2006 Beltwide Cotton Conferences, San Antonio, Texas - January 3 - 6, 2006

VARIABILITY IN THE RELATIONSHIP BETWEEN BUG DAMAGED BOLLS AND YIELD

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Abstract

Fifteen field trials were established in Georgia and North Carolina which included bug protected, unprotected, and intermediate bug protected plots. Variability in yield response to bug damaged bolls was observed within and between states. Percent maximum yield in a trial was regressed against percent boll damage for respective treatments and the subsequent equations were y = -0.8353x+100 and y = -0.2978x+100 (y=percent of maximum yield and x=percent boll damage) in Georgia and North Carolina respectively.

Introduction

Boll feeding bugs have elevated in pest status during recent years due primarily to the reduction of broad spectrum insecticide use. Successful elimination of the boll weevil as an economic pest and utilization of Bt transgenic cottons have eliminated the need for boll weevil and tobacco budworm insecticide sprays and significantly reduced the number of applications for bollworm. Additionally, selective insecticides which have no activity on bug pests are being used to a greater degree. Sucking bug pests such as stink bugs and plant bugs have exploited this low insecticide use environment.

Stink bugs and tarnished plant bugs are the most common sucking bug pests infesting cotton in the southeast. Stink bugs are primarily boll feeders and capable of damaging bolls 25 days past anthesis (Greene 2001, Willrich 2004). Historically tarnished plant bug feeding on bolls has not been considered a major source of yield loss; however tarnished plant bugs can damage bolls in the early stages of development (Gore and Cachot 2005, Russell et al. 1999, Horn et al. 1999). Excessive bug damage on small bolls may cause abscission, whereas bolls may remain on the plant when damage is limited or inflicted on older bolls. In Georgia, the most common boll feeding bugs include the southern green stink bug and the brown stink bug. Additional boll feeding bugs occasionally observed include the green stink bug, several *Euschistus* species, tarnished and clouded plant bugs, and leaf-footed bugs.

Stink bugs damage developing cotton bolls by piercing the boll wall and feeding on or near the developing seed. Callous growths or warts form on the inner surface of the boll wall at the feeding site within 48 hrs (Bundy et al. 2000). Stained lint may also be associated with stink bug feeding. In most states, thresholds for boll feeding bugs in cotton have been adapted from Greene et al. 2001 and are based on 1 stink bug per 6 row feet or 10-20 percent medium sized bolls (the diameter of a quarter) displaying internal signs of feeding when stink bugs are present. The objective of this study was to correlate yield with the percent of harvestable bolls which are damaged by sucking bugs.

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Methods

Replicated field trials were established at various locations in Georgia during 2005 and North Carolina during 2004 and 2005 which included bug protected and unprotected 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. At some locations, trials were established in high risk areas for bug infestations, i.e. near or in peanut plantings, to assure damaging infestations. At first open boll, 25 to 100 bolls comprising a representative sample of harvestable bolls were collected from each plot. Bolls were then examined for internal bug damage. Bolls were considered damaged if a callous growth or wart was observed on the inner surface of the boll wall and/or stained lint was present (Bundy et al. 2000). No attempts were made to quantify the number of callous growths or the degree of stained or rotten lint for this analysis. Due to the large amount of bolls to examine and the time required for examination, bolls were often frozen for a period of time prior to making damage evaluations. Plots were machine picked and ginned at the University of Georgia MicroGin to obtain lint fractions for determining lint yields per acre (a common lint fraction was used for determining lint yields for trials which have not been ginned at this time). The University of Georgia MicroGin is a small scale gin which processes cotton consistent with commercial ginning practices.

Regression equations were generated for percent of maximum yield against percent year end internal boll damage for each trial. The y-intercept (percent of maximum yield) was set at 100 percent. Treatment means for all trials within states were also combined and similar regression equations were generated for Georgia and North Carolina respectively.

