ASSOCIATIONS OF EXTERNAL BUG-INDUCED BOLL DAMAGE WITH INTERNAL DAMAGE, LINT YIELD, AND QUALITY

Eric Blinka[1], John Van Duyn[1], Ames Herbert[2], Sean Malone[2], Phillip Roberts[3], J.R. Bradley[1], and Jack Bacheler[1]

[1]North Carolina State University, Raleigh
[2]Virginia Tech, Suffolk
[3]University of Georgia, Tifton

Abstract

Eight fields across northeast North Carolina were identified having stink bug levels above economic threshold. At each location, two cohorts of bolls were sampled. The first cohort was removed when field reached quarter sized bolls. These bolls were removed from the plant and external sunken lesions were identified and counted. Bolls were then dissected and internal damaged identified and counted (warts, damaged seeds, destroyed locks). At the same time the first cohort was being examined, a second cohort was identified in the field and external sunken lesions were counted. The bolls in the second cohort were then marked with tags and allowed to remain in the field until black seed coats were formed. Following the formation of black seed coat, the second cohort was removed from the field and internal damage was identified and counted. The locks of cotton from cohort two were then allowed to fluff out and were ginned through a micro-gin to determine grade and lint quality.

Introduction

The brown stink bug, *Euschistus servus* (Say), and green stink bug, *Acrosternum hilare* (Say), continue to increase their pest status in cotton, *Gossypium hirsutum* L., across North Carolina. The continued adoption of Bt cotton, reduction in broad spectrum insecticide usage, and eradication of the boll weevil, *Anthonomous grandis grandis* Boheman, has lead the stink bugs to become more of a prominent pest (Greene and Herzog 1999, Leonard et al. 1999, Roberts 1999). In 2005, North Carolina cotton producers treated 736,100 acres and still ended up losing 56,151 bales to the stink bug complex (Willams 2005). To date, there is limited information available on the correlation between external boll damage caused by stink bugs and internal boll damage, lint yield, and cotton quality.

Current scouting techniques for stink bug damage requires scouts to collect quarter sized bolls, which are then dissected to determine damage levels based on internal damage. There are methods developed to allow scouts to make damage assessments by visually inspecting the cotton bolls externally. If a correlation could be developed between external boll damage caused by the feeding of stink bugs and the internal damage, it might be possible to develop a new scouting technique that would allow scouts to rapidly examine cotton bolls externally and predict with accuracy the amount of internal damage. This could cut down on the time required by scouts dissecting bolls and allow them to gain more power out of their sampling by collecting and examining more bolls. In order to determine if this could be feasible, we examined the association of external stink bug induced boll damage with internal damage, lint and quality.

Materials and Methods

Stink bug populations were monitored across eastern North Carolina and southeast Virginia in Bollgard® and Bollgard II® fields using sweep nets and examining bolls for stink bug damage. Once stink bug damage was at or near the economic threshold of 20% damage on quarter sized bolls, eight field sights were selected to use in the study. Each field consisted of two cohorts, Same Day Bolls and Black Seed Coat Bolls. Each cohort consisted of 100 quarter sized, first position bolls. Bolls were selected from the same node or nodes within each field site. The nodes between field sites ranged from the seventh node, up to the tenth node, depending upon where quarter sized bolls could be located. The variation of nodes between fields can be attributed to the differences in cotton varieties, maturity, and environmental conditions.

On the day that each field site was initiated, 100 quarter sized Same Day Bolls were removed and examined for external damage (sunken lesions) and dissected to determine internal damage and data were collected (Table 1 and Figure 1).

Table 1. Data Categories for Same Day Boll and Black Seed Coat Boll Collection.

