BOLL WEEVIL ERADICATION UPDATE - TEXAS, 1999

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Abstract

The boll weevil eradication program in Texas began in 1994 in an effort to rid the state of the cotton boll weevil, *Anthonomus grandis* Boheman.

The program was first initiated in the Southern Rolling Plains (SRP) on 220,000 acres of cotton in September 1994 with the diapause phase, followed by season-long phases of the program in 1995, 1996, 1997 and 1998. The confirmation phase which is a transitional phase between eradication and post eradication was successfully implemented in 1999. The SRP is scheduled to formally be declared eradicated in the year 2000.

Boll weevil populations in the SRP were almost nonexistent during the 1999 cotton growing season. The seasonal mean number of boll weevils captured per trap per week in 1999 was significantly less than in 1998, 1997, 1996, and 1995. The mean in 1999 was 0.002, in 1998 it was 0.04, in 1997 it was 1.3, in 1996 it was 2.9, and in 1995 it was 10.6. This represents a reduction of 99.98% in 1999 compared with 1995. Insecticide applications in 1999 were reduced by 96.3% compared with 1995.

In 1996, the program began with the diapause phase in the South Texas/Winter Garden (ST/WG) and in the Rolling Plains Central (RPC) zones on approximately 350,000 and 700,000 acres respectively. In 1997, because of the suspension of field activity during the legal and the legislative process (May-June 1997), program plans in the ST/WG and RPC had to be altered. A second diapause phase was implemented in 1997 instead of the season-long phase. The first season-long phase was implemented in both zones in 1998, and the second was implemented in 1999.

In the ST/WG zone, the seasonal mean number of boll weevils per trap per week in 1999 was significantly less than in 1998 , 1997, and 1996. The 1999 mean was 1.1, in 1998 it was 2.4, in 1997 it was 10.9, and 1996 it was 15.3, a reduction of 92.8% in 1999 compared with 1996.

In the RPC zone, the seasonal mean number of boll weevils per trap per week in 1999 was significantly less than in 1998, 1997, and 1996. The 1999 mean was 0.16, in 1998 it was 1.1, in 1997 it was 13.7, and in1996 it was 18.3, a reduction of 99.1% in 1999 compared with 1996.

These results demonstrate that the area-wide eradication approach, utilizing pheromone traps with sound cultural, mechanical, and chemical controls, represents an effective strategy in reducing boll weevil populations, ultimately eliminating the most destructive cotton pest in the state.

In 1999, the program expanded to include five additional zones. The diapause phase of the program was implemented in the Western High Plains (WHP) on approximately 750,000 acres, the Northwest Plains (NWP) on approximately 450,000 acres, the El Paso/Trans Pecos (EP/TP) on approximately 65,000 acres, the Permian Basin (PB) on approximately 720,000 acres, and the Northern Rolling Plains (NRP) on approximately 300,000 acres. With more than 3.6 million acres under eradication, the Texas program represents the largest boll weevil eradication campaign in U.S. history.

Introduction

The boll weevil, *Anthonomus grandis* Boheman, a native of Mexico and Central America, first entered the United States near Brownsville, Texas, about 1892 (Hunter and Hinds, 1905). By 1922, the pest had spread into cotton-growing areas of the United States from the eastern two-thirds of Texas and Oklahoma to the Atlantic Ocean. Northern and western portions of Texas were colonized by the boll weevil between 1953 and 1966 (Newsom and Brazzel, 1968). In 1903 the Texas Legislature offered a $50,000 cash reward for a practical way to control the boll weevil.

Yield losses attributed to the boll weevil, the cost of insecticide control, environmental considerations, infestation of secondary insect pests, and insect resistance have all resulted in an aggressive effort to develop a beltwide strategy for controlling the boll weevil in the United States.

Although most growers judiciously apply control measures to boll weevil- infested acreage in almost all such areas, 5- 20 percent of the infested acreage may receive inadequate or no control treatments (Knipling, 1979). This uncontrolled

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1076-1082 (2000)
National Cotton Council, Memphis TN

acreage harbors populations capable of reinfesting neighboring areas. Models developed by Knipling (1979) demonstrate that if only 10 percent of a population remains untreated, that portion of the population can develop normally and redistribute throughout the entire area after only four generations, less than one growing season. Also, judicious application of control measures cannot protect against reinfestation from neighboring areas the following season; thus, growers who treat their acreage are faced with a continuing need to reapply insecticide to control reinfestations.

