RE-DEFINING THE CONTRIBUTION OF THE NECTARILESS TRAIT IN TARNISHED PLANT BUG IPM

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Abstract

In recent years, the tarnished plant bug (TPB), *Lygus lineolaris* (Palisot de Beauvois), has become the major cotton pest throughout the Mid-Southern U.S. cotton producing states. Several integrated pest management strategies are recommended for controlling TPB. However, chemical control strategies are the main tool used in controlling this pest. Presently, numerous insecticides are recommended for TPB control, but there is considerable variation in performance among these products. Standard insecticide use strategies can reduce TPB numbers, but none have been able to eliminate this pest. Insecticide susceptibility surveys have shown varying levels of resistance to several of these insecticides.

Several host plant resistance traits in cotton cultivars have been evaluated against tarnished plant bugs. Large glands (nectaries) on cotton plants provide an important source of food and water for many adult insects commonly found in cotton fields. The removal of nectaries from cotton lines (nectariless trait) has been evaluated for reduction of several arthropod pest species in cotton. The nectariless trait is currently being re-evaluated as an IPM tool for managing TPB. The objective of this experiment was to evaluate the effect of nectariless cotton on TPB abundance and plant susceptibility to TPB in a sprayed/non-sprayed environment. In 2007 and 2008, selected nectariless and nectaried cotton varieties and spray regimes were evaluated for TPB. TPB numbers were evaluated weekly before and during flowering. The nectariless cotton variety reduced numbers of TPB during flowering in both years of this study compared to the nectaried. A nectariless cotton variety may help reduce TPB numbers and mitigate cotton yield losses from this pest. This trait coupled with other IPM options may help producers reduce yield losses associated with TPB infestations in cotton.

Introduction

Cotton, *Gossypium hirsutum* (L.), is one of the major agronomic crops grown in the Mid-Southern United States. The states of Louisiana, Arkansas, and Mississippi produced 1.5 million acres of cotton that yielded >3.9 million bales during 2007 (Williams 2008). Producers spent >$190 million for management of a variety of arthropod pests that year. Some of the most important pests include the tobacco budworm, *Heliothis virescens* (F.); bollworm, *Helicoverpa zea* Boddie; cotton aphid, *Aphis gossypii* Glover; and tarnished plant bug (TPB), *Lygus lineolaris* (Palisot de Beauvois). In recent years, the TPB has become the major cotton pest throughout the Mid-South cotton producing states. In 2008, TPB was considered the most costly pest infesting ≈ 95 percent of the region's cotton acreage and was determined to be responsible for a loss of ≈ 99,000 bales (Williams 2008).

Several integrated pest management strategies are recommended for controlling TPB. Although chemical control strategies are the primary tool used to control pest and numerous insecticides are recommended, there is considerable variation in product performance (Cook et al. 2007). Standard insecticide use strategies can reduce TPB numbers, but none have been able to consistently eliminate yield losses. In recent years, the TPB control problem peaked in the Mid-South during 2007 and producers averaged 3-7 insecticide treatments across the region for this pest (Williams 2008). In addition, insecticide susceptibility surveys have shown varying levels of TPB resistance to several of these insecticides (Snodgrass and Gore 2007).

Several host plant resistance (HPR) traits in cotton cultivars have been evaluated against TPB. The glabrous and frego bract traits have been studied for years and can decrease injury to cotton plants (Bailey 1982, Milam et al. 1985). Another HPR trait involves the use of cotton plants that fewer or no intra- and extra-floral glands (nectaries). These structures on cotton plants provide an important source of food and water for many adult insects. Nectariless cotton lines have influence populations of several arthropod pest species in cotton. The nectariless trait reduces TPB numbers by decreasing female fecundity, and providing host non-preference (, Bailey 1982, Bailey et al. 1984, Scott et al. 1986, Milam et al. 1989). With the current TPB control issues, the agro-chemical and seed companies are re-evaluating the nectariless trait as a cotton IPM

tool. The objective of this experiment was to evaluate the effect of nectariless cotton on TPB abundance and plant susceptibility in a sprayed/non-sprayed environment.

