BOLL WEEVIL ERADICATION UPDATE – ARKANSAS, 2008

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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, 2001, and season-long maintenance phases in 2002, 2003, 2004, 2005, 2006, 2007 and 2008. The seasonal mean number of boll weevils captured per trap per week in 2008 was significantly less than in 1998. The mean in 2008 was 0.0 weevils per trap per week, and in 1998 it was 3.99, a reduction rate of 100%. Insecticide applications in 2008 for boll weevils were reduced by 100.0%, compared to 1998.

The program expanded into the Southeast zone in 1999 with the diapause phase, followed by season-long phases in 2000, 2001, 2002, 2003 and season-long maintenance phases in 2004, 2005, 2006, 2007 and 2008. The seasonal mean number of boll weevils captured per trap per week in 2008 was significantly less than in 2000. The mean in 2008 was 0.000771, and in 2000 it was 5.54, a reduction rate of 99.986%. Insecticide applications made by the program in 2008 were less than in 2000 by 98.05%.

The program expanded into the Central zone in 2000 with the diapause phase of the program followed by a season-long phase in 2001, 2002, 2003 and 2004, and season-long maintenance phases in 2005, 2006, 2007 and 2008. The seasonal mean number of boll weevils captured per trap per week in 2008 was significantly less than in 2000. The mean in 2008 was 0.0, and in 2000 it was 15.66, a reduction rate of 100.0% in 2008 when compared with 2000. Insecticide applications made by the program in 2008 were less than in 2000 by 100.0%.

The program expanded into the Northeast Ridge zone in 2001 with the diapause phase, followed by a season-long phase in 2002, 2003, 2004 and 2005, and season-long maintenance phase in 2006, 2007 and 2008. The seasonal mean number of boll weevils captured per trap per week in 2008 was significantly less than in 2001. The mean in 2008 was 0.0, and was 8.70 in 2001, a reduction rate of 100.0%. Insecticide applications made by the program in 2008 were less than in 2002 by 100.0%.

The program expanded in the Northeast Ridge Zone to include Eastern Poinsett in 2002 with the diapause phase, followed by a season-long phase in 2003, 2004, 2005 and 2006, and season-long maintenance phase in 2007 and 2008. The seasonal mean number of boll weevils captured per trap per week in 2008 was reduced when compared to the trapping program in 2001. The mean in 2008 was 0.0, and was 11.79 in 2001, a reduction of 100.0%.

The program expanded into the Northeast Delta Zone in 2003 with the diapause phase, followed by a season-long phase in 2004, 2005, 2006 and 2007, and season-long maintenance phase in 2008. The seasonal mean number of boll weevils captured per trap per week in 2008 was significantly less than in 2003. The season mean number of boll weevils captured per trap per week in 2008 was 0.0, and was 9.576 in 2003 a reduction of 100.0%. Insecticide applications made by the program in 2008 were less than in 2003 by 100.0%.

The overall percent boll weevil damaged squares and bolls during the month of September were significantly lower in zones that have been through multiple full-season phases of the program as compared with zones in the first full-season phase. The percent damage in the Southwest Zone was 0.00%, in the Southeast Zone it was 0.00%, in the Central Zone it was 0.00%, in the Northeast Ridge Zone it was 0.00%, and in the Northeast Delta Zone it was 0.00%. In 2002 prior to the initiation of eradication activities within the Northeast Delta Zone the percent damage was 59.6.

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 is proving successful in eradicating the boll weevil. Quality control of all aspects of program activities continues to be carried out season-long.

Introduction

The plan to eliminate the boll weevil, *Anthonomus grandis* Boheman, a native of Mexico and Central America, from the United States has expanded into all regions of the US cotton belt in 2005. This is certainly true in the state of Arkansas. Expansion of the eradication effort into Eastern Poinsett in 2002 and into Eastern Craighead and Mississippi counties in 2003 brought all cotton acreages located in the State of Arkansas and the entire Southeastern portion of the cotton belt into active eradication. This is critical to the success of the Arkansas eradication effort as well as to adjoining states, which have been effected by migrating boll weevil populations. The history of the boll weevil eradication program in Arkansas was previously described (Kiser, et al. 2001).

The Southwest Zone program was initiated with the diapause phase 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, the first season-long maintenance phase in 2002, the second season-long maintenance phase in 2003, the third season-long maintenance phase in 2004 the fourth season-long maintenance phase in 2005, the fifth season-long maintenance phase in 2006, the sixth season-long maintenance phase in 2007 and the seventh season-long maintenance phase in 2008. 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, the third season-long phase in 2002, the forth season-long phase in 2003, the first season-long maintenance phase in 2004, the second season-long maintenance phase in 2005, the third season-long maintenance phase in 2006, the fourth season-long maintenance phase in 2007 and the fifth season-long maintenance phase in 2008. 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 second season-long phase in 2002, the third season-long phase in 2003, the forth season-long phase in 2004, the first season-long season maintenance phase in 2005, the second season-long maintenance phase in 2006, the third season-long maintenance phase in 2007 and the fourth season-long maintenance phase in 2008. The Northeast Ridge Zone began the program operations with the diapause phase in 2001. The first season-long phase of the program began in the spring of 2002, the second season-long phase in 2003, third season-long phase in 2004, the fourth season-long phase in 2005, the fifth season-long phase in 2006, the first season-long maintenance phase in 2007 and the second season-long phase in 2008. The Arkansas State Plant Board entered into an agreement with the Arkansas Boll Weevil Eradication Foundation to carry out the eradication program in the Northeast Delta Zone as previously reported (Kiser et al, 2005). Program operations were implemented with the diapause phase in the Northeast Delta Zone in August 2003. The first season-long phase of the program began in the spring of 2004, the second season-long phase in 2005, the third season-long phase in 2006, the fourth season-long phase in 2007 and the fifth season-long phase in 2008. With the initiation of the Northeast Delta Zone the entire state of Arkansas is currently under eradication.

Materials and Methods

Five Eradication Zones were established through legislative action, grower referenda and the Arkansas State Plant Board. These zones, including 2008 cotton crop acreage, are as follows (Figure 1):

1.	Southwest	1,127 acres
2.	Southeast	151,909 acres
3.	Central	130,657 acres
4.	Northeast Ridge	105,235 acres
5.	Northeast Delta	217,052 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: Boll weevil pheromone traps (Plato Industries, Inc., Houston, Texas) (Plato et al, 2001) were placed around the perimeter of all fields located in season-long active phase zones shortly after planting at a space of approximately 300 feet (Boyd et al, 2000). During 2008 all Arkansas Boll Weevil Eradication Program (ABWEP) Zones where 2007 fall weevil trap captures had averaged at or above .01 boll weevils per trap per week spacing was 300 feet, between .01 and .002 boll weevils captured per trap in fall of 2007 the spacing was 900 feet, where 2007 fall weevil captures averaged .001 or less boll weevils per trap, the spacing was 1800 feet and where in 2007 and 2006 no weevils were captured the spacing was 7200 feet. Fields adjacent to other states were trapped at approximately 300 feet. In 2007 all ABWEP Zone traps were baited with combo lure, 25 mg of grandlure and 60 mg eugenol impregnated onto polyvinyl chloride one-inch square laminated dispenser (Plato Industries, Inc., Houston, Texas) and were inspected either weekly in areas where spaced at 300 or 900 feet or every three weeks where traps were spaced at 1800 or 7200 feet. Grandlure dispensers were replaced tri-weekly, leaving the dispenser from the previous cycle in addition to the new dispenser. Therefore, each dispenser was left in the trap for a total of six weeks. On the same schedule as listed for grandlure replacement one-inch by half-inch laminated polyvinyl chloride dispensers impregnated with 0.6 gm of dichlorvos (DDVP) (Plato Industries, Inc., Houston, Texas), were placed in each trap to kill weevils as they entered traps.

