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Alternative Cotton Production Systems

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Abstract

Mississippi cotton farmers are adjusting to the current problem of low cotton price and high cotton production cost by modifying the way(s) they have traditionally grown cotton. This paper compares seven alternative production systems to the costs and returns associated with the conventional or traditional system labeled "solid cotton, 8-row equipment." Systems that combine wider equipment (less labor and machinery time per acre) with reduced tillage technology appear to offer opportunities to increase returns. Specific adjustments on individual farms will probably be dominated by the distribution of soil types.

Keywords: conservation tillage, ultra-narrow, no-till, skip-row, costs, returns

Foreword

The current costs of producing cotton and its low price, which has persisted for several years, has resulted in negative returns for many Mississippi cotton growers. Growers with the highest whole farm yields have been able to maintain positive returns with conventional practices, but their rate of return has been greatly diminished.

The Department of Agricultural Economics at Mississippi State University, along with scientists from other departments and related agencies, is in the process of examining the profitability of alternative systems for cotton production. This activity involves special cooperation between State scientists in the Department of Agricultural Economics and the Delta Research and Extension Center, plus ARS/USDA scientists located at the Jamie Whitten Delta States Research Center.

This report is the eighth in a series designed to examine costs, yields and returns associated with alternative systems of cotton production in Mississippi. Other reports in this series have tended to deal with a single production system, such as no-till cotton, ultra-narrow row cotton or skip-row cotton. This publication compares eight systems of cotton production from eight recent publications [Staff Reports 99-002, 2000-001, 2000-002, 2000-003, Research Reports 99-004, 2000-001, 2000-002, and Agricultural Economics Report 106 (12-99)]. The details of every "trip-over-the-field" plus several budget tables for each system can be found in the text and/or appendix tables of these publications.

Whole-farm systems analysis is suggested as a means for organizing the quantity and variety of information available to cotton farmers to analyze the alternative ways of organizing cotton and other crops grown on Mississippi cotton farms. Systems analysis [Ashley; Boulding] is also suggested as a means to research this complex problem. It is hypothesized that emerging systems of production will involve fewer trips-across-the-field and/or wider equipment. A reduction in either area will have a beneficial influence on direct expenses such as labor, fuel, and repairs, and on traditional fixed expenses associated with power units and towed equipment. Additionally, either may reduce two large cost items typically ignored by researchers; general farm overhead and hired management.

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INTRODUCTION

The Department of Agricultural Economics, Mississippi State University, releases estimates of the per acre cost of producing most of the state's agricultural enterprises on an annual basis. These estimates are generally referred to as budgets. The department's standard cotton budget [Parvin, et al, 1999], labeled "Solid cotton, 8-row equipment", for the 2000 season reports total direct expenses per acre of $459.33. Total fixed expenses per acre are estimated at $78.40. The department's estimate of total specified expenses, the sum of direct and fixed expenses, based on a yield of 825 pounds of lint per acre, is $537.73 per acre.

The cost items not addressed by the department's annual budget reports are land, management, and general farm overhead. Readers can assume an average land charge of approximately $90.00 per acre. Management plus general farm overhead tends to average about $70.00 per acre. These cost items (land, management, and general farm overhead) total approximately $160.00 per acre.

The relationship between cotton price and production costs has changed considerably in recent years. In the past, the distinction between a cotton acre and a land acre was important in an agronomic and economic sense. While the agronomic relationships are still valid, the economic distinction between a land acre and a cotton acre have vanished. All yields, costs, and returns, in this report, are reported on a **land basis** for dryland or non-irrigated cotton.

THE 1975-1999 PERIOD

Since 1975, the Department of Agricultural Economics at Mississippi State University has published cotton budgets on an annual basis. Table 1 reports direct and fixed costs per acre for 1975-1999, along with budgeted or expected yield, state average yield, gross domestic product, and deflated price and cost estimates. For the period 1975-1978 relative to the period

1995-1998, price (column 9, average price received by Mississippi cotton farmers) increased by 18%, while direct cost plus fixed cost (column 6) increased by 81%. During the same period deflated price (column 12) decreased by 51%, while deflated cost (column 13) decreased by 24%. The relationship between deflated cost per pound (column 14) and deflated price (column 12) merits discussion. From 1975-1978 to 1995-1998, deflated cost per pound declined by 52% while deflated price declined by 51%. Some policy analysts may conclude that in real (deflated) terms, cotton growers have fared pretty well and should not be in financial difficulty. However, growers do not deal in deflated dollars. They settle their accounts each year in current dollars. If the balance is positive, they pay taxes in current dollars. Or, if the balance is negative, refinance the difference in current or undeflated dollars at current interest rates. Mississippi cotton growers are in financial difficulty and have been for several years. Clearly, they have not participated in the economic boom of the last decade, which saw gross domestic product increase by 23%, and the Dow Jones Industrial Average, which closed at 2,899.26 on July 2, 1990 and 11,326.04 on August 25,1999, increase by 291% [U.S. Department of Commerce].

THE COMPONENTS OF COST

Historically Mississippi cotton growers have attempted to optimize the difference between **revenue** and **cost** by maximizing yield. Currently break-even yields and expected yields are not close. Additionally break-even prices and expected prices are not close. Producers are price takers in both the input market and the output market. Current producer adjustments seem to be in the general area of cost reduction by reducing the level or amount of inputs since yield increasing opportunities appear limited. The tendency is to emphasize or concentrate on cotton direct cost per acre. But the other crops produced on the cotton farm should also be examined, especially for ways they can interact with cotton to reduce its cost and/or increase yield (reduce cost per pound). In addition, the other component of cost, especially fixed cost and general farm overhead, should be carefully examined. Savings in other areas are just as valuable as a reduction of a dollar in direct cost.

Many of Mississippi’s cotton producers are beginning to grow cotton differently (cheaper per acre with the expectation that yield can be maintained and cost per pound reduced) than they have in the past years. Some began in 1999. A few, with lower yielding cotton soils, began several years ago. In general, the first growers to modify their system of production were the first to experience negative returns. On average, these producers were utilizing the state's lower yielding cotton soils.

