THE BI-NATIONAL PINK BOLLWORM ERADICATION PROGRAM, AN OVERVIEW

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Abstract

The pink bollworm eradication program in Mexico has accomplished a great deal in the last 6 years. Evidence of reproduction is not apparent in the majority of the 141,392 acres of cotton in the state of Chihuahua. Most of the trap capture in the state is attributed to migration. The only measurable larval population is in one border location encompassing minimal acres in the Juarez Valley. When the entire contiguous eradication program is considered it is impressive. In 2007 larvae were found in only 7 localized "pockets" in 26 non Bt fields. There are 3703 susceptible non Bt fields in this 377,514 acre program. The continuation and orderly expansion of this program is thus encouraged as early as possible.

Introduction

The pink bollworm, *Pectinophora gossypiella (Sanders)* is currently the target of a multi-tooled integrated eradication program. This program is currently under way over most of the pest's economic range in the US and much of its range in Mexico. This presentation will do two things. The authors of this paper will briefly report on progress for all of program areas of Mexico. The authors will then provide a context for consideration of the program and the progress it has made in a "North American" context. The programs of the US are well reported by each state organization manager within this series of papers.

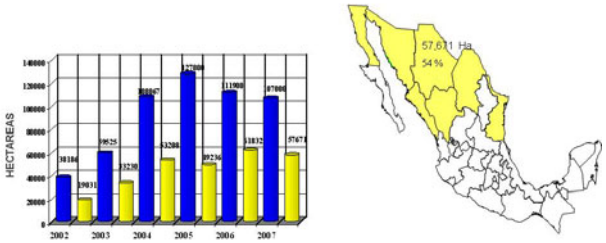
Pink Boll Worm Eradication, Chihuahua Mexico

The program in Mexico does not separate pink bollworm (PBW) and boll weevil (BW) eradication in there operations. However, this report will consider the results of activities and data pertinent to PBW only. As control technology has been discussed within related papers in this proceeding's series and in the literature by numerous authors including a programmatic outline by El-Lissy et al (2002), only brief discussion of procedures will ensue. All fields were mapped and categorized using GPS technology. Bt and non-Bt cotton and all trap locations were categorized using MapInfo nested within an information management system developed for the Texas programs. The standard PBW Delta trap was used with a 4Mg impregnated septa as a lure (Foster et al 1977). Cultural control was enforced. At the onset of the program all non-Bt cotton was treated at or about the 6 leaf stage with the PB rope (pheromone rope dispensers). As the program has made progress the 500/hectar rate has been reduced to 250 per treated hectare on all but high priority areas and eliminated over large areas unless a given field starts the season with a history or has an in-season positive capture. It is important to note that there is no Pima in Mexico. Only the area of greatest risk, the Juarez valley, has been targeted for sterile release. In the southern areas PBW populations are positively impacted by treatments for boll weevil. This area has also been subjected to PBW migration from growing areas south of Chihuahua. In 2005 sterile release activities in Juarez were documented by Walters et al (2006). In 2006 releases in Juarez were targeted at 8 million per week and increased to 10 million per week starting the week of June 29. Releases were made 4 days a week. In 2007, 15 million moths per week were targeted using 5 flights on 3 days. Conventional insecticide treatments have been largely limited to fields with positive boll and or bloom larval infestations. In the last 5 years sterile release for PBW control in Mexico has been limited to Juarez. A very limited amount of sprayable pheromone has been used in Mexico.

Results and discussion Chihuahua PBW eradication

The cotton growing states of Mexico are shown in our Figure 1 with representations of the number of hectares for the nation and for Chihuahua separately.

