USE OF PHEROMONE TRAPPING DATA TO EVALUATE BOLL WEEVIL ERADICATION IN THE SOUTHERN ROLLING PLAINS OF TEXAS

Thomas W. Fuchs, Richard Minzenmayer and Christopher Sansone
Texas Agricultural Extension Service
San Angelo, TX

Abstract

This paper reports results of studies to evaluate the progress of the boll weevil eradication program conducted by the Texas Boll Weevil Eradication Foundation in the Southern Rolling Plains (SRP) of Texas. Data from a boll weevil pheromone trapping study and a winter habitat sampling study are presented. Data from both studies support the effectiveness of the eradication effort. Data from the trapping study indicate that numbers of overwintered boll weevils were reduced by 99.9% between 1994 and 1998.

Introduction

Boll weevil pheromone traps baited with grandlure are powerful monitoring devices which have been used successfully across the Cotton Belt for many years. Data from strategically placed traps can be used to estimate the relative abundance of weevils at certain times of the year and to compare their relative population levels from year to year. The Texas Agricultural Extension Service has conducted a systematic boll weevil pheromone trapping program in Runnels and Tom Green counties in the SRP each year since 1980 (Fuchs and Minzenmayer 1990).

The Texas Boll Weevil Eradication Program was initiated in 1994 when it began in the SRP of Texas (El-Lissy and Myers 1997). Data from the pheromone trapping program were used to help plan strategies and activities for this program. We decided to expand the trapping efforts so that it could be used as a partial evaluation of the eradication effort.

Winter habitat sampling to determine relative numbers of boll weevils overwintering in various habitats has been used for many years (Beckham 1957, Bottrell et al. 1972, Pfrimmer and Merkel 1981, Fuchs and England 1989). While the accuracy of this technique to measure absolute density can be questioned, it has proven to provide useful information in comparing relative survival of boll weevils in various habitats and in various years. While evaluation of the boll weevil eradication effort was not the primary reason to conduct habitat sampling, data from a systematic winter habitat survey conducted each February provide some insight into the effectiveness of the eradication program through time. Data from winter habitat surveys conducted from 1992 to 1998 are included in this manuscript to support the evaluation effort.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:838-840 (1999)
National Cotton Council, Memphis TN

Materials and Methods

Pheromone Trap Survey

A systematic pheromone trapping survey was conducted by the Texas Agricultural Extension Service from 1980 through 1998. The survey consisted of approximately 104 traps placed a minimum of one mile apart in eight cotton production areas of Runnels and Tom Green counties from 1980 through 1993. The Texas Boll Weevil Eradication Program was initiated in 1994 in the SRP Zone. This zone included all or parts of 9 counties. Although Runnels and Tom Green counties grew approximately 80% of the cotton acreage in the entire zone, the trapping survey was expanded into two additional counties, Concho and McCulloch counties and one additional growing area of Tom Green County beginning in 1994 to provide a reliable third party evaluation of the eradication effort. The total number of traps from 1994 until 1998 was 128. Traps were installed in late April and data were collected through the second week in July when traps were removed. Hardee® traps were generally used from 1980 until 1994 and Hercon Boll Weevil Scout® or Southeastern Boll Weevil Foundation® traps were used since 1994. Traps were baited with 10 milligrams of grandlure every two weeks and traps were inspected and numbers of boll weevils recorded weekly.

Winter Habitat Survey

A systematic winter habitat sampling survey was conducted in Runnels, Tom Green and Concho counties in the SRP since 1980 to estimate the relative density of overwintering boll weevils in various habitats. The sampling techniques used have been described by Fuchs and England (1989). Each sample consisted of the ground-thrash (leaves, stems, debris etc) along with approximately 0.5 to 1.0 cm of soil in a one square meter area in the appropriate habitat. Habitats sampled include broadleaf litter, mesquite litter, fencerows and various grasses used in the Conservation Reserve Program.

Texas Boll Weevil Eradication Program

The Texas Boll Weevil Eradication Program began in the SRP zone with a fall diapause program initiated on September 26, 1994. This zone contained approximately 220,000 acres of cotton, mostly rainfed production with an average yield of approximately 280 pounds of lint per acre.

