ECONOMIC ADVANTAGE OF TRANSGENIC COTTON IN ARGENTINA

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Abstract

Transgenic varieties (Bt) are becoming more widespread in cotton plantations in Argentina, reaching about 10,000 hectares in the 1999/2000 campaign. In this paper, we carried out an economic analysis to find out differences between transgenic (Bt) and conventional varieties in terms of costs and income. We analyzed the information provided by 32 growers who are using this technology. To calculate Bt additional benefit per hectare, we used the partial budget method. Overall results show that Bt income surpassed $159.02 /ha and the additional benefit of using it was $65.05 /ha. Bt total direct costs, yield, and fiber quality were better. When using the Bt variety, the number of insecticide applications decreased 2.41 times (63.74 %) and costs by $27.55 /ha.

Introduction

With new transgenic cotton varieties, genetic engineering has changed the production system. Land sown with transgenic varieties is growing in Argentina. This new technology will allow applying alternative methods of handling crops −mainly for insecticides. An economic analysis must be conducted in different ecologic areas to compare their results against conventional varieties. This study focused on analyzing costs and income differences between transgenic and conventional varieties. Additional benefits were determined through the analysis of all direct costs of the crop cycle and not just the costs of insecticide application. Widespread use of this technology seems to be rooted in its potential to provide better total economic results associated with better yields and lower costs.

Data Sources and Methods

The work was conducted in 64 lots in growers fields (32 sites of transgenic varieties and their corresponding shelters), scattered in the Provinces of Chaco and Santiago del Estero, which are leading cotton growing areas in the country. The survey covered different agro-ecological areas, such as: a) Central North and South *Domo* (areas 4 and 1) are defined by the Thornthwaite Index (TI) as "sub-humid;" b) Sub-humid dry *Chaco and Santiago,* TI's "sub-humid dry" (areas 2 and 5) and c) *Semiarid Chaco* (area 3), TI's "semiarid" (INTA, 1990). The soil from areas 1 and 4 are made of original loess material, while the remaining ones are alluvial (Ledesma, 1977). The geographical location of the areas described is shown in Figure 1.

The transgenic variety used was NC 33 B (Bt), and shelter varieties (S) were conventional varieties generally used in the area, mainly Guazuncho 2 INTA, Chaco 520 INTA, Gringo INTA, Porá INTA and DP 5690. Data gathering for costs covered from the beginning of land preparation to the end of harvesting. Labor costs are for a 100 HP tractor. Input prices were averages for the area of Sáenz Peña, as of June 2000, excluding VAT. Yields per raw cotton ha, ginning yield and commercial quality of cotton produced were borne in mind to determine income, the latter two as determining price factors. The price of cotton was the current market price passed by the Argentine Cotton Chamber for the same date, without premium or discounts. The current exchange rate in Argentina is 1 $ = 1 dollar.

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The methodology used was partial budget (Bryan et al. 1997). Direct costs was disaggregated in components: land preparation labor and crop handling, insecticide application, seed (Gibson et al., 1997), other inputs and harvesting and marketing. The incremental benefit, such as income differences and additional costs, were calculated (ReJesus et al., 1997). The analysis of sites as a whole was carried out, and they were classified by area. Average values and variability of economic results of both alternatives were ascertained.

Results and Discussion

Results obtained were disaggregated by components, for Costs as well as for Income, and they were expressed in $/ha. Labor costs necessary for crop handling were determined, except insecticide application. In the global average, there were practically no differences in labor costs between both alternatives. Minimum and maximum values were 14.30 and 76.92 $/ha, respectively, the minimum corresponding to a no-till planting system, and the maximum to a conventional tillage system. In each site, the planting system was the same for both alternatives. No differences in labor costs were spotted within the areas, except in area 5. There were differences among different areas, area 4 being the one with highest labor costs at 61.98 $/ha, and area 5 with the lowest labor costs, with Bt 42.81 $/ha and S 38.61 $/ha.

Regarding the number of insecticide applications, Bt accounted for an average reduction of 2.41 insecticide applications, which represents 63.74% less applications than shelter. Maximum and minimum values ranged from 3 to 0 for Bt, and from 8 to 1 for shelter. Reduction of insecticide applications between Bt and S (shelter) ranged, depending on the area, between 1.20 and 4.38 (33.3% to 85.4% less applications) in areas 3 and 5. The average of the 32 sites analyzed showed a difference in costs of −27.55 $/ha in insecticide applications, favoring Bt use. In all areas this cost was lower for Bt, and savings ranged from 15.38 to 46.36 $/ha.

