ESTABLISHING TRAP CROPS TO AGGREGATE AND SUPPRESS SPRING POPULATIONS OF BOLL WEEVIL - AN ALTERNATIVE TACTIC FOR MIDSOUTH ERADICATION PROGRAMS

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Abstract

Studies were continued in 1996 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 10 mg boll weevil pheromone lures (1 per 100 ft) and sprayed with ULV malathion applications 2 times weekly, was significantly advanced over commercial cotton (3 wks) and continued to be attractive to boll weevil even after commercial fields began fruiting.

Introduction

Cost and and secondary pest concerns make investigations of alternative suppression approaches for Midsouth boll weevil eradication programs a priority research area. This is especially true in the northern areas of the cotton production region where boll weevil pressure historically has been low. One possible alternative tactic under review is use of trap crops to aggregate and destroy overwintered weevils as they enter fields in spring. Trap crops long have been recognized 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 be killed easily with insecticides. 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 hand planted along the edges of the cotton fields. They cited problems with survival and growth of transplanted cotton and concluded that use of trap rows of transplanted cotton was impractical. A major problem was that the trap crops did not begin squaring sufficiently early to outcompete the commercially planted cotton in attracting boll weevils. Research initiated in 1995 using modern horticultural production methodology, indicated that trap crops could be installed using cotton transplants set with high speed mechanical transplanters (Teague and Tugwell 1996). The maturity differential between trap crop and the direct seeded commercial crop in square initiation was 3 to 4 weeks.

This Cotton Incorporated funded research project was repeated in 1996. Should research results indicate that transplanted trap crops are feasible on a large scale, this tactic may be deployed in the Arkansas eradication program in cotton production zones with historically low boll weevil population densities. The overall goal is an efficient, economical, and ecologically sound means of weevil suppression to enhance the probability of success of boll weevil eradication.

Materials and Methods

Paired commercial fields with similar quality boll weevil overwintering habitat adjacent to the field and with presumedly similar agronomic characteristics were selected in NE Arkansas near Black Oak, Red Onion (MO), Manila and Lake City. Adjacent overwintering habitat consisted of deciduous trees with abundant (up to 5 inch accumulation) leaf litter. This 'high quality' habitat occurred only on one side in each of the sites; however, there were drainage ditches and field borders associated with the fields. Inspection of these areas and estimations of the insulative quality of these overwintering habitats indicated to the researchers that boll weevils would have low probability of surviving in these sites. In addition, observations of consultants familiar with historical boll weevil pressure in these fields, indicated that boll weevil problems generally were associated with portions of the fields adjacent to the high quality habitat. The fields had a history of requiring insecticide applications for boll weevil practically every year. For each pair of fields, one received a trap crop treatment, and the other was treated as a control. The trap crop was 2 rows wide. Length varied with location and ranged between ca. ¼ mile long for Red Onion and Manila and ½ mile long for Lake City and Black Oak. This project's transplanting team was responsible for putting up beds in the Red Onion, Lake City and Manila fields. The trap crop areas were in poorly drained areas of these 3 fields, and bed preparation was difficult. A 2 row disk bedder was pulled through the field, and then the tops of the beds were flattened with a roller. Farmer land preparation in the Black Oak field included disking, applying herbicide and establishing beds. In addition the farmer applied trifluralin herbicide preplant incorporated. This was the only field where preplant herbicides were used.

Variety TAMCOT HQ 95 transplants that had been seeded on 1 April in the greenhouse in Model 100A Todd flats (200 cells/flat; cell size 5/8" X 1/2" width X 3" depth)

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(Speedling, Inc., Sun City, FL) were set in raised beds on 2, 3 and 4 May along the field margin adjacent to boll weevil overwintering habitat. 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 1 and 3 ft. In mid-May, 10 mg boll weevil pheromone lures were fastened to transplants using paper clips. One lure was clipped to plants every 100 ft, and new lures were added every 2 wks. In each field, 3 pheromone traps were placed adjacent to the overwintering habitat to monitor boll weevil activity. Traps were monitored every 6 to 10 days. ULV Malathion (95%) applications were initiated in all trap crop fields on 28 May. Trap crops were sprayed 2 times weekly using a mist blower which delivered 12 ounces ULV malathion/ac. The application was applied to the trap crop, but it also reached out ca. 50 ft into the commercial crop. Malathion applications continued until the commercial crop reached cutout (NAWF = 5). No ULV malathion applications were made in the control field.

