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TEXAS PINK BOLLWORM ERADICATION 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 five years in the El Paso/Trans Pecos region. The program removed pink bollworm as an economic concern for cotton growers in the region during its first year of operations. Pink bollworm moth populations have been suppressed by over 99.6 percent from 1999 population levels. Larval boll infestations have been reduced by over 99 percent since the program began.

Introduction

Since it was first found and identified 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 has cost 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 have historically been seen primarily in cotton fields along and west of the Pecos River with periodic infestations occurring in southern parts of the Texas High Plains. 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. Multiple insecticide applications were required to prevent extensive crop damage. But chemical control was costly, and the cotton crop was subjected to increased risk of damage from secondary pest outbreaks. 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 Bt transgenic versions of the Pima and Acala cotton varieties commonly planted in the region are not available. The lack of an area-wide approach to population suppression/eradication has allowed pink bollworm populations to persist as a threat to the cotton industry.

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. In addition, the availability of sterile pink bollworm moths has provided the Texas program with eradication technology the Arizona program did not have.

In March of 1999, cotton producers in the El Paso/Trans Pecos (EP/TP) zone passed a referendum with an 80 percent favorable vote to conduct boll weevil eradication and pink bollworm suppression/eradication 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 on the 37,962 acres of cotton in the zone in 2003. In March of 2003 a retention referendum was held in which 89 percent of the growers voted to continue the program. In 2004 program operations continued on 42,134 acres of cotton. In June 2005 a referendum was held to continue boll weevil eradication, move from a pink bollworm suppression program to a pink bollworm eradication program and extend

the number of years an assessment can be collected to pay for the program. The referendum passed by with over 95 percent of the growers voting in favor of the changes. Cotton acreage in the zone in 2005 was 43,405 acres.

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 begin programs to eradicate pink bollworm in their areas so the program could be completed in the region. In 2002 producers in the state of Chihuahua, Mexico, and in south central New Mexico initiated programs similar to the Texas program. This brought about a regional effort with three separate programs working to eliminate the pink bollworm. These programs are mutually supportive by sharing technology and reducing costs through preventing migration into neighboring program areas. In 2006 Arizona cotton growers will begin the process of eradicating pink bollworm from their state.

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

Use 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.) for the presence of Bt toxin. 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 technologies were used. Testing for the presence of the Bt toxin in 2005 revealed that 17,272 acres of the zone's 43,405 acres or 40 percent was Bt cotton. Bt cotton percentages varied in each work unit. In the Pecos work unit the percentage of cotton acreage planted to Bt cotton ranged from 70.5 percent Bt cotton in 2003 to 90 percent of the acreage in Bt varieties in 2005. The percentage of Bt cotton planted in the Fort Hancock work unit ranged from 24.2 percent in 2003 to 48 percent in 2001. The lowest Bt cotton use was in the El Paso work unit which ranged from 10 percent of the acreage in 2005 to 32 percent in 2001. 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 9,226 acres of cotton in 2005. This was down from the 19,815 acres which were treated with long duration pheromone rope in 2004 and a reduction of over 60 percent from 2003, the peak year of rope use. Local labor contractors were used to apply the pheromone rope dispensers. In 2001 rope was used on those fields that were difficult to treat with aircraft. In subsequent years the effectiveness and lower cost of rope compared with fiber brought about increased use of rope. When sufficient sterile insects became available for season-long use on all EP/TP cotton acres, fields targeted for rope applications were those in which wild-type moths were being caught and/or those identified with larval infestations the previous year. In the Pecos work unit only 384 acres were treated with rope in 2005. These were organic cotton acres at Van Horn, TX. Higher percentage Bt cotton use and lower pink bollworm populations allowed lower use of the effective but expensive rope in the Pecos work unit. The Fort Hancock work unit had higher 2004 fall pink bollworm captures, more fields with larval infestations and higher

spring 2005 moth captures than the other work units. Long duration pheromone rope was used on 6,504 acres in the Fort Hancock work unit in 2005. In the El Paso work unit 2,338 acres received rope treatment in 2005. The high dose rope dispensers provided near season-long suppression from a single application.

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. During 2005 only 6,228 acres were treated with Fiber. This was down 69 percent from the 26,225 acres were treated with fiber in 2004 and 96 percent from the 142,842 acres treated with Fiber in 2001.

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. In 2005 only 2,152 acres received dual treatments of Lorsban and Fiber and only 770 acres were treated with Lorsban without the Fiber. The 2,922 acres that were treated with Lorsban (either alone or as dual treatments) was down 88 percent from 2004 and 94 percent from 2001.

