2005 Beltwide Cotton Conferences, New Orleans, Louisiana - January 4 - 7, 2005

TARNISHED PLANT BUG SAMPLING AND MANAGEMENT IN THE MISSISSIPPI DELTA

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Abstract

A field experiment was established to investigate sampling tarnished plant bug populations in flowering cotton. Large plots were established in Stoneville, MS in a randomized complete block design with four replications. Insecticides were applied to plots at different times during the flowering period to establish different densities of tarnished plant bugs and damage. Applications were initiated the second through seventh weeks of flowering. Plots were maintained insect free for the remainder of the season. Prior to initiation of treatments, tarnished plant bug densities were sampled with a sweep net, shake sheet (=ground cloth), and visual observation. In addition, several plant based parameters (i.e. fruiting form damage) were measured. Tarnished plant bugs caused significant yield reductions in this experiment. Plant based scouting procedures provided a better estimate of yield reductions from tarnished plant bugs than actual insect counts. Results from this experiment will be important for managing a key pest of cotton in the mid-South.

Introduction

The tarnished plant bug, *Lygus lineolaris* (Palisot De Beauvois), is an important pest of cotton in the mid-South (Layton 2000). Prior to the release of Bollgard cotton and initiation of boll weevil eradication, tarnished plant bugs had been perceived as being only an early season pest. Insecticide applications targeting tarnished plant bugs were primarily made prior to the blooming period of cotton development (Black 1973). During the blooming period, numerous applications of broad spectrum insecticides were made for boll weevils and lepidopteran pests. The assumption has been that those applications also provided some control of tarnished plant bugs; thereby, reducing the need to control them during the flowering period. Since the widespread adoption of Bollgard cotton and successful implementation of boll weevil eradication in the mid-South, losses associated with tarnished plant bugs and subsequent control costs have been increasing during the flowering period (Williams 2004). Again, the assumption is that the reduction in the use of broad spectrum insecticides resulting from these technologies has allowed tarnished plant bugs to more readily exploit blooming cotton as a host.

Sampling tarnished plant bugs has always been a difficult task. Considerable work has been done to determine the most efficient and accurate methods for sampling tarnished plant bugs and their damage during the pre-bloom stages of cotton plant development (Fleischer et al. 1985, Snodgrass 1993). Consequently, agricultural pest managers have become comfortable with the sampling procedures and action thresholds recommended by state extension personnel for tarnished plant bugs in pre-bloom cotton. During the pre-bloom period, sweep net samples along with square retention counts are used to determine the appropriate timing of insecticide applications for tarnished plant bugs. In contrast, there is some confusion about the most efficient method for sampling tarnished plant bugs during the flowering stages of cotton development. Shake sheet samples are recommended to determine when to make insecticide applications for tarnished plant bugs in flowering cotton (Snodgrass 1993). However, consultants and pest managers are reluctant to use shake sheets because of the labor involved and the time required for shake sheet samples. Therefore, many agricultural consultants are basing their control recommendations on visual observation. Accurate thresholds have not been established for visual samples and many applications are based solely on experience of the consultant and not on scientific data. The current experiment was initiated to determine the impact of tarnished plant bug infestations during the flowering period of cotton development on yields. Also, this experiment compares various sampling procedures for their effectiveness at predicting yield losses form tarnished plant bugs.

Materials and Methods

A field experiment was initiated during the 2003 growing season to assess various sampling procedures for tarnished plant bugs on cotton. Plots (24 rows by 150 ft.) were established in Stoneville, MS. Treatments were assigned to plots in a randomized complete block design with four replications. Treatments included initiation of insecticide applications during the second, third, fourth, fifth, sixth, and seventh week of flowering as well as a non-treated control. After insecticide applications were initiated for a particular plot, that plot was sprayed one to two times each week throughout the season to obtain complete control and minimize re-infestations. Treatments were applied in this manner to establish different levels of tarnished plant bugs and their damage in each plot.

Prior to the initiation of a treatment, the plots were sampled using various plant based procedures in addition to insect counts. Tarnished plant bug adult and nymph populations were sampled with a 38 cm diameter sweep net, 1 m^2 shake sheet (ground cloth), and by visual observation in squares. Plant based methods included dirty squares (squares with external evidence of feeding [yellow frass]), internal square damage, first position square retention on the upper five nodes, dirty blooms, and boll damage. Also, various plant development parameters were measured. Each plot was only sampled one time. The samples were taken before application, but on the same day the first application was scheduled. The non-treated plots and the plots where insecticide applications were initiated the second week of flowering (season long control) were sampled each week. There was no true season long control in this study because excessive rainfall during June and early July prevented insecticide applications during the early flowering period. Because of this, tarnished plant bug nymphs became established low in the canopy across the entire test area. Therefore, the second week of flowering treatment was considered season long control for comparison.