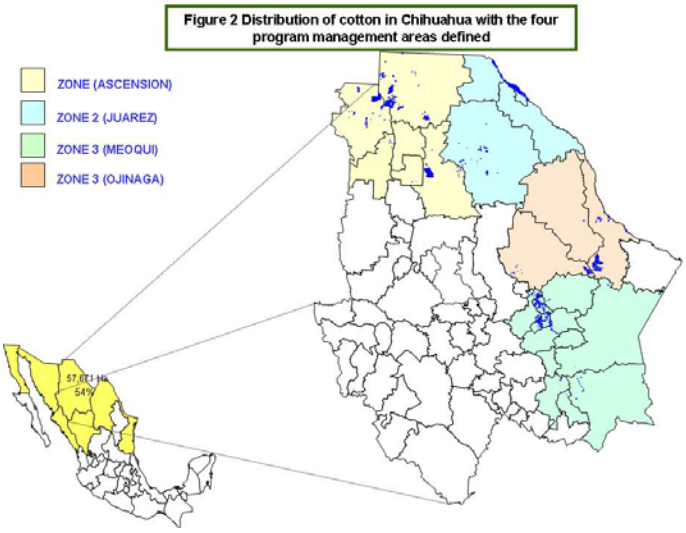
Figure 1 The cotton growing states of Mexico with hectars grown nationwide
And in Chihuahua



Chihuahua produced cotton on 54% of the ground planted in 2007.The majority of all cotton is within a biological unit with US cotton. That simply means it is close enough that migration and natural spread can be expected into any area from a near neighbor. The national and international borders have no biological relevance.

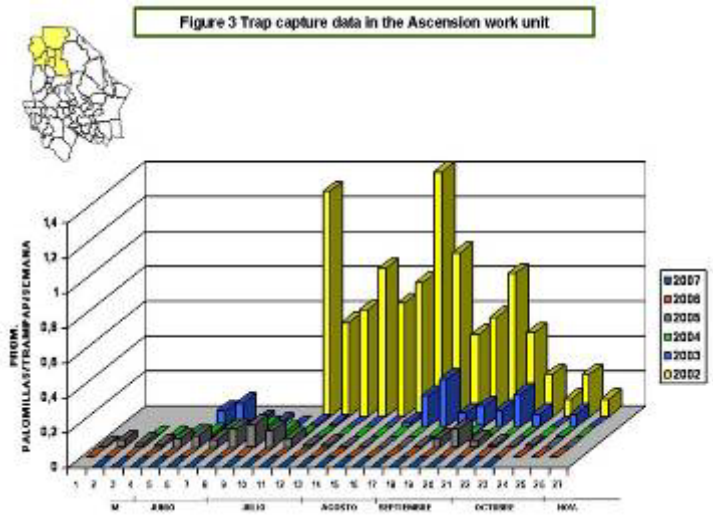
The distribution of cotton within Chihuahua is shown with its respective management zones, which will be used as geographical references for this presentation are provided in figure 2.

Figure 2 Distribution of cotton in Chihuahua with the four program management areas defined



Of particular importance is the fact that most of this cotton is biologically linked with the rest of phase 1 program activity but has some isolation (Ojinaga excluded) from all non programmatic states in Mexico.

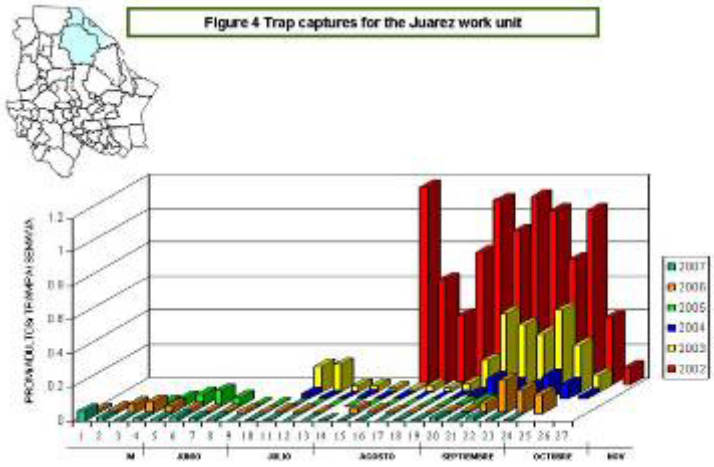
The Ascencion region trap capture data is provided from the first year of operation through 2007 in figure 3.