Transgenic seeds costs include the charge for technology and the costs of conventional seeds only the seed. By area, Bt varieties costs exceeded the cost of conventional seeds in values that ranged from 68.50 to 79.32 $/ha. Average Bt seed costs were 73.89 $/ha higher than for conventional seeds. The greatest difference between Bt and S was observed in seed cost components. According to this data, a 460 kg/ha difference in average additional yield of raw cotton from bio-cotton would be required to offset the difference in seed costs. As regards areas, additional yields ranged from 345 to 518 kg/ha.

Herbicides, growth regulators, fertilizers, defoliators, etc., were included in other inputs. No major differences were spotted between average costs, being higher for Bt by 1.65 $/ha. Cost differences by area were −3.94 $/ha in area 1 and −0.74 $/ha in area 5. In areas 2, 3 and 4 costs were higher for bio-cotton by 6.17; 1.06; and 2.30 $/ha, respectively.

Harvesting costs were calculated by type of harvesting used by the producer: mechanical or manual (manually, only 1 producer for 50% of the surface). Marketing costs included taxes and contributions based on current legislation. Average harvesting and marketing cost differences for the 32 sites, showed that bio-cotton presented higher values by 45.11 $/ha. Maximum costs ranged between 241.47 $/ha and 181.10 $/ha, and minimum costs from 67.91 to 52.82 $/ha for bio-cotton and shelter respectively. As regards area, costs were also higher for bio-cotton. Differences ranged from 13.43 $/ha in area 3, to 89.73 $/ha in area 5. This is another strongly influential component.

Total direct average costs for bio-cotton were 93.97 $/ha higher. It can be explained by increase in seed costs, crop and marketing, which exceeded savings obtained by reduced used of insecticides and other components. Differences per area ranged from 68.27 $/ha to 115.31 $/ha. The direct total cost per ton (t) of Bt raw cotton was found to be 56 $/t lower than S. In areas 4 and 5, Bt the cost per ton was 31 $/t and 91 $/ lower than S, respectively. In areas 1 and 3, it was 23 $/t and 14 $/t higher than S, and in area 2 there were no cost differences between the alternatives.

To determine income, yield, commercial quality and ginning yields were analyzed, the latter two determining the price obtained for the product. Average raw cotton yields were taken and weighted by total surface sown, for Bt and S. Bt raw cotton yields were 907/ha higher, in the global average, varying by area from 216 to 1,252 kg/ha.

Most frequent values for quality were taken, without observable differences between Bt and S. Among maximum values, Bt had a superior quality with a 1.25 quality difference and 0.75 at minimum values.

Ginning yield is another variable that determines price. S's average value exceeded Bt by 0.54 %, and the variability obtained among data was low (4 to 6%). In the analysis by area, just the opposite took place in area 3, i.e., Bt exceeded S by 0.64%.

Average raw cotton price in the 32 sites was 0.009 $/kg higher for bio-cotton (0.236 for bio-cotton $/kg and 0.227 for shelter), i.e., not a very important difference.

Average income for the 32 Bt sites were 159.02 $/ha higher than for S. In the analysis by area, average incomes were also higher for Bt. Differences among areas, from area 1 to 5 were 62.29 $/ha, 183.71 $/ha, 58.73 $/ha, 95.68 $/ha and 289.80 $/ha. The smaller difference was found in area 3, and the highest difference in area 5. This was so because of the difference of yields spotted between Bt and S in both areas: 1,252 kg/ha in area 5 and 227 kg/ha in area 3.

The average Incremental Benefit generated by the use of Bt variety was 65.05 $/ha. The degree of variation between maximum and minimum values ranged from −214.39 to 326.48 $/ha. The coefficient of variation was high. For the 32 data analyzed, 11 (34%) exhibited negative results, 9 (28%) positive results up to 100 $/ha, 7 (22%) with values ranging from 101 to 200 $/ha, and 5 (16%) with more than 200 $/ha. The average incremental benefit in areas 1 and 3 was −12.43 and −9.54 $/ha. Positive but different values were obtained in areas 2, 4 and 5. Bearing in mind that this data corresponds to only 1 year, the analysis per area would indicate that, under conditions of the 1999/2000 campaign, the more appropriate areas for bio-cotton, as measured by Incremental Benefit, were 2 and 5.

