STINK BUGS ON COTTON: A TEMPORAL OCCURRENCE

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Abstract

Stink bugs (*Nezara viridula, Acrosternum hilare, and Euschistus servus*) were exposed to small- and medium-sized bolls for 24 hours. Bolls were examined for external and internal evidence of feeding at 2, 4, 6, 8, and 10 days after feeding. Results showed no relationship between numbers of external marks and internal warts. Therefore, external marks cannot be used accurately as an indicator of internal damage. Neither size nor number of external marks or warts increased significantly among the five post-feeding sampling dates. All evidence of damage is present by the second day. Results from a smaller study indicate that all symptoms of damage are present in some form within 24 hours, and all but lint damage present within 12 hours. There was a significant increase in lint and seed damage through time. Finally, a strong relationship exists between stylet sheath and wart number. A regression equation was generated to predict the presence of internal damage (warts) from the number of stylet sheaths.

Introduction

Stink bugs have recently reemerged as major pests of cotton. The most important pentatomid species of the stink bug complex on cotton in the southeast are the southern green stink bug, *Nezara viridula* (L.), the green stink bug, *Acrosternum hilare* (Say), and the brown stink bug, *Euschistus servus* (Say) (Roach 1988, Bundy et al. 1998). These pests feed on developing seeds and lint (Barbour et al. 1988), causing shedding of young bolls, yellowing of lint, and reduction in harvestable locks (Roach 1988, Wene and Sheets 1964). Internal evidence of stink bug damage has been reported to be a Ayellowish to brownish discoloration...beneath insertion area@ (Barbour et al. 1988) and Aa watery or blisterlike, bright green area@ by Morrill (1910). External evidence is somewhat more confusing. One report indicates that damage is visible as small, purple spots on a green boll (Barbour et al. 1988). Morrill (1910) found no indication of a connection between external spots and internal damage; another source reported that damage was not visible externally (Greene and Turnipseed 1996). One sign of feeding by these sucking insects that is not often mentioned is the presence of the stylet sheath. This sheath, formed during feeding, surrounds the mouthparts of the bug and allows food to be imbibed. The presence of this structure has been used as an indicator for feeding of the rice stink bug on rice (Bowling 1979), but has not been utilized for cotton.

Little work has been done on the timing of boll damage by stink bugs. One recent study (Greene et al. 1998) found that during a 5-day feeding period, young bolls (4-15 days from white bloom) were significantly damaged by pentatomids whereas mature bolls (18 days from white bloom) were not. The current work was initiated in an attempt to determine when damage appears after feeding on developing bolls.

Materials and Methods

Plots of *Bt* cotton (NuCotn 33b) were grown using standard production practices. Two planting dates of the cotton were utilized (13 May and 20 August) in order to have access to the appropriate boll sizes for an extended period. Large field cages (6 ft. by 6 ft. by 12 ft.) were placed in the plots at the beginning of white bloom. Plants within the cages were sprayed with pesticides to kill the arthropods present. The earlier planting of cotton was sprayed with Baythroid (cyfluthrin) on 16 July, and Capture 2 (bifenthrin) and Provado 1.6 (imidachloprid) on 20 July. The later planting of cotton was sprayed with Capture 2 on 1 October. The application rate for all pesticides was 0.05 lb (AI)/acre. White blooms were tagged with flagging tape to accurately age the developing bolls. Two sizes of bolls were used in this study: small (aged 7-8 days from white bloom) and medium (aged 11-12 days from white bloom). Small cages (modified from Greene et al. 1998) were placed over single bolls of the appropriate age. Field-collected adults of *N. viridula*, *A. hilare*, and *E. servus* were used in this experiment depending upon availability. Lab-reared individuals were occasionally supplemented when necessary. Preliminary data showed no significant differences in boll damage among the 3 species. Therefore, stink bug damage was assumed to be the same for the purposes of this experiment.

Bugs were starved for a period of 24 hrs. before being placed in the cages to better facilitate feeding. Two stink bugs were isolated on each caged boll and removed after 2 days. The bolls were removed at 2, 4, 6, 8, and 10 days after exposure. Cages remained closed around the bolls during this time in order to prevent the possibility of contamination by other insects. Controls consisted of bolls surrounded by small cages without stink bugs and were maintained for the periods given above. After removal, all bolls were examined externally for the number of stylet sheaths and external markings, and internally for the number of warts, damaged lint, and damaged seed. The diameters of the warts and external markings were also measured on each of the post-feeding dates.

Two sets of the experiment were initiated on 21 August and 9 September 1998 for cotton planted in May. Two more sets of the experiment were initiated on 9 and 21 October for

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cotton planted in August. A total of 215 bolls were examined.

In an attempt to more closely identify when damage signs appear after feeding, a smaller number of bolls were exposed to stink bugs for 12 and 24 hours. After the same period of starvation described above, stink bugs (2 each) were enclosed with small (n = 30) and medium (n = 20) bolls for 24 hours. Small bolls were also exposed to the same conditions for a 12 hour feeding period.

Results and Discussion

There was no relationship between numbers of external marks and internal warts. This supports the findings of Morrill (1910). There was also no difference in number of external marks among the 5 post-feeding dates or 2 boll sizes sampled.

The numbers of warts did not increase significantly among the 5 sampling dates. Medium-sized bolls did have a significantly greater number of warts than small bolls ($P > .0312$).

There were significant increases in lint and seed damage through time ($P > .0453$, and $P > .0025$, respectively) (Figs. 1 and 2). The slight decrease in damage at days 8 and 10 was probably due to sampling error. A larger sample size would probably show an increase in damage for these days as well.

