Effect of Varying Levels of Boll Feeding Bug Damage on Fiber Quality of Machine Picked Cotton Processed at the UGA MicroGin

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Abstract

Field trials were conducted in southeastern cotton producing states which included aggressively sprayed and untreated plots and in some locations one or more intermediate treatments for control of boll feeding bugs. Seedcotton from the 24 trials were machine picked and ginned at the University of Georgia MicroGin which processes cotton consistent with commercial ginning practices. Lint samples were submitted to Cotton Incorporated for HVI and AFIS fiber quality measures. Most fiber quality measures were negatively impacted by excessive boll feeding bug damage.

Introduction

Successful boll weevil eradication programs and high adoption of Bt cottons have created a low insecticide use cotton production system in the southeast. Reduced use of broad spectrum insecticides has afforded true bugs to elevate in pest status, becoming primary pests in many areas. Stink bugs are the most common boll feeding bugs found in the southeast. The three most common stink bug species observed include the southern green stink bug, green stink bug, and brown stink bug. Southern green stink bugs are typically observed in more southern areas whereas the green stink bug is more common in northern production areas of the southeast. Brown stink bugs may be found in all southeastern states. Additional boll feeding bugs occasionally observed include several *Euschistus* stink bug species, tarnished and clouded plant bugs, and leaf-footed bugs.

Stink bugs feed on developing cotton bolls by piercing the boll wall and feeding on or near the developing seed with their piercing-sucking mouthparts (Wene and Sheets 1964). Stink bugs may physically damage the seed which impacts fiber development. Indirect damage to developing bolls may also occur through the introduction of boll rot pathogens during feeding or the entry of rot organisms through feeding wounds causing individual locks or the entire boll to rot (Kirkpatrick and Rothrock 2001, Willrich 2004). Stink bugs prefer to feed on bolls ranging in age from 7-27 days after anthesis (Willrich et. al. 2004), but may feed on other bolls in their absence. Excessive feeding on small bolls may result in boll shedding, whereas larger bolls often remain on the plant when fed upon.

Cotton fibers develop to maturity in about 45 days beyond anthesis. Most fiber elongation occurs during the first 3 weeks following anthesis, whereas fiber deposition or thickening primarily occurs during the second 3 weeks of boll development. Although stink bug damaged bolls are often harvestable and damage occurs while fibers are developing, relatively few studies have examined the impact of boll feeding bugs on fiber quality (Toscano and Stern 1976, Barbour et al. 1990, Roberts et. al. 2004). Mean fiber length, coefficient of variation of fiber length, upper quartile fiber length, and percent short fiber content were negatively impacted by excessive boll feeding bug damage in handpicked samples ginned on a tabletop gin, i.e. seed and fiber separated (Roberts et. al. 2004). Additional studies are needed which use a machine picker and commercial ginning practices. Perhaps a mechanical picker will harvest a lower percentage of bug damaged locks compared to handpicking. Perhaps commercial ginning practices (lint cleaners and other ginning processes) will further impact quality parameters. Thus the objective of this study was to evaluate the impact of boll feeding bug damage on fiber quality of machine picked cotton processed in a manner consistent with commercial ginning practices.

Methods

Replicated field trials were established at various locations in Georgia, North Carolina, South Carolina, and Alabama during 2005 which included aggressively sprayed and untreated 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 and included 3-4 replications. At some locations, trials were established in high risk areas for pest infestations, i.e. near or in peanut plantings, to enhance the likelihood of damaging stink bug infestations. Plots were machine picked and ginned at the University of Georgia MicroGin. The University of Georgia MicroGin is a small scale gin which processes cotton consistent with commercial ginning practices. Lint fractions were determined and three lint samples were collected from each plot sample and submitted to Cotton Incorporated for HVI and AFIS fiber quality measures.

Table 1. Summary of HVI and AFIS fiber quality means for treatments with varying levels of yield loss attributed to boll feeding bug damage from 24 trials conducted in Georgia, North Carolina, South Carolina, and Alabama during 2005 (machine picked, UGA MicroGin).

