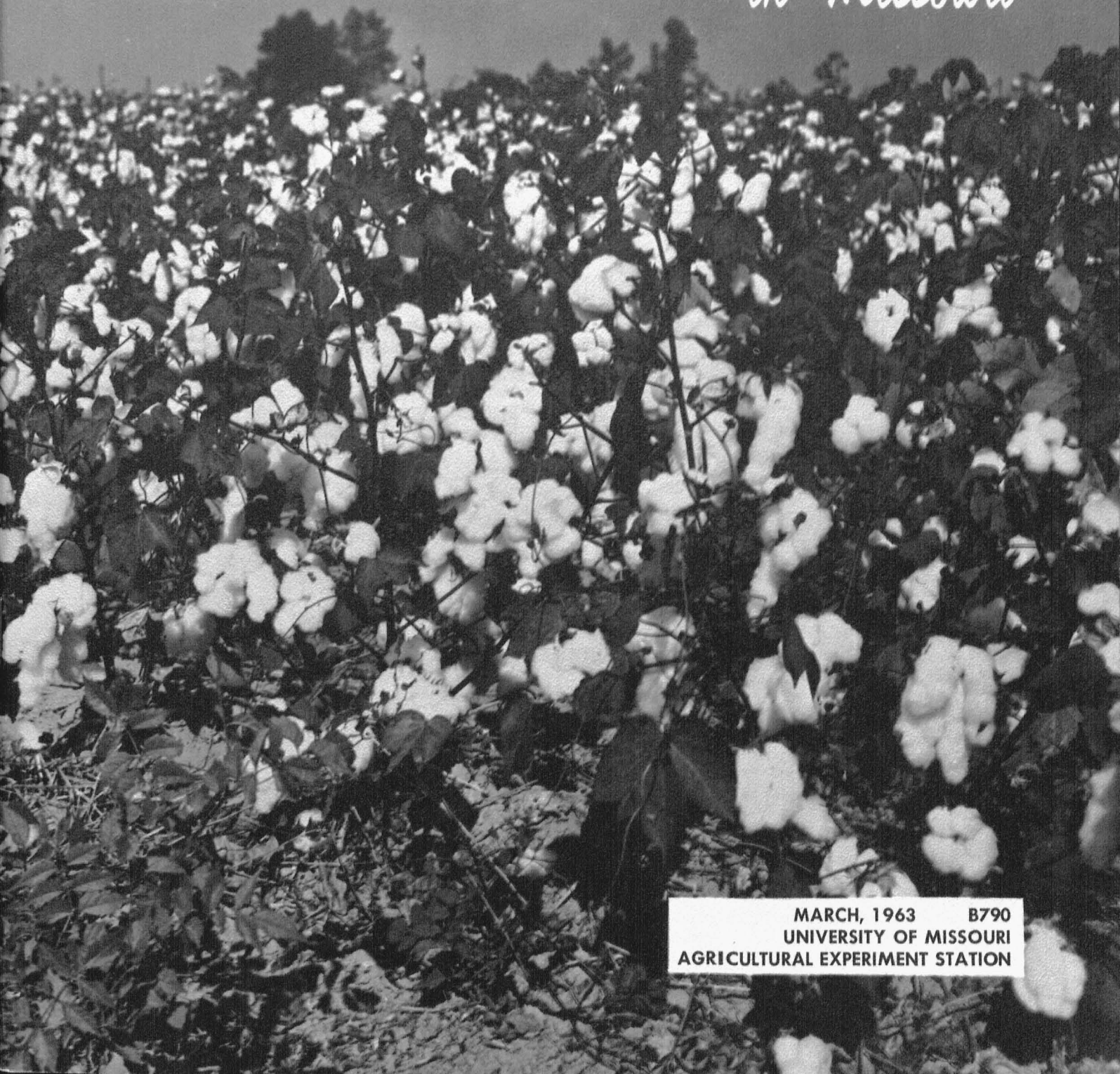
Costs and Returns of PRODUCING COTTON in Missouri



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Summary

One of the basic needs of farmers is to have accurate production information. This production information, often called input-output data, is essential in planning, and must be kept up to date. In 1959, a three-year study was started to determine the current costs and returns of producing cotton in enterprises of various sizes and to study the influence of level of mechanization, lint yield, lint prices, and level of fertilizer use on net income.

Detailed records were obtained from Missouri cotton producers in 1959, 1960, and 1961. The weather was excellent in 1959; 1960 was a "good" year, but most farmers had to replant their cotton; and 1961 could best be called a "fair" year. Among the more important results revealed in this study were:

1. Lint yields on the farms studied averaged 680 pounds per acre in 1959, 622.8 pounds in 1960, and 538.5 pounds in 1961. The yield decline in the three-year period corresponds to the weather conditions noted above.

2. The average cost of production per acre of cotton declined each year of the study: $149.05 per acre in 1959, $133.97 in 1960, and $119.62 in 1961. Certain costs are directly associated with lint yields, thus some reduction in per acre costs in 1960 and 1961 would be expected as a result of the lower yields.

3. The average cost of production per cwt. of lint was approximately the same all three years. As it cost approximately $22 per cwt. of lint under three different weather conditions, this figure should be a practical cost guide for farmers using a good general run of production practices.

4. There was considerable variation in costs among the individual farms studied. Total costs on individual farms varied from $15.44 to $28.68 per cwt. of lint produced. These data show clearly that farmers in the upper end of this range must reduce costs to compete successfully in the future.

5. Labor and machinery costs amounted to over one-half of the total cost of cotton production. There was a definite decline, however, in total labor and machinery costs per acre, from $86 in 1959 to $61 to 1961. Part of this decline was due to lower lint yields, and part due to greater mechanization. Increased machine picking was the major change, but greater use was also made of mechanical and chemical methods of weed control.

Considering the high percentage of total cost that labor and machinery represents, no other phase of cotton production offers as great a challenge for cost cutting as these two items. This is particularly true for small farmers.

6. Net returns to management averaged highest in 1959 at $85.44 per acre. Lower yields and lower price supports in 1960 caused net returns to decline to $75.82 per acre. Net returns increased again in 1961, to $81.27 per acre. Higher cottonseed and lint price (due to support price and lint quality) more than offset the lower 1961 yield. Net returns per acre varied a great deal on the individual farms.

