Assessment of the Potential Damage and Economic Impact of Phytophagous Stink Bugs on Soybean Production

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(Includes results provided by Joanne Whalen and Judy Hough-Goldstein,
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Two species of phytophagous stink bugs (green stink bug, *Acrosternum hilare* (Say) and brown stink bug, *Euschistus servus* (Say)) can be found in most mid-Atlantic soybean fields in late August through to harvest but reports to date have not linked their feeding to yield or seed quality losses. Stink bugs use their piercing, sucking mouthparts to feed on plant juices from the foliage and pods. Their feeding injury on pods causes discolored, shriveled beans and reduces the yield and quality of the beans. In addition, they can introduce disease organisms into the developing pods via their feeding, resulting in reduced seed quality. In the South and in recent years here in mid-Atlantic area, stink bug populations appear to be increasing. However, observations indicate that stink bugs are most abundant when soybean fields have reached later pod fill stages (R6 and R7). Thus, the key question is whether feeding injury at these late growth stages has any impact on yield or seed quality. In the south, economic infestations of stink bugs occur much earlier in pod development. Generally, insecticide control is recommended based on treatment thresholds that vary from 0.33 to 1 bugs per 1 ft of row, depending upon soybean growth stage.

This second year project was a continuation of the 2006 studies to examine the potential impact of phytophagous stink bugs on soybean production. It was part of a regional project with Joanne Whalen and Judy Hough-Goldstein at the University of Delaware and Ames Herbert at the VPI Research Station in Suffolk, VA. The Delaware and Virginia studies were also funded by their state Soybean Boards. The protocol and data collected were the same in the three states. Specifically, we assessed the effects of stink bug infestations at different soybean growth stages on various yield components and the incidence of seed diseases.

Procedures:

In Maryland, a study involving manually infested soybean plants was conducted at the Lower Shore Research and Education Centers, Salisbury, MD. The same experimental approach was used in studies conducted at two locations in Delaware (Allen and Apiary) and at the VPI Station in Suffolk. At each location, three or four plots of double-cropped soybeans (var. Southern States RT4451N) were established in late June and grown according to commercial recommendations. Nylon mesh bags were used to confine stink bugs on one foot sections of row (~3 to 7 soybean plants). Adult green stink bugs, adult brown stink bugs, and late instar nymphs

were collected from naturally occurring populations in soybean fields and manually introduced into individual cages at four soybean growth stages: R4 (full pod, 3/4" pod in top 4 nodes), R5 (1/8" seed in top 4 nodes), R6 (full size seed in top 4 nodes), and R7 (beginning maturity, one mature pod). We tried to setup at least 8 cages of each type of stink bug and an additional four cages with no stinkbugs as controls in each replicate plot per growth stage. However, due to low naturally-occurring populations, we were unable to collect enough brown adults and nymphs to establish a complete set of replicates for these insect stages. Furthermore, stink bug populations were very low during September, so we were unable to establish infestations at R7, except for the Virginia location. Thus, the results reported here were derived from caged plants infested with adult green stink bugs at R-4, R-5, and R-6. Cages were checked several times during the first week after introduction, and stink bugs replaced if dead or missing. Infestations were left to feed for three weeks, after which the insects were removed and the bags remained over plants until harvest maturity.

At harvest maturity, plants in each bag were removed, the number and type of pods recorded, and the beans threshed manually or by a small plot combine. Seeds were inspected for discoloration due to diseases, deformation, and/or pitting caused by insect feeding injury. Data on number of plants, total number of seeds, and seed weight were recorded. The data were converted and expressed as bushels per acre, weight per 100 seeds, and percentage of seeds with disease symptoms. The data set from each study location was analyzed by the mixed model SAS procedure to test for main effects for growth stage and treatment (infested versus uninfested) and their interaction effect, after adjustments were made for lack of normality and homogeneity of variances. The replicate plots at each study location were treated as completely randomized blocks and thus considered as a random factor in the model. Replicate bags of the same treatment within plots were considered sub-samples and averaged. The Tukey option was used to test for significance among multiple mean comparisons.

Results and Discussion:

In the Maryland study, there were no significant differences and no apparent trend in the yield components and seed quality in bags infested with adult green or brown stink bugs. Moreover, bags infested with nymphs were set up only at growth stage R4. To simply the analysis and increase statistical power for testing treatment effects, data from all bags infested with stink bugs (irrespective of species or life stage) were pooled and compared with uninfested, control bags. Fig. 1 summarizes the effects of stink bug infestations (one insect per foot of row) on average yield, weight per 100 seeds, and percentage of diseased seeds for each soybean growth stage. Unlike the 2006 results, which showed significant yield reductions caused by stink bug infestations, differences between infested and uninfested bags for all variables were not significant. In fact, the average yields in the infested bags at the three growth stages were numerically higher than yields in the control bags.