Materials and Methods

Selected cotton varieties and spray regimes were evaluated against TPB at the Macon Ridge Research Station near Winnsboro, LA (Franklin Parish). In 2007, treatments included nectariless (MCS0701B2RF) and nectaried (DP164B2RF) varieties that were either Non-sprayed or sprayed when TPB exceeded action thresholds (10 TPB/100 sweeps or 4-6 TPB/10 ft row). In 2008, an additional treatment was included in addition to the t treatments used the preceding year. This new treatment required the nectariless (MCS0701B2RF) variety to be treated when square retention was < 80%. Cotton seed were planted into a Gigger silt loam soil on 21 May in 2007 and 4 Jun in 2008. Plot size was sixteen rows (centered on 40-inches) X 100 ft. Treatments were placed in a RCBD with 4 replications in 2007 and 3 replications in 2008. In 2007, foliar insecticides (Orthene 0.9 lb AI/acre) were applied to the action threshold treatments on 8 and 18 Aug. In 2008, Centric 0.047 lb AI/acre (6, 14 Aug) and Orthene 0.9 lb AI/acre (22, 29 Aug) were applied to the action threshold treatments. Orthene (same rate) was applied to the square retention treatment on 22 and 29 Aug. All applications were made with a John Deere high clearance sprayer and CO_2-charged system calibrated to deliver 5 GPA through TeeJet® TX-8 hollow cone nozzles (2/row) at 50 psi. TPB adults and nymphs were sampled weekly from match head square throughout flowering with either a standard sweep net (18 in. diameter) or 2.5 x 2.5 ft black shake sheet. Two sets of 25 sweep net samples were taken prior to flowering during both years. On the 4 center rows of each plot during flowering, 4 shake samples (20 row ft total) were taken in 2007 and 2 shake samples (10 row ft total) taken in 2008. TPB damaged squares were recorded on 10, 15, and 20 Aug in 2007 by sampling 100 first sympodial position squares on the upper 1/3 of randomly selected plants in each plot. Square retention was determined by counting the number of first sympodial position squares on the upper 3 main stem nodes of 25 plants per plot in 2008. Seedcotton yields were determined by harvesting two rows from each plot with a mechanical cotton harvester. Samples of seedcotton were ginned with a tabletop gin to estimate seed and lint fractions. Data were subjected to ANOVA and means separated according to DMRT.

Results and Discussion

In 2007, there were no significant differences in the average number of TPB adults, nymphs, or total TPB the treatments during the pre-flowering period (Table 1). Mean TPB adults, nymphs, and total TPB were higher in the nectaried (DP164B2RF) non-sprayed treatment compared to the nectariless (MCS0701B2RF) non-sprayed and sprayed treatments and the nectaried sprayed treatment after flowering (Table 2). There were no significant differences among treatments for damaged squares on any sampling date. Lint yield was significantly higher in the nectariless sprayed treatment compared to the nectariless non-sprayed, nectaried sprayed, and nectaried non-sprayed treatments (Table 3).

In 2008, there were no significant differences in the number of TPB adults, nymphs, or total TPB among treatments during the pre-flowering period (Table 4). Mean TPB nymphs and total TPB were higher in the nectaried (DP164B2RF) non-sprayed treatment compared to the nectariless (MCS0701B2RF) non-sprayed, nectariless sprayed, nectariless square retention, and nectaried sprayed treatments after flowering (Table 5). There were no significant differences among treatments for square retention on any of the sample dates. Lint yields were significantly higher in the nectariless non-sprayed, nectariless sprayed, nectariless retention treatments compared to the nectaried non-sprayed and nectaried sprayed treatments in 2008 (Table 6).

The nectariless cotton trait reduced TPB numbers after flowering compared to the nectaried variety in these studies. The nectariless insecticide overspray treatments had higher yields compared to the nectaried overspray treatments in both years of this experiment. A nectariless cotton variety may help to reduce TPB numbers and mitigate cotton yield losses from this pest. This trait coupled with other integrated pest management options may improve help producers improve management of TPB infestations in Mid-South cotton.

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Table 1. Mean number of tarnished plant bug adults and nymphs per 50 sweeps during pre-flowering cotton plant development (5 sample dates), 2007.

Treatment			Tarnished Plant Bugs		
Variety	Trait	Spray Regime	Adults[1]	Nymphs[1]	Total [1]
MCS0701B2RF	Nectariless	Non-sprayed	1.4a	1.0a	2.4a
DP164B2RF	Nectaried	Non-sprayed	2.5a	1.2a	3.7a
MCS0701B2RF	Nectariless	Sprayed	1.6a	0.5a	2.1a
DP164B2RF	Nectaried	Sprayed	2.1a	0.8a	2.9a

[1]Means within columns followed by a common letter are not significantly different (DMRT, P=0.05).
[2]Orthene 0.9 lb AI/acre applied on 8 and 18 Aug.