2. Field Survey: The purpose of the survey was to establish the level of boll weevil damage inside active eradication zones. The eradication zones included in the survey were the Southwest Zone, Southeast Zone, Central Zone, Northeast Ridge Zone and Northeast Delta. 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 2008. 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 and zone.

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 a necessary boll weevil host-free period. 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:
      1) Southwest Zone: In 2008, ABWEP personnel implemented the seventh season-long maintenance phase of the program. Beginning at pinhead square, fields reaching treatment criteria (action threshold), received three automatic applications 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 surrounding fields were also treated.

2) Southeast Zone: in the spring of 2008 ABWEP personnel began the fifth season-long maintenance phase of the program. Beginning at pinhead square, fields reaching treatment criteria (action threshold), received three automatic applications of Fyfanon® ULV at (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 surrounding fields were also treated.
3) Central Zone: in the spring of 2008 ABWEP personnel began the fourth season-long maintenance phase of the program. Beginning at pinhead square, fields reaching treatment criteria (action threshold), received three automatic applications of Fyfanon® ULV at (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 adjacent fields were also treated.
4) Northeast Ridge Zone: in the spring of 2008 ABWEP personnel began the third season-long maintenance phase of the program. Beginning at pinhead square, fields reaching treatment criteria (action threshold), received three automatic applications of Fyfanon® ULV at (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 adjacent fields were also treated.
5) Northeast Ridge Zone (Eastern Poinsett): in the spring of 2008 ABWEP personnel began the second season-long maintenance phase of the program. Beginning at pinhead square, fields reaching treatment criteria (action threshold), received three automatic applications of Fyfanon® ULV at (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 adjacent fields were also treated.
6) Northeast Delta Zone: in the spring of 2008 ABWEP personnel began the first season-long maintenance phase of the program. Beginning at pinhead square, fields reaching treatment criteria (action threshold), received three automatic applications of Fyfanon® ULV at (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. This threshold was adjusted in some areas depending upon weevil captures thru the season. When fields triggered according to the above criteria adjacent fields were also treated.

Results and Discussion

Trap captures from zone trapping programs (Figure 14), boll weevil damage surveys (Figure 4), and field observations indicate reductions in boll weevil populations in all active zones.

Southwest Zone

The Southwest Zone is exhibiting no boll weevil population from trapping data for 2008, and economic damage caused by boll weevils was not noticed in any fields during the 2008 season.

The 2008 season-long mean number of adult weevils captured per trap per week was zero, a total reduction when compared to captures from the 1998 season. The mean number for 2008 was 0.0000, in 2007 was 0.0000, in 2006 was 0.0000, in 2005 was 0.0004, in 2004 was 0.0000, in 2003 was 0.00013, in 2002 was 0.00196, in 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 100% in 2008 as compared to 1998 (Figure 2). The increase in weevils per trap from 2004 to 2005 is due to a single weevil capture in 2005 that is suspected to have come into the area on farm machinery. Accurate comparisons of trap captures between the 1997 diapause phase and 2008 season are unavailable due to very limited trapping information for the 1997 season.

The season-long average number of program applications in 2008 was 0.00, in 2007 was 0.00, in 2006 was 0.00, in 2005 was 0.00, in 2004 was 0.00, in 2003 was 0.00, in 2002 it was 3.07, in 2001 it 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 100% in 2008 compared to 1998 (Figure 3). 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. For more detailed analysis of treatments during past seasons see Kiser, et al, 2001and 2002.

As indicated by the boll weevil damage survey conducted the first week of September 2008, no boll weevil damaged cotton fruit was detected in any county located within the ABWEP eradication area. 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 0.20% damage calculated for the cotton growing counties in the fourth season-long phase of the program.

Southeast Zone

In the Southeast Zone, boll weevil trap captures were reduced following the fall diapause phase of the program in 1999, and the season-long phases in 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007 and 2008. The 2008 season-long overall mean number of adult boll weevils captured per trap per week was significantly less than 2000. The mean number for 2008 was .000772, and in 2000 it was 5.54, a reduction of 99.986% in 2008 as compared to 2000 (Figure 5). The weevils per trap per week number went up from 2004 to 2005 and 2006 due to trapping density being reduced by 80% in 90% of the zone where no weevil populations were detected. Over 99% of the weevils captured in the Southeast Zone during 2008 were captured within a two mile radius of an area near Montrose, Arkansas. Accurate comparisons of trap captures between the 1999 diapause phase and 2008 season are unavailable due to very limited trapping information for the 1999 season. Historically, fall boll weevil trap captures in the Southeast Zone prior to eradication activity have been very high, averaging over 100 boll weevils per trap per week in certain counties (Donald R. Johnson, personal communication).

As indicated by a boll weevil damage survey conducted the first week of September 2008, no boll weevil damaged cotton fruit was detected when compared to boll weevil damage survey results conducted during the first season-long phase of eradication.. The percentage of hostable cotton fruit damaged by boll weevils in 2008 was 0.00 % compared to 6.17% damage calculated for the first season-long phase of the program (Figure 4).

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 2008 was .24, in 2007 it was .39, in 2006 it was .24, in 2005 it was 0.35, in 2004 it was 1.27, in 2003 it was 4.18, in 2002 it was 7.19, in 2001 it was 9.30 and in 2000 it was 12.11, a reduction of 98.05 % in 2008 compared to 2000 (Figure 6).

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 season-long phases in 2001, 2002, 2003, 2004, 2005, 2006, 2007 and 2008. The 2008 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 2008 was 0.0000, in 2007 it was .00211, in 2006 it was .00214, in 2005 it was 0.029, in 2004 it was 0.014, in 2003 was .028, in 2002 it was 0.32, in 2001 it was 0.41, and in 2000 it was 15.66, a reduction of 100.0% in 2008 as compared to 2000 (Figure 7).

As indicated by a boll weevil damage survey conducted the first week of September 2008, no boll weevil damaged cotton fruit was detected when compared to boll weevil damage survey results conducted during the first season-long phase of eradication.. The percentage of hostable cotton fruit damaged by boll weevils in 2008 was 0.00 % compared to 1.57% damage calculated for the first season-long phase of the program (Figure 4).

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 2008 was 0.0, in 2007 it was .21, in 2006 it was .29, in 2005 it was 1.00, in 2004 it was 1.27, in 2003 it was 8.77, in 2002 it was 10.88 and in 2001 it was 12.80 applications per acre (Figure 8). Treatments were reduced by 100.0% when applications made in 2008 were compared with 2001.

Northeast Ridge Zone

In the Northeast Ridge Zone, boll weevil trap captures have been reduced following the fall diapause phase of the program in 2001, and the season-long phases in 2002, 2003, 2004, 2005, 2006, 2007 and 2008. The 2008 season-long overall mean number of adult boll weevils captured per trap per week was significantly less than in the 2001 season. The mean number for 2008 was .0000 and in 2001 it was 8.70, a reduction of 100.0% in 2008 as compared to 2001 (Figure 9).

