PERFORMANCE OF BT COTTON IN MISSISSIPPI, 1999

M. B. Layton, M. R. Williams and J. L. Long
Mississippi State University Extension Service
Mississippi State, MS

Abstract

Approximately 65% of Mississippi's 1.16 million acres of cotton were planted to Bt-transgenic varieties in 1999. 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, 1.48% vs 3.44%, and received significantly fewer foliar insecticide treatments for control of bollworm and tobacco budworm, 0.44 vs 2.47.

Introduction

Of the approximately 1.16 million acres of cotton grown in Mississippi in 1999, an estimated 65% were planted to Bt-transgenic varieties. Utilization of Bt-cotton was considerably higher in the Hill region and South Delta region of the state than in the North Delta. The Hill and South Delta regions, respectively, were involved in the second and first full season of boll weevil eradication, and most growers planted a high percentage of their acreage to Bt varieties to mitigate risks of outbreaks of tobacco budworm, *Heliothis virescense*.

While past experience has shown that transgenic Bt varieties are highly effective against tobacco budworm, they have proven to be less effective against bollworm, *Helicoverpa zea*, and may require supplemental foliar treatments when high populations of bollworms occur (Layton, 1997: Mahaffey, et. al., 1995). During the 1996 season, the first year of commercial planting of transgenic Bt-cotton, 28% of the Bt fields included in a statewide survey received at least one foliar treatment to control bollworms (Layton et. al., 1997). In a similar survey conducted in 1997, 41% of all Bt fields received one or more bollworm treatments (Layton, et. al., 1998). This 1997 survey also showed that Bt fields sustained significantly less caterpillar induced boll damage than non-Bt varieties, 1.86% vs 2.73%, and received significantly fewer foliar insecticide treatments for caterpillar pests, 0.86 treatments per field vs 3.14. In a 1998 study 79% of the Bt fields received at least one treatment for control of bollworms, and Bt fields sustained an average of 2.55% caterpillar induced boll damage, compared to 4.81% caterpillar induced boll damage in non-Bt fields. Bt fields also received fewer foliar treatments to control caterpillar pests in 1998, 1.22 vs 5.18 sprays per acre (Layton, et. al., 1999).

Because Bt varieties are highly effective against tobacco budworm but potentially susceptible to damage from high populations of bollworms, special scouting and management guidelines are recommended for Bt-cotton (Layton, 1997). Current guidelines 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, 1999). With the exception of the size criterion, this is the same threshold recommended for non-Bt varieties. Late season boll damage surveys provide a mechanism for evaluating the performance of Bt varieties and for gaining insight into the effectiveness of current recommendations for managing Bt-cotton.

Methods

Beginning in mid August of 1999 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 93 fields were included in the survey, 55 Bt and 38 non-Bt, from 20 different counties.

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 5 or fewer nodes above the first position white bloom). Because of the unusually early crop maturity experienced in 1999, many fields had some open bolls on the lower nodes when the survey was conducted. Because bolls that are damaged after they have attained approximately 7 days of age often remain on the plant, sampling fields at this stage provides an effective method of comparing relative levels of cumulative boll damage. However, it must be emphasized that these percent damaged boll counts do not provide a complete estimate of insect induced yield loss. Many fruit, especially those damaged as squares and small bolls, were shed from the plant before the survey samples were taken.

Percent boll damage was determined by sampling 300 bolls per field, taken as 100 consecutive unopened bolls from each of 3 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

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1037-1039 (2000)
National Cotton Council, Memphis TN

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. This is an important point, because the Hill region of the state was involved in the second full season of boll weevil eradication, and fields in this region received an average of 8.0 applications of ULV malathion. A similar number of ULV malathion treatments were applied in the South Delta, which was involved in the first full season of eradication. Also, beginning in August, fields in the North Delta received an average of 8.7 applications of ULV malathion as part of the initial fall diapause phase of the boll weevil eradication program. 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 analyzed as a simple t-test with the P level set at 0.1.

Results and Discussion

A total of 93 fields, from 20 different counties were included in the survey. Fifty-five of these fields were planted to Bt varieties, with DPL NuCotn 33B being the most common Bt variety, and 38 fields were planted to non-Bt varieties, with Stoneville 474 being the dominant variety. Forty-seven of the fields sampled were from the Delta region of the state, and 46 fields were from the Hills.

Overall insect populations were unusually low in 1999, and this was especially true for caterpillar pests. As in previous years there were no reports of Bt-cotton requiring treatment to control tobacco budworms, and only 34.5% of the Bt fields in the survey received treatments to control bollworms (Table 1). This is much lower than the more than 79% of Bt fields that were treated for bollworms in 1998 (Layton et. al., 1999). Also, none of the Bt fields included in the survey required treatment for other caterpillar pests, such as, loopers or armyworms.

