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PINK BOLLWORM ERADICATION IN TEXAS - A PROGRESS REPORT

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Abstract

The Texas Pink Bollworm Suppression/Eradication program has been operating under the supervision of the Texas Boll Weevil Eradication Foundation (TBWEF) to suppress/eradicate this damaging pest of western cotton for four 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 96 percent from 1999 population levels. Larval boll infestations have been reduced by 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 relied on insecticides to avoid severe yield losses from pink bollworm. This insecticide based system had a number of associated problems. Thorough, frequent 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. The multiple insecticide applications required were costly, and the vulnerability of the cotton crop to 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 the costs of using Bt technology 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. This restricts growers and forces them into conventional pesticide systems if they choose to plant non-BT pima, acala or upland varieties. The lack of an area-wide approach to population suppression has allowed 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 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. With the availability of sterile pink bollworm moths for the Pecos work unit in 2004, the Texas program benefited from this technology which was not available to the Arizona program.

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, the 37,962 acres of cotton in 2003 and the 42,134 acres of cotton in 2004.

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 were 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 2004 revealed that 16,473 acres of the zone's 42,134 acres or 39 percent, was Bt cotton. Bt cotton percentages varied in each work unit. 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 and 78.7 percent Bt cotton in 2004. The Fort Hancock work unit was 48 percent Bt in 2001, 40 percent Bt cotton in 2002, 24.2 percent Bt cotton in 2003 and 27.4 percent Bt cotton in 2004. 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, 15.4 percent Bt cotton in 2003 and 11.2 percent Bt cotton in 2004. Bt and non-Bt acres were treated with 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 19,815 acres of cotton in the zone in 2004. 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 for several reasons. Reasons fewer acres received rope applications in the Pecos work unit were a high percentage of the crop was Bt cotton, labor for hand application of the ropes was not readily available and the Pecos work unit was being treated with sterile pink bollworm moths in 2004. Only 417 acres, 2.7 percent of the planted acres, were treated with rope there. Roped acres in the Pecos work unit were the organic cotton acres near Van Horn, TX. In the Fort Hancock work unit 8,855 acres, or 68.2 percent, were treated with rope in 2004. And in the El Paso work unit 10,543 acres, or 75.4 percent, received rope treatment in 2004. 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 when pheromone release from ropes declined and moth catches triggered treatments.

NoMate PBW Fiber (Scentry Biologicals Inc.) was the sprayable pheromone product used. The fiber was used at a rate of 15 grams of fiber per acre applied in a thick adhesive (BioTac, Scentry Biologicals Inc. 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. 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 of wild-type moths around a field indicated the presence of pink bollworm moths and low enough concentration of pheromone or sterile moths in the field that adult moths could find one another and mate. If pheromone traps were capable of attracting wild-type males, the assumption was that female moths could also attract males resulting in larval infestations. The period of peak Fiber use was the

early season period with 16,709 acres treated between May 31 and July 12. This accounted for 64% of the fiber used and all but 510 of the treated acres were in the Fort Hancock and El Paso work units. After August 2, 9,516 acres were treated with fiber (36% of the fiber treatments for the year). Treatments in the Pecos work unit increased after August 2 in response to migration of moths into the area. Acres treated in the fall were as follows: Pecos work unit 4,009, Fort Hancock work unit 2,397 and El Paso work unit 3,110. For the year, 26,225 acres were treated with fiber.

Fields in which moths were caught at above 1 moth per trap per night received applications of Lorsban 4E (chlorpyrifos) applied at a rate of 24 fluid oz. per acre with 24 oz. of cottonseed oil diluent/surfactant. These treatments were applied with or without fiber. Through July, 11,881 acres received Lorsban treatment, 45% of the treatments for the year. From August through October 17, 14,397 acres were treated, the remaining 55% of the treatments for the year. Because of a lingering low level infestation on a few fields, the Fort Hancock work unit treated a cumulative 19,819 acres with Lorsban during the year. Lorsban treatments in the Fort Hancock work unit accounted for 75% of the Lorsban use in the zone during 2004. The cumulative total acreage treated with Lorsban was 26,278.