Therefore, some of Mississippi's most innovative cotton producers have been developing systems of production for the state's poorer cotton soils. Hence, when the authors sampled no-till and UNRC producers in 1999, yields observed were likely biased downward for Class I soils.

For a given soil type, the authors expect no-till yields to be equal to yields associated with conventional systems of production. However, UNRC may not be economically feasible on Class I soils without genetic improvements in plant type.

Direct Cost. Direct expenses include such items as seed, fertilizer, herbicides, insecticides, growth regulators, defoliants, other chemicals, labor, fuel, custom operations, and interest on operating capital. Also included are the estimated costs of repairs and maintenance for all machinery, including towed equipment and self-propelled power equipment. Direct expenses vary directly with the number of acres cropped.

Fixed Cost. Fixed expenses include such items as depreciation and interest on investments associated with the production process. These costs, at the farm level, do not vary as a function of the number of acres produced. Theoretically they are incurred even if the farm fails to produce a single acre. In the cotton budgets, fixed expenses are related to tractors, pickers, high clearance sprayers, and towed equipment. Many economists and most computerized budget generators (which calculate fixed cost on a per acre basis) tend to view fixed costs as noncash costs (assumes 100% equity in equipment). However, if the grower is leasing equipment and/or making annual payments on purchased equipment, the distinction between equipment direct cost and fixed cost becomes rather arbitrary. Generally, it is better to conceptualize fixed cost on a whole farm basis and ignore the concept of per acre fixed cost.

General Farm Overhead Cost. Overhead expenses are associated with operating the farm business and reflect expenses that while significant, are not necessarily specific to any particular enterprise. Examples of farm overhead costs include tax services, record keeping, utilities, maintenance of farm buildings, maintenance of turn rows and drainage ditches, insurance, and property taxes. Other overhead charges include legal fees, farm organization and membership dues, marketing services and computer services.

General farm overhead includes a fixed, as well as a direct cost component. It also includes the fixed costs associated with tractor and equipment associated with farmstead maintenance, maintenance of turn rows and drainage construction and maintenance. In addition, the costs for the operation of the farm shop and general use of pickup trucks are included.

General farm overhead expenses probably are increasing at a faster rate than other cost categories. For example, in 1998 the Department of Agricultural Economics and Agribusiness, Louisiana State University, estimated direct general farm overhead cost at $55.03 per acre [Richardson, et al, 1998]. The fixed component was estimated at $9.29 per acre, a total of $64.32 per acre. In 1999 their estimates were increased to $57.40 and $12.77 for a total of $70.17 per acre, an increase of 9.1% in a single year [Richardson, et al, 1999].

Land Cost. In general, the procedure employed in this project or research activity was to assign a charge to land equal to the average net cash rent represented by the rental market in the Delta area of Mississippi. Land cost can be viewed as an opportunity cost for land, since landowners should receive a return to the land in production "equivalent to" what could be received by renting the land out of production. Readers interested in an average land charge should probably utilize $90.00 per acre. Some cotton land rents for more. Rented land planted to cotton that rents for less is comprised largely of Class II or III cotton soils.

Management Cost. For purposes of this paper, management cost is defined as the cost of hired management and is included with general farm overhead. Hence, the difference between total revenue and total cost (as defined) is returns to owner/operator management and risk. Owner/operators that draw a salary and/or charge the farming business for living expenses should include these costs. In such cases, the residual between total cost and total revenue could be viewed as returns to risk.

ECONOMIC MODEL

The economic principles are quite clear. In simplest terms, when output price falls relative to input prices, producers should adjust by reducing the level (amount) of inputs (reduce cost). Similarly, when selected input prices increase relative to output price, growers should adjust by lowering the amount of the specific inputs with relative price increases (reduce cost). Most of Mississippi's cotton producers will grow their future cotton crops differently than they did in the recent past. In addition, they will operate their farms differently. Changes will not be restricted to the cotton acreage. Cotton growers are employing whole farm system techniques [Optner, Parvin and Tyner] to improve the profitability of their farm business.

Inherent in the economic model being employed, is the implication that with reduced inputs, yield will decline. This is because the economic model is based on physical relationships between the level of inputs and the level of yield and assumes constant technology. However, if the shock that causes the need to reduce inputs, such as a declining output price or increasing prices of inputs, is accompanied by the introduction of new technology, the adjustments may not result in a reduction in yield.

TYPES OF ADJUSTMENTS

Perhaps the most rational initial adjustment is simply to reduce all inputs. Most Mississippi growers are opting for this approach. The more radical or complex adjustments such as shifts from solid to skip-row or to ultra-narrow row cotton production systems and/or no-till systems are being adopted at a slower rate. The authors expect their rates to increase dramatically as growers become more familiar with currently available technologies.

Ultra Narrow Row. Ultra-narrow row cotton (UNRC) production systems are based on stripper harvest and cotton generally planted in 7.5, 10.0, or 15.0-inch row widths [Sprott, et al]. Often the system is based on genetically modified varieties. UNRC is typically planted flat, with or without deep tillage and pre-emergence chemicals. UNRC is often produced no-till, especially in the non-Delta area of Mississippi and on the heavier soils in the Delta.

A disadvantage of this system is the large amount of seed required. This is especially troublesome when some of the more expensive genetically modified varieties are employed. Rebates to UNRC growers, where the per acre technology fee is based on pounds of seeds planted per acre, will be important. Another disadvantage lies in the "perceived" discount associated with stripper cotton. The advantages lie in reduced labor, power, and equipment requirements per acre. Problems may exist with current harvesting and ginning technology. In the authors' opinion, these problems, if real, will be quickly and easily solved if UNRC acreage increases significantly.

No-Till. A few of Mississippi's cotton producers have been employing this technology for several years. As with UNRC, some producers have attempted this approach and have discontinued its use.