It is important to note that the previous year's data cannot be shown in this scale. Trap capture rates are at 2 native moths per 10,000 traps (.0002 per trap/week).

The authors note that the Juarez area represents the highest current biotic risk for PBW in Chihuahua. It represents the area where PBW has required the most effort to control. Progress however is clearly evident when we examine population data.

Trapping details are provided in figure 4.



Again, when a scale is used which expresses pre-treatment magnitude, details between the 6 years of program operation are lost. This data is therefore not included for brevity. As is apparent, populations have been reduced each year, indicating progress. A more detailed map shows field distribution within the sterile moth release zone in this work unit (Figure 5).

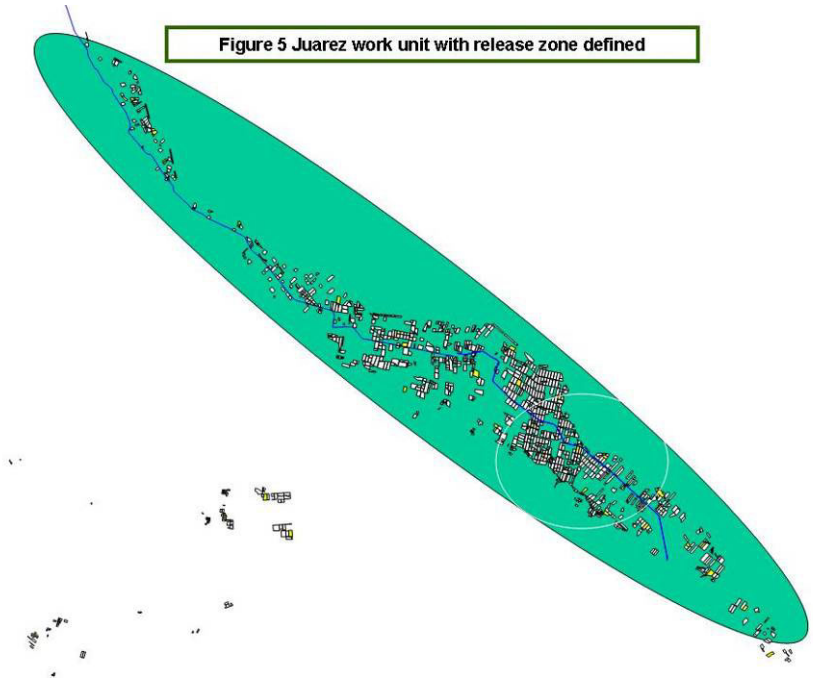


Figure 5 Juarez work unit with release zone defined

The entire area runs from the outskirts of Cuidad Juarez to the south east end of the Rio Grande valley. The entire north east border is the Rio Grande River (Rio Bravo in the Mexico). Cotton in the Texas program is always close and usually with in 100 to 1000 Meters. The circled area on this map represents the area of critical concern shared with the Texas program. The entire highlighted zone represents the sterile release zone.

The next figure shows the area where the majority of all positive trap captures occurred (Figure 6).

