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SUPPRESSION OF TARNISHED PLANT BUGS IN COTTON BY TREATMENT OF EARLY SEASON WILD HOST PLANTS WITH HERBICIDES IN NINE-SQUARE-MILE AREAS OF THE MISSISSIPPI DELTA

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Abstract

Broadleaf weeds found in marginal areas by fields, roads, and ditches were controlled with the herbicides Trimec® or Strike 3™ in nine-square-mile areas of the Mississippi Delta in March or April of 1999, 2000, and 2001. These weeds serve as early season food and reproductive hosts for tarnished plant bugs and population buildups occur on these weeds prior to movement of plant bugs into cotton. Cotton fields in the treated areas and in untreated nine-square-mile areas were sampled for tarnished plant bugs weekly during June and July of all three years. Overall mean numbers of tarnished plant bug adults and nymphs were significantly lower in cotton in the treated areas. The average reduction in overall mean numbers of plant bugs was 45.5 and 47% for adults and nymphs, respectively, for the three-year period. Grower costs for insecticides used to control plant bugs were lower in cotton in the treated test sites in all three years. Elimination of broadleaf weeds was found to be an effective method for reducing numbers of plant bugs in cotton. However, it did not reduce numbers of tarnished plant bugs in any year to a level in cotton where additional control with insecticides was not needed.

Introduction

Tarnished plant bugs, *Lygus lineolaris* (Palisot de Beauvois), are controlled in cotton almost exclusively with insecticides. In the Midsouth, control of tarnished plant bugs in cotton has become more expensive and difficult because of insecticide resistance. Populations have become resistant to pyrethroid insecticides with lower levels of resistance to a cyclodiene, and several organophosphate insecticides (Hollingsworth et al. 1997, Pankey et al. 1996, Snodgrass and Elzen 1995, Snodgrass 1996). When eradication of the boll weevil, *Anthonomous grandis* Boheman, is completed in the Midsouth, plant bugs will often be the main early season pest of cotton. Having to control plant bugs in cotton with insecticides will reduce benefits that growers derive from boll weevil eradication. Control methods for tarnished plant bugs not based solely on insecticides are badly needed.

The Delta region of the Midsouth is intensively farmed and only a small area of the land is undisturbed by agricultural practices. Snodgrass et al (1991) estimated that marginal areas near roads, fields, and ditches undisturbed by agriculture comprised only 2.4% of the land in a 6.4 km square area of Washington County, Mississippi. In these marginal areas, broadleaf weeds are abundant and are utilized for food and reproduction by tarnished plant bugs in the winter and spring. As these weeds senesce, adult plant bugs move from them into cotton and other crops (Snodgrass et al. 1984, Tugwell et al. 1976). Management of wild hosts in these marginal areas by mowing or use of herbicides is economically feasible because of the small acreage involved. In addition, growers in the Midsouth in the mid 1990's widely adopted a weed control program in which winter and spring weeds are controlled in their fields with herbicides, mainly in February. This farming practice further restricts plant bugs in early season to the wild host plants available in the marginal areas not treated by the growers.

A large experiment was conducted in 1999, 2000, and 2001 to determine whether numbers of tarnished plant bugs found in cotton could be reduced by management of early season broadleaf wild host plants found in marginal areas near the cotton fields. Results from this experiment are reported herein.

Materials and Methods

The experiment was conducted each year using four approximately square test sites 4.8 km (3 miles) on a side. In two of the test sites each year, a single application of Trimec® (1999) or Strike 3™ (2000 and 2001) was applied to most marginal areas with wild host plants during the first two weeks of April 1999 and first two weeks of March 2000 and 2001. These herbicides both contain mecoprop, 2,4-D, and dicamba and are effective in killing broadleaf weeds which can reduce reproduction of tarnished plant bugs in treated marginal areas (Snodgrass et al. 2003). The remaining two test sites (checks) did not receive the early season herbicide application each year. In 1999 and 2000 the same treated and check test sites were used. The two treated test sites were located near Tribbett and Dunleith in Washington County, Mississippi, while the two check test sites were near Holly Ridge in Washington County and Kenlock in Sunflower County. The site near Tribbett was used as a check site in 2001, while the second

check site was located near Choctaw in Boliver County. The two treated test sites in 2001 were located near Arcola and Holly Ridge in Washington County.

