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PERFORMANCE OF BT COTTON IN MISSISSIPPI: A 7-YEAR SUMMARY

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Abstract

Approximately eighty-one percent of Mississippi's 1.18 million acres of cotton was planted to Bt-transgenic varieties in 2002. A field survey was conducted during late season to compare performance of Bt and non-Bt varieties. Statewide, Bt fields sustained less caterpillar induced boll damage, 2.56% vs. 4.32%, and received significantly fewer foliar insecticide treatments for control of bollworm and tobacco budworm, 1.17 vs. 3.35. Differences in number of bollworm/tobacco budworm sprays applied to Bt and non-Bt were greater in the Delta region, 1.96 vs. 5.32, than in the Hill region, 0.65 vs. 2.07.

Introduction

Mississippi cotton producers planted approximately 1.18 million acres of cotton in 2002, with 81% of this acreage being planted to Bt-transgenic varieties. At least 18 different varieties of transgenic Bt-cotton were planted in Mississippi this year, but three of these Bt varieties: Stoneville 4892BR, DeltaPine 451 B/RR, and Paymaster 1218 BG/RR, accounted for 51% of the state's total cotton acreage. Although at least 19 different varieties of non-Bt cotton were grown in the state, Stoneville 4793R and DeltaPine 436 RR were the two most common non-Bt varieties, accounting for approximately 10% of the state's total cotton acreage (U.S. Dept. Ag., 2002).

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, 2002). Current guidelines for scouting and managing Bt cotton recommend supplemental foliar treatments for bollworms if the number of larvae surviving to 1/8 inch in length or greater exceeds four per 100 plants (Layton 1997; Layton 2002). With the exception of the size criterion, this is the same threshold recommended for non-Bt varieties.

Methods

Beginning in mid-August of 2002, 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 114 fields were included in the survey, 66 Bt and 48 non-Bt. Fields from 30 different counties, 11 Delta counties and 19 Hill Region counties, were included in the survey. Forty-five of the fields sampled were from the Delta region of the state, and 69 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 that the grower indicated were targeted primarily against bollworm or tobacco budworm were recorded as bollworm or tobacco budworm treatments. Thus, a treatment targeted pri-

marily against fall armyworms was not recorded as a bollworm treatment, even though the material used may also have activity against bollworms. Tank mixtures that clearly were applied in an attempt to control two separate species, such as bollworms and tarnished plant bugs, were counted as two applications, one for each pest.

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 2002, and through the month of July less than 8% of the fields in the state were treated for boll weevils in any given week (Smith, pers. com.). Fifty-seven percent of the cotton fields in the state remained boll weevil free for the entire growing season. Statewide an average of 1.5 applications were applied to Mississippi cotton fields as part of the BWEP, however, the majority of these sprays were applied late in the season after treatments for other pests had been terminated. Thus in 2002, BWEP treatments had relatively little impact on populations of other pests and on the number of treatments applied by producers for control of other pests

Data were analyzed as a simple t-test with the P level set at 0.1.

Results and Discussion

A total of 114 fields were included in the survey. Sixty-six of these fields were planted to Bt varieties. Paymaster PM 1218BG/RR, DeltaPine DPL 451B/RR, and Stoneville 4892BR were the most common Bt varieties, but a total of 10 different Bt varieties were represented in the survey. Forty-eight non-Bt fields were included in the survey, with the most common non-Bt varieties being, Stoneville ST 4793R, DeltaPine DPL 436 RR and Phytogen 355.

