BOLL WEEVIL ERADICATION UPDATE - TEXAS, 1997

Osama El-Lissy and Lindy Patton
Texas Boll Weevil Eradication Foundation, Inc.
Abilene, TX
Technical Advisory Committee:
Ray Frisbie, Tom Fuchs, Don Rummel, Roy Parker
Texas A&M
College Station, San Angelo, Lubbock, and Corpus Christi, TX
Don Dipple
Texas Department of Agriculture
Austin, TX
J.R. Coppedge
USDA-ARS
College Station, TX
Gary Cunningham
USDA-APHIS
Riverdale, MD
Frank Carter
National Cotton Council
Memphis, TN
James Boston
Cotton Grower
Roscoe, TX
Jack Hayes
Department of Health
San Antonio, TX

Abstract

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

In May of 1997, the Texas Supreme Court rendered a decision finding the boll weevil law by which the Texas Boll Weevil Eradication Foundation, Inc. (TBWEF) operates, unconstitutional in that the nonprofit Foundation has authority similar to governmental agencies. In an unprecedented event, the Texas Legislation in the 75th session addressed the concerns that were outlined by the Supreme Court and a new law was passed and signed by the governor in June of 1997. The new law ratified program activities in the Southern Rolling Plains (SRP), the Rolling Plains Central (RPC), and the South Texas/Winter Garden (ST/WG) zones. The plan is to sequentially implement the program in all of the cotton growing regions to achieve statewide eradication.

The program was first initiated in SRP on 220,000 acres of cotton in September of 1994 with the diapause phase followed by season-long phase of the program in 1995, 1996, and 1997.

The season-long mean number of boll weevils captured per trap per week in 1997 was significantly less than in 1996 and 1995. The mean in 1997 was 1.2, in 1996 was 2.8, and in 1995 was 10.6, a reduction rate of 88.7% in 1997 as compared to 1995 and 57.1% as compared to 1996. The 1997 ginning records in the SRP indicate approximately 23% increase in the yield as compared to the historical five-year average.

In 1996, the program was also initiated with the diapause phase in the South Texas/Winter Garden (ST/WG) and the Rolling Plains Central (RPC) zones on approximately 500,000 acres each. In 1997, due to 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. Fields in both zones received weekly applications of Fyfanon® ULV beginning at the open boll crop phenology. Treatments continued until all hostable plants and food supply were eliminated by harvesting, stalk destruction or a killing freeze.

The overall mean number of boll weevils per trap during the spring of 1997 was significantly less than 1996 in both RPC and ST/WG zones. In RPC, the mean was 37.0 in 1996 and was 8.6 in 1997, a reduction rate of 76.8%. In ST/WG, the mean was 16.7 in 1996 and was 2.2 in 1997, a reduction rate of 86.8%.

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 the boll weevil populations as planned, subsequently eliminating the most destructive cotton pest in the state.

Introduction

The boll weevil, *Anthonomus grandis* Bohman, a native of Mexico and Central America, was first introduced into the United States, near Brownsville, Texas, about 1892 (Hunter et al., 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 during a subsequent range expansion that occurred 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.

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

Approximately $70 million is spent annually for boll weevil control and the pest still causes an estimated $200 million in crop losses each year (Knipling, 1964). The National Cotton Council estimates that the boll weevil has cost United States cotton producers more than $13 billion since entering from Mexico a century ago (NCC, 1994). It is generally agreed that cotton cannot be profitably grown in areas where the insect cannot be controlled and that other control strategies are imperative.

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 initiated in 1971 in southern Mississippi and parts of Louisiana and Alabama. This experiment used an integrated control approach including 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 that it was technically and operationally feasible to eliminate the boll weevil. The success of a 3-year boll weevil eradication trial, initiated in 1977 on 32,500 acres in North Carolina and Virginia, led to the Southwestern and Southeastern boll weevil eradication programs (USDA, 1991).

