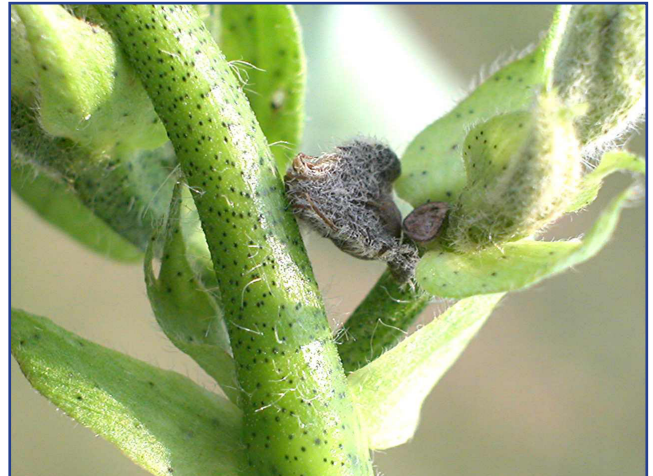


MID-SOUTH MULTI-STATE EVALUATION OF

# Treatment Thresholds for Tarnished Plant Bug in Pre-Flowering Cotton



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## Introduction

Prior to bloom, the primary hemipteran pest of cotton in the Mid-South is the tarnished plant bug (TPB). Cotton fleahopper and clouded plant bug are other hemipteran pests that are occasionally observed. These pests reduce yields by feeding on squares (flower buds), which often shed. Mid-sized or larger squares may not shed, but feeding injury is generally evident in the form of yellow staining on the surface of the square and damaged anthers in flowers (i.e., dirty blooms). Square loss can delay maturity and sometimes reduce yield. Delays in crop maturity, even when not causing yield loss, can increase mid-and late-season control costs for cotton arthropod pests. To compound the problem in the Mid-South, TPB has developed resistance to some insecticides. This has contributed to higher control costs and crop losses since 1995.

In contrast to mid-season populations of plant bugs, prebloom populations of tarnished plant bug are relatively sporadic in most areas. Considerable work has been done to determine the most efficient and accurate methods for sampling TPB and their damage during the prebloom stages of cotton plant development. Thus, agricultural pest managers are comfortable with TPB sampling procedures in prebloom cotton. Sweep-net samples and square retention counts are typically recommended at this time to determine the appropriate timing of insecticide applications. However, some pest managers have not been as comfortable with existing treatment thresholds for tarnished plant bugs in prebloom cotton. Consequently, TPB control recommendations sometimes include applications of insecticide to sub-threshold infestations, or preventative applications are made based on crop developmental stages or other criteria without regard to infestation levels.

In the Mid-Southern states, universities' Extension recommendations for controlling TPB in prebloom cotton are similar. Most states recommend an insecticide application during the first two weeks of squaring if populations reach or exceed eight tarnished plant bugs per 100 sweeps using a 15-inch diameter sweep net. During the third week of squaring and until bloom, a threshold of 15 or 16 plant bugs per 100 sweeps is suggested. Monitoring square loss also is recommended with the intent of maintaining retention during the prebloom period at 80 percent or higher. Treating sub-threshold infestations of TPB is generally recommended if square retention is below 80 percent.

## Procedures

From 2006 to 2008, a standardized test was successfully completed at 33 Mid-Southern locations including Arkansas (14), Louisiana (3), Mississippi (7), Missouri (4) and Tennessee (5). Large field plots (24 rows x 100 ft minimum) were arranged in a randomized complete block with four replications per treatment. Treatments were:

- Auto: Weekly insecticide application beginning at pinhead square and continuing until first bloom