Results and Discussion

Bug damaged bolls and yield losses ranged from low to high in the fifteen trials conducted in Georgia and North Carolina during 2004 and 2005. Examination of bolls for internal boll damage was time consuming since many of the bolls were approaching maturity and difficult to manually open. Older bolls which had been frozen and thawed were much easier to open, i.e. could be easily squashed between your thumb and forefinger. Originally, freezing bolls was used to preserve the integrity of the boll, but fortunately it also allowed for easier examination.

Stink bug populations and bug damaged bolls were moderate to high at all Georgia locations during 2005. Regression equations for individual trials indicated that for one percent year end boll damage 0.5767, 0.6261, 0.6899, 0.7724, 0.8085, 0.8386, 1.1134, and 1.1434 percent yield loss would occur. When all trials from Georgia were combined and percent maximum yield in a trial was regressed against percent boll damage for respective treatments the subsequent equation was $y = -0.8353x+100$ (y=percent of maximum yield and x=percent boll damage) with an R^2 of 0.8233 (Figure 1).

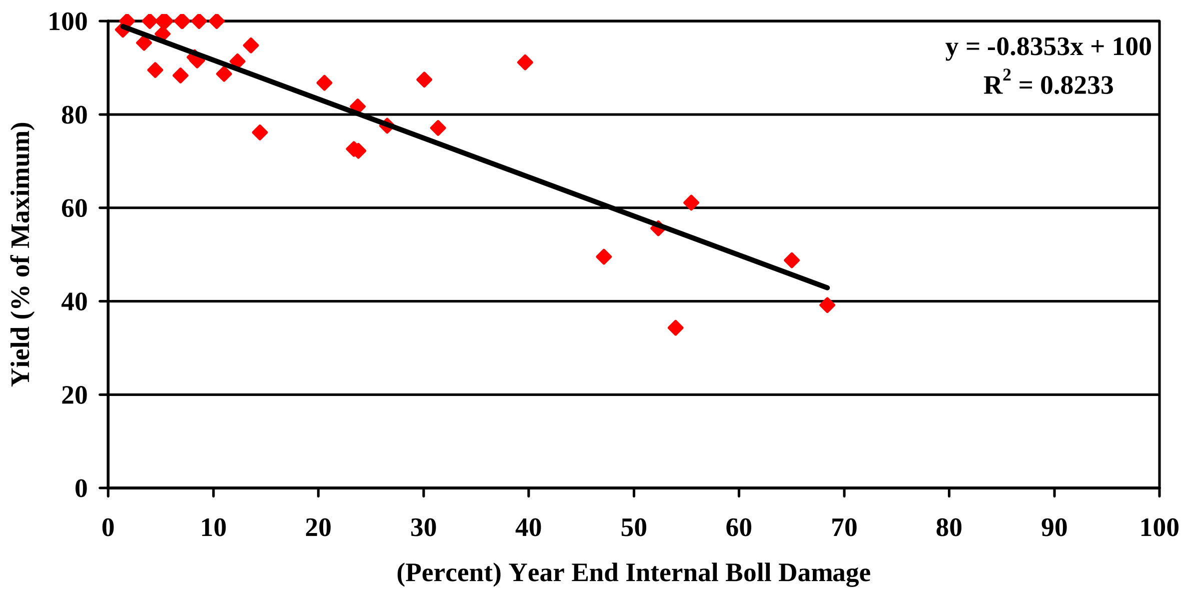

Figure 1. Percent of maximum yield in individual trials and percent year end boll damage for bug protected, unprotected, and intermediate bug protection treatments in Georgia during 2005.

Stink bug populations and bug damaged bolls were relatively high during 2004 and bug damaged bolls were low to moderate during 2005 in North Carolina. Regression equations for individual trials indicated that for one percent boll damage 0.1311, 0.2402, 0.2661, 0.2860, 0.3978, 0.4106, and 0.4767 percent yield loss would occur. When all trials from North Carolina were combined and percent maximum yield in a trial was regressed against percent boll damage for respective treatments the subsequent equation was $y = -0.2978x+100$ (y=percent of maximum yield and x=percent boll damage) with an R^2 of 0.5287 (Figure 2.).