In 1993, the Texas Boll Weevil Eradication Foundation (TBWEF) was established by the Texas Legislature to govern and oversee the implementation of the boll weevil eradication program in Texas. The Foundation divided the cotton growing area in the state into nine eradication zones each encompassing approximately 150,000 to 3.9 million acres. In March of 1994, the cotton producers and landowners in the Southern Rolling Plains (SRP) passed a referendum with a majority vote of 84% to initiate the first eradication zone 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 of 1994, the 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 of 1996, the LRGV growers opted to discontinue the program. In 1996, the program began in South Texas/Winter Garden (ST/WG) zone on approximately 500,000 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 500,000 acres with the diapause phase after a majority vote of 85% in December of 1994. In September of 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 of 1997, the Texas Supreme Court rendered a decision finding the initial boll weevil law by which the TBWEF operates unconstitutional, in that the nonprofit Foundation has authority similar to governmental agencies. In an unprecedented event, the Texas Legislation in the 75th session addressed the concerns that were outlined by the Supreme Court and a new law was passed and signed by the governor in June of 1997. As an outcome of the new law, the Texas Department of Agriculture (TDA) was granted oversight authority and the TBWEF is 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). Further, the law mandates the holding of referendums in each of the zones to provide growers the opportunity to vote to continue the already initiated eradication programs in SRP, RPC, and ST/WG, and to vote to initiate a suppression program in the SHP. On August 1, 1997, 51% of the growers in SHP opted not to initiate a suppression program. On October 20, 1997, the growers in ST/WG voted to continue the eradication program by nearly 70%. The growers in SRP and RPC are scheduled to vote on February 2, and 27, 1998, respectively. The St. L zone has yet to determine a date to hold a referendum. Moreover, the Texas legislature elected to remove seven of the 31 counties in the ST/WG zone, including Austin, Brazoria, Colorado, Fort Bend, Jackson, Matagorda and Wharton.

Due to 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 had to be implemented in 1997 instead of the scheduled season-long phase. Despite the late start, a season-long phase was implemented in the SRP.

Materials and Methods

Six statutory eradication zones were designated by the Texas Legislature during the 75th session in May of 1997. The designated eradication zones are:

1. Southern Rolling Plains (SRP), (220,000 acres).

2. Rolling Plains Central (RPC), (750,000 acres).
3. South Texas/Winter Garden (STWG), (400,000 acres).
4. St. Lawrence (St. L), (150,000 acres).
5. Northern High Plains (NHP), (1,700,000 acres).
6. Southern High Plains/Caprock (SHP/C), (1,200,000 acres) (Figure 1)

Mapping

Mapping is one of the first phases of operation in any eradication zone. The purpose of mapping is to identify the exact location of each cotton field and determine the surrounding environment. The program continues to utilize a numbering system that is 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

(a.) Trapping: Boll weevil traps were utilized as the primary tool of detection. Traps were baited with one-inch square laminated polyvinyl chloride dispensers impregnated with 10 mg of grandlure. In the SRP, traps were placed at or shortly after planting around all cotton fields at a density of one per five acres and inspected weekly in the same manner as in 1995 (El-Lissy et al., 1996). The crop phenology of each field was also reported the same time traps were inspected. In RPC and ST/WG, where a second diapause phase was implemented, the trap density was at the rate of one trap per 20 acres. The purpose of the trapping in RPC and ST/WG zones was to identify areas with high weevil density and collect comparative historical data relative to boll weevil population densities in 1996 and future years. The program continues to utilize the Bar Code System in the same manner as described previously (El-Lissy et al., 1997).

(b.) Field Survey (scouting): The purpose of the survey was to measure the level of field infestation as it relates to trapping information. In SRP, 60 randomly selected fields were designated as survey fields, 30 of which were located near boll weevil overwintering sites. Each of the designated fields was divided into four quadrants and fifty squares were randomly collected from each quadrant weekly. All squares were examined and weevil damage was recorded. Additional fields were inspected for infestation when the trap catch was borderline to the action threshold for treatment. Further, during the week of September 20, 1997, ten randomly selected fields per county in SRP, RPC, NHP, SHP and adjacent counties north of RPC (formerly known as the Northern Rolling Plains zone) were scouted. The purpose of this survey was to measure boll weevil population densities both in and out of active eradication zones.