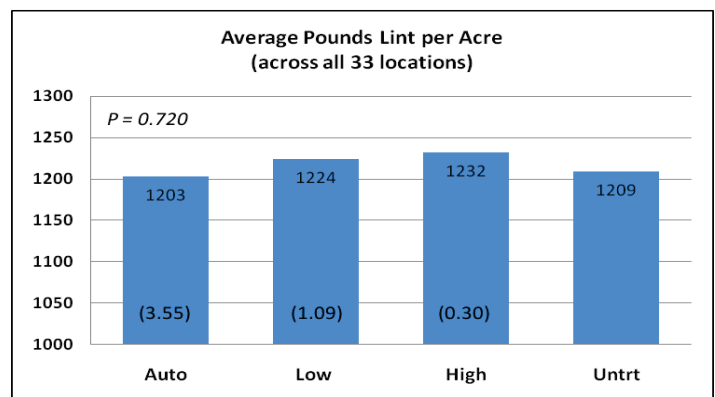
- Low: Insecticide application when TPB density reached 8 TPB/ 100 sweeps or if square retention dropped below 80 percent
- High: Insecticide application when TPB density reached 16 TPB/ 100 sweeps or if square retention dropped below 60 percent
- Untrt: Untreated prior to first bloom

All fields were planted with a transgenic Bt cotton variety to minimize the impact of caterpillar pests. Sweep-net sampling consisted of two sets of 25 sweeps in each plot (200 sweeps per treatment). Square retention in each plot was determined by examining the third node below the terminal for the presence/absence of squares on 50 plants per plot. Insecticide application decisions were based on average counts from the four replicates of a treatment. Clouded plant bugs or cotton fleahoppers were a low percentage of the total plant bug population in these tests and were counted as equivalent to tarnished plant bugs when making threshold calculations.

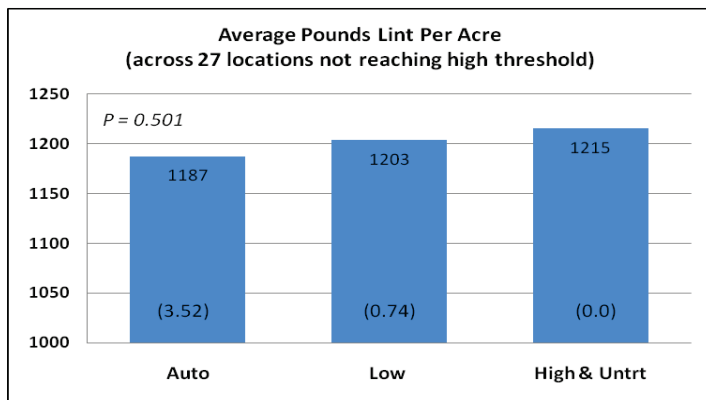
Most locations were sampled and sprayed once per week, but twice-weekly samples were sometimes taken, and insecticides were applied as needed. The neonicotinoid insecticides thiamethoxam (*Centric* @ 2 oz [form.]/acre) and imidacloprid (*Trimax Pro* @ 1.8 oz [form.]/acre) were rotated weekly for treatment applications. Just after first bloom, the entire test was sprayed with an organophosphate insecticide (e.g., Orthene or Bidrin) to reduce TPB populations. Plots were then managed uniformly according to grower standards for the remainder of the season, and yield data were collected.

## Results

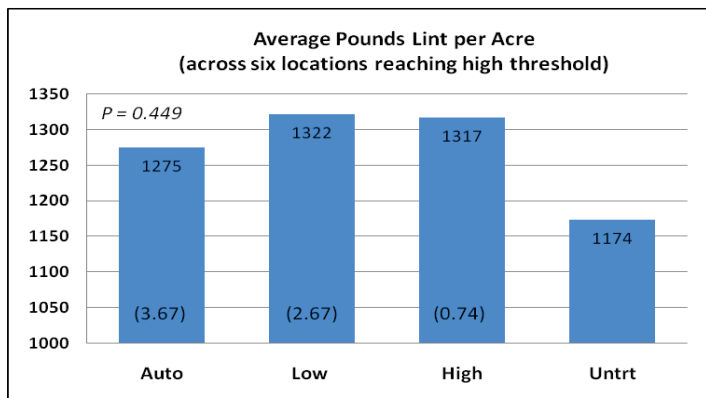
Tarnished plant bug infestations failed to reach the low threshold during the prebloom period in 13 of 33 locations; 14 locations reached the low threshold but not the high threshold, and six locations reached the high threshold at least once. Average yields across locations were not statistically affected by treatment threshold (Figs. 1, 2 and 3), although a trend was evident where high pest pressure was observed (Fig. 3).



