INFLUENCE OF STINK BUG DAMAGE ON FIBER QUALITY OF MACHINE PICKED COTTON GINNED AT THE UGA MICROGIN

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Introduction

Boll feeding bugs have elevated in pest status during recent years due primarily to the reduction of broad spectrum insecticide use. Successful elimination of the boll weevil as an economic pest and utilization of Bt transgenic cottons have eliminated the need for boll weevil and tobacco budworm insecticide sprays and significantly reduced the number of applications for corn earworm. Additionally, selective insecticides which have no activity on bug pests are being used to a greater degree. Sucking bug pests such as stink bugs and plant bugs have exploited this low insecticide use environment.

Stink bugs and tarnished plant bugs are the most common sucking bug pests infesting cotton in the southeast. Stink bugs are primarily boll feeders and capable of damaging bolls 25 days past anthesis (Greene 2001, Willrich 2004). Historically tarnished plant bug feeding on bolls has not been considered a major source of yield loss; however tarnished plant bugs can damage bolls in the early stages of development (Gore and Cachot 2005, Russell et al. 1999, Horn et al. 1999). Excessive bug damage on small bolls may cause abscission, whereas bolls may remain on the plant when damage is limited or inflicted on older bolls. In Georgia, the most common boll feeding bugs include the southern green stink bug and the brown stink bug. Additional boll feeding bugs occasionally observed include the green stink bug, several *Euschistus* species, tarnished and clouded plant bugs, and leaf-footed bugs.

Stink bugs damage developing cotton bolls by piercing the boll wall and feeding on or near the developing seed. Callous growths or warts form on the inner surface of the boll wall at the feeding site within 48 hrs (Bundy et al. 2000). Stained lint may also be associated with stink bug feeding. The objective of these trials was to generate seedcotton samples of varying levels of stink bug damage allowing for inferences to be made on the relationship of stink bug damage on fiber quality.

Methods

Replicated field trials were established at various locations in Georgia during 2005 which included bug protected (weekly insecticide applications) and unprotected plots and in some locations one or more intermediate treatments such as protection at various plant phenology stages or a 20% internal boll damage threshold. Plots ranged in size from 6 rows wide and 40 feet in length to 36 rows wide and 125 feet in length. At some locations, trials were established in high risk areas for bug infestations, i.e. near or in peanut plantings, to assure damaging stink bug infestations.

Data Collection: Plant and pest based sampling procedures were conducted to varying degrees depending upon the objective of individual trials (Table 1). Pest based sampling procedures included the use of a drop cloth to sample and quantify species of boll feeding bugs on 12 row feet per plot. Plant based sampling procedures included internal boll injury, symptoms of external boll injury and internal lint staining, square retention, and dirty or damaged white blooms.

Table 1. Plant and pest based data collected in respective boll feeding bug trials (Georgia 2005).

	Boll Injury						
Trial	Internal Injury	External Stain/Rot	Year End	Drop Cloth	Square Retention	Dirty Blooms	Lint Fraction
RDC	x		x				x
ABAC	x	x	x				x
TVP	x	x	x	x	x	x	x
PD1	x	x	x	x	x	x	x
PD2	x	x	x	x	x	x	x
EXPO	x						x
Scout School	x						x
Hardlock	x		x				x
Pheno #1	x	x	x	x	x	x	x
Pheno #2			x				

Fiber Quality: All plots were machine picked and seedcotton was ginned at the University of Georgia MicroGin to obtain lint fractions for determining lint yields per acre. The University of Georgia MicroGin is a small scale gin which processes cotton consistent with commercial ginning practices. Lint samples were submitted to Cotton Incorporated for HVI and AFIS fiber quality analysis.

Variability in the Relationship Between Bug Damaged Bolls and Yield: Year end boll damage assessments were conducted by collecting 100 bolls from each plot which comprised a representative sample of harvestable bolls at first open boll. Bolls were examined for internal bug damage. Bolls were considered damaged if a callous growth or wart was observed on the inner surface of the boll wall and/or stained lint was present. No attempts were made to quantify the number of callous growths or the degree of stained or rotten lint for this analysis. Due to the large amount of bolls to examine and the time required for examination, bolls were often frozen for a period of time prior to making damage evaluations. Regression equations were generated for percent of maximum yield against percent year end internal boll damage for each trial. The y-intercept (percent of maximum yield) was set at 100 percent. Treatment means for all trials were also combined and a similar regression equation was generated.

Results

Yields: Stink bug populations were light to heavy depending on location and treatment. Untreated and bug protected plots were included in eight of the nine trials conducted during 2005. Yields were increased in protected plots for an average yield increase of 542 lbs. lint per acre (Table 2). Yield increases ranged from 222 to 842 lbs. lint per acre in protected compared with untreated plots.

Table 2. Trial name, location, variety, lint yield, and number of insecticide applications applied (#) for respective boll feeding bug treatments. Insecticide applications included Bidrin at 8 ozs./acre or Bidrin at 8 ozs./acre plus Baythroid at 3.2 ozs./acre.

