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BOLL WEEVIL ERADICATION UPDATE – ARKANSAS, 2001

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Abstract

The Arkansas Boll Weevil Eradication Program (ABWEP) was initiated in 1997 to rid the state of the boll weevil *Anthonomus grandis* Boheman.

The Arkansas program began in the Southwest zone in 1997 with the diapause phase, followed by season-long phases in 1998, 1999, 2000, and 2001. The seasonal mean number of boll weevils captured per trap per week in 2001 was significantly less than in 1998. The mean in 2001 was 0.065 weevils per trap per week, and in 1998 it was 3.96, a reduction rate of 98.36%. Insecticide applications in 2001 for boll weevils were reduced by 25.2%, compared to 1998.

The program expanded into the Southeast zone in 1999 with the diapause phase, followed by season-long phases in 2000, and 2001. The seasonal mean number of boll weevils captured per trap per week in 2001 was significantly less than in 2000. The mean in 2001 was 0.328, and in 2000 it was 5.54, a reduction rate of 94.08%. Insecticide applications made by the program in 2001 were less than in 2000 by 23.2%.

The program expanded into the Central zone in 2000 with the diapause phase of the program followed by a season-long phase in 2001. The seasonal mean number of boll weevils captured per trap per week in 2001 was significantly less than in 2000. The mean in 2001 was 0.399, and in 2000 it was 15.66, a reduction rate of 97.45% in 2001 when compared with 2000.

The program expanded into the Northeast Ridge zone in 2001 with the diapause phase, with the season-long phase to be implemented in 2002. The seasonal mean number of boll weevils captured per trap per week in 2001 was 5.42.

The overall percent boll weevil damaged squares and bolls during the month of September were significantly lower in active eradication zones as compared with regions outside eradication. The percent damage in the Southwest Zone was 0.00 %, in the Southeast Zone it was 0.62%, in the Central Zone it was 1.57%, in the Northeast Ridge Zone it was 4.75%, while in the non-active eradication zones it was 34.27%.

The results of the ABWEP, demonstrated to this point, indicate significant progress made toward eradication, especially when proven operational principles are effectively implemented. The use of pheromone baited traps for detection, along with sound cultural, mechanical, and chemical control methods, simultaneously implemented within a harmonized system, have proven successful in eradicating the boll weevil. An extensive environmental monitoring program (as reported in Catanach and Pietsch, 2002) has also been implemented to 1) ensure that all acreage near sensitive sites are treated timely; 2) prevent off-target drift into sensitive areas; 3) provide documentation to verify conditions and activities associated with treatments to improve safety, while reducing liability issues for the Program.

Introduction

The plan to eliminate the boll weevil, *Anthonomus grandis* Boheman, a native of Mexico and Central America, from the United States continues to expand into most regions of the cotton belt. This is certainly true in the state of Arkansas. The history of the boll weevil eradication program in Arkansas was previously described (Kiser, et al. 2001). Expansion of the eradication effort into the Northeast Ridge Zone in 2001 leaves the Northeast Delta Zone as the only region not yet involved in program activities in Arkansas.

The Southwest Zone program was initiated in 1997 with operations under the direction of the Louisiana Boll Weevil Eradication Program. The Arkansas Boll Weevil Eradication Foundation (ABWEF) assumed program operations starting with the third season-long phase of the program in 2000, and continued during the fourth season-long phase in 2001. Program operations were initiated in the Southeast Zone with the diapause phase in August 1999. The first season-long phase of the program began in the spring of 2000, and was followed by a second season-long phase in 2001. Program operations were also implemented with the diapause phase in the Central Zone in August 2000, and were followed by the first season-long phase in 2001. The Northeast Ridge Zone began the program operations with the diapause phase in 2001. A referendum was held on November 30, 2001, to begin a fall diapause program in 2002 in the Northeast Delta Zone; that vote failed with 644 votes for the program and 414 opposed. While the majority of the growers and landlords voting wanted the program, Arkansas law requires that 2/3 of the growers and landlords voting endorse the program. The Arkansas Boll Weevil Eradication Board of Directors has proposed a new referendum with a modified assessment to be held on February 15, 2001. If the referendum passes, the entire state of Arkansas will be participating in eradication.

Methods and Materials

Five Eradication Zones were established through legislative action, grower referenda, and the Arkansas State Plant Board. These zones, including 2001 cotton crop acreage, are as follows (Figure 1):

1. Southwest 7,673 acres
2. Southeast 331,213 acres
3. Central 275,399 acres
4. Northeast Ridge 135,154 acres
5. Northeast Delta 376,000 acres

Mapping

In active eradication zones, all cotton fields were located, identified, and accurately mapped for successful implementation of eradication programs. Geo-Explorer global positioning system (GPS) hand held units along with post processing deferential correction, using Pathfinder software, were utilized in identifying the exact location of each field (within a sub-meter of accuracy). Maps were created for each field by using geographic data in a geographic-database (MapInfo). Each field is assigned a unique nine-digit number as previously reported (El-Lissy et al, 1996). In addition to the advantages discussed in the previously noted publication, determining the exact location of each field and using the unique identifying numbers makes it possible to ensure high quality of aerial, ground, and mistblower applications by overlaying GPS treatment data on field maps. It also allows for detailed spatial analysis of trapping data.