7. The relationships of costs and returns to cotton acreage were not consistent over the three years. Net income per acre was more variable on small farms than on larger ones, due mainly to the ability or inability of the small farmer to hold down labor and machine costs. Results, however, show that the small producer can compete with the large producer, if he can attain high yields and hold down labor and machine costs.

8. The method of harvesting had a major impact on harvesting costs. Generally speaking, the more labor involved in the harvesting operations the higher the costs per acre and per cwt. of lint produced.

9. Method of harvesting had a tremendous impact on total labor used in cotton production. Farmers who machine picked their entire crop used only 20 hours of labor per acre to produce cotton, whereas those who hand picked cotton used around 100 hours of labor per acre.

10. A very significant result of this study was the tremendous effect lint yield had on net income. Net income per acre was directly related to lint yield. For example, farmers with lint yields of nearly two bales per acre averaged $70 more net income per acre than farmers with yields of one bale. Farmers with high yields had higher costs per acre, but costs were lower per cwt. of lint.

CONTENTS

Costs and Returns of Producing Cotton in Missouri

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Farm operators are faced each year with many decisions concerning the crops to grow, livestock to raise, machinery to buy, alternatives of voluntary governmental programs, and other aspects of the farm business. The profitableness of a farm business depends largely upon how well the farm operator chooses between alternative courses of action in these decisions.

Various budgeting techniques are available for systematically studying decision alternatives. These are techniques, however, and the success in their use depends upon the availability of accurate production information. The production information needed, often referred to as input-output data, includes physical production requirements (labor and machinery inputs) and financial information (costs and returns) for different sizes of operations and different methods of production.

Several years ago it became evident to persons working with cotton producers in Southeast Missouri that the input-output information available on cotton was out of date and needed revision. A three-year study was initiated in 1959 to supply current data. Results of this project, conducted by personnel of the University of Missouri Agricultural Extension Service and Department of Agricultural Economics, are presented in this report.

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Objectives and Method of Study

The specific objectives of this study were:

1. To determine the physical input-output relationships and the costs and returns of producing cotton in relation to size of enterprise.

2. To determine the physical input-output relationships and the costs and returns of producing cotton in relation to level of mechanization.

3. To determine the effects of factors such as yields, amount of fertilizer, and various production practices on the costs and returns of producing cotton.

Detailed enterprise records were used to collect the data. The records were detailed to the extent that they provided data on hours of labor and machine use for the various field operations. Extension personnel obtained the cooperation of farmers in keeping these records and supervised the record keeping. Upon completion, the records were sent to the University and summarized by personnel in the Department of Agricultural Economics.

The results reported here cover the three crop years of 1959, 1960, and 1961. Forty-two farm cotton records were summarized in 1959, 27 in 1960, and 14 in 1961.[1] The decline in the number of records summarized was due to a number of factors, primarily shifts in Extension personnel and Extension personnel assignments. The small number of records kept on the 1961 cotton crop prevented the analysis of a number of important production factors; consequently, the 1959 and 1960 results will receive major emphasis in this report.

Production Conditions During Period of Study

To study the results correctly, it is necessary to briefly review the production conditions during the three years. In Southeast Missouri, 1959 was an excellent year for cotton production. The state average cotton yield was the highest on record. The weather was not as good in 1960, with wet spring weather forcing many farmers to replant their cotton. Yields were down over the previous

TABLE 1 - COSTS AND RETURNS PER ACRE OF COTTON PRODUCTION

Item	Averages of All Farms Studied in: 1959	1960	1961
Number of Farms	42	27	14
Average Cotton Acreage	57	61.2	75.4
Pounds of Lint Produced Per Acre	680	622.8	538.5
Costs: (Dollars)			
Total Labor Cost	42.18	32.49	23.96
Machine Cost (Operational)	25.58	23.27	23.37
Machine Depreciation	13.89	12.94	9.96
Taxes on Machinery	*	.90	.80
Interest on Machinery	4.35	3.00	2.74
Total Labor & Machine Cost	86.00	72.60	60.85
Materials:			
Fertilizer Cost	10.69	11.85	11.82
Seed Cost	2.76	3.63	2.47
Other Materials	3.74	3.41	3.39
All Materials (Including Seed & Fertilizer)	17.19	18.89	17.68
Ginning, Bagging, Other Marketing Charges	26.72	23.96	21.25
Land Charges (Total)	18.67	18.02	19.56
Miscellaneous	.47	.50	.28
Total of All Costs	149.05	133.97	119.62
Returns: (Dollars)			
Lint Receipts	214.87	179.61	179.10
Total Receipts (Lint + Seed)	234.49	209.79	200.89
Net Returns to Management	85.44	75.82	81.27
Efficiency: (Dollars)			
Returns Per $100 Charged for Land, Labor, and Capital	158.71	156.40	168.58

* Property tax on machinery not pulled out as separate item in 1959.

[1]The results of the 1959 cotton records were published in Agricultural Experiment Station Bulletin 758, *Cotton Production Costs and Returns,* November, 1960.

year on many farms but, generally speaking, 1960 could be classified as a "good" year.

The weather during the growing season of 1961 was the poorest of the three years for cotton. This is evident in the 1961 state average cotton yield of 469 pounds, compared with the 1960 average of 548 pounds and the 1959 average of 607 pounds. The quality of cotton lint was quite high in 1961, however, and commanded an appreciably higher price per pound than in either 1959 or 1960.

Thus, the records were obtained under three kinds of weather. This was advantageous to the project as it permitted analysis of production costs and returns under different conditions. Unfortunately, the number of records obtained declined each year to a point where only a minimum of relationships could be explored in 1961.

Average Costs and Returns

Cost Per Acre

The average cost of production per acre of cotton declined each year of the study (Table 1). Certain costs, such as custom machine picking, hand picking, and marketing costs (bagging and ginning charges) are directly associated with lint yields, thus the lower per acre costs in 1960 and 1961 when yields were lower could be expected.

The per acre cost of production varied a great deal from farm to farm. The highest total cost per acre was $242.45, recorded on one farm in 1959. Lowest cost was $89.33 per acre recorded on another farm in 1961. Some of this variation is due to variation in yields, but obviously many other factors were influential. Some of these can be changed readily by the farmer; others cannot. Importance of the various factors will be brought out later.

Cost Per Cwt.