The National Cotton Council estimates that the boll weevil has cost U.S. cotton producers more than $13 billion since entering from Mexico a century ago (National Cotton Council, 1994).

In view of the economic and environmental problems posed by the boll weevil and in recognition of the technical advances developed over the past 100 years, a cooperative boll weevil eradication experiment was implemented in 1971 in southern Mississippi and parts of Louisiana and Alabama. This experiment used an integrated control approach that included chemical treatment, releases of sterile boll weevil males, mass trapping, and cultural control. Based on this experiment, a special study committee of the National Cotton Council of America concluded it was technically and operationally feasible to eliminate the boll weevil. The success of a subsequent 3-year boll weevil eradication trial, initiated in 1977 on 32,500 acres in North Carolina and Virginia, led to the initiation of the Southwestern and Southeastern boll weevil eradication programs (USDA, 1991). Except for occasional minimal reappearances of weevils, boll weevils, for all practical purposes, have been eradicated from the cotton-growing regions in the states of Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, California, Arizona, and Northwest Mexico (Cunningham and Grefenstette, 1998).

In 1993, the Texas Legislature established the Texas Boll Weevil Eradication Foundation (TBWEF) to oversee the implementation of the boll weevil eradication program in Texas. In March 1994, cotton producers and landowners in the Southern Rolling Plains (SRP) passed a referendum with a majority vote of 84% to initiate the first eradication program in the state. The program started in the SRP with the diapause phase in the fall of 1994 on approximately 220,000 acres. In October 1994, producers and landowners in the Lower Rio Grande Valley (LRGV) zone passed a referendum with a majority vote of 73% to initiate the eradication program. The program started in the LRGV in the spring of 1995 with the season-long phase on approximately 360,000 acres. In January 1996, the LRGV growers opted to discontinue the program. In 1996, the program began in the South Texas/Winter Garden (ST/WG) zone on approximately 350,000 acres with the diapause phase after a majority vote of 73% in February of 1995. In 1996, the program also began in the Rolling Plains Central (RPC) zone on approximately 700,000 acres with the diapause phase after a majority vote of 85% in December 1994. In September 1996, producers and landowners in the St. Lawrence (St.L) zone also passed a referendum with a majority vote of 75% to start the program with the diapause phase in the fall of 1997.

In May 1997, the Texas Supreme Court declared the initial boll weevil law, under which the TBWEF operated unconstitutional because the nonprofit Foundation had authority similar to governmental agencies and had no legislative oversight. The 75th session of the Texas Legislature addressed the concerns outlined by the Supreme Court and a new law was passed and signed by the governor in June 1997. The new law granted the Texas Department of Agriculture (TDA) oversight authority and the TBWEF was charged with carrying out eradication programs in the state. The law also outlined six statutory zones; the Southern Rolling Plains (SRP), the Rolling Plains Central (RPC), the South Texas/Winter Garden (ST/WG), the Northern High Plains (NHP), the Southern High Plains/Caprock (SHP/C), and the St. Lawrence (St. L). Additionally, the Texas legislature elected to remove seven of the 31 counties in the ST/WG zone: Austin, Brazoria, Colorado, Fort Bend, Jackson, Matagorda, and Wharton. Further, the law mandated the holding of referendums in each of the zones to provide growers an opportunity to vote to continue the eradication programs in the SRP, RPC, and ST/WG. On October 20, 1997, the growers in ST/WG voted to continue the eradication program by nearly a 70% majority vote. On February 2, 1998, the growers in SRP voted to continue the eradication program by nearly a 80% majority vote; and on March 11, 1998, the RPC growers passed the referendum to continue the program by an 86% majority vote.

Because of the suspension of field activity during the legal and the legislative process (May-June 1997), program plans in the ST/WG and RPC had to be altered. A second diapause phase was implemented in 1997 instead of the scheduled season-long phase. Despite the late start, a season-long phase was implemented in the SRP. The 1998 season marked the implementation of the first season-long phase in both RPC and ST/WG zones.

