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# PERFORMANCE OF BT COTTON IN MISSISSIPPI, 2001

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## Abstract

Approximately eighty percent of Mississippi's 1.62 million acres of cotton was planted to Bt-transgenic varieties in 2001. A field survey was conducted during late season to compare performance of Bt and non-Bt varieties. Bt fields sustained less caterpillar induced boll damage, 2.08% vs 2.59%, and received significantly fewer foliar insecticide treatments for control of bollworm and tobacco budworm, 0.84 vs 2.27. Differences in number of bollworm/tobacco budworm sprays applied to Bt and non-Bt were greater in the Delta region of the state than in the Hill region, which experienced very low pressure from bollworm/tobacco budworm in 2001.

## Introduction

Approximately 80% of the 1.62 million acres of cotton grown in Mississippi in 2001 were planted to Bt-transgenic varieties (U.S. Dept. Ag., 2001). This is the highest statewide planting of Bt cotton since this technology was first introduced in 1996. The Hill region of the state was involved in the fifth year of its Boll Weevil Eradication Program (BWEP), while the South Delta and North Delta were in the fourth and third years of BWEP, respectively. Statewide involvement in BWEP is one of the primary reasons for this high usage of Bt-cotton. Growers are aware that the risks of secondary pest outbreaks are increased during BWEPs and Bt-cotton is known to reduce the risks from caterpillar pests.

Since it was first introduced in 1996, transgenic Bt cotton has proven to be highly effective against tobacco budworms, *Heliothis virescens*, and there have been no cases in which Bt fields have required supplemental treatment to control tobacco budworms. However, Bt cotton is less effective against bollworms, *Helicoverpa zea*, as well as loopers and armyworms (Layton, 1997: Mahaffey, et. al., 1995). In past years the number of supplemental foliar sprays applied to Bt fields for control of bollworms has ranged from 0.27 to 1.22 sprays per field (Layton, et al., 1997; 1998; 1999; 2000; 2001). Current guidelines for scouting and managing Bt cotton recommend supplemental foliar treatments for bollworms if the number of larvae surviving to 1/4 inch in length or greater exceeds four per 100 plants (Layton 1997; Layton 2001). With the exception of the size criterion, this is the same threshold recommended for non-Bt varieties.

## Methods

Beginning in mid August of 2001, a statewide survey was conducted with the primary objectives being: 1) to compare percent of bolls damaged by caterpillar pests, and "bugs" (plant bugs or stink bugs) in Bt and non-Bt cotton fields and 2) to compare number of foliar insecticide treatments applied for each of these pests.

Fields included in the survey were chosen with the assistance of county agents and/or local crop consultants. In most cases a pair of fields, one Bt and one non-Bt, were sampled from each farm visited. A total of 118 fields were included in the survey, 67 Bt and 51 non-Bt. Fields from 27 different counties, 11 Delta counties and 16 Hill Region fields, were included in the survey. Sixty-four of the fields sampled were from the Delta region of the state, and 54 fields were from the Hills.

Only non-Bt fields that were planted as part of the "sprayed refuge option" were included in the survey. Fields that were part of the "5% unsprayed refuge option" were excluded. Thus, all non-Bt fields that were included in the survey were fields that would have received treatments for control of bollworm/tobacco budworm whenever economically damaging infestations occurred.

The survey was conducted during the later half of August and early September and only included fields that had entered "cutout" as defined by Bourland et. al. (1992) (ie. terminal growth had declined to the point that there were five or fewer nodes above the first position white bloom).

Percent boll damage was determined by sampling 300 bolls per field, taken as 100 consecutive bolls from each of three randomly chosen sites per field, and determining the average percent of bolls damaged by caterpillars (bollworms, tobacco budworms, armyworms, etc), boll weevils, or "bugs" (plant bugs or stink bugs). No attempt was made to differentiate between damage caused by bollworm/budworm and other caterpillar pests.

Treatment history was determined by interviewing the producer, referencing field treatment records, and determining the primary target pest of each insecticide application. Only treatments, which the grower indicated were targeted primarily against bollworm or tobacco budworm were recorded as bollworm or tobacco budworm treatments. Thus, a treatment targeted primarily against fall armyworms was not recorded as a bollworm treatment, even though the material used may also have activity against bollworms.

