HIGH SPEED TRANSPLANTING OF COTTON FOR TRAP CROPS - A POSSIBLE TACTIC FOR MIDSOUTH BOLL WEEVIL ERADICATION

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Abstract

Studies were conducted to evaluate the feasibility of incorporating a spring trap crop-pheromone tactic into a boll weevil (*Anthonomus grandis grandis* Bohemann) eradication program for Midsouth cotton. Trap crops were successfully installed using cotton transplants (plugs) and set in the field using a high speed transplanter. The transplanted cotton, baited with boll weevil pheromone chips (1 per 100 ft) and sprayed with ULV malathion applications 2 to 3 times weekly, was significantly advanced over commercial cotton (3 to 4 weeks) and continued to be attractive to boll weevil even after commercial fields began fruiting. Costs associated with trap crop establishment and maintenance appear to be in an acceptable range for an eradication program. Use of this transplant technique would increase the probability that a trap crop could be an effective alternative tactic in boll weevil suppression in an overall eradication strategy. Current eradication plans in Arkansas include use of this tactic in zones with historically low boll weevil population density.

Introduction

Traditional boll weevil eradication programs that were implemented in the SE states may not be practical or economical for Arkansas and the Midsouth. The historical level of Federal assistance will not be available for eradication efforts in Arkansas, and program costs will be important to farmers as they decide on whether to initiate an eradication effort. This is especially true in the northern areas of the cotton production region where boll weevil pressure has traditionally been low compared to the more southern states. In addition, grower concerns about secondary pest outbreaks that could be associated with broad scale applications of malathion in fall (fall diapause control) and spring (treatments for overwintered adults) urgently require exploration of alternative suppression approaches. One possible tactic is use of trap crops.

Trap crops were recognized early in the century as a possible means of countering boll weevil in cotton. Malley (1901) suggested concentrating overwintered weevils by planting a few rows of an early maturing cotton variety in advance of regular planting. Isley (1950) reported that early planted trap crops concentrated boll weevils in areas where they could easily be killed with insecticides. This tactic was expanded following identification of the boll weevil aggregating pheromone. Cross et al. (1969) used male weevils as the pheromone source in trap crops. Scott et al. (1974) found that attractiveness of trap crops was enhanced if they were baited with the synthetic boll weevil pheromone, grandlure. They concluded that small populations of overwintered boll weevils could be suppressed effectively in the spring with baited trap plots. Effectiveness of the trap crop technique was improved in Alabama if cotton size in the trap crop was considerably different than the commercial crop (Gilliand 1974). Moore and Watson (1990) found that trap crops along with delayed uniform planting and pinhead square treatments were effective in reducing spring populations of boll weevil in Arizona. Even without the presence of early cotton, individual pheromone lures attached directly to plants have been shown to work well in commercial fields to aggregate weevils in field margins were insecticide applications are "stripped in" rather than using broadcast field sprays (J. R. Phillips, personal communication).

There have been problems with implementation of the trap crop tactic. Bottrell and Rummel (1976) and Rummel et al. (1976) reviewed the use of trap crops established using transplanted cotton that had been grown in cold frames and established along the edges of the cotton fields. The trap crops were surrounded with pheromone traps several weeks before the commercial crop was planted. In their reviews they cited major problems with survival and growth of transplanted cotton and concluded that use of trap rows of transplanted cotton was impractical and did not provide the earliness required to outcompete the regularly planted cotton in attracting boll weevils.

This Cotton Incorporated funded research project was initiated in spring 1995 to evaluate feasibility of a trap crop tactic for use in a boll weevil eradication program for regions in Arkansas and the Midsouth that historically have had low population densities of boll weevil. Alternative approaches for suppression of overwintering boll weevil are needed in Mid-South areas where population density of boll weevils is low. Adoption of an effective trap crop tactic could lead to a more efficient, economical, and ecologically sound means of weevil suppression to enhance the probability of success of the boll weevil eradication program.