A very brief description of the methods used in the eradication program will be provided here. A more complete description was provided by El-Lissy and Myers (1997) and El-Lissy and Patton (1998).

1994. All cotton fields in the zone which had fruiting structures capable of hosting boll weevils were treated weekly using Fyfanon® (malathion) ULV at a rate of 16

ounces per acre until cool weather slowed down boll weevil activity. At that time treatment intervals were extended to 10-14 days. Fields received an average of 4 applications during the fall prior to the first killing freeze with individual fields receiving up to 7 applications depending upon termination and harvest dates.

1995. The first season-long phase of the program was conducted in this area in 1995 after an unusually mild winter. Boll weevil pheromone traps were placed by the Boll Weevil Eradication Foundation around the periphery each field at the trap density of one trap per five acres. Fyfanon® ULV at the rate of 12 ounces per acre was applied to all fields that reached the treatment threshold. The treatment threshold for early season control was a total of two boll weevils caught in all of the traps around the field (El-Lissy and Myers 1997). The treatment threshold was increased to eight adult weevils per field beginning August 7 to reduce the number of treatments applied mid-season after an outbreak of beet armyworms occurred. The threshold was reduced to five adults per field on September 18 and remained at that level for the remainder of the season (El-Lissy and Myers 1997).

1996. Severe outbreaks of beet armyworms, bollworms, tobacco budworms and aphids during the 1995 season which severely damaged much of the cotton in the zone, led growers to modify the program during 1996 to reduce the impact on natural enemies of cotton pests. Growers were given the option to have their fields treated by the Foundation with Vydate® CLV (oxamyl) instead of Fyfanon® ULV (malathion) for control of overwintered boll weevils and with Phaser ®(endosulfan) instead of Fyfanon® ULV in mid-season. (Growers had the option to use alternative boll weevil insecticides at any time during the program at their own expense.) Also, the treatment threshold was raised from two to ten adult weevils per field from July 4 until August 10. After August 10, the threshold was reduced to two weevils per field for the diapause phase of the program. Relatively few fields were treated during mid-season using the increased trap threshold and few secondary pest outbreaks occurred. However, due to budgetary constraints, diapause treatments were terminated prematurely. Apparently, a significant number of boll weevils were able to build fat reserves, enter overwintering habitats in good condition and overwinter successfully.

1997. To complicate matters further, in May 1997, the Texas Supreme Court rendered a decision finding the state boll weevil law under which the program operated unconstitutional. The Texas legislature acted quickly to address the concerns outlined by the Supreme Court and passed a new law which was signed by the Governor in June 1997 (El-Lissy and Patton 1998). Although the Texas Boll Weevil Eradication Foundation acted as quickly as they could to reinstate the program, timing of early season treatments during 1997 was far from optimal. This, combined with changes made in 1996 to reduce the impact on natural enemies, perhaps some migration of boll weevils from surrounding areas, rainfall that prevented timely fall applications and the impact of prematurely ending diapause applications due to budget constraints, led to higher populations of overwintered boll weevils during 1997. Additional complicating factors included improper timing of applications by individual growers using alternative treatments during 1996, growers who tampered with pheromone traps to avoid reaching treatment threshold levels and another mild winter which allowed relatively high boll weevils populations to survive. A successful program during the 1997 production season, an excellent diapause control program in the fall of 1997 and an early crop harvest reduced boll weevils numbers to low levels.

1998. A severe drought during 1998 limited cotton acreage in the SRP. Although planted acreage was near the normal 220,000 acres, harvested acreage was less than 140,000 acres. A very aggressive eradication effort was conducted during 1998. Fyfanon® was used almost exclusively at low threshold levels further reducing boll weevil populations. During 1998, very few growers saw any live boll weevils in their fields. By October, no boll weevils had been trapped in 62% of the fields with another 26% of the fields trapping between 1-5 for the entire season (El-Lissy, personal communication).

Results and Discussion

Pheromone Trap Survey

Historical data from the pheromone trapping surveys conducted from 1980 through 1994 are shown on Table 1. The figures represent the average number of boll weevils per trap recorded during the 12 week trapping period from the last week of April through the first two weeks of July. While the number vary widely, the years 1992 and 1994 stand out as being significantly higher than either the long term average through the decade of the 1980s or compared to 1991 or 1993. A four fold increase in the average number of boll weevils per trap occurred between 1993 and 1994.

