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BOLLGARD VS. CONVENTIONAL COTTON IN NORTH CAROLINA IN 2004: YEAR OF THE STINK BUG

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Abstract

A large-scale, fall damaged boll survey of randomly-selected grower-managed cotton fields was begun in 1985 in North Carolina to quantify the pest status of bollworms, European corn borers, and fall armyworms. A stink bug damaged boll category (plant bug damage to bolls was also "scored" as stink bug damage) was added to the survey in 1989. From 1989 to 1995, Cleveland County, representing a western Piedmont part of North Carolina with fewer insecticide applications (approx. 0.5) than the remainder of the state (approx. 2.70) for bollworms, revealed stink bug damage to bolls almost 7-fold higher was present collectively in the other counties. The introduction of Bollgard cotton in 1996 created a similar scenario for Bollgard vs. conventional cotton, with Bollgard cotton being treated on average 0.79 times from 1996 to 2004 and conventional cotton treated 2.75 times. Boll damage by stink bugs in Bollgard and conventional cotton during this period was 4.40 and 1.59%, respectively. Increasing adoption of Bollgard cotton by North Carolina's producers from 1998 through 2001 appeared to correlate with increasing bug-damaged bolls; however, the low bug damage years of 2002 and 2003 appeared to reverse that "trend". Nothing prepared the state's producers and consultants for the unprecedented stink bug levels in 2004 in both Bollgard and in conventional cotton. The 2004 state mean for stink bug damage to bolls was 15.3% and 7.0% for Bollgard and conventional cotton, respectively- higher by more than 3-fold than the previous high of 4.7% in 2000 in Bollgard cotton and by almost 4-fold higher than the previous high of 1.8% in 2001 in conventional cotton. Although these extremely high levels of stink bugs and their associated damage to bolls was probably influenced by the greater adoption of Bollgard cotton by North Carolina's cotton producers, previous trends in bolls damaged by stink bugs in Bollgard cotton and the high damage levels in conventional cotton suggest that these high levels were weather-related and far less the result of increased adoption of Bollgard cotton.

Introduction

Since its introduction in 1996, Bollgard cotton has resulted in a significant shift toward lesser boll damage by bollworms and budworms and greater damage by stink bugs. To quantify late season pest shifts both before and after the introduction of Bollgard cottons, a large-scale damaged boll survey of producer-managed cotton fields, begun in 1985 on conventional cotton (Bacheler and Mott 1995), was continued on both conventional and on Bollgard cotton. We previously reported on the results of these comparisons (Bacheler et al. 1998; Bacheler and Mott 2003). Because bug levels, mostly green (*Acrosternum hilare* [Say]) and brown (*Euschistus servus* [Say]) stink bugs, and to a lesser degree tarnished plant bugs (*Lygus lineolaris* [Palisot de Beauvois] occurred at levels unapproached in prior years (Williams 2005), we are herein reporting on whether increased Bollgard acreage or other factors may account for this dramatic, unprecedented level of bug damage to bolls.

Method and Materials

Beginning in 1985, a survey of late season boll damage by bollworms (*Helicoverpa zea*) [Boddie]), European corn borers (*Ostrinia nubilalis* [Hubner]), and fall armyworms *(Spodoptera frugiperda* [J.E. Smith] of producer-managed cotton fields was undertaken. Approximately 8 to 12 randomly selected cotton fields from each of 6 to 10 representative cotton producing counties were assessed annually by selecting 100 randomly selected bolls and examining the bolls for damage from the above species (Bacheler and Mott 1995). Stink bug assessments were added in 1989. Beginning in 1996, equal numbers of Bollgard vs. conventional cotton fields were selected for the survey (Bacheler and Mott 2003). Data on late season insecticide use for Bollgard vs. conventional cotton fields were collected annually through a mail survey of independent cotton consultants, several county agents whose counties were not served by consultants, and selected large producers not utilizing a consultant.

Results

Late season damage to bolls in a western NC county in which cotton producers only treated an average of 0.5 times per year for late season bollworms showed 3.9% stink bug damage compared with only 0.57% boll damage for the average of remainder of the state in which producers treated an average of 2.70 times annually (Fig.1).

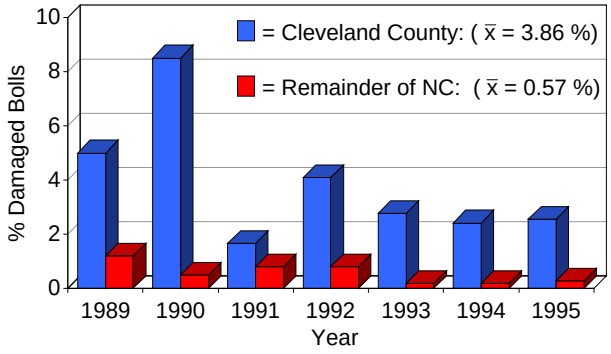

Figure 1: Stink Bug Damage to Bolls, 1989 - 1995
Cleveland Co. (0.5 apps.) vs. State (3.1 apps.)

