BOLL WEEVIL ERADICATION UPDATE – ARKANSAS, 2000

Danny Kiser, Michael Catanach and Douglas Ladner
Arkansas Boll Weevil Eradication Foundation, Inc.
Little Rock, AR
Technical Advisory Committee:
Don Johnson, Gus Lorenz, Keith Martin, Don Plunkett,
Bill Roberson and Jerry Williams
University of Arkansas Cooperative Extension Service
Little Rock, Blytheville, Helena, AR
Cecil Williams
Agriculture Council of Arkansas
West Memphis, AR
Tina Tigue
Arkansas State University
Jonesboro, AR
Phil Tugwell and Bill Yearian
University of Arkansas
Fayetteville, AR
Charles Denver and Moris O'Quinn
Cotton Consultant, Dermott
Forrest City, AR
Osama El-Lissy
USDA, APHIS, PPQ
Riverdale, MD
Gene Martin
Arkansas Farm Bureau
Little Rock, AR
David Wildy
Cotton Grower
Manila, AR

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 was first initiated in the Southwest zone in 1997 with the diapause phase, followed by season-long phases in 1998, 1999, and 2000. The seasonal mean number of boll weevils captured per trap per week in 2000 was significantly less than in 1998. The mean in 2000 was .67, and in 1998 was 3.96, a reduction rate of 83%. Insecticide applications in 2000 for boll weevils were reduced by 72.7%, compared to 1998.

Eradication was initiated in the Southeast zone in 1999 with the diapause phase of the program followed by a season-long phase in 2000. The overall mean number of boll weevils captured per trap per week was reduced in 2000 as compared to 1999. The mean in 2000 was 3.3.

The Central zone began eradication with the diapause phase in August of 2000, and is scheduled to implement the first season-long phase in 2001.

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 Southeast Zone was 6.1%, in the Central Zone it was 17.3%, and in the non-active eradication zones it was 71.7%.

The results of the ABWEP effort, demonstrated to this point, indicate that progress toward eradication is being made, especially when a sound approach to eradication is implemented. The use of pheromone traps for detection, along with sound cultural, mechanical, and chemical control in an area wide approach is an effective and proven program for boll weevil eradication.

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Introduction

The history of boll weevil, *Anthonomus grandis* Boheman, a native of Mexico and Central America, movement into the United States and the subsequent economic havoc this pest has imposed upon the U.S. cotton industry are well documented in numerous beltwide cotton publications. Lincoln and Williams (1952) reported boll weevil damage to cotton in Arkansas averaged from 10 to 27 percent where insecticides were applied, compared to 58 percent in untreated cotton. Reductions in cotton yield, cost of insecticide control, environmental concerns related to insecticide use to control boll weevil, increases in cost of controlling secondary pests, the potential of resistance developing in the boll weevil to currently used insecticides, and the potential of many of the insecticides currently used not being available in the future (due to changes in registration regulations) were all important issues that led Arkansas cotton growers to vote referenda to eliminate boll weevils from the state.

Discussions regarding the ABWEP began during the summer of 1988. Dr. Gerald Musick, Dean of the University of Arkansas College of Agriculture and Home Economics, and Director of the Agricultural Experiment Station, appointed the first technical committee (co-chaired by Donald Johnson, University of Arkansas Extension Service and J.R. (Jake) Phillips, Research Entomologist, University of Arkansas) on July 10 1989. The committee included representatives from research and Extension faculty, State Plant Board, Soil and Water Conservation, Industrial Development Commission, producers, consultants, Agricultural Council of Arkansas, and the Arkansas Farm Bureau. The committee explored potential implementation of a boll weevil eradication program. Following the recommendation of the technical advisory committee the first Arkansas Boll Weevil Eradication Foundation (ABWEF) legislative bill was introduced at the 78th General Assembly of Arkansas in 1991. The bill passed and became ACT 710, authorizing the creation of the ABWEF Board, which operates under the auspices of the Arkansas State Plant Board in carrying out the program. In 1993, ACT 854 passed to allow the ABWEF Board to issue ginning certificates proving assessment payments by producers. Producers without certificates could not have their cotton ginned.

The technical committee was reorganized in 1995 under the leadership of Dr. Bill Yearian, University of Arkansas Entomology Department Head. Upon the recommendation of the technical advisory committee and the Grower Board in 1995, the General Assembly of Arkansas passed ACT 529, allowing for a grower referendum in the Southwest Zone. In 1997 ACT 330 contained enabling legislation that allowed for regional referenda areas (zones), as determined necessary by the Board (Johnson and Martin, 2000).

