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EFFICACY OF BOLLGARD II COTTON UNDER NON-ENHANCED AGRONOMIC CONDITIONS IN NORTH CAROLINA, 1996-2002

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Abstract

Bollgard II (line 15985) was compared to Bollgard (DP-50B), and to conventional (DP-50) cotton in six replicated small plot tests maintained under typical NC cotton production practices from 2000 through 2002. Under these conditions (no irrigation, no bollworm moth flight/beneficial insect disruption, and avoidance planting dates after May 20), no live budworms, bollworms, or European corn borers were found, and only a single bollworm-damaged boll was scored on Bollgard II throughout the test period. In the 2002 test at the Edgecombe County location, Bollgard II cotton also held beet armyworm feeding to almost non-detectable levels, with Bollgard cotton showing approximately half the damage as the conventional cotton plots. Under typical producer conditions, it would appear that Bollgard II cotton lines will seldom require insecticide treatment for caterpillar control in North Carolina. However, in the absence of insecticides used for caterpillar control (vs. the current 0.88 applications/year [Bacheler and Mott, 2003]), stink bug and plant bug levels can be expected to increase somewhat.

Introduction

The registration of Bollgard II cotton in the US in December, 2002 means that cotton producers will now have cotton lines with two Bt insecticidal proteins with caterpillar activity, Cry 1Ac and Cry2Ab. These proteins are not active against non-lepidopterous insects and activity against pest caterpillars only partially (bollworms) or poorly (beet and fall armyworms, soybean loopers and others) by Bollgard cotton is expected to be greatly enhanced with Bollgard II cotton, and the time line for bollworm/budworm resistance will likely increased significantly (Jackson et al, 2002). Because the impact of various cotton caterpillar pests vary across the cotton belt, so to will the utility and potential fit of Bollgard II cotton. We therefore initiated studies of Bollgard II in 2000 to determine the effectiveness Bollgard II under grower conditions, and to ultimately provide NC producers with realistic expectations about the potential fit of this new technology.

Materials and Methods

The tests were located in Hoke (2000), Wilson (2000), Onslow (2001), and Edgecombe (2000, 2001, and 2002) counties, and represented areas of both high cotton acreage and moderate to high insect pressure. Monsanto personnel planted and maintained the Hoke and Wilson County tests. Each test was composed of 4 to 12 row plots with 50 to 100 ft. rows, and contained 4 replicates. All tests contained Bollgard II (line 15985) (herein designated as DP-50BII), DP-50B, and DP-50 conventional cotton. In each of the tests, the above 3 treatments (cotton lines) were sprayed as needed for caterpillar control or unsprayed (6 treatment total), except for those in Hoke and Wilson Counties, which were unsprayed only. The sprayed plots received 3 to 4 pyrethroid applications, using a CO_2-powered backpack sprayer calibrated to deliver 8.0 gpa at 3 mph with a single TX-8 hollow cone nozzle per row.

At the onset of oviposition and larval establishment from the major late July major bollworm moth flight, weekly or bi-weekly evaluations of square and boll damage and live bollworms were taken. The presence of other caterpillars was also monitored, but other species were extremely light at the test sites, and, with the exception of beet armyworms at the Edgecombe site in 2002, are not included in the information presented below. In the graphs presented below, the highest boll damage scouting data was used to avoid pre- and post-peak assessments that were not representative of the damage occurring to a particular test. At the conclusion of the bollworm damage period, an assessment of stink bug damage was undertaken in each of the tests. At the Edgecombe County location in 2002 beet armyworms were present in the test plots. Therefore, 10 leaves were sampled per plot (40 per treatment) and the number of larval feeding holes were counted.

Because early season insect pressure and damage among the varieties were not effected by the Bt endotoxin (thrips, cotton aphids, early plant bugs, and spider mites), no data on levels of these insects are presented.

All data were subjected to Gylling's ARM 6.2 software, and the means separated by ANOVA and LSD tests (P = 0.05).