Tables 1 and 2 summarize Costs, Income and Incremental Benefits obtained through the use of Bt variety. They are grouped by analyzed components for all the (general) sites and areas.

Conclusions

Bt use reduced insecticide applications by 2.41 (63.74 %), considering the average of the 32 sites. In the analysis by area, there is a decrease that ranged from 1.2 (33.3 %) in area 3 to 4.38 (87. 3%) in area 5.

The reduction of insecticide applications due to bio-cotton use was 27.55 $/ha for the global average. All areas together saved from 15.38 to 46.36 $/ha.

An amount of 345 and 518 kg of raw cotton/ha of Bt additional yielding would be needed to offset the difference of seed costs that existed between Bt and S.

Seed costs, as well as harvesting and marketing costs, had the strongest impact on direct total costs.

The reduction of insecticide application costs couldn't offset cost increases generated by Bt use.

For Bt, direct total costs per unit of surface, average for the 32 sites, were 93.97 $/ha higher than those obtained with conventional varieties.

Bt direct total cost per unit of product, average of the 32 sites, is 56 $/ton lower than shelter. When the analysis is carried out by area, values were higher, equal or lower.

Bt yield was 907 kg/ha higher than S in the global average, the difference varying by area from 216 kg/ha to 1,252 kg/ha.

Bt income was 159.02 $/ha higher in the global average, varying by area from 58.73 $/ha to 289.80 $/ha.

The average incremental benefit ascribed to Bt was 65.05 $/ha. In the analysis by area, Bt's incremental benefit for areas 2, 4 and 5 was higher, ranging from 10.97 to 174.50 $/ha. Incremental benefits for areas 1 and 3 were negative and with values −12.43 $/ha and −9.54 $/ha, raising the production risk in those areas, in the present campaign.

Bearing in mind that this data corresponds to only 1 year, under the conditions of the 1999/2000 campaign, 2 and 5 were the more appropriate areas for Bt. Coefficients of variation for many analyzed results were high. Results should be corroborated in future campaigns.

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Table 1. Costs, Income and Incremental Benefits per ha, overall and by area. (Bio-cotton– Shelter)

DESCRIPTION	OVERALL	AREA 1	AREA 2
Income	159.02	62.29	183.71
Labor costs	0.87	0	- 0.63
Insecticide application costs	-27.55	-18.70	- 24.01
Seed costs	73.88	71.75	79.32
Other Input	1.65	- 3.94	6.17
Harvesting and Marketing Costs.	45.11	25.61	43.15
Direct Total Costs	93.97	74.72	104.02
Bt Incremental Benefit	65.05	-12.43	79.70

Benefit attributed to Bt was calculated as the difference between income and additional costs.

Table 2. Income, Costs and Incremental Benefits per ha, overall and by area. (Bio-cotton– Shelter)

DESCRIPTION	AREA 3	AREA 4	AREA 5
Income	58,73	95,68	289,80
Labor Costs	0	0	4,19
Insecticide Application Costs	-15,38	- 23,84	-46,36
Seed Costs	69,16	78,27	68,50
Other Input Costs	1,06	2,3	- 0,75
Harvesting and Marketing Costs	13,43	27,97	89,73
Direct Total Costs	68,27	84,70	115,31
Bt Incremental Benefit	- 9,54	10,97	174,50

Benefit attributed to Bt was calculated as the difference between income and direct, total and additional costs.

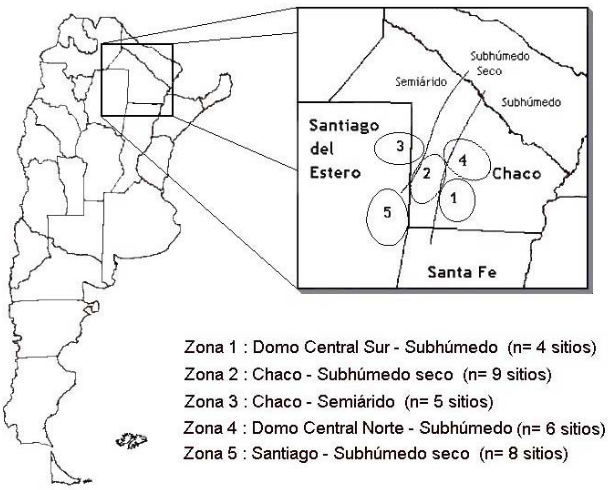

Figure1. Geographical location of agro-ecological areas.