Additionally, upon the request of growers, the SHP/C and NHP statutory zones were divided into five eradication zones, including: the Western High Plains (WHP), Permian Basin (PB), Southern High Plains/ Caprock (SHP/C), Northwestern Plains (NWP), and Northern High Plains (NHP).

In the winter of 1998 and spring of 1999, producers in five additional zones approved beginning eradication efforts. The WHP passed the referendum in December 1998, with a 79%

majority vote; the NWP in March 1999 with a 75% majority; the EP/TP, also in March 1999, with a 77% majority; the PB in April 1999 with a 73% majority, and the NRP in May 1999 with a 71% majority. All five zones began the program in 1999 with the diapause phase, the WHP on approximately 750,000 acres, the NWP on approximately 450,000 acres, the EP/TP on approximately 65,000 acres, the PB on approximately 720,000 acres, and the NRP on approximately 300,000 acres.

With more than 3.6 million acres under eradication, the Texas program represents the largest boll weevil eradication campaign in the U.S. history.

Materials and Methods

Thirteen eradication zones have been established through legislative action, grower referenda, and by the Texas Department of Agriculture. The designated eradication zones are:

1. Southern Rolling Plains (SRP), (260,000 acres)
2. St. Lawrence (St.L), (150,000 acres)
3. South Texas/Winter Garden (ST/WG), (370,000 acres)
4. Rolling Plains Central (RPC), (700,000 acres)
5. Southern High Plains/Caprock (SHP/C), (1,200,000 acres)
6. Northern High Plains (NHP), (550,000 acres)
7. Western High Plains (WHP), (800,000 acres)
8. Permian Basin (PB), (720,000 acres)
9. Northern Rolling Plains (NRP), (400,000 acres)
10. Northwest Plains (NWP), (550,000 acres)
11. Southern Blacklands (SBL), (200,000 acres)
12. El Paso/Trans Pecos (EP/TP), (65,000 acres)
13. Northern Blacklands (NBL), (200,000 acres), (Figure 1).

Mapping

Mapping is one of the first phases of operation in any eradication zone. Mapping identifies the exact location of each cotton field and determines the surrounding environment. The program uses a numbering system designed to identify each cotton field in the state with a unique number (El-Lissy et al., 1996). All cotton fields are mapped using the differentially corrected Global Positioning System (GPS) in the same manner as described previously (El-Lissy et al., 1997).

Detection

1. Trapping: Boll weevil traps continue to be used as the primary tool of detection. Traps were baited with one-inch square laminated polyvinyl chloride dispensers impregnated with 10 mg of grandlure. In SRP, RPC, and ST/WG zones, traps were placed at or shortly after planting around all cotton fields at a density of one per five acres. Except for fields located in Deaf Smith, Castro, and Parmer counties of NWP, and El Paso and Hudspeth counties of EP/TP, traps were placed around all cotton fields beginning the weekending July 25, 1999 at one trap per 40-acres in the WHP, PB, NRP, and the remainder of the NWP and EL/TP zones. Trapping during the diapause phase enables program managers to establish a relative baseline of weevil population density and distribution for comparison purposes during the subsequent years of the program. Fields located in Deaf Smith, Castro, and Parmer counties of NWP, were trapped at one trap per ten acres. Fields located in El Paso and Hudspeth counties of EP/TP were trapped at one trap per five acres. Based on trapping information provided by Plains Cotton Growers Association, Inc., and the Texas Agricultural Extension Service, it was apparent that weevil infestation was not as widely spread in Deaf Smith, Castro, and Parmer counties of NWP as was the case in the remainder of the zone. Treatment decisions were made based on the presence of weevils in traps on an area (groups of contiguous fields) by area basis. In El Paso and Hudspeth counties, infestations occurred in approximately 15% of all fields; hence, treatment decisions were made on a field-by-field basis utilizing trap captures. The crop phenology of each field was also reported when traps were inspected. The program continued to use the barcode system in the same manner as described previously (El-Lissy et al., 1997).
2. Field Survey (scouting): In zones where the season-long phase of the program was implemented, fields were inspected for infestation if the trap catch was borderline to the action threshold for treatment or when traps were nonfunctional. Each field was divided into four quadrants, and fifty squares were randomly collected at each inspection. All squares were examined and weevil damage was recorded. Further, during a two week period beginning September 8, 1999, ten randomly selected fields per county in RPC, WHP, PB, NRP, SHP/C, NWP, and NHP were scouted. The survey measured boll weevil damage inside and outside active eradication zones by examining 50 squares and/or green bolls per field.

