The Effect of Recent and Futuristic Changes in Cotton Production Technology on Direct and Fixed Costs Per Acre, Mississippi, 2004

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Abstract

The introduction of genetically modified seed technology dramatically changed cotton production practices. Production systems based on reduced tillage and BtRR varieties improved net returns by $47.35 per acre (53%) when compared to systems based on conventional tillage and non-transgenic varieties. The impact of other technology induced changes are reported.

Keywords: emerging technology, tillage practices, skip-row, picker with onboard module builder

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Introduction

Monsanto introduced their genetically modified seed (GMS) technology in 1996 and dramatically changed the way cotton is grown. In 1995 most of the cotton grown in the Mid-south was based on conventional varieties and employed conventional tillage practices. In 2004 approximately 95% of the Mid-south cotton acreage was planted with genetically modified varieties (Mississippi Agricultural Statistics Service) and was based on conservation tillage or no-till production practices. The new technology has reduced the number of trips-over-the-field, reduced labor and equipment requirements per acre of cotton, and stimulated the development of other new technology. Basically, the new systems of production employ fewer trips-over-the-field with wider equipment.

The Department of Agricultural Economics, Mississippi State University, annual cost of production estimates, (available on line at http://www.agecon.msstate.edu/Research/budgets.php) indicate that since the introduction of Monsanto's genetically modified seed technology (1996-2004) tractor hours per acre of cotton have been reduced by 49% and labor hours have been cut by 43%. Currently, on many cotton farms, more tractors are required during the harvest season than any other period during the production cycle. New harvesting technology, which eliminates boll buggies and module builders and the tractors that support them is expected to increase the reduction in tractor hours to 74% and labor hours to 64% relative to 1995 levels.

Data and Methods

Data on the cost/unit of production inputs such as labor, fuel, fertilizer, herbicides, insecticides, etc. are 2004 estimates (Cotton 2004 Planning Budgets). Data associated with power units (tractors and cotton pickers) and towed equipment include 2004 estimates of price, length of life, annual hours of use, performance rate (hours per acre), repairs, salvage value, etc. (Cotton 2004 Planning Budgets). Cost to producers of technology not yet marketed was estimated by contacting knowledgeable individuals in the cotton industry. The experience of the author has been that estimates of this type involve errors of unknown magnitude but that the cost of new technology is typically underestimated.

GMS technology has directly impacted two components of the cotton production system, insect control and weed control. Genetic traits have been added that allow over-the-top application of selected herbicides and that control selected insect pests. The new technology should be jointly evaluated as a component of an insect management subsystem and a component of a weed control subsystem within an overall cotton management system. The Mississippi State University Budget Generator (Laughlin and Spurlock), a widely accepted computer algorithm which standardizes many accounting calculations, was utilized to estimate the impact of recent and futuristic changes in cotton production technology on the cost of producing cotton.

Results

This section examines the impacts of four changes in cotton production systems induced by the introduction of GMS; tillage practices, planting pattern and seed drop rate, pickers with onboard module building (PWOBMB), and a single power unit that functions as a tractor, sprayer, and cotton picker. This section begins by comparing cotton production systems based on 8 row (8R) planters and 4R pickers (dominant 1995 equipment size) and ends by comparing systems based on 12R planters and 6R pickers (current or emerging equipment size).

Tillage Practices

The adoption of GMS which allows over-the-top applications of selected herbicides has opened new opportunities to consider reduced tillage and no-till cotton in situations where previously it was not practical. Per acre budgets were estimated for three systems of cotton production.