No-till cotton is being grown successfully (profitably) in Mississippi. For example, the authors are researching a no-till cotton monoculture farm (which has some cotton on non-cotton soils) that produces approximately 1,000 acres of cotton with one tractor, one planter, two high-boys, and one 4-row picker. Farm profits have increased since the no-till technology was initiated.

With this technology, the soil is undisturbed except when absolutely necessary, such as extreme rutting associated with wet harvesting conditions. This system employs the standard spindle picker. In general this system reduces fixed costs on a percentage basis much more than direct costs. In addition, labor, power, and equipment requirements are reduced relative to conventional production systems. Most of the farms utilizing these systems employ genetically modified varieties on a percentage of the acreage but some growers rely entirely on conventional varieties. Typically no-till cotton farmers produce all of their crops by employing no-till technology.

Skip-Row. These systems have fewer linear feet of row per acre than solid planted cotton. With full-skip (2 x 1) planting patterns, materials applied "down the row" are 67% of solid and on narrow-skip they are 77% of solid [Parvin, Cooke and McCarty]. In addition, there are two other important distinctions. The yield reduction [Cooke] should be considerably less than the reduction in linear feet of row (88-96% of solid on a land acre basis). The serious reader is referred to Research Report 99-004 for a detailed review and summary of the Mississippi research literature associated with the impact of soil types on cotton yield and their interaction with planting patterns. Harvesting costs (approximately $100 per acre with solid cotton) [Parvin, et al, 1999; Stephens, Parvin and Cooke] are reduced.

According to conventional wisdom, low prices favor skip-row planting patterns while high prices favor solid planted cotton. Current high production costs have redefined the point at which a low price becomes a high price relative to skip-row versus solid planting pattern decisions. Growers considering a shift from solid to skip-row cotton must be able to produce high yields, more than 90% of the solid yield on a land acre basis.

Relative to solid planted 40-inch cotton, full-skip, usually denoted "2 x 1", has an 80-inch skip between the drills in the skip-row. In other words, full-skip has an additional 40-inch skip for every third unplanted row. Narrow-skip planting pattern has a 64-inch skip between the drills in the skip-row, i.e., an additional 24-inch skip relative to solid planted but 16 inches less than a full skip pattern.

Solid cotton planted in 40-inch rows has 13,068 linear feet of row per acre while narrow-skip has 10,052.3 linear feet of row per acre. A narrow-skip pattern is 76.92 percent cotton relative to solid planted cotton. Additionally, there is another important distinction. One turn, or round, through the field with a 4-row cotton picker in solid planted 40-inch cotton covers 320 inches. One turn with the same picker adjusted to harvest narrow-skip, covers 416 inches of width. With narrow-skip, the performance rates for the cotton harvesting units (pickers, boll buggies, and module builders) are improved so that their cost per acre is reduced. For example, the performance rate for a fully supported and efficient 4-row picker in solid planted cotton is 0.181 hours per acre [Parvin, et al, 1999]. The performance rate for the same picker in narrow-skip planted cotton is 0.139 hours per acre. One 4-row picker, boll buggy, module builder plus two tow tractors costs more than $400,000. Not only is harvest direct cost per acre reduced as a function of the change in performance rate. The potential exists to spread annual fixed cost over additional acres so that the fixed cost per acre is also reduced. If additional cotton acres are not available and fixed cost per acre is not reduced, harvest is completed in fewer days. A faster (fewer total days) harvest (a type of earliness) increases realized yield and quality (price [Parvin 1990a, 1990b]). A faster harvest also lowers the producer's level of risk.

In general, an acre of solid cotton exhibits higher yields than one acre of skip-row cotton. The narrower the skip, the closer the yield of skip-row cotton approaches the yield of solid planted cotton. Hence, narrow-skip exhibits higher yields than a full-skip pattern. The question is, at what range of prices of cotton does the difference in production costs and difference in yields favor solid cotton and over what range of prices is a specific skip-row pattern preferred.

Limited Seedbed/Chemical Tillage. These systems, often referred to as "reduced tillage", are built around chemical cultivation after emergence and maintenance of old seedbeds. In these systems, down the row deep tillage seems to be replacing subsoiling at a 45-degree angle to the row. These systems may or may not employ genetically modified varieties and preplant herbicides. Like UNRC and no-till systems, this approach reduces labor and items correlated with labor, such as tractors, towed equipment, fuel, and repairs.

It is very unlikely that current adjustments will result in one new system of cotton production emerging for all Mississippi growers [Parvin, Cooke and McCarty]. Production systems will differ by soil types. But producer attitudes related to dramatic reductions in the farm labor force, leased equipment, and custom farming (especially custom cotton harvest), will be important. Additionally, the portion of the farm that is irrigated, the percent equity in land

and equipment, the number of years remaining on current land leases, and level of management will be factors of major importance on selected farms. Initially, most adjustments will tend to be driven by efforts to reduce direct cost, but many of the adjustments (with proper planning) can have a positive impact on fixed costs and general farm overhead.

COSTS, YIELDS AND RETURNS

Table 2 reports estimated costs, yield and returns for eight cotton production systems [Parvin and Cooke, 1999]. The authors have made minor adjustments to the systems as previously reported so that comparisons between systems are as reasonable as possible. System 1, 8-row-38-inch solid, is considered the standard for Mississippi. Systems 2, 5, 6, and 7 employ the same production practices i.e., each "trip-over-the-field" is the "same". Materials are identical, but their rates are adjusted for planting pattern.

System 8 [Parvin, Cooke, and Stephens, 2000a; Parvin, Cooke, and Stephens, 2000b] is based on a case study of a large commercial operation in west Tennessee. It employs reduced tillage techniques and wider equipment. Systems 6, 7 and 8 utilize the 6-row harvester.

