

YIELD, COST, AND NET RETURN OF SEED TECHNOLOGIES AND PRODUCTION SYSTEMS: A FOUR-YEAR SUMMARY

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Introduction

Seed technologies in cotton are changing rapidly. Transgenic cotton varieties offer benefits and convenience to the producer. By convenience we mean savings in the time and labor expense associated with field operations that these technologies make possible. While the value of such “convenience” is difficult to measure, the evidence is clear that cotton producers have readily accepted and value these seed technologies as a part of their herbicide, insecticide, and overall management program.

In 2005, 98 percent of Georgia’s cotton acreage was planted to transgenic varieties. The majority of the acreage was in “stacked” (BR or Bollgard-Roundup Ready) varieties. In 2005, 73% of the state’s acreage was planted to a single variety, DP 555 BGRR.

In recent years, Georgia acreage has trended away from straight RR (Roundup Ready) varieties and toward BR. This has been due to BR varieties consistently producing higher yields than RR varieties in Georgia trials. More recently, new technologies such as Liberty Link (LL), Bollgard II Roundup Ready (B2R), Roundup Ready Flex (B2RF and RF), and Widestrike (W, WR, WRF) have been introduced but are not yet used on a large scale.

The University of Georgia began conducting “systems trials” at Tifton in 2001 and at both Tifton and Midville in 2003. The purpose of these tests is to compare yield, fiber quality, costs, and net returns of conventional (non-transgenic) cotton and transgenic cotton (Bt, RR, BR, B2R, LL, etc.). A specific secondary objective is to determine the factor(s)—variety, system, yield, fiber quality, etc. that most contribute to increased economic returns.

This paper presents results of the 4 years 2001-2004. Results for 2005 are not yet available. This research continues for 2006.

Methodology

In the “systems trial”, each technology is produced according to its’ specific pest management (herbicide and/or insecticide) regime and following UGA Extension recommendations. Each year, the “Net Return Above System Costs” was calculated for each variety and each technology at each location. “System Costs” were seed,

technology fee (if applicable), herbicides, insecticides, and application costs. The number of varieties in the systems trial by technology, year, and location is summarized in Table 1. Varieties selected have been those commercially available and based on trends in use in the state. The test has also included newer varieties and technologies—some tested before being largely available to producers.

Varieties/technologies included in the test have changed (some deleted, others added) as the test has progressed over time. The trial has included conventional/non-transgenic (CV) varieties, Bollgard (Bt) varieties, Roundup Ready (RR) varieties, “stacked” varieties (BR), Bollgard II stacked varieties (B2R), and Liberty Link (LL) varieties. In 2005, Roundup Ready Flex (RF), WideStrike Roundup Ready (WR), and Bollgard II Roundup Ready Flex (B2RF) were added but are not included in this paper.

All varieties at each location and each year were replicated 4 times in a random block design. Each technology was produced according to its’ intended herbicide and/or insecticide regime and in accordance with UGA Extension recommendations. Plots were mechanically harvested. Random samples of seedcotton from each plot were ginned at the USDA Cotton Ginning Laboratory in Stoneville, MS to determine gin lint turn-out, seed weight, and HVI fiber quality.

For each variety and technology, the Net Return Above System Costs was calculated. System Costs included seed, technology fee if applicable, herbicides, insecticides, and application costs. All other inputs and costs were the same regardless of technology.

The Net Return Above System Costs was calculated as:

$$NR_{xy} = (Y_x \times LP_{qx}) + (C_x \times SP) - S_{xy} - H_y - I_y - A_y$$

NR = the Net Return Above System Costs for variety x, technology y

Y = lint yield (Lbs per acre) for variety x

LP = the November avg Ga price/lb adjusted for quality q for variety x (includes LDP)

C = the cottonseed yield for variety x

SP = the November average Georgia price received for cottonseed

S = seed cost per acre for variety x, technology y

H = herbicide costs per acre for technology y

I = insecticide costs per acre for technology y

A = herbicide and insecticide application costs per acre for technology y

Results

Relevant costs for the analysis were only those costs associated with variety and technology. All other inputs and costs were the same, thus need not be considered. System costs were seed, technology fee if applicable, herbicides, insecticides, and the cost of applications.