Trapping information for the Eastern Poinsett portion of the Northeast Ridge was kept separate due to the different phases of the program in each area. In Eastern Poinsett (added to the Northeast Ridge Zone in 2002) the 2008 season-long overall mean number of adult boll weevils captured per trap per week was significantly less than in the 2002 season. The mean number for 2008 was 0.0000 and in 2002 it was 6.127, a reduction of 100.0% in 2008 as compared to 2002 (Figure 10).

As indicated by a boll weevil damage survey conducted the first week of September 2008, no boll weevil damaged cotton fruit was detected when compared to boll weevil damage survey results conducted during the first season-long phase of eradication. The percentage of hostable cotton fruit damaged by boll weevils in 2008 was 0.00 % compared to 3.76% damage calculated for the first season-long phase of the program (Figure 4).

The season-long mean number of applications in the Northeast Ridge Zone in 2008 was 0.0000, in 2007 it was 0.23, in 2006 it was 2.69, in 2005 it was 5.76, in 2004 it was 6.78, in 2003 it was 8.77, in 2002 it was 11.48 and in 2001 it was 10.42 applications per acre (Figure 11). Treatments were reduced by 100.0% when applications made in 2008 were compared with 2002.

Northeast Delta Zone

In the Northeast Delta Zone, boll weevil trap captures have been reduced following the fall diapause phase of the program in 2003, and the season-long phase in 2004, 2005, 2006, 2007 and 2008. The 2008 season-long overall mean number of adult boll weevils captured per trap per week was significantly less than in the 2003 season. The mean number for 2008 was 0.0000 and in 2003 it was 9.58, a reduction of 100.0% in 2008 as compared to 2003 (Figure 13).

As indicated by a boll weevil damage survey conducted the first week of September 2008, no boll weevil damaged cotton fruit was detected when compared to boll weevil damage survey results conducted during the first season-long phase of eradication. The percentage of hostable cotton fruit damaged by boll weevils in 2008 was 0.00 % compared to .860% damage calculated for the first season-long phase of the program (Figure 4).

The season-long mean number of applications in 2008 was 0.00, in 2007 it was 0.84, in 2006 it was 4.00, in 2005 it was 5.49, in 2004 it was 7.41 and in 2003 it was 9.03 applications per acre (Figure 15). Treatments were reduced by 100.0% when applications made in 2008 were compared with 2003.

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 full season programs as compared with diapause programs.

Acknowledgements

We gratefully appreciate the entire ABWEF staff for their diligent effort in working toward the goal of boll weevil eradication: Ken Pierce (USDA, APHIS); Lane Garner (Chief Financial Officer); Mark Crowder (Human Resource Manager ABWEF); David Murray (Associate Director of Operations); Joel Pietsch (State Environmental Monitoring Specialist); Chad Bishop (IT Director); (Jay Young (Oracle Administrator); Bill Benefield and Larry Rodgers (Operation Support); Toni Graham (Contract Coordinator/Safety Manager); Regina Coleman, Jack Davis and Glenn “Bear” Harrell, ABWEF zone managers; Josh Bean, Chris Berg, Leigh Gibson and Dusty Kennemore, ABWEF district supervisors are all due special thanks for their leadership and support of the eradication effort. Assistant district supervisors including; Chad Crawford, Larry “Shag” Johnson, Jr., David Lynn and Brent Wellman are also due special recognition. The Agriculture Council of Arkansas, Arkansas Boll Weevil Eradication Foundation Board of Directors, Arkansas Boll Weevil Eradication Technical Advisory Committee, Arkansas Farm Bureau, Arkansas State Plant Board, Arkansas State University, Arkansas UAEX Service, cotton grower associations and grower committees, National Cotton Council, University of Arkansas, USDA-APHIS-PPQ and USDA-FSA provided invaluable leadership and support to the ABWEP.

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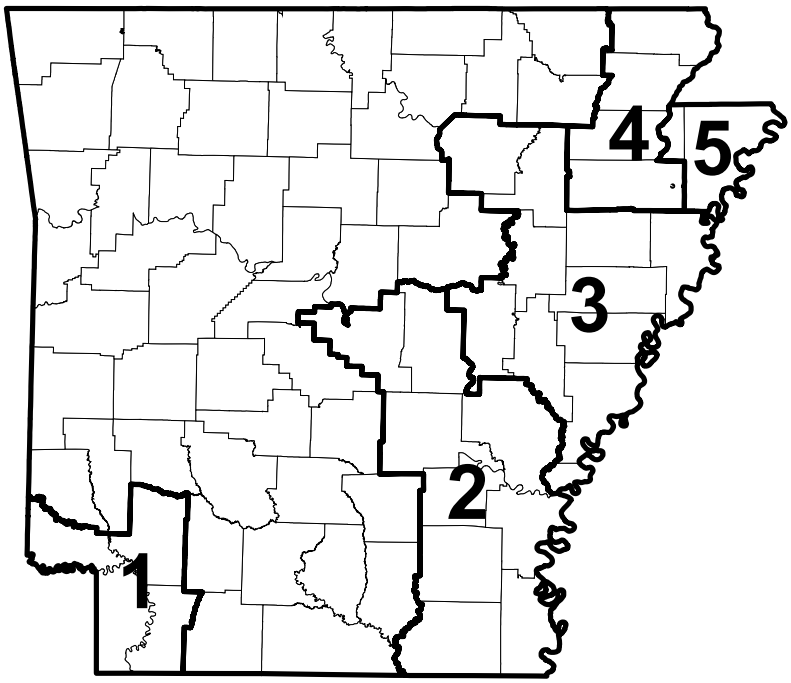

Figure 1. Boll weevil eradication zones in Arkansas, 2007.

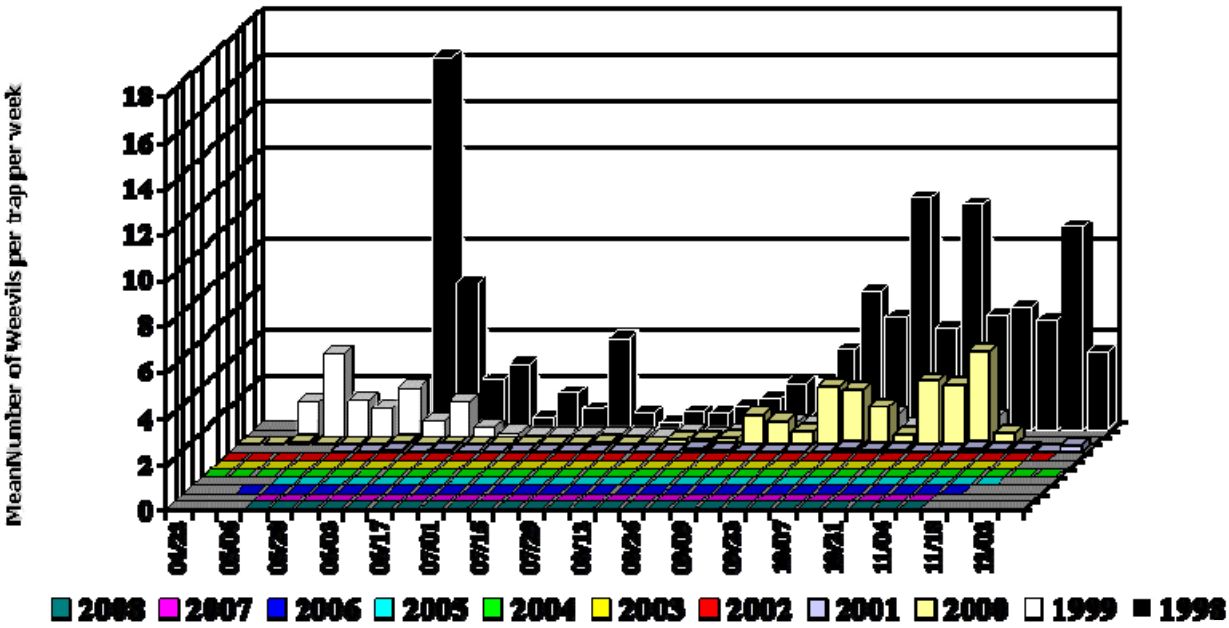

Figure 2. Mean number of adult boll weevils captured per trap per week by year, Southwest Zone.