As the data in Table 2 reveal, total costs of production per cwt. of lint produced averaged approximately

TABLE 2 - COSTS AND RETURNS PER 100 POUNDS COTTON LINT

Item	Averages of All Farms Studied in: 1959	1960	1961
Number of Farms	42	27	14
Average Cotton Acreage	57	61.2	75.4
Costs: (Dollars)			
Total Labor Cost	6.01	5.11	4.27
Machine Cost (Operational)	3.91	3.90	4.47
Machine Depreciation	2.09	2.18	1.89
Taxes on Machinery	*	.14	.15
Interest on Machinery	.63	.50	.52
Total Labor & Machine Cost	12.64	11.83	11.30
Materials:			
Fertilizer Cost	1.58	1.96	2.23
Seed Cost	.42	.62	.49
Other Materials	.59	.57	.62
All Materials (Includes Seed & Fertilizer)	2.59	3.15	3.34
Ginning, Bagging, Other Marketing Charges	3.92	3.88	3.94
Land Charges (Total)	2.81	2.98	3.65
Miscellaneous Costs	.07	.05	.03
Total of All Costs	22.03	21.89	22.26
Returns: (Dollars)			
Lint Receipts	31.51	30.34	33.25
Total Receipts (Lint + Seed)	34.41	33.61	37.27
Net Returns to Management	12.38	11.72	15.01

* Property tax on machinery not set out as separate cost item in 1959.

the same all three years even though weather conditions and yields were different. It cost the farmers an average of approximately $22 per cwt. of lint under the three different conditions. This figure appears to be a good production cost guide for Missouri farmers using the general run of production practices and utilizing labor and machinery at average efficiency.

There was considerable variation in the cost per cwt. of lint produced among the individual farms, but not as much as in the case of cost per acre because many costs are directly associated with the lint yield. There was less variation among producers in the total costs of production per cwt. of lint in 1961 than in 1960, and less variation in 1960 than in 1959 (Table 3). This is probably due, in part at least, to the smaller number of records each year and method of selection of cooperators, but it may be partly the result of greater adherence to recommended production practices, crop varieties, etc. (at least on the part of the farmers studied).

Although some variation would always be expected, the data point out clearly that cotton producers in the upper end of the per cwt. cost range must study carefully the many parts of their production process for ways to cut costs if they are to compete successfully in the future.

Receipts Per Acre

Receipts per acre of cotton depend upon the lint yield, lint quality, and the price received for lint and cottonseed. Lint yields on the farms studied averaged 680 pounds per acre in 1959, 622.8 pounds in 1960, and 538.5 pounds in 1961. The decline in yields was similar to that noted in the state average figures. Total receipts per acre declined each year of the study, from $234.49 in 1959 to $200.89 in 1961.

Receipts Per Cwt.

The decline in total receipts was not as great as the decline in lint yield during the period, primarily because of the higher government support price and the high lint quality in 1961. The farmers studied received an average of $33.25 per cwt. of lint in 1961, compared with $30.34 in 1960 and $31.51 in 1959 for their lint. The average price received for lint was influenced by the prevailing governmental program. The two alternative price support programs of 1959 and 1960 were replaced with a mandatory acreage control program in 1961.

Total receipts in 1961 were bolstered also by higher cottonseed prices. The average cottonseed price per ton received by Missouri producers on the 1961 crop was estimated by the Agricultural Marketing Service at $48.10, compared with $39.50 for the 1960 crop.

Net Returns

Net returns to management[2] averaged the highest in 1959, at $85.44 per acre. Lower yield was the major factor causing the net returns to drop to $75.82 per acre in 1960. Net returns to management increased again in 1961 to $81.27 per acre. Higher prices of lint and cottonseed in 1961 more than offset the lower lint yields. Net returns per cwt. of lint averaged higher in 1961 than in either of the previous years.

Net returns varied a great deal. One producer had a lint yield of 1,165 pounds and a net return to management of $191.65 per acre in 1960. On the other hand, a

[2]In determining net returns to management all costs of production, including the operator's labor used in direct production operations, have been charged against the cotton enterprise.

TABLE 3 - NUMBER OF FARMS IN THIS STUDY HAVING TOTAL PRODUCTION COSTS PER CWT. OF LINT IN VARIOUS COST CATEGORIES

Costs/Cwt. of Lint (Dollars)	No. of Farms 1959	No. of Farms 1960	No. of Farms 1961
Under 16.00	2	1	0
16.00 - 16.99	4	1	0
17.00 - 17.99	1	3	0
18.00 - 18.99	2	0	1
19.00 - 19.99	1	2	1
20.00 - 20.99	2	2	2
21.00 - 21.99	7	1	1
22.00 - 22.99	7	8	4
23.00 - 23.99	4	2	3
24.00 - 24.99	5	3	0
25.00 - 25.99	3	3	1
26.00 - 26.99	1	0	1
27.00 - 27.99	1	1	0
28.00 - 28.99	2	0	0
Total	42	27	14

farmer in 1959, the best production year, had a net income of only $30.18 per acre. This farmer had an above-average cotton yield of 560 pounds per acre.

Production Efficiency

One of the best measures of farm efficiency is the returns per $100 spent for land, labor, and capital. This measure is important as it tells the farmers how many dollars return (gross) he received for every $100 he spent for all production cost items. On individual farms this figure varied from $122 to $226. But the averages for the three years did not vary as much as might be expected with the different weather conditions. Two factors mentioned previously, (1) direct association of some costs with lint yield and (2) higher lint and cottonseed prices in 1961, were the important factors in this relative stability.

Production Costs

Tables 1 and 2 present the per-acre and per-cwt.-of-lint costs for various production items.[3] There were many similarities in expenditures for individual items during the three-year period, but there were also some interesting differences, reflecting the yearly production conditions and adjustments cotton farmers are making in their businesses.

Labor and Machinery

As expected, labor and machinery costs were the major cost items in the production of cotton. On the farms studied, labor and machinery costs amounted to over one-half of the total cost of production. During the three-year period, however, there was a definite decline in the total labor and machinery costs per acre, from an average of $86 in 1959 to $60.85 in 1961. Part of this decline (considerably less than 50 percent) was due to the level of lint yields. Where hand picking or custom machine picking is used, the harvesting costs per acre are directly associated with the lint yields and the lower yields in 1960 and 1961 would reduce these costs. But this was not the entire reason as evidenced by the fact that labor and machine costs per cwt. of lint also declined during the period.