Although the acceptance of Bollgard cotton in NC began slowly with only a 2-3% adoption rate in 1996 and 1997, by 2000 more than half of NC cotton acreage was planted to Bollgard cotton, and by 2003 that figure had risen to more than 2/3 (Fig. 2).

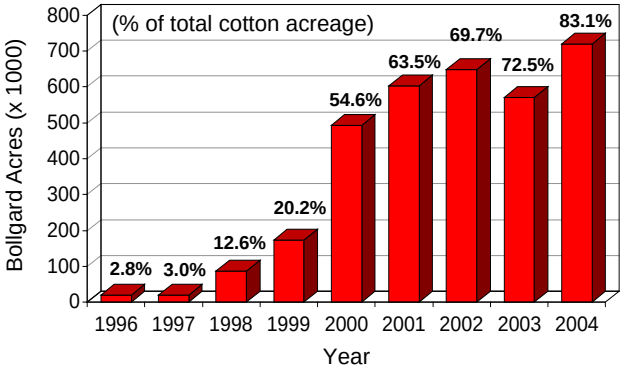

Figure 2: Bollgard Adoption in NC; 1996 - 2004

By 2004, over 80% of NC cotton acreage was planted to this technology. For the period 1996 to 2003, Bollgard cotton, treated an average of 0.79 times, sustained more than 3-fold greater stink bug damage than conventional cotton which was treated an average of 2.75 times (Figure 3).

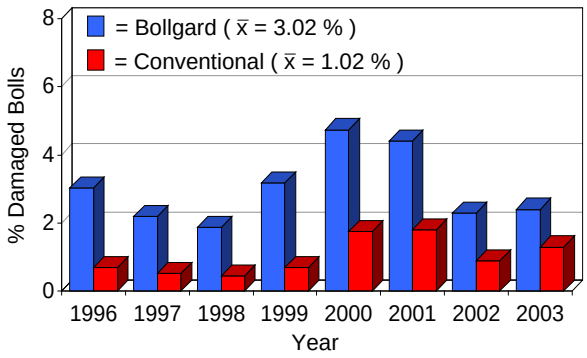

Figure 3: Stink Bug Damage to Bolls in Bollgard vs. Conventional Cotton, 1996 - 2003

Beginning in 1998, stink bug damage began to show trend of higher damage on Bollgard cotton that appeared to be related to higher adoption rates. However, with Bollgard adoption rates still climbing in 2002 and 2003 (Fig. 2), stink bug damage to Bollgard cotton dropped significantly. In 2004, stink bug (and to a lesser degree plant bug) damage to bolls in both Bollgard and conventional cotton was several-fold greater than the highest previous year (Fig. 4).

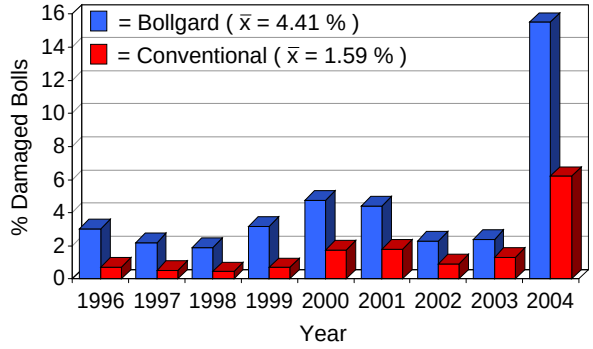

Figure 4: Stink Bug Damage to Bolls in Bollgard vs. Conventional Cotton, 1996 - 2004

Even conventional cotton sustained boll damage from stink bugs that was higher than in any "Bollgard year" except 2004. In looking at the bug-related boll damage in the 8 surveyed counties in 2004, a very large variation between some counties can be seen, particularly in Bollgard cotton, with Union County showing an average of 6.1% boll damage and Sampson County showing an average of 24.0% boll damage from bugs (Fig. 5).

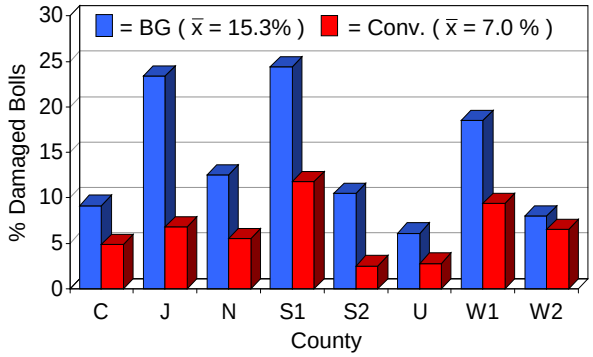

Figure 5: Stink Bug Damage to Bolls by County Bollgard vs. Conventional, 2004

In looking at county level resolution, Union County Bollgard cotton fields showed relatively low boll damage in Bollgard cotton; however one cotton field sustained 31% boll damage (Fig. 6).