Applications of ULV malathion applied as part of Mississippi's BWEP were not included in the survey. However, boll weevil numbers were very low in 2001, and, as of Sept. 5, only 19.2% of the fields in the state had been treated as part of the statewide BWEP (Smith, pers. com.). As of July 4, only 3.0 percent of the fields in the state had received an application of ULV Malathion. Thus in 2001, applications of ULV malathion applied as part of Mississippi's BWEP had relatively little impact on populations of other pests and on the number of treatments applied by producers for control of other pests. In past years the number of BWEP sprays was much higher, and these treatments had considerable influence either in flaring populations of pests, such as cotton aphids and tobacco budworm, or in coincidentally controlling pests, such as tarnished plant bug.

Data were subjected to log transformation and analyzed as a simple t-test with the P level set at 0.1.

## Results and Discussion

A total of 118 fields were included in the survey. Sixty-seven of these fields were planted to Bt varieties. Paymaster PM 1218BG/RR, Deltapine DPL 451BR, and Stoneville ST 4892BR were the most commonly planted Bt varieties, but a total of 10 different Bt varieties were represented in the survey. Fifty-one fields were planted to non-Bt varieties, with the most commonly planted non-Bt varieties being Phytogen PSC 355, Stoneville ST 4793R, and Deltapine DPL 436 RR.

Tobacco budworm populations were low in 2001, and as in previous years, there were no reports of Bt-cotton requiring treatment to control tobacco budworms. Beet armyworm and fall armyworm numbers were also low. However, bollworm populations were relatively high in the Delta region of the state, and 81.6% of the Bt fields in the Delta received treatments to control bollworms (Table 1). Bollworm pressure was much lower in the Hill region, with only 20.7% of the Bt fields in the Hills being treated for bollworms.

A summary of the statewide results is presented in Table 2. As in previous years, Bt fields received significantly fewer treatments targeted specifically against bollworm/tobacco budworm, 0.84 vs 2.27. Bt fields also sustained slightly less boll damage, 2.08% vs 2.59%, but this difference was not significant. It is noteworthy that Bt fields received significantly more sprays than non-Bt fields for control of tarnished plant bugs, 2.63 vs 2.00. This is attributed to the fact that the lower number of treatments applied to control bollworm/budworm in Bt fields resulted in less coincidental control of plant bugs. This observation agrees with results of past surveys conducted before the initiation of BWEP, in which Bt fields were observed to receive more treatments for pests such as boll weevil and tarnished plant bug and/or to sustain more boll damage due to these pests (Layton, et. al., 1998; 1999). The fact that only one boll weevil damaged boll was detected in the 2001 survey is evidence of the progress of Mississippi's BWEP.

Overall insect pressure was much greater in the Delta region, where non-Bt fields received an average of 7.38 foliar insecticide sprays (Table 3), than in the Hill region, where non-Bt fields received only 1.52 sprays (Table 4). Bt fields in the Delta received an average of 1.29 supplemental bollworm sprays, but this was significantly fewer than the 3.88 treatments applied to control bollworm/budworm on non-Bt fields. However, there was no significant difference in the percent of caterpillar damaged bolls in Bt vs non-Bt in the Delta (Table 3). In the Hills Bt fields received significantly fewer bollworm/budworm treatments than non-Bt, 0.24 vs 0.60, and also sustained significantly less caterpillar induced boll damage (Table 4). Although the trend for Bt fields to receive more plant bug treatments than non-Bt fields was apparent in both regions (Tables 4 and 5), these differences were not significant at the regional level.

Statewide, Bt fields received approximately 0.8 fewer total insecticide sprays than non-Bt fields. Obviously, this reduction in sprays is not sufficient to offset the approximately $30.00 per acre "technology fee" that growers payed to plant Bt varieties. However, within the Delta Region Bt fields received an average of 1.9 fewer sprays than non-Bt fields, which would bring the total cost of insect control on non-Bt fields closer to that of Bt fields.

Table 5 presents a comparison of the performance of the Bt variety Stoneville ST 4892 BG/RR to that of all other Bts. This comparison was made because of calls received during the growing season inquiring whether or not this variety was known to be more susceptible to bollworm infestations than other Bts. However, for the fields surveyed, no significant differences were observed between Stoneville 4892 and other Bt varieties.

This is the sixth year in which this survey of Bt and non-Bt cotton has been conducted. Yearly results are summarized in Table 6. These results show that Bt varieties have consistently received fewer foliar insecticide treatments for control of caterpillar pests, while also sustaining less caterpillar-induced boll damage.