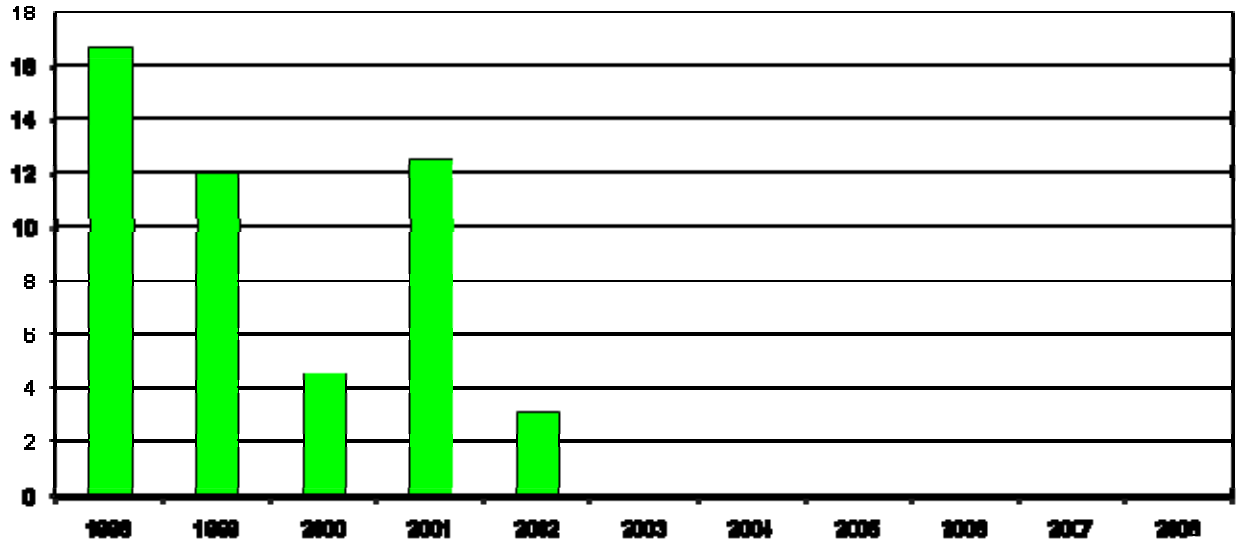

Figure 3. Season-long mean number of insecticide applications per acre in the Southwest Zone of Arkansas.

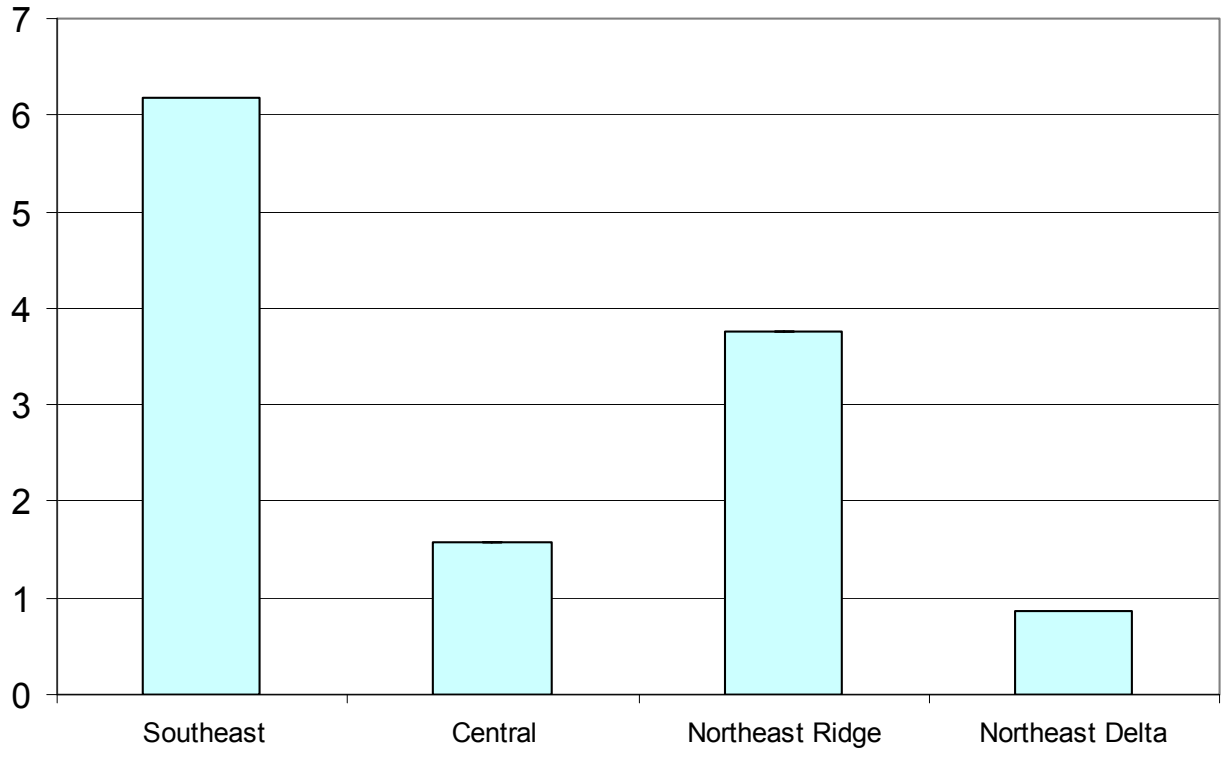

Figure 4. Boll Weevil Damage Survey. Overall percent boll weevil damage squares/bolls in the Southeast, Central, Northeast Ridge and Northeast Delta zones, Arkansas, during their first season-long phase of the program.

