ARIZONA PINK BOLLWORM ERADICATION PROGRAM UPDATE 2010

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Abstract

In 2006, Arizona initiated activities to eradicate the Pink Bollworm, *Pectinophora gossypiella* (Saunders) as part of the larger, bi-national pink bollworm eradication plan. The program administered by the Arizona Cotton Research and Protection Council (ACRPC), is divided in three program areas. Program activities began in the central and eastern Arizona (Area 1) in 2006, followed by the LaPaz and Mohave counties (Area 2) in 2007, and Yuma County (Area 3) in 2008. In 2010, over seven hundred field samples and twenty four thousand bolls from across the three programs areas have shown no evidence of reproduction. The average reduction in native moth captures for the three areas currently stands at over 99%.

Introduction

From 2006 to 2010, Pink Bollworm populations in Arizona have been reduced dramatically using a combination of technologies in a highly successful integrated pest management approach, which has been previously documented in detail (Antilla and Liesner 2008). This presentation will attempt to document the dynamics of the current program advances, realized benefits and technical challenges.

Methods and Materials

Mapping

All cotton fields are mapped using Global Positioning System (GPS) and Geographic Information System (GIS) technology. Each field is identified as Bt or conventional (Non-Bt) early season and tested using Immunostrip® technology manufactured by Agdia, to confirm the presence or absence of Bt proteins.

Trapping

All conventional cotton is trapped at one trap per ten acres or one trap per field. Bt cotton is trapped at one trap per forty acres. Migration or desert line traps are placed in strategic locations around the state at 1-5 mile intervals. All traps are inspected weekly; any traps with moths are transferred to a central location for identification. Moths that do not readily show dye are subjected to chromatography to determine if the insect is sterile (internally dyed) or native. All trapping and field information is handled via a centralized relational database.

Control

Cultural Control- Most notably the Arizona cotton plow down program.

Bt cotton- Arizona's 24C for Bt cotton allows for homogeneous planting of Bt cotton where sterile insects are released at the USDA/APHIS recommended rate to replace structured refuges. This approach dramatically reduces program cost and resource demand while providing for the most efficient use of the sterile insect component.

Pheromone Mating Disruption- Pheromone rope, pheromone fiber or sprayed formulations utilized as circumstances require.

Sterile Moth Releases- Internally dyed sterile insect are released over Bt at low rates based on 24C requirements and conventional cotton at much higher rates based on monitoring data and Pink Bollworm population history. Insecticides- Limited use of insecticides labeled for Pink Bollworm control to reduce large populations to levels manageable with pheromone and sterile insects.

Results

Arizona cotton acreage for 2010 totaled 202,480.51 (35.6% increase over 2009), conventional cotton comprised 8,847.55 (4.37%) of the total acreage. Yuma County (Area III) conducted year three of eradication activities. La Paz and Mohave counties (Area II) completed year four eradication activities. Central and eastern Arizona (Area I) completed a fifth year of eradication activities and a second year with no evidence of reproduction (Figure 1). In the three zones, 4,233 traps were checked weekly.

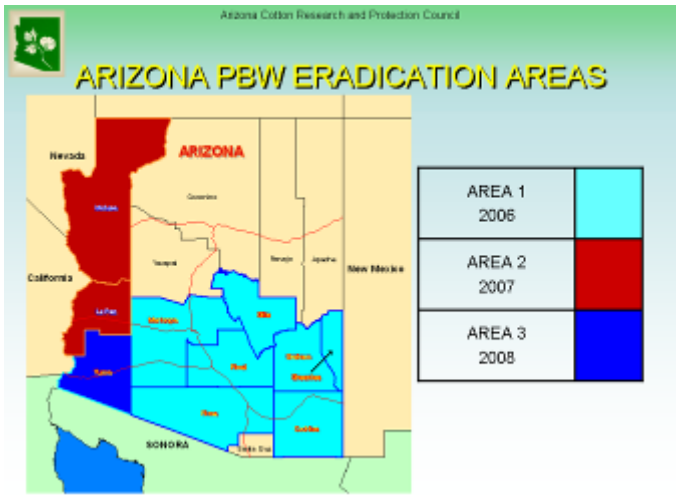


Figure 1. Arizona program areas.

In Yuma County, native captures were down 99.86% (85) in all cotton and down 100% (0) in Non-Bt cotton in comparison with 2007 pre-program captures (Figures 2 & 3). All conventional cotton and okra were treated with pheromone rope and released with sterile Pink Bollworm at a rate of 300 moths/acre/day season long. Bt cotton was released at 10 moths/acre/day from bloom to defoliation. Boll sampling in Yuma produced no larvae in 2,900 bolls (Figure 4). Captures in fall desert line traps in the Yuma area have fallen from over 76 moths/trap/week in 2006 to zero in 2010, highlighting the regional program success in the Lower Colorado River Basin areas of the United States and Mexico (Figure5).