The average number of boll weevils per trap for the years 1994 through 1998 are shown on Table 2. Data for 1994 were collected in the spring and summer prior to the initiation of the diapause phase of the eradication program on September 26, 1994. Data for 1995 indicate that boll weevils were reduced by 78% between 1994 and 1995. Certainly there are additional factors that influence boll weevil populations during the production season and during the winter but the authors believe that the eradication program was primarily responsible for reductions between 1994 and the spring of 1995. The first full season of eradication during 1995 resulted in 97% fewer boll weevils being captured during the 12 week trapping period in 1996 compared to 1995. This is a rather dramatic reduction, however, there were several factors that probably influenced this reduction in addition to applications made for boll

weevils by the Texas Boll Weevil Eradication Foundation. First, the severe beet armyworm, bollworm, tobacco budworm and aphid outbreaks that occurred during the 1995 season resulted in a large number of insecticide applications for these pests in addition to applications made by the Foundation for boll weevil control. A number of products used are also known to control boll weevils. Also, a significant number of growers decided to abandon their cotton and destroyed the crop prior to the normal harvest time.

Numbers of overwintered boll weevils caught in pheromone traps during the trapping period in 1997 were increased compared to 1996 (Table 2). We believe this to be due to a number of factors. The severe outbreaks of beet armyworms, bollworms, tobacco budworms and aphids during the 1995 season led growers to modify the program during 1996 in an attempt to reduce the impact of the program on natural enemies. Growers were given the option to use Vydate® CLV (oxamyl) instead of Fyfanon® ULV for control of overwintered boll weevils and Phaser® (endosulfan) instead of Fyfanon® ULV in mid-season. Also, the treatment threshold was raised from two to ten adult weevils per field from July 4 until August 10. Relatively few fields were treated during mid-season using the increased trap threshold. Rains during the diapause phase of the 1996 program disrupted timing and planned intervals of applications. Diapause treatments were terminated prematurely due to budget problems. Apparently, a significant number of boll weevils were able to build fat reserves and enter overwintering habitats in good condition. A mild winter allowed these weevils to overwinter successfully.

The 1997 eradication effort began somewhat late due to legal problems concerning the boll weevil law under which the Foundation operated. This complicated and compromised timing of applications for overwintered weevils. In addition, more insecticide applications were required due to higher overwintered weevil populations. The mid and late season effort, however, was more intense than the 1996 program due to determination by growers to reach the end of the eradication process. The diapause phase of the program proceeded very well with applications relatively well timed, on strict intervals and with few weather related problems. An open fall resulted in a timely harvest.

As a result of the successful 1997 program, populations of overwintered weevils in the spring of 1998 were very low. Trapping data indicated a 96% reduction from the spring of 1996 to the spring of 1998 with traps catching an average of one tenth of a weevil per trap per week during the 12 week trapping period (Table 2).

The accumulative percent reduction by years from 1994 population levels is shown on Table 2. The 1994 diapause phase of the program resulted in a 78.2% reduction and the first full year of eradication an accumulative 99.4% reduction. As noted previously, the 1996 program was much less successful as indicated by a decrease from 99.4% accumulative reduction in overwintered weevil populations in 1996 to 96.0% in the spring of 1997. Populations in the spring of 1998, however, were reduced 99.9% from the 1994 level.

Winter Habitat Surveys

Results from winter habitat sampling conducted in February from 1992 through 1998 are summarized in Table 3. The number of samples represent a total of those taken from all habitats sampled. The percent with live boll weevils represent the percentage of all samples that contained one or more live boll weevils. The average number of live weevils per infested sample included only those samples in which one or more live weevils were recovered. This figure is meant to reflect an relative density within infested samples. Since samples were taken in February of each year, the 1992 figure, for example, would reflect boll weevils that entered habitat in the fall of 1991 and survived the winter.