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Materials and Methods

Greenhouse studies were initiated in February to evaluate procedures for growing cotton transplants for use in trap crops. Transplants (plugs) were grown in inverted pyramid, Todd Flats (Speedling Inc., Sun City, FL) to examine cotton growth with this type transplant technology. Vegetables are commonly grown in this manner. Five sizes of transplant types were evaluated. Transplant root development, developmental time and vigor were noted. In addition, greenhouse space and costs for each size was considered. (Infrastructure requirements for producing large scale volumes of cotton plants in the greenhouse are increased if larger sized transplants are required.) Previous experience by the primary investigator with watermelon and bell pepper research had indicated that Model 100A with 200 cells/flat (size 5/8" X 1/2" width X 3" depth) were most economical for vegetable production in the Midsouth. Limited greenhouse evaluations in spring 1995 indicated that this size appeared to be appropriate for cotton, and it was selected for use in the field studies for trap crop.

Variety HQ 95, an early squaring cotton that is cool weather tolerant was seeded on 23 March in the greenhouse. Problems encountered during production included excessive "legginess" of the greenhouse grown plants at 4 wks. This age (ca 2 true leaves) was considered the ideal time for setting transplants; however, weather delays required that some plants be held an additional 3 wks. These late plants held up well and performed well compared to those set out at the ideal 4 wks. This is a significant finding in that delays in planting apparently will not have negative effect on square initiation in the trap crop.

In planning for a trap crop component within an overall early season boll weevil suppression program, input from the farmers is an essential element in assuring development of a program that has the greatest potential for successful implementation. For this project, the cooperating farmer's use of 12 row equipment, row arrangement, and other cultural inputs were considered, and the experiment designed to fit their systems. A primary objective was to create a trap crop plan that would result in minimum inconvenience to the farmer yet allow establishment of the trap crops as quickly as possible. This will be a necessity in an eradication program.

Initially, the experiment was planned for 7 fields (+7 controls), but cooperating growers indicated that the original plan of skips within the trap crop were unacceptable. Full length rows through the fields were installed. In all fields receiving trap crops these were 1/4 mile rows. Availability of transplants limited number of fields to 4.

Commercial fields located in Mississippi County and eastern Craighead County in NE Arkansas were used for all trials. Paired fields with similar historical boll weevil pest pressure and similar agronomic characteristics were selected in Leachville, Manila, Red Onion and Caraway. For each pair, one field received a trap crop treatment and the other was treated as a control. On or before dates of planting for commercial crops 2 rows of cotton were transplanted along the field margin adjacent to favorable boll weevil overwintering habitat. Farmer land preparation prior to transplanting included disking, establishing beds, and application of Prowl herbicide. This project's transplanting team was responsible for knocking down beds and setting plants. A one-row tractor mounted high speed transplanter (Mechanical 4000 transplanter, Holland MI) was used to set plants. The transplanter applied ca 50 ml of fertilizer mixture (Golden Harvest Plus, Stoeller Chemical Co., Houston, TX at 1 qt/25 gal) for each plant. Plants were spaced between 10 and 12 inches. Time required for 2 people to transplant 2, 1/4 mile rows of cotton was 1 hr.

Plants were set on 21 April in Manila in the farmer's rows and 22 April in Caraway outside the farmer's rows; commercial fields were planted the same day. Poor weather conditions including heavy rains, low temperatures, high wind, and blowing sand resulted in sufficient damage such that farmer cooperators had to replant the commercial fields. The transplanted trap crops were damaged but survived. Weather delayed transplanting Red Onion and Leachville fields until May. Plants were set on 11 May at Red Onion in the farmer's rows (he included the trap crop in his tillage and herbicide program along with his commercial field), and on 12 May at Leachville outside the farmers rows (not included in the farmer's field activities). There was hail on 19 May in Manila and the field was replanted on 22 May.

Pheromone lures (1 per 100 ft changed every 2 wks) were fastened to transplants in mid-May to assist in aggregating weevils in the trap crop. Pheromone traps were placed within the trap crop to monitor boll weevil activity.

