MICROBIAL CONTROL OF TOBACCO BUDWORM AND BEET ARMYWORM IN ALABAMA COTTON

W. J. Moar and R. C. McCollum
Department of Entomology, Auburn University, Auburn, AL

Abstract

Microbial insecticides were tested against Tobacco Budworm, *Heliothis virescens*, and Beet Armyworm, *Spodoptera exigua*, in cotton in Prattville, Alabama, summer, 1995. Larval counts and damage by *H. virescens* were intermediate in number. Several microbial insecticides such as Condor XL, Dipel ES, Gemstar, and AfNPV gave significant reduction in larval and damage counts. Larval counts by *Spodoptera exigua* were extreme in August. Although Pirate was superior in all five day trials, numberous Bt products and viruses such as Spod-X and AfNPV also gave significant protection compared with the untreated control. These results suggest that microbial control products can reduce damage and larval numbers in cotton.

Introduction

There is increasing interest in the use of microbial insecticides to control cotton insect pests because of environmental and resistance concerns with the use of synthetic insecticides. Historically, *Bacillus thuringiensis* (Bt) and baculovirus formulations typically were not efficacious against cotton lepidopteran insect pests such as *Heliothis virsecens* and *Spodoptera exigua* for reasons including: 1) relative cost for economic control; 2) inherent lack of toxicity of the formulations; 3) lack of coverage; or 4) a reduction in environmental stability. Recently, however, many microbial insecticides are being produced which can more effectively compete economically witht traditional chemical insecticides. Additionally, more toxic and efficacious Bt's and viruses have been discovered. For example, products containing CryIC (the most active *B. thuringiensis* delta-endotoxin against *Spodoptera* spp.) recently have been developed and targeted for commercial use against *S. exigua*. Xentari® (Abbott Laboratories, North Chicago, IL) is a *B. thuringiensis* subsp. *aizawai*-based product containing CryIC that is over seven-fold more toxic against *S. exigua* than *B. thuringiensis* subsp. *kurstaki*-type products (eg. Dipel 2X) (Moar & Breed, 1994). The Beet Armyworm Virus [SeNPV, commercial name Spod-X (Biosys, Columbia, MD)] and the Celery Looper Virus [AfNPV, (Biosys, Columbia, MD)] are two insect baculoviruses which show promise in controlling a specific insect pest, and a somewhat broader insect pest host range, respectively. Recently introduced spreader/stickers (e.g. Kinetic) environmental stabilizers (e.g. Soydex) and stabilizers/synergists (e.g. Blankophore BBH) also show promise in increasing the toxicity of microbial insecticides in cotton

The objective of our studies was to determine the efficacy of Bt and virus formulations, and potential environmental stabilizers and synergists against *H. virescens* and *S. exigua* in cotton in Central Alabama.

Materials and Methods

All tests were conducted in July and August, 1995 at the Prattville Experimental Field in Prattville, AL. DPL50, (field 27) DPL 51 (field 23) or DPL 5690 (fields 14, 21) cotton varieties were planted in non-irrigated fields on April 27 (field 14); April 29 (field 21); June 8 (field 27) and June 29 (field 23). All treatments consisted of five row plots (36 inch centers) X 60 feet long with 18 foot alleys. Treatments were arranged in a randomized complete block design and replicated 4 times. Applications were made with a high-clearance sprayer to deliver ca. 8 gallons/acre using TEEJET TX 3 hollow cone tip drop nozzles. City water pH was 8.0 and Kinetic (2 oz./A) was added as a spreader/sticker. Treatments were initiated when either 20% of 25 terminals (top six inches) were infested with *H. virescens* eggs, or at least four *S. exigua* egg masses were observed per plot.. Applications and evaluations made were, repectively: Field 14: 7/12 and 7/14; 7/21; Field 21: 7/13, 7/17; 8/14 and 8/17, 8/23; Field 23: 8/18 and 8/21, 8/23; Field 27: 8/18 and 8/22, 8/28. Treatment efficacy typically was evaluated 2-3 days post application, however, a 10 day post-application determination was used for *S. exigua* virus fields. All results are based on: *H. virescens*: No. Damaged squares/bolls per 25 terminals; No. Larvae per 25 terminals and *S. exigua:* No. of large (4-5 instar) and Total No. of larvae per three row feet. (In field 27, Total Larvae = 3-5 instars). All observations are based on samples from rows two and three for each plot, replicated four times.. Reults were analyzed using GLM followed by LSD.

