

**YIELD, INSECTICIDE USE, AND PROFIT
CHANGES FROM ADOPTION
OF Bt COTTON IN THE SOUTHEAST**
G.A. Carlson, Michele C. Marra
North Carolina State University
Raleigh, NC
Bryan J. Hubbell
University of Georgia
Griffin, GA

Abstract

Southeastern cotton growers were surveyed in the winter of 1996-97 to obtain information on the impacts of Bt cotton in the first year. Adopters of Bt cotton in 1996 experienced a 11.4% yield improvement on their Bt acres compared to their conventional cotton acres. Insecticide applications per season were 72% lower on their Bt cotton relative to their conventional cotton acres. There was also a significant reduction in total insecticides applied, with a more than proportional reduction in synthetic pyrethroids on their Bt acres. Additional profit from Bt cotton adoption averaged \$142 per hectare (\$51 per acre), or a 155% return on the seed investment.

Introduction

Transgenic crop technology promises to revolutionize crop production. Cotton with the Bt (*Bacillus thuringiensis*) gene expressed in it was marketed commercially for the first time in 1996 (Carlson et al., 1997). A random sample of southeastern cotton growers in Alabama, Georgia, South Carolina and North Carolina were surveyed during the winter months following the 1996 growing season. About 300 farmers completed the survey forms for a response rate of 30%. For the entire sample of respondents about 22% of the cotton acres were planted to Bt cotton in 1996, but 36% of all growers planted some Bt cotton. Reported acreage adoption was much higher in the Lower South (25% in GA and 66% in AL) than in the Upper South (3% in NC and 14% in SC). The percentage adoption results from the survey match fairly well with reported state level acreage adoption percentages from other sources. For example, Demaske (1997) reported 26% acreage adoption in GA, 77% in AL, 3% in NC and 18% in SC in 1996.

Discussion

Yield Changes

The average yield increase on Bt cotton acres compared to adopters' conventional cotton acres was not statistically significant in the Upper South, but adopters in the Lower South experienced a 13% average yield increase on their Bt cotton acres. In both regions growers who did not adopt Bt

cotton in 1996 had significantly lower yields than the conventional cotton yields of those who did adopt Bt cotton on some of their acreage. Most of this difference occurred in Georgia. This result is somewhat puzzling and is being explored further.

Insecticide Use Changes

Adopters in both regions showed a significantly lower number of insecticide applications on their Bt acres compared to their conventional acres. On average, insecticide applications dropped from 2-3 applications per season to 1 or less. Forty-five percent of the adopters did not spray at all. The average percent decrease in insecticide applications was 72%. Total insecticide active ingredients applied decreased, as well, in both regions. Growers used proportionately less synthetic pyrethroids on their Bt cotton acres and slightly more organophosphates. This decrease in pyrethroid use may help to slow resistance build-up to this class of insecticides in cotton.

Profit Changes

Combining the increased yield effects with the lower insecticide use resulted in additional net benefits to adopters over and above the additional seed cost and technology fee. Average additional profit was \$82/ha. in the Upper South (assuming the yield increase occurred) and twice as much in the Lower South (\$160/ha). This represents a 121% rate of return on the extra investment (the higher seed price of \$4.11/ha. plus the \$92/ha. technology fee) in the Upper South and a 174% rate of return in the Lower South.

Summary

During the first year Bt cotton was available commercially, growers in the Southeast who adopted it experienced significant net benefits on their Bt cotton compared to their conventional cotton. Both yield increases and lower pesticide costs contributed to the relative profitability of Bt cotton. Reported insecticide use was lower on Bt cotton, and growers reported a significant shift from synthetic pyrethroids to other types of insecticides on their Bt cotton. Lower insecticide use can result in less off-site movement of toxins. Shifts in types of insecticides used can result in slowing of resistance build-up to currently-used conventional insecticides. Based on the survey results, Bt cotton adoption should proceed fairly rapidly in the southeastern states, especially in the Lower South.

References

- Carlson, G.A., Michele C. Marra, and Bryan J. Hubbell. 1997. Transgenic technology for crop protection: The new "super seeds". *Choices* (3rd quarter): 31-36.
- Demaske, C. 1997. Notes from a Bt seminar: What have we learned? *Cotton Grower*, 33(7): 32-33.

Table 1. Survey results: 1996 Bt cotton adoption in the Southeast.

	% of Farmers Planting Bt	% of Cotton Area Planted in Bt
North Carolina	18.60	3.29
South Carolina	37.50	14.00
Georgia	40.16	24.97
Alabama	67.86	65.69
Total Sample	35.74	21.91

Table 2. Survey results: Bt adopters' cotton yield. Bt and non-Bt areas, and non-adopters' yield in 1996.

	Bt Adopters				Non-Adopters	
	Bt Cotton ----kilos/ha----	Non Bt Cotton	Percent Change	t Statistic		All Cotton kilos/ha
Upper South	931.4	859.4	+8%	1.12	845.3	
Lower South	995.3	874.3	+13%	2.57*	748.3	
Total Sample	968.6	870.0	+11.4%	2.76*	797.6	

*=Statistically significant at at least the 95% level of confidence.

Table 3. Survey results: Changes in Bt adopters' 1996 insecticide applications.

	Bt Adopters				Non-Adapters	
	Bt Areas Applications/yr.	Non Bt Areas	Percent Change	t Statistic		All Areas App/yr.
Upper South	0.86	3.29	-74%	-6.17	2.88	
Lower South	0.74	2.58	-71%	-6.25	1.76	
Total Sample	0.78	2.81	-72%	-8.41	2.38	

Table 4. Survey results: Change in adopter profit with Bt cotton in 1996.

	Increase in Total Revenue	Pesticide Application Savings	Pesticide Material Savings	Pesticide Added Seed Cost	Pesticide Added Profit	Rate of Return
	----per hectare----					
Upper South	\$131.42	\$29.95	\$31.73	\$91.79	\$111.30	121%
Lower South	\$201.36	\$30.25	\$20.06	\$91.79	\$59.88	174%
Total Sample	\$176.46	\$33.37	\$23.62	\$91.79	\$142.21	155%

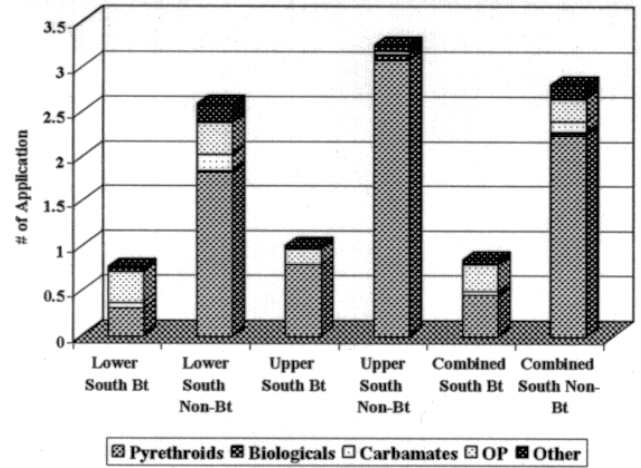


Figure 1. Survey results: Adopters' insecticide amounts and types on their Bt cotton and conventional (non-Bt) cotton.