The data reported in Table 2 for Systems 3 and 4 (including yield) are averages of observations obtained during the 1999 production system. During 1999, ten no-till [Parvin and Cooke, 2000a] and 13 ultra-narrow row growers [Parvin and Cook, 2000b] participated in a detailed study designed to estimate the practices and costs associated with these systems of production. The growers selected were all commercial growers employing the technology on all or a substantial portion of their acreage.

The yield assigned to System 8 is based on historical yields at that location. The yields assigned to the other systems are long-term averages based on multi-year research in Mississippi.

The standard system, System 1, 8-row-38 inch solid, at the yield reported, results in negative returns above direct and fixed expenses of $6.20 (price of lint = $0.61 per pound). System 2 reports the same technology as System 1. The difference in net returns of approximately $50 per acre is due entirely to the additional width of the system. System 2 covers more acres per unit of time than System 1.

Net returns associated with Systems 3, and 4 are the same. Either system is expected to increase net returns relative to System 1 by approximately $60 per acre. These systems employ considerably less labor per acre and utilize less fuel per acre than System 1. Both employ more herbicides and growth regulators than the standard. However, two cost items should be noted. Insecticide costs for Systems 3 and 4 are those experienced in 1999, a low insecticide use year. Both are considerably less than the $90 per acre noted for the average associated with System 1. In addition, some of the savings in direct costs are due to lower ginning charges associated with reduced yields.

System 5 is similar to System 2 in that both are wider than System 1 and employ the same "trips-over-the-field".

System 6 also employs the same "trips-over-the-field," etc. as System 1. The difference of approximately $115 for both systems 5 and 6 is associated with the added width of the towed equipment, such as planters and cultivators, and the added width of the 6-row harvester versus the 4-row harvester.

The implication is clear, all else equal, wide systems are more efficient than narrow systems.

System 8 employs a combination of no-till practices after planting in conjunction with a 6-row picker "spread out" to facilitate the skip-row planting pattern. Some of the reductions in expenses are associated with the wider equipment and some are associated with the reduced tillage. Mississippi growers are cautioned that the results in Table 2 associated with System 8 were obtained in west Tennessee. West Tennessee insect pressure (on average) is lighter than most of Mississippi.

CONCLUSIONS

This research is preliminary in the sense that the information provided is for the purpose of conducting whole farm analysis instead of simply constructing and reporting per acre budgets. However, per acre budgets are necessary for whole farm analysis. No formal whole farm analysis has been conducted to date. However, some preliminary conceptualizations of whole farm analysis based on incomplete information indicate that systems based on reduced tillage and systems based on wider equipment are more efficient than our current standard system.

On certain soils, skip-row cotton appears to be more efficient than the standard. Equipment associated with System 7 is not commercially available. A grower employing this technology would by necessity have to customize most of his tools in his own farm shop and tools would probably have to fold twice.

Three whole farm situations appear promising. The first is a cotton monoculture farm (a farm that grows cotton and nothing but cotton). Preliminary analysis indicates that these farms are uniquely efficient. They capture advantages in the area of fixed costs, general farm overhead, and hired management. Additionally they are uniquely positioned to take advantage of savings associated with custom harvest.

Whole farms based on a cotton/corn rotation also appear promising. The most promising utilize a 30-inch row spacing for both crops. A major question is whether or not the cotton can be grown in a skip-row pattern. That decision probably depends upon the distribution of soil types on specific farms. The preferred rotation appears to be 1:1. This rotation of 50% cotton and 50% corn allows for maximum efficient use of the irrigation capacity of the farm.

A cotton/rice rotation is possible on some farms. The advantage of this rotation is that both crops are so-called "high value." Farms with a high proportion of forestdale and/or britain soils seem to fit this category.

SUGGESTED RESULTS

Conventional wisdom indicates that Mississippi's cotton soils require subsoiling or deep tillage to obtain their expected yields and that without annual deep tillage, yields will decline. In other words, no-till cotton production will not "work" in Mississippi.

However, it appears likely that no-till cotton production systems (with smaller tractors and no towed equipment, except for planting) can be successfully utilized on all Mississippi soils. Initial yields appear to be less than expected with conventional tillage systems, but over time will increase and will be equal to and possibly greater than conventional yields. The agronomic and/or soil physics characteristics that may cause this relationship are unknown to the authors. But, if the equipment that caused the compaction is not utilized, the compaction may not occur, and the need to correct it may not exist.

UNRC production, with current varieties, requires an above average level of management. UNRC growers would benefit from a major genetic change in plant type. UNRC plants should be relatively short, with no vegetative branches and only position one fruit on fruiting branches (only one fruiting site per fruiting branch). In addition, the plant should exhibit these characteristics in 15 inch as well as 7.5 inch and 10 inch rows. Until a cotton variety with a plant of this type is developed, it is unlikely that UNRC can be profitably grown on Mississippi's best cotton soils.

In Mississippi, most growers must harvest all their cotton in a timely manner every year or the farm firm may not survive. Harvesting is (once again) the most costly component of cotton production.

All of our initial whole farm studies indicate that cotton would benefit from a technological breakthrough in harvest, i.e. the labor associated with harvest is a serious bottleneck. More labor is required during harvest than at any other period of the cotton production year. This excess labor tends to make all cotton farms inefficient regardless of farm type: cotton monoculture, cotton/soybeans, cotton/corn, dryland or irrigated.

IMPLICATIONS FOR RESEARCH

A farm that shows promise is a land formed rice farm reorganized to grow cotton and rice. The cotton technology would be irrigated no-till UNRC. The authors have been unable to identify such a farm in Mississippi.

A second farm the authors would like to investigate would be a 12-row 38-inch full skip farming operation.

There is no doubt that the most efficient planting pattern varies by soil type. Additional planting pattern research by soil type is probably needed at this time. For example, 45-inch solid has never been compared with 30-inch 2 x 1 full skip. Both systems have the same number of linear feet of row per acre. The authors propose studies by soil types to examine, at a minimum, 30 and 38-inch solid, 30 and 38-inch full skip, as well as 45-inch solid, 50-inch solid, and 60-inch solid. Our experience leads us to believe the 45, 50, and 60-inch full skip should be examined at the same time.