The Southwest Zone program was initiated in 1997 with operations under the direction of the Louisiana Boll Weevil Eradication Program. The ABWEF assumed program operations starting with the third season-long phase of the program in 2000. 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. Program operations were also implemented with the diapause phase in the Central Zone in August 2000. Growers in the Northeast Ridge Zone passed a referendum on September 25, 2000 by 73.9%. Program operations are scheduled to begin with the diapause phase in the fall of 2001. Plans are being developed for the Northeast Delta Zone, which is tentatively scheduled for a vote in the fall of 2001 looking toward a fall 2002 start up. 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 2000 cotton crop acreage, are as follows (Figure 1):

1.	Southwest	6,886 acres
2.	Southeast	298,258 acres
3.	Central	211,823 acres
4.	Northeast Ridge	122,000 acres
5.	Northeast Delta	350,000 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 previous 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 data recorded as treatments are applied. It also allows for detailed spatial analysis of trapping data.

Detection

1. Trapping:
   a. Boll weevil pheromone traps were placed around the perimeter of all fields shortly after planting at a space of 175 to 350 feet depending on the quality of overwintering habitat adjacent to each field. Traps were baited with 10 mg of grandlure impregnated onto polyvinyl chloride one-inch square laminated dispensers. In the Central 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. In all zones grandlure dispensers were replaced biweekly, 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 four weeks. Every forth week one inch by half inch laminated polyvinyl chloride dispensers impregnated with 0.6 gm. of dichlorvos, were placed in each trap to kill weevils as they entered traps.
   b. In the Southwest Zone, as weevils were detected by perimeter traps in mid-season, T-trapping was employed to identify the location of boll weevil infestations within fields. Treatments were then placed to target infestations. Another goal of T-trapping is to trap out low populations of boll weevils. T-trapping is an in-field trapping technique with four traps in a "T" pattern perpendicular to the perimeter trap that had a positive catch (communications with Ken Pierce, USDA, APHIS, PPQ). The four infield traps were placed at a spacing interval of approximately 100 to 125 feet (Figure 2).
   c. Trap lines were deployed in April 2000 along north south highways linking the Southeast, Central, Northeast Ridge, and Northeast Delta Zones. Trap lines were also deployed along east west highways through the Northeast Ridge and Northeast Delta Zones. Trap line information was gathered to evaluate the difference in weevil catches in active and non-active eradication zones. Trap line information is also used to indicate relative weevil population levels in non-eradication zones to assist in planning future programs. Traps were placed in groups of three, 300 feet apart, and every three miles. Traps were inspected weekly throughout the 2000 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 Southeast Zone and Central Zone. The non-active eradication zones were the Northeast Ridge Zone and 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 walking along a circular pattern extending into a large portion of each field. This survey was conducted the first week of September 2000. 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 Services, 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 in the first year of the program. The first phase of the incentive was based upon having cotton destroyed by September 15, 2000 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 15, 2000 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 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 ultra low volume 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 ultra low volume (ULV) Malathion (16.0 fl oz/ac, 1.23 lb [AI]/ac).

a. Season-long phase:
   1) Southwest Zone: In 2000, ABWEP personnel implemented the third 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). Spring and mid-season treatments were based on an action threshold of two weevils trapped per 40 acres or if a boll weevil infestation was evident. Fall treatments (mid-August) were applied to complete fields when one or more boll weevils were detected in traps. Beginning in early mid-season, in addition to Fyfanon® ULV applications, BWACT (Boll Weevil Attract and Control Tubes), Plato Industries1994, were deployed on the perimeter of fields at a spacing of approximately one hundred feet when boll weevils were detected at increased levels. BWACTs were replaced after three weeks (personal communication with Ken Pierce, USDA, APHIS, PPQ).
   2) Southeast Zone: in the spring of 2000 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). Spring and late season treatments were based on an action threshold of two weevils trapped per 40 acres or if boll weevil infestations were evident. The mid-season action threshold was raised to five weevils trapped per 40 acres.

b. Diapause phase: on July 31, 2000 ABWEP personnel in the Central Zone initiated mistblower applications. Aerial applications began on August 14, 2000. Once applications began, all fields were treated weekly until the elimination of hostable cotton fruit either through defoliation, harvest, crop destruction, or a killing freeze.

Results and Discussion

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 2000 growing season.