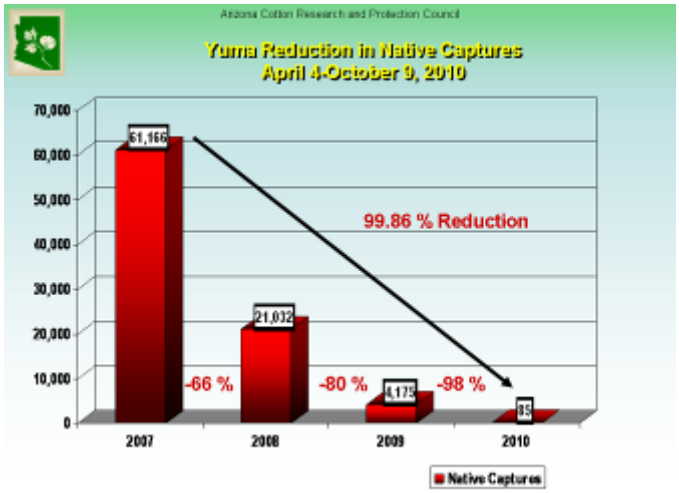


Figure 2. Area 3 native moth captures in all cotton.

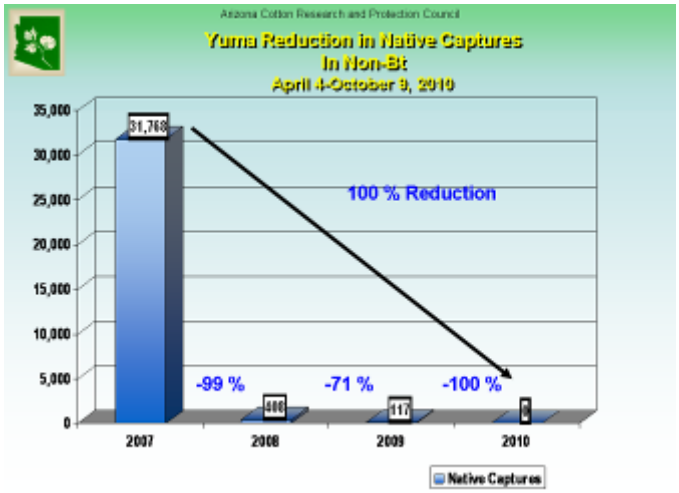
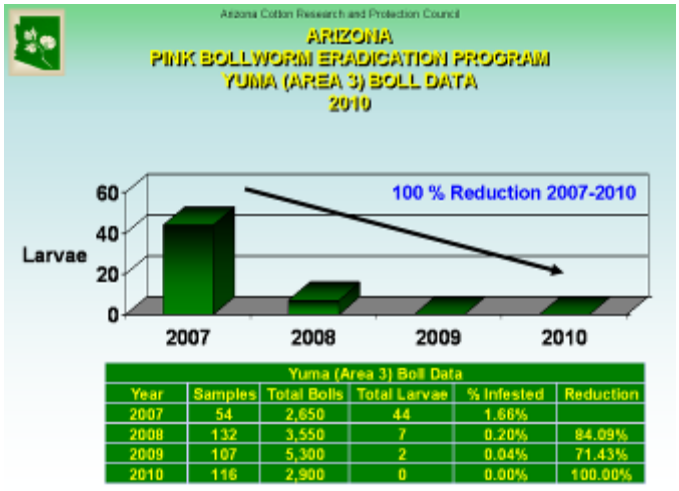


Figure 3. Area 3 native moth captures in Non-Bt cotton.



Yuma (Area 3) Boll Data					
Year	Samples	Total Bolls	Total Larvae	% Infested	Reduction
2007	54	2,650	44	1.66%	
2008	132	3,550	7	0.20%	84.09%
2009	107	5,300	2	0.04%	71.43%
2010	116	2,900	0	0.00%	100.00%

Figure 4. Area 3 boll data.