After cut out (when the final boll populations were on the plants), percent boll damage was determined for each plot. Percent boll damage was determined by removing all bolls from four 3 ft. sections of row per plot. Plots were harvested with a mechanical harvester and weighed in a boll buggy equipped with sensors and a digital scale. Data for end of season boll damage and yields were analyzed with analysis of variance (PROC MIXED, SAS Institute, Version 8.2, Cary, NC). In addition, various sampling procedures used during the season were correlated with final yields to determine which factor provided the best indicator of a yield response.

Results

Treatments in this experiment resulted in varying levels of tarnished plant bug boll injury (Figure 1). Boll damage was significantly reduced by all of the insecticide applications. When insecticide applications were initiated during the second, third, and fourth week of flowering, boll damage was significantly lower than when insecticides were initiated during the sixth, and seventh weeks.

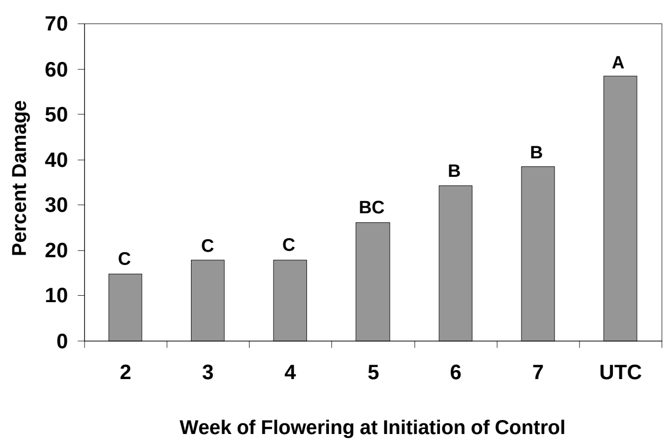

Figure 1. Total boll damage from tarnished plant bugs.

As reflected by boll damage, tarnished plant bugs significantly impacted yields among the different treatments (Figure 2). Yields were higher when insecticide applications were initiated during the early flowering period. When insecticide applications were initiated during the second and third weeks of flowering, yields were higher than when applications were initiated during the fifth through seventh weeks of flowering. Also, when insecticide applications were initiated during the fourth week of flowering, yields were higher than when applications were initiated during the sixth and seventh weeks of flowering.

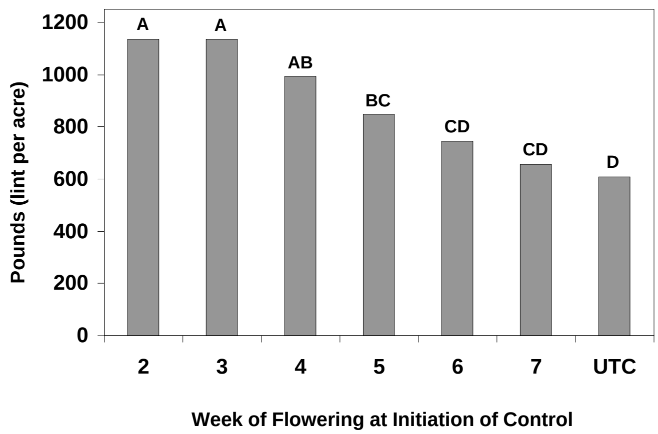

Figure 2. Impact of tarnished plant bugs on cotton yields.

Tarnished plant bug numbers varied among the different treatments (Figure 3). During the second week of flowering (first week of treatment, July 6), tarnished plant bug populations averaged 2.3 per 6 row ft. (0.8 per 25 sweeps). Populations increased to 8.6 per 6 row ft. (6.4 per 25 sweeps) by the fifth week of flowering. Shake sheet samples appeared to provide a better estimate of overall plant bug numbers during the second through fifth weeks of flowering. However, sweep net samples appeared to provide a better estimation during the sixth and seventh weeks of flowering. During the sixth week of flowering, plant bug numbers declined to 2.8 per 6 row ft. based on shake sheet samples. In contrast, sweep net samples indicated that plant bug numbers increased slightly from the fifth to sixth weeks of flowering averaging 6.8 per 25 sweeps.