Seed and technology cost for Tifton are shown in Table 2. The Tifton test was planted in 36 inch rows at 3 seed per foot. Midville (2003 and 2004), not shown, was planted at

the same seeding rate but in 38 inch rows so the cost per acre would be approximately 5% less. In the 4 years at Tifton, BR varieties averaged \$39.73 per acre higher cost than conventional. In 2 years, 2003 and 2004, B2R averaged \$8.68 per acre higher than BR. In 2003 (the only year that both RR and LL were both in the test), LL was \$3.28 per acre more than RR.

Herbicide and insecticide costs are summarized in Tables 3 and 4. These costs are for chemicals only. Machinery, equipment, fuel, and labor costs of application and cultivation (in non-Roundup Ready technology only as needed) were calculated separately. Technology fee is included with seed cost in Table 2.

Over 4 years at Tifton, herbicide costs for RR (RR, BR, B2R) and non-RR varieties (conventional, Bt, and LL) was essentially the same (RR varieties averaged \$0.75 per acre less). At Tifton in 2003 and 2004, herbicide costs for LL averaged \$6.57 per acre less than RR. At Midville, herbicide costs averaged \$64.80 per acre for non-RR varieties, \$46.75 for RR varieties, and \$36.89 per acre for LL.

At Tifton in 2001, no sprays were needed on either Bt (Bt, BR) or non-Bt (conventional, RR) cottons. In 2002, no sprays were needed on Bt cotton. For the 4 years of the study at Tifton, insecticide costs for Bt cotton averaged \$16.36 per acre less than non-Bt cotton. In the 2 years of the study at Midville, Bt cotton averaged \$8.19 per acre less than non-Bt.

Total “system costs” by year and location for each technology are presented in Tables 5 and 6. At Tifton, 4 years of conventional, non-transgenic cotton has averaged \$105.91 per acre compared to \$119.98 for BR. Six technologies have been tested at Tifton. RR had the lowest system costs in 1 of 3 years in the trial. Conventional technology was the least expensive in 1 of 4 years. In 2003 and 2004, B2R technology averaged \$8.36 per acre higher than BR. In the 3 years that both were in the trial (2001-2003), BR technology was \$4.26 per acre cheaper than RR.

Across both locations, Tifton and Midville, in 2003 and 2004, total system costs were the lowest for RR and LL technology (Table 6). B2R had the highest total system costs and averaged \$8.31 per acre higher than BR

In 2001 and 2002 at Tifton, there were 13 varieties common to both years (Table 7). Average yield and net return was calculated for these varieties. Rather than a statistical means comparison, an alternative approach taken in this analysis is to *rank varieties by yield and net return then compare systems by how varieties of the same system rank in relation to other systems*. For the 13 varieties at Tifton in 2001-2002, 3 of the top-five yielding varieties were BR. Three of the 5 lowest yielding varieties were RR. Of the 5 top-yielding varieties, 4 were also in the top-five in Net Return. One of the 4 conventional varieties was in the top-five in both yield and Net Return. One conventional variety was not a top yielder but was among the highest in Net Return.

Across both locations in 2003 (Table 8), 3 of the top-five yielding varieties were BR. One conventional and one LL rounded out the top 5. All 5 varieties that were the top-five in yield were also the top-five in Net Return. The B2R varieties were in the middle or near the bottom in yield and Net Return. Three of the lowest five in Net Return were RR.

In 2004, yields and Net Return were significantly different by location so results could not be combined. At Tifton, 4 of the top-five varieties in yield were BR or B2R (Table 9). Four of the top-five yielders were also among the top-five in Net Return. One conventional variety was in the top-five at Tifton but did not rank as high at Midville. One LL variety was among the top-five in Net Return at Tifton but LL varieties did not perform as well at Midville. At Midville in 2004, the top-five yielders were BR and B2R and were also the top-five in Net Return (Table 10).

Summary and Conclusions

Seed technologies in cotton are changing rapidly. Transgenic cotton varieties offer benefits and convenience to the producer. While the value of “convenience” is difficult to measure, the evidence is clear that cotton producers have readily accepted and value these seed technologies as a part of their herbicide, insecticide, and overall management program. The purpose of these “systems trials” has been to evaluate these seed technologies for yield, fiber quality, costs, and net return.