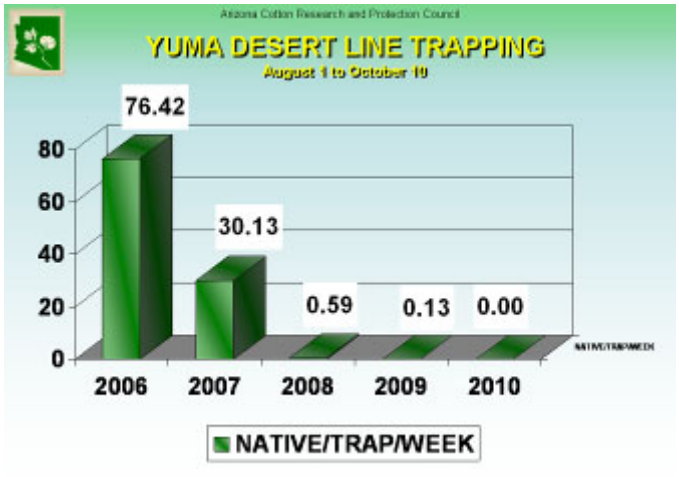


Figure 5. Area 3 fall desert line trapping.

In La Paz and Mohave counties, native captures were down 99.98% (36) in all cotton and 99.51% (1 early season) in conventional cotton when compared to 2007 captures (Figures 6 & 7). All conventional cotton and okra were treated with pheromone rope and released at a rate of 300 moths/acre/day season long. Bt cotton was released at 10 moths/acre/day from bloom to defoliation. Boll sampling produced no larvae in 3,675 bolls (Figure 8). These results mark three years with no larval finds in La Paz and Mohave counties.

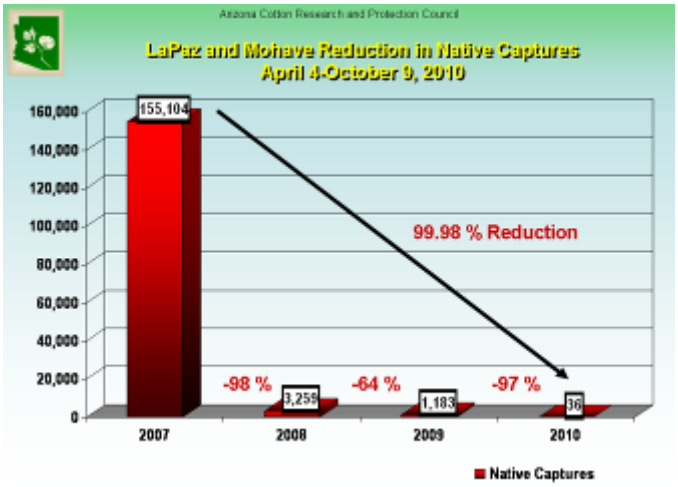


Figure 6. Area 2 native captures in all cotton.

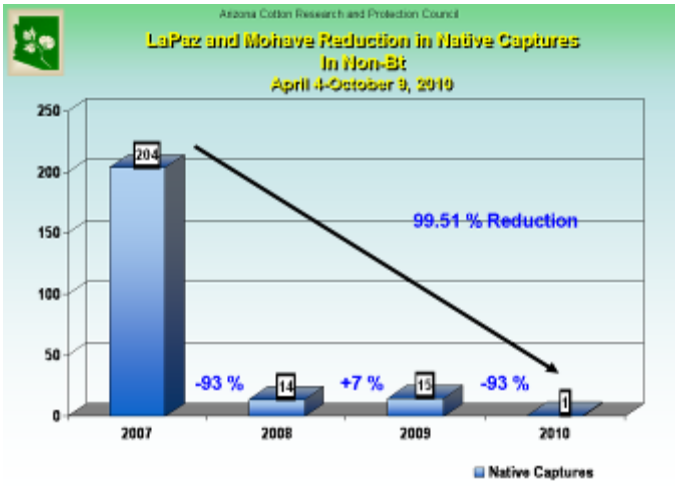
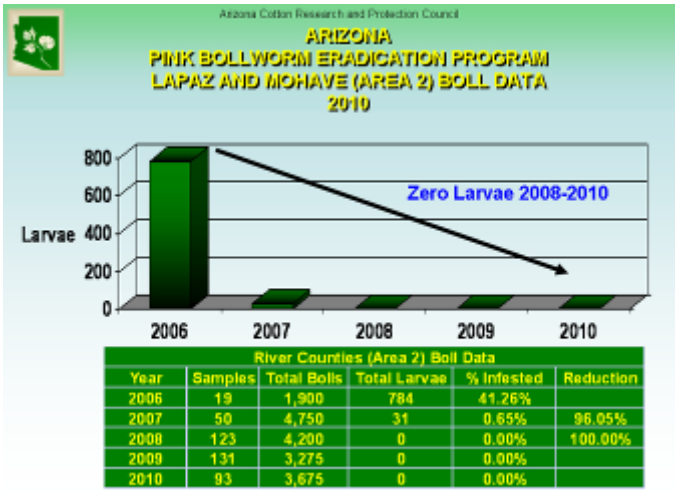


Figure 7. Area 2 native captures in Non-Bt Cotton.



