2004 BELTWIDE COTTON CONFERENCES, SAN ANTONIO, TX – JANUARY 5-9

TEXAS PINK BOLLWORM ERADICATION PROGRAM REPORT

L.E. Smith, C.T. Allen, S.E. Herrera, and L.W. Patton
Texas Boll Weevil Eradication Foundation
Abilene, TX
O. El-Lissy
United States Department of Agriculture
Animal and Plant Health Inspection Service
Riverdale, MD

Abstract

The Texas Pink Bollworm Suppression/Eradication program has been operating under the supervision of the Texas Boll Weevil Eradication Foundation (TBWEF) to suppress this damaging pest of western cotton for three years in the El Paso/Trans Pecos region. The program has removed pink bollworm as an economic concern for cotton growers in the region. Pink bollworm moth populations have been suppressed by more than 91 percent from 1999 population levels. Larval boll infestations have been reduced more than 99 percent since the program began.

Introduction

Since its first appearance in the U.S., in Robertson County, TX about 1917, the pink bollworm has become a key pest in western areas of the U.S. Cotton Belt. The National Cotton Council estimates pink bollworm costs cotton producers in the western U.S. approximately $21.6 million annually in prevention, control and yield losses. In Texas, pink bollworm infestations and losses are seen primarily in cotton fields along and west of the Pecos river. In the past, producers have had to rely on insecticides to avoid severe yield losses from pink bollworm. This insecticide based system had many associated problems. Frequent, accurate scouting was essential to properly time treatments. Occasionally infestations went undetected and severe damage occurred. Some producers were vigilant and protected their crop while neighboring producers did not. The lack of an area-wide approach to the problem allowed infestations to persist and often worsen. Multiple insecticide applications were costly, and the risk, frequency and severity of secondary pest outbreaks increased. The advent of Bt transgenic cotton has allowed producers to stabilize their cost of controlling pink bollworm and this technology has provided excellent control, but there are costs associated with the use of the Bt technology that must be paid each year. And in systems relying primarily on Bt technology for pink bollworm suppression producers are limited in their variety selection to only those varieties with the Bt gene. In addition, the lack of an area-wide approach to population suppression allows pink bollworm populations to persist as a threat to the cotton industry in infested areas.

Much of the technology used in the Texas pink bollworm program was developed in a similar, successful program which was conducted in Parker Valley, Arizona from 1990-95 (Antilla et al. 1996). The Arizona program was similar in its use of an area-wide approach including mapping, trap triggers, pheromone mating disruption technology, and insecticide applications. It differed from the Texas program by not having Bt transgenic technology available and by utilizing area-wide treatments in the spring and reliance on grower treatments in the fall.

In March of 1999, cotton producers in the El Paso/Trans Pecos (EP/TP) zone passed a referendum to conduct a boll weevil and pink bollworm suppression/eradication program to begin in the fall of that year. The program began with initiation of boll weevil eradication and two years of trapping to provide population information prior to the initiation of the pink bollworm program. The treatment phase of the pink bollworm program began on 46,621 acres of cotton in 2001. The program was improved and continued on the zone's 41, 652 acres of cotton in 2002 and 37,962 acres of cotton in 2003.

The initial objective was to reduce pink bollworm populations and damage across the zone to below levels at which economic damage would occur. This objective was reached in 2001, the first year of the program. The next objective was to continue to suppress pink bollworm populations and work with cotton producers in adjacent areas of Mexico and New Mexico to eradicate the pest from the region. In 2002 producers in the state of Chihuahua, Mexico, and in the Mesilla Valley of New Mexico initiated programs similar to the Texas program, thereby forming a cohesive effort to eliminate pink bollworm from the region.

Methods and Materials

El-Lissy et al. (1997) provided a detailed description of the boll weevil eradication methods from which the methods used in this program were adapted.

Mapping

The planting of Bt transgenic cotton varieties was encouraged by reducing the assessment on acres planted to these varieties. Immediately after seedling emergence, all cotton fields were mapped using differentially corrected GPS technology (Geo II and III GPS units and Pathfinder Software, Trimble Navigation). The presence or absence of the Bt toxin was determined by randomly selecting seedlings from all cotton fields in the El Paso/Trans Pecos zone and testing them using ELISA test procedures (AgDia Inc.). Field maps were constructed using Map Info software. Field maps were color coded to indicate Bt transgenic cotton, non-Bt cotton, and sensitive site fields (those near houses, schools, etc.). Producer data, field numbers, and other information was electronically associated with each field.