Treatments:

ABG-6426 (2 lbs./A)
ABG-6395 (4 pts./A)
AfNPV (Low rate)
AfNPV (High rate)
AfNPV (High rate)+ BLA (0.5%)
Condor XL(12 oz./A)
Condor XL(12 oz./A) + BLA (0.5%)
Condor XL (12 oz./A) + Gemstar (300ml/A)
Condor XL (12 oz./A) + Gemstar (300ml/A) + BLA (0.5%)

Untreated Control
Dipel ES (1.5 pts./A)
Gemstar (300 ml/A)
Gemstar (300 ml/A) + Soydex (100ml/A)
Gemstar (300 ml/A)+ BLA (0.5%)
Javelin (1lb./A)
Larvin (0.6 lbs.AI/A)
Pirate (0.2 lbs.AI/A)

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1048-1050 (1996)
National Cotton Council, Memphis TN

Spod-X (50ml/A)
Spod-X (100ml/A)
Spod-X (100ml/A) + BLA[2](0.5%)
Spod-X (100ml/A) + Soydex (100ml/A)
Xentari (1lb/A (field 27); (2lbs./A (field 23)

Results

H. virescens

July and August flights of *H. virescens* were moderate. Additionally, a substantial population of natural enemies helped reduce egg and subsequent larval populations.

Field 14: All microbial products signficantly (P=0.05) reduced larval damage. Additionally, Dipel ES, Gemstar, AfNPv (Low and High rates), Larvin, and AfNPV + Blankophore signficantly (P=0.05) reduced larval numbers compared with the untreated control Table 1).

Field 21: For the July flight, Gemstar + CondorXL, and Condor XL gave signficantly (P=0.05) reduced larval numbers and larval damage as compared with the untreated control (Table 2). For the August flight, Gemstar + CondorXL, and Condor XL gave signficantly (P=0.05) reduced larval numbers. Additionally, Condor XL, Gemstar + Condor XL + Blankophore and Gemstar + Condor XL signficantly (P=0.05) reduced larval damage as compared with the untreated control (Table 3).

S. exigua

Field 23: This field consisted of very late planted (replanted) "skippy" cotton which typically is attractive to *S. exigua*. When this August *S. exigua* flight occurred, cotton plants only were 12-18 inches tall. *S. exigua* deposition was extremely heavy and synchronous such that essentially every cotton plant contained at least one egg mass within a 24 hr. period. Because this and surrounding fields contained significant numbers of natural enemies, recommended rates of methyl parathion and orthene were sprayed one day before egg deposition.

All products tested gave significantly (P=0.05) reduced "large" larval numbers as compared with the untreated control (Table 4). Pirate treated plots had significantly (P=0.05) reduced "large" larval numbers as compared with all microbial products. Much of the success of these treatments probably can be attributed to the superior coverage obtained on such small plants, and the synchronous emergence of neonates. To substantiate this later claim, Total larval numbers for all microbial treatments were not significantly different (P=0.05) compared with the untreated control (Data not shown). This can be explained because Bt products typically only have a 1-2 day "half-life" on cotton, whereas Pirate can have up to a two week or more residual. As a result, a five day post application (application #1) evaluation would include many larvae that had emerged probably after the Bt's had sufficiently degraded.

Field 27: This field consisted of very late planted (replanted) "skippy" cotton which typically is attractive to *S. exigua*. When this August *S. exigua* flight occurred, cotton plants only were about 12-18 inches tall. *S. exigua* deposition was extremely heavy and synchronous s such that essentially every cotton plant contained at least one egg mass within a 24 hr. period.

This field experiment was targeted toward evaluation of viruses with a recommended 10-day post application (application #1) evalution. As a result, subsequent larval hatch and migrant larvae from untreated plots and fields (numerous larval were observed crossing dirt roads) resulted in all but one treatment being not signficant (P=0.05) from the untreated control (Table 5). Only Spod-X (50 ml/A)gave significantly (P=0.05) reduced "total" larval numbers as compared with the untreated control. These observations can also be sustantiated by the "observed" lack of control by Pirate. All other tests performed with Pirate against *S. exigua* gave superior control, and even in this test, Pirate treated plants had relatively little damage after five days.