Due to the relatively low numbers of samples taken in any year and because the number of samples taken from any specific habitat is not in proportion to the number of boll weevils that overwinter successfully within the habitat only trends through time can be used in this evaluation. Each year from 1992 through 1994 had a significant percentage of the total samples infested by one or more boll weevils. There is a precipitous decrease in the percentage of samples containing live boll weevils in 1995 after the initial diapause phase of the eradication program in the fall of 1994. This occurred even though the winter between 1994 and 1995 was among the mildest on record and the percentage of boll weevils that survived in other locations was at record levels (Rummel 1998, personal communication). No boll weevils were found in any samples taken subsequent to the first full year of boll weevil eradication in 1995.

These data from winter habitat sampling support the pheromone trap data indicating the boll weevil eradication program in the SRP of Texas has successfully reduced boll weevil populations to extremely low levels. Results of complimentary studies reported elsewhere at this confeence documented similar reductions in percent square damage in the field and support this evaluation.

Conclusions

Data presented in this manuscript indicate that data from a boll weevil pheromone trapping survey can be used to evaluate the progress of a boll weevil eradication program in reducing boll weevil numbers. The data can also be used to identify weaknesses in the program. Winter habitat sampling data serve to compliment and substantiate pheromone trapping data. The data do not reflect problems

associated with boll weevil eradication that involved pests other than boll weevils.

Acknowledgment

The authors gratefully acknowledge the efforts of Amanda England who conducted the pheromone trapping survey from 1980 until 1986 and the financial and moral support of the Southern Rolling Plains Cotton Producers Association.

References Cited

Beckam, C. M. 1957. Hibernation studies of the boll weevil in relation to a small Georgia Piedmont cotton field. J. Econ. Entomol. 50:833-834.

Bottrell, D. G., R. E. Reeves, L. K. Almand, D. D. Hardee and W. H. Cross. 1970. Studies of boll weevil populations and their movement in the High and Rolling Plains of Texas using male-baited traps. Tex. Agric. Exp. Sta. Misc. Publ. 904.

El-Lissy, O. 1998. Texas Boll Weevil Eradication Foundation. Personal communication.

El-Lissy, O. and F. Myers. 1997. Boll Weevil Eradication Update- Texas. 1996. Proc. Beltwide Cotton Production and Research Conf., National Cotton Council of America. New Orleans, LA 973-979 pp.

El-Lissy, O. and L. Patton. 1998. Boll Weevil Eradication Update- Texas. 1997. Proc. Beltwide Cotton Production and Research Conf., National Cotton Council of America. San Diego, CA 1001-1004 pp.

Fuchs, T. W. and A. England. 1989. Winter habitat sampling for overwintered boll weevils as a component of an integrated pest management program. Southwestern Entomol. 14 (3) 265-269.

Fuchs, T. W. and R. Minzenmayer. 1990. Ten year history of overwintered boll weevil emergence profile in the Concho Valley of Texas, 1980-89. Southwestern Entomol. 15 (4) 497-498.

Pfrimmer, T. R. and M. E. Merkel. 1981. Boll weevil: Winter survival in surface wood trash in Mississippi. Environ. Entomol. 10:419-423.

Rummel, D. 1998. Texas Agric. Exp. Sta. Personal communication.

Table 1. Average number of boll weevils per trap per week during a 12 week trapping period from late April through mid- July in Runnels and Tom Green counties, TX, 1980-94.

Year	Ave./Trap/Week
1980-90	13.1
1991	5.3
1992	30.8
1993	16.6
1994	70.2

Table 2. Average number of boll weevils per trap per week during a 12 week trapping period from late April through mid-July in the Southern Rolling Plains of Texas during boll weevil eradication.

Year	Ave/Trap/Week	% Reduction	Acc. % Reduction
1994	70.2	–	--
1995	15.3	78	78.2
1996	0.4	97	99.4
1997	2.8	0	96.0
1998	0.1	96	99.9

Table 3. Winter habitat samples for overwintering boll weevils, Southern Rolling Plains, 1992-98.

Year	No. Samples	% w/live weevils	Ave.weevils/ infested sample
1992	62	21.2	1.8
1993	64	27.0	2.7
1994	63	12.7	1.5
1995	65	4.7	1.0
1996	61	0	0
1997	34	0	0
1998	11	0	0