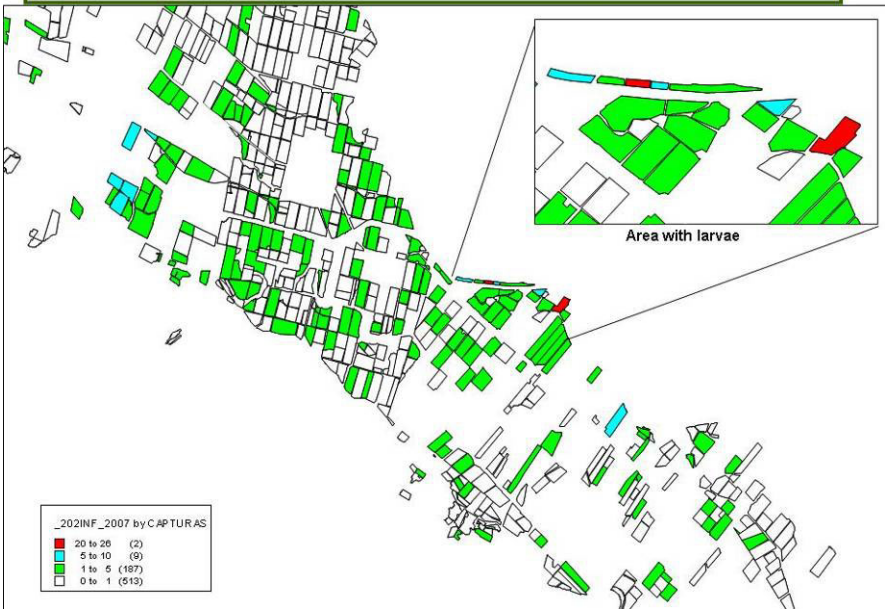


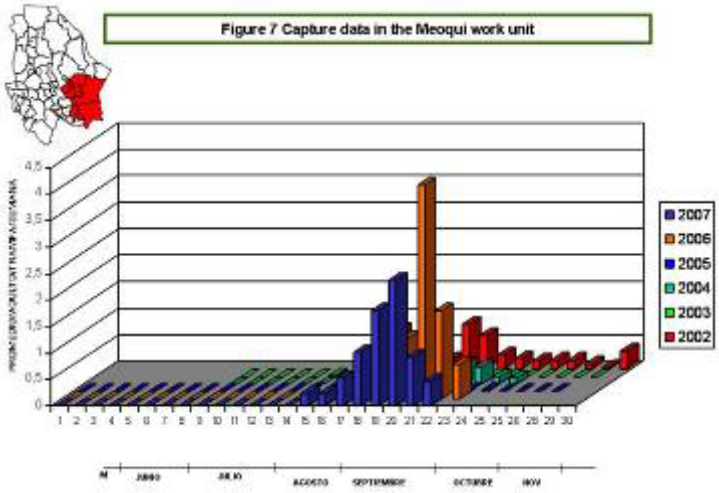
Figure 6 Location where the majority of native moths and all larvae were recovered

The further expanded inset area shows trap capture levels in a “hot spot” shared with the adjacent Texas program. The entire area was treated with rope and received escalated sterile releases. Fields with positive larval finds (confined to the hot spot) were treated with insecticide. These fields were treated a second time with a full rate PB rope treatment. The two most affected fields ended the season with a 20% and 23% boll infestation respectively in

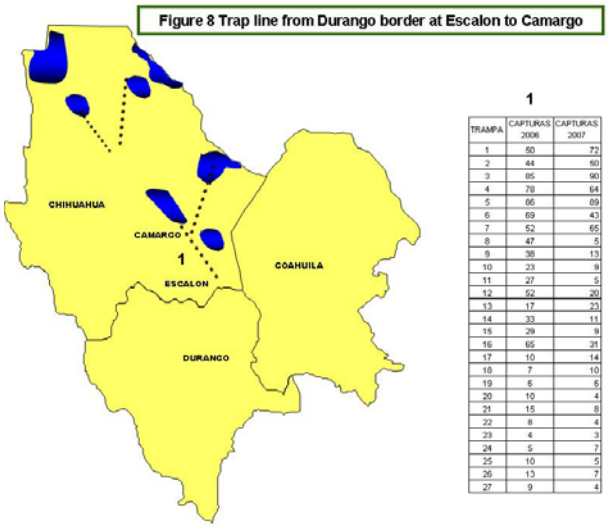
the last bolls at the top of the plants. Although this late fruit would not contribute to yield, larvae infestations may provide spring emergence the following growing season.