Control

The control part of the eradication program consists of cultural, mechanical, and chemical control:

1. Cultural Control: Windows for uniform cotton planting and harvesting, as organized by a grower advisory committee in each zone, are key components of cultural control in providing the necessary host-free period. In the SRP and RPC, most growers started to plant on or about May 15. Growers began planting about February 15 in the ST/WG. In the RPC, because of the severe drought conditions experienced in 1999, growers were offered a rebate to destroy failed cotton fields as soon as possible in an effort to reduce insecticide treatments. In zones with mandatory stalk destruction rules and regulations, such as the ST/WG zone where temperate climates may induce regrowth during the winter months (off-season), program personnel assisted the Texas Department of Agriculture (TDA) in maintaining a host-free period. Information was provided to TDA identifying fields that were out of compliance with plow-up regulations before the stalk destruction date.
2. Mechanical Control: Although the primary function of the trap is to measure adult boll weevil population densities and identify their locations, another key benefit is removing portions of these populations (El-Lissy, 1998).
3. Chemical Control:
   a. Season-long phase (SRP, RPC, and ST/WG zones): A single application of Fyfanon® ULV (malathion ULV) at a rate of 12.0 fl oz/ac (0.92 lb [AI]/ac) was made, beginning at a pinhead square growth stage, to fields that had reached the treatment criteria (action threshold). In the SRP, the action threshold was a trap catch of one adult boll weevil per field. In the RPC and ST/WG zones, the action threshold was two adult weevils per 40-acre field or if weevil colonization was evident. Additionally, growers had the option of using alternate insecticides in lieu of program treatments of Fyfanon® ULV during early and mid-season.
   b. Diapause phase (WHP, NWP, EL/TP, PB, and NRP zones): A single (weekly) application of Fyfanon® ULV at a rate of 12 .0 fl oz/ac was made to fields exhibiting the early open-boll stage. The early open boll stage is defined as a crop stage exhibiting one open boll per plant on approximately 25% of all plants in the cotton field. All cotton fields began receiving weekly applications when approximately 50% of all fields in each zone exhibited the early open boll stage. Insecticide applications in WHP, NWP, EL/TP, PB, and NRP began during the weeks ending August 29, September 5, September 5, August 22, and August 29, respectively. The weekly applications continued until the hostable parts of the cotton plant and food sources, including squares, blooms, and green bolls were eliminated by defoliation, harvesting or a killing freeze. Fields located in Deaf Smith, Castro, and Parmer counties of the NWP zone began to receive weekly applications only when weevils were present on an area (groups of contiguous fields) by area basis as indicated by trap captures. One insecticide application was made on a field-by-field basis when at least one weevil was captured in traps placed around fields located in El Paso and Hudspeth counties in EP/TP zone. Atrapa™ ULV (malathion ULV) at a rate of 12 .0 fl oz/ac, 0.92 lb [AI]/ac. was utilized in NRP only.

Aerial applications were made by airplanes equipped with a spray system designed and calibrated to deliver ultra-low volume. Each aircraft was equipped with a differentially corrected guidance system. This Global Positioning System (GPS) technology is similar to the one used in mapping, and was used for documentation and quality control purposes in the same manner as described previously (El-Lissy et al., 1997).

Fields located within close proximity to some of the designated environmentally sensitive sites or near permanent obstacles were treated with high-clearance ground sprayers. Mist blowers mounted on pickup trucks were also used to provide accurate placement of insecticide on corners and edges of fields and under power lines or other obstacles where airplanes had less accessibility (El-Lissy et al., 1996).

Results and Discussion

Southern Rolling Plains Zone

The SRP is the first zone to near eradication status in the state of Texas. Boll weevil populations in the SRP were almost nonexistent during the 1999 cotton growing season. Preliminary analyses indicate that the 1999 weekly mean number of weevils per trap was significantly less than the previous four years (Figure 2).