Same Day Bolls	Boll Diameter (cm)	# Obivous External Sunken Lesions	# "Maybe" External Sunken Lesions	# Basal Stains	# Internal Puncture Marks	# Warts <2mm	# Warts >2mm	# Minor Stains	# Major Stains	# Locks Destroyed	
Black Seed Coat Bolls	# of Locks	# Obivous External Sunken Lesions	# "Maybe" External Sunken Lesions	Boll Rot	# Warts <2mm	# Warts >2mm	# Minor Stains	# Major Stains	# Locks Destroyed		

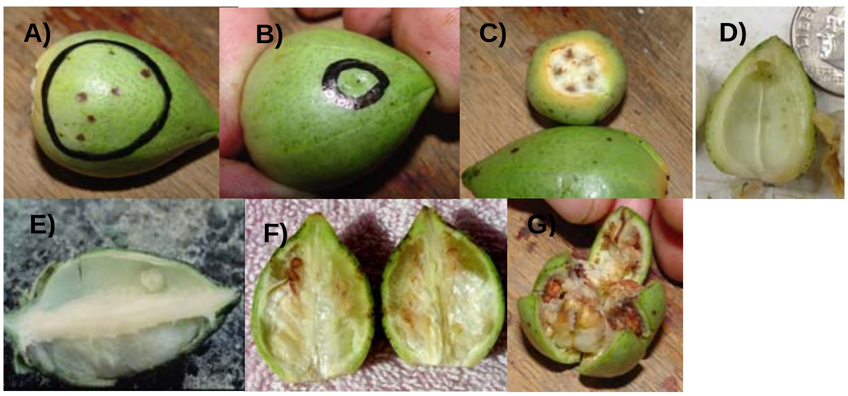

Figure 1. (A) External Lesion, (B) “Maybe” External Lesion, (C) Basal Puncture, (D) Internal Marks, (E) Internal Wart, (F) Lint Stains, and (G) Destroyed Locks.

On the same initialization day for each field site, 100 quarter sized Black Seed Coat Bolls were selected, numbered with orange plastic tags, and examined for external stink bug damage. Once data was collected, Black Seed Coat Bolls were allowed to remain in the field until development of a black seed coat and were removed just prior to boll crack. In order to preserve the level of stink bug damage that was recorded during field initialization, weekly sprays with 6.4 oz/acre of Capture 2EC and 2 oz/acre of Centric 40WG were applied using a backpack sprayer. Once Black Seed Coat Bolls matured, just prior to boll cracking, they were removed and placed in plastic bags along with their respective tags, returned to the lab for dissection, and data collected (Table 1). Data collected from Same Day Bolls and Black Seed Coat Bolls were analyzed in Proc Corr in SAS® and estimates were ploted using Proc GPlot to determine if a correlation exists between external damage and internal damage.

Once Black Seed Coat Bolls were dissected, the locks of cotton were separated into damage categories (Table 2 and Figure 2) and aired dried. Each category was then ginned on a table top gin and sent to Cotton Inc. to be sent through an Advanced Fiber Information System (AFIS) and High Volume Instrument (HVI). Data were then examined to evaluate percent lint gin-out and quality.

Table 2. Ginned Cotton Damage Categories.

Clean, w/o Boll Fungus	Minor Damage	Major Damage	Clean w/Boll Fungus

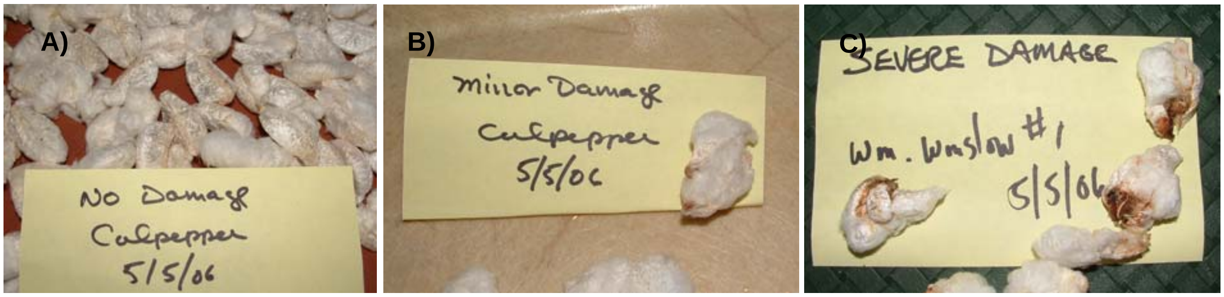

Figure 2. Ginned Cotton Categories: (A) Clean w/o Boll Fungus, (B) Minor Damage, (C) Major Damage.