I. 8R-40" solid, conventional tillage, non-transgenic (conventional) variety [CT/CV].

II. 8R-40" solid, reduced tillage, BtRR variety [RT/BtRR].

III. 8R-40" solid, no-till, BtRR variety [NT/BtRR].

Reduced tillage is often referred to as conservation tillage or limited seedbed/chemical tillage. Output prices selected were $0.64/lb. of lint and $0.04/lb. for cottonseed. Yield (lbs. of lint/a) was set to 825. System I was compared to the other systems in terms of selected costs, returns, labor, and equipment. Table 1 reports estimated per acre revenue, selected costs, labor hours, and gallons of diesel fuel for each of the three systems of production. Relative to system I, the direct cost associated with systems II and III is reduced 7%. Estimated fixed cost is reduced 13% for system II and 19% for system III. Net returns are improved by $47.35 per acre or 305% for system II and by $52.99 per acre or 341% for system III. Tractor driver labor hours are reduced 29% for system II and 42% for system III. The reader is reminded that the number of tractor hours is equal to the number of tractor driver labor hours. Hand or support labor is reduced by 11% for system II and 15% for system III.

Gallons of diesel fuel are reduced 20% for system II and 30% for system III. The percentage differences for diesel fuel are less than the percentage for tractor driver labor hours for systems II and III, because diesel fuel for pickers (unchanged for systems I, II, and III) is included. Repairs and maintenance charges per acre are reduced 10% for system II and 18% for system III.

Skip-Row and Seeding Rate

Monsanto, their competitors, and the seed companies are not simply selling seed – they are providing a simpler system of production that increases net returns (otherwise, the adoption rate of the new genetically modified seed technology would not approach 100%). Growers can best counter their high seed cost per acre by developing a complete system of production which reduces linear feet of row per acre (change the planting pattern to utilize wider equipment which improves labor and equipment cost per acre and reduces all inputs applied down the row) and by reducing the seeding rate (seed per foot) which lowers seed cost per acre and the cost of inputs dropped with the seed – typically in-furrow insecticides, and fungicides.

In 1995, the price of cottonseed was $0.84 per pound and the average planting rate was ten pounds per acre. Cotton growers paid $8.40 per acre for their planting seed. In 2004, ten pounds of BtRR cottonseed cost $14.90 and growers paid an additional tech fee of $3.82 per pound, bringing their total cost for planting seed to $53.10 per acre.

In 2005, cottonseed will be priced per thousand and not per pound. The average price of BtIIRR seed is expected to be $0.332 per thousand and the BtIIRR tech fee is expected to average $1.08 per thousand. A maximum BtIIRR tech fee of $51.00 per acre is expected. If a grower plants 47,000 BtIIRR seed per acre, his total cost for planting seed will be (47 x $0.332) + (47 x $1.08) or $66.37 per acre.

Table 2 reports the estimated 2005 seed cost per acre for BtIIRR cotton, a 38" solid planting pattern (13,756 linear feet of row per acre), and selected seed drop rates (seed per foot of row). The author notes:

1) While 25,000-35,000 uniformly spaced plants per acre does not reduce yield in small research plots, 25,000 plants per acre on commercial acreage, and planted with many

planters currently in use, will likely result in a “skippy stand”, which will reduce yield and delay maturity. Some growers are successfully dropping 2-4 seed per foot.

2) Cotton growers will try to save money by reducing their seeding rate. A reduction from an average of 4.0 to 3.0 (25%) reduces total seed cost per acre by $11.00 or 16%.

An effective change in planting pattern for some growers has been 38" solid to 30" 2 x 1 full skip. [The width of a 6R 30" 2 x 1 picker is 22.5 feet. The width of a 6R 38" solid picker is 19.0 feet]. Table 3 compares the cost of a 38" solid system with a 30" 2 x 1 full skip system (both built around a 12-row planter [12 rows planted] and a six-row picker). It is assumed that the picker conversion (solid to skip-row) costs $5,000.00. The seeding rate for the 38" solid system of 4.0 seed per foot of row is reduced to 3.0 (25%) for the 30" 2 x 1 system. Cotton grown in a 30" 2 x 1 planting pattern has 11,616 linear feet of row per acre (84% of 38" solid).