The next area of discussion is the area found in the southern region of Chihuahua. It is an area with extreme fluctuations in cotton with a high of 9,332 hectares in 2004 and 933 hectares in 2007. Programmatically, we are extremely fortunate that only 113 hectares are non-Bt verities. This area has been heavily impacted with migration from an expanded area in of Durango and Coahuila south of Chihuahua. This is one of the clearest cases of migration and its impact the senior author has seen.

Figure 7 provides trap data for this area.



It is extremely important to point out that the majority of the captures in the last 3 years are in Bt cotton, or in traps located on a highway trap line that stretches from the cotton growing area in Durango to Meoqui (figure 8).



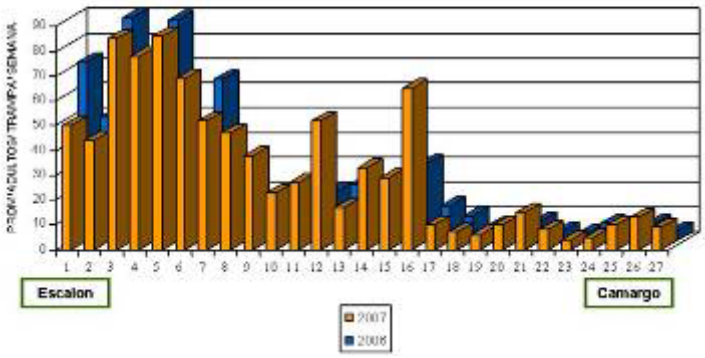
1

TRAMPA	CAPTURAS 2006	CAPTURAS 2007
1	50	72
2	44	50
3	85	90
4	78	64
5	86	89
6	69	43
7	52	65
8	47	5
9	38	13
10	23	9
11	27	9
12	52	20
13	17	23
14	33	11
15	29	9
16	65	31
17	10	14
18	7	10
19	5	6
20	10	4
21	15	8
22	8	4
23	4	3
24	5	7
25	10	5
26	13	7
27	9	4

Although it is somewhat obscured by capture rates in 2006 and 2007, the moth captures in 2003 and 2004 had diminished to near zero. In Figure 8 tabular data for trap number 1 which shows 50 moths captured in 2006 and 72 moths captured in 2007 is located closest to cotton in Durango.

This south to north trap distribution is clearly illustrated in figure 9.

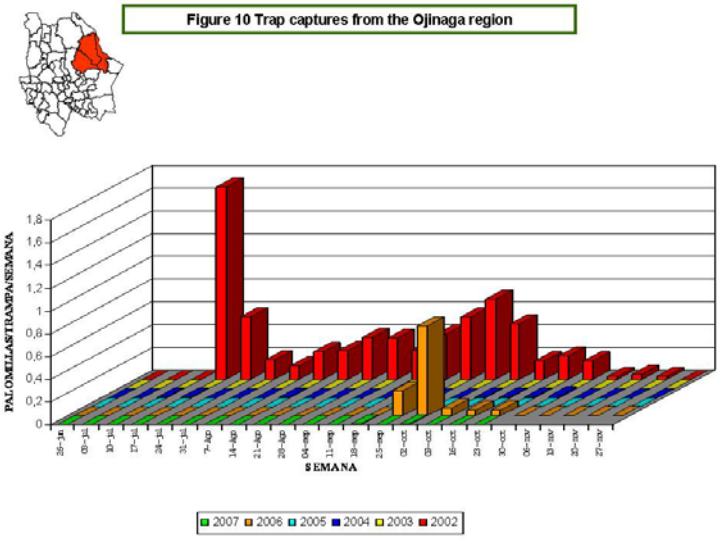
Figure 9 Trap capture of moths late season on most southern highway trap line