Detection

1. Trapping:
   a. Boll weevil pheromone traps (Plato Industries, Inc., Houston, Texas) (Plato et al, 2001) were placed around the perimeter of all fields shortly after planting at a space of approximately 300 feet. Traps were baited with 10 mg of grandlure impregnated onto polyvinyl chloride one-inch square laminated dispensers (Plato Industries, Inc., Houston, Texas). In the Northeast Ridge Zone, where the diapause phase was implemented, traps were deployed at a density of one trap per field shortly after planting. Trapping information gathered during the diapause phase is not used for

treatment decisions, but to provide a baseline of weevil populations for comparison in future years. Grandlure dispensers were replaced weekly in all zones, leaving the dispenser from the previous cycle in addition to the new dispenser (Boyd et al, 2000). Therefore, each dispenser was left in the trap for a total of two weeks. Every fourth week one-inch by half-inch laminated polyvinyl chloride dispensers impregnated with 0.6 gm of dichlorvos (Plato Industries, Inc., Houston, Texas), were placed in each trap to kill weevils as they entered traps.

b. Trap lines were deployed in April 2001 along north south highways linking the Southeast, Central, and Northeast Ridge. Trap lines were also deployed along east west highways through the Northeast Ridge Zone. Trap line information was gathered to evaluate the difference in weevil catches in active and non-active eradication zones. Traps were placed every mile. Traps were inspected weekly throughout the 2001 growing season. Grandlure dispensers and insecticide kill strips were used as described above (Figure 2).

c. A grid trapping program was conducted in the Northeast Delta Zone to determine population densities and determine if an alternate diapause program could be successfully implemented. Traps were placed along the roadside every mile in a grid pattern across the zone. Traps were inspected weekly throughout the 2001 growing season. Grandlure dispensers and insecticide kill strips were used as described above (Figure 3)

2. Field Survey: The purpose of the survey was to access the level of boll weevil damage inside and outside active eradication zones. The active eradication zones included in the survey were the Southwest Zone, Southeast Zone, Central Zone, and Northeast Ridge Zone. The non-active eradication zone was the Northeast Delta Zone. Ten randomly selected fields from each county located in the above zones were surveyed. One hundred hostable (squares, blooms, and/or green bolls) cotton fruit were randomly collected while scouts walked along a circular pattern extending into a large portion of each field. This survey was conducted the first week of September 2001. All collected cotton fruit was examined for evidence of boll weevil damage and the percent damage for each field was calculated. The overall percent of boll weevil damage was then calculated for each county.

Control

The control component of the ABWEP is comprised of cultural, mechanical, and chemical control:

1. Cultural Control: timely cotton planting, defoliation, harvesting, and crop destruction, as recommended by Arkansas Agricultural Extension Service, are essential in providing necessary boll weevil host-free period. Additionally, to encourage producers to terminate their cotton crop in a timely manner, the Board of Directors approved incentives for early cotton crop destruction for all active zones. The first phase of the incentive was based upon having cotton destroyed by October 8, 2001, for the producer to receive a $4 per acre credit to be applied to future assessments. The second phase of the incentive was based upon having cotton destroyed by October 22, 2001, for the producer to receive a $2 per acre credit. If cotton were allowed to re-grow to the point of producing hostable fruit, the earned incentive credit would be forfeited. Another important cultural practice is maintaining well-drained, accessible turn-rows, which allow for timely inspections of boll weevil traps and mistblower treatments.
2. Mechanical Control: while detection remains the principal function of the boll weevil trap, a certain percentage of the boll weevil population is also removed in the process. As boll weevil populations are reduced in the field, the percentage of the boll weevils that are removed by traps increases (Lloyd et al, 1972). Traps become especially important as a control mechanism in the final phase of eradication.
3. Chemical Control: Malathion ultra-low-volume (ULV) was applied by air and ground equipment. Airplanes and helicopters were equipped with differentially corrected GPS data recording systems and spray systems calibrated for ULV applications following USDA-APHIS-PPQ guidelines. High-clearance ground sprayers and trucks were equipped with Big John Mistblower units. All ground spray systems were equipped and calibrated to apply ULV malathion (16.0 fl oz/ac, 1.23 lb [AI]/ac).
   a. Season-long phase:
      i. Southwest Zone: In 2001, ABWEP personnel implemented the fourth season-long phase of the program. Beginning at pinhead square, fields reaching treatment criteria (action threshold), received a single application of Fyfanon® ULV (12.0 fl oz/ac, 0.92 lb [AI]/ac). Season-long treatments were based on an action threshold of one weevil trapped per field or if a boll weevil infestation was evident. When fields triggered according to the above criteria all adjacent fields were also treated.
      ii. Southeast Zone: in the spring of 2001 ABWEP personnel began the second season-long phase of the program. Beginning at pinhead square, fields reaching treatment criteria (action

threshold), received a single application of Fyfanon® ULV or Atrapa® ULV (10.0 fl oz/ac, 0.77 lb [AI]/ac). Season-long treatments were based on an action threshold of one weevil trapped per field or if a boll weevil infestation was evident. When fields triggered according to the above criteria all adjacent fields were also treated.