These trials have been difficult to manage and analyze due to the fact that varieties within a technology change rapidly (new varieties are developed which need to be evaluated) and the technologies themselves have changed and continue to change. B2R and LL varieties were added to the test in 2003 and 2004 and RF (Roundup Ready Flex) and WR (Widestrike Roundup Ready) were added in 2005.

After 4 years of study, BR and B2R have generally been the most expensive technologies but have also proven to be among the most profitable. BR and B2R have been the most profitable on a consistent basis but choice of variety within a system is the most crucial factor. Some BR and B2R varieties, for example, have not performed as well as others.

LL and RR have generally been the cheapest technology but generally have been middle-of-the-pack or near the bottom in Net Return.

The difference in costs per acre between technologies can be 10 to 20% but less in some years. Even in years when costs are highly different, the difference in cost can be relatively minor in terms of the equivalent pounds of lint. This leads to the conclusion that the highest yielders tend to also be the most profitable regardless of technology. Technologies may offer new management options but if technology does not come with high yield, the technology will not prove most profitable compared to alternatives. Some conventional varieties continue to compete with transgenic varieties in both yield and net return.

Fiber quality has thus far not been a significant factor in choice of technology.

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Table 1. Summary of Technologies and Varieties, By Year and Location

	2001	2002	2003	2004	2005
	Tifton		Tifton and Midville		
Conventional	4	4	3	1	1
Bt	4	2			
RR	4	4	4		1
BR	4	5	5	8	1
B2R			2	5	3
LL			1	2	1
RF					3
WR					1
B2RF					5
Total	16	15	15	16	16

Table 2. Seed and Technology Cost Per Acre By System, Tifton 2001-2004

	2001	2002	2003	2004
Conventional	\$9.32	\$11.30	\$11.44	\$17.41
Bt	\$38.68	\$37.62		
RR	\$18.29	\$21.66	\$25.76	
BR	\$45.13	\$50.93	\$51.75	\$60.58
B2R			\$62.85	\$66.85
LL			\$29.04	\$28.70

Table 3. Herbicide Cost Per Acre, By System, Tifton and Midville

	2001	2002	2003	2004
Tifton Non-RR	\$27.77	\$29.60	\$29.08	\$28.28
Tifton RR	\$23.37	\$24.05	\$30.01	\$34.32
Tifton LL			\$28.84	\$22.35
Midville Non-RR			\$54.17	\$75.44
Midville RR			\$41.55	\$51.94
Midville LL			\$32.93	\$40.86

Table 4. Insecticide Cost Per Acre, By System, Tifton and Midville

	2001	2002	2003	2004
Tifton Non-Bt	\$0.00	\$24.69	\$36.66	\$58.19
Tifton Bt	\$0.00	\$0.00	\$9.60	\$44.49
Midville Non-BT			\$28.68	\$16.53
Midville Bt			\$23.63	\$5.20

Table 5. Average Total System Costs Per Acre, By Technology, Tifton

	2001	2002	2003	2004
Conventional	\$74.18	\$100.92	\$113.23	\$135.31
Bt	\$103.54	\$95.55		
RR	\$73.69	\$103.11	\$124.19	
BR	\$100.53	\$100.69	\$112.56	\$166.14
B2R			\$123.00	\$172.41
LL			\$126.30	\$140.07

Table 6. Average Total System Costs Per Acre By Technology, Tifton and Midville

	Tifton		Midville		Average
	2003	2004	2003	2004	
Conventional	\$113.23	\$135.31	\$124.65	\$143.25	\$129.11
RR	\$124.19		\$119.35		\$121.77
BR	\$112.56	\$166.14	\$135.41	\$137.38	\$137.87
B2R	\$123.00	\$172.41	\$145.96	\$143.33	\$146.18
LL	\$126.30	\$140.07	\$113.84	\$111.14	\$122.84

Table 7. Comparison of Yield and Net Return Per Acre, Average of 13 Common Varieties, Tifton 2001-2002

