UPDATE ON THE AREA-WIDE BUDWORM/BOLLWORM MANAGEMENT PROGRAM WITH VIRUS: IS IT A COST EFFECTIVE INSURANCE PROGRAM?

D. A. Streett, M. R. Bell and D. D. Hardee
USDA, ARS, Southern Insect Management Laboratory
Stoneville, MS

Abstract

Results were reported from the 1996 area-wide management program with baculovirus in the Mississippi Delta. A circular study area encompassing approximately 9,972 ha was treated in late April and early May with virus to coincide with the larval emergence of bollworms and tobacco budworms, respectively. Enclosure cages and pheromone traps were monitored to assess the impact of the virus in an area-wide management program. The enclosure cage data were inconclusive due to low emergence in the area. Pheromone trap data suggested that total moth emergence was reduced 40% when compared with moth emergence in untreated areas. A projected cost analysis for a large area-wide program (ca. 324,000 ha) during 1998 in the Mississippi Delta is also addressed.

Introduction

The cotton bollworm, *Helicoverpa zea* (Boddie) and the tobacco budworm, *Heliothis virescens* (F.) are multivoltine pest species on cotton and other cultivated crops. In the Mississippi Delta these pests are active prior to the availability of host crops and the first larval generation of these species develops on wild host plants (Stadelbacher 1981). The principal wild host plant is a wild geranium, *Geranium dissectum* L.. (Stadelbacher 1979) with *H. zea* larvae usually found one week earlier than *H. virescens* larvae among wild host plants in the Delta of Mississippi (Stadelbacher, 1981).

Knipling and Stadelbacher (1983) proposed an area-wide approach to *Heliothis* management that would implement preventative suppression tactics to manage tobacco budworm and bollworm populations during the first generation as opposed to managing the pests during later generations with chemical insecticides. Several potential control tactics were discussed, including application of the baculovirus, *Helicoverpa zea* nuclear polyhedrosis virus (HzNPV). Since 1990, an area-wide management program with HzNPV has been conducted in the Delta to control the first generation of bollworm and tobacco budworm (Hardee and Bell 1996) in geranium before movement to cotton can occur in the later generations.

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The following study reports the results from the 1996 area-wide management program with HzNPV. In addition, an assessment will be presented on the impact of the virus in an area-wide management program and a projected cost analysis for the proposed 1998 grower-funded program for managing bollworms and tobacco budworms.

Materials and Methods

Treatment Site and Virus Application

A circular treatment area with a 5.6 km radius was established at N $90^0 48' 38''$ W 33^0 19' 00" that encompassed approximately 9,972 ha. The HzNPV formulation used in this study consisted of Gemstar™ LC (biosys, Inc.) diluted in water with an equal volume of Soysurf™ (Sanders Seed Co., Cleveland, MS) and applied at an application volume of 2.33 liters per ha. Aerial applications of virus were applied at a rate of 4.94×10^{11} occlusion bodies (OB's) per ha to the entire area on two separate occasions (30 April and 9 May) . These two dates were selected to coincide with the larval emergence of bollworms and tobacco budworms, respectively.

Laboratory bioassays were conducted to verify virus activity as described by Bell and Romine (1986) with the following modifications. Six concentrations of virus were incorporated into the diet by dispersing each pathogen concentration in 30 ml of distilled water and blending with 270 ml of diet.

Enclosure Cage Sampling

Twelve enclosure cages (26.8 m^2 x 1.8 m high) were set up in a randomized complete block design of three replicates with four treatments at two locations. Treatments within each replicate were an untreated control; early virus treatment only; late virus treatment only and both virus treatments. A single cage was used for each treatment and each cage was monitored daily for adult emergence from May 20 until June 10. Earlier studies have shown that each enclosure cage isolated a representative sample of tobacco budworm and bollworm larvae. The number and species of moths emerging in each cage were recorded for data analysis.

Pheromone Trap Sampling

Sampling transects ran from the study site center, bisecting the circle and extending for 8 km beyond the study site boundaries. Sampling sites were located every 1.6 km along the transects with two (one each for bollworm and tobacco budworm) standard cone traps (Hartstack et al. 1979) established at each site. Trap contents were sorted for identification and counted three times each week over the 12 wk period following virus application.

Results and Discussion

Enclosure Cage

Overall adult emergence among all of the treatments in the study area was low, and this was attributed to the low moth populations observed in the area. The low rates of adult emergence precluded any statistical analysis of the data.

Pheromone Trap

Mean total trap captures per week for the four sampling sites along the transect near the center of the virus treatment area (treated) and at the four sampling sites along the transect that were furthest from the center of the treatment area (control) are presented in Figure 1. *H. zea* was the predominant species with >90 % in the control and treated area. Tobacco budworm moth captures in the center of the virus treatment area averaged 21 moths/trap/week versus 268 moths/trap/week in the untreated area during peak trap capture. This represented a 92% reduction in tobacco budworm moth captures. Trap counts for bollworms in the center of the virus treatment area were 9% lower than moth captures in the surrounding untreated area.