Results and Discussion

Results showed that there was a moderate correlation between external stink bug induced boll damage with separate internal damage categories (Table 3) for Same Day Bolls and Black Seed Coat Bolls (Table 5). The correlation was slightly stronger when external stink bug induced boll damage was correlated to pooled internal damage categories for both the Same Day Bolls and Black Seed Coat Bolls (Tables 4 and 6). During examination of Same Day Bolls, basal stains had a moderate correlation to destroyed locks (Table 4).

Results demonstrated that it would require four and six external lesions to predict internal damage from the Same Day Bolls and Black Seed Coat Bolls, respectively, with 90% accuracy.

Table 3. Same Day Pearson Correlation Coefficients for Individual Categories (R^2 values).

	Internal Marks	Small Warts <2mm	Large Warts >2mm	Minor Stains	Major Stains	Basal Stains	Destroyed Locks
External Lesions	0.32	0.43	0.49	0.44	0.47	0.17	0.37
"Maybe" External Lesions	0.10	0.27	0.26	0.17	0.16	-0.03	-0.01
Total External Lesions	0.31	0.47	0.55	0.42	0.48	0.14	0.33

Table 4. Same Day Pearson Correlation Coefficients for Combined Categories (R^2 values).

	Warts	Stains	Total Damage	Destroyed Locks
External Lesions	0.58	0.59	0.63	
"Maybe" External Lesions	0.31	0.22	0.31	
Total External Lesions	0.63	0.59	0.66	
Basal Stains				0.54