Trapping

Between seedling emergence and the appearance of pinhead squares, gossyplure (pink bollworm sex pheromone) baited delta traps (Scentry Biologicals) were deployed around all fields at a density of approximately 1 trap per 10 acres (minimum of 2 traps per field). Each trap was bar coded which allowed the trap data to be electronically associated with a physical location on the maps. From deployment to the time fields were harvested and no longer hostable, traps were checked weekly and replaced at least every two weeks. Trap catch information, crop stage and other data were recorded weekly using hand held electronic scanners/data loggers (TimeWand II, Videx).

Control

Several pink bollworm control components were used. Testing for the presence of the Bt toxin in 2003 revealed that 13,302 acres of the zone's 37,962 acres or 35 percent, was Bt cotton. Bt cotton percentages varied in each work unit and year. The Pecos work unit was 76 percent Bt cotton in 2001, 83.4 percent Bt cotton in 2002 and 70.5 percent Bt cotton in 2003. The Fort Hancock work unit was 48 percent Bt in 2001, 40 percent Bt cotton in 2002 and 24.2 percent Bt cotton in 2003. The lowest Bt cotton use was in the El Paso work unit which had 32 percent Bt cotton in 2001, 21.5 percent Bt cotton in 2002 and 15.4 percent Bt cotton in 2003. Bt and non-Bt acres were treated with other pink bollworm controls only as needed and in compliance with U.S. E.P.A. Bt cotton refugia requirements.

Several pheromone mating disruption products were used. High dose, hand applied gossyplure dispensers (PB-ROPE L, Pacific Biocontrol Corporation) were used at an application rate of approximately 200 dispensers per acre on 23,551 acres of cotton in the zone. Local labor contractors were used to apply the pheromone rope dispensers. As many fields as possible were treated with rope because of the effectiveness of this formulation for season-long population suppression. In the Pecos work unit rope was used on fewer acres because a high percentage of the crop was Bt cotton, and labor was not readily available. Only 882 acres, 7.6 percent of the planted acres, were treated with the rope there. In the Fort Hancock work unit 9,660 acres, 76.1 percent, were treated with rope. And in the El Paso work unit 11,161 acres, 81 percent, received rope treatment. The high dose rope dispensers were expected to provide near season-long suppression from a single application. Some of the rope treated fields received aerially applied pheromone and/or Lorsban insecticide late in the season if moth catches triggered treatments.

The primary sprayable pheromone mating disruption product used was NoMate PBW Fiber (Scentry Biologicals Inc.). The fiber was applied in a thick adhesive (BioTac, Scentry Biologicals Inc.) at a rate of 15 grams of fiber per acre. Zeta-cypermethrin (Fury, FMC Corp.) was added to the mixture such that it was applied at a rate of 0.000586 lbs ai/acre (1/2 fl. oz/acre) to provide suppression of adult male moths attempting to mate with the fibers. The period of peak Fiber use was in the prebloom period in the Fort Hancock and El Paso work units. The percentage of the year's Fiber use that had been applied by the end of June was 1.6 percent in the Pecos work unit, 69 percent in the Fort Hancock work unit and 74.2 percent in the El Paso work unit. This was in response to the higher than expected early season moth captures. For the year, 9,739 acres were treated with Fiber in the Pecos work unit, 16,236 acres received treatment in the Fort Hancock work unit and 12,319 acres were treated with Fiber in the El Paso work unit. A total of 38,294 acres were treated with Fiber. Fiber treatments were initiated at pinhead square stage. After the pinhead square treatments, the Fiber was reapplied when traps around a field caught pink bollworm moths. Positive trap catches around a field indicated the presence of pink bollworm moths and low enough concentration of pheromone in the field that adult moths could find one another and mate. If pheromone traps were capable of attracting males, the assumption was that female moths could also attract males resulting in larval infestations.