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 growers in each zone, are key components of cultural control by providing the necessary host-free period. In the SRP and RPC, most growers started to plant on or about May 15 and beginning February 15 in the ST/WG. In zones with mandatory stalk destruction rules and regulations, such as the ST/WG zone in which temperate climates may induce regrowth during the winter months (off-season), TBWEF personnel assisted 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---While the primary function of the trap was to measure the adult boll weevil population densities and identify their locations, another key benefit was removing segments of these populations in the process. In the SRP, traps removed a total of 3,144,161 adult boll weevils during the 1995 season, 1,122,457 during 1996 and 862,471 during 1997.

(3.) Chemical Control---In the SRP, a single Fyfanon® ULV (12.0 fl oz/ac, 0.92 lb [AI]/ac) application was made to fields that had reached the treatment criteria (action threshold). The action threshold was a trap catch of two adult boll weevils per 40-acre field or if weevil colonization was evident. The action threshold remained the same throughout the growing season. Additionally, growers had the option of using alternate insecticides in lieu of program treatments of Fyfanon® ULV. All cotton fields in both ST/WG and the RPC received single applications of Fyfanon® ULV (12.0 fl oz/ac, 0.92 lb [AI]/ac) on a weekly basis. These applications commenced at the early open boll crop phenology in both ST/WG (July 14) and in RPC (August 25). Treatments continued until all hostable plants and food supply were eliminated by harvesting, stalk destruction or a killing freeze.

Aerial applications were made by airplanes equipped with a spray system designed and calibrated to deliver ultra-low volume. Aerial applications in 1997 required 105, 74 and 10 aircraft in ST/WG, RPC and SRP, respectively.

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 utilized for documentation and quality control purposes in the same manner as described previously (El-Lissy et al., 1997).

Fields that were located within close proximity to some of the designated environmentally sensitive sites or near permanent obstacles were treated with high clearance ground sprayers. Mistblowers 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

In the SRP, preliminary analyses indicate that the 1997 season-long mean number of adult weevils captured per trap per week was significantly less than 1996 and 1995. The mean in 1997 was 1.2, in 1996 was 2.8, and in 1995 was 10.6, a reduction rate of 88.7% in 1997 as compared to 1995 and 57.1% as compared to 1996 (Figure 2).

The overall mean number of adult weevils captured per trap per week during the spring emergence (June 2 to July 21) in 1997 was slightly higher than 1996 and significantly less as compared to 1995. The mean in 1997 was 0.9, in 1996 it was 0.5 and in 1995 it was 21.0. The slight increase in the spring of 1997 appears to be residuum of the increased number of weevils observed during the fall (September 16 to December 8) of 1996 when compared to the fall of 1995 (Figure 3). The 1996 mean was 6.0 and the 1995 was 5.0. The increase in trap catches during the fall of 1996 may have been attributed to the following: short term efficacy (24h) provided by Phaser® (England et al., 1997) during mid-season applications; the increased action threshold (ten weevils per field) during the same time frame; late-season rainfall which prevented timely applications of Fyfanon® ULV and premature termination of the fall insecticide applications due to budgetary constraints.

Despite the increase in trap catches during the spring of 1997 as compared to 1996, the mean number of weevils per trap per week during the fall of 1997 was less than 1994, 1995 and 1996. The mean in 1997 was 2.3, in 1994 it was 49.6, in 1995 it was 5.0 and it was 6.0 in 1996, a reduction rate of 95.4%, 54% and 61.7 % as compared to 1994, 1995 and 1996 respectively (Figure 4).

In SRP, the season-long cumulative number of acres treated in 1997 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 10.0 applications per acre.

Preliminary ginning records for SRP in 1997 indicate 23% increase in the yield as compared to the historical five-year average (1990-1996, excluding 1995). The 1997 mean number of pounds of lint per acre was 300 and the five-year average was 230 (USDA, AMS, Cotton Division) (Figure 5).

