THE ECONOMICS OF BT COTTON IN THE MISSISSIPPI DELTA 1997-2000

Fred T. Cooke, Jr., Agricultural Economist
Delta Research and Extension Center, MAFES, MSU
William P. Scott, Entomologist
Jamie Whitten Delta States Research Center, USDA/ARS
Steven W. Martin, Agricultural Economist
Mississippi State Extension Service
Stoneville, MS
David W. Parvin, Jr., Agricultural Economist
Agricultural Economics Department, MAFES, MSU
Mississippi State, MS

This project is funded by U. S. Department of Agriculture, A.R.S., Mississippi State University, MAFES, and Cotton Incorporate.

Abstract

Data were taken on 12 to 15 farms in the Mississippi Delta from 1997 through 2000 to measure the entomological and economic impact of Bt cotton when compared with conventional cotton. Data from 1997 showed that insect control costs were slightly less for conventional cotton. In 1998, data showed that in the face of a heavier tobacco budworm problem, there was a significant reduction in insect control costs for Bt cotton. In 1999, all cotton insect problems were very low and the data indicated a smaller cost for insect control in conventional cotton. In spite of the extremely unfavorable weather conditions (drought and heat), yield and cost of insect control were not significantly different from other years in 2000 with no significant difference in either yield or cost between Bt and conventional cotton.

The profitability of Bt cotton is a function of the severity and duration of tobacco budworm infestations in any given year and to a lesser extent this is true for cotton boll worm. The problems associated with tobacco budworm infestations in 1995 are always a threat, and it appears that cotton growers should always plant some Bt cotton varieties. The amount they plant should probably be based on the history of tobacco budworm infestations associated with the producer's farm.

Introduction

The introduction of genetically modified cotton varieties with the *Bacillus thuringiensis* gene generated a great deal of controversy in its early years concerning their biological effectiveness and economic value. A study was initiated in 1997 to address some of these issues. The biological (entomological) data for this study were collected by an entomologist in the Southern Insect Management Research Unit, USDA, Jamie Whitten Laboratory, Stoneville, MS. The economic data were collected by agricultural economists located at Delta Research and Extension Center and at the Department of Agricultural Economics at Mississippi State University.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:175-177 (2001)
National Cotton Council, Memphis TN

Methodology

Data for this study were collected from commercial farms in the Mississippi Delta. Results are based on four years of data. This report presents the economic data for the study. It was important to ensure a geographical distribution of Delta farms so that differences in infestations could be detected. Farms100 miles north and 65 miles south of Stoneville were selected as well as farms located near the eastern and western edge of the Mississippi Delta. Fourteen producers participated in 1997, 15 in 1998, 13 in 1999, and 12 in 2000.

On each farm paired fields or split fields were selected to standardize soil and topographic variability. Treatment one of each farm was a Bt cotton variety and the second treatment was a conventional variety (grower choice of specific varieties). Insect counts were made on a weekly basis to obtain temporal data on levels of infestations on each farm. The data verified that private consultants hired by the producers did a good job (one exception-year 1) of maintaining pest populations below economic threshold levels. Infestation levels of budworms were lower in Bt than conventional cotton during all years.

Economic data were obtained bi-weekly on each trip-over-the-field; tractor and equipment size were identified, and the kind and rates of the various inputs such as fertilizer, seed and pesticide were obtained for 1997-1999. No input data were obtained in 2000 other than those directly associated with insect control. The very slight difference in total input costs and yields for all the years in the study was the reason all inputs and their costs were not obtained in the year 2000. The 2000 crop growing season in the Mississippi Delta was extremely unfavorable for cotton production. Very low rainfall during the winter of 1999-2000 resulted in a much lower than normal amount of subsoil moisture available to the cotton plant. This problem was confounded by extremely low rainfall during the 2000 growing season and unusually high temperatures, particularly in July and August. Yields varied greatly from farm to farm as a function of planting date, soil type, irrigation method or non-irrigated. However, data in Table 1 show that when all of the yields were averaged the difference between Bt and conventional cotton was negligible. If the reader has some interest in looking at the total input costs and returns per pound of lint, he can refer to a paper presented at the 2000 Beltwide Cotton Conference in San Antonio, TX (Cooke, et al., 2000). The tests were harvested using the farmer's cotton picker and three or four reps per treatment were harvested in each field (or split field) to obtain yield estimates. Seed cotton from each plot was weighed in a boll buggy equipped with electronic load scales. In addition, two 50-pound samples were obtained from each plot to be ginned at the microgin at the USDA Ginning Laboratory at Stoneville, MS to obtain data on turnout, grade and staple.