Cost items associated with linear feet of row per acre are reduced by 16%. Cost associated with seed drop rate are reduced by 37%. Some cost items such as materials applied by air and fertilizer are unchanged. The author’s experience has been that cotton grown in a 38" solid pattern and yielding 700 pounds per acre in Northeast Mississippi, yielding 900 pounds in West Tennessee, and yielding 1,200 pounds along Deer Creek in the South Mississippi Delta, all yield slightly more when converted to a 30" 2 x 1 pattern. [The serious reader can go to http://www.agecon.msstate.edu/research/Budgets/cot04.pdf (see pgs. 42-45) to view the specific details of each trip-over-the-field and each input for a 12-row 40" solid budget with identical operations].

Changing the planting pattern and reducing the seeding rate reduces total specified expenses by $60.13 per acre (12%). With a yield of 825 pounds of lint per acre, price per pound of lint = $0.64, and price per pound of seed = $0.04 (1.55 pounds of seed per pound of lint); returns above total specified expenses are $77.58 per acre. A 12% reduction in costs of $60.13 per acre increases returns above specified expenses by 78%.

The reader is reminded that total specified expenses do not include the cost of land, management, or general farm overhead. Therefore, a 76% change in returns above specified expenses is not a 76% improvement in profits. However, the point is, any cost reduction without a yield reduction, goes directly into profits.

Another effective change in planting pattern for many growers has been 38" solid to 38" 2x1 narrow skip (64"). The width of a 6R38" 2x1 narrow skip picker is 25.5 feet, 13% wider than the 6R30" 2x1 picker and 34% wider than the 6R38" solid picker. The 38" 2x1 narrow skip planting pattern has 10,249 linear feet of row per acre, 12% less than 30" 2x1 and 25% less than 38" solid. Hence, the 38" 2x1 narrow skip planting pattern is more likely to result in a yield reduction (relative to 38" solid) than the 30" 2x1 planting pattern. However, if it does not, 38" 2x1 narrow skip is preferred to the 30" 2x1 planting patterns.

Cotton Picker With Onboard Module Builder

Table 4 lists selected parameters for two pickers: 6R38" solid and 6R38" solid with onboard module builder (Parvin 2002, 2003). Performance rate (PR) is a function of width, mph, and efficiency [% of time machine is harvesting cotton - primarily field size and shape]. PR and annual hours of use limit acres per year. Table 5 presents the direct and fixed cost per acre for each system. The lines labeled "boll buggy" and "module builder" include the cost of a 190 hp tractor with annual hours of use equal 600. The per acre cost of the 6R picker WOBMB is $16.60 per acre less than the current 6R system, a reduction of 32%.

Table 6 begins to examine the impacts at the farm level (the big savings). For a 6000-acre cotton farm the 6R system requires three pickers, three BB, three MB, six tractors, nine drivers, and six support laborers. The 6RWOBMB system requires three pickers, zero BB, zero MB, zero tractors, three drivers, and three support laborers.

Growers with the new harvesting technology will be able to reduce the number of tractors and laborers per farm resulting in cost savings which will be much larger than those reported in Table 5. On most farms the reduction in the number of tractors will be constrained by the number of planters required to complete planting in a timely manner. For example, a Mississippi grower familiar with a 6R picker WOBMB currently harvests with six 6R pickers, eight BB, eight MB, 16 tractors, 22 drivers, and eight support laborers (one per MB). With the new technology he plans to harvest (the same acres) with six 6R pickers WOBMB, six drivers, and three support laborers (one per two pickers). He uses six planters. He will reduce BB by eight, MB by eight, tractors by ten [16 – 6], drivers by 16, and support labor by five. The estimated savings [assuming the pickers WOBMB cost an additional 80 thousand dollars (80k), BB cost 15k, MB cost 21k, 12 row tractors cost 133k, drivers cost 32k/yr & support laborers cost 24k/yr] are 8*15 + 8*21 + 10*133 + 16*32 + 5*24 - 6*80 = $1,770,000.00. The grower realizes that the new technology will harvest more acres per hour than the old technology and some growers with similar acres of cotton will likely reduce their number of pickers from six to five. He will complete harvest in fewer days with less yield loss (larger realized yield). He will deliver a larger percentage of the agronomic or field yield to the front (and the back) of the gin. A major factor in the decision related to the number of pickers WOBMB is the requirement of six dependable drivers at planting.