Results from the pheromone trap capture data suggests that the virus application was less effective at reducing bollworm moth emergence then tobacco budworm moth emergence. Timing of application or movement into the treatment area were considered to be the primary factors responsible for the observed lack of reduction in bollworm moth emergence in the treatment area. The pheromone trap sites reported for the treatment area were only 6 km from the border of the treatment area. Movement of 8 km and upwards to 19 km has been reported for *H. virescens* and *H. zea* depending upon environmental conditions (Hayes 1991). This degree of movement could have a significant impact on any attempt to evaluate the success of the 1996 area-wide program using pheromone trap capture data.

Projected Cost Analysis

A grower-funded program for managing *Heliothis/Helicocoverpa* has been proposed for the Mississippi Delta in 1998 that would encompass approximately 324,000 ha. A conservative estimate on the amount of cotton planted in this area would be approximately 91,000 to 101,000 ha of cotton although this amount may vary by 20% for a given year. The total grower contribution per cotton hectare can be calculated by determining the total cost of the program and dividing by the total amount of cotton planted in the treated area.

The estimated cost for aerial application of the virus would range from $1.24 to $1.73 per ha and the cost for the oil adjuvant would be approximately $1.06 per ha. Thus, the estimated total cost for the aerial application and oil adjuvant would not exceed $2.79 per ha. Virus costs would range from $4.94 to $6.18 per ha depending upon the quantity purchased. The estimated total cost for the program in the proposed area would be $8.97 per ha or $2,906,000. If we assume that the cotton acreage represents 31% of the total area in the treatment program then the estimated cost per hectare of cotton would be $28.70 ($11.61 per cotton acre).

Future Research Plans

The actual cost of the program at roughly $29.00 per hectare of cotton may still be cost prohibitive to most growers. Application and spray oil adjuvant are fairly fixed costs. However, it may be possible to use a lower virus application rate and still obtain adequate suppression of the pest population.

Knipling and Stadelbacher (1983) originally proposed 90% suppression of reproduction during the first generation of *H. zea* and *H. virescens* to ensure adequate protection of the crop during the entire growing season. However, the 90% level of suppression was proposed to control the 2^{nd}, 3^{rd}, and 4^{th} generation of moths during the growing season. Shorter season varieties are now utilized for most cotton production in the MidSouth area (Luttrell 1994). This would significantly reduce the importance of suppressing the 4^{th} generation moth populations and consequently lower the level of suppression necessary for controlling the 2^{nd} and 3^{rd} generation of moths.

If a lower level of suppression during the first generation of moths will provide adequate protection of the crop, then a lower virus application rate may be acceptable. In an earlier enclosure cage study by Bell (1990) a lower application rate of virus was found to sufficiently reduce adult moth emergence. Enclosure cages in the study had been artificially infested with larvae and treated with either 0, 50 or 100 larval equivalents (LE) of virus per ha. The 50 and 100 LE/ha treatments produced similar results with adult moth emergence reduced 95% when compared to the 0 LE/ha rate. Bell (1990) suggested the effectiveness of the 50 LE/ha rate may have been due to the artificially high larval numbers actually promoting the spread of the virus. Early instar mortality due to virus can serve as inoculum for healthy larvae. Nevertheless, while density-dependent horizontal transmission may explain the effectiveness of the 50 LE/ha rate in treated plots, other explanations may also account for the effectiveness of the 50 LE/ha rate and should be evaluated more thoroughly in the field.

It is our intention to evaluate the impact of the lower virus application rate during the 1997 field season . If the lower virus application rate still provides an adequate suppression of the pest population it will be possible to reduce grower costs in future area-wide management programs to approximately $19.00 per ha of cotton ($7.69 per cotton acre).

Conclusion

The *Helicoverpa zea* nuclear polyhedrosis virus has been used in the Delta since 1990 as a preventative suppression tactic to manage tobacco budworm and bollworm populations during the first generation. Application of HzNPV in all of the management programs thus far has resulted in a substantial prevalence of infection among larvae. We believe that the costs for an area-wide management program with HzNPV will be a cost-effective preventative suppression tactic to manage tobacco budworm and bollworm populations in the Delta.

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Disclaimer

Mention of a proprietary product does not constitute an endorsement by the USDA.

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Table 1. Estimated Cost for the Area-Wide Program in 1988

	Cotton in Treatment Area (Ha)		
	91,093	101,214	111,336
200 billion OB's	$31.88	$28.70	$26.09
100 billion OB's	$20.90	$18.81	$17.10

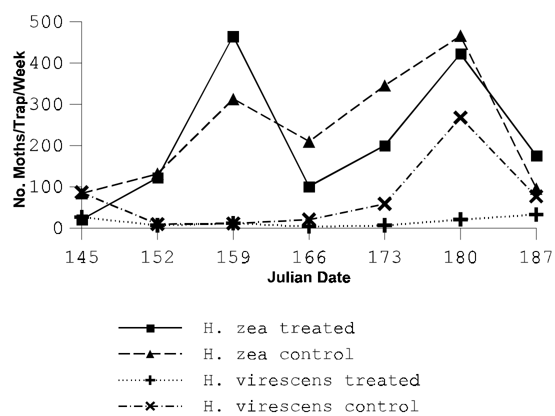

Figure 1.. Mean Pheromone trap captures per week for *H. virescens* and *H. zea* in 1996