment, ca. one inch of simulated rainfall was applied with a lateral move overhead irrigation system to the appropriate plots. As previously described, terminal leaves were collected from each plot and infested with tobacco budworm larvae. Mortality was recorded at 24, 48, and 72 HAI. The results were analyzed using microcomputer-based GLM procedures.

Field Trials

Three tests were conducted at the Macon Ridge Location of the Northeast Research Station near Winnsboro, LA. Recommended cultural practices and integrated pest management strategies were used to maintain all plots in a similar manner within each test. In some instances, variety and planting date were manipulated to increase the probability of obtaining economic infestations of native populations of tobacco budworm and bollworm. Cotton seed of a single recommended non-Bollgard cultivar was sequentially planted on multiple dates in large blocks. Selective insecticides were applied for control of non-target pests during the tests.

Treatments were arranged in a RBD with four to six replications. Plots consisted of four to eight rows (40 inches row centers) x 50 ft. The insecticide treatments in these tests included Asana XL (0.02 lb AI/acre), Curacron (1.0 lb AI/acre), Denim 0.16EC (0.01 lb AI/acre), Intrepid 80WP (0.25 lb AI/acre), Karate 2.08SC (0.03, 0.04 lb AI/acre), Larvin 3.2F (0.8, 0.9 lb AI/acre), Steward 1.25SC (0.11 lb AI/acre), S-1812 4EC (0.1, 0.15 lb AI/acre), and Tracer 4SC (0.062, 0.067, 0.09 lb AI/acre). Treatments were timely applied targeting hatching eggs and <three d-old tobacco budworm and bollworm larvae. Multiple (three to five) applications of each treatment were applied within each test. Applications in all tests were made with a CO_2 charged delivery system and tractor mounted boom calibrated to deliver six GPA at 42 psi.

Treatment efficacy against tobacco budworm and bollworm was determined by examining 50 to 100 flower buds (squares)/plot. Plots were sampled at three to five days after each treatment application (DAT) for evidence of damage and infestations of larvae in squares. The data for individual sample dates were pooled to determine mean treatment effects following multiple applications. Results for all tests were subjected to GLM procedures to determine significant treatment effects. Duncan's Multiple Range Test (P=0.05) was used to compare treatment means within each respective test (SAS Institute 1988).

Results and Discussion

Field/Laboratory Bioassays

In the first experiment, tobacco budworm larval mortality in the non-treated control plots was 9.9%, 15.6%, and 21.6% at 48, 72, and 96 HAI, respectively. With the exception of Intrepid at 48 HAI, all three insecticides produced significantly higher mortality levels than that observed for larvae on non-treated leaves at all three evaluation intervals. (Fig. 1). Cumulative larval mortality at 96 HAI exceeded 82% for Steward, Tracer, and Intrepid.

In the insecticide wash-off study, tobacco budworm mortality in the non-treated plots remained below 10% at 24, 48, and 72 HAI. In the plots not receiving simulated rainfall, Steward, Tracer, and Denim produced mortality levels that were significantly higher than that observed for larvae on non-treated leaves at all three evaluation intervals. (Fig. 2). Cumulative larval mortality at 72 HAI exceeded 80% for Steward, Tracer, and Denim. in the non-irrigated plots. In the plots receiving simulated rainfall, larval mortality levels for the three insecticides was not different from that in the non-treated plots at 24 HAI. With the exception of Tracer at 24 HAI, tobacco budworm mortality was significantly reduced by simulated rainfall for each insecticide at all evaluation intervals. Cumulative mortality in the insecticide treated plots was reduced by an average of 28% with 1.0 inch of simulated rainfall within 1-hr post-treatment. Reduced efficacy will pose a critical issue for agricultural consultants making recommendations for re-treatment of fields following rainfall events. This study only examined one rate of simulated rainfall very near the time of application and additional research should be done to evaluate rainfall quantity and occurrence at longer post-treatment intervals to further determine the persistence and efficacy of these three insecticides.

Field Trials

The pyrethroid insecticides failed to significantly reduce tobacco budworm damaged squares in 1998 (Karate Z 0.033 lb AI/acre) and again in 1999 (Baythroid 0.033 lb AI/acre) below that observed in the non-treated plots (Fig. 3). The standard insecticide in these tests for controlling tobacco budworm is Tracer. In the same tests that the pyrethroid failed to provide satisfactory control of tobacco budworm, Tracer consistently reduced square injury to an acceptable level. Pyrethroid resistance has become widespread in Louisiana populations of tobacco budworm and these products are no longer effective against this species (Bagwell et al. 1999a). In 1999, the pyrethroids were removed from the list of insecticides recommended against tobacco budworm in the Louisiana Cooperative Extension Service cotton insect control guide (Bagwell et al 1999b).

In Test 1, only plots treated with Curacron and Tracer significantly reduced the number to Heliothine damaged squares compared to that in the non-treated control (Table 1). There was no difference among treatments in the number of larval infested squares. Karate Z and Larvin were not effective due to a high proportion of the Heliothine complex being insecticide-resistant tobacco budworm.