Boll weevils in trap crops were controlled using ULV applications of malathion every 3 to 4 days beginning when the trap crop reached the pinhead square stage. Squares were observed in Caraway on 23 May. ULV malathion applications were initiated in all trap crop fields on 7 June. Orientation of the trap crop in relation to the commercial field was such that the malathion applications extended into the commercial crop (ca. 40 ft.) in Caraway, Manila and Red Onion. In Leachville the drive lane was located between the commercial field and the trap crop rows so that the malathion was applied toward the overwintering habitat away from the commercial field. All commercial fields received insecticide applications associated with the farmer's standard practices.

After successful establishment of trap crops, the pheromone baited trap crops were sprayed 2 to 3 times weekly with ULV malathion applications using spray equipment on loan from the USDA. Plant development was monitored by examining plants in 7 ft of row in 4 randomly selected areas of each field. Numbers of 1/3 grown squares (suitable for boll weevil oviposition) and older were counted for each sample area. Boll weevil population densities were estimated using standardized sampling protocols including pheromone trap catches. Weekly square damage counts in the commercial fields were made using line-intercept method. Comparable records were obtained from the non-trap crop control fields. Control fields had pheromone traps but did not receive other extensive pheromone baiting. Insecticide applications in the control fields (no trap crop) were limited to only those applied by the farmer in his standard practice.

Results

On the average, trap crops had squares available to boll weevils 3 wks prior to the commercial, direct seeded crops (Figures 1, 2, 3, 4). This fruiting differential is significant in that the squaring plants are much more attractive to boll weevils than non-squaring cotton. The plants grew off extremely well after transplanting, producing large amounts of fruit beginning about the 4th node.

Pheromone baited, squaring cotton is extremely effective in *aggregating and holding* boll weevils. The malathion treatments then kill those weevils. Pheromone baiting is necessary because there is very little natural source for pheromone when insecticide sprays are applied 2 to 3 times weekly. Problems encountered with the ULV sprays included outbreaks of aphids and spider mites in some of the trap crop plants. This problem with secondary pests must be addressed because the trap crops could become a source of pests that could move into the commercial crop. A solution for this problem in unknown at this time.

Boll weevil damage was low in all fields except the Red Onion area which lies adjacent to the St. Francis River and levee (Fig 4, 5, 6, 7). This area offers good overwintering quarters for boll weevil and has highest population pressure in that area of the County. There was no indication that trap crops created any boll weevil problems in any fields. No differences in weevil infestations were apparent indicating the lack of "hot spots" created by trap crops. This was a real concern for cooperating farmers in the initial planning phases of the project.

Estimates of time requirements for each activity in establishing and maintaining trap crops using this method were made (Table 1). These are calculated based on labor available to this project, and it is expected that time required for planting would be reduced using professional transplanting teams. Also included in the budget are estimates for destroying the crop. Mowing probably will be the optimal method. Originally it was thought that farmers would be responsible for destroying the crop, but the destruction would be needed at a busy time for farmers (irrigation season). Because of the importance of timely destruction, it is recommended that the destruction be included in the overall establishment and maintenance cost. Also included in maintenance is weekly scouting of the trap crop and area around it (30 min/field) to assure that any problems are quickly addressed (hot spots, secondary pests, etc.).

In eastern Craighead and Mississippi Counties of Arkansas, current eradication plans include 151 miles of trap crops in fields that border very favorable overwintering habitat (well drained areas with deep accumulations of leaf litter). Our estimates for the time and infrastructure requirements for transplanting 151 miles of trap crops are 1.6 million transplants assuming 12 inch spacing. One 30 X 300 ft greenhouse will have adequate space for growing transplants. Time frame for transplanting in northern portion of the Midsouth Production Area will be 15 April through 22 May. We estimate that time required for transplanting 151 miles of transplant will be between 302 and 604 hrs depending on the speed of the transplant team (0.25 compared to 0.5 mph). This would require 3, 3-person transplant teams to cover 151 miles between 13 and 25 days. Total per acre cost estimates for the 243,000 acre area planned in NE Arkansas is less than $1.00 / acre.