Cotton fields in all four test areas were identified in May of each year and their location marked on aerial maps of the test areas. These maps were obtained from the Geographic Information Satellite Center at the Delta Research and Extension Center, Stoneville, Mississippi. Each of the test sites were divided into quadrants for sampling purposes. Approximate field size was determined by determining row width and number in each field and by measuring field length with the odometer of a truck. Sample fields were chosen at random each week from those found in each quadrant of each test area. Fields were sampled weekly with 15 to 20 fields sampled each week from each of the four test sites. A total of 157, 185, and 212 fields was available in the four test test areas for sampling in 1999, 2000, and 2001, respectively.

Sampling was done by sweep net, and each sample was 10 sweeps with a standard (38-cm) sweep net swept back and forth across a single row of cotton. The number of samples taken per field was determined by field size and varied from 10 to 100. Numbers of tarnished plant bug adults and nymphs captured were recorded in the field. Sampling began during the first week in June and ended during the last week in July. A person was hired each year to contact growers and obtain records on insecticides used for plant bug control and their cost during each growing season.

Experimental design in each year was completely random design with two replicates per treatment with several levels of subsampling. The following three analysis of variance were performed: (1) data for each year were analyzed separately by sample week and year; (2) data for all three years were combined by sample week using years as another replication; (3) data was combined by treatment over all sample weeks and years. All analyses were performed with PROC MIXED (SAS Institute 1999).

Results and Discussion

Tarnished plant bugs had lower mean numbers in cotton sampled in the treated test sites in all but two weeks in 1999 and 2000, and in all but one week in 2001. Mean numbers found in cotton in the treated areas were significantly lower in three weeks in 1999 and 2001, and in two weeks in 2000 (data not shown). Because of the inconsistent treatment effect, data were combined for analyses over years by treatment and sample week to add more replication (years) and improve the precision of the data analysis. Results from analysis of the combined data (Table 1) showed no significant differences in mean numbers of plant bugs from cotton in the treated and untreated test areas among sample weeks. However, in every case, the mean number found in the cotton from the treated areas was lower than the mean number from cotton in the untreated areas. The coefficient of variation (cv, Table 1) which indicates the degree of precision with which the treatments were compared (it expresses experimental error as a percentage of the mean) was consistent and less than 7% through the first week in July. In the remainder of July, it increased to its highest percentage (15.1%) in the fourth sample week of July. This increase occurred as mean numbers of plant bugs also increased in fields in the check and treated areas. Movement of tarnished plant bugs into cotton in July has become a consistent occurrence in the Midsouth each year because of several agricultural changes. These changes include boll weevil eradication, increased corn production, widespread production of early planted group IV soybeans, and use of transgenic cotton. Boll weevil eradication has reduced insecticide use for this pest as has transgenic cotton for lepidopterous pests. This reduction in insecticide use allows plant bugs more opportunities to utilize cotton as a host. Tarnished plant bugs can also produce one new generation in corn and group IV soybeans when they bloom. As the corn matures and the group IV soybeans finish blooming in July, adult plant bugs leave these crops and move into the most abundant host available, cotton. Numbers of wild hosts available for plant bugs are also at their lowest level during July and August (Snodgrass et al. 1984). Mean numbers of plant bugs found each week in cotton in the treated and untreated areas were also consistent from year to year, because in only one week (the third sample week in June), was the year by treatment interaction significant (Table 1). Analysis of data combined by treatment over all sample weeks in all three years showed that the mean numbers of nymphs, adults, and total plant bugs, were all significantly lower in cotton in the treated test sites as compared to the mean numbers found in cotton in the untreated test sites (Table 2). Adults, nymphs, and total plant bugs averaged 45.5, 47.0, and 46.1% lower per sample in the cotton from the treated areas.

