ECONOMIC EVALUATION OF TRANSGENIC COTTON SYSTEMS IN ARKANSAS

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RESEARCH PROBLEM

The number of transgenic cotton varieties available for commercial production has increased greatly in recent years. Cotton producers now have multiple choices when choosing transgenic cotton varieties. The choice of variety now dictates the insect and weed control programs that will or can be used. Cotton varieties containing the Bollgard gene, the Roundup Ready gene, and the Buctril-resistant gene have been planted on a significant number of Arkansas' cotton acres since 1996. The success of these varieties has been mixed. The University of Arkansas has conducted tests comparing transgenic varieties to conventional varieties each year beginning in 1996. This manuscript presents the economic results of these comparisons.

STUDIES REVIEWED

Bryant, Robertson, and Lorenz (1999b) compared the cost and returns of Bollgard cotton to that of non-Bt cotton every year since 1996. Very comparable fields on the same farm were used to make comparisons. One field in each comparison was planted in Bollgard cotton, while the other was planted in a non-Bt variety. Each field was managed with the goal of maximizing profits. Partial budgeting was used to calculate the net change in profit associated with growing a Bollgard variety instead of a non-Bt variety (Bryant *et al.*, 1999b).

Bryant, Allen, Bourland, and Earnest (1999a) compared the costs and returns of certain transgenic varieties to certain non-transgenic varieties in 1998 and 1999. This study was composed of 10 treatments, each replicated four times. The treatments were conventional and transgenic cotton varieties with their respective insect and weed control programs. Each treatment was managed with the goal of maximizing profits. This arrangement was planted at Rohwer in Southeast Arkansas and at Keiser in Northeast Arkansas in plots 40 feet long by 4 rows wide arranged in a randomized complete-block design. Best management practices were used for each individual treatment. Rec-

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ommended fertilization and irrigation programs were used on all plots at both locations (Bryant *et al.*, 1999a).

In 1999, Bill Robertson established replicated experiments at five locations comparing stacked gene varieties to conventional varieties. Three stacked gene varieties and three conventional varieties were grown in replicated plots at each location. These six varieties included DP 451 B/RR, SG 125B/R, PM 1220BG/RR, DP 5111, SG 747, and ST 474. Each treatment was managed with the goal of maximizing profits using Best Management Practices. One observation of lint quality was taken from each variety at each location in an effort to address differences among varieties and technology. The quality traits for each variety averaged across the five locations were used to assign premiums and discounts to the base price based on the 1999 CCC loan tables.

RESULTS

The economic comparisons of Bollgard cotton to non-Bt varieties as observed by Bryant, Robertson, and Lorenz are displayed in Table 1. Positive numbers indicate an increase for the variable in question when Bollgard cotton was grown instead of the conventional variety. The results are mixed depending on location, year, and varieties involved. NuCOTN 33B has resulted in a positive change in profit every year at the Southwest Arkansas location, and in all but one observation at the Southeast Arkansas location. At the South Central and Central Arkansas locations, however, the Bollgard varieties have resulted in negative changes in profits most of the time, especially in recent years. It is worthwhile to note that a positive change in gross returns (which is the result of a higher yield on the Bollgard variety) almost always results in a positive change in profit, and visa versa. Thus, the variety that can produce the higher yield usually has the highest profit.

The economic comparisons of transgenic and non-transgenic cotton varieties as calculated by Bryant *et al.* are displayed in Table 2. At the Northeast Arkansas location, all six varieties resulted in yields that were not statistically different. In this case the variety that can be produced at the least cost should be selected to maximize profits. The conventional varieties had the lowest costs, followed by the Roundup Ready varieties, the Bollgard variety and the stacked gene variety. At the Southeast Arkansas location, a conventional variety resulted in yields and returns that were statistically greater than the remaining varieties. A stacked-gene variety resulted in yields and returns that were statistically less than the other five varieties. The remaining four varieties were not statistically different in yield and had very similar costs.

The economic comparisons of stacked gene cotton varieties to conventional varieties for 1999 as measured by Robertson are displayed in Table 3. These change in income figures take into account not only the yield differences between the stacked and conventional varieties, but also the premiums and discounts that farmers might encounter due to cotton lint quality differences in the varieties. The results were mixed. The stacked gene varieties resulted in a very large positive change in profit at the Desha county location, and very large negative changes in profit at the Craighead and Lonoke county locations. The other two locations had slight to moderate positive changes in profits.

CONCLUSIONS

The University of Arkansas has conducted economic evaluations of transgenic cotton systems since 1996. The results have been mixed depending on the year of comparison, varieties involved, location, and the management practices utilized. In only one study was an attempt made to include cotton lint quality as a factor in gross returns (Robertson, unpublished data). In a large majority of the cases, however, the variety that resulted in the greatest yield (as reflected in the change in gross returns) also had the greatest profit. Thus we can conclude that yields are still the driving force in selecting the most economical cotton variety and/or technology.