Fruit counts to evaluate square initiation in trap crops were made weekly by examining 5 consecutive plants in 3 randomly selected sections / plot. As 1/3 grown squares appeared in the commercial fields, weekly square damage counts were made using stratified sampling and the line-intercept method (Willers et al. 1992). Samples were drawn from 3 ft lengths of row along transect lines across 24 rows (38" rows) originating from baselines set adjacent to habitat, in the center portion of the field, and at the margin of the field farthest from overwintering habitat. Markers were placed permanately on the field margin so that baseline origins were apparent for each sample date. Starting points of transects along each baseline were randomly chosen before entering the field using a random number table. A 3ft section of soil across each row was examined for fallen boll weevil damaged squares (old ground squares). The scout then forcefully struck the 3 ft sample area to dislodge any squares that had been damaged (new ground squares). They also pulled 3 randomly selected squares in the 3 ft sample area and examined those squares for boll weevil damage (= 72 squares/sample). Total ground area examined per sample was 228 sq ft (24 rows * 3 ft * 38/12 ft). There were 9 transects sampled per field except for Red Onion where 6 samples were made. Sampling continued until cutout.

Results

In 1995 trap crop research, the time required for 2 people to transplant 2, ¼ mile rows of cotton was 1 hr (Teague and Tugwell 1996). In those fields, the field area for the trap crop had been well drained, and the cooperating farmer had done sufficient land preparation such that the tractor and transplanter could go directly into the field with no delay or land preparation required. In 1996 work, there was little land preparation prior to arrival of the transplant team at the Red Onion, Lake City and Manila sites. The transplanting sites also were muddy. Total time for establishing trap crops in these fields was ca 2 hrs for every 2, ¼ mile rows. Advance farmer preparation at the Black Oak field lead to transplant time of less than 1 hr for 2, ¼ mile rows.

Weed infestations in the trap crops at the Red Onion, Lake City and Manila sites required a post emergence herbicide application on 27 May. Other weed control inputs included tillage of the trap crop at the Red Onion Site by the cooperating farmer who included the trap crop rows in his tillage and his post emergence herbicide program along with his commercial field. Preplant herbicide applications of trifluralin at the Black Oak field provided excellent weed control; however the trap crop was stunted severely, and this site was abandoned by 15 June.

As occurred in 1995, the 1996 trap crops were significantly advanced over commercial cotton and continued to be attractive to boll weevil even after commercial fields began fruiting. Pinhead squares were observed 23 May in Red Onion, Lake City and Manila. During the 1st week of June, 1/3 grown squares were observed in these fields (Figure 1). On the average, trap crops had squares available to boll weevils 3 wks prior to the commercial, direct seeded crop in the same field. This fruiting differential is significant in that the squaring plants are much more attractive to boll weevils than non-squaring cotton.

The plants grew well after transplanting, producing squares beginning the 5th and 6th node. Plant spacing of 3 ft seemed to be sufficient for trap crop establishment. There were some problems encountered with minor outbreaks of aphids and spider mites in some trap crop plants following repeated applications of malathion. Secondary pests in 1996 did not present the severe problems they did in 1995. Border sprays by the farmer could be necessary if pest numbers began to increase significantly in commercial fields.

No trends in differences between pheromone trap catches were noted between pheromone traps in control, and trap crop fields, so pheromone trap data were pooled. Pheromone trap catches (Figure 2) began to increase during the last week of May just as squares appeared in transplated cotton. Spring catches were higher in Lake City and Red Onion compared to the other fields. These sites are near the St. Francis River levee, a large area of high quality overwintering habitat in comparison to the smaller overwintering area at Manila.

