FEEDING EVIDENCE ON SQUARES AS A TRIGGER FOR INSECTICIDE APPLICATIONS AGAINST TARNISHED PLANT BUGS IN COTTON

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Abstract

This study comprises the initial effort to develop an action threshold for tarnished plant bug that will trigger insecticide applications based on external and internal feeding evidence on squares. These results indicate that to manage square feeding evidence (SFE) at levels of ≤5%, insecticides would likely need to be applied at least weekly, or in some instances more often. Lint yields were comparable in plots receiving sprays applied weekly, or triggered at ≥5% and ≥10% SFE. Additional data is needed but, these results suggest that an action threshold of 10-20% SFE could be effective in reducing insecticide applications without sacrificing cotton lint yield.

Introduction

The tarnished plant bug (TPB), *Lygus lineolaris* (Palisot de Beauvois), has been a primary pest of cotton in the mid-southern United States for the past ten years. Prior to then, this pest was considered an occasional problem, but in some years did cause significant yield losses (Layton 1995). During 2005 and 2006, a complex of *Lygus spp*. were the second most damaging pests behind the tobacco budworm, *Heliothis virescens* (F.), and bollworm, *Helicoverpa zea* (Boddie), across the United States cotton belt (Williams 2005, 2006). In Louisiana during 2006, tarnished plant bugs were responsible for a loss of >43,000 cotton bales (Williams 2006). An increase in the significance of this pest during recent years is related to a reduction in the application frequency of broad spectrum insecticide applications that would have inadvertently controlled tarnished plant bug populations. This reduction can be attributed to the adoption of transgenic Bt cotton cultivars that target heliothines, and the success of the boll weevil eradication program (Roberts 1999). In addition, there has been an increase in the use of target-specific insecticides that do not express high levels of efficacy against tarnished plant bug (Leonard 2006).

Cotton is most susceptible to economic injury from tarnished plant bug after flower bud (square) initiation but continues throughout the flowering stages of plant development (Tugwell et al. 1976). Feeding on small squares by tarnished plant bug adults and nymphs can cause abscission to occur, and in some instances reduce seed cotton yield (Pack and Tugwell 1976, Layton 1995). The primary sites for tarnished plant bug feeding are anthers and pollen in squares and flowers. Anthers may become necrotic and atrophy of pollen sacs can occur (Pack and Tugwell 1976). Tarnished plant bug feeding on cotton bolls has been observed, but generally was found to be not as important as feeding on squares (Pack and Tugwell 1976). However, damage to bolls also can reduce seed cotton yield and affect seed quality. With the aforementioned changes in cotton IPM practices, tarnished plant bugs have become more of a mid-to-late season problem injuring squares and bolls (Musser et al. 2007). Russell et al. (1999) showed that tarnished plant bugs caged on small bolls can cause abscission and yield losses until those bolls have accumulated an average of 245 and 326 heat units beyond anthesis, respectively.

Several IPM strategies currently are recommended to manage this pest (Bagwell et al. 2005, Catchot 2007, Stewart and Lentz 2005). However, insecticides remain the primary tool used to control tarnished plant bug in cotton. For insecticide control strategies to be successful, proper timing of these applications is critical. Several indirect and direct sampling methods currently are being used to estimate populations and/or damage levels for action thresholds to initiate treatments during the early and mid-season (Bagwell et al. 2005, Catchot 2005). Frequently, tarnished plant bugs re-infest fields and these thresholds are further used to schedule treatments throughout the season. Several of the more recently registered classes of insecticides recommended for tarnished plant bug control have novel modes of action, which make them more difficult to evaluate for actual performance compared to many of the older, common insecticides used in commercial cotton fields. Therefore, new or revised sampling protocols coupled with existing action thresholds are needed to successfully schedule applications of these new products. Recently, Musser et al. (2007) evaluated several sampling protocols to estimate tarnished plant bug populations and the associated injury to cotton fruiting forms. That work suggests several methods can be used to sample this insect and provide relatively consistent information across a range of conditions. Gore (2005) has suggested that the presence of frass-stained squares or squares with evidence of feeding (SFE) also may provide precise estimates of tarnished plant bug injury in cotton fields. In many crop IPM systems, sampling plants and or plant parts targeted by pests provides a more sensitive and repeatable process of estimating economic infestations of insects.

Therefore the objective of this study was to evaluate tarnished plant bugs feeding evidence (presence of external frass or internal necrotic anthers) on squares as a trigger to schedule insecticide applications during the flowering to boll maturation period of cotton plant development.