Conclusions

Trap crops for boll weevils in cotton can be established in commercial fields using transplant technology. Trap crops were at least 3 wks earlier in squaring than direct seeded commercial fields. Such a significant maturity difference between a trap crop and commercial crop to attract and retain boll weevils entering the field. For an eradication program, costs and time requirements for establishment and maintenance of transplanted trap crops appear to be economically feasible.

Further research is required to evaluate such elements as greenhouse production of quality plants, large scale feasibility, secondary pest problems, spraying schedules, optimal field arrangement. and, of course, whether the tactic has a significant effect in decreasing density of overwintered populations. This work is planned for 1996.

Acknowledgments

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Table 1. Estimated budget for trap crop establishment, maintenance and destruction.

Item	Unit	Price/ unit[1]	No. Units	Per 1/4 Mile
Transplants	ea	$0.03	2,640	$79.20
Labor	hr	$5.00	3	$15.00
Machinery	hr	$20.00	1	$20..00
Pesticide	app	$3.44	14	$48.16
Spray Labor	hr	$5.00	3.5	$17.50
Scouting	hr	$5.00	3.5	$17.50
Traps	ea	$1.50	2	$3.00
Pheromone	ea	$0.25	45	$11.25
Destruction	hr	$25.00	0.5	$12.50
Travel	mi	$4.25	31	$131.75
		TOTAL		$355.86

[1] Assumes 2 single rows of transplanted cotton spaced 12 inches apart, sprayed 2 to 3 times weekly (12 oz malathion ULV) and scouted weekly for 6 wks. Pheromone chips are placed at 100 ft intervals and changed every 2 wks. Trap crop is destroyed my mowing. Mileage allows 31 trips, 17 miles @ $0.25/mile

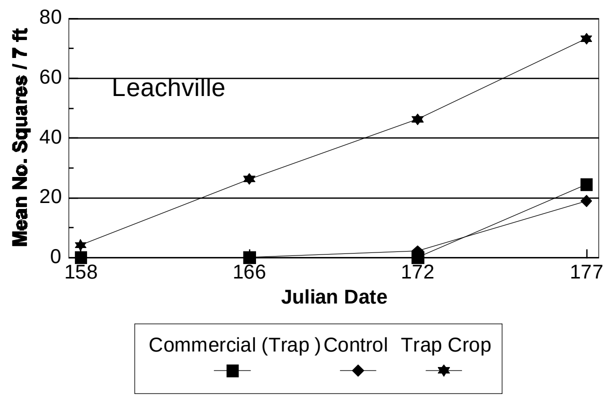

Figure 1. Mean no. of 1/3 grown squares per 7 ft in trap crop, commercial field and in control field in Leachville, AR.

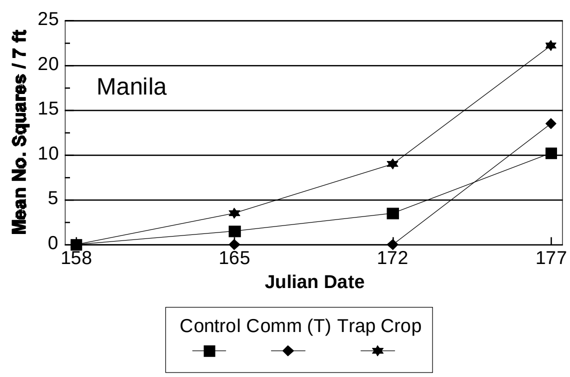

Figure 2. Mean no. of 1/3 grown squares per 7 ft in trap crop, commercial field and in control field in Manila, AR.