Sterile moths were released from aircraft over all EP/TP cotton acreage for the first time in 2005. During the period May 9 (pre-pinhead) to October 9 (last mature boll) an average of 53,433,215 sterile moths were released per week. This was 1,231 sterile moths per acre per week or 176 sterile moths per acre per day for the zone. The moths were reared in the California Department of Food and Agriculture (CDFA)/USDA APHIS pink bollworm rearing facility in Phoenix, AZ and flown to El Paso on commercial aircraft each night for release the next day. They were maintained in specially designed cooler storage/distribution boxes which were held overnight in a refrigerated cooler. The following morning the distribution boxes were mounted directly into the aircraft and dropped onto cotton fields. The goal was to maintain a ratio of 60 sterile moths captured for each wild-type moth captured on all fields. Fields that did not maintain the 60:1 ratio were treated with pheromone or insecticide or both. Recapture data for the zone showed the 60:1 ratio was reached after the second week of release in May and maintained through the last week of release in October. The average ratio of sterile moths to wild-type moths was 133:1 season-long.

The primary technologies used to suppress/eradicate the pink bollworm in the EP/TP zone have changed as the program as progressed. In 2001, the initial year of the program, the technologies given the highest priority and greatest use were Bt cotton and sprayable pheromone mating disruption products. Long duration, hand applied pheromone mating disruption technology and insecticide treatments received lower priority and use. In 2002 and 2003, Bt cotton remained a high priority and high use product, but the long duration, hand applied pheromone mating technology replaced sprayable mating disruption in the high priority and high use category. Sprayable mating disruption and insecticides received lower priority and lower use. In 2004, sterile insect use joined Bt cotton and long duration, hand applied mating disruption in the high priority and high use category. Sterile insect availability was limited, however and only the Pecos work unit received season-long sterile moth coverage. The Fort Hancock unit received limited sterile moths were released during 2004. It received moths for six weeks in late spring (late May through mid-June) and six weeks in the fall (mid-September through late October. Sprayable mating disruption pheromone and insecticides were in the low priority and low use category in 2004. In 2005 sterile moths and Bt cotton were the high priority and high use technologies. Use of long duration, hand applied pheromone mating disruption technology was lower priority and use. Use of sprayable pheromone mating disruption and insecticides were the least used of the technologies in 2005.

Monitoring

Two methods of monitoring pink bollworm populations were used. Trapping data 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. Sterile moth numbers and responsiveness were monitored using pheromone traps. Field personnel collected pink bollworm infested traps and returned them to the field offices where moths were identified as sterile or wild-type and counted. To facilitate this

process the sterile insects were marked with dye placed in their diet in the Phoenix rearing facility. The trapping information was used to direct sterile moth drops so that the necessary 60:1 ratio of sterile to wild-type moths could be maintained.

Since 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.

Results

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 2005. From 2000 forward about 100,000 trap inspections were conducted in the zone each year. Captures of wild-type pink bollworm moths have declined each year since initiation of treatments in 2001. Overall, captures of wild-type pink bollworm moths have declined 99.6 percent from 1999 to 2005.

The sterile insect releases were highly effective in 2005. A total 1,335,830,385 sterile moths were released. Only 11,917 wild-type moths captured for the year while 1,449,053 sterile moths were recaptured. Between May 9 and October 30 Foundation employees captured a ratio of 1 wild type moth for every 133 sterile moths captured in pheromone traps.

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, larval infestations of from 20 to 50 percent of late set bolls were common in fields in that did not receive several well timed insecticide applications 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 0.1 percent in 2005. Boll infestations the first year of the program dropped to 4.5 percent. The percentage of bolls infested fluctuated between 0.8 percent and 0.1 percent 2002 through 2005. The 2005 boll infestation, 0.1 percent, was a 98 percent reduction from the boll infestations measured in the first year of the program and a 99.5 percent reduction from levels reported before the program began.

Bt cotton strongly reduced pink bollworm larval infestations. Larval sampling in Bt cotton fields did not result in discovery of mature surviving larvae in 2005. 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.

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 has been used. Applications have been 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.

Wild-type moth trap catches have been reduced each year of the program. Long duration pheromone rope, Bt cotton and sterile moth releases are very effective products for pink bollworm population reduction and eradication.

Extensive boll sampling indicated that larval infestations and boll damage were maintained at less than 5 percent in 2001 and have been reduced to 0.1 percent in 2005.

In 2002 neighboring cotton producing areas in Chihuahua, Mexico and in the Mesilla Valley of New Mexico began pink bollworm eradication programs. Impressive 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. In 2006 pink bollworm eradication program expansion is planned. Arizona cotton growers have voted to begin the program.

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. Continued program expansion reduces this threat. The continued high cost of eradication activities is also a 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.

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Table 1. Pink bollworm moth trapping data from the El Paso/Trans Pecos zone from 1999 to 2005[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
2005	15,749		42,536	50,908	109,193
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
2005	0.037		0.19	0.066	0.10

[1]1999 data from fall only; 2000, 2001, 2002, 2003, 2004 and 2005 are season-long trapping data.