Agronomic practices proved to be unequal between control and trap crop fields, particularly in relation to irrigation practices. In all three sites, irrigation of control fields was delayed until after 2nd week of July. This lead to differences in square initiation and in time to cutout in the fields. With differences in availability of squares between the commercial fields, square damage data may be confounded. Regardless of crop maturity differences, however, numbers of boll weevil damaged squares in all fields were low. Mean no. damaged old + new ground squares observed /sample was < 2 (Figure 3). For pulled squares, damage through the season was never above 2% (Figure 4).

Cost estimates for each activity in establishing and maintaining trap crops were made in 1995 (Teague and Tugwell 1996). Those costs were based on 151 miles of transplants estimated needed for the eastern Craighead and Mississippi County areas of NE Arkansas. Cost per acre for the region (243,000 acres) was at < $1.00 per acre. Those estimates were based on time required for 3 people to set 2 rows of transplants along 1/4 mile at between 45 and 60 minutes if the farmer has prepared beds. Plant spacing of 1 transplant/ft also was assumed. New estimates were made in 1996 with changes in labor costs (increased minimum wage) and changes in costs for transplants (industry cost increase from $0.03 to $0.05/plant) (Table 1). Reducing the planting density from 1 per foot to 1 per 3 ft will reduce costs for transplants, and based on 1996 observations, have no negative effect on trap crop establishment. One further potential change in costs would be associated with time required for trap crop establishment. If the transplant team was required to make and shape beds, labor costs will be doubled because of additional time requirements. With farmer assistance with land preparation, however, the procedures and costs associated with using transplants for trap crop establishment appear to be feasible and in an acceptable cost range for an eradication program.

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References

Bottrell, D. G. and D. R. Rummel. 1976. Suppression of boll weevil populations with pheromone traps. Chapter 7 In RM 8. TX. Agr. Exp. Sta.

Isley, D. 1950. Trapping weevils in spots with early cotton. Ark. Agr.Exp. Sta. Bull. 496:45-36.

Mally, F. W. 1901. The Mexican cotton-boll weevil. U.S. Dep. Agr. Farmer's Bull. 130. pp 11-12.

Rummel, D. R., R. C. McIntyre, and C. W. Neeb. 1976. Suppression of boll weevils with grandlure-baited trap crops. Chapter 5 In RM 8. TX. Agr. Exp. Sta.

Teague, T. G. and N. P. Tugwell. 1996. High speed transplanting of cotton for trap crops - a possible tactic for Midsouth boll weevil eradication. Proc. Beltwide Cotton Prod. Res. Conf. p. 721-724.

Willers, J. L., S. R. Yatham, M. R. Williams, and D. C. Akins. 1992. Utilization of the line-intercept method to estimate the coverage, density, and average length of row skips in cotton and other row crops. Proc. Applied Stat. Agric., Kansas State Univ., Manhattan.

Table 1. Cost estimates for establishment, maintenance, and destruction of 1 mile of transplanted trap crop 2 rows wide*.

Item	Unit	Price/unit	No units	Total
Transplants	ea	$0.05	3520	$176.00
Labor	hr	$6.00	12	$72.00
Machinery	hr	$20.00	4	$80.00
Pesticide	app	$13.80	14	$193.20
Spray Labor	hr	$6.00	14	$84.00
Scouting	hr	$6.00	14	$84.00
Traps	ea	$1.50	8	$12.00
Pheromone	ea	$0.25	180	$45.00
Destruction	hr	$25.00	2	$50.00
Travel	mi	$4.25	31	$131.75
			Total	$927.95

*Assumes 2 single rows of transplanted cotton spaced 3 ft apart (3 person transplant crew), sprayed 2 times weekly (12 oz malathion ULV) and scouted weekly for 6 wks. Pheromone lures are placed at 100 ft intervals and changed every 2 wks. Trap crop is destroyed by mowing. Mileage allows 31 trips, 17 miles @ $0.25/mile.