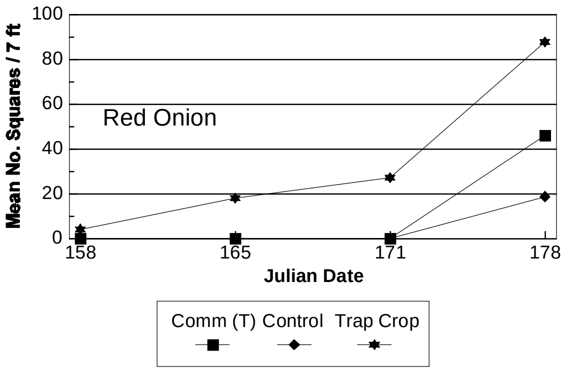

Figure 3. Mean no. of 1/3 grown squares per 7 ft in trap crop, commercial field and in control field in Red Onion, MO.

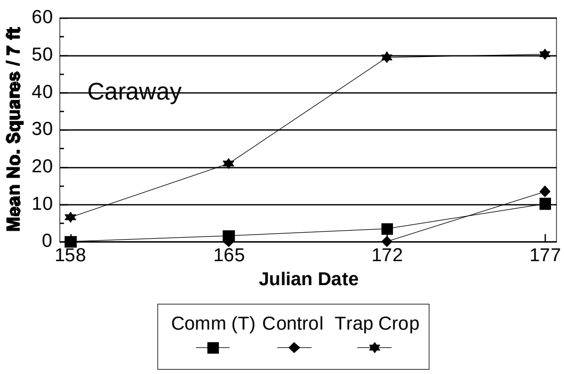

Figure 4. Mean no. of 1/3 grown squares per 7 ft in trap crop, commercial field and in control field in Red Caraway, AR.

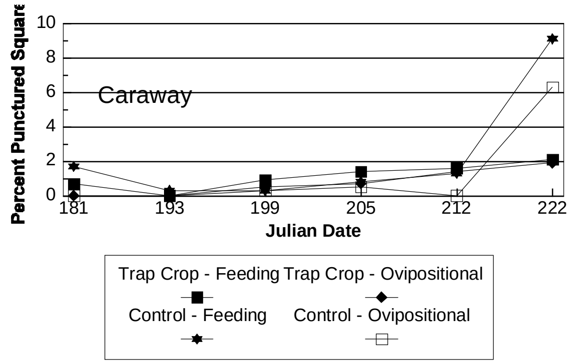

Figure 5. Mean no. of boll weevil punctured squares in trap crop, commercial field and in control field in Caraway, AR.

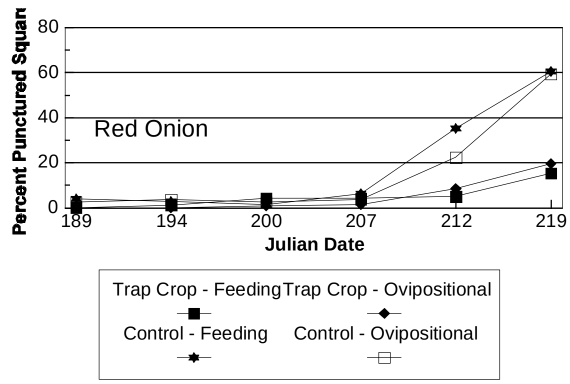

Figure 6. Mean no. of boll weevil punctured squares in trap crop, commercial field and in control field in Red Onion, MO.

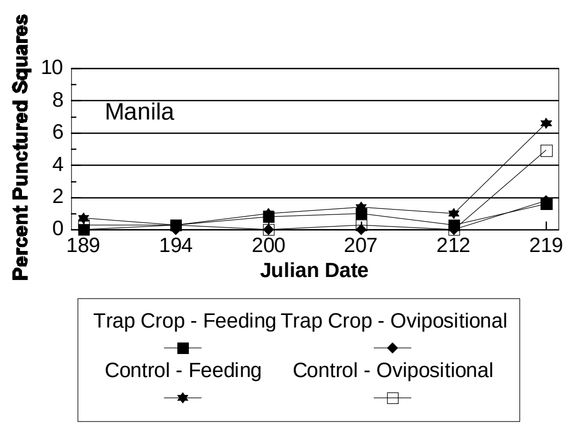

Figure 7. Mean no. of boll weevil punctured squares in trap crop, commercial field and in control field in Manila, AR