Some of the more heavily infested fields and fields with more chronic infestations received "dual applications" or combination treatments of both fiber and Lorsban. A total of 9,510 acres received these dual treatments (note: these acres were previously reported as fiber and as Lorsban treated). These acres accounted for 36% of the fiber treatments and 36% of the total Lorsban treatments. Sixty-nine percent of the dual treatments were applied in the Fort Hancock work unit, while 23% were applied in the El Paso work unit and 8% were applied in the Pecos work unit.

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 provided a baseline to which populations in later years can be compared. 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 2004, sterile moth releases were made season-long in the Pecos work unit and a few sterile insect releases were conducted early season and late season in the Fort Hancock work unit. Supervisors inspected each of the traps and counted the dyed sterile moths separately from the un-dyed wild-type moths. This information was used to "calibrate" the sterile moth drops to attain the necessary 60:1 ratio of sterile to wild-type moths.

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 generally worked quite 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. Since 2001, the highest concentration of rope treated fields has been in the El Paso work unit and strong pink bollworm population reduction has resulted (Table 1). Conversely, problem areas have been those where non-Bt, rope treated fields have been surrounded by Bt cotton fields which were not treated with rope.

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. This approach has not been generally used as a stand alone treatment 2003 and 2004 because of its higher cost and less effective control. However, it can be effectively used in early spring to provide pheromone disruption before ropes are applied and in late fall when the pheromone ropes begin loosing their effectiveness.

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. Lorsban 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.

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 2004. 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.

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 and over 93% from 2000 to 2004.

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 in fields in which multiple insecticide applications were not used to suppress 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 0.9 percent in 2004. Calculated from prior to the start of the program (estimated 20 percent average infestation) boll infestations have been reduced by 99 percent.

Bt cotton strongly reduced pink bollworm larval infestations. Larval sampling in Bt cotton fields did not result in discovery of surviving larvae. A few small larvae were discovered in the 14,985 blooms and bolls sampled in 2004. A cumulative total of 107 larvae were counted, 1.01% of the fruit sampled, but large larvae were not found.

A cumulative total of 104 larvae were found in 13,550 randomly sampled fruit from non-Bt fields treated with mating disruption ropes, 1.06% infestation.

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 used. Applications were made in a timely manner in accordance with the established protocol. Grower treatments for pink bollworm control were almost totally eliminated in 2001 and none have been made since that time.

Moth trap catches have been 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. This is evident from the relatively low numbers of moths per trap inspected in the El Paso work unit in an area that has consistently had a higher percentage of acres roped than the other work units since the program began. At the end of the 2004 season pink bollworm moth captures per trap inspection were 5.77X and 2.48X higher in the Fort Hancock and Pecos work units, respectively, than in the El Paso work unit.

The sterile insect releases were highly effective in the Pecos work unit. Wild-type pink bollworm moth captures for the year averaged 0.27 moths per trap until migration of wild-types from surrounding cotton producing areas began the week of September 13. By the end of the year, wild-type moths per trap averaged 0.75. Captures per trap inspection in the Fort Hancock work unit were 2.33X higher than the number per trap inspection captured in the Pecos work unit.

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

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 period 2002 through 2004. In-spite of favorable conditions for pink bollworm survival and population increase in this 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. Strong pink bollworm population reductions have been reported from these areas as well. 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 EP/TP 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 critical to the program's success. When sterile moths become available to all EP/TP cotton, pink bollworm can be completely eliminated, re-infestation can be prevented and program costs can be reduced.

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Table 1. Pink bollworm moth trapping data from the El Paso/Trans Pecos zone from 1999 to 2004[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
2004	16,775		36,065	43,251	96,091
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
2004	0.75		1.74	0.30	0.92

[1] 1999 data from fall only; 2000, 2001, 2002, 2003 and 2004 are season-long trapping data.