Rolling Plains Central Zone

In the RPC, the overall mean number of weevils captured per trap per week during the spring emergence (June 2 - July 22) in 1997 was significantly less than in 1996. The 1997 mean was 8.6 and in 1996 it was 37.0, a reduction rate of 76.8%. The overall mean number of weevils per trap per week during the fall of 1997 (September 8 - December 8) was not significantly different as compared to 1996. The 1997 mean was 17.8 and in 1996 it was 17.4. This signifies the importance of implementing sound season-long control following the diapause phase of the program. Further, this demonstrates that a diapause phase alone would provide a reduction in populations the following spring and in the absence of season-long activity, weevil populations would likely increase to the original level. However, due to the early development of the cotton crop in the fall of 1997, boll weevil trap catches appeared to have peaked three weeks earlier than in 1996. This resulted in lower trap catches during the latter part of November and December (Figure 6) which may lead to a lower population density in the spring of 1998 as compared to 1997 .

The 1997 season-long cumulative number of acres treated in the diapause phase was 4,315,861 acres, averaging 7.0 applications per acre; in 1996 it was 3,018,434 acres, averaging 6.0 applications.

The percent squares and young bolls damaged by weevils during the week of September 20, 1997 was significantly less in the SRP and RPC as compared to NRP, NHP and SHP. The percent damaged squares and young bolls in SRP was 0.1, RPC was 15.3, NRP was 66.2, NHP was 59.4 and SHP was 48.0 (Figure 7). Historically, the level of boll weevil infestation has been higher in SRP and parts of RPC as compared to NRP, NHP and SHP (Dr. Tom Fuchs, personal communication).

South Texas / Winter Garden Zone

In the ST/WG, a second diapause phase was implemented in 1997 in lieu of the season-long phase due to the interruption of program activity as a result of the legal and legislative process.

The overall mean number of weevils captured per trap per week during the spring emergence (February 16 - May 19) in 1997 was significantly less than in 1996. The 1997 mean was 2.2 and the 1996 was 16.7, a reduction rate of 86.8%. The overall mean number of weevils per trap per week during the fall of 1997 (July 28 - November 17) was not significantly different as compared to 1996. The 1997 mean was 19.3 and the 1996 it was 19.8. This supports the observation made in the RPC relative to the importance of implementing sound season-long control along with the diapause phase and that a diapause phase alone would not likely to provide the necessary reduction in weevil populations from one growing season to the next. The ST/WG also experienced early development of the cotton crop in the fall of 1997, stimulating boll weevil trap catches to peak three weeks earlier than 1996. This resulted in lower trap catches during the months of November and December (Figure 8), which may lead to a lower population density in the spring of 1998.

The 1997 season-long cumulative number of acres treated for the diapause phase was 1,353,028 acres, averaging 4.5 applications per acre and in 1996 it was 1,772,915 acres, averaging 5.9 applications. In 1997, The ST/WG growers were exceptionally proactive in carrying out an effective stalk destruction program, resulting in a significant reduction in the late season program treatments.

Conclusion

Based on the above, we conclude that the outcome of the area-wide boll weevil eradication program in the SRP has been successful. Boll weevil populations have been significantly reduced and cotton yield has increased when compared to the historical average. Moreover, according to the scouting survey conducted during the week of September 20, 1997, 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. As an outcome of the 1996 diapause phase, RPC and ST/WG experienced significantly reduced weevil populations in the spring of 1997, resulting in less insecticide usage by growers and contributed to an increased yield. In RPC and ST/WG zones, the trapping data suggest that the 1997 diapause phase of the program was successful in reducing the late-season boll weevil populations and a reduction in 1998 populations is expected.

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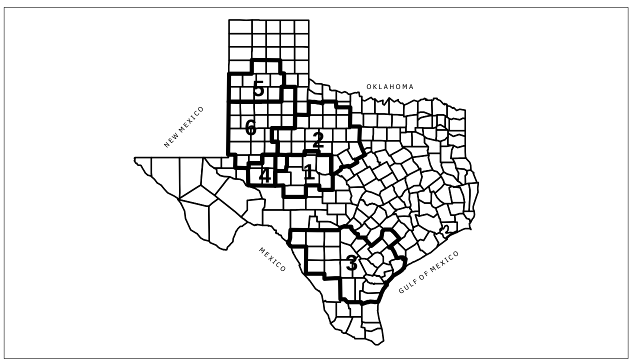

Figure 1: Boll weevil statutory eradication zones in Texas, 1997.