The Ojinaga area is an area where major growth in cotton cultivation has occurred in a previously undeveloped area. The old production area centering at the town of Ojinaga has declined in 2007 to only a few fields. In 2002 there was 1,382 hectares of cotton. In 2007 the program operated in 19,885 hectares. Much of this cotton has been in production from 1 to 3 years. In the last 3 years the crop has averaged 75% Bt cotton. During the period from 2003-2005 virtually no adult PBW adults were found. Larvae have not been found in monitoring samples since the program applied its first pheromone in 2002. No larvae have been found in targeted 1,000 boll samples in the last 3 years. These samples were taken in the few non-Bt fields in the extreme southern edge of new areas where migration seemed to congregate.

Trap capture data is provided in figure 10.

Figure 10 Trap captures from the Ojinaga region



The spike from September 25-October 30, 2006 is definitely attributed to migration. No significant in season moth flights have occurred in any season after the first year of the program.

Figure 11 shows the two generalized areas in this zone and a generalization of the highway trap line from Camargo through Cienes to the town of Ojinaja.

Figure 11 Trap line from Camargo to Ojinaga

CAMARGO-CIENES

TRAMPA	CAPTURAS 2007	CAPTURAS 2006
82	1	9
80		4
78	4	3
76		4
74		1
72		4
70		5
68		1
66	1	
64		2
62		3
60		3
58		6
56	6	6
54	1	6
52	0	0
50	5	19
48	1	8
46	2	6
44	2	6
42	2	5
40	1	3
38	1	11
36	2	6
34	1	15
32	5	13
30	2	6
28	0	0
26	1	5
24		10
22		21

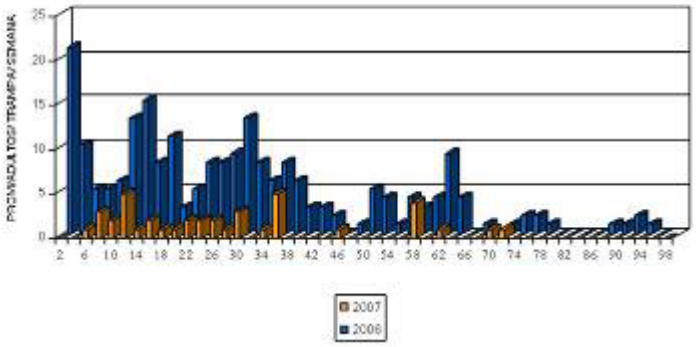
CIENES-OJINAGA

TRAMPA	CAPTURAS 2007	CAPTURAS 2006
56		
54		1
52		2
50		1
48		1
46		
44		
42		
40		
38		1
36		2
34		2
32	1	1
30	1	
28		1
26		
24		4

The inset tabular data clearly illustrates the magnitude of movement particularly in 2006. It should be noted that traps are not close to any cotton along this highway.

Figure 12 clearly illustrates the distribution pattern of high trap captures at the south end of this "transect".

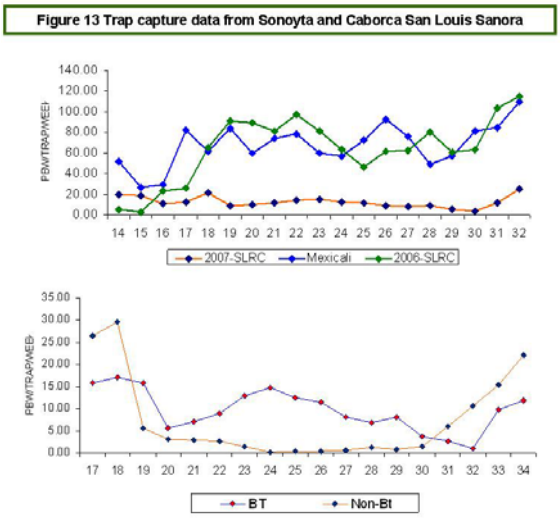
Figure 12 Trap line from Camargo to Ojinaga