iii. Central Zone: in the spring of 2001 ABWEP personnel began the first season-long phase of the program. Beginning at pinhead square, fields reaching treatment criteria (action threshold), received a single application of Fyfanon® ULV or Atrapa® ULV (10.0 fl oz/ac, 0.77 lb [AI]/ac). Season-long treatments were based on an action threshold of one weevil trapped per field or if a boll weevil infestation was evident. When fields triggered according to the above criteria all adjacent fields were also treated.

b. Diapause phase: on July 30, 2001, ABWEP personnel in the Northeast Ridge Zone initiated mistblower applications around field borders. Aerial applications began on August 1, 2001, on fields within a two mile band of cotton on the east side of Crowley's Ridge. Aerial applications of all cotton fields began on August 13, 2001. Fields were treated weekly until the elimination of hostable cotton fruit either through defoliation, harvest, crop destruction, or a killing freeze.

Results and Discussion

Trap captures from zone trapping programs (Figure 15), trap lines (Figure 8), boll weevil damage surveys (Figure 6), and field observations indicate reductions in boll weevil populations in all active zones.

Southwest Zone

The Southwest Zone is exhibiting significantly reduced weevil populations, and economic damage caused by boll weevils was not noticed in any fields during the 2001 growing season.

The 2001 season-long mean number of adult weevils captured per trap per week was significantly less than in the 1998 season. The mean number for 2001 was 0.065, in 2000 it was 0.66, in 1999 it was 0.68, and in 1998 it was 3.96, a reduction rate of 98.36% in 2001 as compared to 1998 (Figure 4). Accurate comparisons of trap captures between the 1997 diapause phase and 2001 season are unavailable due to very limited trapping information for the 1997 season.

The season-long average number of program applications in 2001 was 12.52, in 2000 it was 4.57 applications per acre, in 1999 it was 12.03, and in 1998 it was 16.73, a reduction of 25.2% in 2001 compared to 1998 (Figure 5). Information regarding the applications per acre in 1997 was unavailable. The increase in number of applications from 2000 to 2001 is attributed to methods of treatments applied during the 2000 season, including treating only the edge of fields (strip spraying), using "T" trapping to determine exactly what part of the field to treat, interference of detection from BWACTs (Kiser, et al, 2001), and above average rainfall during key parts of the 2001 season.

As indicated by the boll weevil damage survey conducted the first week of September 2001, percent boll weevil damaged cotton fruit was significantly less in counties located within the Southwest Zone compared to levels in counties outside active eradication zones. The percentage of hostable cotton fruit damaged by boll weevils within the collected samples from counties located in the Southwest Zone was 0.0 % compared to 34.3% damage calculated for the cotton growing counties outside active eradication zones (Figure 6).

Southeast Zone

In the Southeast Zone, boll weevil trap captures have been reduced following the fall diapause phase of the program in 1999, and the season-long phases in 2000 and 2001. The 2001 season-long overall mean number of adult boll weevils captured per trap per week was significantly less than 2000. The mean number for 2001 was 0.328, and in 2000 it was 5.54, a reduction of 94.08% in 2001 as compared to 2000 (Figure 7). Accurate comparisons of trap captures between the 1999 diapause phase and 2001 season are unavailable due to very limited trapping information for the 1999 season. Historically, fall boll weevil trap captures in the Southeast Zone have been very high, averaging from 100 to 250 boll weevils per trap per week in certain counties (Donald R. Johnson, personal communication).

As indicated by the boll weevil damage survey conducted the first week of September 2001, percent boll weevil damaged cotton fruit was significantly less in counties located within the Southeast Zone compared to levels in counties outside active eradication zones. The percentage of hostable cotton fruit damaged by boll weevils in counties located in the Southeast Zone was 0.6 % compared to 34.3% damage calculated for the cotton growing counties outside active eradication zones (Figure 6).

Trap line data also indicated significant differences between boll weevil trap catches in the Southeast Zone when compared to the grid trapping captures from the Northeast Delta Zone. The overall season-long mean number of adult weevils captured in the Southeast Zone trap line per trap per week for the 2001 growing season was 0.28 (Figure 8).

The overall mean number of treatments during the diapause phase of 1999 was 5.43 applications per acre. The season-long average number of program applications in 2001 was 9.30, and in 2000 it was 12.11, a reduction of 23.2 % in 2001 compared to 2000 (Figure 9).

Central Zone

In the Central Zone, boll weevil trap captures have been reduced following the fall diapause phase of the program in 2000, and the first season-long phase in 2001. The 2001 season-long overall mean number of adult boll weevils captured per trap per week was significantly less than in the 2000 season. The mean number for 2001 was 0.40, and in 2000 it was 16.20, a reduction of 97.45% in 2001 as compared to 2000 (Figure 10).

As indicated by the boll weevil damage survey conducted the first week of September 2001, percent boll weevil damaged cotton fruit was significantly less in counties located within the Central Zone compared to levels in counties outside active eradication zones. The percentage of hostable cotton fruit damaged by boll weevils in counties located in the Central Zone was 1.6 %, which represents a significant difference when compared to 34.3% damage calculated for the cotton growing counties outside active eradication zones (Figure 6).