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Table 1. Percent of Bt cotton receiving supplemental foliar treatments for control of bollworms, 2001.

| # bollworm sprays | Delta | Hills | MS combined |
|---|---|---|---|
| 0 | 18.4% | 79.3% | 44.8% |
| 1 or more | 81.6% | 20.7% | 55.2% |
| 1 | 47.4% | 17.2% | 34.3% |
| 2+ | 34.2% | 3.4% | 20.9% |

Table 2. Comparison of percent boll damage and number of insecticide treatments, Bt-cotton vs non-Bt cotton, Mississippi, 2001.

| | % damaged bolls | | Avg. no. foliar treatments[1] | | | |
|---|---|---|---|---|---|---|
| | caterpillars | "bugs"[2] | Bollworm & tobacco budworm | "bugs"[2] | Total Sprays[3] | N |
| Bt | 2.09 | 1.22 | 0.84* | 2.63* | 3.75 | 67 |
| non-Bt | 2.59 | 1.18 | 2.27* | 2.00* | 4.51 | 51 |

Pairs of means followed by * are significantly different according to t-test (P = 0.1).
[1] Does not include treatments of ULV malathion applied as part of BWEP.
[2] The category "bugs" includes tarnished plant bugs and stink bugs.
[3] Includes sprays for bollworm/tobacco budworm, "bugs" and other pests.

Table 3. Comparison of percent boll damage and number of insecticide treatments, Bt-cotton vs non-Bt cotton, Mississippi Delta Region, 2001.

| | % damaged bolls | | Avg. no. foliar treatments[1] | | | |
|---|---|---|---|---|---|---|
| | caterpillars | "bugs"[2] | Bollworm & tobacco budworm | "bugs"[2] | Total Sprays[3] | N |
| Bt | 2.89 | 1.33 | 1.29* | 3.76 | 5.47* | 38 |
| non-Bt | 3.34 | 0.83 | 3.88* | 3.23 | 7.38* | 26 |

Pairs of means followed by * are significantly different according to t-test (P = 0.1).
[1] Does not include treatments of ULV malathion applied as part of BWEP.
[2] The category "bugs" includes tarnished plant bugs and stink bugs.
[3] Includes sprays for bollworm/tobacco budworm, "bugs" and other pests.

Table 4. Comparison of percent boll damage and number of insecticide treatments, Bt-cotton vs non-Bt cotton, Mississippi Hill Region, 2001.

| | % damaged bolls | | Avg. no. foliar treatments[1] | | | |
|---|---|---|---|---|---|---|
| | caterpillars | "bugs"[2] | Bollworm & tobacco budworm | "bugs"[2] | Total Sprays[3] | N |
| Bt | 1.02* | 1.08 | 0.24* | 1.14 | 1.48 | 29 |
| non-Bt | 1.81* | 1.54 | 0.60* | 0.72 | 1.52 | 25 |

Pairs of means followed by * are significantly different according to t-test (P = 0.1).
[1] Does not include treatments of ULV malathion applied as part of BWEP.
[2] The category "bugs" includes tarnished plant bugs and stink bugs.
[3] Includes sprays for bollworm/tobacco budworm, "bugs" and other pests.

Table 5. Comparison of Stoneville 4892 to all other Bts.

| | No. Bollworm Sprays * (n) | | % Caterpillar Boll Damage * (n) | |
|---|---|---|---|---|
| Region | Stv. 4892 | Other Bts | Stv. 4892 | Other Bts |
| Hills | 0.43 (7) | 0.18 (22) | 1.42 (7) | 0.89 (22) |
| Delta | 1.00 (8) | 1.36 (30) | 3.53 (8) | 2.72 (30) |
| Statewide | 0.73 (15) | 0.87 (52) | 2.55 (15) | 1.94 (52) |

* Differences between pairs were not significant (P = 0.1).

Table 6. Comparison of number of insecticide treatments and percent boll damage on Bt and non-Bt cotton in Mississippi, 6-year summary.

| | avg. no. bollworm/budworm treatments | | Avg. % caterpillar Damaged bolls | |
|---|---|---|---|---|
| Year | Bt | non-Bt | Bt | non-Bt |
| 1996 | 0.33 | 3.05 | 2.70 | 4.90 |
| 1997 | 0.86 | 3.14 | 1.86 | 2.73 |
| 1998 | 1.22 | 5.18 | 2.55 | 4.81 |
| 1999 | 0.44 | 2.47 | 1.48 | 3.44 |
| 2000 | 0.27 | 2.44 | 1.96 | 3.40 |
| 2001 | 0.84 | 2.27 | 2.08 | 2.59 |