Power Unit That Functions as a Tractor, Sprayer, and Cotton Picker

A major problem with cotton pickers has always been their high cost and their low annual hours of use. The new cotton picker WOBMB will likely cost more than $400,000.00 and be used less than 2 months per year [annual hours of use = 200 (MSU average estimate) to 300 (industry estimate for efficient growers)] making direct and fixed cost per hour and per acre large. With the basket and headers removed, it can be used to plant and to spray (replacing a tractor). Removing the basket and dropping the headers should not be difficult or expensive. Front mounted planters and sprayers are already available. Even though the PWOBMB is not yet commercially available, selected individuals and firms are already considering converting it to plant and spray. Hence, cotton picker manufacturers may produce the PWOBMB with the basket and heads designed to be removed.

The MSU estimate of annual hours of use per tractor is 600. Table 7 summarizes the relative costs. A 2000 acre farm based on a 190 hp tractor used 600 hours per year and a picker WOBMB used 300 hours per year has tractor plus picker direct and fixed cost totaling $102,243 per year. The same farm with the power unit that functions as a tractor, sprayer, and picker used 900 hours per year has direct and fixed cost totaling $94,545 per year – a savings in power unit direct and fixed cost per year of 7%.

Limitations and Conclusions

This paper would be improved if the cost (including repair cost and salvage value) to producers of the emerging and futuristic technology was known with certainty. However, just as the rapid adoption of GMS was largely due to the fact that production systems based on GMS were simpler and easier to manage, PWOBMB will be rapidly adopted because they make harvesting systems simpler and easier to manage. Current harvesting systems based on boll buggies and module builders require growers to obtain and manage large numbers of seasonal workers (some as tractor drivers). Seasonal workers reduce picker efficiency (% of total harvest period the picker is actually harvesting), making harvesting costs increase. PWOBMB greatly reduces the number of seasonal workers and improve picker efficiency relative to current harvesting systems.

References

Cotton 2004 Planning Budgets. 2003. Budget Report 2003-002, Department of Agricultural Economics, Mississippi State University.

Laughlin, D.H. and S.R. Spurlock. 2003. User's Guide for the Mississippi State Budget Generator: Version 6.0 for Windows. AEC Staff Report 2003-01, Department of Agricultural Economics, Mississippi State University. Online at ftp://web.agecon.msstate.edu/pub/Laughlin/MSBG6.0 him.

Mississippi Ag. Statistical Service. 2004. Mississippi Ag Report, Volume 04-13. (Released: July 15, 2004) Online at: http://www.nass.usda.gov/ms/vol04-13pdf.

Parvin, D.W. 2002. The Economic Implications of a Cotton picker with Onboard Module Building Capabilities. Proceedings of the Beltwide Cotton Conference, National Cotton Council of America, Memphis, TN.

Parvin, D.W. 2003. The Economic Impact of a Cotton Picker With An Onboard Module Builder. Proceedings of the Beltwide Cotton Conference, National Cotton Council of America, Memphis, TN.

Table 1. Estimated per acre revenue, selected costs, labor, fuel, and equipment repairs and maintenance (R&M), 3 cotton production systems, Mississippi, 2004.

System		I. CT/CV	II. RT/BtRR	III. NT/BtRR
Item	Unit			
Total Revenue	$	579.15	579.15	579.15
Direct Cost	$	463.21	428.48	429.59
Fixed Cost	$	100.44	87.82	81.07
Net Revenue	$	15.50	62.85	68.49
Labor				
Tractor Driver	hr	1.68	1.19	.98
Hand	hr	.95	.85	.81
Diesel Fuel	gal	21.74	17.33	15.30
R&M	$	25.81	23.20	21.19

Table 2. Estimated seed cost, tech fee, and total seed cost per acre, selected Seed Drop Rates, BtIIRR cotton, 38" Solid Planting Pattern, 2004.