Trap line data also indicated significant differences between boll weevil trap catches in the Central Zone when compared to the grid trapping captures from the Northeast Delta Zone. The overall season-long mean number of adult weevils captured in the Central Zone trap line per trap per week for the 2001 growing season was 0.53 (Figure 8).

The overall mean number of treatments during the diapause phase of 2000 was 6.55 applications per acre. The season-long mean number of treatments in 2001 was 12.80 applications per acre (Figure 11).

Northeast Ridge Zone

Trapping information was collected from all fields in the Northeast Ridge Zone during the diapause phase of the eradication program in 2001. This information will serve as a baseline to evaluate reductions in weevil populations in coming years of the eradication program. The overall season-long mean number of adult weevils captured in the Northeast Ridge Zone per trap per week in 2001 was 5.42 (Figure 12). The mean number of weevils captured per trap per week during the diapause period of the program was 9.34 (Figure 12).

The percentage of hostable cotton fruit damaged by boll weevils, as indicated by the 2001 survey, during the first week of September 2001 in counties located in the Northeast Ridge Zone was 4.8%, which represents a significant difference when compared to 34.3% damage calculated for the cotton growing counties outside active eradication zones (Figure 6).
The season-long overall mean number of adult weevils captured in the Northeast Ridge Zone trap line per trap per week for the 2001 growing season was 4.75 (Figure 8).

The season-long mean number of applications in 2001 was 10.42 applications per acre (Figure 13).

Non Active Eradication Zone (Northeast Delta)

The percentage of boll weevil damaged hostable cotton fruit, as indicated by the survey conducted the first week of September 2001, in counties located in the non-eradication zones was 34.3% (Figure 6). Historically, insecticide use for boll weevil control in the Northeast Delta Zone has been significantly lower than areas that are currently in active eradication zones. The lower insecticide use is a direct result of lower boll weevil damage levels (Johnson, 1993).

Grid trapping data was collected on weekly intervals throughout the 2001 growing season within the non-active eradication zone. The 2001 overall season-long mean number of adult weevils captured per trap in the Northeast Delta Zone grid trapping per week was 11.56 (Figure 14).

Conclusions

Based upon the above results, we conclude the ABWEP continues to significantly reduce weevil populations as evidenced by reduced trap captures, and boll weevil damage in active zones as compared with non-active eradication zones. An important trend in grower practices that is impacting the cost of boll weevil eradication involves an increase in no-till cotton acreage. This has resulted in a significant increase in late-season applications required to treat re-growth.

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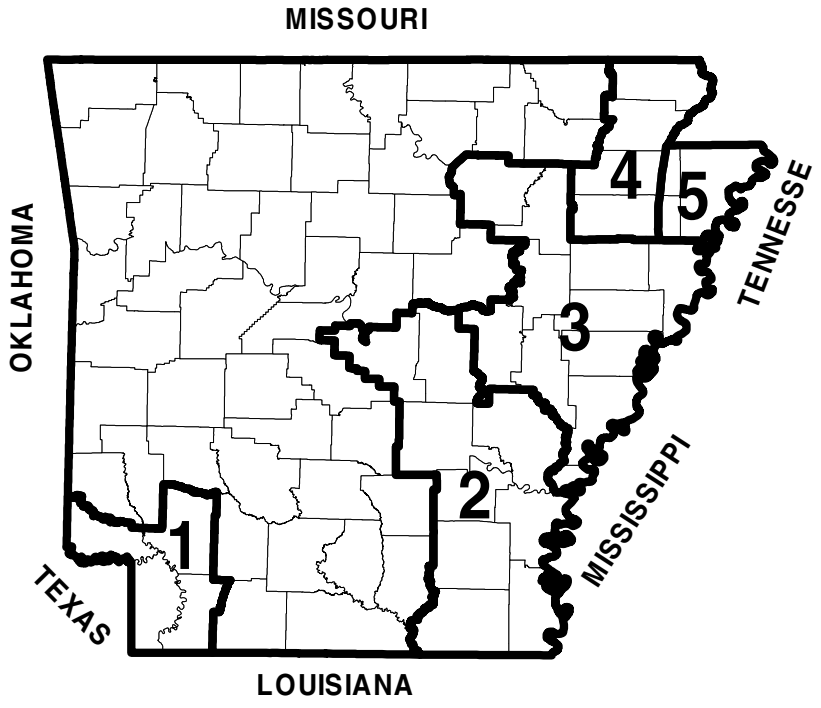

Figure 1. Boll weevil eradication zones in Arkansas, 2001.

