PERFORMANCE OF BT COTTON IN MISSISSIPPI, 2000

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Abstract

Approximately seventy-five percent of Mississippi's 1.28 million acres of cotton was planted to Bt-transgenic varieties in 2000. A field survey was conducted during late season to compare performance of Bt and non-Bt varieties. Bt fields sustained significantly less caterpillar induced boll damage, 1.96% vs 3.40%, and received significantly fewer foliar insecticide treatments for control of bollworm and tobacco budworm, 0.27 vs 2.44. Results of similar surveys conducted from 1996 through 1999 are summarized. During the first five years of its use in Mississippi, Bt cotton consistently received fewer foliar insecticide treatments while also sustaining less caterpillar induced boll damage than non-Bt cotton.

Introduction

Approximately 75% of the 1.28 million acres of cotton grown in Mississippi in 2000 were planted to Bt-transgenic varieties. Planting of Bt varieties was up considerably in the North Delta region of the state, which was in the second year of a Boll Weevil Eradication Program (BWEP). This increase in use of Bt cotton was a result of grower's awareness that risks of secondary pest outbreaks are increased during the early years of a BWEP and that planting Bt varieties helps lower the risk of caterpillar pest outbreaks. The remaining portions of the state were involved in the third or fourth years of BWEP and growers in these regions continued to plant a high percentage of their acreage to Bt varieties.

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 known to be less effective against bollworms, *Helicoverpa zea*, as well as loopers and armyworms (Layton, 1997: Mahaffey, et. al., 1995), and often requires supplemental foliar treatments to control other caterpillar pests, particularly bollworms. During the 1998 season 79% of all Bt fields involved in an end of season survey received one or more supplemental foliar treatments to control bollworms (Layton, et. al., 1999). However, in 1999 only 34.5% of the Bt fields surveyed received supplemental treatments for bollworm (Layton, et. al., 2000). Current guidelines for scouting and managing Bt cotton recommend supplemental foliar treatments for bollworm if the number of larvae surviving to 1/4 inch in length or greater exceeds four per 100 plants (Layton, 1997: Layton, 2000). With the exception of the size criterion, this is the same threshold recommended for non-Bt varieties.

Methods

Beginning in mid August of 2000, a statewide survey was conducted with the primary objectives being: 1) to compare percent of bolls damaged by caterpillar pests, boll weevils, 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 three groups of 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 59 fields were included in the survey, 34 Bt and 25 non-Bt. 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 a boll weevil eradication program were not included in the survey. Fields in the North Delta received an average of 6.8 BWEP treatments in 2000, while fields in the Eastern Hills, Western Hills, and South Delta received an average of 3.1, 5.0, and 3.0 ULV malathion sprays, respectively. Because these treatments were applied uniformly to both Bt and non-Bt cotton, they would be expected to have a masking effect on potential differences in boll damage and number of treatments for non-caterpillar pests.

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 59 fields were included in the survey. Thirty-four of these fields were planted to Bt varieties. DPL 33B, DPL 451, and Stoneville 4691 were the most commonly planted Bt varieties, but a total of 12 different Bt varieties were represented in the survey. Twenty five fields were planted to non-Bt varieties, with the most commonly planted non-Bt varieties being: Stoneville 747, Stoneville BXN 47, Stoneville 474, and Phytogen 355. Thirty of the fields sampled were from the Hill region of the state, and 29 fields were from the Delta.

Overall caterpillar populations were unusually low in 2000. As in previous years there were no reports of Bt-cotton requiring treatment to control tobacco budworms, and only 26.5% of the Bt fields in the survey received treatments to control bollworms (Table 1). The percentage of Bt fields that was treated for bollworms in 2000 was considerably higher in the Delta, where 47% of the fields were treated, than in the Hills, where only 5.9% of the Bt fields received supplemental treatments 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, 0.27 vs 2.44, and also sustained significantly less caterpillar induced boll damage, 1.96% vs 3.40%. There were no significant differences between Bt and non-Bt cotton in number of foliar treatments applied to control plant bugs, or in the percent of bolls damaged by these pests. However, it must be emphasized that ULV malathion treatments applied as part of BWEP would have provided collateral control of plant bugs and this would tend to mask potential differences. The extremely low percentage of bolls damaged by boll weevils is evidence of the progress being made toward eradicating this pest. In past surveys conducted before the initiation of BWEP, 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).