			Treatments			
Trial	County	Variety	Untreated	Threshold	Protected	Other
[p]RDC	Tift	DP 555BR	791		1294 (7)	
ABAC	Tift	PHY 470WR	1060	1303 (2)	1311 (8)	1375 (3)
TVP	Tift	DP 555BR	773	1541 (3)	1584 (5)	
[p]PD1	Sumter	DP 543BGIIRR	523	1168 (4)	1335 (7)	
[p]PD2	Sumter	DP 543BGIIRR	556	855 (1)	1123 (5)	
EXPO	Colquitt	DP 543BGIIRR	949	1336 (2)		1372 (3), 1417 (3)
Scout School	Tift	DP 444 BR	862		1088 (4)	
Hardlock	Colquitt	DP 555BR	635		1142 (4)	
[p]Pheno#1	Tift	DP 543BGIIRR	452		1294 (4)	1318 (6), 1169 (5), 1144 (4), 957 (3)
Pheno#2	Tift	DP 543BGIIRR	1718		1665 (7)	1687 (6), 1884 (5), 1738 (4), 1721 (3), 1540 (2), 1360 (1)

[p] The RDC, PD1, PD2, and Pheno#1 trials were established in or immediately adjacent to peanuts.

Untreated, 20 percent internal boll damage threshold, and protected treatments were included in four trials. Yields were significantly greater in the threshold and protected treatments compared with the untreated. Although not significantly different, yields were numerically lower in the threshold treatments, 1217 lbs. lint per acre, compared with protected treatments, 1338 lbs. lint per acre. Threshold treatments required an average of 2.5 insecticide applications compared with protected plots which were treated 6.25 times on average.

Pest Based Sampling Procedures: A complex of boll feeding bugs was sampled and included tarnished and clouded plant bugs, southern green, brown, and green stink bugs, and several *Euschistus* species. Stink bugs were the predominant boll feeding bugs sampled; plant bugs generally comprised a minor percentage of the bug complex. The most common stink bugs observed were the southern green and brown.

Plant Based Sampling Procedures: Internal boll damage appeared to be the most reliable plant based sampling procedure for stink bugs compared with square retention and dirty blooms. Although small differences in square retention and dirty blooms were present between untreated and protected plots; damage rarely approached the threshold levels of 80 percent square retention and 15 percent dirty blooms in the presence of high stink bug infestations. Internal boll damage commonly exceeded the 20 percent threshold in untreated plots.

Fiber Quality: Eight of the nine trials which included untreated and protected treatments conducted in Georgia have been ginned at the University of Georgia MicroGin. HVI data has been received from Cotton Incorporated but AFIS fiber quality analysis is still ongoing. Means from the eight trials for untreated and protected treatments for HVI parameters as well as lint yield and lint fraction are presented in Table 3. T-tests were conducted on trial means for untreated and protected treatments. Both yield and percent lint were greater in protected treatments compared with untreated. Significant differences were observed for all HVI quality measures with the exception of strength. Micronaire was lower in untreated and is most likely due to immature fibers resulting from feeding damage and/or delayed maturity. Staple and uniformity were improved by 0.49 and 0.47 units respectively in the protected treatment. Reflectance was reduced and yellowness increased in the untreated compared with protected treatments. AFIS fiber quality data are included in Table 4. These differences represent a worst case scenario in that few farmers would not treat stink bug infestations which would cause yield losses in excess of 500 lbs. However, these data do suggest that stink bug damage can reduce fiber quality which is machine picked and ginned by processes similar to commercial ginning practices. Our intention is to correlate the various fiber quality measures to year end boll damage as we have done with yields.

Table 3. Lint yield, lint fraction, and HVI measures for untreated and protected treatments in eight trials conducted (Georgia 2005)

	Untreated	Protected	Prob t
Lint (lbs/acre)	707	1271	0.0001
Percent Lint	35.89	37.12	0.0013
Micronaire	4.26	4.49	0.0026
Staple (32nds)	35.72	36.21	0.0002
Uniformity	81.39	81.86	0.0022
Strength	30.00	29.90	0.2812
Reflectance	76.15	78.63	0.0001
Yellowness	8.87	8.03	0.0005

Variability in the Relationship Between Bug Damaged Bolls and Yield: Bug damaged bolls and yield losses ranged from low to high in the various treatments and trials conducted during 2005. Examination of bolls for internal boll damage was time consuming since many of the bolls were approaching maturity and difficult to manually open. Older bolls which had been frozen and thawed were much easier to open, i.e. could be easily squashed between your thumb and forefinger. Originally, freezing bolls was used to preserve the integrity of the boll, but fortunately it also allowed for easier examination.

Stink bug populations and bug damaged bolls were moderate to high at all Georgia locations during 2005. Regression equations for individual trials indicated that for one percent year end boll damage 0.5767, 0.6261, 0.6899, 0.7724, 0.8085, 0.8386, 1.1134, and 1.1434 percent yield loss would occur. When all trials from Georgia were combined and percent maximum yield in a trial was regressed against percent boll damage for respective treatments the subsequent equation was $y = -0.8353x+100$ (y=percent of maximum yield and x=percent boll damage) with an R^2 of 0.8233 (Figure 1).