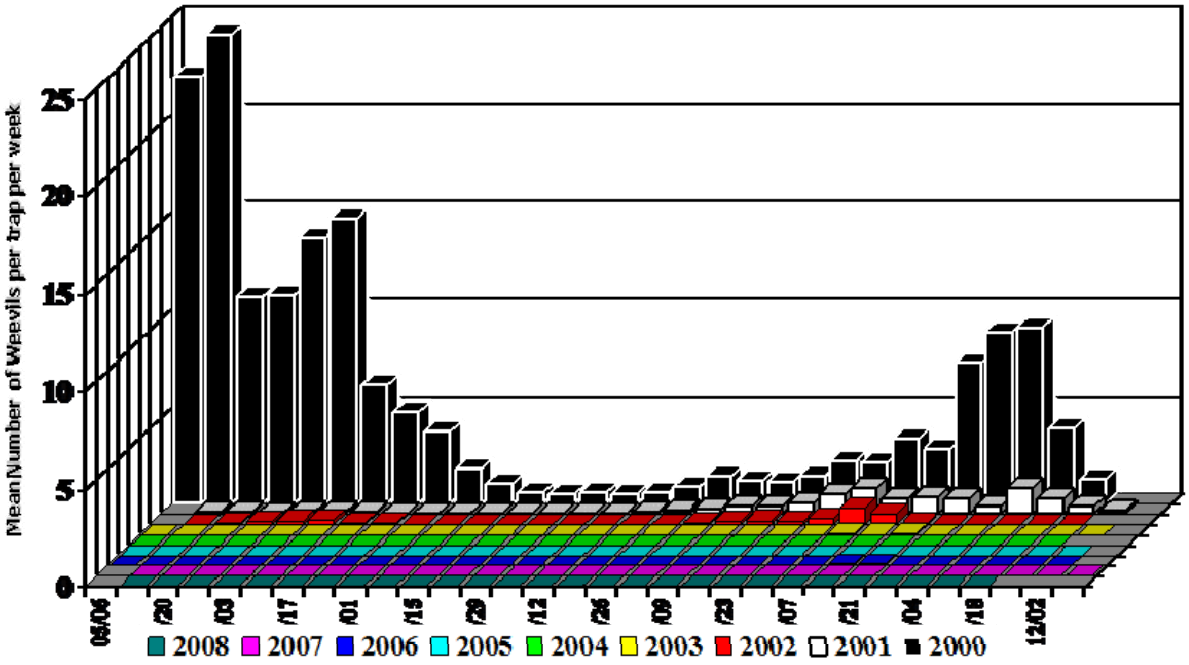

Figure 5. Mean number of adult boll weevils captured per trap per week by year, Southeast Zone.

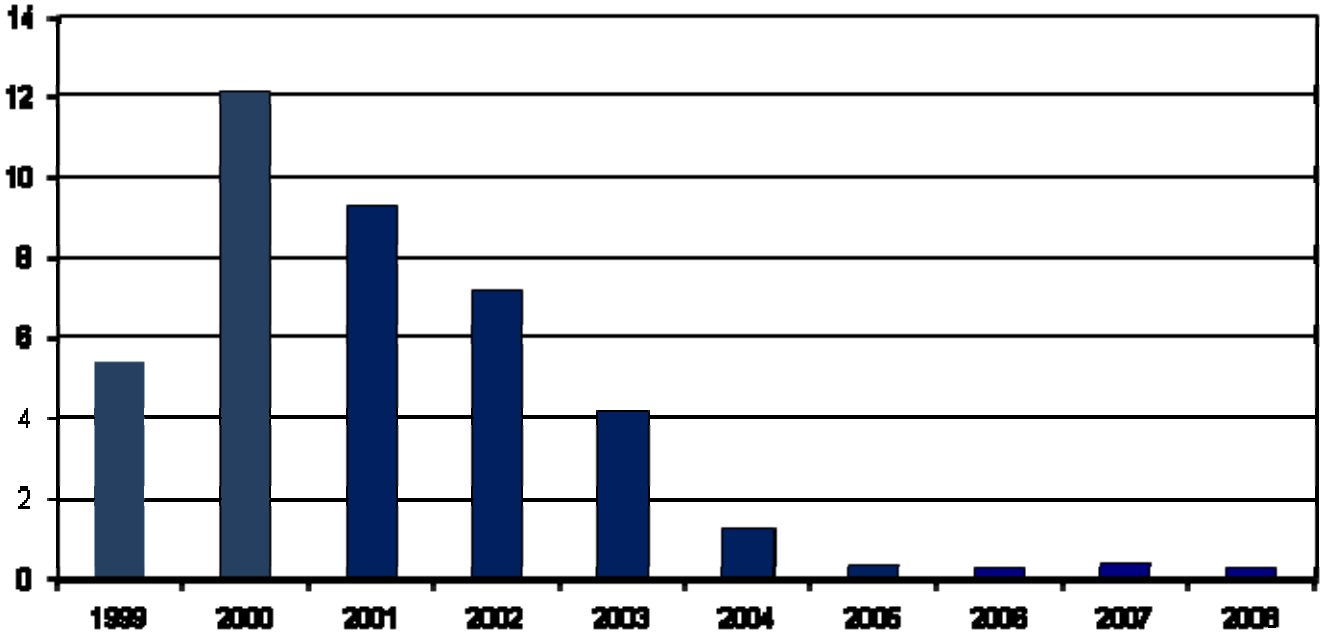

Figure 6. Season-long mean number of insecticide applications per acre in the Southeast Zone of Arkansas.

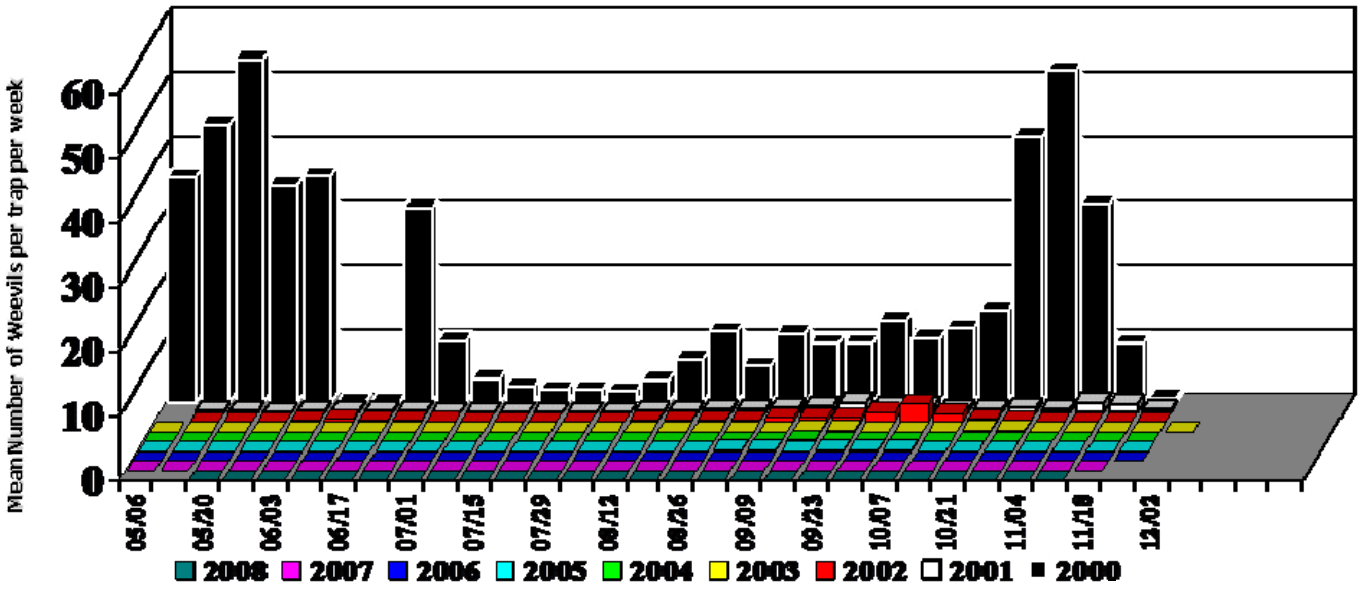

Figure 7. Mean number of adult boll weevils captured per trap per week by year, Central Zone.