Results

Boll damage to the untreated DP-50BII line was significantly less in the DP-50B line, with the former being close to zero, averaged over 4 tests shown in Figure 1. The treated DP-50B was statistically similar to the untreated DP-50BII line, although not a single bollworm-damaged Bollgard II boll was found in the 4 tests. Live bollworms, although statistically higher in the untreated DP-50 than in the DP-50B and the DP-50BII treatments, were not found in the DP-50BII line among the 400 bolls examined (25 per plot x 4 reps. X 4 tests) (Fig. 2). In the 2000 untreated tests conducted in Hoke and Wilson counties, boll damage levels were statistically higher in the DP-50 than in the DP-50B or the DP-50BII, as expected. And although the DP-50 and the DP-50BII treatments showed the same damage levels statistically, the DP-50BII did not have a single damaged boll among the 400 examined (50 per plot x 4 reps. x 2 tests) (Fig. 3). At these locations, stink bug levels were statistically similar between the 3 untreated lines.

Because stink bug levels were low (less that 1%) in the 4 tests other that the ones in Hoke and Wilson counties (Fig. 3), comparisons of stink bug damage to bolls in paired Bollgard and conventional in 1048 cotton fields managed by NC cotton producers from 1996 through 2002 are presented (Fig. 4). Stink bug damage to bolls in Bollgard cotton which had received a mean of 0.88 insecticide applications was 3.1%, compared to 1.0% boll damage to conventional cotton which had been treated an average of 2.6 times.

At the Edgecombe County site in 2002, beet armyworm feeding holes in the untreated DP-50 were greater than the DP-50B, and the DP-50B also had a statistically greater number of feeding holes than the DP-50BII.

Conclusions

Under the "non-bollworm-enhanced" realistic conditions of these tests, similar to what producers might reasonably expect to encounter, Bollgard II cotton held boll damage to almost non-detectable levels. In the 6 replicated tests evaluated, only a single bollworm damaged boll was found. Because stink bug levels were light at 4 of the 6 test sites, we used actual data collected from an annual damaged boll survey of 524 pairs of grower managed Bollgard vs. conventional cotton fields (1996 to 2002)(Bacheler and Mott, 2003). Because the mean stink bug damage was 3.1% for these Bollgard cotton fields that were treated an average of 0.8 times, stink bug levels could be expected to be somewhat higher in the anticipated lower Bollgard II spraying environment required for caterpillars. Based on this preliminary information, it would appear that sprays for caterpillars in Bollgard II cotton will be very rare in NC, and that the potential for boll damage from bug pests will therefore increase. Because caterpillar damage is presently low in Bollgard cotton in NC (1.2% bollworm damaged bolls vs. 4.8% with conventional cotton), the economics of late season insect control with Bollgard and Bollgard II will likely be similar, perhaps favoring Bollgard II if the technology fees of Bollgard and Bollgard II are approximately equal.

References

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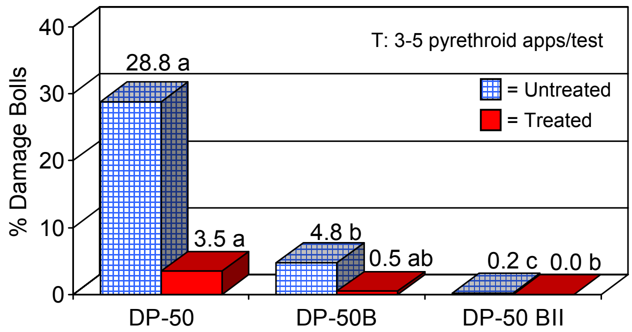
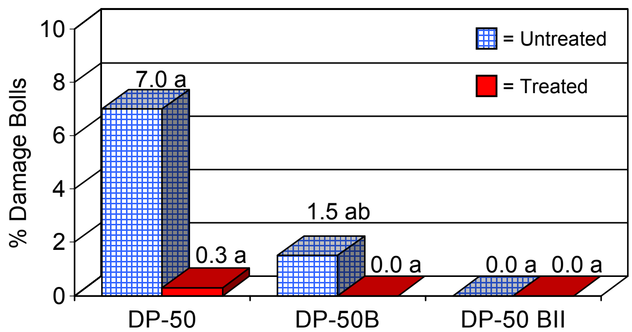
Jackson, R.E., J.R. Bradley, and J.W. Van Duyn. 2002. Estimated production of *Helioverpa zea* adults from Bollgard and Bollgard II cottons and implications for resistance management. *In*, Proceedings, 2002 Beltwide Cotton Conferences, National Cotton Council, Memphis, TN.