Table 4. Lint yield, lint fraction, and AFIS measures for untreated and protected treatments in eight trials conducted (Georgia 2005)

	Untreated	Protected	Prob t
Lint (lbs/acre)	707	1271	0.0001
Percent Lint	35.89	37.12	0.0013
Nep size (um)	707	692	0.0043
Neps per Gm	325	249	0.0014
L(w) [in]	0.9624	0.9949	0.0004
L(w) CV [%]	36.09	34.30	0.0005
UQL (w) [in]	1.18	1.20	0.0015
SFC (w) [%]	10.68	8.86	0.0005
L(n) [in]	0.6989	0.7461	0.0002
L(n) CV [%]	61.58	57.50	0.0003
SFC (n) [%]	35.59	31.15	0.0003
L5% (n) [in]	1.32	1.34	0.0006
Total Cnt/g	441	329	0.0036
Trash Size [um]	374	373	0.4286
Dust Cnt/g	349	260	0.0042
Trash Cnt/g	91.42	68.49	0.0042
VFM [%]	1.97	1.40	0.0025
SCN Size (um)	1067	1090	0.0257
SCN (Cnt/g)	27.17	18.52	0.0016
Fine [mTex]	164	168	0.0112
IFC [%]	5.68	5.09	0.0021
Mat Ratio	0.8948	0.9089	0.0012

Yield response to percent of year end bug damaged bolls varied by trial. A two fold difference in yield response to bug damaged bolls occurred among trials. Reasons for variability in yield response to percent year end bug damaged bolls are not fully understood. Bolls were scored as damaged or undamaged and obviously the degree of injury will vary greatly from single feeding sites to multiple feeding sites and boll rot for damaged bolls. Perhaps the species complex present in individual trials creates variability in yield response to boll damage. Various species of stink bugs, tarnished and clouded plant bugs, leaf-footed bugs, and other bugs are capable of causing warts or callous growths on the inner surface of the boll wall and may impact yield differently. Other potential explanations of variability include spatial and temporal distribution of damage on plants, variety, growing conditions, and compensation ability of plants. There are also questions on how bug damage manifests itself in a developing boll. In some situations we observe severe boll rots associated with stink bug damage whereas in others an individual lock may fail to fluff. These data demonstrate that the percent of harvestable bolls which exhibit internal signs of bug feeding is correlated to yield and that variability among locations exists.

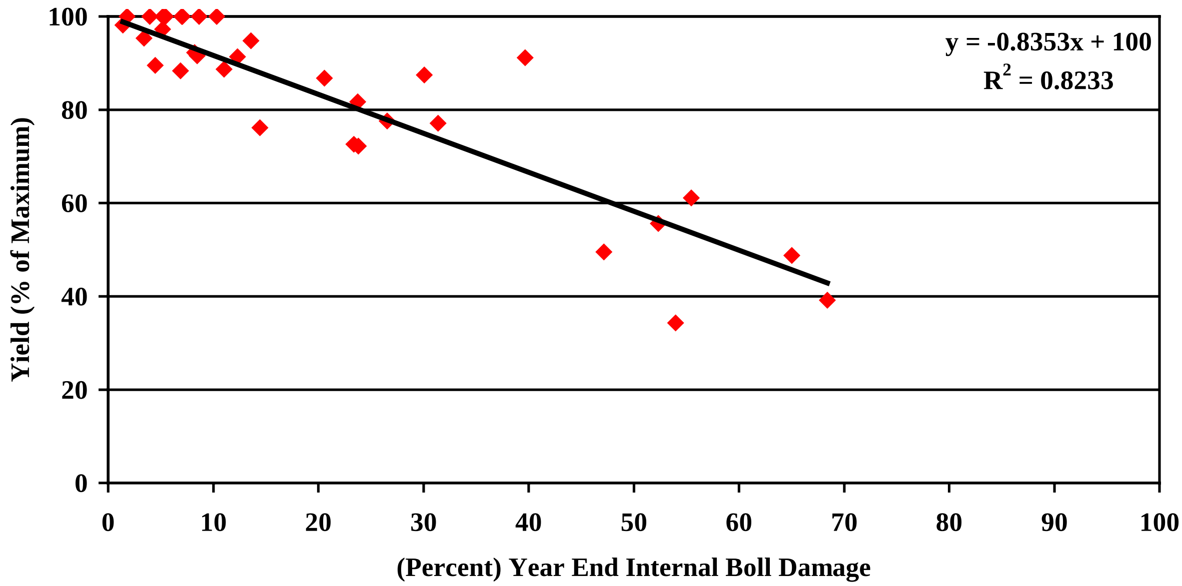

Figure 1. Percent of maximum yield in individual trials and percent year end boll damage for bug protected, unprotected, and intermediate bug protection treatments in Georgia during 2005.

Additional studies will be conducted during 2006 to build upon the current database which will allow for greater precision of correlating sampling procedures, yield, and fiber quality with bug damage.

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