Materials and Methods

Studies were conducted at the Macon Ridge Research Station, near Winnsboro, LA. Cotton cultivars were planted in a Gigger silt loam with a John Deere planter during mid-May of 2005, 2006, and 2007. Plots were 8 rows (centered on 40 inches) by 50 feet. The actual treatments included: (1) Non-treated control, (2) weekly insecticide sprays initiated at first flower and continued until crop cutout, and target thresholds of (3) ≥5% squares with feeding evidence (SFE), (4) ≥10 % SFE, (5) ≥20% SFE, and (6) ≥30% SFE. Treatments were arranged in a randomized complete block design with four to six replications. The insecticides used for these applications included Orthene 90SP (0.8 lb form./acre) and Centric 40WG (2 oz form./acre) and were applied with a John Deere high clearance sprayer calibrated to deliver 6 GPA with Teejet TX-6 hollow cone nozzles. All plots were sampled by examining 50 randomly selected squares from the upper 1/3 of the cotton plant on the center four rows of each plot. Feeding evidence was determined by visual inspection of the squares externally for frass and internally for necrotic anthers. Plots were mechanically harvested with a spindle-type picker and ginned to determine lint yields. Data were subject to ANOVA and means were separated using Duncan's multiple range test (SAS 2003).

Results and Discussion

During this study, the total number of applications across all treatments ranged from 0 (Non-treated control and ≥30% SFE) to 6 (automatic weekly applications) (Table 1). The frequency of sprays triggered at ≥5% SFE was very similar to those sprays applied on a schedule. Attempts to reduce evidence of tarnished plant bug feeding <5% likely would require insecticide applications be applied at least weekly, if not more often. As expected, fewer applications were triggered in the ≥10% and ≥20% SFE treatments compared to that for the ≥5% SFE and automatic weekly sprays. The action threshold of ≥30% SFE was never reached during all three years of the study and no sprays were applied to those plots.

Table 1. Frequency of sprays required to maintain selected levels of tarnished plant bug feeding evidence on squares (SFE) during the flowering period.

	No. of Applications[a]			
Treatments	**2005**	**2006**	**2007**	**Average**
Non-Treated	0	0	0	0
Weekly @ 1st Flower	6	6	6	6
≥5% Feeding Evidence	6	4	6	5.3
≥10% Feeding Evidence	4	2	5	3.7
≥20% Feeding Evidence	2	0	1	1
≥30% Feeding Evidence	0	0	0	0

[a]Insecticide applications included Orthene 90SP @ 0.8 lb form. /acre and Centric 40 WG @ 2 oz. form. /acre.

Significant differences among treatments in cotton lint yields were detected in each year (Table 2). The non-treated plots yielded significantly lower than all insecticide-treated plots, except for those triggered at ≥20% SFE (not in 2005) and ≥30% SFE thresholds during all three years. During 2005, the ≥20% SFE was sprayed twice and the yield was higher than that for the non-treated plots. No significant differences in yield were detected between the automatic weekly sprays, and the plots triggered at ≥5% and ≥10% SFE in any year. The automatic weekly sprays, ≥5% SFE, and ≥10% SFE treatments produced significantly higher yields than that in the non-treated, ≥20% SFE, and ≥30% SFE treatments except in 2006. Only the ≥10% SFE treatment produced significantly higher yields than the non-treated plots during that year. Based upon the tarnished plant bug infestation levels during the three years of this study, sprays triggered weekly (automatic) or based upon ≥5% and ≥10% SFE thresholds consistently had higher yields than the other treatments. The study by Gore et al. (2005) produced results similar to that of the present work and showed that as the percentage of frass-stained squares increase, seed cotton yields decrease.

Table 2. Cotton lint yields for selected levels of tarnished plant bug feeding evidence on squares (SFE) during the flowering period. Means followed by the same letter are not significantly different (Duncan's multiple range test).

	Yield (lb lint/acre)			
Treatments	**2005**	**2006**	**2007**	**Average**
Non-Treated	817c	700b	872b	796
Weekly @ 1st Flower	945a	759ab	972a	892
≥5% Feeding Evidence	947a	766ab	991a	901
≥10% Feeding Evidence	931a	801a	971a	901
≥20% Feeding Evidence	897ab	712b	913b	840
≥30% Feeding Evidence	840bc	717b	879b	812

Summary

This study comprises the initial effort to develop an action threshold for tarnished plant bug that will trigger insecticide applications based on external and internal feeding evidence on squares. These results indicate that to manage square feeding evidence (SFE) at levels of ≤5%, insecticides would likely need to be applied at least weekly, or in some instances more often. Lint yields were comparable in plots receiving sprays applied weekly, or triggered at ≥5% and ≥10% SFE. Additional data is needed but, these results suggest that an action threshold of 10-20% SFE could be effective in reducing insecticide applications without sacrificing cotton lint yield.

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