Table 1. Expected (Budgeted) and State Average (Actual) Yield, Cost, Price, Gross Domestic Product, Deflated Price and Cost, Cotton, Mississippi, 1975-1999.

Year	Budgeted[1]	Actual[2]	Direct[1]	Fixed[1]	Sum[1]	Budgeted Cost per Pound	Actual Cost Per Pound	Price[2]	GDP[3] (billions)	GDP Index	Deflated Price	Deflated Total Cost	Actual Deflated Cost/LB
	Yield (in pounds)		Cost (in dollars)										
1975	700	454	227.11	47.80	274.91	37.66	60.55	52.50	42.09	1.0000	52.50	274.91	60.55
1976	700	376	213.42	49.42	262.84	36.01	69.90	61.50	44.55	1.0584	58.11	248.34	66.05
1977	700	581	219.13	53.43	272.56	37.34	46.91	52.50	47.43	1.1269	46.59	241.87	41.63
1978	700	561	234.08	61.33	295.41	40.47	52.66	60.00	50.89	1.2091	49.62	244.32	43.55
1979	700	657	260.36	71.08	331.44	45.40	50.45	63.50	55.23	1.3122	48.39	252.58	38.44
1980	700	488	290.27	75.38	365.65	52.24	74.93	76.40	60.33	1.4334	53.30	255.09	52.27
1981	700	626	300.78	91.57	392.35	56.05	62.68	58.40	66.01	1.5683	37.24	250.18	39.96
1982	700	853	331.68	110.00	441.68	63.10	51.78	60.00	70.17	1.6671	35.99	264.94	31.06
1983	700	640	323.79	102.44	426.23	60.89	66.60	66.20	73.16	1.7382	38.09	245.21	38.31
1984	700	767	320.40	95.45	415.85	59.41	54.22	56.00	75.92	1.8038	31.05	230.54	30.06
1985	700	764	310.23	92.66	402.89	57.56	52.73	55.90	78.53	1.8658	29.96	215.93	28.26
1986	700	571	310.62	93.23	403.85	57.69	70.73	50.90	80.58	1.9145	26.59	210.94	36.94
1987	700	829	300.87	87.06	387.93	55.42	46.79	63.60	83.06	1.9734	32.23	196.58	23.71
1988	750	736	318.18	87.55	405.73	54.10	55.13	53.70	86.09	2.0454	26.25	198.36	26.95
1989	750	732	329.09	84.20	413.29	55.11	56.46	62.90	89.72	2.1316	29.51	193.89	26.49
1990	750	728	334.53	88.53	423.06	56.41	58.11	65.40	93.60	2.2238	29.41	190.24	26.13
1991	750	888	355.33	85.78	441.11	58.81	49.67	55.20	97.32	2.3122	23.87	190.78	21.48
1992	750	761	371.48	86.19	457.67	61.02	60.14	52.60	100.00	2.3759	22.14	192.63	25.31
1993	750	572	363.89	75.82	439.71	58.63	76.87	57.50	102.64	2.4386	23.58	180.31	31.52
1994	825	806	401.21	76.87	478.08	57.95	59.32	71.70	105.09	2.4968	28.72	191.48	23.76
1995	825	622	407.95	84.11	492.06	59.64	79.11	73.40	107.51	2.5543	28.74	192.64	30.97
1996	825	819	394.30	77.30	471.60	57.16	57.58	68.00	109.53	2.6023	26.13	181.22	22.13
1997	825	901	422.04	67.44	489.48	59.33	54.33	65.20	111.57	2.6507	24.60	184.66	20.50
1998	825	740	467.98	79.13	547.11	66.32	73.93	60.40	112.70	2.6776	22.79	204.33	27.61
1999	825	704	454.16	82.93	537.09	65.10	76.29	47.00	115.00	2.7322	17.20	196.58	27.92

[1][Cooke, et al. 1975,82,83,84,86; Dillard, et al; Hurt, et al; Laughlin, et al. 1995,97; Lee, et al. 1993,94; Parvin, et al. 1976,77,78,79,80,81; Robinson, et al. 1997,98; Simpson, et al; Stennis, et al. 1988,89,90,91; Williams, et al.]

[2]National Agricultural Statistics Service: http://www.nass.usda.gov:81/ipedb/

[3]U.S. Department of Commerce

Table 2. Estimated Costs, Yield, and Returns, 8 Production Systems, Mississippi, 2000.

	1	2	3	4	5	6	7	8
Item	**8-row-38"**	**12-row-38"**	**No-Till**	**UNR**	**8-row-Full-Skip**	**8-row-NSK**	**12-row-38" 2x1**	**12-row-30" 2x1**
	dollars/acre							
Operator labor	20.83	13.93	12.46	8.69	13.09	15.66	11.13	10.52
Diesel fuel	13.08	8.95	6.27	4.42	8.24	8.48	6.94	6.20
Repairs & maintenance	40.52	30.74	25.62	15.21	28.27	28.47	25.12	29.13
Interest on Operating Capital	14.32	13.61	17.62	18.52	9.77	12.65	10.88	17.66
Gin	66.00	66.00	56.74	56.91	59.52	60.80	59.52	64.00
Haul	16.50	16.50	14.18	14.33	14.88	15.20	14.88	16.00
Growth regulators	9.00	9.00	13.57	22.04	6.00	4.25	6.00	6.99
Harvest aids	16.79	16.79	12.69	20.88	11.14	11.14	11.14	9.32
Fertilizers	36.96	36.96	36.89	43.78	33.03	34.01	34.11	69.63
Herbicides	35.27	35.27	71.49	56.58	38.52	36.21	24.64	22.82
Insecticides	91.13	91.13	26.24	17.68	60.57	60.57	60.75	20.30
Seed	9.40	9.40	10.81	35.09	6.26	7.24	6.26	7.92
Total Specified Expenses	573.39	520.67	432.26	428.87	404.39	414.23	394.41	415.02
Yield (lbs. of lint/ac.)	825	825	709	706	744	760	744	800
Income[1]	567.19	567.19	487.44	485.38	511.49	522.50	511.49	550.00
Returns	**-6.20**	**46.52**	**55.18**	**56.51**	**107.09**	**108.27**	**117.08**	**134.98**

[1]includes 1.55/lbs. of seed per pound of lint at $0.05/lb, price of lint = $0.61/lb.