Rank By Yield			Rank By Net Return		
Variety	Technology	Yield	Variety	Technology	Net Return
DP555BR	BR	1143	FM989	CV	\$660.97
FM989	CV	1107	DP555BR	BR	\$641.43
ST4892BR	BR	1091	DP458BR	BR	\$606.15
DP458BR	BR	1057	PHGA161	CV	\$603.13
DP33B	B	1027	ST4892BR	BR	\$600.50
PHGA161	CV	1022	PEARL	CV	\$581.00
PEARL	CV	1016	DP33B	B	\$575.86
FM989BR	BR	1001	DP448B	B	\$570.19
DP448B	B	997	FM989BR	BR	\$568.84
ST580	CV	979	ST580	CV	\$541.32
FM989R	RR	952	FM989R	RR	\$539.65
ST4793R	RR	936	SG521R	RR	\$508.70
SG521R	RR	929	ST4793R	RR	\$490.10

Table 8. Comparison of Yield and Net Return, Average of Tifton and Midville, 2003

Rank By Yield			Rank By Net Return		
Variety	Technology	Yield	Variety	Technology	Net Return
DP491	CV	1202	DP491	CV	\$799.13
DP555BR	BR	1198	DP555BR	BR	\$769.04
ST5599BR	BR	1156	FM966LL	LL	\$751.42
FM966LL	LL	1151	FM989BR	BR	\$733.82
FM989BR	BR	1126	ST5599BR	BR	\$731.39
DP494R	RR	1108	DP494R	RR	\$711.60
SG215BR	BR	1096	PEARL	CV	\$670.21
PEARL	CV	1039	SG215BR	BR	\$655.12
DP424B2R	B2R	1037	PHGA161	CV	\$642.06
SG521R	RR	1004	DP424B2R	B2R	\$636.97
ST4646B2R	B2R	997	SG521R	RR	\$589.51
PHGA161	CV	989	ST4646B2R	B2R	\$582.76
ST4793R	RR	934	FM991RR	RR	\$573.46
FM991R	RR	911	DP458BR	BR	\$557.17
DP458BR	BR	905	ST4793R	RR	\$550.50

Table 9. Comparison of Yield and Net Return, Tifton, 2004

Rank By Yield			Rank By Net Return		
<i>Variety</i>	Technology	Yield	Variety	Technology	Net Return
DP555BR	BR	1059	DP555BR	BR	\$517.35
PEARL	CV	984	PEARL	CV	\$515.92
DP543B2R	B2R	891	DP543B2R	B2R	\$415.35
FM960B2R	B2R	828	FM960B2R	B2R	\$383.06
SG215BR	BR	784	FM966LL	LL	\$362.09
FM960BR	BR	784	FM960BR	BR	\$360.58
ST5599BR	BR	750	SG215BR	BR	\$354.36
FM966LL	LL	747	FM981LL	LL	\$347.06
DP449BR	BR	733	DP449BR	BR	\$325.58
FM981LL	LL	727	ST5599BR	BR	\$324.22
FM991BR	BR	714	FM991BR	BR	\$320.85
ST5242BR	BR	703	ST5242BR	BR	\$292.32
DP444BR	BR	690	DP444BR	BR	\$284.97
FM991B2R	B2R	647	FM991B2R	B2R	\$264.36
DP424B2R	B2R	600	DP424BR	BR	\$227.98
ST4646B2R	B2R	589	ST4646B2R	B2R	\$201.40

Table 10. Comparison of Yield and Net Return, Midville, 2004

Rank By Yield			Rank By Net Return		
Variety	Technology	Yield	Variety	Technology	Net Return
DP555BR	BR	1597	DP555BR	BR	\$933.50
DP449BR	BR	1463	DP449BR	BR	\$863.85
FM960BR	BR	1427	FM960BR	BR	\$852.10
DP424B2R	B2R	1361	DP424B2R	B2R	\$787.14
DP543B2R	B2R	1303	DP543B2R	B2R	\$746.36
ST5599BR	BR	1302	FM960B2R	B2R	\$746.07
FM960B2R	B2R	1280	FM991BR	BR	\$727.98
FM991BR	BR	1256	ST5599BR	BR	\$713.48
PEARL	CV	1250	PEARL	CV	\$711.30
FM991B2R	B2R	1185	FM991B2R	B2R	\$649.57
ST4646B2R	B2R	1090	ST5242BR	BR	\$601.48
ST5242BR	BR	1075	ST4646B2R	B2R	\$597.34
SG215BR	BR	1048	SG215BR	BR	\$581.36
FM966LL	LL	980	FM966LL	LL	\$556.85
FM981LL	LL	940	FM981LL	LL	\$547.70
DP444BR	BR	866	DP444BR	BR	\$457.60