Similar results were obtained from the Delaware studies, which revealed no evidence of any negative impact of adult green stink bugs on soybean yield components or disease incidence (Figs. 2 and 3). At the Apiary location, average yields in infested bags were consistently higher than control yields, and the main effect due to stink bug infestation was statistically significant ($F_{(1,12)} = 7.96$, $P = 0.015$), indicating an increase in seed weight in the infested bags. At the Allen

location, where overall yields were much higher, there were no significant main or interaction effects on any variable.

In the Virginia study, enough insects were collected to establish complete sets of replicate bags infested with adult green stink bugs and nymphs. Results comparing the yield, weight per 100 seeds, and disease incidence in bags placed over soybean plants infested with these insect stages are given in Fig. 4. At R4, there were consistent trends showing reductions in soybean yield and increases in the percentage of diseased seeds in the infested bags. Differences from the controls were greater for adult stink bugs than for nymphs. The overall incidence of purple stain and gray mold infected seeds was much higher in the Virginia study than levels recorded in Maryland and Delaware. However, neither the interaction effects nor the main effects for infestation were statistically significant. Differences in yield and disease incidence relative to the controls at R5 and R6 showed no consistent trends that would suggest a negative impact due to stink bug infestations. Worth mentioning is that at R5 there was a reversal of the relative differences between infested and uninfested bags for both insect stages.

Conclusions:

The weight of evidence provided by the collective results of the four studies would suggest that the impacts of stink bug feeding on soybean may be minimal. However, the data were highly variable; resulting in inconsistent differences among locations and also clear treatment trends in some cases that were not statistically significant (i.e. R4 results at the Virginia location). The variation was largely due to the natural variability in plant responses, given the small experimental unit of one foot of row. In addition, there were some confounding effects due to contamination by corn earworms on the enclosed soybean plants, and modifying effects of the mesh bags on plant physiology. In summary, we expected to see significant effects of stink bug feeding at R4, which has been reported in previous studies using an infestation density of one stink bug per foot of row. Unfortunately, given the enormous effort and time involved in carrying out these four studies, we consider the findings to be inconclusive and thus additional studies are needed.

Figure 1. Average yields, weight (g) per 100 seeds, and percentage of disease infected seeds of stink bug infested and uninfested soybean plants. Infestations of one adult bug per foot of row were introduced in mesh bags enclosing plants at three soybean growth stages. Maryland. 2007.

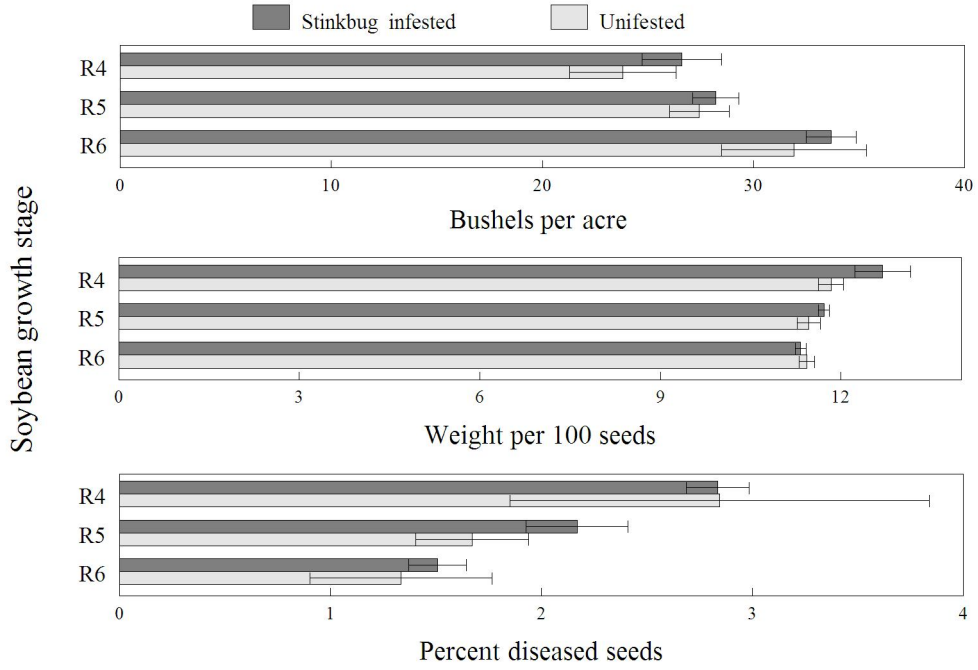

Figure 2. Average yields, weight (g) per 100 seeds, and percentage of disease infected seeds of stink bug infested and uninfested soybean plants. Infestations of one adult bug per foot of row were introduced in mesh bags enclosing plants at three soybean growth stages. Delaware – Apiary location. 2007.