**Figure 1.** Average lint yield response to threshold treatments across all 33 test locations. Numbers in parentheses are the average number of insecticide applications made to each treatment.



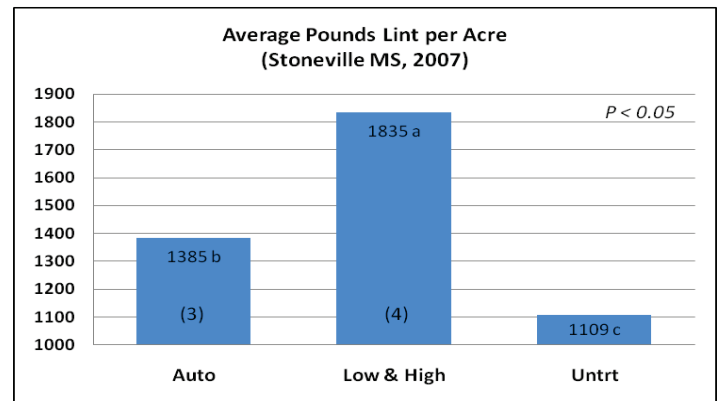
**Figure 2.** Average lint yield response to threshold treatments across 27 test locations not reaching the high threshold. Numbers in parentheses are the average number of insecticide applications made to each treatment. Auto = weekly applications, Low = threshold of 8 TPB/100 sweeps, and High = threshold of 16 TPB/100 sweeps.



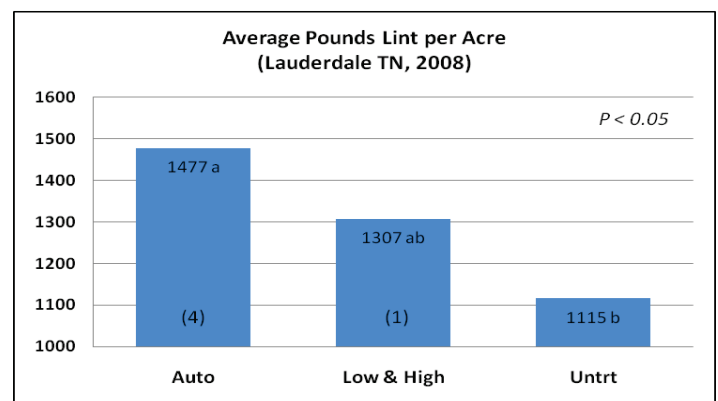
**Figure 3.** Average lint yield response to threshold treatments across six test locations reaching the high threshold. Numbers in parentheses are the average number of insecticide applications made to each treatment. Auto = weekly applications, Low = threshold of 8 TPB/100 sweeps, and High = threshold of 16 TPB/100 sweeps.

Significant increases in lint yield resulting from insecticide applications were detected for several individual locations. At one Mississippi location, insecticide sprays greatly increased yield when TPB populations were present in sustained, very high numbers (Fig. 4). Populations in this test averaged about 40 TPB/100 sweeps in untreated plots during the prebloom period, and infestations were above the high threshold in all treatments on every sampling date. High but less sustained TPB pressure was observed in Lauderdale County, TN in 2008, and insecticide sprays during the first 10 days of squaring also improved yields at this location (Fig. 5). This is the only location where the automatic treatment appeared better than a threshold approach. Populations during the first week of squaring, when only the automatic treatment was sprayed, averaged about 2 TPB/100 sweeps. The next week, untreated plots