Fields in which moths were caught at above 1 moth per trap per night received applications of Nufos 4E (chlorpyrifos) applied at a rate of 24 fluid oz. per acre. No Nufos 4E treatments were made prior to the end of June. It was used most heavily in August and September. A total of 13,604 acres were treated with Nufos. When moth catches averaged above 1 moth per trap per night, dual applications consisting of Nufos 4E (24 fluid oz. per acre) and Fiber (15 grams per acre) were applied to the fields. Due to the higher spring trap catches in the Fort Hancock and El Paso work units in 2003, higher use of dual applications was made in those units in prior to bloom. No dual applications were made in the Pecos work unit before July 1. In the Fort Hancock work unit 5,006 acres received dual applications (38.1 percent of the total dual applications for the season in the Fort Hancock work

unit) and in the El Paso work unit 1,148 acres received dual treatments (22.8 percent of the total dual applications for the season in the El Paso work unit) prior to July 1. Two peak use periods for dual treatments were seen in 2003. The first week of June had the highest dual use of any week of the year with 4,129 acres treated. During the first three weeks of June 6,154 acres received dual treatments (32 percent of the total dual treatments applied during 2003). The second peak in dual application use began in mid-August and lasted into the first week of October. During that time period 11,764 acres received dual treatments. A total of 18,792 acres received dual treatments during the 2003 season.

Monitoring

Two methods of monitoring pink bollworm populations were used. Trapping information has been collected since the fall of 1999 when the program was begun in the EP/TP zone**.** The 1999 and 2000 trap catch information provides a baseline to which populations in later years can be compared. In this data set, information from the Fort Hancock and El Paso work units were combined in 1999 but separated in the 2000 and subsequent year's data sets.

In 2001, 25 blooms and later 25 bolls were sampled in each of four quadrants of 20 randomly selected fields in each of 3 work units each week. The 60 fields chosen for sampling stayed constant during the year. This sampling method has been used each year since 2001.

Results

Control

The ropes worked well in providing season-long pink bollworm trap suppression. Rope treated areas tended to perform better in reducing moth captures when higher percentages of fields in an area were treated with the high dose rope pheromone. The highest concentration of rope treated fields was the El Paso work unit in which strong program progress was seen in pink bollworm population reduction in 2001, 2002 and 2003 (Table 1).

Sprayable pheromones were effective in suppressing moth trap catches. The NoMate PBW Fiber mating disruption/male attract and kill approach was effective in suppressing pink bollworm moth trap catches for about 14 days after an application.

Insecticides were used on a limited basis when trap captures increased. The objective of insecticide use was to reduce numbers of mated female moths. Insecticides provided short term elimination of the threat of larval boll infestation. They also renewed effectiveness of the mating disruption treatments since mated moths were eliminated and emerging unmated moths could be prevented from mating using mating disruption. Nufos provided excellent short term reductions in trap catches. It was helpful in suppressing pink bollworm populations in more heavily infested areas primarily late in the season.

Bt cotton strongly reduced pink bollworm moth catches and larval infestations. Larval sampling in Bt cotton fields very rarely resulted in discovery of surviving larvae. No larvae were discovered in 10,745 bolls sampled in 2003.

Trap Data

The results of the pink bollworm trapping data are given in Table 1. The data show numbers of traps inspected and moth trap catches by work unit from 1999 to 2003. Relatively large numbers of traps were inspected in each work unit each year. Captures of pink bollworm moths have declined each year since initiation of treatments in 2001. While all work units saw reductions in moths trapped, the largest reductions were seen in the Pecos work unit in 2001, when large migrations of moths did not affect the trap catch data, and the El Paso work unit where the long duration pheromone rope was more heavily used.

Overall, moth trap catches declined 62 percent from 2000 to 2001 and 81.5 percent from 2000 to 2002 and 91.2 percent from 2000 to 2003.

Boll Sampling Data

Boll infestation data are not available for the years prior to the start of the treatment phase of the program. Prior to the inception of the program infestations of from 20 to 50 percent of late set bolls were common where multiple insecticide applications were not used to prevent them. Even with treatment pink boll worms typically infested 20 percent or more of the top late set bolls. Since the program began the percentage of pink bollworm infested bolls has dropped from the 20+ percent to 4.53 percent in 2001, 0.81 percent in 2002 and 0.13 percent in 2003. Calculated from prior to the start of the program (estimated 20 percent average infestation) boll infestations have been reduced by more than 99 percent. Since the first year of the program boll infestation has been reduced more than 97 percent.

Only 37 infested bolls were found in 17,280 boll inspections (0.21 percent) from randomly selected fields that had received long duration mating disruption treatments.

Conclusions

The treatment phase of the pink bollworm program in the EP/TP zone was initiated in the spring of 2001 and has been conducted successfully since that time. An aggressive monitoring and treatment protocol was followed. Applications were made in a timely manner in accordance with the established protocol. Grower treatments for pink bollworm control were practically eliminated in 2001 and none were made in 2002 or 2003.