Increasing substitution of machinery and chemicals for hand labor was clearly evident on the farms studied. The percentage of total production costs which were machine costs increased from 29.5 to 30.9 percent during the period, whereas the labor costs declined from 28.3 to 20.0 percent of the total. Part of this apparent increase in mechanization was due to fewer farms in our study in 1960 and 1961 having less than 25 acres of cotton, but greater mechanization was apparent in every size-of-enterprise category. Greater reliance on machine cotton picking was the major change, but greater emphasis was also placed on mechanical and chemical methods of weed control to reduce the amount of hand chopping.

Machinery costs were divided into two categories in this study: (1) operation costs and (2) ownership costs. Operation costs include a charge for such items as fuel, lubricants and repairs. Ownership costs include primarily charges for depreciation, property taxes, and interest on capital invested in machinery.

This division was made because the implications of the costs to the individual farmer are different. Operation costs for a specific machine are basically the same per hour of machine use whether the machine is used 100 hours or 200 hours. Total operation cost varies, therefore, in proportion to the amount of use of the machine.

Total ownership costs of a machine on the other hand are the same whether the machine is used 100 or 200 hours, but the ownership costs per hour would be only half as much if the machine is used 200 hours. Farmers need to understand the difference between these two classes of costs because of the importance of spreading the fixed ownership costs over an adequate number of bales of cotton. This is particularly true of the farmers with small cotton acreages, who must be very careful to hold down their machinery investments to a level that can be justified by their size of business.

Materials

During the three-year period, expenditures for materials, which included seed, fertilizer, insecticides, and other chemicals, averaged between $17 and $19 per acre. The materials costs averaged highest in 1960, primarily due to the wet spring which forced most farmers to replant their cotton.

The farmers spent an average of $10.69 per acre for fertilizer in 1959, $11.85 in 1960, and $11.82 in 1961. These averages approached 10 percent of the total cost of cotton production. The fertilizer figures include an annual charge for applications of fertilizers such as limestone and rock phosphate which benefit crops more than one year. As with most production items, there was a large variation in the fertilizer costs on individual farms; the smallest amount spent by an individual was $3.33 per acre and the largest $22.54. Although variations in fertilizer costs would be expected due to soil types, previous crop, and tenure situation, it was obvious that some producers were not using enough fertilizer to get the yields they should obtain (see later section on fertilizer costs and net income).

[3]In the appendix the specific methods of calculating the various costs are presented.

Approximately $3.50 per acre was spent on other chemicals. These included weed control chemicals, insecticides, fungicides, and defoliants. The variation among farms was from zero to $13 per acre, with farmers having large cotton acreages tending to use more chemicals. Expenditures for chemical weed and insect control are partly due to planned action and partly to the incidence of a problem.

Marketing Costs

Marketing costs, which include charges for ginning, bagging, C.C.C. storage charges, and in some cases dues of organizations working with cotton farmers, were approximately 18 percent of the total cost of production. This percentage was consistent during the three-year period. These costs amounted to around $3.90 per cwt. of lint. As the marketing costs are directly associated with the actual amount of cotton produced the average cost per acre declined each year of the study due to declining lint yields.

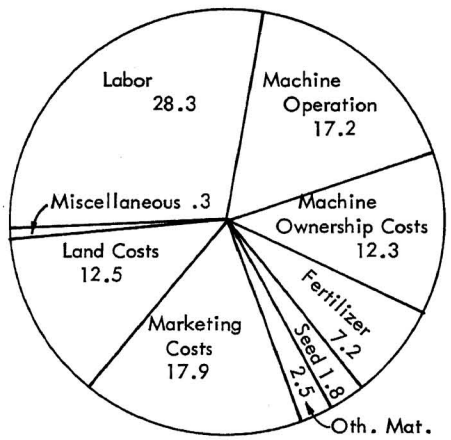
Land Costs

Land taxes and implicit interest on the investment in land averaged between $18.02 and $19.56 per acre for the three-year period. Among farms the land cost varied from $5.71 to $34.82 per acre. The range was large as the land on which cotton was produced varied a great deal in physical properties, from light sandy to heavy gumbo soil. The land charge averaged lower on the smaller farms as a number of these were located on the less productive soils in Butler and Ripley Counties. A surprisingly large variation in general real estate taxes, and special drainage district taxes paid on certain farms also contributed to the difference in land charges. The real estate taxes varied among individual farms from $0.71 to $5.00 per acre.

Miscellaneous Costs

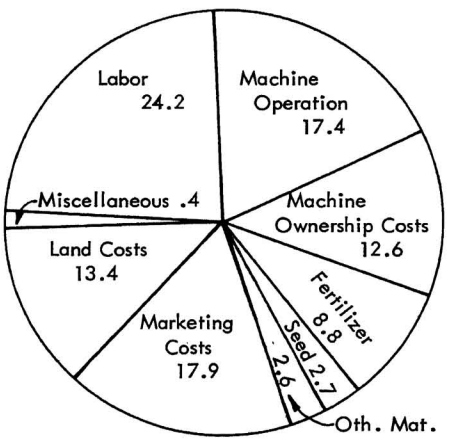
This category of costs included a multitude of items which could not be justifiably placed somewhere else. Examples are: (1) Cost of rye and vetch seed, where these were used as winter cover on cotton fields, (2) cost of geese used to clean weeds out of cotton, and (3) cost of hiring a cotton insect scout. These costs averaged less than 50 cents per acre on all farms, but on certain individual farms were major items.

Figure 1-A



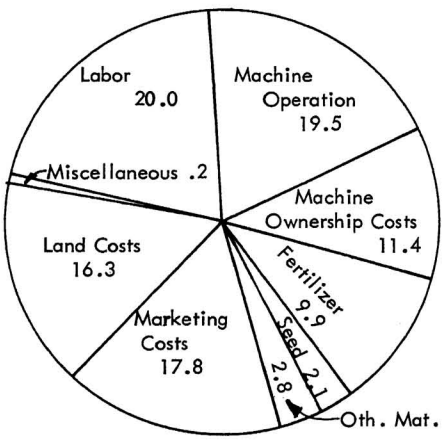
The percentages various costs were of total cost of producing cotton on 42 Missouri farms, 1959

Figure 1-B



The percentages various costs were of total cost of producing cotton on 27 Missouri farms, 1960

Figure 1-C



The percentages various costs were of total cost of producing cotton on 14 Missouri farms, 1961

General Comments on Costs

Cost items should not all be studied the same way. Some need to be reduced to increase net income. Others need to be increased to give greater income. It is desirable to divide different cost items into the three categories that follow.

