Trap Crop Effectiveness in Community Boll Weevil Control Programs

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Abstract

Trap crops, along with delayed uniform planting and pinhead square treatments, greatly reduced spring populations of overwintered boll weevils, Anthonomus grandis Boheman, in a Laveen, Arizona community-wide IPM program in 1987. Thirty four trap crops, planted fifteen days ahead of the regular crop, had as many as 39536 damaged plants/ha before insecticide treatments were initiated. Five insecticide applications at 3-day intervals beginning at square initiation were used to destroy weevils before the trap crops were plowed under at the time pinhead square treatments were initiated in regular planted fields. Damaged square infestations were 2 to 11 times lower throughout the season in 1987 compared to 1986 while average lint yields per ha increased from a low of 942 kg in 1985 to 1345 kg in 1986 and 1506 kg in 1987.

Introduction

Regulations were changed by the Arizona Commission of Agriculture and Horticulture in 1978 to permit growing stub cotton in Arizona. The practice was then permissible for a 5-yr. period, during which time problems with the boll weevil, *Anthonomus grandis* Boheman, and other pests became so severe that the practice was again abolished. Bergman et al. (1982) documented the buildup and spread of boll weevil in Arizona during the period following initiation of stub cotton culture. During an earlier period of stub production in the mid 1960's, Fye (1968) reported sporadic infestations of the boll weevil in cultivated cotton, *Gossypium* spp., and concluded that culture of stub cotton resulted in increased boll weevil populations and greater damage. He also concluded that adequate early stalk destruction and sanitation were essential for cultural control of the boll weevil. Persistence of the boll weevil problem following cessation of stub cotton culture prompted a study by Watson et al. (1986), on the basic biology of the Arizona population of the boll weevil. They concluded that the present weevil has adapted toward greater survival in the hot, arid southwestern U.S. than was shown by the weevil that Fye had investigated ca. 20 years earlier.

Considerable research has been conducted on the ecology of the boll weevil and the potential for its cultural control; much was done in the southern U.S. cotton belt, particularly in Arkansas, ca. 60 years ago. Among other things, Isely (1934) reported a benefit in using a trap crop to lure and concentrate early-emerging overwintered weevils on small acreages of early-planted cotton where they could be subsequently destroyed. This concentration and destruction of weevils in the spring prevented or reduced widespread infestations in the major, later-planted, cotton acreage.

In 1987, a similar trap-cropping practice was incorporated into a community-wide integrated pest management (IPM) program in Laveen, AZ., an area of central Arizona which had experienced heavy boll weevil infestations during the three preceding seasons. The Laveen area is an agricultural community immediately southwest of Phoenix that produces about 3035 ha of cotton. It is mostly isolated from other cotton production to the south and west by mountains and to the east by the city

of Phoenix. The Salt River separates the area from cotton production to the north. A boll weevil buildup in the area became devastating in 1985 when yields were reduced by one-third to one-half and insecticide costs were greatly increased.
To help deal with the boll weevil infestations, Arizona Cooperative Extension assisted growers in developing a community-wide integrated pest management approach to the problem. Practices that approximately 95% of the growers adopted for the 1986 season included pinhead square treatments, timely in-season control, irrigation cut-off by 1 September, early harvest, and stalk shredding immediately behind the last harvesting operation. Watson et al. (1978) have shown the effects of some of these practices, particularly irrigation cut-off, on late-season pink bollworm, *Pectinophora gossypiella* (Saunders) populations and the resultant effect on subsequent spring populations.

The 1986 practices resulted in greatly improved yields but control costs and boll weevil populations in the area remained high. To improve the program for 1987, 100 percent of the growers agreed to a delayed uniform planting date (UPD) of 1 April. Masud et al. (1985) demonstrated the value of a UPD in the Texas Rolling Plains by conducting an impact analysis using data from 1970 to 1981. Their analysis showed the UPD system as compared to the conventional production system resulted in increased yields/ha (in spite of dramatically higher cotton hectares), and lower costs for insecticides, cottonseed and labor. The resulting increase in net returns for the UPD cotton was $52.78/ha. Growers in Laveen also agreed to plant trap crops throughout the area on 15 March. Effect of trap crops on boll weevil populations was evaluated throughout the 1987 growing season and results are reported herein.

Materials and Methods

Trap crop locations were randomly selected throughout the area on set-aside or fallow land. The intent was to locate trap crops reasonably close to regular planted cotton throughout the area with consideration given to available land and willingness of growers to participate.

Growers prepared strips of land and planted TAMCOT SP-37 cottonseed on 15 March. This gave 15 days separation between the trap crop planting and the beginning of regular crop planting on 1 April. TAMCOT SP-37 was selected because it is an early-fruiting variety with known susceptibility to the boll weevil. Each trap crop consisted of 12 rows planted 102 cm apart running the length of the field to accommodate one swath by an airplane when treatments were applied. The trap crops ranged in size from 0.4 to 0.6 ha and were planted, fertilized, irrigated, and cultivated according to usual cotton production practices. Three grandlure pheromone traps were evenly spaced along one edge of each trap crop, one at the middle and one ca. 40 m from each end, as an additional means of attracting weevils into the area and as a measure of boll weevil activity.