In Test 2, all treatments except Intrepid and all treatments significantly reduced the number of damaged squares and larval infested squares, respectively, compared to that in the non-treated plots (Table 1). Plots treated with Tracer had significantly fewer damaged squares compared to that in the Intrepid treated plots. The Tracer and Larvin treated plots had fewer larvae than that in the Intrepid treated plots. Previous field studies have demonstrated the optimum rate of Intrepid against Heliothines should be 0.35 lb AI/acre.

In Test 3, all treatments except S-1812 (0.1 lb Ai/acre) significantly reduced the number of Heliothine damaged and larval infested squares compared to that in the non-treated plots (Table 1). The Heliothine population in this test was predominately bollworm, but a low density of tobacco budworms were observed across the test area.

The data from the field tests presented in this report briefly summarize insecticide efficacy against tobacco budworm and bollworm on non-Bollgard cotton. These results coupled with previously published information support recommended use strategies for the labeled products and confirm the potential of the experimental compounds against these pests.

Acknowledgments

The authors express their sincere appreciation to the summer field personnel at Macon Ridge Research Research Station for plot maintenance, pesticide application and data collection. The financial assistance given by Cotton Incorporated and Louisiana's cotton producers to support these studies is appreciated.

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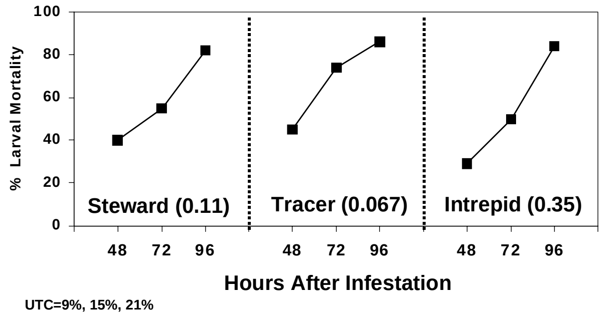

Figure 1. Insecticide toxicity to tobacco budworm (L3 stage) on treated cotton foliage.

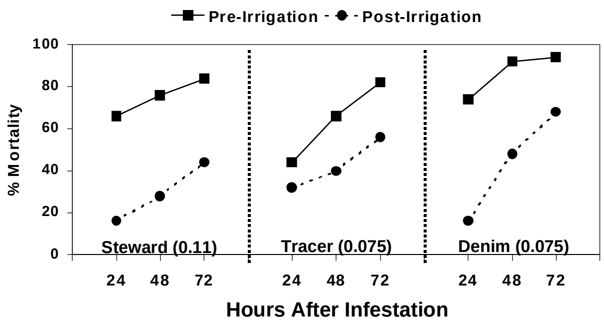

Figure 2. Effect of simulated rainfall on insecticide efficacy against tobacco budworm (L3 stage) on treated cotton foliage.

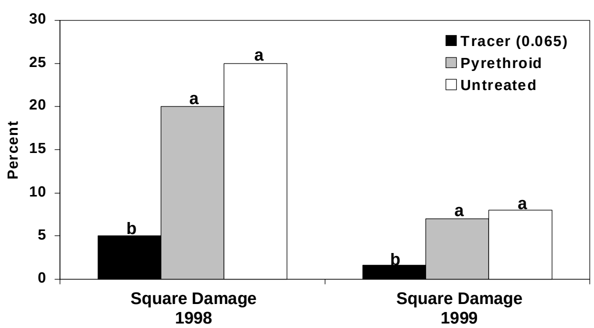

Figure 3. Pyrethroid and Tracer 4SC efficacy against tobacco budworm in Louisiana during 1998 and 1999.

Table 1. Insecticide efficacy against tobacco budworm and bollworm in Louisiana field trials during 1999.

Treatment	Rate/acre lb (AI)	%Damaged Squares[2]	% Larval Infested Squares[2]
Test 1[1]			
Curacron 8EC	1.0	3.6bc	0.9a
Karate Z 2.08SC	0.04	6.8ab	3.1a
Tracer 4SC	0.09	1.9c	0.5a
Larvin 3.2F	0.9	5.1ab	1.6a
Non-Treated	---	7.9a	2.7a
Test 2[1]			
Karate Z 2.08SC	0.03	8.0bc	1.6bc
Tracer 4SC	0.062	5.8c	0.3c
Steward 1.25SC	0.11	8.7bc	1.2bc
Denim 0.16EC	0.01	8.8bc	1.1bc
S-1812 4EC	0.11	6.8bc	1.6bc
Intrepid 80WP	0.25	11.2ab	2.9b
Larvin 3.2SC	0.8	7.0bc	0.7c
Non-treated	---	15.2a	5.8a
Test 3[1]			
S-1812 4EC	0.1	8.2a	1.9ab
S-1812 4EC	0.15	4.1b	1.0b
Asana XL 0.66EC	0.02	5.2b	0.8b
Tracer 4SC	0.067	3.6b	0.8b
Non-treated	---	9.1a	2.5a

Means in a column within each test followed by a common letter are not significantly different (P=0.05, DMRT).

[1]Species composition in Test 1, Test 2, and Test 3 was ca. 80% tobacco budworm, ca. 80% bollworm, and >90% bollworm, respectively.

[2]Seasonal mean values.