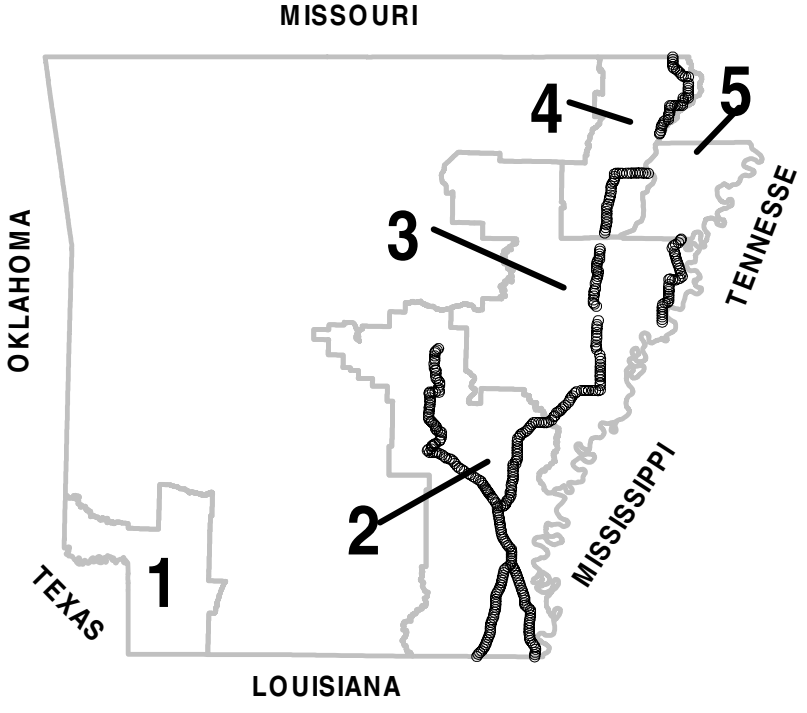

Figure 2. Boll weevil trap line locations in Arkansas, 2001.

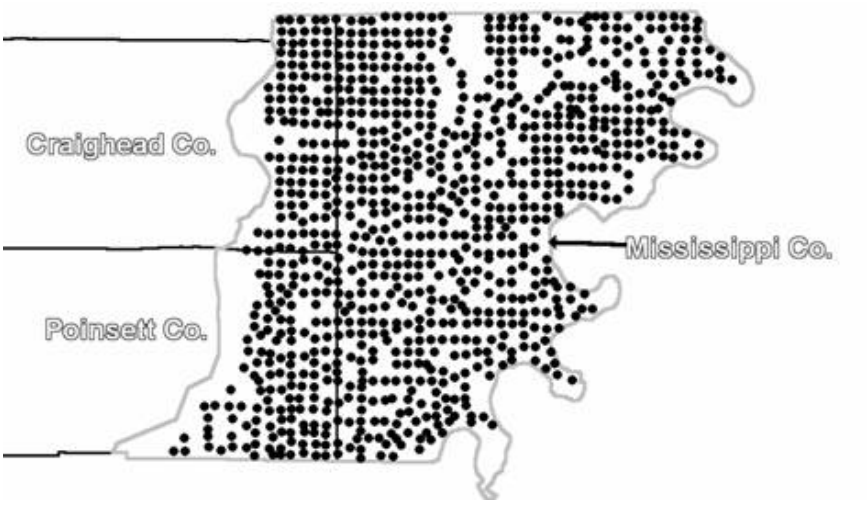

Figure 3. Boll weevil grid trap locations in Northeast Delta, 2001.

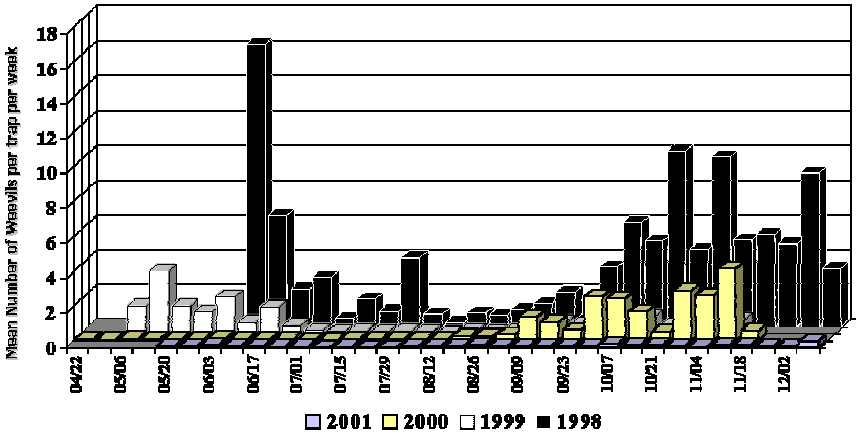

Figure 4. Mean number of adult boll weevils captured per trap per week by year, Southwest Zone.

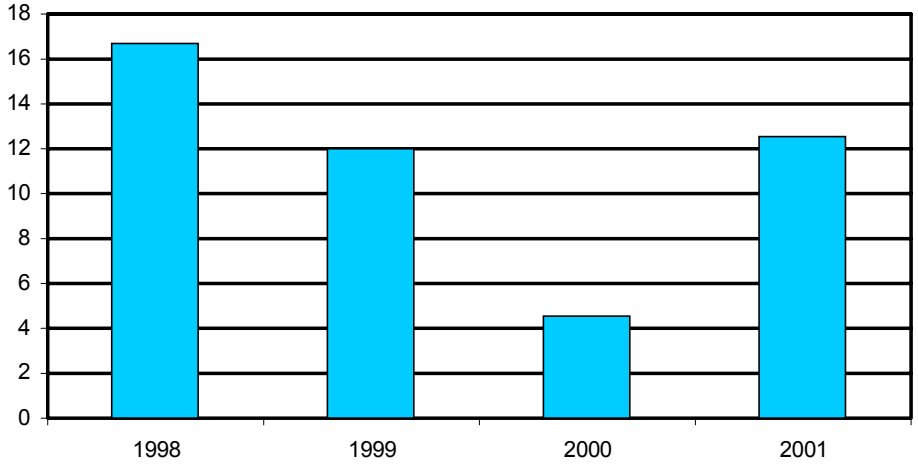

Figure 5. Season-long mean number of insecticide applications per acre in the Southwest Zone of Arkansas.