There was a strong relationship between stylet sheath numbers and boll damage ($P > .0001$). The R^2 was not particularly high ($R^2 = 0.611$). However, a large portion of the error leading to this value was probably due to sampling error. Stylet sheaths were occasionally knocked off when handled and thus overlooked. Closer scrutiny would most likely lower the sampling error and increase the R^2 value. A regression equation was formulated ($y = .915 + .655x$, where y = wart number and x = stylet sheath number) in order to predict the presence of internal damage (warts) from the number of stylet sheaths (Fig. 3).

There were no significant differences in the sizes of warts or external marks over time; however, our data did show a slight increase in wart size as the days progressed (Table 1).

The results of observations of a 12 hour feeding exposure showed that 100 % of the bolls had stylet sheaths present, indicating that feeding did occur. External marks were present on 90% of the bolls. Internally, warts were present as flat to slightly raised areas in 30% of the bolls, seed was damaged in 10% of the bolls, and there was no lint damage.

The results of observations of a 24 hour feeding exposure showed that 100% of both boll sizes had stylet sheaths present. External marks were present on 83% of the small bolls and 80% of the medium bolls. Internally, warts were present on 93% of small bolls and 90% of medium bolls. Warts ranged from flat, discolored regions to the typical well-raised regions. Seed was damaged in 40% of both small and medium bolls. Lint damage was present as a slight flecking of yellow in 23% of small and 30 % of medium bolls (Table 2).

Summary

These results show that damage due to feeding by stink bugs appears surprisingly fast. All evidence of damage is present in some form by the second day. In fact, observations of 12 and 24 hour feeding periods indicate that most forms of damage are actually present within 12 hours. The sizes of warts and external marks are not statistically significant from the 2nd to the 10th day after feeding. This indicates that for the time period sampled, the sizes of these structures cannot be accurately used to determine when feeding has occurred. Also, the number of external marks is not correlated to internal damage. Therefore, while an external mark may sometimes show that a boll has been fed upon, it is not a reliable indicator of internal damage. A much more reliable factor is the presence of stylet sheaths. These structures are highly correlated with boll damage, and a regression equation is given to predict wart number. This equation will need to be tested, but could offer a valuable tool for predicting the presence of internal boll damage.

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Table 1. Mean diameter (mm) of warts and external marks on cotton bolls.

Day	Wart	n	External Mark	n
2	1.30	188	1.03	58
4	1.48	294	0.91	39
6	1.61	330	1.01	46
8	1.70	192	1.00	59
10	1.81	208	1.12	62

Table 2. Percent boll damage following a 24 hour stink bug feeding exposure.

Size	s. sheath	ext.mark	warts	lint damage	seed damage	n
small	100	83	93	23	40	30
large	100	80	90	30	40	30

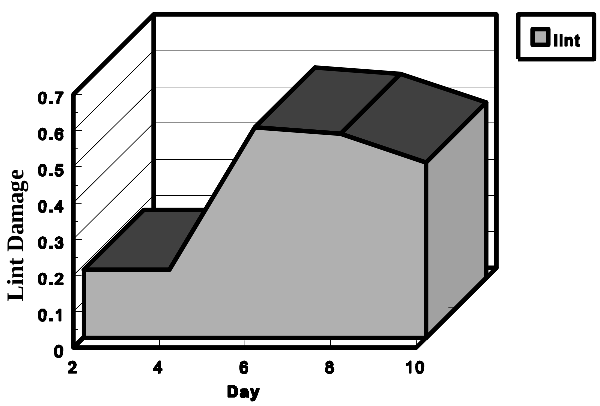

Figure 1. Stink bug-induced lint damage on selected days after a 48 hr. feeding exposure.

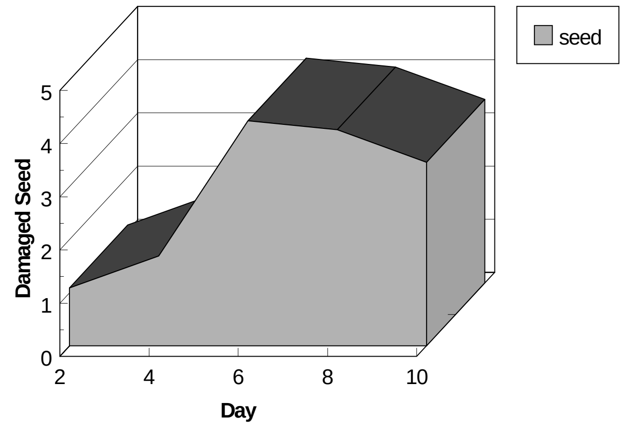

Figure 2. Stink bug-induced seed damage on selected days after a 48 hr. feeding exposure

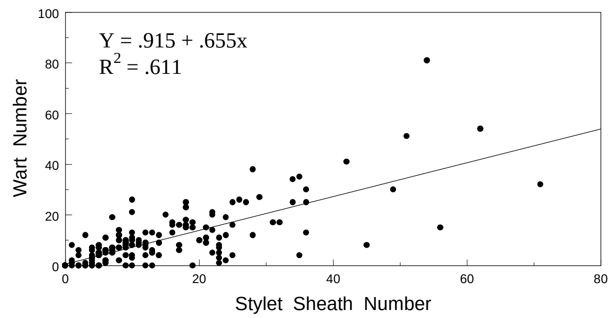

Figure 3. Regression line for the correlation of stylet sheath and wart number.