The 1999 season-long mean number of adult weevils captured per trap per week was significantly less than 1998, 1997, 1996 and 1995. The mean in 1999 was 0.002, in 1998 it was 0.04, in 1997 it was 1.3, in 1996 it was 2.9, and in 1995 it was 10.6, a reduction of 99.98% in 1999 when compared with 1995, 99.93% compared with 1996, 99.89% compared with 1997, and 95.0% compared with 1998 (Figure 3).

The season-long cumulative number of acres treated in 1999 was 121,109, averaging 0.4 applications per acre; in1998 it was 198,133 acres, averaging 1.1 applications per acre; in 1997 it was 1,302,847 acres, averaging 7.0 applications per acre; in 1996 it was 785,546 acres, averaging 4.3 applications per acre; and in 1995 it was 2,095,696 acres, averaging 10.9 applications per acre, a reduction of 96.3% in 1999 compared with 1995 (Figure 4). Nearly 80% of season-long insecticide applications in 1999 took place after September 1, and mostly on the western region of the zone. This coincided with weevil movement that began around mid-August from the St.L zone (located west of SRP) as indicated by trap lines extended between the St.L and the SRP zones. The 1999 observation confirms the importance of the AREA-WIDE approach for the success of the eradication effort.

Rolling Plains Central Zone

In the RPC, preliminary analyses indicate that the 1999 weekly mean number of weevils per trap was significantly less than 1998, 1997, and 1996 (Figure 5).

The overall mean number of weevils per trap per week in 1999 was 0.16, in 1998 it was 1.1, in 1997 it was 13.7, and in 1996 it was 18.3, a reduction rate of 99.1% in 1999 compared with 1996 (figure 6).

The 1999 season-long cumulative number of acres treated was 1,924,559, averaging 3.2 applications per acre, and in 1998 it was 1,021,945 acres, averaging 4.1 applications. In 1997 the cumulative number of acres treated in the diapause phase was 4,315,861 acres, averaging 7.0 applications per acre, and in 1996, it was 3,018,434 acres, averaging 6.0 applications.

South Texas / Winter Garden Zone

In the ST/WG, preliminary analyses indicate that the 1999 weekly mean number of weevils per trap was significantly less than 1998, 1997 and 1996 (Figure 7).

The season-long mean number of weevils per trap per week in 1999 was 1.1, in 1998 it was 2.4, in 1997 it was 10.9, and in 1996 it was 15.3, a reduction rate of 92.8% in 1999 compared with 1996 (Figure 8).

The 1999 season-long cumulative number of acres treated was 2,184,990 acres, averaging 5.9; in 1998 it was 1,765,189 acres, averaging 5.8 applications per acre. The cumulative number of acres treated during the early and mid-season period (week ending April 12-July 4) in 1999 was 354,979, averaging 0.9 applications per acre. The cumulative number of acres treated during the same time frame in 1998 was 533,148, averaging 1.8 applications per acre. This represents a 50% reduction in the number of applications in 1999 compared with 1998. In spite of repeated rainfall during the latter part of July and early August 1999, prompting additional applications of insecticide, the overall number of applications per acre was significantly less than 1996. The cumulative number of acres treated during the fall (July 18-November 21) of 1999 was 1,754,288, averaging 4.7 applications per acre. The average in 1996 was 8.6 applications, a reduction of 45.4% in 1999 compared with 1996. The average in 1998 was 3.6 and in 1997 it was 6.8 applications per acre.

1999 Expansion (WHP, NWP, EP/TP, PB, and NRP)

Boll weevil population in the EP/TP and NWP zones was significantly lower than in the WHP, PB, and NRP zones. The overall mean number of weevils captured per trap per week (July 25-November 26) in the EP/TP was 0.3, in NWP it was 7.2, in WHP it was 18.2, in PB it was 13.2, and in NRP it was 18.5 (Figure 9).

The cumulative number of acres treated during the diapause phase in EP/TP was 182,128, averaging 3.7 applications per acre; in NWP it was 2,977,933, averaging 6.9 applications per acre; in WHP it was 6,871,365, averaging 9.5 applications per acre; in PB it was 5,461,184, averaging 7.7 applications per acre; and in NRP it was 2,722,065, averaging 9.4 applications per acre (Figure 10). The program-wide cumulative number of acres treated in 1999 was 21.9 million acres, making the Texas program the largest eradication campaign in U.S. history.