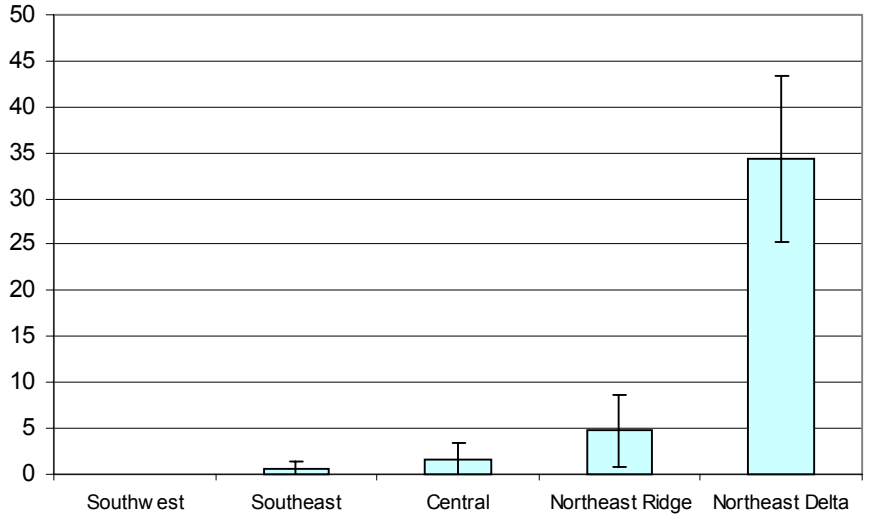

Figure 6. Boll Weevil Damage Survey. Overall percent boll weevil damage squares/bolls and standard error in the Southeast, Central, Northeast Ridge, and Northeast Delta (non-eradication) zones, Arkansas, 2001.

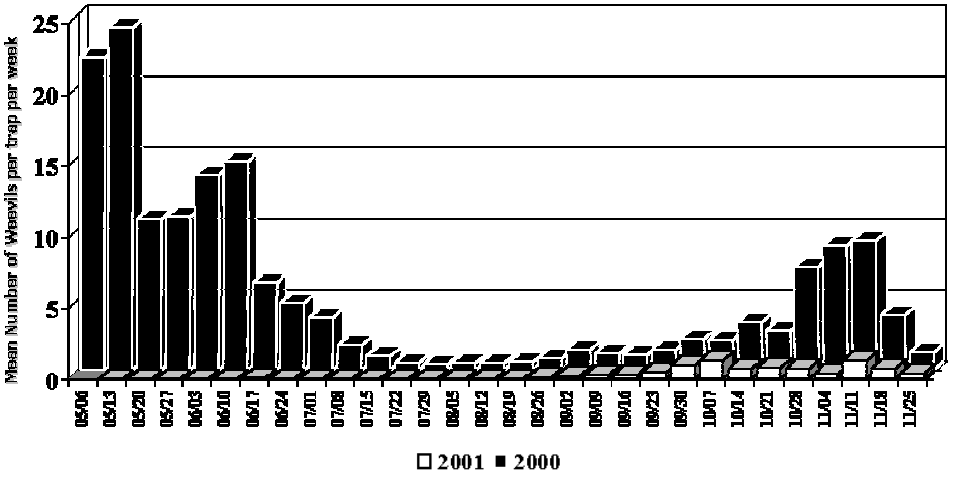

Figure 7. Mean number of adult boll weevils captured per trap per week by year, Southeast Zone.

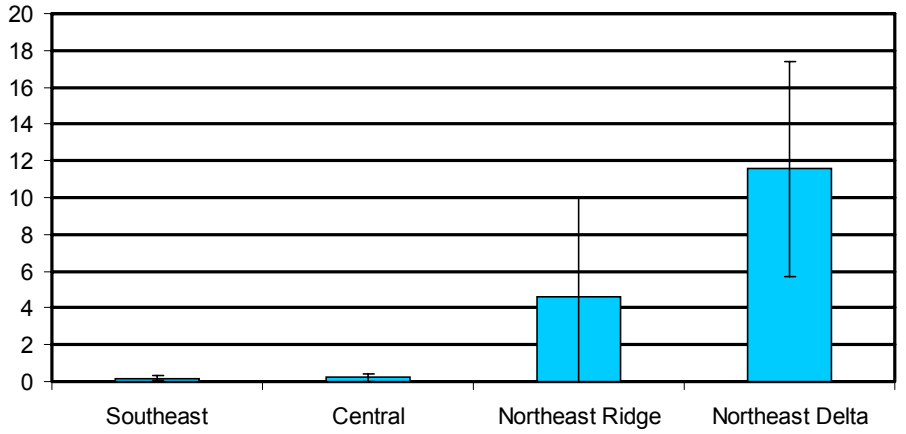

Figure 8. Season-long mean number of adult boll weevils captured per trap per week and standard error on the trap line by zone, 2001.