Pink Bollworm Eradication/Suppression, Northern Sonora Mexico

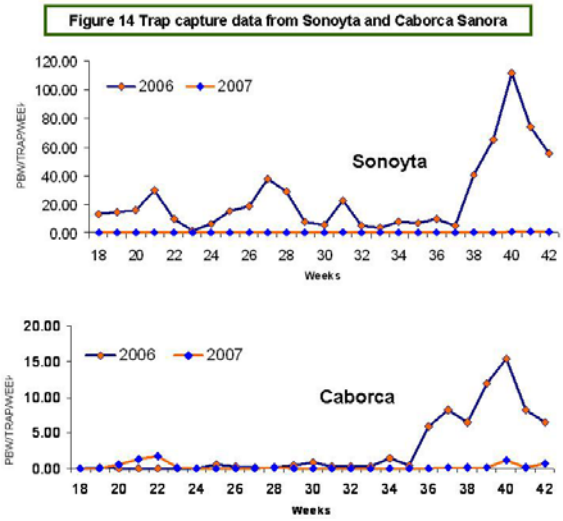
The cotton growers in three areas of northern Sonora elected to begin suppression/eradication measures against PBW in 2007. These areas were San Luis Rio Colorado, Sonoita and Caborca with 3,518 hectares, 679 hectares and 60 hectares respectively. It is important that only the smaller two areas had minimal separation from the contiguous Mexicali Valley of Baja California. San Luis had a long western boundary contiguous with the Mexicali valley and separation from Yuma Arizona by only a few miles of the border cities of San Luis Mexico and San Luis Arizona. In this environment all non-Bt cotton was treated with PB rope at 6 leaf stage. Conventional insecticide was used as needed where loss of trap shut down and or larval population detection occurred. Fields were sampled for larvae in locations where traps indicated a problem. The local crop advisors, not associated with the program organizationally, continued their scouting in parallel with program activities. In San Luis 79% of the cotton was Bt cotton. In the combined remaining areas only 1 field in Caborca was Bt. All non-Bt fields were treated with PB rope.

Figure 13 compares trap capture data from the beginning of the season until the week of mandated water termination in San Luis.



As Mexicali was not in the program but chose to continue monitoring efforts we have two important comparisons in this figure. After water termination the entire area was subject to major PBW movement. Much of Yuma also terminates early for rotation to winter vegetables. The majority of trap capture was confined to Bt cotton during boll bloom and boll set. It is extremely important that in late June, July and early August there were only 4 problematic fields which required supplemental chemical treatments. It is also important that 227 of 252 fields with 608 of 858 hectare remained free of conventional pesticide treatments for PBW. The entire area received an average of .5 treatments of conventional pesticide for eradication/suppression compared to 1.5 the previous year for PBW control. Two hundred twenty one fields of 252 presented no larval detection. Eventually, only 25 fields were treated with a conventional pesticide. Of those, most were treatments late in the season. There are secondary benefits when expected PBW treatments can be reduced in the form of better biological control of pests such as White Fly.

Population data for Sonoita and Caborca are important and are shown in figure 14.



These areas were at least partially spared of migration, as they are partially up-wind or not in the direct path of fronts moving from south west out of the Gulf of California (El Mar de Cortez) during August and September. In both instances, PBW biotic potential is less than longer season areas in Arizona and Southern California or in San Luis and Mexicali. It is important to note that populations were held to a very low level in the absence more than a

token amount of Bt cotton. In Sonoita 36 of 40 fields had less than 7 moth captures season long. In Caborca all 4 fields had similar (less than 7/season) capture rates. No larvae were found.