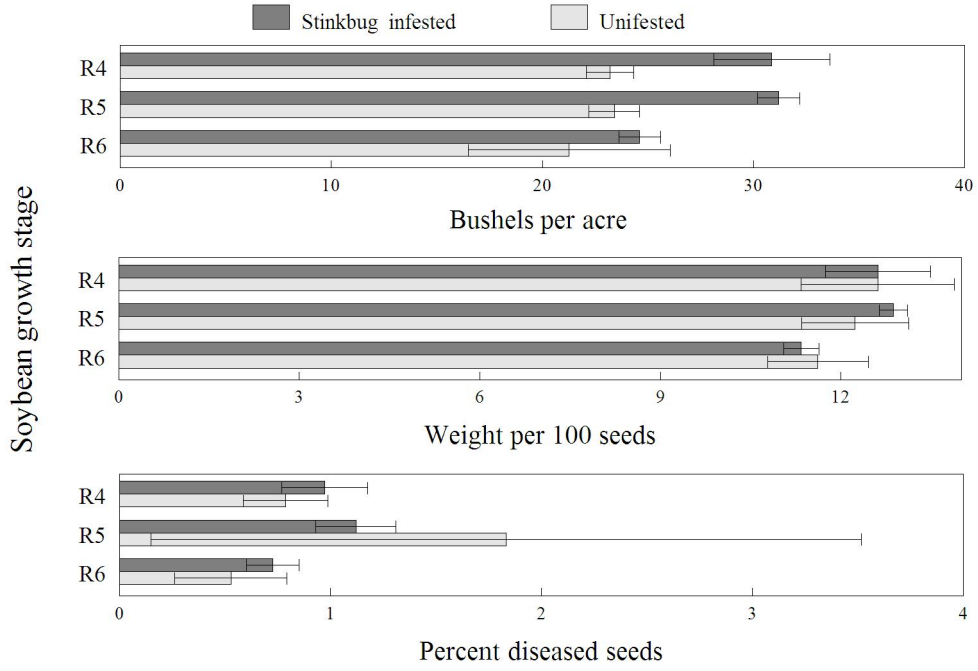

Figure 3. Average yields, weight (g) per 100 seeds, and percentage of disease infected seeds of stink bug infested and uninfested soybean plants. Infestations of one adult bug per foot of row were introduced in mesh bags enclosing plants at three soybean growth stages. Delaware – Allen location. 2007.

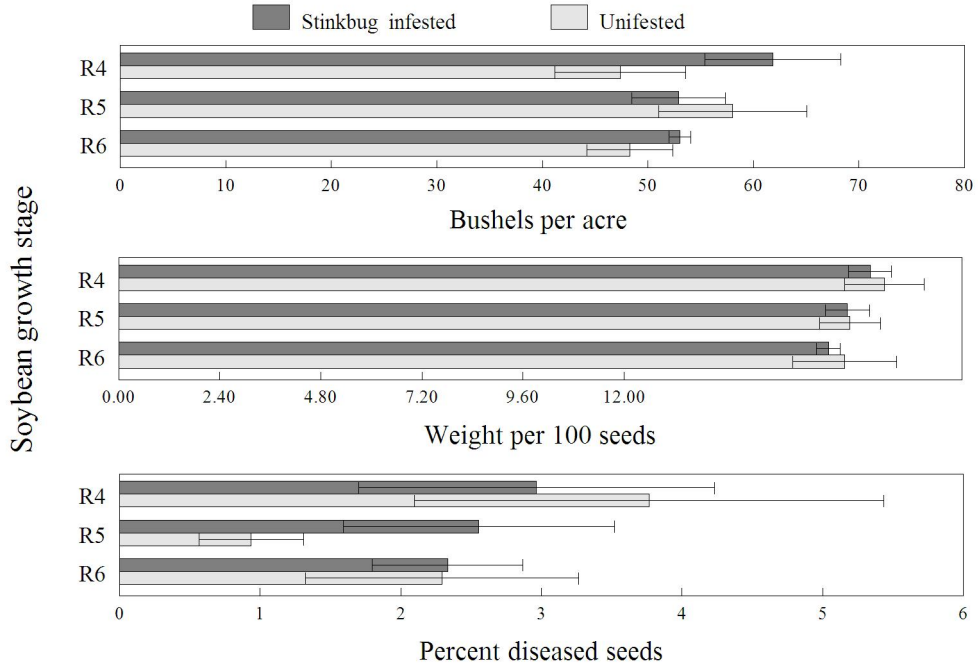

Figure 4. Average yields, weight (g) per 100 seeds, and percentage of disease infected seeds of stink bug infested and uninfested soybean plants. Infestations of one adult or nymph bug per foot of row were introduced in mesh bags enclosing plants at three soybean growth stages. Virginia 2007.