The 2000 season-long mean number of adult weevils captured per trap per week was significantly less than 1998. The mean number for 2000 was 0.67, in 1999 was 0.68, and in 1998 was 3.96, a reduction rate of 83% in 2000 as compared to 1998 (Figure 4).

The season-long average number of program applications in 2000 was 4.57 applications per acre, in 1999 it was 12.03, and in 1998 it was 16.73, a reduction of 72.7 % in 2000 compared to 1998 (Figure 5).

Control benefits of the "T" trapping technique and the deployment of BWACTs in the Southwest zone could not be identified. As shown above, the level of reduction in weevil populations in 2000 was rather disappointing when compared to 1999. Until data becomes available and further evaluations are conducted, we would be very cautious to recommend the implementation of these techniques in an eradication program.

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 first season-long phase in 2000. The season-long overall mean number of adult boll weevils per trap per week captured in 2000 was 5.54. The overall mean number of weevils captured per trap per week for the fall period of 2000 was 3.3 weevils (Figure 6). Accurate comparisons of trap captures between the 1999 diapause phase and the same period during the 2000 fall trapping season are unavailable due to very limited trapping information for the 1999 fall period. However, 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, as reported by Donald R. Johnson, University of Arkansas Extension Service, from 1993 to 1998.

As indicated by the boll weevil damage survey conducted the first week of September 2000, 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 6.1 % compared to 71.7% damage calculated for the cotton growing counties outside active eradication zones (Figure 7).

Trap line data also indicated significant differences between boll weevil trap catches in the Southeast Zone when compared to trap captures from non-active eradication zones.

The overall season-long mean number of adult weevils captured in the Southeast Zone trap line per trap per week for the 2000 growing season was 3.01 (Figure 8).

The overall mean number of treatments during the diapause phase of 1999 was 5.43 applications per acre. The season-long mean number of treatments in 2000 was 12.11 applications per acre (Figure 9).

Central Zone

Trapping information was collected from all fields in the Central Zone during the diapause phase of the eradication program in 2000 (Figure 10). This information will serve as a base line 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 Central Zone per trap per week in 2000 was 16.3. The mean number of weevils captured per trap per week during the diapause phase of the program was 16.25 (Figure 10).

The percentage of hostable cotton fruit damaged by boll weevils, as indicated by the 2000 survey, during the first week of September 2000 in counties located in the Central Zone was 17.3 % compared with 71.7% damage calculated for the cotton growing counties outside active eradication zones (Figure 7).

The season-long overall mean number of adult weevils captured in the Central Zone trap line per trap per week for the 2000 growing season was 21.04 (Figure 8).

The season-long mean number of applications in 2000 was 6.55 applications per acre (Figure 9).

Non Active Eradication Zones (Northeast Ridge and Northeast Delta)

The percentage of boll weevil damaged hostable cotton fruit, as indicated by the survey conducted the first week of September 2000, in counties located in the non-eradication zones was 71.7% (Figure 7). Historically, insecticide use for boll weevil control in the non-eradication zones 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).

Trap line data was also collected on weekly intervals throughout the 2000 growing season within the non-active eradication zones. The 2000 overall season-long mean number of adult weevils captured per trap in non-active eradication zones trap line per week was 42.25 (Figure 8).

Conclusions

Based upon the above results, we conclude the ABWEP is bringing about reduced weevil populations as evidenced by reduced trap captures, and boll weevil damage in active zones as compared with non-active eradication zones.

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), Patricia Carr (office manager ABWEF); Bill Benefield, Toni Graham, Billy Isaacs, and Don Moses, ABWEF work unit managers are all due special thanks for their leadership and support of the eradication effort. Assistant work unit managers including; C. Kay Catanach, Kent Childers, Ronnie Clary, Regina Coleman, and Lawanda McElroy are also due special recognition. The Agriculture Council of Arkansas, Arkansas Boll Weevil Eradication Foundation Board of Directors, 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, and USDA, APHIS, PPQ have provided invaluable leadership and support to the ABWEP.