REFERENCES

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Table 1. Field observations on returns, costs, and profits comparing Bollgard cotton to conventional varieties, Arkansas, 1996-1999.

Year	BG Variety	Conventional Variety	Change in Gross Returns	Change in Variable Cost	Change in Profit
		Southwest Arkansas (Lafayette Co.)			
1996	DP NuCOTN 33B	DP 5415	$58.22[z]	$10.16	$68.38
1997	DP NuCOTN 33B	SG 125	$68.64	$13.63	$55.01
1998	DP NuCOTN 33B	DP 20	$91.80	$24.97	$66.83
1999	DP NuCOTN 33B	DP 51	$31.20	$14.94	$16.26
		Southeast Arkansas (Desha Co.)			
1997	DP NuCOTN 33B	DP 5409	$116.16	($18.21)[y]	$134.37
	DP NuCOTN 33B	SG 501	$18.48	($17.31)	$35.79
	DP NuCOTN 33B	DP 5415	($58.08)	($8.04)	($50.04)
1998	DP NuCOTN 33B	DP 5415	$189.72	($61.24)	$250.96
	STV 4740BG	STV 373	$118.32	($2.99)	$121.31
	STV 4740BG	STV 373	$79.56	($2.99)	$82.55
		South Central Arkansas (Jefferson Co.)			
1996	DP NuCOTN 33B	DP 20	$207.32	$3.03	$204.29
	DP NuCOTN 33B	DP 5409	$189.57	$10.33	$179.24
	DP NuCOTN 33B	SG 125	$76.86	$5.71	$70.97
	DP NuCOTN 33B	SG 125	($9.23)	$2.73	($11.96)
1997	DP NuCOTN 33B	SG 125	$10.56	$32.76	($22.20)
	DP NuCOTN 33B	STV 474	($153.78)	$12.87	($166.65)
	DP NuCOTN 33B	SG 125	($110.88)	$64.02	($174.90)
1998	DP 50BG	STV BXN47	($4.76)	$0.34	($5.10)
1999	DP 20B	STV BXN47	($206.40)	($8.90)	($197.49)
		Central Arkansas (Crittenden Co. 1996, 1998; St Francis Co. 1999)			
1996	DP NuCOTN 33B	DPL 5415	$24.14	$14.62	$9.52
1998	Variety Demo	STV 373	($129.20)	($22.75)	($106.45)
1999	PM 1560 BG	ST BXN 47	($59.89)	$58.82	($118.71)

[z] Positive numbers indicate an increase for Bollgard compared to the conventional variety.

[y] Parentheses indicate a negative value.

Table 2. Replicated comparisons of transgenic and non-transgenic cotton varieties, Arkansas, two year average of 1998 and 1999.

Variety	Yield	Weed Control Cost	Insect Control Cost	Seed and Tech. Cost	Returns
		Northeast Arkansas (Keiser)			
DP 5415RR	1202 a[z]	$44.50	$44.50	$26.00	$708.28
DP 5415	1135 a	$41.50	$44.50	$16.00	$675.56
NuCOTN 33B	1114 a	$41.50	$38.50	$46.00	$637.09
DP 458B/RR	1111 a	$44.50	$38.50	$55.00	$623.04
ST 474	1042 a	$41.50	$44.50	$18.00	$609.77
PM 1220RR	1009 a	$44.50	$44.50	$29.00	$573.25
		Southeast Arkansas (Rohwer)			
ST 474	1032 a	$49.00	$70.50	$16.00	$571.00
DP 5415RR	922 b	$53.50	$70.50	$23.00	$496.00
NuCOTN 33b	895 b	$49.00	$53.50	$43.00	$467.00
DP 5415	888 b	$49.00	$70.50	$15.00	$474.00
PM 1220RR	855 b	$42.00	$70.50	$26.00	$447.00
DP 458B/RR	732 c	$42.00	$53.50	$50.00	$356.00

[z] Means followed by the same letter are not significantly different (P = 0.05).

Table 3. Replicated comparisons of stacked gene cotton varieties to conventional varieties, Arkansas, 1999.

County	Change in Gross Returns	Change in Variable Cost	Change in Profits
Desha	$329.40[z]	($8.40)	$337.80
St. Francis	$59.76	$29.51	$30.25
Crittenden	$8.06	$0.97	$7.09
Craighead	($82.75)	$39.71	($122.46)
Lonoke	($280.23)	($34.65)	($244.98)

[z] Comparison of stacked gene to conventional variety.