PROGRESS AND CHALLENGES IN MANAGING A BOLL-FEEDING SUCKING BUG COMPLEX OF STINK BUGS AND PLANT BUGS ON COTTON: SAMPLING AND DAMAGE ASSESSMENT

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<u>Abstract</u>

Both cotton-boll feeding plant bugs and stink bugs (Hemiptera: Miridae and Pentatomidae) are found along the coastal cotton growing region of South Texas, resulting in a dilemma of how to manage the complex. Boll damage, boll rot, and yield loss were compared for verde plant bug and one representative stink bug (southern green stink bug). Boll damage and yield loss differences between the species were not detected, but they were detected for cotton boll rot. Overall, the expectation of higher boll damage and yield loss from the larger stink bug was not consistent with the trends in the results, but cotton boll rot may be more of a concern with the southern green stink bug. A comprehensive management system may be feasible with appropriate adjustments to the period of field monitoring. Additional study years and experiments will help clarify the association of boll rot, and the sensitivity of the results to differing environmental conditions.

Introduction

Damage to developing cotton, *Gossypium hirsutum* L. (Malvaceae) by boll-feeding sucking bugs has increased substantially with the advent and implementation of transgenic Bt (*Bacillus thuringiensis*) cotton varieties. As a result of reduced broad-spectrum insecticide, the pest status of plant bugs and stink bugs (Hemiptera: Miridae and Pentatomidae) has been elevated during the last 10 to 15 years, including along the Gulf Coast of South Texas (Brewer 2011). The boll-feeding plant bug that occurs is verde plant bug, *Creontiades signatus*. Damage during 2009-2010 was wide ranging. Where it occurred along the Texas Gulf Coast, yield loss was between 5 and 25% (Brewer et al. 2012a). Southern green stink bug, *Nezara viridula*, feeding damage has been shown to cause boll abscission, lint staining and loss, and seed loss (Greene et al. 2001). Loss is magnified when bacteria causing boll rot are introduced during feeding as shown for southern green stink bug (Medrano et al. 2009). Our objectives for this study were to compare feeding damage of verde plant bug and southern green stink bug side by side in a controlled field cage experiment. The results will be useful to determine if adjustments of economic thresholds and field monitoring activities will be needed and the extent to which this species complex can be addressed in a comprehensive management system.

Materials and Methods

Controlled Field Cage Experiment

Studies were conducted at Texas A&M AgriLife Research and Extension Center, Corpus Christi, TX, during the 2013 cotton growing season. First-position cotton bolls of Phytogen 367 WRF were identified at white bloom (first day anthesis) by tagging the pedicle of the boll with a plastic tag containing the date, and attaching a colored ribbon to the main stem of the plant. First position cotton bolls of specific ages defined as 3 days and 5 days post-anthesis (11mm and 17mm) were enclosed with small nylon-fabric bags and infested for 72 hours with each species, verde plant bug and southern green stink bug separately, one insect per boll, along with the same number of uninfested controls.

This trial was conducted three times. Experimental plots used for infesting cotton bolls consisted of four rows of cotton, 12 m in length. Only the two center rows were used for tagging and infesting. For each trial, bolls were tagged every 1 to 2 weeks and maintained insect free with organic pyrethrins, (0.02% by volume, Bonide products, Oriskany, NY) to ensure availability of developing bolls during mid to late bloom and when field-collected insects were available. First position cotton bolls were used for uniformity and because they are a significant portion of the total yield (Jenkins et al. 1990). Three days before infestation, the available tagged fruiting bodies were randomly assigned across the two boll ages and three insect treatments (verde plant bug, southern green stink bug, and uninfested control).

Adult verde plant bugs and southern green stink bugs used to infest first-position bolls were collected on various developmental stages of grain sorghum in Nueces County. Only healthy adult insects with complete intact-appendages were used for infesting. They were starved for an 18 hr period before infestation. After a 72 h infestation period, insecticide was used to kill the insects.