LITERATURE CITED

Ashley, W.R. 1958, "General Systems Theory as a New Discipline." General Systems, 3, pp. 1-6.

Boulding, Kenneth. 1956, "General Systems Theory." Management Science, Vol. 2, pp. 197-208.

Cooke, F.T. 1975, "Row spacings to lower production costs." Proceedings of Beltwide Cotton Production-Mechanization Conference, New Orleans, LA.

Cooke, Fred T., Jr., et al. 1975, "Crop Budgets and Planning Data for Major Farm Enterprises in the Mississippi-Louisiana Delta, 1975." Mississippi Agricultural and Forestry Experiment Station Bulletin 834.

Cooke, Fred T., Jr., et al. 1982, "Estimated Costs and Returns, Crops, Delta Area of Mississippi, 1982." Agricultural Economics Report No. 3, Mississippi State University.

Cooke, Fred T., Jr., et al. 1983, "Estimated Costs and Returns, Crops, Delta Area of Mississippi, 1983." Agricultural Economics Report No. 8, Mississippi State University.

Cooke, Fred T., Jr., et al. 1984, "Estimated Costs and Returns, Crops, Delta Area of Mississippi, 1984." Agricultural Economics Report No. 14, Mississippi State University.

Cooke, Fred T., Jr., et al. 1986, "Estimated Costs and Returns, Cotton, All Areas of Mississippi, 1986." Mississippi Agricultural and Forestry Experiment Station.

Dillard, James G., et al. 1992, "Cotton 1993 Planning Budgets." Agricultural Economics Report 51, Mississippi State University.

Hurt, Verner G., et al. 1986, "1987 Cotton Costs and Returns." Agricultural Economics Report 20, Mississippi State University.

Laughlin, David H., et al. 1995, "Cotton 1996 Planning Budgets." Agricultural Economics Report 71, Mississippi State University.

Laughlin, David H., et al. 1997, "Cotton 1997 Planning Budgets." Agricultural Economics Report 81, Mississippi State University.

Lee, John E., Jr., et al. 1993, "Cotton 1994 Planning Budgets." Agricultural Economics Report 58, Mississippi State University.

Lee, John E., Jr., et al. 1994, "Cotton 1995 Planning Budgets." Agricultural Economics Report 65, Mississippi State University.

Optner, S.L. 1965, "Systems Analysis for Business and Industrial Problem Solving." Englewood Cliffs, N.J.: Prentice-Hall.

Parvin, David W., Jr., et al. 1976, "Cost of Production Estimates for Major Crops, Mississippi Delta, 1976." Mississippi Agricultural and Forestry Experiment Station Bulletin 843.

Parvin, David W., Jr., et al. 1977, "Budgets for Major Crops, Mississippi Delta, 1977." Mississippi Agricultural and Forestry Experiment Station Bulletin 850.

Parvin, David W., Jr., et al. 1978, Budgets for Major Crops, Mississippi Delta, 1978." Mississippi Agricultural and Forestry Experiment Station Information Bulletin 2.

Parvin, David W., Jr., et al. 1979, "Budgets for Major Crops, Mississippi Delta, 1979." Mississippi Agricultural and Forestry Experiment Station Research Highlights Bulletin 40.

Parvin, David W., Jr., et al. 1980, "Budgets for Major Crops, Mississippi Delta, 1980." Mississippi Agricultural and Forestry Experiment Station Research Highlights Bulletin 47.

Parvin, David W., Jr., et al. 1981, "Budgets for Major Crops, Mississippi Delta, 1981." Agricultural Economics Report 115, Mississippi State University.

Parvin, D.W. 1990a., "The importance of harvest initiation date." Beltwide Cotton Production Research Conference, Las Vegas, NV.

Parvin, D.W. 1990b., "The weight loss associated with defoliated cotton and its implications." Beltwide Cotton Production Research Conference, Las Vegas, NV.

Parvin, D.W. and F. T. Cooke. 1999, "Current Adjustments to Cotton's High Production Cost and Low Price by Mississippi Producers." Staff Report 99-002, Department of Agricultural Economics, Mississippi Agricultural & Forestry Experiment Station, Mississippi Cooperative Extension Service, Mississippi State University.

Parvin, D.W., F. T. Cooke and Will McCarty. 1999, "The Impact of Current Cotton Price and Production Costs on Skip-Row Cotton." Research Report 99-004, Department of Agricultural Economics, Mississippi Agricultural & Forestry Experiment Station, Mississippi Cooperative Extension Service, Mississippi State University.

Parvin, D.W., et al. 1999, "Cotton 2000 Planning Budgets." Agricultural Economics Report 106, Department of Agricultural Economics, Mississippi Agricultural & Forestry Experiment Station, Mississippi Cooperative Extension Service, Mississippi State University.

Parvin, D.W. and F. T. Cooke. 2000a., "Costs, Yields, and Net Returns, Commercial No-Till Cotton Production, Mississippi, 1999." Research Report 2000-001, Department of

Agricultural Economics, Mississippi Agricultural & Forestry Experiment Station, Mississippi Cooperative Extension Service, Mississippi State University.

Parvin, D.W. and F. T. Cooke. 2000b., "Costs, Yields, and Net Returns, Commercial Ultra-Narrow Row Cotton Production, Mississippi, 1999." Research Report 2000-002, Department of Agricultural Economics, Mississippi Agricultural & Forestry Experiment Station, Mississippi Cooperative Extension Service, Mississippi State University.