Although many fields of non-Bt cotton required treatment for tobacco budworms in 2002, there were no reports of Bt-cotton requiring treatment to control this pest. Beet armyworm and fall armyworm numbers were relatively low through out the state, but some treatments were applied for each of these species. However, bollworm populations were relatively high in the Delta region of the state, and 84% of the Bt fields in the Delta received treatments to control bollworms, with 68% of the fields receiving two or more bollworm treatments (Table 1). Bollworm pressure was somewhat lower in the Hill region, with 46.3% of the Bt fields in the Hills being treated for bollworms, and only 19.5% of the fields receiving two or more treatments. It is notable that 34.5% of the non-Bt fields in the Hill region did not require treatment for caterpillar pests, and several of the non-Bt fields in the Hill survey received no foliar treatments for any pest. These last data emphasize the low insect pressure experienced in many portions of the Hill region in 2002.

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, 1.17 vs 3.35. Bt fields also sustained significantly less boll damage, 2.56% vs 4.32%. It is noteworthy that Bt fields received significantly more sprays than non-Bt fields for control of tarnished plant bugs, 2.18 vs 1.56. 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 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, 2001, 2002). Although no area of Mississippi has yet achieved eradication of the boll weevil, populations are very low and no boll weevil damaged bolls were detected in the 2002 survey.

Overall insect pressure was much greater in the Delta region, where non-Bt fields received an average of 9.42 foliar insecticide sprays (Table 3), than in the Hill region, where non-Bt fields received only 3.31 sprays (Table 4). Bt fields in the Delta received significantly fewer bollworm/budworm sprays than non-Bt fields, 1.96 vs 5.32. Percent caterpillar damaged bolls was lower in Bt than in non-Bt fields, 2.97 vs 4.32, but not significantly so (Table 3). In the Hills, Bt fields received significantly fewer bollworm/budworm treatments than non-Bt, 0.65 vs 2.07, and also sustained significantly less caterpillar induced boll damage, 2.28 vs 4.32, (Table 4). Although the trend for Bt fields to receive more plant bug treatments than non-Bt fields was apparent in both regions (Tables 3 and 4), these differences were significant only in the Delta, where Bt fields received approximately one additional foliar spray for control of tarnished plant bugs.

Statewide, Bt fields received approximately 1.4 fewer total insecticide sprays than non-Bt. Assuming an average cost per spray of approximately $10 per acre, this reduction in sprays is not sufficient to offset the approximately $27.00 per acre "technology fee" that growers pay to plant Bt varieties. However, within the Delta Region, Bt fields received an average of 2.35 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.

This is the seventh year in which this survey of Bt and non-Bt cotton has been conducted. Yearly statewide results are summarized in Table 5, and yearly results for the Delta and Hills are summarized in Tables 6 and 7, respectively. 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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References

Bourland, F.M., D.M. Oosterhuis, and N.P. Tugwell. 1992. Concept for monitoring cotton plant growth and development using main-stem node counts. J. Prod. Agric. 5:532-8.

Layton, M.B. 1997. Insect Scouting and Management in Bt-transgenic Cotton. Mississippi Cooperative Extension Service Publication 2108. 4 p.

Layton, M.B. 2002. Cotton Insect Control Guide, 2002. Mississippi State Univ. Ext. Serv. Publ. 343. 35 p.

Layton, M.B., M.R. Williams, and S. Stewart. 1997. Bt-cotton in Mississippi: The first year. Proc. Beltwide Cotton Conf. Vol II. p. 861-863.

Layton, B., S.D. Stewart, and M.R. Williams, 1998, Performance of Bt cotton in Mississippi, 1997. Proc. Beltwide Cotton Conf. Vol II, p. 970-973.

Layton, M.B., S.D. Stewart, M.R. Williams, and J.L. Long, 1999, Performance of Bt cotton in Mississippi, 1998. Proc. Beltwide Cotton Conf. Vol II, p. 942-946.

Layton, M.B., M.R. Williams, and J.L. Long, 2000, Performance of Bt cotton in Mississippi, 1999. Proc. Beltwide Cotton Conf. Vol II, p. 1037-1039.

Layton, M.B., M.R. Williams, and J.L. Long, 2001, Performance of Bt cotton in Mississippi, 2000. Proc. Beltwide Cotton Conf. Vol II, p.847-849.

