ECONOMICS OF TRANSGENIC COTTON: SOME INDICATIONS BASED ON GEORGIA PRODUCERS

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Abstract

The producer choice between Bt and non-Bt cotton varieties should be based on the expected economic returns generated when using a variety rather than agronomic results alone. Producer concerns about the economic costs and returns associated with Bt cotton varieties led to a state-wide project in Georgia. The objective was to obtain independent, field-level research results from producer fields of Bt and non-Bt cotton varieties grown in close proximity and under similar production systems. Bt cotton varieties were found to produce an average yield of 104 pounds lint per acre more than the same producer's non-Bt variety grown in a similar production system. The number of spray applications for insect and plant growth control were reduced an average of 2.5 applications per acre on the Bt variety versus the non-Bt. For a cotton market price of $0.70 per pound of lint, the yield advantage would mean $72.80 of added gross returns per acre. Cost savings from the 2.5 fewer insect control applications would total $27.50 per acre, assuming an $11 cost per acre for materials and spraying. Average gross economic advantage in favor of Bt cotton would thus total about $100 per acre. Subtracting the $32 technical charge, Bt cotton varieties were still found, on average, to have a sizeable economic advantage over the non-Bt varieties selected.

Introduction

The success of the Boll Weevil Eradication Program in Georgia has drastically reduced the spray application frequency and product strength required to maintain economically effective insect control in cotton. Further advances toward more environmentally and economically sound cotton production may be possible by incorporating biotechnology advances. An example of such advances is Bt cotton that was released in 1996. Bt cotton is the common term being applied to all seed carrying a transferred gene with the insecticidal protein from *Bacillus thuringiensis*, a familiar insecticide product. Small plot entomology research had shown Bt cotton to have consistent, excellent control of tobacco budworms, the most damaging cotton pest since eradication of the boll weevil and development of biological controls for beet armyworms. Most Bt cotton variety research had compared yields of the transgenic cotton to its parent variety and had been conducted by companies that sought to market the seed. Imposition of a technology fee and a seed premium on Bt varieties raised producer concerns about the economic profitability of Bt versus non-Bt cotton varieties. Limited field-scale research results from independent sources prompted further economic questions.

Objective

The Georgia Cotton Commission responded to producer concerns by funding a statewide project to sample economic net return levels that were being achieved for Bt and non-Bt cotton varieties. Yield, returns, and costs data were to be collected in selected production regions of Georgia to provide initial indications of any economic advantages that might be possible.

Literature Review

Delta and Pine Land Company (DPL) joined forces with Monsanto to market the NuCOTN 33^{B} and NuCOTN 35^{B} varieties in 1996. Both varieties carried the Bollgard™ gene developed by Monsanto. Bollgard contains the insecticidal protein from *Bacillus thuringiensis* (Bt). Promotional material distributed by the companies stated that the Bt varieties presented opportunities for increased profitability, especially where the boll weevil had been eradicated (Kerby).

Research and extension entomologists from land grant universities have provided guarded endorsements of the technology with clear recognition of the economic costs. In a January 1996 extension release to Georgia producers, Dr. Bill Lambert stated "transgenic cottons will improve yields, cut costs and make growing cotton easier for some producers. However, the technology has limitations and the license to use it is expensive" (Lambert). The Bt cotton workshop at the 1996 Beltwide Conferences provided added support for reduced insecticide applications (Layton) and grower claims of equal to better yields than other varieties plus $60-90 insect control savings in Mississippi (Mitchener). Observations on the 1996 cotton crop in Mississippi have shown a $60 savings on strictly insect control costs (Cooke). It has also been noted that cotton producers in boll weevil treatment areas should have greater awareness for adjustments in weevil control that may be required for Bt varieties (Layton).

More recent results from a limited study in Arkansas, where boll weevil eradication has not been attained, indicate that Bt cotton varieties can still offer increases in yield, but insecticide savings tend to fall in the $18-27 per acre range (Bryant). An economic comparison of eradicated areas like Georgia to boll weevil infested Arkansas fields should provide further insights on the value of Bt cotton varieties under different growing conditions.

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Project Design and Procedures

Eight cotton production locations representing most of the cotton-producing counties in the state of Georgia were selected for this project based in part on recommendations of the Extension Cotton Team and the Georgia Cotton Commission. The locations were chosen to permit generalization of the results to most Georgia cotton producers. Special consideration was given to include both the Piedmont (a region above the fall line characterized by clay soils) and the Coastal Plain (a region with sandy soils and greater emphasis on irrigation systems). Twenty-six producers agreed to participate with the facilitation of 10 County Extension Agents/Area Directors in the University of Georgia system.

An early decision on design of this project was to allow producers to select their individual production system and the varieties of Bt and non-Bt cotton that best suited their farm operation. All of the producers would grow both Bt and non-Bt varieties with production systems as similar as possible for each variety.

Data used in this project were all obtained from field-scale cotton production within the state of Georgia. Two reports were sought from each producer. A Post-Planting Report containing all input quantities employed through planting, a general description of the basic production system, and specification of the cotton varieties being used in the research project was collected in June. Post-Harvest Reports were requested after the producers and extension personnel took yield samples during harvest.