Costs in Performing Necessary Functions

Some costs are for items employed because they are essential to cotton production. Seedbed preparation, planting and weed control are jobs which must be done. We do not usually think of these functions as influencing

the yields as long as they are done adequately. This is not strictly correct as it is difficult to say what is adequate, but assuming it to be correct the farmer should strive to select the methods that will perform these tasks at lowest cost for his size of enterprise. He should, for example, strive to find the combination of methods that will give adequate weed control at lowest cost per acre.

Income-Stimulating Costs

Other costs are for items employed to increase the yield and/or the quality of cotton produced. Fertilizers, insecticides, land leveling costs, and irrigation costs are examples of this type of costs. They are not absolutely necessary in cotton production.

The farmer should approach these costs entirely different from those listed above. He should not try to minimize these costs, but should approach them positively—in terms of added returns they produce versus the added costs associated with their use. For example a farmer considering whether to level his cotton land must estimate the added yields and income he can expect from this practice in relation to the added costs involved in adopting this practice.

This principle applies whether the item is an all or nothing proposition (deciding whether or not to spray for spider mites) or an item which can be used in varying amounts (fertilizer). The only difference is that for items which can be used in varying amounts the added returns and added costs must be estimated at different levels to determine the right amount to use. The emphasis in studying fertilizer costs and other income-stimulating cost items which can be used in varying amounts should be "how much will it pay me to use?" It should not be "how little must I apply to get by?"

A farmer should also include seed as an income-stimulating item; in other words, a farmer should not select the "cheapest" seed; rather, he should select seed for high germination, high yielding ability, and inherently high fiber quality.

Income-Associated Costs

Still other costs are directly associated with the level of production, i.e., the higher the lint yield per acre the higher these costs will be. These costs are different from those listed above in that they are the result of the yield level rather than the cause of yield level. Marketing costs (ginning, bagging, etc.) per acre, for example, are directly associated with the lint yield. Another example of these income-associated costs in cotton production is the charge for hand picking or custom machine picking. Charges for these two harvesting methods are on a per cwt. of seed cotton basis; thus the per acre costs of harvesting, where these methods are used, vary directly with the cotton yield. This was evident in the cost data presented above.

Consequently, you would expect these costs per acre to be higher on the more progressive farms; high per acre costs of these items does not indicate inefficiency. In examining these cost items for inefficiencies it is necessary to analyze them on a per unit of production basis (per cwt. of cotton lint).

Separating this kind of costs from the others may appear to be merely academic, but if the nature of these costs is understood it will have application in practical decision making. For instance, because of the nature of the charges for hand and custom machine picking a farmer obtaining high cotton yields would need a much smaller cotton acreage to justify owning a cotton picker than would a producer with low cotton yields.

Comparison of Enterprise Size and Costs and Returns

One of the major current trends in agriculture in the United States is the trend toward larger farm businesses. Greater production efficiency is the primary reason usually given for farmers increasing their size of business. One of the objectives of this study was to determine the relationship of acres of cotton to costs and returns.

Tables 4 to 6 give costs and returns data for different cotton enterprise size categories. A number of interesting relationships were revealed; but with the limited number of records it cannot be inferred that they exist for all cotton farms in Southeast Missouri.

Labor and Machine Costs

Total labor and machine cost *per acre* declined with increasing size of enterprise. A number of things contributed to this relationship, including higher lint yields and greater effort to attain these yields on small farms. Total labor and machine costs *per cwt. of lint* also averaged higher on the small acreages but the difference was not as great as when these costs were compared on a *per acre* basis. Producers with small enterprises had considerably more variation in these costs.

Labor costs, especially, were higher on the smaller enterprises as more of these producers hand-picked their cotton. The smaller producers also tended to do more hand chopping instead of relying on chemical weed control.

TABLE 4 - COSTS AND RETURNS PER ACRE AND PER CWT. OF COTTON LINT BY SIZE OF COTTON ENTERPRISE ON 42 MISSOURI FARMS IN 1959

Item	Average of all farms	Averages of Farms Having 5-24 all farms	24-49 acres	50-74 acres	75-99 acres	100-124 acres	125 or more acres
Number of Farms in Each Class	42	19	6	4	4	4	4
Average Acreage	57	12.1	37.8	61.6	83.8	106.5	185.5
Pounds of Lint Per Acre	680	702	763	587	635	668	622
Costs Per Acre: (Dollars)							
Total Labor Cost	42.18	50.29	55.95	37.25	31.16	20.40	27.73
Machine Operation Cost	25.58	27.79	24.23	13.70	24.04	32.50	24.04
Machine Ownership Costs	18.24	21.14	24.04	15.45	8.79	12.66	12.57
Total Labor & Machine Cost	86.00	99.22	104.22	66.40	63.98	66.56	64.34
Materials:							
Fertilizer Cost	10.69	10.43	10.61	9.65	12.27	13.45	9.09
Seed Cost	2.76	3.24	2.40	2.07	2.73	2.87	1.87
Other Materials	3.74	3.59	2.40	4.30	2.23	4.49	6.11
All Materials (Including Seed and Fertilizer)	17.19	17.26	15.41	16.02	17.23	20.81	17.07
Ginning, Bagging, Other Marketing Charges	26.72	27.95	30.49	21.18	25.12	26.41	23.90
Land Charges (Total)	18.67	16.02	119.38	21.02	20.48	25.39	19.22
Total of All Costs*	149.05	160.72	170.88	126.89	127.00	140.51	124.69
Returns Per Acre: (Dollars)							
Lint Receipts	214.87	221.61	243.19	182.81	202.24	213.78	191.90
Total Receipts (Lint + Seed)	234.49	242.23	264.35	198.26	221.58	233.63	210.09
Returns to Management	85.44	81.51	93.47	71.37	94.58	93.12	85.40
Costs Per Cwt. Lint: (Dollars)							
Total Labor & Machine Cost	12.46	14.16	13.61	11.38	10.27	10.27	10.57
All Materials (Including Seed and Fertilizer)	2.59	2.49	2.11	2.77	2.70	3.16	2.86
Ginning, Bagging, Other Marketing Charges	3.92	3.99	3.98	3.60	3.99	4.02	3.72
Land Charges (Total)	2.81	2.36	2.56	3.77	3.04	3.74	3.14
Total of All Costs*	22.03	23.04	22.33	22.00	20.10	21.41	20.38
Returns Per Cwt. Lint: (Dollars)							
Lint Receipts	31.51	31.58	31.61	31.14	31.69	32.02	30.91
Total Receipts (Lint + Seed)	34.41	34.53	34.38	33.79	34.62	35.03	33.84
Net Returns to Management	12.38	11.49	12.05	11.79	14.52	13.62	13.46
Efficiency:							
Returns Per $100 Charged for Land, Labor, and Capital	158.71	152.28	156.07	156.37	175.10	166.00	168.76

* Total cost will exceed sum of items listed as miscellaneous costs are not listed in this table.