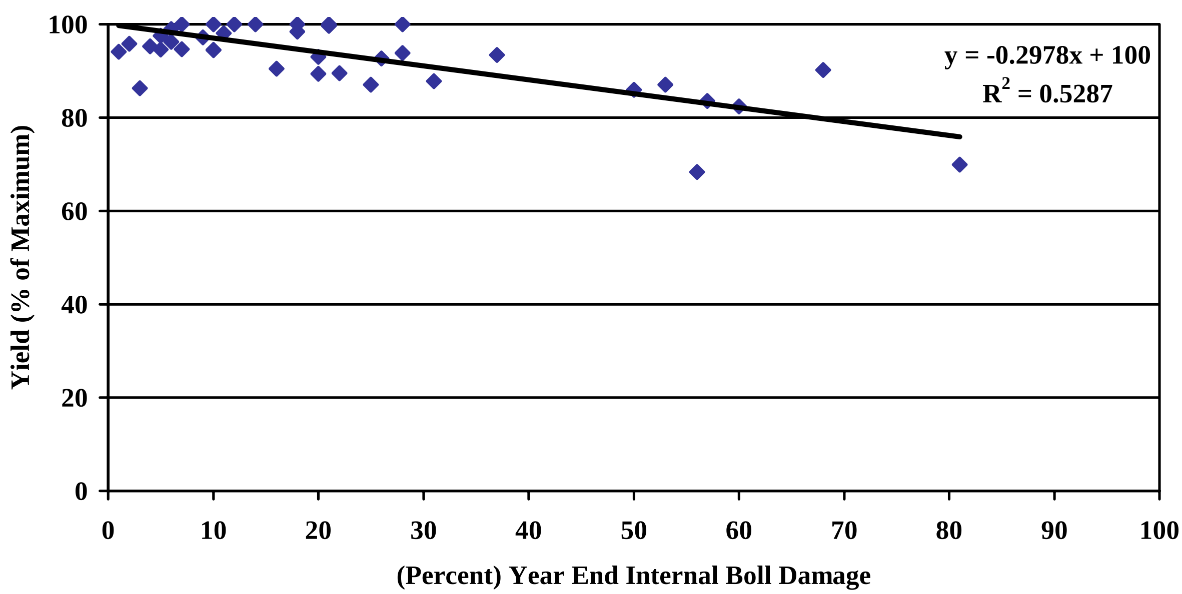

Figure 1. Percent of maximum yield in individual trials and percent year end boll damage for bug protected, unprotected, and intermediate bug protection treatments in North Carolina during 2004 and 2005.

Yield response to percent of year end bug damaged bolls varied by trial within and between states. In Georgia a two fold difference in yield response to bug damaged bolls occurred among trials, whereas in North Carolina a three fold difference was observed between trials. Reasons for variability in yield response to percent year end bug damaged bolls are not fully understood. Perhaps the differences in yield response between Georgia and North Carolina trials is that damage ratings were subjective and differences in recognition and scoring of damage existed. Yield loss was 2.5 times greater in Georgia compared with North Carolina for similar levels of boll damage. Bolls were scored as damaged or undamaged and obviously the degree of injury will vary greatly from single feeding sites to multiple feeding sites and boll rot for damaged bolls. Perhaps the species complex present in individual trials creates variability in yield response to boll damage. Various species of stink bugs, tarnished and clouded plant bugs, leaf-footed bugs, and other bugs are capable of causing warts or callous growths on the inner surface of the boll wall and may impact yield differently. Other potential explanations of variability include spatial and temporal distribution of damage on plants, variety, growing conditions, and compensation ability of plants. There are also questions on how bug damage manifests itself in a developing boll. In some situations we observe severe boll rots associated with stink bug damage whereas in others an individual lock may fail to fluff. In summary, we have demonstrated that the percent of harvestable bolls which exhibit internal signs of bug feeding is correlated to yield. However some variability among locations does exist.

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