Program wide / North American context an overview

All presentations of this program have been based on the individual management unit basis. This "compartmental" organization of thought is fully understandable and, is what the authors of this report have done to this point in adding the program report for Mexico to this ad hoc symposium in this text. It is critical at this time that we examine accomplishment across the program without regard to political/organizational boundaries. This is an important task as PBW has clearly proven behavioral movement over considerable distances. This movement is documented in literature as early as the 70's (Stern et al 1979). It is only when we have been able to monitor populations over complete regions with very large blocks of Bt cotton that the magnitude has become more understandable. This does not diminish these accomplishments!

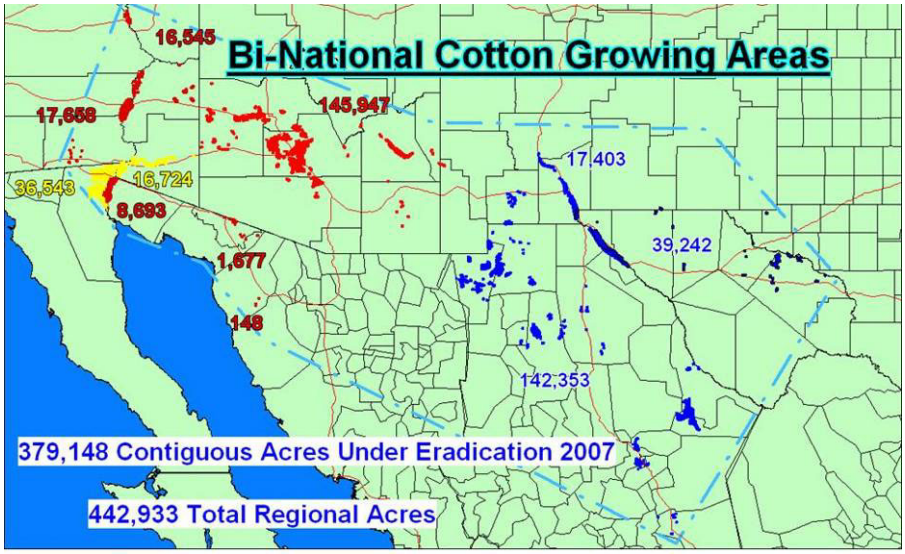
It is imperative that we look at the entire 'contiguous" region for our current program in the generally infested area. Figure 15 provides a map of the entire area. We have not included the northern Senora suppression area in this analysis as it will not reach or have a chance of maximum suppression before its neighbors along its contiguous borders are included in the program. In this perspective the authors look at size of area and presence and detection of known larval/reproducing populations. Important statistics are in the following table 1.

Table 1

Entity	Acres	# Of Non-Bt fields	Units With Larvae	Positive Fields
Chihuahua				
Ascension	72,223	1,183	0	0
Meoqui	2,305	46	0	0
Ojinaga	48,024	201	0	0
Juarez	18,840	943	1*	9
Texas				
El Paso Valley	28,315	883	1*	5
Pecos	10,525	19	0	0
New Mexico				
All	17,403	290	0	0
Arizona				
Phase 2	145,947	120	2	3
Phase 3	16,545	15	3	9
California				
Desert Program	17,859	3**	1	1
San Joaquin**	428,725	3,682	Last known larvae 1998	

* The Juarez and El Paso unit is biologically one population
** Total non Bt cotton in 3 plots totaling less than 4 acres
*** The San Joaquin is 99+ % non Bt cotton

In considering this data it is apparent that there are very few areas where reproduction can still be measured. Excluding the San Joaquin which can not be considered as part of any generally or previously infested area there are only 7 relatively isolated/separate pockets where reproduction is measurable. This is admittedly in a program where (Arizona) Bt acres are high but there are many fields where populations could exist if not under rigorous management. In 379,148 acres of cotton there are 3,703 fully susceptible fields. PBW larvae were found in only 26 fields in 7 localized locations. PBW would have caused severe economic loss and or mandated repeated conventional pesticide usage through out the entire area. This program is successful. In order to minimize or eliminate long term costs, the inclusion of areas which are the sources of migrating populations is a major advantage and a logical strategy to pursue.



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