Although virus-killed larvae were observed in the virus treated plots, many large "uninfected" larvae also were observed indicating that a true epizootic had not occurred. Either addtional applications of virus were needed, or environmental factors such as heat and UV irradiation sufficiently reduced viral inoculum prior to insect feeding.

Conclusions

Several Bt formulations and insect baculoviruses were effective at reducing *H. virescens* larval numbers and damage compared to the untreated control. Additionally, several Bt formulations and insect baculoviruses were effective at reducing *S. exigua* larval numbers compared to the untreated control. Additives such as Soydex and Blankophore did not typically synergize viruses. Microbials should be considered as viable alternatives to control these pests in cotton, however, results from these experiments suggest that at least for *S. exigua*, adequate coverage is essential to obtain optimal control.

References

1. Moar, W. J. And C. Breed. 1994. Toxicity of two *Bacillus thuringiensis* products against beet armyworm and cotton bollworm, 1992. Arthropod Mgmt Tests. 19: 372.

Table 1. Microbial Control of *H. virescens* in Alabama Cotton

Treatment	Field 14: July Mean No. Damage[1]	Mean No. Larvae[1]
Control	41.3a	13.0a
Gemstar = Soydex	28.00bc	9.5ab
Gemstar + BLA	29.5b	9.0abc
Dipel ES	19.5c	7.5bc
Gemstar	28.8bc	7.5bc
AfNPV (High rate)	22.8bc	6.8bc
Larvin	24.0bc	6.8bc
AfNPV (Low rate)	25.0bc	5.8bc
AfNPV + BLA	21.8c	4.3c

[1] Means within columns followed by the same letter are not significantly different P=0.05, LSD)
[2] Blankophore BBH

Table 2. Microbial Control of *H. virescens* in Alabama Cotton

Treatment	Field 21: July Mean No. Damage[1]	Mean No. Larvae[1]
Control	32.6a	18.6a
Condor XL+ BLA[2]	31.3ab	15.5abc
Condor XL + Gemstar + BLA	26.0abc	12.3abcd
Condor XL+ Gemstar	23.8c	10.5cd
CondorXL	24.5bc	8.5 d

[1] Means within columns followed by the same letter are not significantly different P=0.05, LSD)
[2] Blankophore BBH

Table 3. Microbial Control of *H. virescens* in Alabama Cotton

Treatment	Field 21: August Mean No. Damage[1]	Mean No. Larvae[1]
Control	17.8a	8.0a
Gemstar	12.3a	5.0ab
Condor XL	5.8b	2.8b
Gemstar + Condor XL+ BLA	4.8b	4.5ab
Condor XL+ Gemstar	4.5b	2.3b

[1] Means within columns followed by the same letter are not significantly different P=0.05, LSD)
[2] Blankophore BBH

Table 4. Microbial Control of *S. exigua* in Alabama Cotton

Treatment	Field 23: August Mean No. Large Larvae[1]	Mean No. Total Larvae[1]
Control	12.1a	54.9a
ABG-6426	6.6b	54.9a
Xentari	6.3b	46.9a
Javelin	6.0b	41.7a
ABG-6395	4.7b	41.6a
Pirate	0.3c	0.4b

[1] Means within columns followed by the same letter are not significantly different P=0.05, LSD)

Table 5. Microbial Control of *S. exigua* in Alabama Cotton

Treatment	Field 23: August Mean No. Total Larvae[1]
Larvin	52.9a
Xentari	42.3ab
Spod-X+ BLA[2]	34.6bc
Spod-X (100ml/A)	32.5bcd
Control	28.9cde
Spod-X + Soydex	28.6cde
Pirate	27.9cde
AfNPv (Low rate)	22.3def
AfNPv (High rate)	20.6ef
Spod-X (50ml/A)	16.0f

[1] Means within columns followed by the same letter are not significantly different P=0.05, LSD)
[2] Blankophore BBH