Treatments with 561 gm ai/ha of Penncap-M^{R} were begun on 8 May when young squares first appeared in the trap crops. The insecticide was sprayed by airplane on all 34 trap crops each treatment day. Treatments were repeated at 3-day intervals until about 18 May, when squaring began in the regular planted cotton. This required four or five treatments of each trap crop, depending upon square initiation in nearby regular planted fields. All trap crops were destroyed by plowing or disking on the day following their last treatment. The first of three pinhead square treatments was applied to regular planted fields the day following destruction of the trap crops.

Effectiveness of the trap crops was measured during the pre-square and early square period by making weekly counts of damaged plants and weevil numbers. Four-m of row were examined adjacent to each of the pheromone traps and in an equal number of areas between traps. In addition, counts of the pheromone trap catches were made every 2 days. Weekly square counts were made for weevil damage on 19 randomly selected regular planted fields throughout the season. Similar pheromone trap and square-damage counts were made in 1986 and were compared to those made in

1987. In addition, a survey of growers provided yield estimates for the years 1985, 1986, and 1987.

Results and Discussion

Populations of overwintered boll weevil adults were high in the Laveen area during the spring of 1987 with trap catches averaging about 60% of those from a comparable trapping period in 1986. Populations peaked on 20 April and declined gradually toward very low populations by early June. Lack of an adequate food source and temperatures increasing to 37.7° C and higher by late May contributed to the population decline.

Trap catches in fields located near rivers and mountains were comparable and high, but catches in interior valley fields were much lower throughout the pre-square period. This agrees closely with the findings of Rummel and Adkisson (1970) who found that during a period of low weevil density on the High and Rolling Plains of Texas, the distribution of cotton fields infested with weevils appeared to be influenced primarily by the abundance of favorable weevil overwintering habitats within the cotton growing area, and by the distance of the habitats from the cotton fields.

Boll weevils began to move into the trap crops soon after the cotton plants emerged. Most feeding occurred just below the terminal area or on leaf petioles. This feeding caused the area above to die and turn black, a symptom sometimes referred to as black flagging. Populations of weevils were so heavy that as many as 39536 plants/ha or about 40% of the total plants were damaged in some trap crops. This reduced or delayed plant growth and pointed to the possible need for more trap crop acreage to handle such large numbers of boll weevils. There was a strong correlation between boll weevil numbers and flagged plants, both near and away from pheromone trap sites. Weevil numbers in trap crops were still averaging 250 to 450/ha at the time regular planted fields began to square while counts in representative regular planted fields showed no weevils or damage through the pre-square stage. At the time trap crops were destroyed, only 1 of 16 regular planted fields sampled showed very light evidence of boll weevil activity. No plant damage was detected in the other 15 fields.

Damaged square counts in 1987 regular planted fields were essentially zero through June and averaged less than 3% at the end of July. Despite agreeing earlier to the 1 April planting date, one grower planted a few fields about a week early. These fields became infested first and continued to be a problem throughout the season. This agrees with the findings of Slosser (1978) who studied the influence of planting date on boll weevil management. He found that in early planted fields, peak boll weevil populations were 4.6 times greater than in late planted fields. He concluded that an unmanaged, early May planted, out-of-phase field acts as a trap crop, and that the use of uniform planting dates within a community would be a good boll weevil management strategy.

Some treatment occurred in the 1987 Laveen program in late July, but most fields were not treated until August and by that time a good yield of cotton had been set in most cases. Counts showed an average of 2.4% damaged squares on 29 July 1987 compared to 22.4% on the same date in 1986. Rummel et al., (1980) showed a high correlation between the number of overwintered weevils captured per trap per field just prior to the appearance of squares suitable for oviposition and the percent oviposition-damaged squares during the early 1/3-grown square period. Trap catches in the Laveen area were about 1.7 fold higher in 1986 as compared to 1987 and would indicate the potential for somewhat comparable square damage. This failed to materialize (Table 1) and the additional management component in 1987--trap cropping--appears to be the only logical explanation. All fields required treatment through August and until the crop was terminated in September, but boll weevil infestations remained at least 50% lower than the levels recorded in 1986 (Table 1).

A survey of representative growers in the program area showed that lint yields per ha averaged about

942 kg in 1985, 1345 kg in 1986, and 1506 kg in 1987. Numbers of insecticide applications were similar for the 3 yr, averaging 17 in 1985, 18 in 1986, and 17 in 1987.

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Table 1. Percent Infested Squares in Regular Planted Cotton. Laveen, AZ.[a]

Date		Year	
		1986	1987
1	July	4.0	0.0
8		9.1	0.6
15		14.9	2.3
22		21.6	2.0
29		22.4	2.4
5	Aug	18.7	9.2
13		16.8	7.6
20		15.1	6.1
26		23.4	2.5
2	Sep	23.0	3.0
9		--	3.5
16		19.1	2.7

[a]Represents 19 comparable sampling sites (fields) in both years.