TABLE 5 - COSTS AND RETURNS PER ACRE AND PER CWT. OF COTTON LINT BY SIZE OF COTTON ENTERPRISE ON 27 MISSOURI FARMS IN 1960

Item	Average of all farms	Farms Having Following Acreages of Cotton				
		5-24 acres	24-49 acres	50-74 acres	75-99 acres	100 or more acres
Number of Farms	27	8	7	6	2	4
Average Acreage	61.2	15.8	33.0	63.3	76.5	190.6
Pounds of Lint Per Acre	622.8	731.6	607.7	561.4	522.0	573.8
Costs Per Acre: (Dollars)						
Labor Cost	32.49	48.04	30.85	19.27	36.00	22.55
Machine Operation Cost	23.27	28.57	21.54	21.04	20.26	20.49
Machine Ownership Costs	16.84	12.23	17.07	21.20	15.25	19.77
Total Labor & Machine Cost	72.60	88.83	69.46	61.51	71.53	62.81
Materials:						
Fertilizer Cost	11.85	12.57	12.30	11.58	11.49	10.24
Seed Cost	3.63	4.01	4.76	2.49	3.09	2.89
Other Materials	3.41	2.04	2.21	4.95	2.32	6.45
All Materials (Including Seed and Fertilizer)	18.89	18.62	19.27	19.02	16.90	19.58
Ginning, Bagging, Other Marketing Charges	23.96	29.10	23.17	21.29	21.06	20.54
Land Charges (Total)	18.02	16.74	15.44	21.13	16.81	21.06
Total of All Costs *	133,97	153.29	128.21	123.61	126.30	124.79
Returns Per Acre: (Dollars)						
Lint Receipts	179.61	227.95	186.78	164.90	153.76	172.91
Total Receipts (Lint + Seed)	209.79	250.57	207.78	183.87	170.87	190.05
Net Returns to Management	75.82	97.28	79.57	60.26	49.57	65.26
Costs Per Cwt. Lint: (Dollars)						
Total Labor & Machine Costs	11.83	12.31	12.00	10.88	13.76	11.02
All Materials (Including Seed and Fertilizer)	3.15	2.58	3.38	3.49	3.30	3.35
Ginning, Bagging, Other Marketing Charges	3.88	3.98	3.94	3.79	4.06	3.59
Land Charges (Total)	2.98	2.37	2.55	3.79	3.21	3.65
Total of All Costs *	21.89	21.24	21.87	22.07	24.35	21.74
Returns Per Cwt. Lint: (Dollars)						
Lint Receipts	30.34	31.08	30.77	29.36	29.50	30.00
Total Receipts (Lint + Seed)	33.61	34.22	34.27	32.73	32.82	32.99
Net Returns to Management	11.72	12.98	12.40	10.66	8.47	11.25
Efficiency:						
Returns Per $100 Charged for Land, Labor, and Capital	156.40	162.52	162.86	149.84	135.04	153.41

* Total cost will exceed sum of time listed as miscellaneous costs are not listed in this table.

TABLE 6 - COSTS AND RETURNS PER ACRE AND PER CWT. OF COTTON LINT BY SIZE OF COTTON ENTERPRISE ON 14 MISSOURI FARMS IN 1961

Item	Average of all farms	Averages of Farms Having 10-49 acres	50-99 acres	100 or more acres
Number of Farms in Each Class	14	4	6	4
Average Acreage	75.4	29.0	66.1	135.8
Pounds of Lint Per Acre	538.5	531.4	544.8	521.1
Costs Per Acre: (Dollars)				
Total Labor Cost	23.96	25.79	26.27	18.66
Machine Operation Cost	23.37	26.39	22.51	21.66
Machine Ownership Costs	13.50	8.33	14.71	16.89
Total Labor & Machine Cost	60.85	60.52	63.50	57.22
Materials:				
Fertilizer Cost	11.82	9.20	10.44	16.52
Seed Cost	2.47	3.46	2.60	1.28
Other Materials	3.39	1.62	3.16	5.49
All Materials (Including Seed and Fertilizer)	17.68	14.28	16.20	23.30
Ginning, Bagging, Other Marketing Charges	21.25	20.79	22.57	19.74
Land Charges (Total)	19.56	20.00	19.56	19.13
Total of All Costs*	119.62	116.35	121.85	119.55
Returns Per Acre: (Dollars)				
Lint Receipts	179.10	171.93	187.16	174.19
Total Receipts (Lint + Seed)	200.89	193.91	209.82	194.47
Net Returns to Management	81.27	77.56	87.96	74.91
Costs Per Cwt. Lint: (Dollars)				
Total Labor & Machine Cost	11.30	11.56	11.31	11.04
All Materials (Including Seed and Fertilizer)	3.34	2.72	2.92	4.57
Ginning, Bagging, Other Marketing Charges	3.94	4.01	4.00	3.79
Land Charges (Total)	3.65	3.80	3.54	3.66
Total of All Costs*	22.26	22.15	21.79	23.08
Returns Per Cwt. Lint: (Dollars)				
Lint Receipts	33.25	32.65	33.55	33.40
Total Receipts (Lint + Seed)	37.27	36.77	37.57	37.33
Net Returns to Management	15.01	14.62	15.78	14.25
Efficiency:				
Returns Per $100 Charged for Land, Labor, and Capital	168.58	167.47	173.18	162.78

*Total cost will exceed sum of items listed as miscellaneous costs are not listed in this table.

Machine operation costs averaged higher per acre on the small enterprises, although this was not true for all small farms. Lower machine operation costs on the large enterprises was due to the fact that larger producers used larger equipment, often resulting in lower operation costs *per acre* but higher ownership costs. In a real sense a farmer with a given size of farm who switches from 2 to 4-row equipment or from a 1 to 2-row cotton picker is substituting (profitably he hopes) higher ownership costs for lower operating costs. Similarly, a producer who buys a cotton picker instead of having his cotton hand picked or custom machine picked is substituting ownership costs, partially, for cash operation costs.