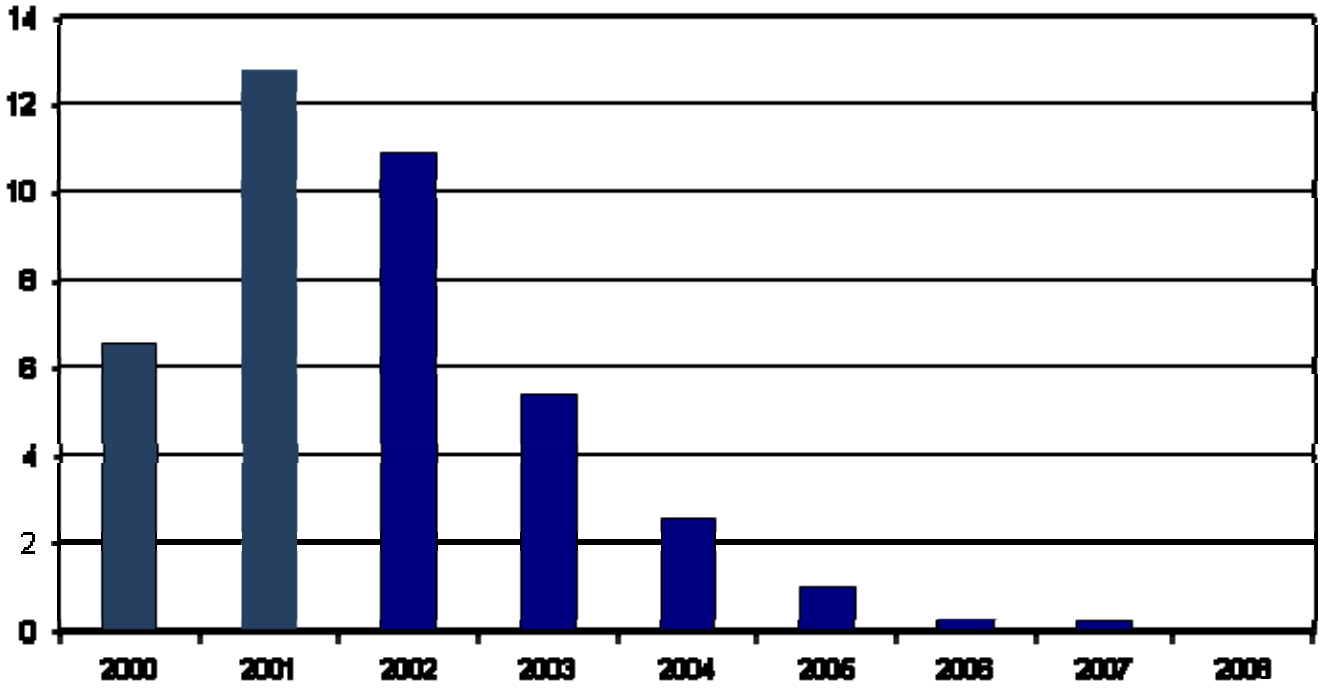

Figure 8. Season-long mean number of insecticide applications per acre in the Central Zone of Arkansas.

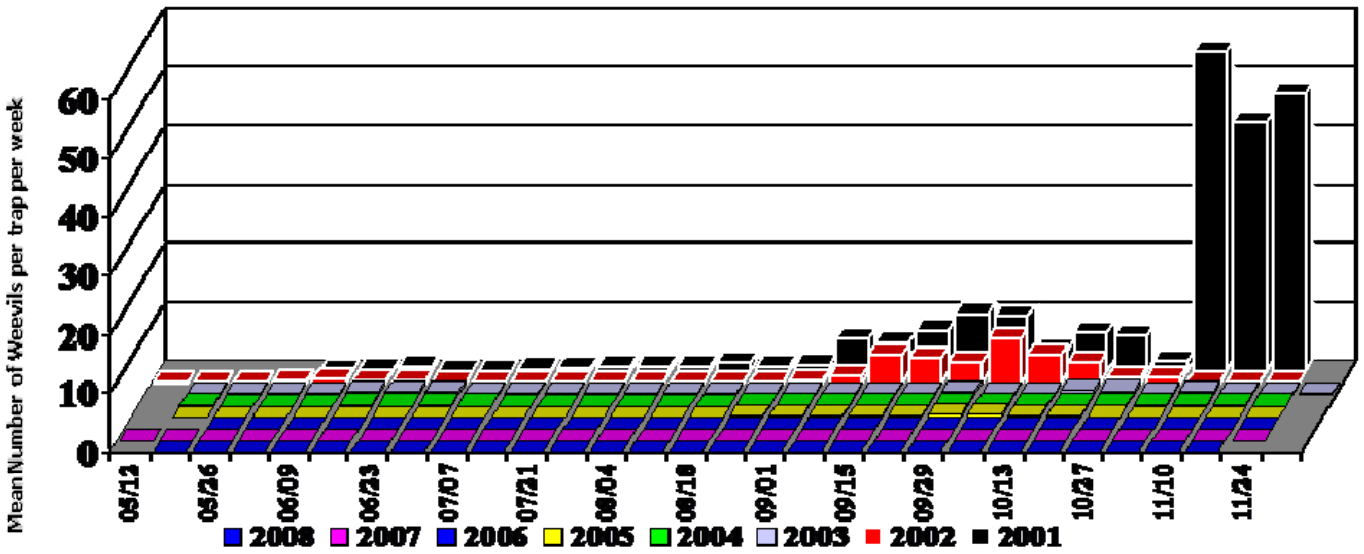

Figure 9. Mean number of adult boll weevils captured per trap per week by year, Northeast Ridge Zone without trap counts from Eastern Poinsett County.

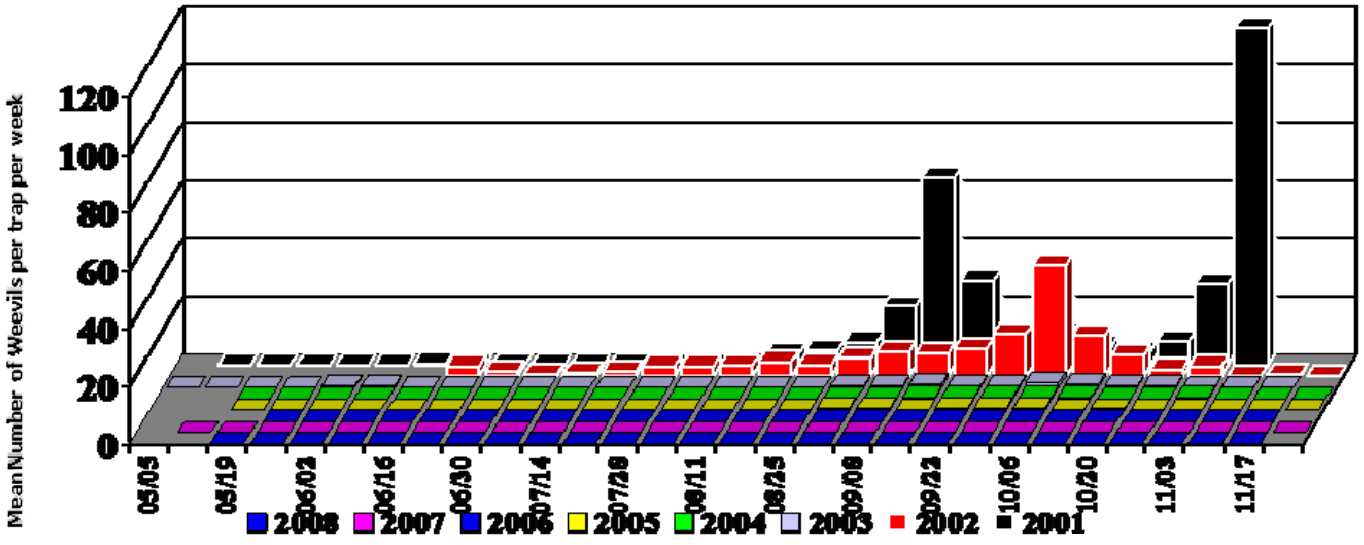

Figure 10. Mean number of adult boll weevils captured per trap per week by year, Eastern Poinsett County, Northeast Ridge Zone.