Table 2 presents comparisons of percent boll damage and treatment history in Bt and non-Bt cotton from a statewide perspective. As in previous years, Bt fields received significantly fewer treatments targeted specifically against bollworm/tobacco budworm, 0.44 vs 2.47, and sustained significantly less caterpillar induced boll damage. There were no significant differences between Bt and non-Bt cotton in number of foliar treatments applied to control boll weevils or plant bugs, or in the amount of boll damage inflicted by these pests. However, it must be emphasized that ULV malathion treatments applied as part of Boll Weevil Eradication Programs tended to mask many potential differences due to non-caterpillar pests. In past surveys conducted before the initiation of boll weevil eradication programs, 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).

Trends in the individual regions of the state were similar to those of the state as a whole. In the Delta Region (Table 3) Bt fields received an average of 0.63 bollworm/tobacco budworm treatments per field, compared to 2.35 treatments in non-Bt fields. In the Hill Region, Bt fields also received significantly fewer foliar bollworm/tobacco budworm sprays than non-Bt fields, 0.25 vs 2.61. In both regions, percent caterpillar induced boll damage was significantly lower in Bt fields, but there were no significant differences in damage or number of treatments applied to control boll weevil or tarnished plant bug in either the Hills or the Delta.

This is the fourth year in which this survey comparison of Bt and non-Bt cotton has been conducted. Table 5 presents an overview of the year by year results for the state as a whole. These results show that Bt varieties have consistently received fewer foliar insecticide treatments for control of caterpillar pests and sustained less caterpillar induced boll damage than non-Bt varieties.

Acknowledgements

We thank the following individuals for providing assistance in locating survey fields and collecting survey information: Gordon Andrews, Brian Atkins, Jim Burkhalter, John Coccaro, Rickey Ferguson, Dalton Garner, Judd Gentry, Herbert Jones, Ed McWhirter, Jay Phelps, Dennis Reginelli, Steve Richardson, Ann Ruscoe, Jon Ruscoe, Jerry Singleton, Charlie Stokes, Guy Wilson, Steve Winters, Stanley Wise, Clint Young.

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. 1999. Cotton Insect Control Guide, 1999. Mississippi Cooperative Extension Service Publication 353. 35 p.

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 S. Stewart. 1997. Bt-cotton in Mississippi: The first year. Proc. Beltwide Cotton Conf. Vol II. p. 861-863.

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.

Table 1. Percent of Bt cotton receiving supplemental foliar treatments for control of bollworms, 1999

# bollworm sprays	Delta	Hills	MS combined
0	48.1	82.1	65.5
1 or more	51.9	17.9	34.5
1	40.7	10.7	25.5
2	11.2	7.2	9.0
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, 1999

	% damaged bolls			
	caterpillars	boll weevils	"bugs" [1]	n
Bt	1.48 *	0.02	0.35	55
non-Bt	3.44 *	0.02	0.14	38
	avg. no. foliar treatments [2]			
	bollworm & tobacco budworm	boll weevil	"bugs" [1]	n
Bt	0.44 *	0.18	0.78	55
non-Bt	2.47 *	0.26	0.76	38

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 Boll Weevil Eradication Programs.

Table 3. Comparison of percent boll damage and number of insecticide treatments, Bt-cotton vs non-Bt cotton, Mississippi Delta Region, 1999

	% damaged bolls			
	caterpillars	boll weevils	"bugs" [1]	n
Bt	1.10 *	0.01	0.58	27
non-Bt	2.07 *	0.00	0.13	20
	avg. no. foliar treatments [2]			
	bollworm & tobacco budworm	boll weevils	"bugs" [1]	n
Bt	0.63 *	0.37	1.22	27
non-Bt	2.35 *	0.50	1.10	20

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 Boll Weevil Eradication Programs.

Table 4. Comparison of percent boll damage and number of insecticide treatments, Bt-cotton vs non-Bt cotton, Mississippi Hill Region, 1999

	% damaged bolls			
	caterpillars	boll weevils	"bugs" [1]	N
Bt	1.86 *	0.02	0.13	28
non-Bt	4.96 *	0.04	0.14	18
	avg. no. foliar treatments [2]			
	bollworm & tobacco budworm	boll weevils	"bugs" [1]	N
Bt	0.25 *	0.00	0.36	28
non-Bt	2.61 *	0.00	0.39	18

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 Boll Weevil Eradication Programs.

Table 5.Comparison of number of insecticide treatments and percent boll damage on Bt and non-Bt cotton in Mississippi, 4 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	4.9
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