Parvin, D.W., F. T. Cooke, and J. D. Stephens. 2000a., "Estimated Costs, Yields, and Returns Associated with 8-Row, 12-Row, and 12-Row Skip-Row Cotton Production Systems." Staff Report 2000-02, Department of Agricultural Economics, Mississippi Agricultural & Forestry Experiment Station, Mississippi Cooperative Extension Service, Mississippi State University.

Parvin, D.W., F. T. Cooke, and J. D. Stephens. 2000b., "Estimated Costs, Yields, and Returns Associated with 8-Row Solid and 12-Row Skip-Row Cotton Production Systems: A Case Study." Staff Report 2000-003, Department of Agricultural Economics, Mississippi Agricultural & Forestry Experiment Station, Mississippi Cooperative Extension Service, Mississippi State University.

Parvin, D.W.,Jr. and Fred H. Tyner. 1974, “The Systems Approach-Research or Research Management.” Southern Journal of Agricultural Economics.

Richardson, William B., et al. 1998, "Projected Costs and Returns and Whole Farm Analysis for Major Agricultural Enterprises Louisiana, 1998." A.E.A. Information Series No. 169-176. Louisiana State University.

Richardson, William B., et al. 1999, "Projected Costs and Returns and Whole Farm Analysis for Major Agricultural Enterprises Louisiana, 1999." A.E.A. Information Series No. 169-176. Louisiana State University.

Robinson, John R. C., et al. 1997, "Delta 1998 Planning Budgets." Agricultural Economics Report 90, Mississippi State University.

Robinson, John R. C., et al. 1998, "Delta 1999 Planning Budgets." Agricultural Economics Report 100, Mississippi State University.

Simpson, James H., et al. 1987, "Cotton 1988 Costs & Returns." Agricultural Economics Report 25, Mississippi State University.

Sprott, J.M., et al. 1976, "Agronomic, Economic, Energy and Environment Implications of Short-Season, Narrow-Row Cotton Production." Texas Agricultural Experiment Station Miscellaneous Publication-1250C.

Stennis, Earl A., et al. 1988, "1989 Costs and Returns Cotton." Agricultural Economics Report 30, Mississippi State University.

Stennis, Earl A., et al. 1989, "1990 Costs and Returns Cotton." Agricultural Economics Report 34, Mississippi State University.

Stennis, Earl A., et al. 1990, "Cotton 1991 Planning Budgets." Agricultural Economics Report 39, Mississippi State University.

Stennis, Earl A., et al. 1991, "Cotton 1992 Planning Budgets." Agricultural Economics Report 44, Mississippi State University.

Stephens, J.D., D.W. Parvin, and F. T. Cooke. 2000, "An Analysis of Narrow Skip-Row Cotton." Staff Report 2000-01, Department of Agricultural Economics, Mississippi Agricultural & Forestry Experiment Station, Mississippi Cooperative Extension Service, Mississippi State University.

U.S. Department of Commerce, Bureau of Economic Analysis. The Federal Reserve Bank of St. Louis. 1999. Gross Domestic Product: Implicit Price Deflator 1992=100, Seasonally Adjusted. http://www.stls.frb.org/fred/data/gdp/gdpdef.

Williams, Bob, et al. 1985, "Estimated Costs and Returns, Cotton, All Areas of Mississippi, 1985." Mississippi Agricultural and Forestry Experiment Station.

List of Additional Readings

Anderson, K.L. 1973. "Effects of Nitrogen Rate, Method of Application, Leaf Type and Row Width on Certain Characteristics of Cotton." Ph.D. Dissertation Mississippi State University, Mississippi State, Mississippi.

Anthony, W.S., W.D. Mayfield, and T.D. Valco. 1999. "1998 Ginning Study of Ultra Narrow Cotton." In Proceedings of the Beltwide Cotton Conference, National Cotton Council of America, Memphis, TN.

Bader, M.J. et al. 1999. "UNR Farm Trials in Georgia, 1998." In Proceedings of the Beltwide Cotton Conference, National Cotton Council of America, Memphis, TN.

Bertalanffy, Ludwig von, 1962, "General System Theory–A Critical Review." General Systems,7, pp. 1-20.

Boquet, D.J. et al. 1997a. "Cover Crops and Nitrogen Rate to Optimize Irrigated Cotton Yields with Conservation Tillage." In Proceedings of the Beltwide Cotton Conference, National Cotton Council of America, Memphis, TN, pp. 636-638.

Boquet, D.J. et al. 1997b. "Tillage and Cover Crop Effects on Cotton Growth Yield and Soil Organic Matter." In Proceedings of the Beltwide Cotton Conference, National Cotton Council of America, Memphis, TN, pp. 639-641.

Bradley, J.F. 1993. "Success with No-Till Cotton." In Arkansas Agricultural Experiment Station Special Publication 160, pp. 46-48; revised 01-25-95.

Brown, H.B. "Cotton." McGraw Hill Co., New York, NY. 1938.

Brown, H.B. "Cotton Spacing." Mississippi Agricultural Experiment Station Bulletin 212, 1923.

Burmester, C.H., M.G. Patterson, and D.W. Reeves. 1997. "Effect of Tillage, Herbicide Program and Row Spacing on Cotton Growth and Yield in Two Conservation Tillage Systems." In Proceedings of the Beltwide Cotton Conference, National Cotton Council of America, Memphis, TN, pp. 626-628.

Conway, G. R. 1976. "The utility of system analyses techniques in pest management and crop protection." Proc. Of the 15th International Congress of Entomology, Washington, DC.

Cook, A.F. and R.M. Meade. "Arrangements of Parts in the Cotton Plant." U.S. Department Agr. Bur. Plant Ind. Bulletin 222, 911.

Cooke, F.T. 1999. "Examine Each Input Closely and Put it to the Pencil." Cotton Grower Plus.