Table 2. Mean number of tarnished plant bug adults and nymphs per 20 ft row during flowering cotton plant development (5 sample dates), 2007.
[1]Means within columns followed by a common letter are not significantly different (DMRT, P=0.05).
[2]Orthene 0.9 lb AI/acre applied on 8 and 18 Aug.

Treatment			Tarnished Plant Bugs		
Variety	Trait	Spray Regime	Adults[1]	Nymphs[1]	Total [1]
MCS0701B2RF	Nectariless	Non-sprayed	1.8b	7.1b	8.9b
DP164B2RF	Nectaried	Non-sprayed	3.1a	15.1a	18.2a
MCS0701B2RF	Nectariless	Sprayed[2]	0.8c	6.8b	7.5b
DP164B2RF	Nectaried	Sprayed[2]	1.0c	7.7b	8.7b

Table 3. Mean percent damaged squares (3 sample dates) and lint yield, 2007.

Table 4. Mean number of tarnished plant bug adults and nymphs per 50 sweeps during pre-flowering cotton plant development (4 sample dates), 2008.
[1]Means within columns followed by a common letter are not significantly different (DMRT, P=0.05).

Treatment			Square	Lint Yield
Variety	Trait	Spray Regime	Damage[1]	lb/acre[1]
MCS0701B2RF	Nectariless	Non-sprayed	11.8a	892c
DP164B2RF	Nectaried	Non-sprayed	21.6a	939bc
MCS0701B2RF	Nectariless	Sprayed	10.9a	1123a
DP164B2RF	Nectaried	Sprayed	12.2a	977b

[2]Centric 0.047 lb AI/acre (6, 14 Aug) and Orthene 0.9 lb AI/acre (22, 29 Aug) sprays applied.
[3]Orthene 0.9 lb AI/acre applied to square retention treatment on 22 and 29 Aug.

Table 5. Mean number of tarnished plant bug adults and nymphs per 10 ft row during flowering cotton plant development (5 sample dates), 2008.

Treatment			Tarnished Plant Bugs		
Variety	Trait	Spray Regime	Adults[1]	Nymphs[1]	Total [1]
MCS0701B2RF	Nectariless	Non-sprayed	0.8a	0.2a	1.0a
MCS0701B2RF	Nectariless	Sprayed	1.1a	0.5a	1.6a
DP164B2RF	Nectaried	Non-sprayed	1.7a	0.8a	2.5a
DP164B2RF	Nectaried	Sprayed	1.7a	0.3a	2.0a
MCS0701B2RF	Nectariless	Sprayed	0.8a	0.3a	1.1a

Treatment			Tarnished Plant Bugs		
Variety	Trait	Spray Regime	Adults[1]	Nymphs[1]	Total [1]
MCS0701B2RF	Nectariless	Non-sprayed	1.8a	8.6b	10.4b
MCS0701B2RF	Nectariless	Sprayed[2]	2.5a	7.6b	10.1b
DP164B2RF	Nectaried	Non-sprayed	3.0a	14.7a	17.7a
DP164B2RF	Nectaried	Sprayed[2]	1.8a	8.2b	10.0b
MCS0701B2RF	Nectariless	Sprayed[3]	2.1a	8.0b	10.1b

[1]Means within columns followed by a common letter are not significantly different (DMRT, P=0.05).
[2]Centric 0.047 lb AI/acre (6, 14 Aug) and Orthene 0.9 lb AI/acre (22, 29 Aug) sprays applied.
[3]Orthene 0.9 lb AI/acre applied to square retention treatment on 22 and 29 Aug.

Table 6. Mean percent square retention (9 sample dates) and lint yields, 2008.
[1]Means within columns followed by a common letter are not significantly different (DMRT, P=0.05).
[2]Centric 0.047 lb AI/acre (6, 14 Aug) and Orthene 0.9 lb AI/acre (22, 29 Aug) sprays applied.
[3]Orthene 0.9 lb AI/acre applied to square retention treatment on 22 and 29 Aug.

Treatment			Square	Lint Yield
Variety	Trait	Spray Regime	Retention[1]	lb/acre[1]
MCS0701B2RF	Nectariless	Non-sprayed	81a	707a
MCS0701B2RF	Nectariless	Sprayed[2]	80a	776a
DP164B2RF	Nectaried	Non-sprayed	77a	386b
DP164B2RF	Nectaried	Sprayed[2]	82a	539b
MCS0701B2RF	Nectariless	Sprayed[3]	81a	667a