Field Survey

The overall percent boll weevil damaged squares/bolls in zones that began the eradication program in1999, including NWP, WHP, PB, NRP was 17.4, 29.4, 21.3, and 25.8, respectively. The overall percent boll weevil damaged squares/bolls in neighboring zones that have not began eradication program including SHP/C and NHP was 70.4, and 79.2, respectively. The overall percent boll weevil damaged squares/bolls in the RPC was 0.2 (Figure 11).

Conclusion

Based on the above, we conclude that the outcome of the area-wide boll weevil eradication program has been successful. In SRP, boll weevil populations were almost non-existent during the 1999 cotton growing season. In RPC, boll weevil populations have been reduced by approximately 99.1% and in ST/WG by 92.8%. The diapause phase of the program was effective in containing the fall populations in NWP, EP/TP, WHP, PB, and NRP. According to a scouting survey conducted by TBWEF personnel during the week of September 8, 1999, it is clearly evident that the eradication program has reduced the level of the weevil populations in the eradication zones while the infestations seem to be climbing in neighboring cotton growing regions outside the eradication zones.

Acknowledgments

We gratefully appreciate the diligent efforts of Debbie Mc Partlan, Michael Catanach, Wil Baucom, Randal Schwartz, Larry Smith, Terry Futch, Darrell Dusek, David Murray, and Joey Hogan of the Texas Boll Weevil Eradication Program. This program was also greatly benefitted by the leadership and support of grower steering committees in SRP, RPC, ST/WG, NWP, EP/TP, WHP, PB, and NRP eradication zones. We also appreciate the extraordinary effort of Rick Minzenmayer, Emory Boring, Dr. Chris Sansone, Dr. James Lesser, and the IPM specialists of the Texas Agricultural Extension Service in providing cotton insect training to program personnel and informational seminars to growers. We also value the support provided by Aircraft & Equipment Operations, USDA.

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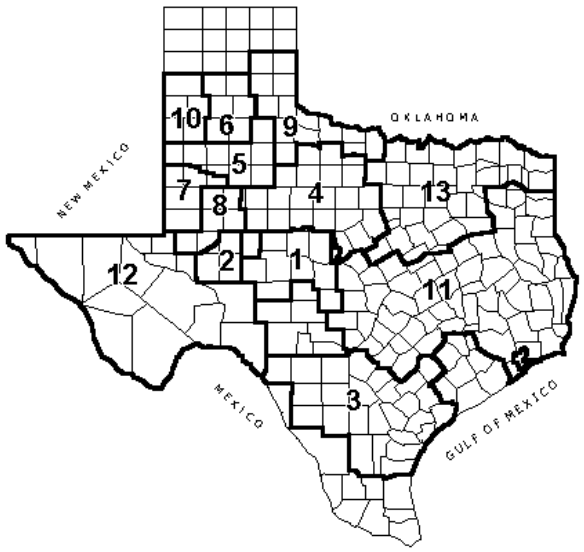

Figure 1. Boll weevil eradication zones in Texas, 1998

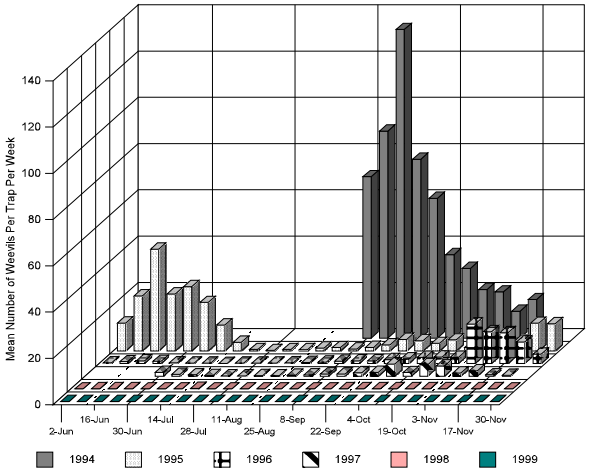

Figure 2. Mean number of adult boll weevils captured per trap per week by year, Southern Rolling Plains Zone of Texas.