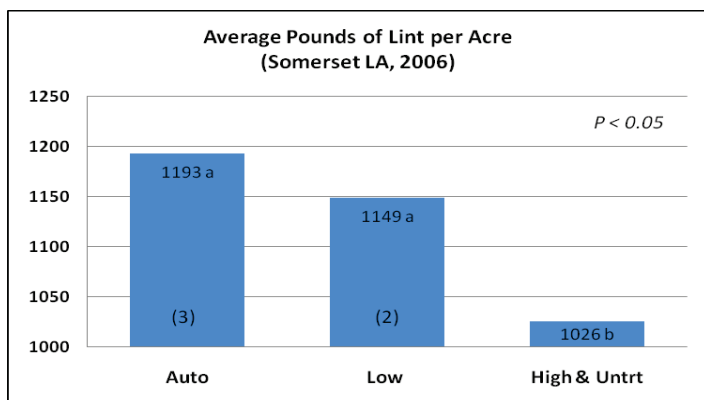
averaged 26 plant bugs per 100 sweeps, and the automatic treatment averaged 8.5 plant bugs per 100 sweeps. Thus, the preemptive insecticide application in the automatic treatment reduced subsequent TPB populations and damage. Treatment of sustained but moderate infestations of TPB improved yield, but less dramatically, at a location in Louisiana during 2006 (Fig. 6). A yield response to treatment was not observed at all locations where the high threshold was reached or exceeded. This may have been because maximum TPB infestation levels did not necessarily reflect average pressure during the prebloom period.



**Figure 4.** Yield response to insecticide treatment thresholds at Stoneville, MS (2007). Numbers in parentheses are the number of insecticide applications made to each treatment. Auto = weekly applications, Low = threshold of 8 TPB/100 sweeps, and High = threshold of 16 TPB/100 sweeps. Note: applications in Low and High treatments were identical.

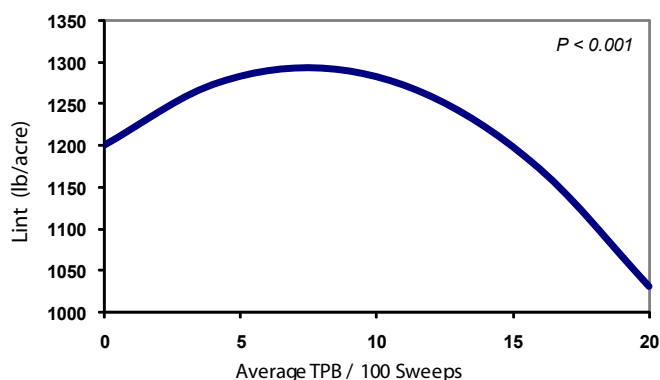


**Figure 5.** Yield response to insecticide treatment thresholds in Lauderdale County, TN (2008). Numbers in parentheses are the number of insecticide applications made to each treatment. Auto = weekly applications, Low = threshold of 8 TPB/100 sweeps, and High = threshold of 16 TPB/100 sweeps. Note: applications in Low and High treatments were identical.

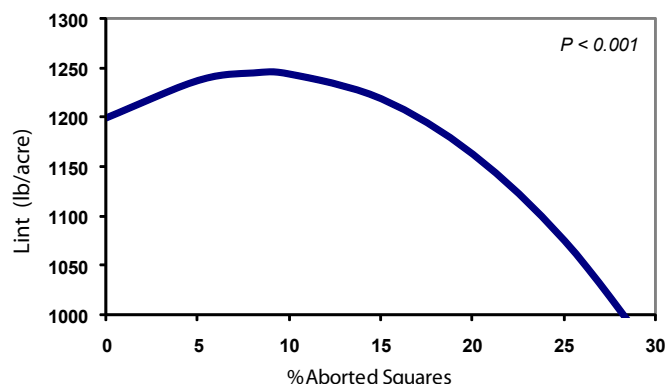


**Figure 6.** Yield response to insecticide treatment thresholds in Somerset, LA (2008). Numbers in parentheses are the number of insecticide applications made to each treatment. Auto = weekly applications, Low = threshold of 8 TPB/100 sweeps, and High = threshold of 16 TPB/100 sweeps. Note: no applications in Untrt or High treatments.