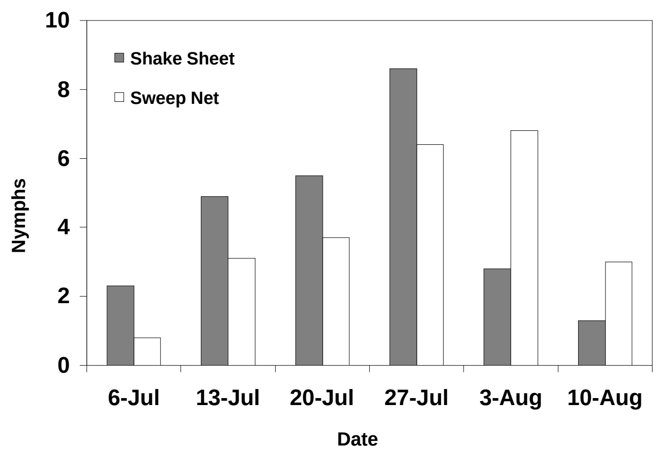

Figure 3. Mean numbers of tarnished plant bug nymphs based on shake sheet (=ground cloth) and sweep net samples. Shake sheet samples are reported as number per 6 row ft. Sweep net samples are reported as number per 25 sweeps.

Based on the correlation coefficients, none of the sampling procedures for tarnished plant bugs or injury provided a good estimate of yield (Table 1). Plant based monitoring procedures provided the best estimate of yields among the procedures used. Percent dirty squares (squares with yellow frass on the outer surface of the bud) was the best predictor of yield losses associated with tarnished plant bugs (r = -0.638). Percent first position square retention on the top five nodes was the second best predictor of yield losses associated with tarnished plant bugs (r = 0.587).

Other plant based samples had correlation coefficients ranging from -0.357 to –0.475. Actual insect counts were variable and in general, had the lowest correlation coefficients.

Table 1. Results of significant correlations between factors measured during the season and final yields.

Sampling procedure correlated with yield	r	*P*
Percent dirty squares (frass)	-0.638	<0.01
Square retention (1st position, top 5 nodes)	0.587	<0.01
Percent internal square damage	-0.489	<0.01
Percent boll damage (medium size)	-0.475	<0.01
Number of nymphs per 25 squares	-0.432	<0.01
Nymphs per 25 sweeps	-0.410	<0.01
Percent boll damage (large size)	-0.404	<0.01
Percent boll damage (small size)	-0.365	<0.01
Percent dirty blooms	-0.357	<0.01
Adults per 6 row feet	-0.334	0.01
Adults per 25 sweeps	-0.313	0.01
Nymphs per 6 row feet	-0.262	0.04

Discussion

This experiment demonstrated the ability of tarnished plant bugs to cause significant yield losses during the flowering period of cotton plant development. It also pointed out the importance of controlling tarnished plant bugs during the flowering period to minimize boll injury and yield losses. Shake sheet samples indicated that tarnished plant bug populations peaked during the fifth week of flowering and rapidly declined during the sixth and seventh weeks of flowering. However, sweep net samples showed that plant bug populations remained high through the sixth week of flowering. This indicated that shake sheet samples are not as efficient for sampling tarnished plant bugs during the later stages of flowering. This is probably a result of overall plant size and fruiting form distribution in the canopy. During the later flowering period, squares are concentrated in the upper portions of the plant canopy. Because squares are the preferred feeding site for tarnished plant bugs (Tugwell 1976), tarnished plant bug densities should also be concentrated high on the plants. During this time, sweep net samples may provide a better estimate of tarnished plant bug densities.

Although the current study showed that tarnished plant bugs need to be controlled to prevent yield losses, there are still some concerns about how to sample tarnished plant bugs in flowering cotton and when to initiate insecticide applications. Data from this experiment indicated that plant based scouting procedures were more accurate for determining when yield losses can result from tarnished plant bug feeding. Percent dirty squares, squares with yellow frass on the outer surface of the bud, provided the best estimate of yield reductions. As the percentage of dirty squares increased, yields decreased. Similarly, square retention also provided a better estimate of yield reductions than other sampling methods. As expected, yields declined as square retention declined. Boll injury did not provide a good estimate of yield reductions associated with tarnished plant bugs. Tarnished plant bug densities based on both shake sheet and sweep net samples were highly variable depending on crop stage and did not provide a good estimate of yield reductions.

In conclusion, this experiment demonstrated the need to control tarnished plant bugs during the flowering stages of cotton plant development. Controls should be initiated in response to data from plant based sampling methods. This experiment will be repeated during 2005 to further refine criteria for managing tarnished plant bugs in flowering cotton.

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