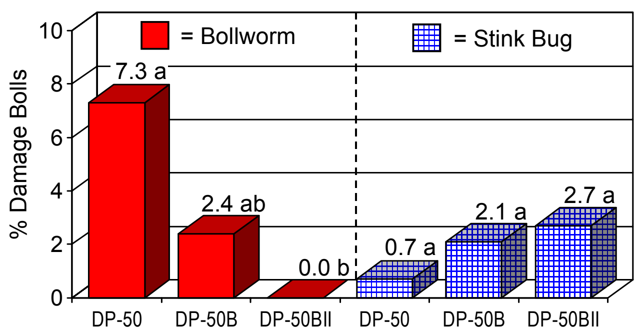
Means sharing the same letter (between varietal lines) are not statistically different (P=0.05; LSD test)

Figure 1. Boll Damage from Bollworms in DP-50, DP-50B, and DP-50BII (n=4 tests), Edgecombe and Onslow Counties, NC 2002-2002.



Means sharing the same letter (between varietal lines) are not statistically different (P=0.05; LSD test)

Figure 2. Live Bollworms in DP-50, DP-50B, and DP-50BII (n=tests), Edgecombe and Onslow Counties, NC 2002-2002.



Means sharing the same letter (between varietal lines) are not statistically different (P=0.05; LSD test)

Figure 3. Boll Damage from Bollworms and Stink Bugs in Untreated DP-50, DP-50B, and DP-50BII in Hoke and Wilson Counties, NC, 2000.

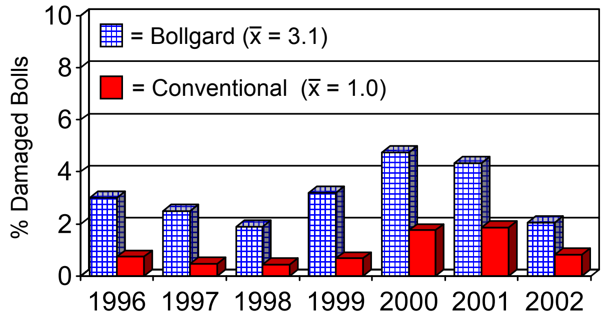


Figure 4. Bollgard vs. Conventional Cotton: Stink Bug Damage to Bolls in NC, 1996-2002.

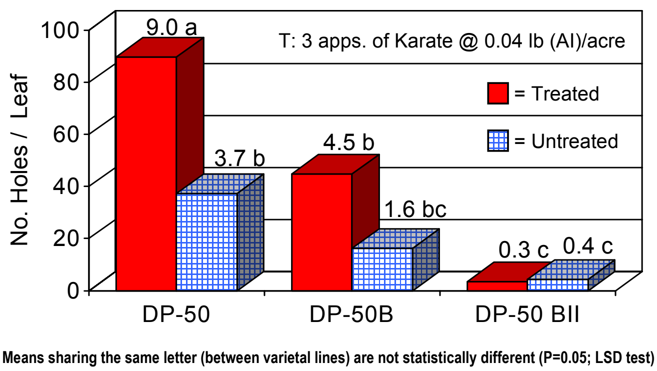


Figure 5. Number of Beet Armyworm Feeding Holes / Leaf in Conventional, vs. BG, vs. BGII Cotton, Edgecombe County, NC, 2002.