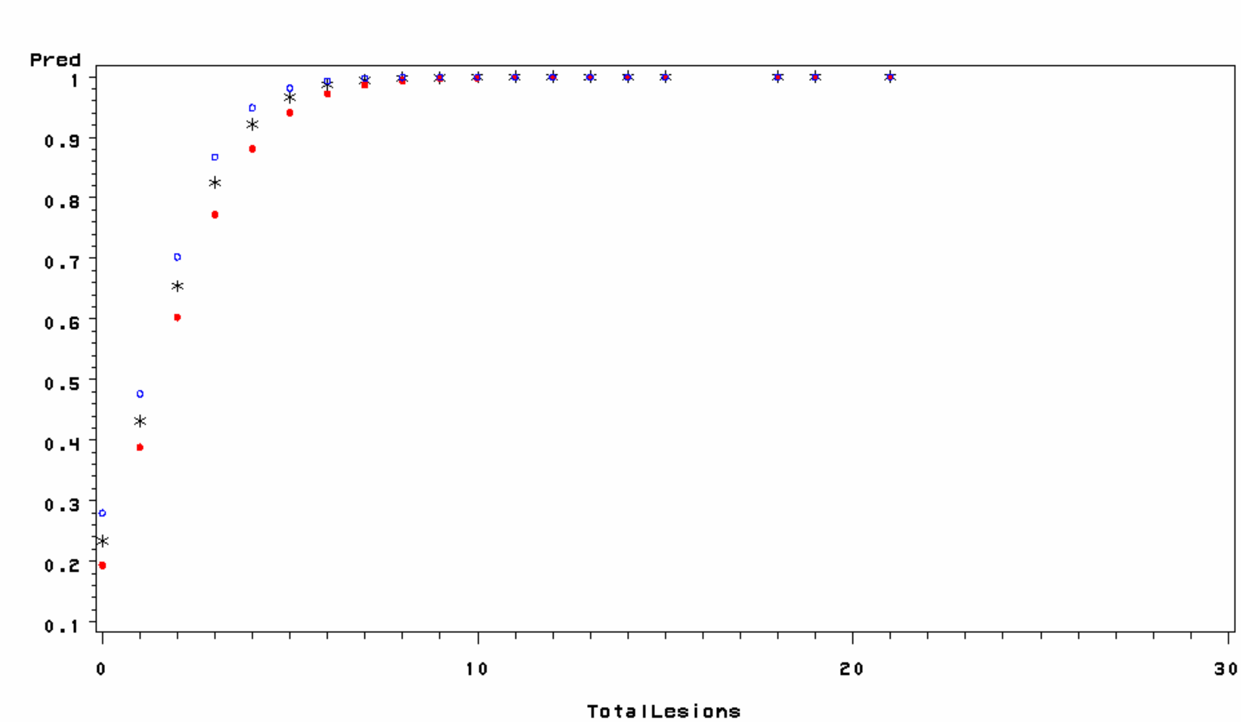

Figure 3. Predictability of Internal Damage Based on Total Lesions from Same Day Bolls.

Table 5. Black Seed Coat Pearson Correlation Coefficients for Individual Categories (R^2 values).

	Small Warts <2mm	Large Warts >2mm	Minor Stains	Major Stains	Basal Stains	Destroyed Locks
External Lesions	0.32	0.38	0.14	0.4	0.06	0.24
"Maybe" External Lesions	0.27	0.29	0.22	0.26	0.03	0.15
Total External Lesions	0.40	0.44	0.22	0.43	0.06	0.27

Table 6. Black Seed Coat Pearson Correlation Coefficients for Combined Categories (R^2 values).

	Warts	Stains	Total Damage
External Lesions	0.44	0.35	0.44
"Maybe" External Lesions	0.35	0.32	0.37
Total External Lesions	0.53	0.43	0.53