Total specified costs include all direct costs plus fixed costs for farm machinery for 1997, 1998, and 1999. No costs were included for ginning. Ginning charges are a function of yield and could lead to some erroneous conclusions when comparing costs among farms with considerably different yields. Land costs, general farm overhead and management are not included.

Cost per unit of production was calculated as yield divided by total specified costs. Total insect control costs per acre include application costs. In the Bt treatment, the technology fee is also included in the insect control costs.

Results

Table 1 presents annual average data of conventional and Bt treatments over the study period. Table 2 presents the average yield and insect control costs for the four years of the study. Tobacco budworm infestations were relatively light in 1997 and, thus, insect control costs for conventional cotton were slightly less expensive. Insect control costs in 1997 for the conventional treatments were $85.40 per acre compared to $91.34 for the Bt treatment, a difference of $5.93 per acre. For 1997, 1998, and 1999, yield and gross income were very similar for both treatments as were total expenses and total returns above specified expenses (Cooke, et al 2000). Production practices (other than insect control) on each farm were nearly identical for each treatment. Other than the technology fee for Bt, the only consistently higher cost associated with Bt cotton was a slight increased use of plant growth regulators (Cooke, et al., 2000).

The 1998 crop year was a period when tobacco budworm infestations were somewhat heavier than normal. For this reason, added insecticide applications for tobacco budworm on conventional cotton resulted in higher insect control costs for conventional cotton. Insect control cost was $29.14 higher per acre for the conventional treatment. The total cost of insect control for the Bt treatment was $97.85. It should be pointed out that in both 1997 and 1998, due to the fewer number of insect control applications, tarnished plant bug applications were slightly higher in Bt cotton than in conventional cotton. A relatively light insect infestation for all of the insect complexes associated with cotton occurred in 1999; therefore, insect control costs were down. As infestations of boll worm and budworm were very light, these results indicate no economic benefits to Bt cotton in 1999.

Averaging of results among all farms in each of the years is masking some of the important data that were obtained as to the relative impact of Bt cotton on insect control. Forty-two usable observations for the four years were divided into three groups (table 3). The first two columns of observations are individual farms where Bt cottons were clearly more profitable, i.e. reduced insect control costs when compared with conventional cotton. The last two columns are observations on individual farms over four years of the study where the cost of the technology fee resulted in Bt not being profitable to farmers. The middle two columns of observations show no meaningful economic difference between Bt and conventional cotton. This group includes farms where the difference in the per acre insect control costs were less than $18 per acre either in favor of Bt or conventional cotton. The $18 determination is the cost of one late season application for tobacco budworm which usually results in higher costs due to resistance associated with the tobacco budworm at this time. It should be pointed out that the usual insecticide application cost for tobacco budworm control earlier in the production season is approximately $12 per acre. If this group (**No Economic Difference**) is broken out on anything costing more than $12 per acre, an additional three farms would have been included with those that were considered very profitable using Bt cotton and four would have been moved into the area where Bt was not profitable. There were 16 observations in which Bt was defined as very profitable. The average benefits on these 16 farms over the four years was $51.09 per acre. Among the 16 observations on farms over the four years where Bt was not considered to be profitable, insect control costs were $38.28 per acre greater for Bt cotton when the technology fee was included. Twenty two farms fall in the category of **No Economic Difference** at the $18 difference level. No meaningful differences in lint turnout, grade or staple was observed on all farms over the four years.