Layton, M.B., M.R. Williams, and J.L. Long, 2002, Performance of Bt cotton in Mississippi, 2001. Proc. Beltwide Cotton Conf., 2002.

Mahaffey, J.S., J.R. Bradley, and J.W. Van Duyn. 1995. Bt Cotton: Field performance in North Carolina under conditions of unusually high populations. Proc 1995 Beltwide Cotton Conference p. 795-798.

Smith, J., Mississippi Boll Weevil Management Corporation, pers. com.

U.S. Department of Agriculture, 2002. Cotton Varieties Planted 2002 Crop. Agriculture Marketing Service, Memphis, TN.

Table 1. Percent of Bt cotton receiving supplemental foliar treatment for control of bollworms, 2002.

# bollworm sprays	Delta	Hills	MS combined
0	15.4%	54.0%	39.4%
1 or more	84.6%	46.0%	60.6%
1	19.2%	25.0%	22.7%
2+	65.4%	20.0%	37.9%

Table 2. Comparison of percent boll damage and number of insecticide treatments, Bt-cotton vs non-Bt cotton, Mississippi, 2002.

	% damaged bolls		Avg. no. foliar treatments[1]			
	caterpillars	"bugs"[2]	Bollworm & tobacco budworm	"bugs"[2]	Total Sprays[3]	N
Bt	2.56*	1.55*	1.17*	2.18*	4.29	66
non-Bt	4.32*	0.87*	3.35*	1.56*	5.72	48

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, 2002.

	% damaged bolls		Avg. no. foliar treatments[1]			
	caterpillars	"bugs"[2]	Bollworm & tobacco budworm	"bugs"[2]	Total Sprays[3]	N
Bt	2.97	1.56	1.96*	3.76*	7.07*	26
non-Bt	4.32	0.79	5.32*	2.79	9.42*	19

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, 2002.

	% damaged bolls		Avg. no. foliar treatments[1]			
	caterpillars	"bugs"[2]	Bollworm & tobacco budworm	"bugs"[2]	Total Sprays[3]	N
Bt	2.28*	1.54	0.65*	1.15	2.47	40
non-Bt	4.32*	0.93	2.07*	0.76	3.31	29

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 number of insecticide treatments and percent boll damage on Bt and non-Bt cotton in Mississippi, 7-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
2002	1.17 *	3.35 *	2.56 *	4.32 *

Pairs of means followed by * are significantly different according to t-test (P = 0.1).

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

	avg. no. bollworm /budworm treatments		Avg. % caterpillar damaged bolls	
Year	Bt	non-Bt	Bt	non-Bt
1996	--	--	--	--
1997	1.27 *	4.40 *	1.73	2.24
1998	1.46 *	5.24 *	2.47	2.56
1999	0.63 *	2.35 *	1.10 *	2.07 *
2000	0.53 *	3.25 *	1.78	1.80
2001	1.29 *	3.88 *	2.89	3.34
2002	1.96 *	5.32 *	2.97	4.32

Pairs of means followed by * are significantly different according to t-test (P = 0.1).

Table 7. Comparison of number of insecticide treatments and percent boll damage on Bt and non-Bt cotton in the Mississippi Hills, 6 year summary.

	avg. no. bollworm /budworm treatments		Avg. % caterpillar damaged bolls	
Year	**Bt**	**non-Bt**	**Bt**	**non-Bt**
1996	--	--	--	--
1997	0.38 *	1.88 *	2.01 *	3.21 *
1998	1.11 *	5.15 *	2.58 *	6.20 *
1999	0.25 *	2.61 *	1.86 *	4.96 *
2000	0.06 *	1.69 *	2.14 *	4.87 *
2001	0.24 *	0.60 *	1.02 *	1.81 *
2002	0.65 *	2.07 *	2.28 *	4.32 *

Pairs of means followed by * are significantly different according to t-test (P = 0.1).