It was pointed out that total labor and machine costs *per cwt.* of lint also averaged higher on the small acreages but the difference was not as great as when these costs were compared on the *per acre* basis. This result is important because, while we make comparisons on the per acre basis, and rightly so, the ability of a farmer to compete depends on his costs per cwt. of lint produced.

Rapid changes in production methods which occurred within this three-year period complicate the labor and machinery data. The major changes were the rapid adoption of mechanical picking during the period and greater reliance on chemical and mechanical weed control, both of which reduce the labor requirements of cotton production. According to USDA estimates, 47 percent of all cotton produced in Missouri in 1959 was machine picked; in 1961, 64 percent was machine picked. In the year preceding this study, 1958, only 33 percent was machine picked. These changes complicate average data because the changes do not occur with equal rapidity on all enterprise sizes.

Generally speaking, larger producers with enough acreage over which to spread fixed ownership costs have been able to adopt mechanical picking much faster than small producers. But during this period more and more of the producers with small cotton enterprises reduced their labor and machine costs greatly by finding ways of adopting mechanical picking. Usually this has been by hiring custom picking, but some bought pickers and did custom picking for other producers. The slower rate of adoption on smaller enterprises is the main reason for the greater variation in the labor and machine costs on the small farms.

Materials Costs

There was no consistent relationship between fertilizer costs and cotton acreage. Each year a different pattern was present, probably due to the limited number of records. As would be expected, farmers with the larger acreages made much more use of chemicals in weed control, insect control, and defoliation.

Marketing and Land Costs

Marketing costs, which are directly associated with lint yields, averaged higher per acre on the smaller enterprises which also averaged higher in yields. There was no apparent relationship between size of enterprise and land costs.

Total Costs and Returns in Relation to Size of Enterprise

The total cost and returns data were not completely consistent during the three-year period, thus each year is summarized separately.

In 1959 total production costs per acre and per cwt. averaged higher on the smaller cotton acreages than on the larger cotton enterprises. These average figures are consistent with the usual expected relationship, but they do not tell the entire story. Farmers with smaller acreages devote more effort and take greater pains with their cotton than farmers with large acreages. A certain part of their higher cost was due to this cause, which, in turn, was likely a major reason why the average yield was higher on the smaller acreages than on the larger ones.

Net returns to management in 1959 averaged somewhat lower per acre and per cwt. of lint on the smaller farms than on the larger farms, but the difference was not consistent. The average net return per acre was very satisfactory for all sizes of cotton enterprises.

In 1960 the total production costs *per acre* again averaged higher on the smaller cotton acreages than on the larger ones. On a *per cwt.* of lint basis, however, the total cost of production averaged somewhat lower on the small acreages. Higher yields on the farms with small cotton acreages was the major factor in the lower costs per cwt. of lint.

Net returns to management per acre and per cwt. of lint averaged higher on the small enterprises than on the large. The same relationship was true in terms of returns per $100 charged for land, labor, and capital. There were three farmers with less than 50 acres of cotton who had extremely high net earnings (one had a 1156 pound lint yield); but the net earnings were actually more consistently high on the small acreages than on the large.

In 1961 total costs per acre averaged approximately the same on farms in all three size categories, although slightly lower on the small enterprises (10 to 49 acres). Total costs per cwt. of lint averaged lowest on the enterprises in the 50 to 99-acre category—$21.79 compared with $22.15 on the small enterprises and $23.08 on the large enterprises.

Net returns averaged more than $10 per acre higher on the farms in the 50 to 99-acre size category than on farms in the other two size categories. Somewhat higher yields and a higher average lint price received by farmers in this size category were major factors in the higher net returns.

At first glance it may appear difficult to draw any conclusions from these results. Averages can hide important relationships and the number of records was

small. For this reason an intensive study was made of the individual records from which a number of conclusions can logically be drawn.

The three-year study revealed that the small producer can compete successfully with the large producer on a per acre basis. In two out of the three years the producer with the highest net returns per acre had less than 20 acres of cotton, and in all three years some small producers made very high net returns per acre. On the other hand there were small producers with low net returns per acre.

To compete successfully the producer with a small cotton acreage must strive for high yields and must strive to hold down certain costs (see discussion on costs). Large scale producers should also try to get high yields and hold down these costs, but on small operations these costs get out of line far more easily. The farmer with a small enterprise must strive to cut down labor costs and at the same time hold down fixed machinery ownership costs.

Costs of Performing Various Operations

Farmers cooperating in this study kept records of the hours of labor and machinery they used in doing various operations. This permitted a detailed analysis of the cost of performing various production jobs. As farms use different types and sizes of machinery and follow different practices to perform the same production job, no attempt was made to find the per-acre costs of a specific operation such as plowing or disking. The machinery cost figures include only operating costs; they do not include ownership costs. The various production operations are discussed briefly below. Finer points can be compared readily in Tables 7 and 8.

TABLE 7 - HOURS AND COST OF LABOR AND MACHINE USE* PER ACRE OF COTTON FOR VARIOUS PRODUCTION OPERATIONS

Item	Average of all farms 1959	Average of all farms 1960	Average of all farms 1961
Hours of Labor Used In:			
Seedbed Preparation	2.1	2.7	1.7
Planting, Fertilizing, etc.	.9	1.3	1.0
Cultivating, Chopping, Insect, etc.	18.7	13.8	12.8
Harvesting	33.3	26.6	18.6
Irrigation and Miscellaneous	.2	.2	.5
Total for All Operations	55.2	44.6	34.6
Hours of Machine Use In:			
Seedbed Preparation	2.1	2.7	1.7
Plainging, Fertilizing, etc.	.8	1.1	.8
Cultivating, Chopping, Insect Control	2.5	2.5	1.9
Harvesting	1.8	2.7	3.2
Irrigation and Miscellaneous	.2	.1	**
Total for All Operations	7.3	9.1	7.6
Total Labor & Machinery Cost In:			
Seedbed Preparation	$ 4.27	$ 5.66	$ 3.48
Planting, Fertilizing, etc.	1.80	2.55	1.80
Cultivating, Chopping, Insect Control	14.87	11.76	9.86
Harvesting	46.24	35.40	31.58
Irrigation and Miscellaneous	.58	.39	.61
Total for All Operations	67.76	55.76	47.33

* Includes only machine operation costs. Machine ownership costs are omitted from this specific comparison.