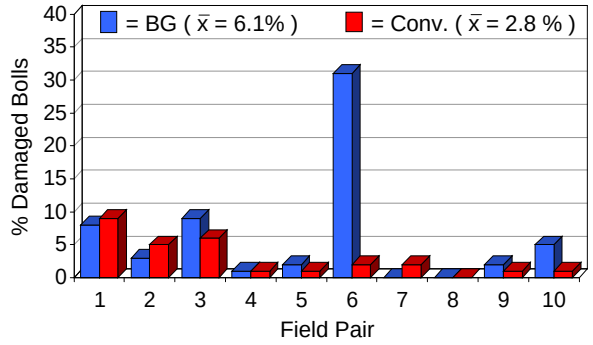

Figure 6: Stink Bug Damage to Bolls in Union County; Bollgard vs. Conventional, 2004

In the county with the highest average boll damage from bugs, four Sampson County Bollgard cotton fields sustained boll damage in the 40% range (Fig.7). One Sampson County conventional cotton field showed 25% bug damage, the highest on record in NC for a conventional cotton field evaluated in our survey (Fig.7).

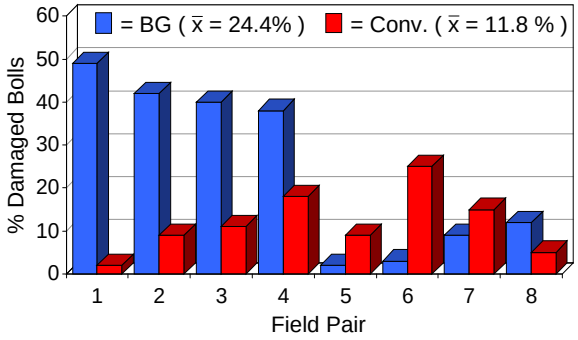

Figure 7: Stink Bug Damage to Bolls in Sampson County; Bollgard vs. Conventional, 2004

Conclusions

As has been well documented across the cotton belt, less treated Bollgard and other Bt cottons are at greater risk from other late season non-lepidopteran pests, such as stink bugs, that had been incidentally controlled by caterpillar sprays. However, in NC, on average, the cost of higher overall late season insect damage (primarily bollworms) and the greater number of insecticide applications in conventional cotton has resulted in slightly higher insect control costs than with Bollgard cotton (technology fee and greater stink bug damage) (Bacheler and Mott 2003). High stink bug damage in 2004 tightened this Bollgard long-term advantage somewhat, however.

Since its introduction in 1996, stink bug damage to Bollgard cotton has not shown a documentable upward trend in North Carolina, as supported by the low levels of bug damage to bolls in 2002 and 2003 (Fig. 3). It would appear that the high levels of bug damaged bolls in both Bollgard and in conventional cotton in 2004 was both the result of high, unpredictable levels of both brown and green stink hugs (and to some degree plant bugs) and the earliness of their invasion into cotton. In a stink bug threshold test in Wayne County, NC damage to less than quarter-sized bolls was 42% within one week following anthesis, to our knowledge unprecedented in NC (JSB).

A Bollgard II test at this same site suggests that the "Year of the Stink Bug" lesson could be largely lost on our producers, many of whom picked near record yields in 2004. Although the untreated check plot picked approximately 1,200 pounds of lint (with 81% stink bug damage to bolls in a late season assessment), the most protected treatment (with 9% stink bug damage) picked just over 1,700 pounds, a difference of a bale (Fig. 8).

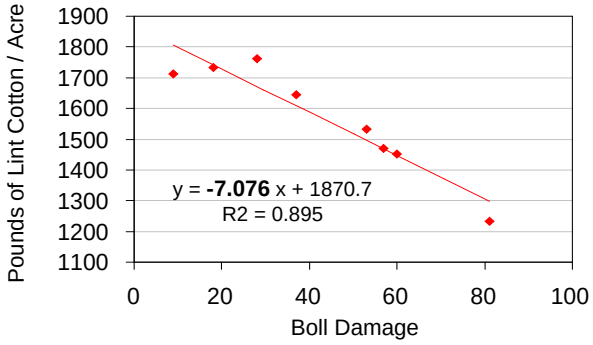

Figure 8: Stink Bug Damage to Bolls vs. Yield in Bollgard II Cotton, Wayne Co., 2004

The combination of high yields and a warm dry harvest season in which bug damage was not fully expressed will probably result in many cotton producers under appreciating the potential added yield and quality losses that would have resulted from a more timely, decisive response to stink bugs in 2004.

Acknowledgements

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