		Difference from Aggessively Sprayed					
	Aggressively Sprayed Mean	**Yield Loss Category (lbs. lint per acre)**					
		<0	**0-99**	**100-199**	**200-299**	**300-499**	**500+**
Comparisons	n=24	n=23	n=22	n=14	n=6	n=7	n=7
Percent Lint	36.39	0.2646	0.1378	-0.0613	-0.2149	-0.9739	-1.7354
HVI							
MIC	4.417	0.0275	-0.0132	-0.0246	-0.1292	-0.0476	-0.3010
UHM	1.123	-0.0019	-0.0011	-0.0048	-0.0096	-0.0120	-0.0171
UI	81.95	-0.0661	-0.0043	-0.0594	-0.3007	-0.3161	-0.5593
STR	29.12	0.0792	0.0923	-0.0138	-0.1576	0.1429	0.2167
ELO	5.337	0.0770	-0.0512	-0.0404	-0.2201	-0.0818	-0.1405
Rd	77.52	0.3933	0.3782	-0.1148	-0.7854	-1.4568	-2.8682
+b	8.308	-0.0377	0.0160	0.1365	0.3403	0.6036	1.1200
AREA %	0.264	-0.0176	0.0052	0.0198	0.0067	0.0439	0.0634
SFC%	7.031	0.0203	-0.0506	0.0137	0.4806	0.6417	1.6629
AFIS							
Nep size (um)	690.2	0.9457	0.4944	2.3643	1.0000	12.4761	21.3079
Neps per Gm	238.8	-4.5471	-5.3965	9.3738	25.8750	39.1815	97.0187
L(w) [in]	0.985	0.0021	0.0021	-0.0055	-0.0191	-0.0192	-0.0330
L(w) CV [%]	34.42	-0.3022	-0.2327	0.0688	0.7792	1.0455	2.1382
UQL (w) [in]	1.197	0.0001	0.0002	-0.0067	-0.0165	-0.0123	-0.0211
SFC (w) [%]	9.030	-0.2038	-0.0470	0.1335	0.8076	1.1190	2.1899
L(n) [in]	0.743	0.0050	0.0046	-0.0053	-0.0240	-0.0312	-0.0537
L(n) CV [%]	57.10	-0.4687	-0.4726	0.1647	1.6493	2.7893	4.8535
SFC (n) [%]	31.06	-0.4632	-0.3597	0.2731	1.9354	2.9738	5.2816
L5% (n) [in]	1.342	0.0000	-0.0005	-0.0077	-0.0178	-0.0155	-0.0263
Total Cnt/g	288.2	-12.1105	-0.5169	20.9167	29.7431	73.8482	154.9849
Trash Size [um]	371.1	-2.3768	2.4394	-0.8131	7.0000	-1.8869	-5.7457
Dust Cnt/g	229.1	-9.3659	-0.5800	17.9714	22.2917	59.5000	127.1853
Trash Cnt/g	58.66	-2.6866	0.1116	3.0202	7.5070	14.4077	27.7349
VFM [%]	1.238	-0.0598	0.0314	0.0678	0.2493	0.3289	0.6406
SCN Size (um)	1085	-6.7426	-25.9902	-5.0906	-16.1112	10.6161	-21.7419
SCN (Cnt/g)	17.26	-0.8623	-0.1318	0.4619	1.6667	5.1726	11.7627
Fine [mTex]	174.7	-0.2753	-0.9093	-0.3560	-2.8889	-0.5566	-4.5048
IFC [%]	5.252	-0.0547	0.0402	0.0256	0.3486	0.3351	0.7226
Mat Ratio	0.913	-0.0030	-0.0034	-0.0022	-0.0084	-0.0056	-0.0183

Treatment means for fiber quality measures were compared to the most aggressive insecticide treatment in respective trials. A total of 24 trials and 103 treatments were included in this project, allowing 79 comparisons of the differences of untreated and intermediate treatment means with the aggressively sprayed treatment to be summarized. Fiber quality measures were summarized into six categories of yield loss compared with the aggressively sprayed treatment (<0, 0-99, 100-199, 200-299, 300-499, >500 lbs. lint per acre).

Eleven trials included three common treatments (1=Untreated, 2=20% Internal Boll Damage Threshold, and 3=Aggressively Sprayed). An analysis of variance was conducted on treatment means from these eleven trials (replicates) for fiber quality measures and means were separated using LSD, P=0.05.

Table 2. HVI and AFIS fiber quality means of eleven trials including three common treatments conducted in Georgia, South Carolina, and Alabama during 2005 (machine picked, UGA MicroGin).

	Untreated	**20% Internal Boll Damage Threshold**	**Aggressively Sprayed**
Lint (lbs/acre)	760 a	1125 b	1232 b
Percent Lint	34.93 a	36.21 b	36.25 b
HVI			
MIC	4.27 a	4.37 b	4.43 b
UHM	1.1132 a	1.1255 b	1.1261 b
UI	81.18 a	81.63 b	81.60 b
STR	30.08 a	29.97 a	30.06 a
ELO	4.9317 a	4.9520 a	5.0574 b
Rd	75.37 a	76.81 b	77.23 b
+b	9.04 a	8.46 b	8.25 b
AREA %	0.2886 a	0.2525 ab	0.2298 b
SFC%	8.5918 a	7.5818 b	7.5513 b
AFIS			
Nep size (um)	703.4 a	692.6 b	691.5 b
Neps per Gm	308.9 a	255.2 b	244.0 b
L(w) [in]	0.9542 a	0.9734 b	0.9806 b
L(w) CV [%]	36.65 a	35.51 b	35.11 b
UQL (w) [in]	1.180 a	1.192 b	1.199 b
SFC (w) [%]	11.21 a	10.02 b	9.61 b
L(n) [in]	0.6894 a	0.7204 b	0.7304 b
L(n) CV [%]	62.09 a	59.40 b	58.57 b
SFC (n) [%]	36.41 a	33.53 b	32.57 b
L5% (n) [in]	1.321 a	1.337 b	1.343 b
Total Cnt/g	413.0 a	322.2 b	293.7 b
Trash Size [um]	360.7 a	364.2 a	366.8 a
Dust Cnt/g	332.1 a	257.8 b	233.9 b
Trash Cnt/g	80.55 a	64.07 b	59.45 b
VFM [%]	1.702 a	1.325 b	1.212 b
SCN Size (um)	1065 a	1073 a	1084 a
SCN (Cnt/g)	23.86 a	17.50 b	16.79 b
Fine [mTex]	172.9 a	173.8 ab	175.6 b
IFC [%]	5.359 a	5.016 b	4.820 b
Mat Ratio	0.9148 a	0.9214 ab	0.9274 b