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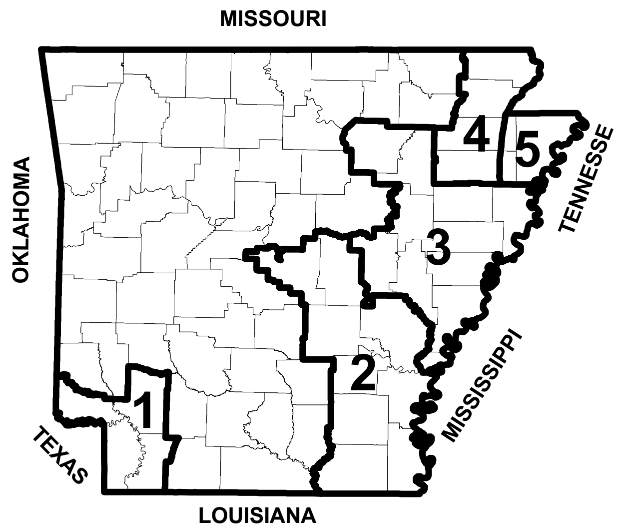

Figure 1. Boll weevil eradication zones in Arkansas, 2000.

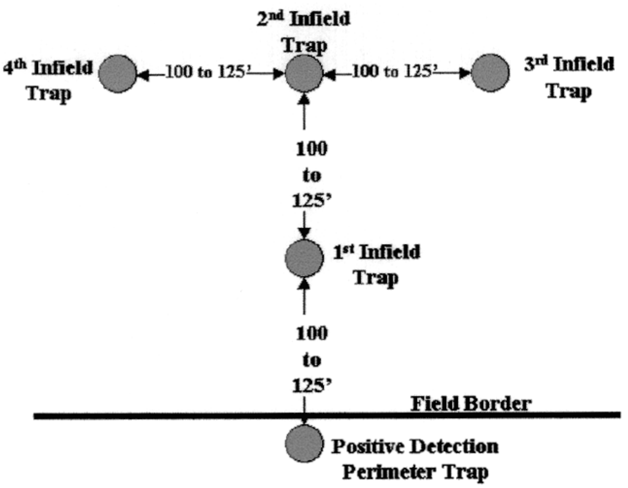

Figure 2. Diagram showing infield traps in a "T" pattern.

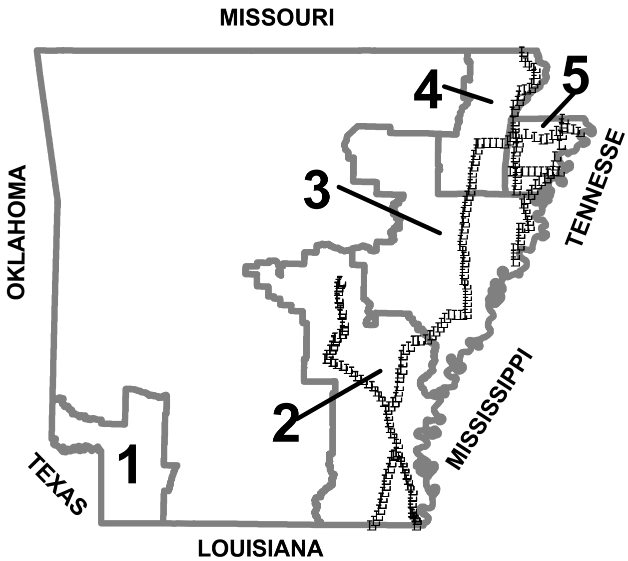

Figure 3. Boll weevil trap line locations in Arkansas, 2000.

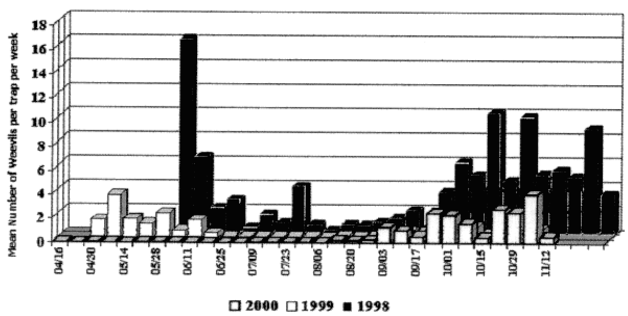

Figure 4. Mean number of adult boll weevils captured per trap per week per year, Southwest Zone.

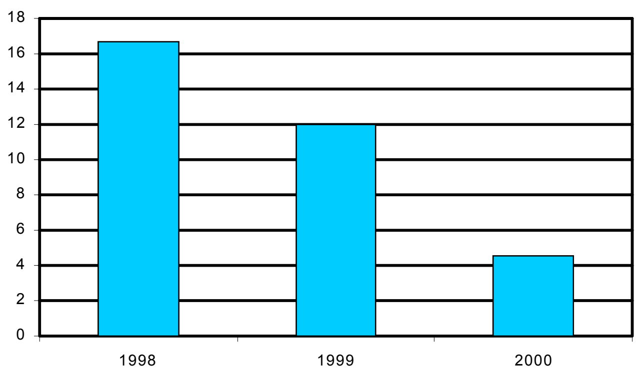

Figure 5. Season-long mean number of insecticide applications per area in the Southwest Zone of Arkansas.