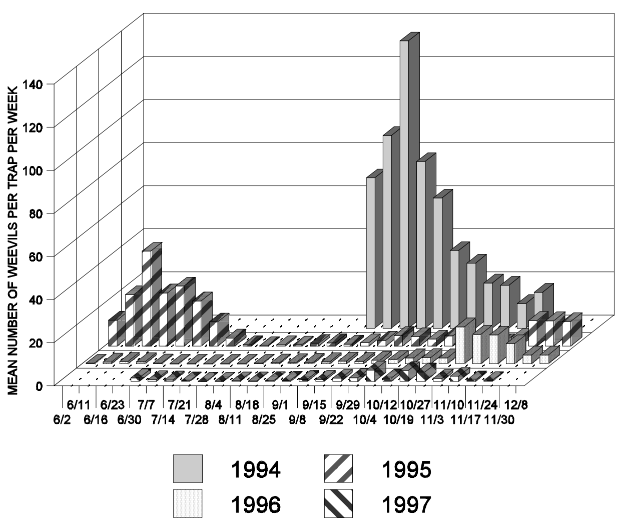

Figure 2. Season-long mean number of adult boll weevils captured per trap per week in the Southern Rolling Plains Zone, Texas, 1995, 1996, and 1997.

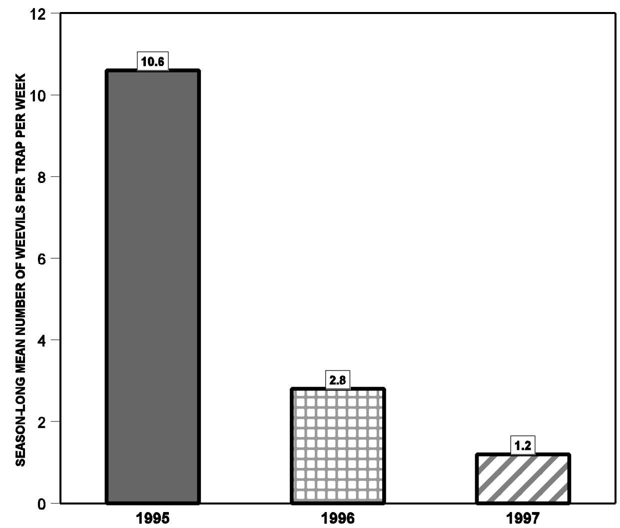

Figure 3. Mean number of adult boll weevils captured per trap per week, during 1995, 1996 and 1997, Southern Rolling Plains Zone, Texas.

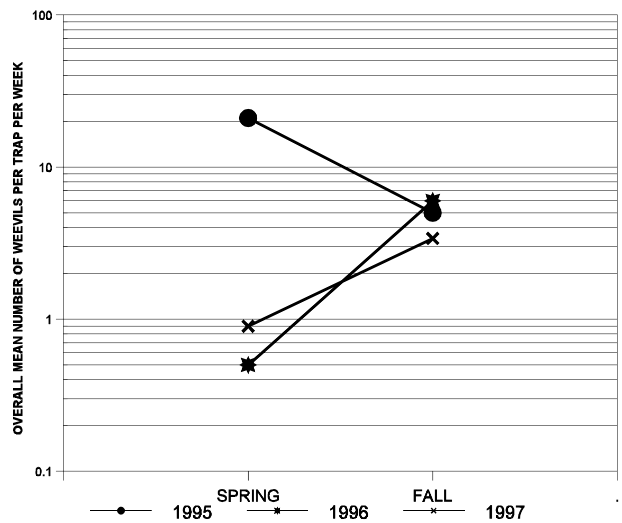

Figure 4. Overall mean number of adult weevils captured per trap per week during the spring and fall of 1995, 1996, and 1997, Southern Rolling Plains Zone, Texas.