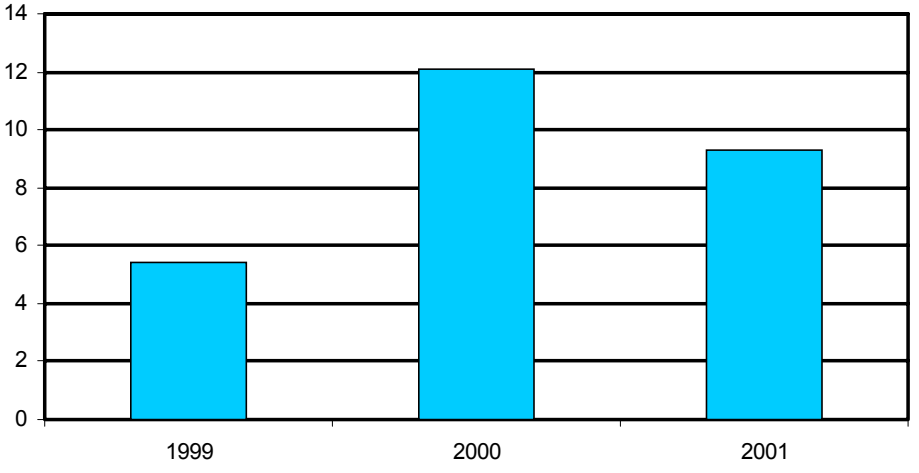

Figure 9. Season-long mean number of insecticide applications per acre in the Southeast Zone of Arkansas.

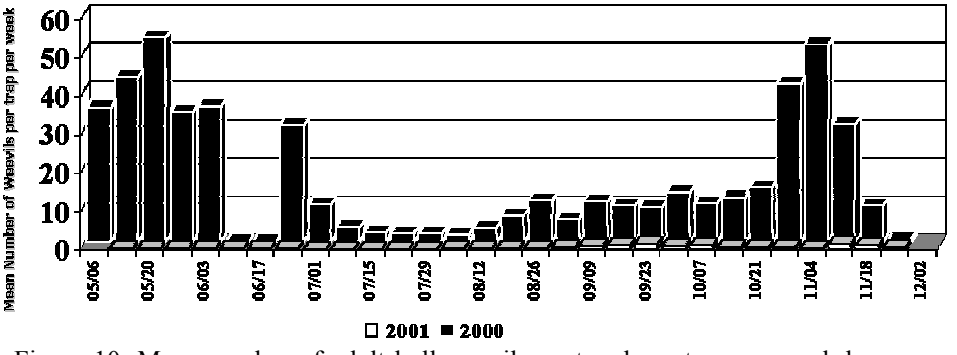

Figure 10. Mean number of adult boll weevils captured per trap per week by year, Central Zone.

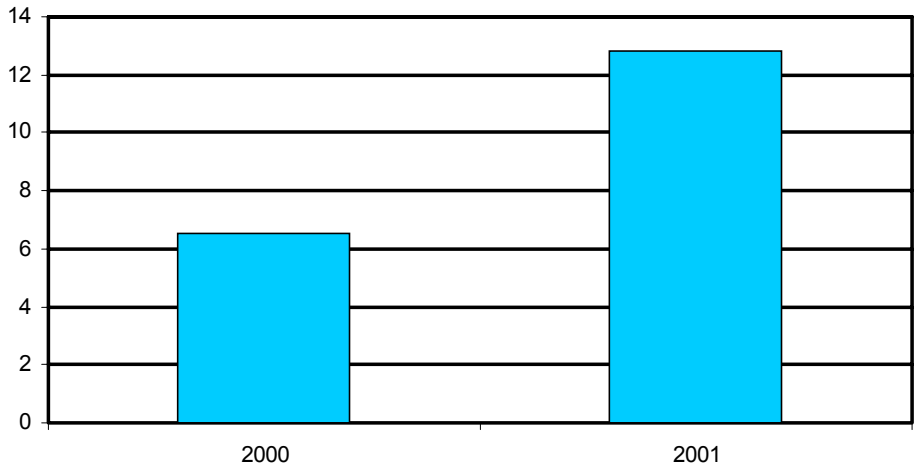

Figure 11. Season-long mean number of insecticide applications per acre in the Southwest Zone of Arkansas.