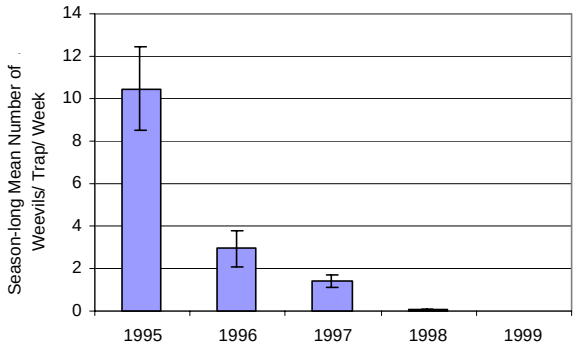

Figure 3. Season-long mean number of adult boll weevils captured per trap per week by year and standard error in the Southern Rolling Plains Zone of Texas.

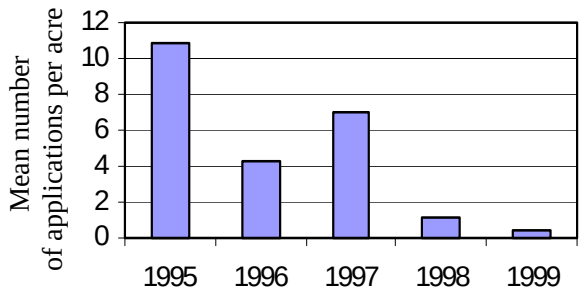

Figure 4. Season-long mean number of insecticide applications per acre in the Southern Rolling Plains Zone of Texas.

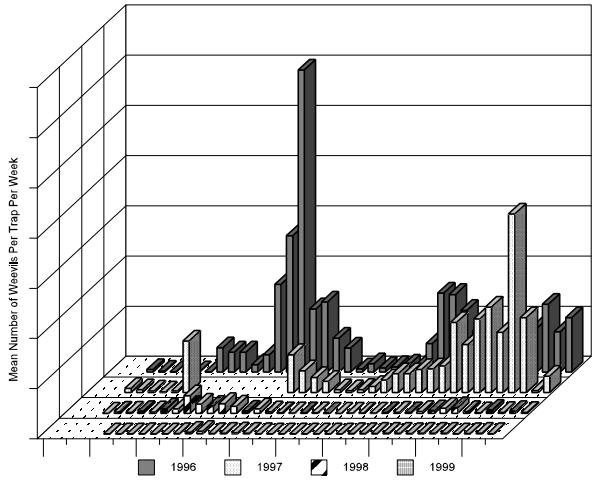

Figure 5. Mean number of adult boll weevils captured per trap per week by year, Rolling Plains Central Zone of Texas. (The absence of trapping information from May 5 to June 22, 1997, was due to the suspension of program activity during the legal and legislative process).

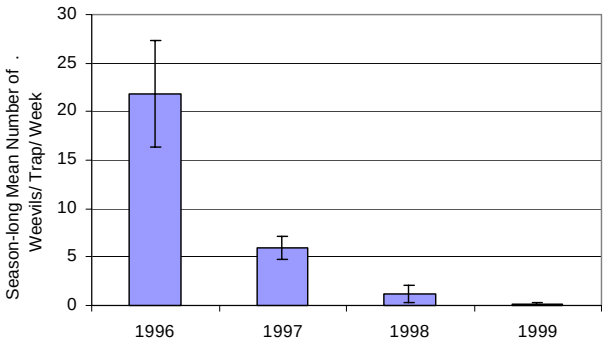

Figure 6. Season-long mean number of adult boll weevils captured per trap per week by year and standard error in the Rolling Plains Central Zone of Texas.