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In the Hill Region (Table 3), Bt fields received an average of only 0.06 bollworm/tobacco budworm treatments per field, compared to 1.69 treatments in non-Bt fields. Also, percent caterpillar induced boll damage was significantly lower in Bt fields than in non-Bt fields, 2.14% vs 4.87%. In the Delta Region (Table 4), Bt fields also received significantly fewer foliar bollworm/tobacco budworm sprays than non-Bt fields, 0.53 vs 3.25. However, there was no significant difference between Bt and non-Bt fields in the percent caterpillar induced boll damage for the Delta. Because of the progress toward boll weevil eradication, the percent of boll weevil damaged bolls was extremely low in both regions. Also, there was no difference in either percent "bug" damaged bolls or in average number of treatments required for plant bugs in either region.

This is the fifth year in which this survey of Bt and non-Bt cotton has been conducted. Yearly results are summarized in Table 5. 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, 2000.

# bollworm sprays	Delta	Hills	MS combined
0	52.9%	94.1%	73.5%
1 or more	47.1%	5.9%	26.5%
1	41.2%	5.9%	23.5%
2	5.9%	0.0%	2.9%
3 or more	0.0%	0.0%	0.0%

Table 2. Comparison of percent boll damage and number of insecticide treatments, Bt-cotton vs non-Bt cotton, Mississippi, 2000

% damaged bolls

	caterpillars	boll weevils	"bugs" [1]	n
Bt	1.96 *	0.01	0.74	34
non-Bt	3.40 *	0.01	0.85	25

avg. no. foliar treatments[2]

	bollworm & tobacco budworm	other caterpillars	"bugs" [1]	n
Bt	0.27 *	0.09	0.85	34
non-Bt	2.44 *	0.08	0.64	25

Pairs of means followed by * are significantly different according to t-test (P = 0.1).
[1] The category "bugs" includes tarnished plant bugs and stink bugs.
[2] Does not include treatments of ULV malathion applied as part of BWEP.

Table 3. Comparison of percent boll damage and number of insecticide treatments, Bt-cotton vs non-Bt cotton, Mississippi Hill Region, 2000.

% damaged bolls

	caterpillars	boll weevils	"bugs" [1]	n
Bt	2.14 *	0.00	1.25	17
non-Bt	4.87 *	0.00	1.36	13

avg. no. foliar treatments[2]

	bollworm & tobacco budworm	other caterpillars	"bugs" [1]	n
Bt	0.06 *	0.00	0.18	17
non-Bt	1.69 *	0.00	0.31	13

Pairs of means followed by * are significantly different according to t-test (P = 0.1).
[1] The category "bugs" includes tarnished plant bugs and stink bugs.
[2] Does not include treatments of ULV malathion applied as part of BWEP.

Table 4. Comparison of percent boll damage and number of insecticide treatments, Bt-cotton vs non-Bt cotton, Mississippi Delta Region, 2000

% damaged bolls

	caterpillars	boll weevils	"bugs" [1]	n
Bt	1.78	0.02	0.18	17
non-Bt	1.80	0.03	0.31	12

avg. no. foliar treatments[2]

	bollworm & tobacco budworm	other caterpillars	bugs" [1]	n
Bt	0.53 *	0.18	1.23	17
non-Bt	3.25 *	0.17	1.00	12

Pairs of means followed by * are significantly different according to t-test (P = 0.1).
[1] The category "bugs" includes tarnished plant bugs and stink bugs.
[2] Does not include treatments of ULV malathion applied as part of BWEP.

Table 5. Comparison of number of insecticide treatments and percent boll damage on Bt and non-Bt cotton in Mississippi, 5 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