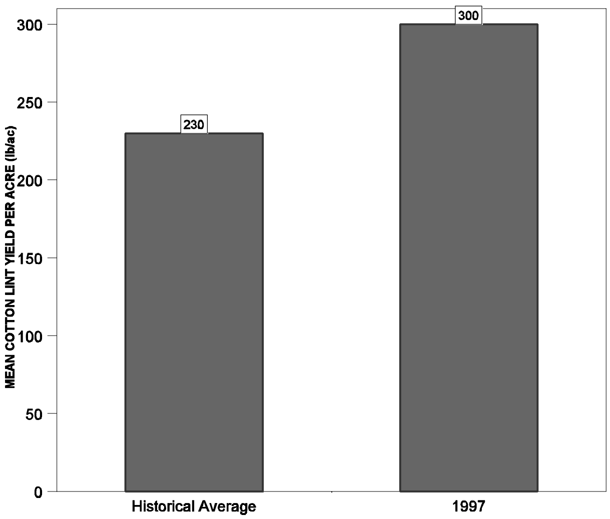

Figure 5. Mean cotton lint yield per acre in 1997 and the historical five-year average in the Southern Rolling Plains Zone, Texas.

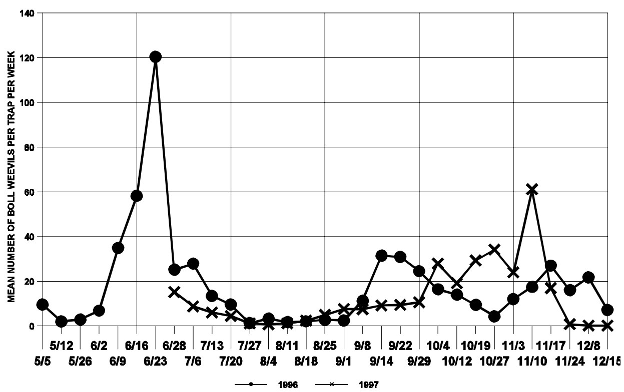

Figure 6. Mean number of adult boll weevils captured per trap per week, during 1996 and 1997, Rolling Plains Central Zone, Texas.

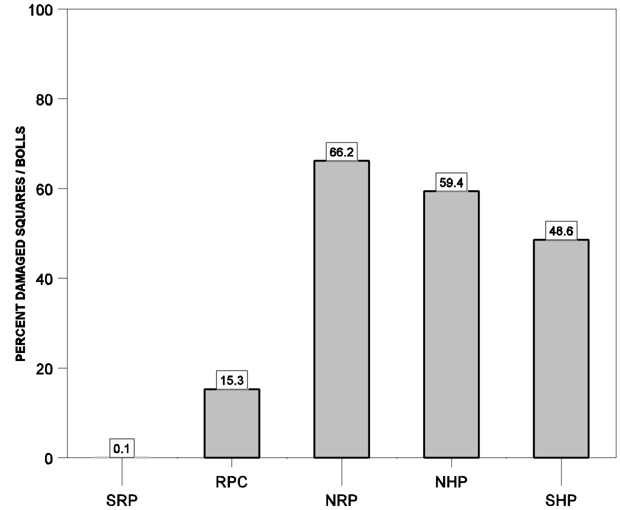

Figure 7. Percent boll weevil damaged square and bolls in the SRP and RPC and NRP, NHP and SHP Zones, Texas, 1997.

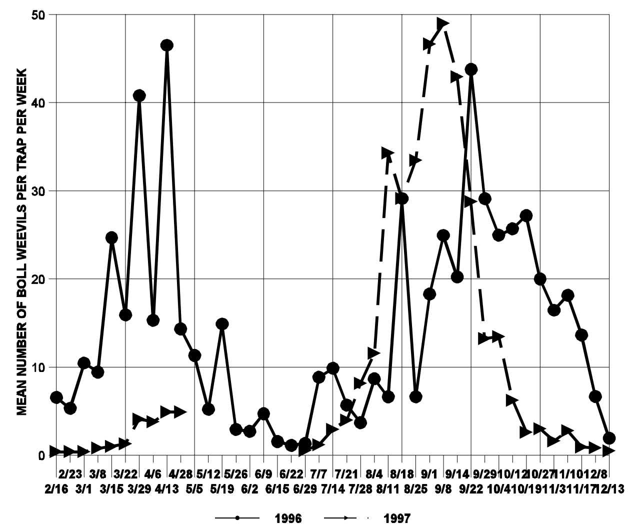

Figure 8. Mean number of adult boll weevils captured per trap per week, during 1996 and 1997, South Texas / Winter Garden Zone, Texas.