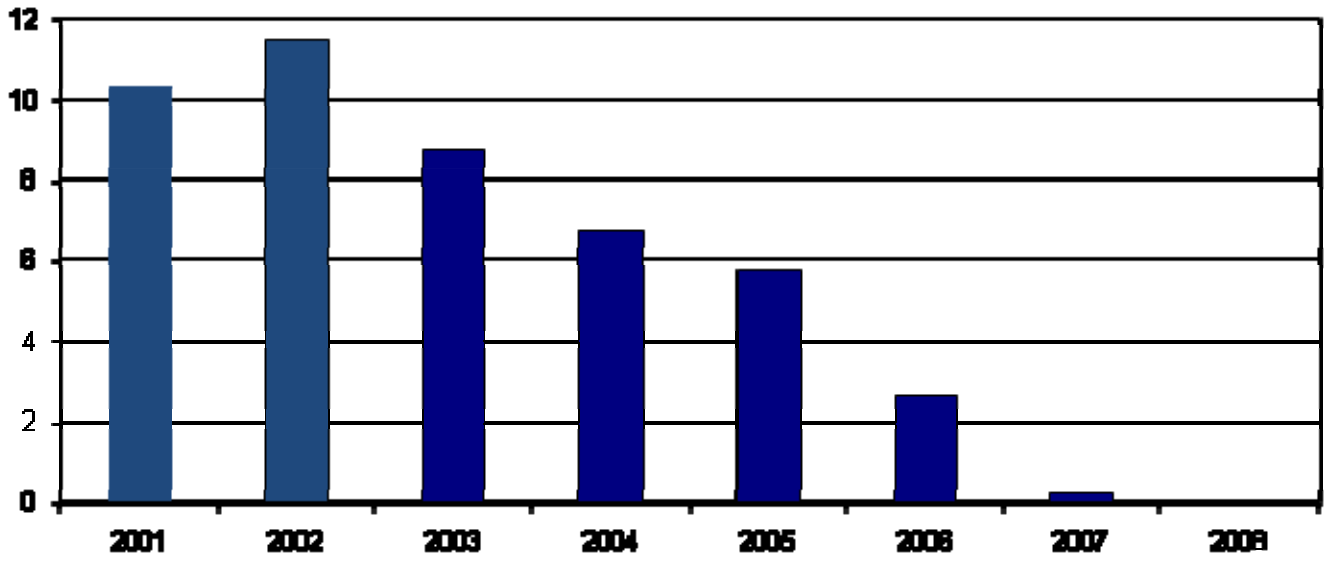

Figure 11. Season-long mean number of insecticide applications per acre in the Northeast Ridge Zone of Arkansas.

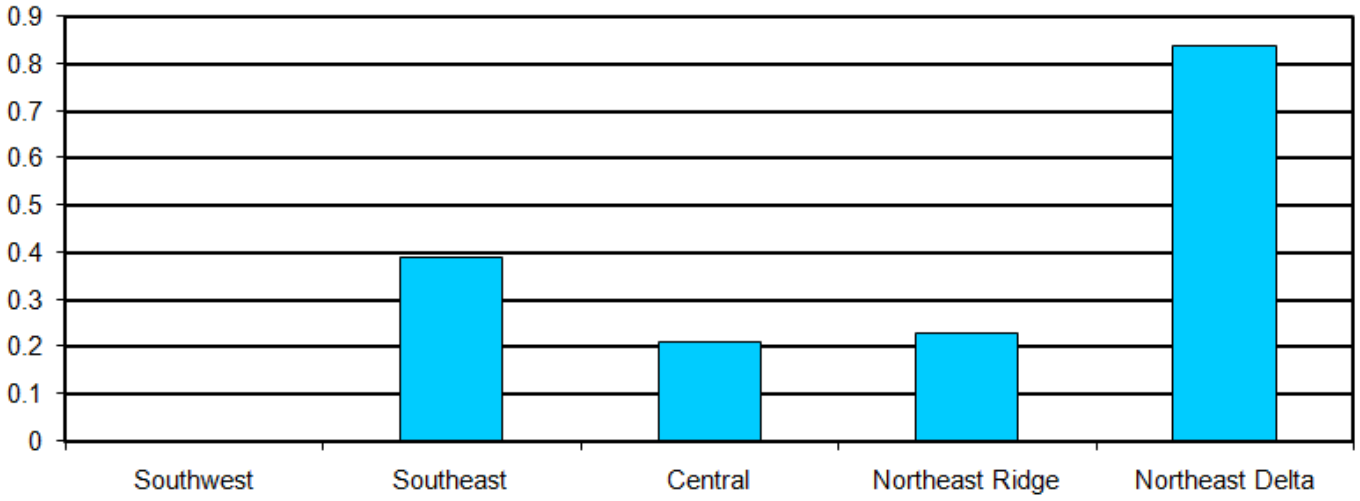

Figure 12. Overall mean number of insecticide applications per acre in the Southwest, Southeast, Central, Northeast Ridge and Northeast Delta zones, Arkansas, 2007.