Conclusions and Limitations

It can be concluded that the benefits of Bt are highly dependent on the levels of tobacco budworm infestations in a given year. It would be an oversimplification to say that there is no significant difference between conventional and Bt cotton. Such a conclusion would be a mistake. It is generally agreed there is no practical way to predict the level of tobacco budworm infestations in a given year. A producer's decision whether to plant Bt cotton varieties and at what percentage, will be affected by several factors. Historically, certain areas have a consistently greater problem with tobacco budworm than other areas. Producers in these areas should plant a larger proportion of their crop in Bt varieties. A second factor would be the concern with the problems associated with the severe outbreak of tobacco budworm that occurred in Alabama and Mississippi in 1995. The final factor is the cost of the technology fee. Bt cotton varieties would have appeared much more favorably in all four of the years had the technology fee been lower.

This paper has not addressed the insurance aspect of Bt cotton varieties. The insurance value of this new technology may be quite large for some producers. This issue will be addressed at a later date.

References

Cooke, Fred T., et al. 2000. The economics of Bt cotton in the Mississippi Delta–A progress report. Proceedings, 2000 Beltwide Cotton Conferences, San Antonio, TX.

Table 1. Difference in average economic data of conventional vs. Bt, 1997-2000.

Item	Yield lb/acre	Total specified insect cost ($/acre)[1]
1997		
Conventional	981	85.40
Bt	965	91.34
Difference	16	-5.93
1998		
Conventional	906	126.99
Bt	902	97.85
Difference	4	29.14
1999		
Conventional	802	70.09
Bt	799	79.14
Difference	3	-9.05
2000		
Conventional	829	80.45
Bt	820	83.97
Difference	9	-3.52

[1]Includes technology fee for Bt cotton.

Table 2. Conventional vs. Bt economic data, 4-year average.

Item	Yield lb/acre	Total specified insect cost ($/acre)[1]
	Conventional	
1997	981	85.40
1998	906	126.99
1999	802	70.09
2000	829	80.45
Average	879	90.73
	Bt	
1997	965	91.34
1998	902	97.85
1999	799	79.14
2000	820	83.97
Average	871	88.07
	Difference	
Conventional	879	90.73
Bt	871	88.07
Difference	8	2.66

[1]Includes technology fee for Bt cotton.

Table 3. Insect control costs and distribution of farm observations by profitability of Bt.

Bt Profitable		No Economic Difference		Bt Not Profitable	
Conv.	**Bt**	**Conv.**	**Bt**	**Conv.**	**Bt**
92.10	79.62	114.20	105.92	89.48	109.03
128.82	116.38	78.17	85.17	58.31	88.19
161.30	88.47	82.72	91.29	45.42	76.40
122.77	91.47	93.84	109.08	59.21	91.21
263.36	106.50	63.76	70.84	49.80	79.00
84.00	64.39	116.09	113.19	56.67	90.83
156.67	97.48	68.30	61.59	89.09	105.66
146.80	53.30	97.45	110.47	65.27	110.54
161.68	93.49	81.29	89.74	11.96	43.96
101.52	68.32	31.10	48.20	32.74	62.94
80.79	63.24	117.08	102.41	32.22	62.22
128.76	54.88	107.58	117.20	83.08	120.15
131.12	86.98	116.44	117.74	10.49	56.77
100.02	53.72	98.13	90.87	37.88	90.43
139.45	91.27	99.49	93.54	42.42	162.47
136.56	108.74	80.27	83.60	112.29	138.97
		82.67	73.38		
		81.94	65.64		
		96.07	108.74		
		82.44	73.00		
		134.23	121.07		
		41.68	43.27		
Average					
133.48	82.39	89.32	89.82	54.77	93.05