Moth trap catches have been strongly reduced each year of the program. Long duration pheromone rope is a very effective product for pink bollworm population reduction. It is especially effective when used on higher percentages of fields in an area.

Extensive boll sampling indicated that larval infestations and boll damage were maintained at low levels in 2001 and were reduced further by program activities in 2002 and 2003.

Declining pink bollworm populations in the eradication zone were notable when compared with the much higher than normal pink bollworm populations, control costs and losses were experienced in Gaines and Yoakum Counties in Texas and Lea County in New Mexico during the 2002 and 2003. In-spite of favorable conditions for pink bollworm survival and population increase in this nearby area not in eradication, pink bollworm populations continued to decline in the EP/TP pink bollworm eradication zone.

In 2002 neighboring cotton producing areas in Chihuahua, Mexico and in the Mesilla Valley of New Mexico began similar pink bollworm eradication programs. This cohesive multi-national and multi-state effort is working toward elimination of the pink bollworm as a pest of cotton in the region.

Movement of pink boll worm moths into the eradication zone from neighboring zones not currently in eradication or suppression programs is a concern. The continued high cost of suppression activities is also of concern. The availability of sterile moths to complete eradication, allow reduction of expenses and prevent immigrating moths from establishing in the zone is the next critical component to the program's success. When sterile moths become available and the sterile moth phase of the program becomes operational, pink bollworm can be completely eliminated, re-infestation can be prevented and program costs can be reduced.

Acknowledgments

The authors wish to thank the many USDA and state university research entomologists for their work in developing the technology used in this program.

Also, we wish to thank Mr. Larry Antilla, Mr. Mike Whitlow, Dr. Bob Staten, Mr. Frank Meyers and their many co-workers in Arizona and California that pioneered use of these technologies in an area-wide pink bollworm suppression programs.

We thank our state and federal legislators for monetary support for this program. Also we thank USDA APHIS for assisting with funds administration and technical program support.

We wish to thank the Texas Department of Agriculture for providing assistance and oversight for this program.

We thank Dr. Tim Dennehy and his co-workers for their work in assessing Bt tolerance in West Texas pink bollworm populations to monitor for changes in the population during the course of the program.

We wish to thank the many TBWEF employees who contributed to the success of this program.

We wish to thank the growers and steering committee in the El Paso/Trans Pecos zone for supporting this program through the referendum process, payment of their assessments, and the program guidance and direction they have provided.

We wish to thank the National Cotton Council Pink Bollworm Technical Advisory Committee for providing information to assist program personnel in running the program in the most technically efficient and effective manner.

And, we wish to thank the Texas Boll Weevil Eradication Foundation Board and Technical Advisory Committee for their support of this program.

References

Anonymous. 2001. Pink Bollworm Eradication: A Window of Opportunity. National Cotton Council of America. 6pp.

Antilla, L., M. Whitlow, R.T. Staten, O. El-Lissy and F. Meyers. 1996. An integrated approach to Areawide Pink Bollworm Management in Arizona. *In* Proc. Beltwide Cotton Conf., National Cotton Council, Memphis, TN. 1083-5.

El-Lissy, O., F. Meyers, R. Frisbie, T. Fuchs, D. Rummel, R. Parker, D. Dippel, E. King, G. Cunningham, F. Carter, J. Boston and J. Hayes. 1997. Boll weevil eradication update - Texas, 1996. *In* Proc. Beltwide Cotton Conf. National Cotton Council, Memphis, TN. 973-9.

Table 1. Pink bollworm moth trapping data from the El Paso/Trans Pecos zone from 1999 to 2002[1].

	Traps Inspected				
Year	Pecos Work Unit	Combined Ft. Hancock/El Paso	Ft. Hancock Work Unit	El Paso Work Unit	EP/TP Zone
1999	11,386	4,998	-	-	16,384
2000	23,617	-	55,182	36,508	102,736
2001	22,672	-	42,611	64,231	142,085
2002	18,175		46,805	44,456	109,436
2003	26,039		35,064	43,094	104,197

	Moths/Trap/Week				
Year	Pecos Work Unit	Combined Ft. Hancock/El Paso	Ft. Hancock Work Unit	El Paso Work Unit	EP/TP Zone
1999	14.10	32.58	-	-	19.74
2000	9.57	-	11.76	18.17	13.53
2001	5.99	-	5.60	4.53	5.18
2002	4.25		2.77	1.48	2.50
2003	2.81		2.04	0.81	1.73

[1]1999 data from fall only; 2000, 2001, 2002 and 2003 are season-long trapping data.