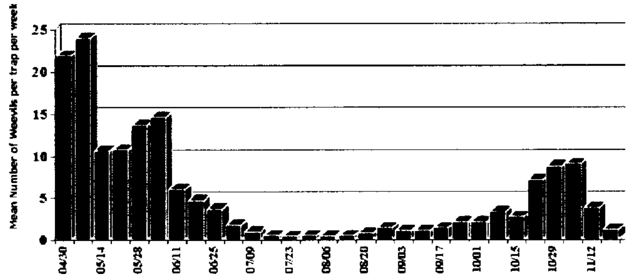

Figure 6. Mean number of adult boll weevils captured per trap per week by year, Southeast Zone, 2000.

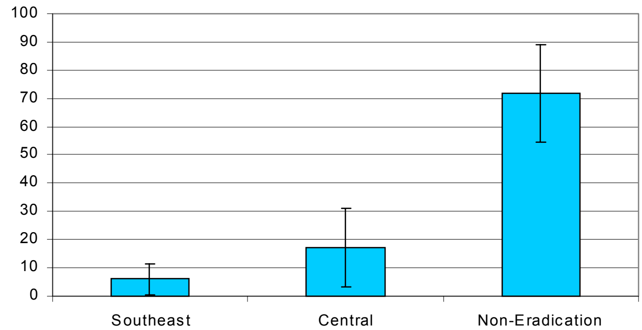

Figure 7. Boll Weevil Damage Survey. Overall percent boll weevil damage squares/bolls and standard error in the Southeast, Central, and Northeast (non-eradication) zones, Arkansas, 2000.

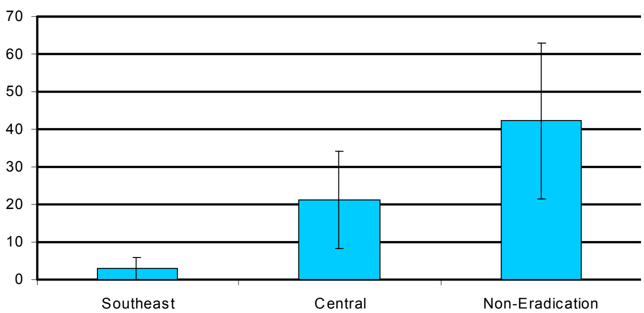

Figure 8. Season-long mean number of adult boll weevils captured per trap per week and standard error on the trap line, 2000.

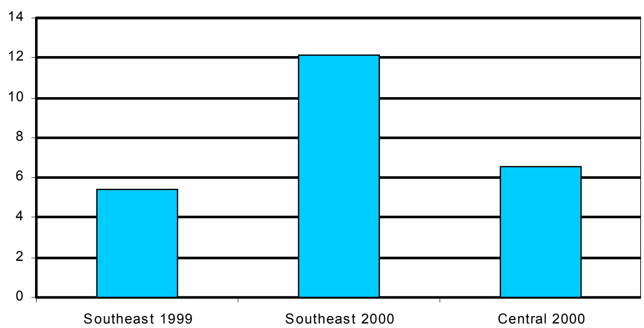

Figure 9. Overall mean number of insecticide applications per acre in the Southeast 1999 (diapause phase), Southeast 2000 (1st season-long phase) and Central 2000 (diapause phase) zones, Arkansas.

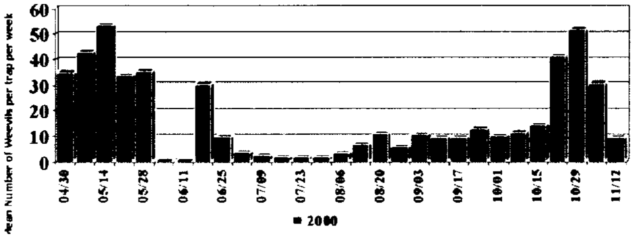

Figure 10. Mean number of adult boll weevils captured per trap per week by year, Central Zone. (The absence of trapping information June 4, 2000 and June 11, 2000, was due to the training of field personnel during that time.)