Cooke, F. T. 1975. "Row spacings to lower production costs." Proceedings of Beltwide Cotton

Production-Mechanization Conference. New Orleans, LA.

Cooke, F.T. and A.M. Heagler. 1969. "An economic appraisal of skip-row cotton planting in the Yazoo-Mississippi Delta." Bulletin 697, MAFES, MSU.

Cooke, F. T. and W. I. Spurgeon. "Limited tillage and row spacings for lower cotton production costs." Proceedings of 16th Annual Meeting of Louisiana Association of Agronomists, Baton Rouge, LA, March 11-12, 1975.

Cooke, Fred T., Jr., Gordon Andrews, and Roy Meeks. "The Economic Importance of Earliness in Delta Agriculture." Delta Business Journal, Vol. 1, No. 4, p. 24-25. September 1998.

Cooke, Fred T., Jr., David W. Parvin, Jr., and Stan R. Spurlock. "The costs of cotton harvesting in the Mississippi Delta." MSU/MAFES Bulletin 972, January 1991.

Fulgham, F. E., J. R. Williford and F. T. Cooke. 1973. "Stoneville wide-bed cultural systems." Bul. 850, MAFES, MSU.

Hall, A.D. and R.E. Fagen. 1956, "Definition of Systems," General Systems, I, pp. 18-29.

Hart, W.E. et al. 1996. "Cotton Yield Performance: The Effect of Row Spacing, Tillage, and Growth Regulator." Tennessee Agri Science, Number 179, pp. 21-25.

Heitholt, J.J., W.T. Pettigrew, and W.R. Meredith, Jr. 1992. "Light Interception and Lint Yield of Narrow-Row." Crop Science 32; 728-733.

Hurst, H.R. 1983. "The Influence of Winter Vegetation on Seedbed Preparation and Weed Control in Cotton." Mississippi Agriculture and Forestry Experiment Station Bulletin 923.

Hurst, H.R. 1994a. "Weed Control With 'Low' and 'Normal' Input Practices in No-Till and Conventional-Till Cotton." Proceedings of the 1994 Southern Conservation Tillage Conference for Sustainable Agriculture, Columbia, South Carolina.

Hurst, H.R. 1994b. "Redvine Control With Fall-Applied Banvel ® and Roundup® After Harvest of No-Till Grain Sorghum." Mississippi Agriculture and Forestry Experiment Station Research Report 19(5).

Hurst, H.R. 1996. "Minimum Tillage Weed Control in Clay Soils." In Proceedings of the 1996 Beltwide Cotton Proceedings Research Conference, National Cotton Council, Memphis, Tennessee, pp. 1550.

Hurst, H.R. 1999. "Redvine Control on Clay with No-Till." In Proceedings of the 1999 Beltwide Cotton Proceedings Research Conference, National Cotton Council, Memphis, TN, pp. 751-752.

Huskin, P.E. and C.O. Gwathmey. 1996. “Fifteen Years of Testing Cotton Response to Tillage Systems.” Tennessee Agri Science, Number 179, pp.18-20.

Kirk, I.W., A.D. Brashears, and E.B. Hudspeth, Jr. "Influence of Row Width and Plant Spacing on Cotton Production Practices On The High Plains." Texas Agricultural Experiment Station Miscellaneous Publication 937, 1969

McClelland, Charles A. 1962, "General Systems and the Social Sciences." ETC, 18, pp. 449-468.

Parvin, D.W. "The importance of harvest initiation date." Beltwide Cotton Production Research Conference, Las Vegas, NV. January 1990.

Parvin, D.W. "The weight loss associated with defoliated cotton and its implications." Beltwide Cotton Production Research Conference, Las Vegas, NV. January 1999.

Parvin, D.W. and F.T. Cooke. 1979. Interdisciplinary Research in Agriculture. Proceedings Beltwide Cotton Prod. Reg. Conf. Phoenix, AZ.

Parvin, D.W. and F.T. Cooke, 1990. The mathematics of cotton harvest." Proceedings Beltwide Cotton Prod. Res. Conf., Las Vegas, NV.

Parvin, D.W., Jr., F. T. Cooke, Jr., W. P. Scott, and J.W. Smith. 1985. "The economics of cotton harvesting in the Midsouth." MAFES Staff Paper Series #69.

Parvin, D.W., Jr., J.W. Smith, and F.T. Cooke, Jr. 1987. "Cost effectiveness of harvesting at the right time." Beltwide Cotton Production Conference. Highlights of Cotton Production Research Conferences, Special Sessions: Cotton Quality Improvement, Short Season Cotton Production Systems, New Developments from Industry. Dallas, TX.

Parvin, D.W., Jr. and Fred H. Tyner. "A Procedural Outline for Developing a Complete Simulation Model of a Cotton Production System." Staff Paper No. 10, Department of Agricultural Economics, Mississippi State University, Fall 1973.

Sappingfield, W. and S.D. Atwell. 1970. “The Influences of Very Narrow Rows on Cotton Structure and Yield on Sandy Loam and Clay Soils.” University of MO Bulletin.

Spurlock, Stan R. and David H. Laughlin. “Mississippi State Budget Generator User’s Guide Version 3.0.” Agricultural Economics Technical Publication No. 88, Mississippi State University, July 1992.

Spurlock, S.R., D.W. Parvin, Jr., and F.T. Cooke, Jr. 1991. "Impacts of scrapping on harvest costs." Beltwide Cotton Conferences. San Antonio, TX.

Tyner, Fred H. and D.W. Parvin, Jr. "Use of Systems Analysis as a Tool for Organization and Management of Agricultural Experiment Station Research." Staff Paper No. 9., Department of Agricultural Economics, Mississippi State University, Fall, 1973.

Wilson, S.G. et al. 1999. "Economic Analysis of Ultra Narrow-Row Cotton Production in the Coastal Plain Region of Georgia." In Proceedings of the Beltwide Cotton Conference, National Cotton Council of America, Memphis, TN.