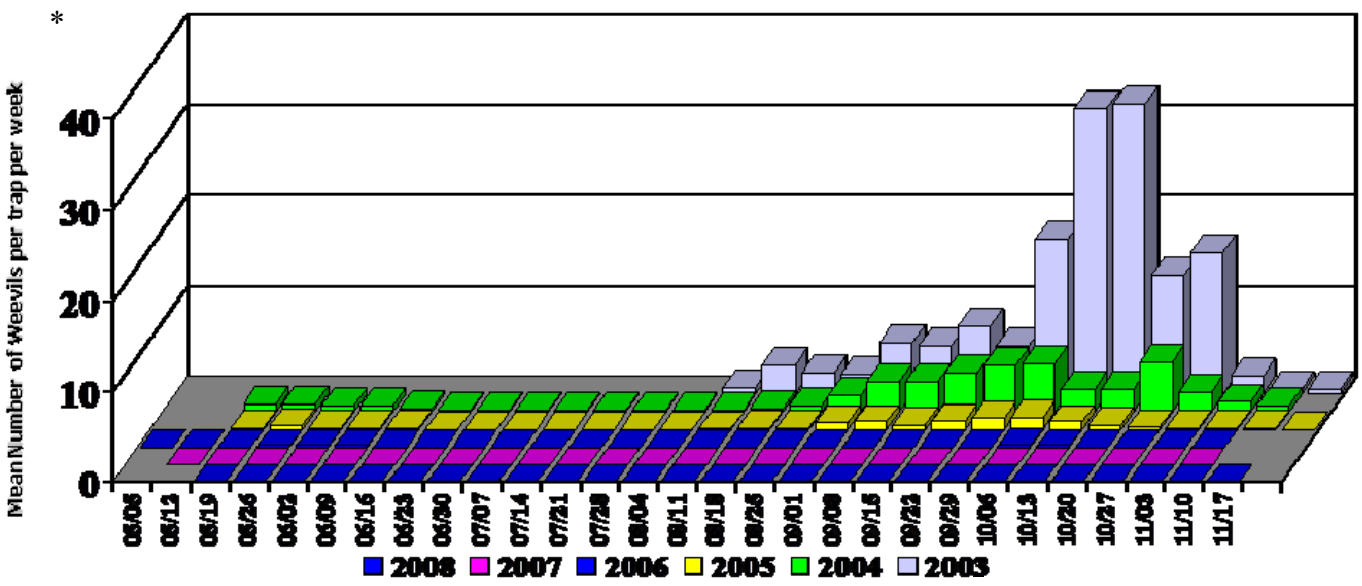

Figure 13. Mean number of adult boll weevils captured per trap per week by year, Northeast Delta Zone.

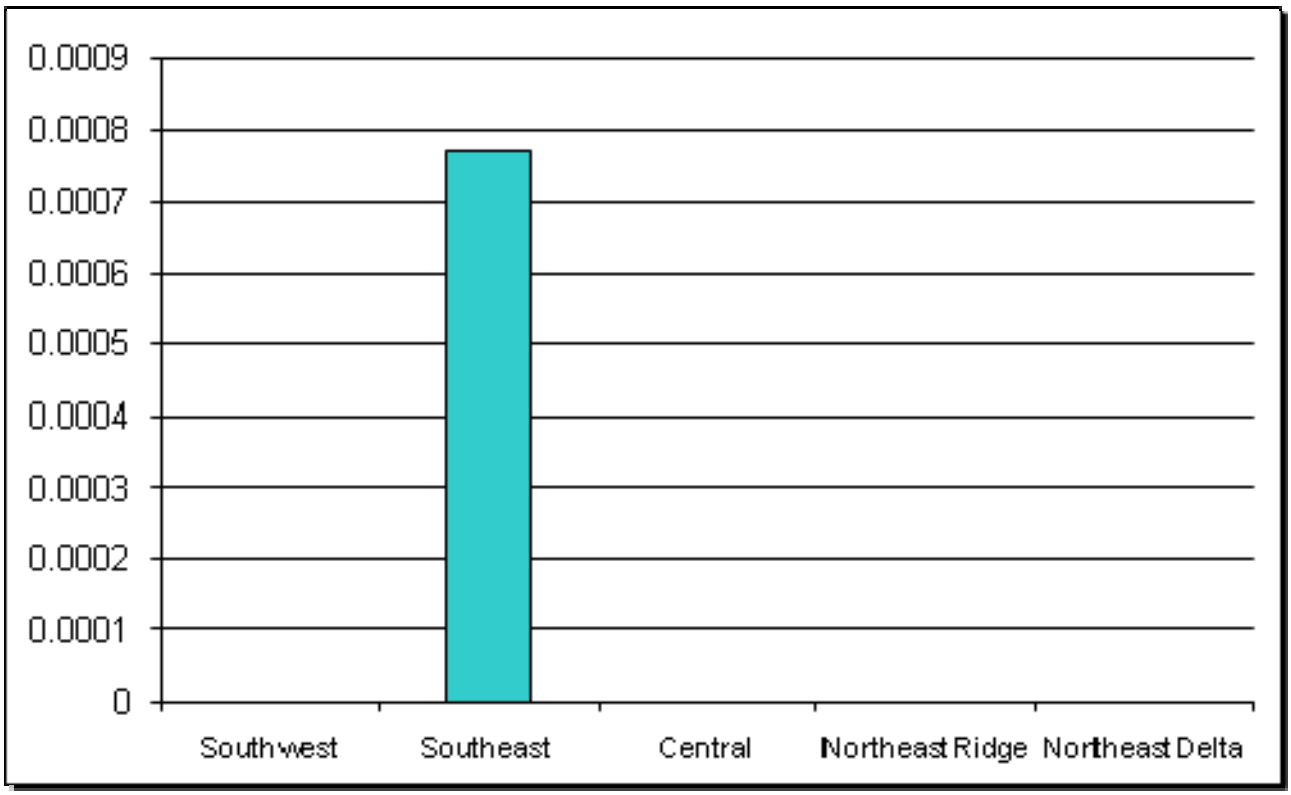

Figure 14. Overall mean number of adult weevils captured per trap per week in the Southwest, Southeast, Central, Northeast Ridge and Northeast Delta, Arkansas, 2007.

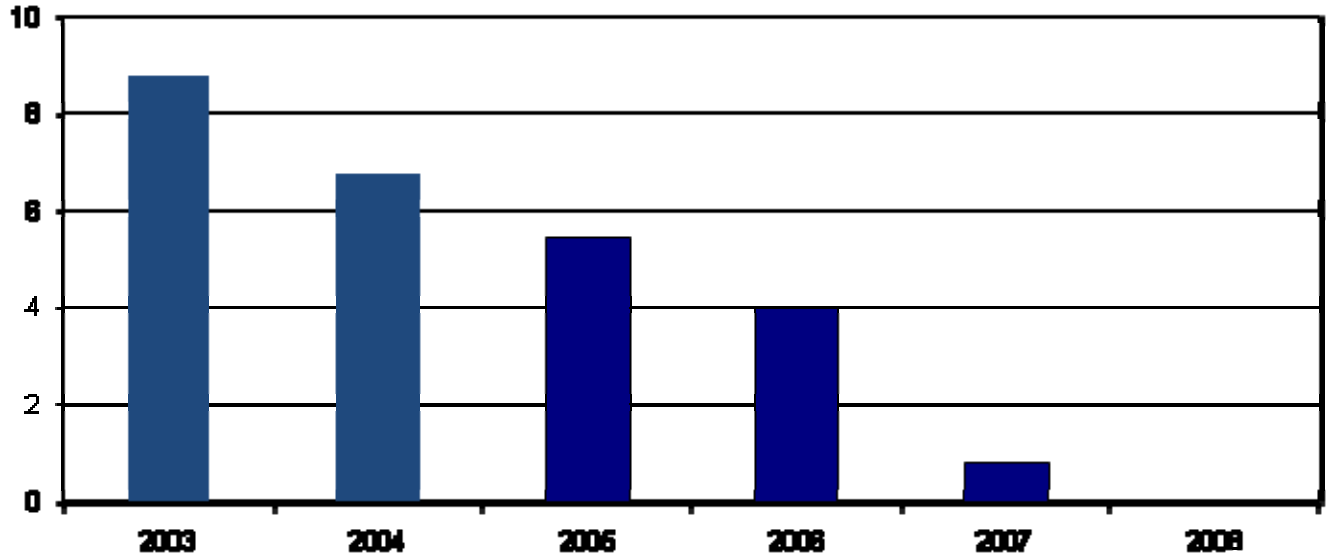

Figure 15. Season-long mean number of insecticide applications per acre in the Northeast Delta Zone of Arkansas.