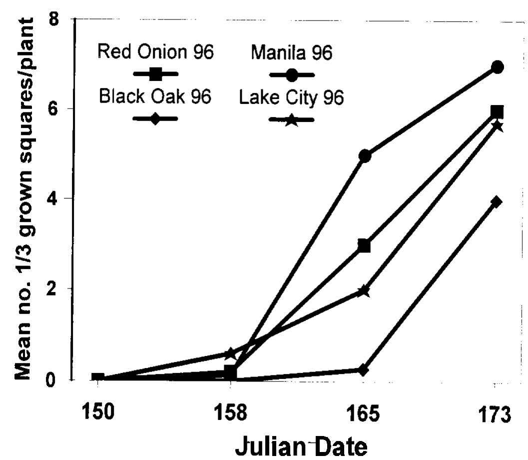

Figure 1. Square production in trap crops in 1996 (approximately 3 to 4 wks in advance of commercial direct seeded cotton in NE Arkansas).

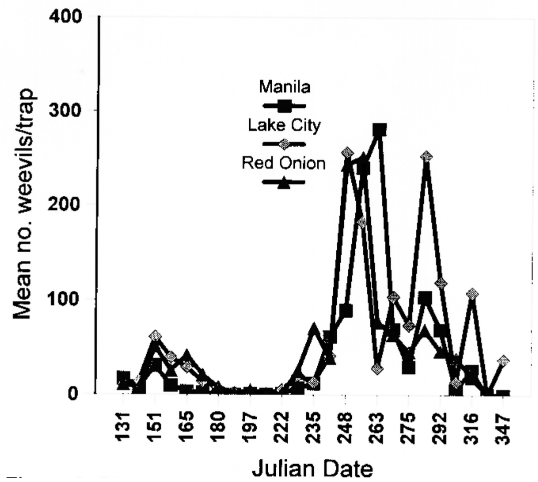

Figure 2. Pheromone trap catches from May through December 1996 for each of the 3 study sites.

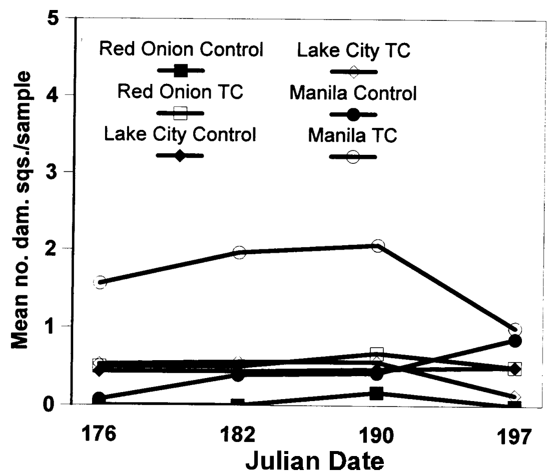

Figure 3. Boll weevil damaged ground squares (old + new) observed in line intercept samples in trap crop (TC) and control fields.

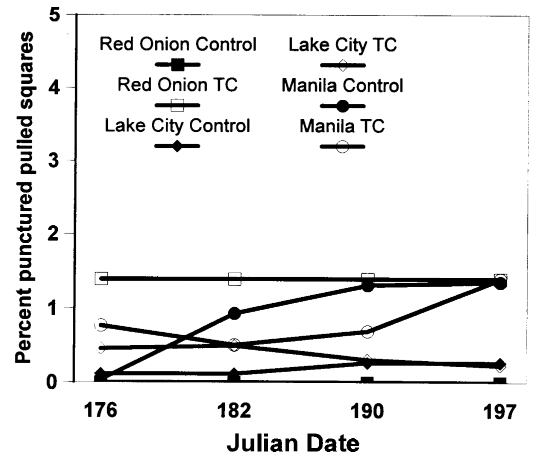

Figure 4. Percent boll weevil damaged squares observed in line intercept samples in trap crop (TC) and control fields.