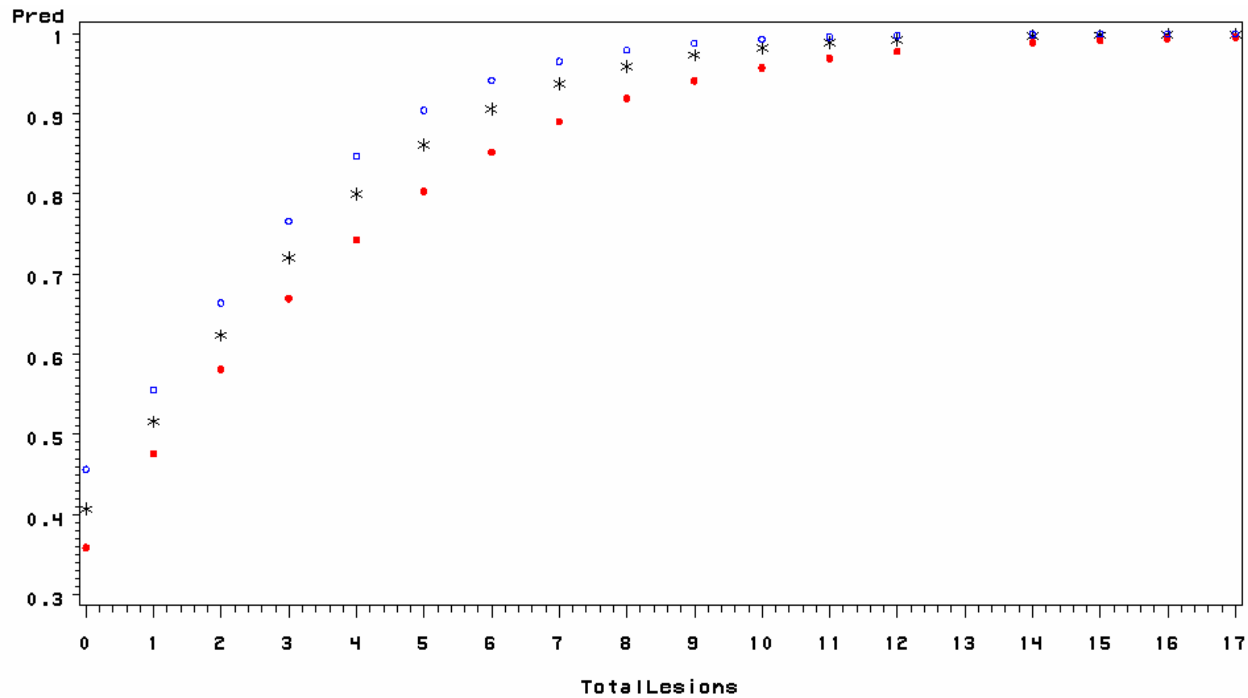

Figure 4. Predictability of Internal Damage Based on Total Lesions of Black Seed Coat Bolls.

Results demonstrated that there were no significant differences in percent lint gin-out between no damage, minor damage, and boll fungi (Table 7 and 8). Yet all three of these categories were significantly greater that the major damage percent lint gin-out. Lint quality was also impacted as the fiber length and upper quartile fiber length both decreased from no damage to minor damage, followed by major damage, and lastly boll fungus (Table 7) as expressed from the Advanced Fiber Information System (AFIS). AFIS also showed quality was impacted as an increase in the length to weight coefficient and short fiber content from no damage to minor damage, followed by major damage, and lastly boll funi (Table 7). The High Volume Instrument (HVI) values were not as definitive as the AFIS values, yet fiber strength was highest for no damage, followed by minor damage, then major damage, and finally boll fungus (Table 8).

Table 7. Percent Lint Comparison and Advanced Fiber Information System Values for Boll Damage Categories.

AFIS	% Lint	L(w) [in]	L(w) CV [%]	UQL(w) [in]	SFC(w) [%]
No Damage	43.03 a	1.08	28.15	1.24	4.05
Minor Damage	41.13 a	1.05	29.90	1.22	4.50
Major Damage	31.76 b	0.99	31.60	1.17	6.50
Boll Fungus	39.33 a	0.93	32.70	1.10	8.30

Significant at P <0.05.

Table 8. Percent Lint Comparison and High Volume Instrument Values for Boll Damage Categories.

HVI	% Lint	MIC	UHM	UI	STR	ELO
No Damage	43.03 a	4.8	1.14	83.2	29.4	4.1
Minor Damage	41.13 a	5.3	1.17	84.1	29.3	6.8
Major Damage	31.76 b	4.3	1.08	81.4	27.3	5.5
Boll Fungus	39.33 a	4.9	1.08	79.9	23.9	6

Significant at P <0.05.

Conclusions

Results demonstrated that there was a correlation between external stink bug induced damage with internal damage. Percent lint gin-out and quality were also impacted by stink bug damage. However, based on one years worth of data, the correlations were neither strong enough nor accurate enough in predicting internal damage based on external stink bug damage to suggest implementing this as a new scouting technique.

References Cited

Greene, J. K., and G. A. Herzog. 1999. Management of stink bugs using symptoms of boll injury as a monitoring tool, pp. 1041-1044. *In* Proceedings 1999 Beltwide Cotton Conference. National Cotton Council, Memphis, TN.

Leonard, B. R., J. B. Graves, and P. C. Ellsworth. 1999. Insect and mite pests of cotton. *In* C. W. Smith [ed.], Cotton: origin, history, technology, and production. Wiley, New York.

Roberts, P. 1999. Observations of emerging pests in low spray environments, p. 1034. *In* Proceedings 1999 Beltwide Cotton Conference. National Cotton Council, Memphis, TN.

Williams, M. R. 2005. Cotton insect losses – 2005. http://www.msstate.edu/dept/entomology/CTNLOSS/2005loss.htm (accessed 01/07).