After the infestation period, the bolls were allowed to mature inside the nylon-fabric bags. Boll damage using a 0 to 4 scale was used (Lei et al. 2003). Bolls were scored on presence or absence of cotton boll rot visually (Medrano et al. 2009). Yield data were estimated by the weight of seedcotton. All data from the three trials were aggregated. Data were analyzed by an ANOVA conforming to a two (boll age) by three (insect species and uninfested control) factorial. Differences in means across the insect species factor for 3 day old bolls and 5 day old bolls were detected using the Tukey's Means Separation Test.

Results

Controlled Field Cage Experiment

There was good evidence that the plant enclosures (nylon bags with draw string) restricted pest feeding to the target species. Cotton boll damage, cotton boll rot, and yield loss resulting from the infestation of verde plant bug and southern green stink bug was significantly higher than non-infested bolls. Specific results of analysis of the three measurements are below.

Boll Damage rating

The damage ratings from the infested treatments resulted in much more damage than the non-infested (F= 13.47; P < 0.0001; df = 2, 61) (Fig. 1). There was no statistical difference between boll damage ratings from verde plant bug and southern green stink bug injury averaged across 3 day and 5 day old bolls. On average boll damage tended to be higher from verde plant bug infesting 3-day old infested bolls, while boll damage was higher from southern green stink bug infesting 5-day old infested bolls, although significant differences were not detected (P = 0.10).



Figure 1. Mean (\pm SE) damage rating (0-4) for cotton boll ages 3 and 5 days post anthesis infested with verde plant bug, southern green stink bug, and for controls (non-infested cotton bolls) located at Corpus Christi, TX, 2013. The letters display differences across species, separately for 3 day old and 5 day old bolls.

Frequency of rot

Boll rot was not detected in the controls (non-infested) across all replicates. The resulting percentage of rot from the infested treatments resulted in much more rot than the zero-rot observation of the non-infested control (F= 6.20; P < 0.0035; df = 2, 61). There was no statistical difference between rot frequency from verde plant bug and southern green stink bug infesting 3 day old bolls. But for 5 day old bolls, southern green stink bug-infested bolls showed more cotton boll rot symptoms than bolls infested with verde plant bug (Fig. 2).



Figure 2. Percentage (\pm SE) of rot detected for cotton bolls infested at 3 and 5 days post anthesis with verde plant bug, southern green stink bug, and for controls (non-infested cotton bolls) located at Corpus Christi, TX, 2013. The letters display differences across species, separately for 3 day old and 5 day old bolls.



Figure 3. Mean (\pm SE) seedcotton in grams for cotton bolls infested at 3 and 5 days post anthesis with verde plant bug, southern green stink bug, and for controls (non-infested cotton bolls) located at Corpus Christi, TX, 2013. The letters display differences across species, separately for 3 day old and 5 day old bolls.

Seedcotton weights

Seedcotton weights (total seed mass + cotton boll lint) were significantly affected by both the verde plant bug and the southern green stink bug versus controls (F= 6.37; P < 0.0031; df = 2, 61). But there was no statistical difference between the seedcotton weights from verde plant bug and southern green stink bug injury (Fig. 3).

Discussion

Our interest in comparing the damage between verde plant bug and southern green stink bug is to better develop "in field" decision making guidelines when a species complex of boll-feeding sucking bugs is present. If boll damage, ability to introduce boll rot, and yield loss differ substantially between species, then adjustments of current thresholds will be needed. In the current study, boll damage, boll rot, and yield loss differences between the species were not detected, but they were detected for cotton boll rot. The contrast of results comparing 3 day and 5 day old bolls was very important and reflects past studies which showed that verde plant bug readily feeds on large squares and small bolls <10 day old (Brewer et al. 2012), In contrast, southern green stink bolls can continue feeding on larger bolls (Greene et al. 2001). A longer window of field monitoring may therefore be necessary when the complex of verde plant bug and stink bugs occur, as seen in the Upper Coastal Bend of Texas. Overall, the expectation of higher boll damage and yield loss from the larger stink bug was not consistent with the trends in the results, but cotton boll rot may be more of a concern with the southern green stink bug. A comprehensive management system may be feasible with appropriate adjustments to the period of field monitoring. Additional study years and experiments will help clarify the association of boll rot (Brewer et al. 2012b), and the sensitivity of the results to differing environmental conditions.

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