Seed Drop Rate Range	Seed Drop Rate Average	Seed Per Acre	Seed Cost	Calculated Tech Fee	Actual Tech Fee	Total Seed Cost
------ seed / ft. ------			------------------------ $ / acre	------------------------		
2-3	2.5	34,390	11.42	37.14	37.14	48.56
2-4	3.0	41,268	13.70	44.57	44.57	58.27
3-4	3.5	48,164	15.99	52.02	51.00	66.99
3-5	4.0	55,024	18.27	59.43	51.00	69.27
4-5	4.5	61,902	20.55	66.85	51.00	71.55

Table 3. Summary of estimated costs per acre, 12-row equipment, 38" solid v. 30" 2 x 1, cotton, Mississippi, 2004.

ITEM	38" Solid	30" 2 x 1	Difference
Direct Expenses			
Custom Spray	11.00	11.00	0.00
Harvest Aids	20.11	20.11	0.00
Gin	66.00	66.00	0.00
Fertilizer	47.03	47.03	0.00
Fungicide	20.55	12.95	7.60
Herbicide			
Cotoran @ planting	7.05	4.44	2.61
Roundup and Karmex	28.76	28.76	0.00
Insecticides			
Temik @ planting	12.24	7.71	4.53
Ground Applied	15.30	12.85	2.45
Air Applied	11.79	11.79	0.00
Seed	18.27	11.52	6.75
Seed Tech	51.00	37.63	13.37
BWF	12.00	12.00	0.00
PGR	7.08	5.95	1.13
Scout	7.00	7.00	0.00
Custom Lime	14.39	14.39	0.00
Haul	16.50	16.50	0.00
Labor	23.44	19.69	3.75
Fuel	14.83	12.45	2.38
R&M	20.43	17.16	3.27
Total Direct Expenses	424.77	376.93	47.84
Fixed Expenses	76.80	64.51	12.29
Total Specified Expenses	501.57	441.44	
Difference			60.13

Table 4. Selected parameters, 2 harvesting systems, Mississippi, 2005.

System	Width	MPH	Efficiency
6R38	19.0	3.8	72%
6R38-WOBMB	19.0	3.8	82%
	------------ PR ------------		
	hr/a	a/hr	Price
6R38	0.159	6.301	323,218
6R38-WOBMB	0.139	7.176	403,218
	Annual Hours of Use	Acres/300 Hours	Pickers Per 6000 Acres
6R38-325	300	1890	3
6R38-WOBMB	300	2152	3

Table 5. Cost per acre, 2 harvesting systems, 2005.

	Direct Cost	Fixed Cost	Total Cost
6R38 Solid			
Picker	12.11	21.08	33.19
Boll Buggy	4.10	4.31	8.41
Module Builder	5.27	4.62	9.89
Sum	21.48	30.01	51.49
6R38 Solid			
Picker WOBMB	11.80	23.09	34.89

Table 6. Number of pickers, support equipment, and laborers per 6000 acres of 38" solid planted cotton, two cotton-harvesting systems.

	6R	6RWOBMB
Pickers	3	3
Boll Buggy [BB]	3	0
Module Builder [MB]	3	0
Tractors	6	0
Laborers		
Drivers	9	3
Support	6	3

Table 7. Purchase price (dollars), annual use (hours) and cost (dollars per hour), three self-propelled machines or power units, Mississippi, 2004.

Item	Size	Price	Annual Use	Direct Cost	Fixed Cost	Total Cost
Tractor	190 hp	111,371	600	23.28	21.92	45.20
Picker with onboard module builder	6R38	403,218	300	84.68	165.73	250.41
Power unit that functions as a tractor, sprayer, and picker	6R38	423,218	900	49.04	56.01	105.05