River Counties (Area 2) Boll Data					
Year	Samples	Total Bolls	Total Larvae	% Infested	Reduction
2006	19	1,900	784	41.26%	
2007	50	4,750	31	0.65%	98.05%
2008	123	4,200	0	0.00%	100.00%
2009	131	3,275	0	0.00%	
2010	93	3,675	0	0.00%	

Figure 8. Area 2 boll data.

In central and eastern Arizona, all conventional cotton was released at 300 moths/acre/day season long and Bt at 10 moths/acre per day from bloom to defoliation. Program activities did not include the use of pheromone rope in central and eastern Arizona in 2010. Captures were reduced by 99.93% (453) in all cotton and 98.72% (409) in conventional cotton from 2006 statistics (Figures 9 & 10).

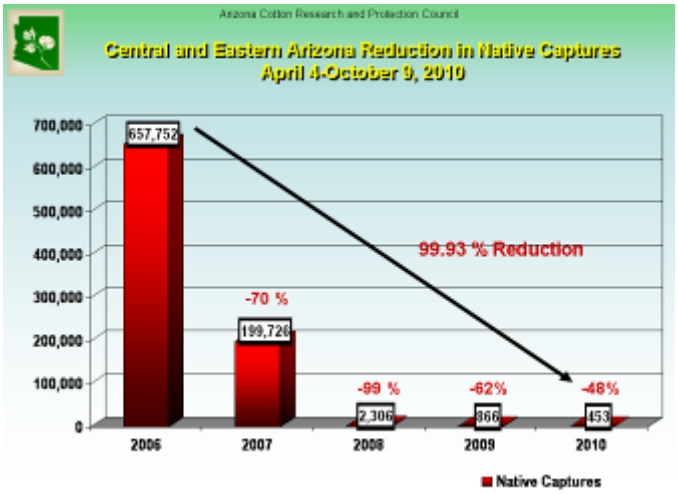


Figure 9. Area 1 native captures in all cotton.

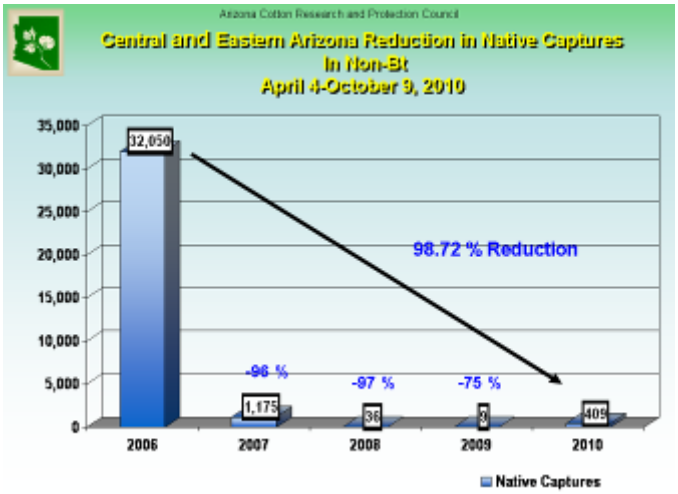
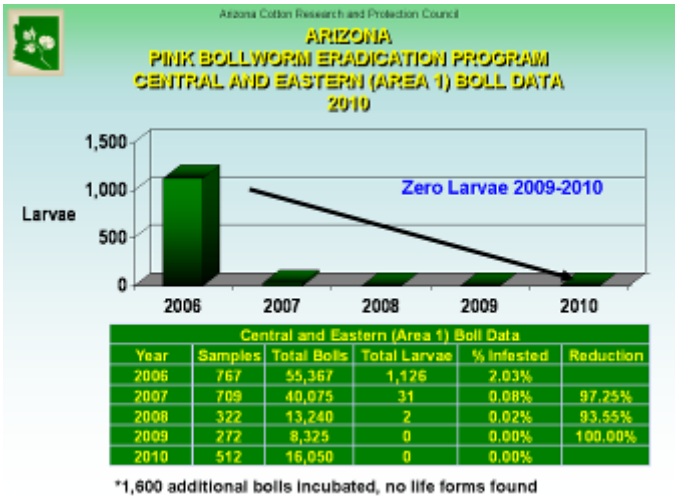


Figure 10. Area 1 native captures in Non-Bt cotton.