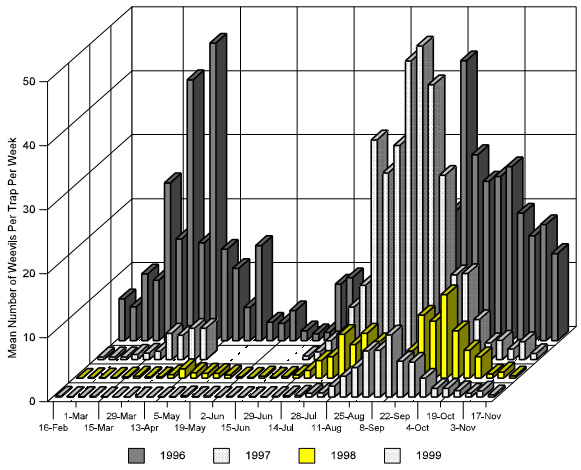

Figure 7. Mean number of adult boll weevils captured per trap per week by year, South Texas / Winter Garden, Texas. (The absence of trapping information from May 5 to June 22, 1997, was due to the suspension of program activity during the legal and legislative process).

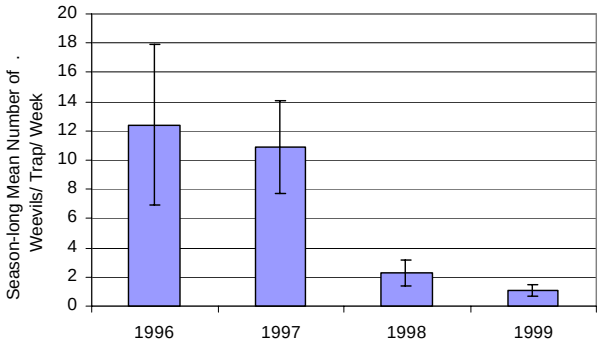

Figure 8. Season-long mean number of adult boll weevils captured per trap per week by year and standard error in the South Texas/Winter Garden Zone of Texas.

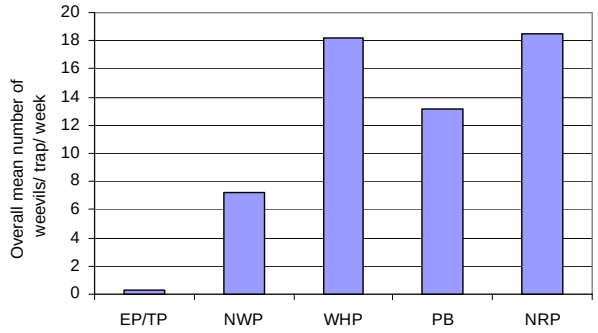

Figure 9. Overall mean number of adult boll weevils captured per trap per week (Week ending August 8-November 28) in EP/TP, NWP, WHP, PB, and NRP zones, Texas, 1999.

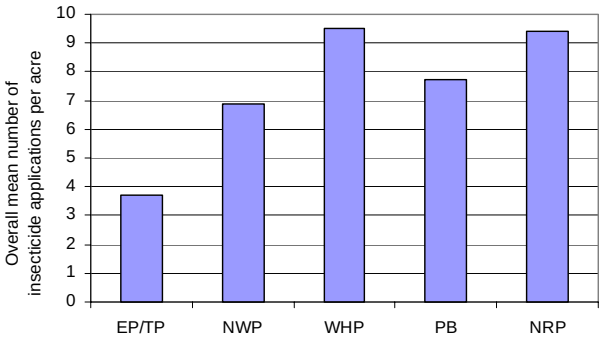

Figure 10. Overall mean number of insecticide applications per acre in the EP/TP, NWP, WHP, PB, and NRP zones, Texas, 1999.

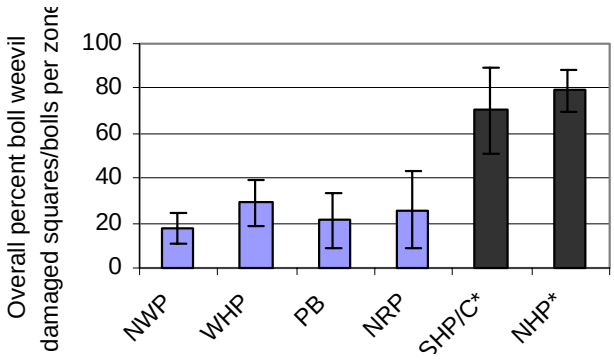

Figure 11. Overall percent boll weevil damaged squares/bolls and standard error in the NWP, WHP, PB, NRP, SHP/C, and NHP zones, Texas, September 1999. * signifies zones that have not begun eradication program as of 1999.