The lower numbers of tarnished plant bugs found in cotton in the treated test sites was reflected in insecticide control costs. These costs were lower in cotton grown in the treated test sites in all three years (Table3). This is important since it showed that the lower numbers of plant bugs found in cotton in the treated test sites could have been the result of the herbicide treatment, not higher insecticide use in the treated areas. The highest plant bug populations occurred in 2001. In this year, large numbers of plant bugs were found in cotton throughout the Delta during July and August. The high numbers of plant bugs were caused in part by economics. A low price for cotton caused some growers to produce the crop without using insecticides, and were growing it just for crop insurance payments. This allowed plant bugs in these fields to reproduce and migrate to other fields.

In summary, the study showed that treatment of early season broadleaf weeds in marginal areas resulted in lower numbers of tarnished plant bugs and lower control costs in cotton grown in the treated areas. The herbicide treatment will not by itself control plant bugs in cotton, but it could be an important component of an integrated control program for plant bugs which included other non-insecticidal control measures. The size of the areas treated with herbicides in the study was nine-square-miles. Research is currently being conducted to determine if smaller treated areas (one-square-mile) will also reduce plant bug numbers in cotton.

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Table 1. Weekly mean numbers of tarnished plant bug adults and nymphs found in cotton grown in untreated areas of the Mississippi Delta, and in nine-square-mile areas in which broad leaf weeds in marginal areas were killed with a herbicide in March or April.

	Mean[a] /10 sweeps						
	Untreated	Treated	cv	Trt F	*P*>F	Trt x Yr F	*P*>F
June							
1st wk	0.2276	0.1395	6.479	1.33	0.265	0.97	0.391
2nd wk	0.1314	0.0791	4.386	1.82	0.248	0.56	0.594
3rd wk	0.1300	0.0961	3.607	0.58	0.459	3.28	0.050
4th wk	0.1292	0.0849	6.479	3.18	0.155	1.36	0.340
July							
1st wk	0.1728	0.0893	4.678	3.27	0.128	1.00	0.431
2nd wk	0.2500	0.1661	8.268	1.06	0.366	0.32	0.756
3rd wk	0.3542	0.1812	10.523	2.29	0.213	0.31	0.762
4th wk	0.5710	0.2652	15.106	2.50	0.145	0.60	0.578

[a] Means are data from 1999, 2000, and 2001 combined over years and treatment by sample week. The means are based on samples from 30 or more fields in each treatment in each year in each week.

Table 2. Overall mean numbers of tarnished plant bugs found in cotton grown in untreated areas of the Mississippi Delta, and in fields in nine-square-mile areas in which broad leaf weeds in the marginal areas were killed with a herbicide in March or April.

	Mean[a] /10 sweeps			
	Untreated	**Treated**	**F**	***P* > F**
Adults	0.2043	0.1114	66.82	0.01
Nymphs	0.0435	0.0230	13.35	0.05
Both	0.2456	0.1324	56.23	0.02

[a] The means are for all sample weeks by treatment in 1999, 2000, and 2001.

Table 3. Grower costs per acre for tarnished plant bug control in cotton grown in nine-square-mile areas of the Mississippi Delta in which broad leaf weeds in marginal areas were killed with a herbicide in March or April and in cotton fields in untreated nine-square-mile areas.

	Treated areas		Untreated areas		
Year	**No. growers**	**Cost ($)**	**No. growers**	**Cost ($)**	**Cost/acre difference**
1999	6	9.11	14	15.58	6.47
2000	18	23.46	5	30.02	6.56
2001	11	32.69	9	41.13	3.44