The majority of the moths captured in Central and Eastern Arizona appeared to be sterile insects in physical appearance; however, current diagnostics were unable to confirm the presence of dye. The moths in question began to appear in late July shortly after crop canopy when sterile longevity increases dramatically and found mainly in areas with the highest levels of sterile release. This pattern is in sharp contrast to previous years when pheromone rope was utilized on all susceptible cotton in area 1. Theses captures triggered targeted boll sampling and increased sterile release. No larvae were found in 16,050 bolls destructively inspected or an additional 1,600 incubated from areas with the highest captures (Figure 11). Additionally, 22 samples (over 14,000 bolls) were transferred to the University of Arizona for examination. With approximately 75% of those samples inspected, no Pink Bollworm life forms or evidence of reproduction has been found.



Central and Eastern (Area 1) Boll Data

Year	Samples	Total Bolls	Total Larvae	% Infested	Reduction
2006	767	55,367	1,126	2.03%	
2007	709	40,075	31	0.08%	97.25%
2008	322	13,240	2	0.02%	93.55%
2009	272	8,325	0	0.00%	100.00%
2010	512	16,050	0	0.00%	

*1,600 additional bolls incubated, no life forms found

Figure 11. Area 1 boll data.

Desert line trapping consisted of 180 strategically placed traps across southern and western Arizona. Two native moths were captured in the area between Yuma and central Arizona early season with no additional captures for the remainder of the cotton-growing season. This is a striking difference from movement in 2006-2008 when populations were more prevalent in Yuma and Mexico.

No evidence of resistance to Bt cotton has been found in moth samples analyzed in the last two years.

Based on Arizona pesticide use reporting data, no grower insecticide applications for Pink Bollworm were reported in 2008 and 2009, 2010 data is expected to also show no grower treatments for Pink Bollworm. The introduction of

new insect growth regulators, the introduction of Carbine, Bt cotton and Pink Bollworm eradication activities are directly linked with large reductions in pesticide use in Arizona for several target species (Figure 12) (Ellsworth et al 2010).

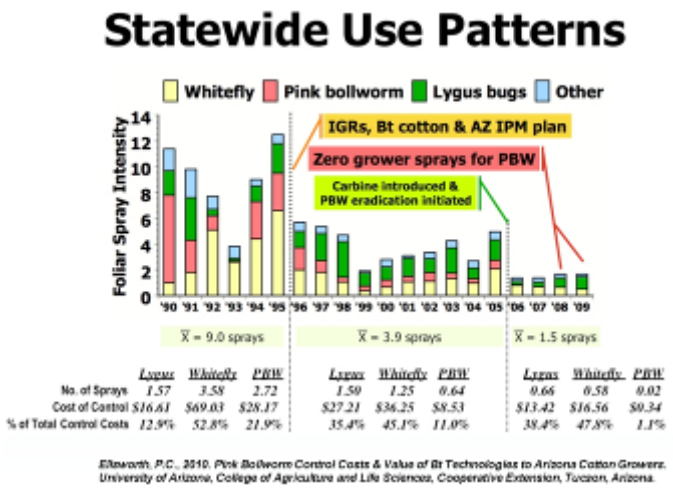


Figure 12. Arizona statewide pesticide use patterns.

Conclusions

Program results continue to exceed expectations in all areas. At present, the questionable moths captured in central and eastern Arizona do not appear to pose a reproductive threat to program success, but do present a substantial technical hurdle.

Additional increases in cotton acreage in the 2011 growing season and reduced requirement for pheromone mating disruption areas free of reproduction will increases the demand on sterile insects as primary treatment option.

Continued technical research and diagnostic development and introduction are critical to future program advancement. Enhanced sterile insect marker technology or diagnostics are vital to differentiate whether moths like those caught in area 1 in 2010, are sterile insects or the produced from wild populations.

Alternatively, the introduction of genetically modified insects (DsRed) for sterile release in programs areas would likely prove to be a comprehensive solution. As program areas reach functional eradication, new developments in identification are also necessary to reducing the number and frequency of required sterile moth releases.

References

Antilla L., L Liesner. 2008. Program Advances in the Eradication of Pink Bollworm Pectinophora gossypiella in Arizona Cotton. Proceedings Beltwide Cotton Conferences, pp. 8415.

Ellsworth, P.C., 2010. Pink Bollworm Control Costs & Value of Bt Technologies to Arizona Cotton Growers. University of Arizona, College of Agriculture and Life Sciences, Cooperative Extension, Tucson, Arizona.