To better reflect overall pest pressure experienced in each treatment from pinhead square to first bloom, yield was compared to average TPB density and average square retention without regard to which treatment the plot was assigned. In these analyses, there was a strong relationship between TPB density and yield (Fig. 7) and between square loss and yield (Fig. 8).

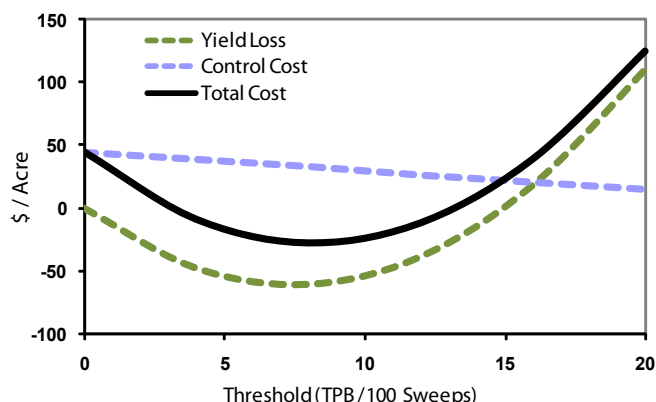


**Figure 7.** Regression analysis of yield response vs. average prebloom plant bug density across all 33 test locations.



**Figure 8.** Regression analysis of yield response vs. average prebloom square loss across all 33 test locations.

Combining yield response estimates with insecticide application data for different thresholds, costs (yield loss + insecticide costs) were minimized when average prebloom pest density was approximately 8 TPB/100 sweeps (Fig. 9). The action threshold needed to realize these prebloom averages should be slightly higher than the averages as it is unlikely that infestation levels would be constant over a 3-4 week squaring period. However, the results in Figure 9 show that a slight shift from the optimum threshold density of 8 TPB/100 sweeps had little impact on overall economics.



**Figure 9.** Economic costs from tarnished plant bug control and yield loss during the squaring period. Economic costs based on lint value of \$0.65 per pound and control costs of \$12.00 per application. Number of insecticide applications based on the average number of applications required when using the weekly, low and high thresholds.

## Discussion

In these tests across the Mid-South, TPB populations occasionally ( $\approx 60$  percent of the locations) exceeded our low treatment threshold of 8 TPB/100 sweeps. Populations reached high numbers that could potentially cause serious yield loss in less than 20 percent of the locations. Treatment with insecticides statistically improved yield at only a few locations. However, large yield increases ( $\approx 350$ -700 lb lint/acre) associated with insecticide applications were occasionally observed when TPB infestations exceeded the high treatment threshold (16 TPB/100 sweeps). Costs associated with plant bug control, including yield loss, were minimized when the average prebloom density was approximately 8 TPB/100 sweeps. Average prebloom infestations ranging from 5-12 TPB/100 sweeps, resulting in square loss of about 5-15 percent, tended to improve yields. This is consistent with reports in the literature indicating that some square loss may alleviate plant stress. Existing thresholds of 8 TPB/100 sweeps during the first two weeks of squaring, 15-16 TPB/100 sweeps from the third week until first bloom, and maintaining a minimum of 80 percent square retention agree with these findings. Indeed, our data suggest that an action threshold of eight plant bugs per 100 sweeps is conservative and would trigger sprays well in advance of any potential yield loss.

These results show a very low risk of yield loss by following the existing threshold recommendations for tarnished plant bug. Delays in crop maturity (data not shown) were detected at two locations when square retention dropped below 80 percent. Because average yields were not improved by treating sub-threshold populations (< 8 TPB/100sweeps), insecticide applications in the absence

of meaningful TPB pressure unnecessarily inflates control costs. Additionally, outbreaks of secondary pests (e.g., spider mites) were observed at a few locations where repeated insecticide applications were made. Costs of applications needed to control secondary pests were not included in the above analyses.

#### Photo Credits

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*Clouded Plant Bug*



*Tarnished Plant Bug*



*Dirty Bloom*



*Immature Tarnished Plant Bug*

#### Acknowledgements

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