Means followed by the same letter in a row do not sisignificantly differ (P=0.05, LSD).

Results and Discussion

A total of 79 treatments were compared with the aggressively sprayed treatments in 24 trials. Yield loss associated with bug damage ranged from none, some treatments actually yielded higher than the aggressively sprayed plots (i.e. less than zero); to severe, greater than 500 lbs. lint per acre, in trials conducted during 2005 (Table 1). Percent lint of seedcotton samples ginned at the UGA MicroGin, HVI, and AFIS quality values are also presented in Table 1.

Percent lint turnout tended to decrease in treatments as yield loss increased. In treatments where yield losses exceeded 500 lbs. lint per acre the percent lint was 1.7354 percent less than the aggressively sprayed treatments in respective trials. There was a tendency for micronaire, upper half mean, and length uniformity index to decrease as yield loss increased. Reflectance (Rd) tended to decrease and yellowness (+b) tended to increase as stink bug damage or yield loss increased.

Neps tended to be larger and neps per gram tended to increase as stink bug losses increased. AFIS measures associated with length were negatively impacted as stink bug yield losses increased. Mean length by weight and number, upper quartile length by weight, and length of the longest five percent of fibers by number tended to decrease as yield loss increased. The coefficient of variation by weight and by number and short fiber content by weight and number increased as yield loss increased. Dust counts also tended to increase as yield loss increased.

Of the 24 trials included in this summary, eleven had three common treatments. Lint yield, percent lint, and HVI and AFIS fiber quality values are presented in Table 2. Means for the aggressively sprayed treatment were significantly different than the untreated for all fiber quality measures with the exception of strength in the HVI analysis and trash size and seed coat nep size in the AFIS analysis. Means for the threshold treatment were significantly different compared with the untreated except for the above mentioned variables and also elongation, area percent, fine, and maturity ratio. All fiber quality variables were statistically similar when comparing the aggressively sprayed with the 20 percent internal boll damage threshold with the exception of elongation. However, there was a tendency for the threshold values to be of slightly reduced quality for most fiber quality measures.

These studies are ongoing and 2006 seedcotton samples from various trials will be ginned at the UGA MicroGin and submitted to Cotton Incorporated for HVI and AFIS fiber quality analysis. First year results of studies conducted in a manner consistent with commercial production and ginning practices support previous studies that stink bugs negatively impact most fiber quality measures. The authors would like to thank Cotton Incorporated and the Southeastern State Support Committees for funding this project.

References

Barbour, Karen S., Julius R. Bradley, Jr. and Jack S. Bacheler. 1990. Reduction in yield and quality of cotton damaged by green stink bug (Hemiptera: Pentatomidae). J. Econ. Entomol. Vol. 83, No. 3, pp. 842-845.

Kirkpatrick, T.L., and C.S. Rothrock. 2001. Compendium of Cotton Diseases, 2nd [ed.]. American Phytopath Soc., St. Paul MN, 77 pp.

Roberts, P.M., C. Bednarz, and J. Greene. 2005. Impact of boll feeding bugs on lint yield and fiber quality, pp. 1718-1724. In Proc. 2005 Beltwide Cotton Conf., National Cotton Council, Memphis TN.

Toscano, Nick C. and Vern M. Stern. 1976. Cotton yield and quality loss caused by various levels of stink bug infestations. J. Econ. Entomol. Vol. 69, No. 1, pp.53-56.

Wene, G.P., and L.W. Sheets. 1964. Notes on control of stink bugs affecting cotton in Arizona. J. Econ. Entomol. 57:60-62.

Willrich, M., R.H. Gamble, J.H. Temple, and B.R. Leonard. 2004. Defining a preferred boll cohort for brown stink bug, *Euschistus servus* (Say). In 2004 Proc. Beltwide Cotton Conf., pp. 1528-1532.