The project director was responsible for compiling the data and generating reports at the state, location and farm levels. Detail of the reports could vary from yield and partial budget analysis to full enterprise budget analysis, depending upon the breadth of data provided by the producer. A final report encompassing all levels would eventually be submitted to the cotton commission.

Results to Date

Cotton yields and spray application data has been collected from seven locations with fourteen cooperating producers filing reports. When this report was being compiled, a total of 30 harvest reports had been received. Both NuCOTN 33^{B} and NuCOTN 35 ^{B} varieties were included in the results. Six non-Bt varieties were used as listed in Table 1. Cotton harvest extended well into December for some portions of Georgia and harvesting of other field crops had also delayed producer reports.

Yield Results

Twenty-eight yield reports were obtained from fourteen producers. A summary of the yields is presented in Table 2. Bt cotton fields averaged 1,027 pounds of lint per acre based on measured field samples obtained at harvest. Bt yields ranged from a low of 746 pounds to a high of 1,378. The results include both dryland and irrigated cotton, but non-Bt yields from the same producer were also grown under irrigated or non-irrigated systems.

Non-Bt yields averaged 923 pounds of lint per acre, or 104 pounds less than the corresponding Bt average. Variability was similar to the Bt distribution with a high of 1,239 pounds and a low of 706. Approximately 70% of the producers reported a yield advantage for the Bt variety over the non-Bt.

Spray Results

A marked difference was found in the number of insecticide and other spray applications (Table 3). Bt fields of cotton required an average of only 1.1 spray applications during the growing season while non-Bt fields received an average of 3.6 applications per acre. Of the eleven spray reports received to date, seven Bt fields received no insecticide spray applications during the growing season. All non-Bt cotton required at least one application with the average being 2.5 applications higher than the Bt fields.

Economic Significance of the Results

Market price booking opportunities for cotton in the Southeast have frequently exceeded $0.70 per pound of lint during the 1996 calendar year (Farm Bureau). Assuming this price, the 104 pound yield advantage for Bt varieties would represent a Gross Returns Difference of $72.80 over the non-Bt varieties (Table 4). The difference is termed "Gross Returns" in recognition that added harvesting, ginning and general marketing charges have not been added to the per acre production cost totals. Including these additional expenses would reduce the advantage for Bt, but not totally offset it.

Economic significance of the spray application advantage can similarly be estimated by assuming an average cost per spray application. Georgia Extension Service budget estimates for cotton production set average spray charges at $11.00 per application (The University of Georgia Cooperative Extension Service). This figure is based on a $3 per acre application charge and $8 for materials, including carrier. Using this rate, the 2.5 fewer spray applications for Bt varieties of cotton would have a dollar value of $27.50 per acre advantage over non-Bt (Table 4).

Summing these added returns and reduced costs for an acre of cotton, we find that Total Gross Economic Advantage for the Bt varieties is approximately $100 per acre (Table 4). This advantage is only partially offset by the $32 per acre industry charge on Bt to cover a seed assessment and technology fee.

Conclusions

Analysis of production data for cooperating cotton producers in Georgia provides four production conclusions, three economic conclusions, and three general conclusions on Bt versus non-Bt cotton varieties. With regard to production, Bt varieties possessed a yield advantage in 70% of the producer comparisons. Statewide, a yield advantage of 104 pounds of lint per acre was calculated in favor of Bt. Bt cotton varieties also possessed an advantage in all comparisons with regard to spray applications of insecticide and materials, requiring an average of 2.5 applications less than non-Bt varieties grown under similar production systems and conditions.

Economically, the Bt yield advantage represents additional gross returns of $73 per acre. The Bt spray application advantage translates into reduced variable costs of $27 per acre. Total economic advantage to offset the $32 per acre assessment and technology fee associated with the Bt varieties is thus approximately $100 per acre.

General conclusions drawn from these research results are that considerable differences exist with regard to the yield advantage of Bt cotton over non-Bt varieties. A more consistent advantage was found for Bt regarding the number of spray applications per acre. Thus, we conclude that Bt cotton shows economic promise and deserves further field-scale study.

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Table 1. Cotton Varieties Used By Cooperating Producers

VARIETY TYPE	Bt COTTON	NON-Bt COTTON
VARIETY	NuCOTN 33 [B]	DPL 51
NAMES	NuCOTN 35 [B]	DPL 90
		DPL 5415
		Suregrow 501
		Stoneville 474
		Stoneville 132

Table 2. Bt and Non-Bt Yield Results *

	Bt FIELDS	NON-Bt FIELDS
Average Yield	1,027	923
High	1,378	1,239
Low	746	706

* Pounds of Lint Per Acre

Table 3. Bt and Non-Bt Spray Application Results *

	Bt FIELDS	NON-Bt FIELDS
Average Number of Applications	1.1	3.6
High	5	10
Low	0	1

* Number of Applications Per Acre

Table 4. Economic Significance of Agronomic Results

Sources of Economic Advantage	Bt Varieties
Yield Advantage	$72.80
Spray Application Advantage	$27.50
Total Economic Advantage	$100.30