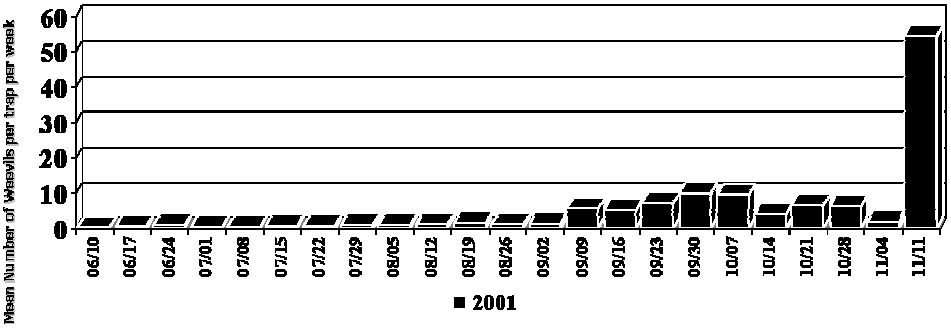

Figure 12. Mean number of adult boll weevils captured per trap per week by year, Northeast Ridge Zone.

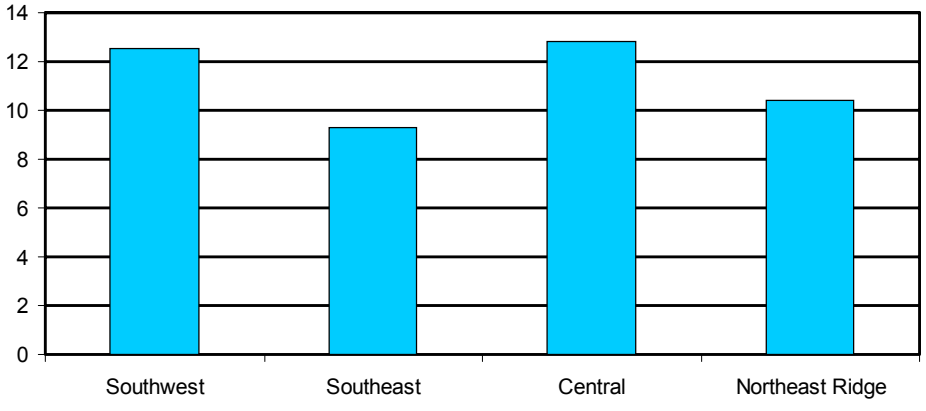

Figure 13. Overall mean number of insecticide applications per acre in the Southwest, Southeast, Central, and Northeast Ridge zones, Arkansas, 2001.

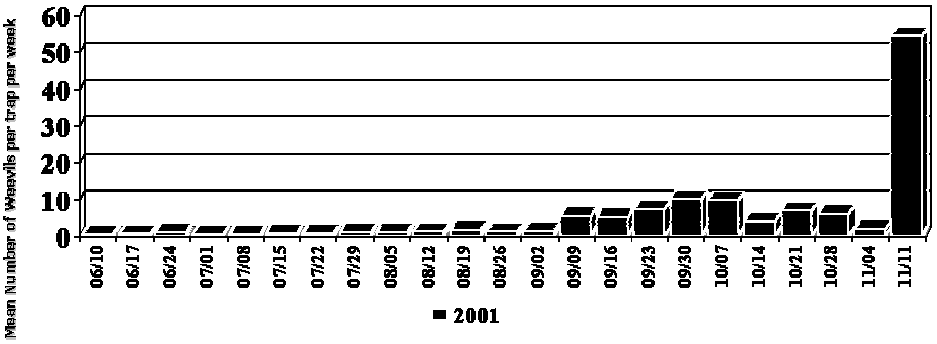

Figure 14. Mean number of adult boll weevils captured per trap per week by year, Northeast Delta Zone.

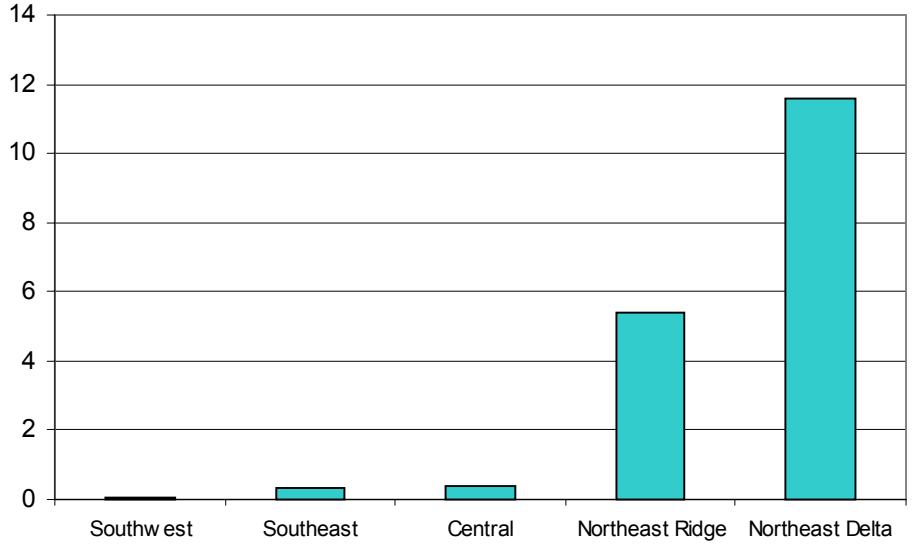

Figure 15. Overall mean number of adult weevils captured per trap per week in the Southwest, Southeast, Central, Northeast Ridge, and Northeast Delta, Arkansas, 2001.