** Negligible amount.

TABLE 8 - HOURS AND COST OF LABOR AND MACHINE USE* PER ACRE OF COTTON FOR VARIOUS PRODUCTION OPERATIONS IN 1959

Item	Average of all farms	Size of Cotton Enterprise 5-24 acres	25-49 acres	50-74 acres	75-99 acres	100-124 acres	125 or more acres
Hours of Labor Used In:							
Seedbed preparation	2.1	2.2	2.2	2.1	2.0	2.0	2.0
Planting, fertilizing, etc.	.9	1.0	.9	.6	.9	.8	.8
Cultivating, chopping, insect control	18.7	20.9	19.5	19.5	14.1	15.0	15.4
Harvesting	33.3	39.7	49.0	23.4	23.2	13.0	21.9
Irrigation and miscellaneous	.2	.2	.4	.2	.2	.3	**
Total for all operations	55.2	64.0	72.0	45.8	40.4	31.2	40.1
Hours of Machine Use In:							
Seedbed preparation	2.1	2.2	2.2	2.1	1.9	2.0	2.0
Planting, fertilizing, etc.	.8	1.0	.6	.6	.8	.7	.5
Cultivating, chopping, insect control	2.5	2.8	2.9	1.8	2.4	2.2	2.1
Harvesting	1.8	1.6	2.1	1.6	2.3	2.4	2.2
Irrigation and miscellaneous	.2	.6	.2	.2	.2	.1	**
Total for all aoperations	7.3	8.2	8.0	6.3	7.6	7.4	6.8
Total Labor & Machinery Cost In: (dollars)							
Seedbed preparation	4.27	4.44	4.25	4.24	4.01	4.28	3.91
Planting, fertilizing, etc.	1.80	2.14	1.67	1.12	1.63	1.66	1.32
Cultivating, chopping, insect control	14.87	16.52	14.52	14.92	12.10	13.88	12.03
Harvesting	46.58	54.22	59.38	30.40	36.74	32.21	34.41
Irrigation and miscellaneous	.58	.76	.36	.27	.72	.87	**
Total for all operations	67.76	78.08	80.18	50.95	55.20	52.90	51.77

* Includes only machine operation costs. Machine ownership costs are omitted from this specific comparison.

** Negligible amount.

Seedbed Preparation

Farmers in this study employed a number of different specific practices and combinations of practices to prepare land for planting. About 40 percent of the producers bedded their land before planting. Practices varied primarily because of type of soil, kinds of equipment available, weather, custom in the community, and the preference of individual farmers. It was therefore virtually impossible with the limited number of records to determine the costs of each of these specific practices.

Planting, Fertilizing, and Accompanying Operations

Most of the farmers combined some other task with their planting. Attachments on planters permitted farmers to apply fertilizer and, in some cases, preemergence weed sprays at the same time they were planting cotton. Therefore, planting, fertilizing, and preemergence applications were combined into one category. It should be noted, however, that only the application cost, not the cost of fertilizer and spray materials, is included.

The difference between the hours of labor and hours of machine use in these operations is due to the extra man that some farmers used to help handle seed and fertilizer. The varying proportion of farmers in the different size categories using 4-row equipment is the major reason for the inconsistencies of hours of machine use (Table 8).

Cultivating, Chopping, and Insect Control

Expenditures for weed and insect control are partly due to planned action by farmers and partly due to the incidence of a problem. For example, a farmer applies preemergence weed control chemicals and treats seed with fungicides as a preventive means of controlling weeds and fungi. These are planned actions and are made before the problem actually exists. On the other hand the expenditure for hand chopping of cotton depends upon the amount of weeds in the cotton, and is not planned. Another expenditure that depends on the existence of a problem is the spraying for red spider mites. This

expenditure usually is not made unless an infestation occurs.

Expenditures for weed, fungi, and insect control varied considerably on these farms, primarily due to variations in the problems. The methods used to combat the problems also varied. The use of weed control chemicals increased during the three-year period; in 1959, 11 of the 42 farmers used weed control chemicals, 16 of the 27 farmers used them in 1960, and 9 of the 14 farmers used them in 1961.

Total cost (with the exception of machine ownership costs) of weed, insect, and fungi control averaged $17.65 per acre in 1959, $15.90 in 1960, and $12.25 in 1961. These figures exceed the figures shown in Table 7 because they include the cost of materials.

Harvesting

Methods of harvesting on the individual farms ranged from all mechanical picking to all hand picking. As stated earlier, the percentage of cotton which was machine picked increased within the three-year period. The next section of this bulletin gives an analysis of the costs of harvesting by different methods.

Irrigation and Miscellaneous

This category of labor and machine costs includes, in addition to irrigation, a number of tasks that cannot be properly classified in any other category. Examples are: (1) fixing fence for geese used in weeding, (2) repairing equipment, and (3) sowing rye and vetch used as cover crop (where chargeable to cotton).

Labor and machine use figures in this category are not very meaningful as production guides. For example, only five of the farmers in this study irrigated part or all of their cotton in 1959 and the irrigation costs on these five farms are divided by 42 to give an average on all farms.

Total Labor and Machine Use

Total hours of labor per acre on the average declined each year of the three year study (Table 7). The decline was rather striking; from 55.2 hours per acre in 1959 to 34.6 hours in 1961. A number of factors contributed to this decline: (1) fewer small enterprises, which often have higher labor requirements, in 1960 and 1961; (2) lower lint yields, which reduce labor needs on farms employing hand picking; (3) greater use of machine picking of cotton in 1960 and 1961; and (4) less hand chopping of cotton (partly due to weather differences). These data clearly show the trend of greater substitution of machinery for labor—particularly in harvesting. Labor used for seedbed preparation and planting and fertilizing averaged higher in 1960 than in 1959 and 1961 due to wet spring weather.

Total cost of labor and machine operation declined over 30 percent in the three-year period, as a result of factors mentioned above. It should be noted again that more decline in hours and cost of labor and machine use occurred on small acreages than on larger operations. Large operations had obviously adjusted far more toward mechanized cotton production prior to the study period. Operators of the small acreages were still in the process of adjustment.

Table 8 gives the hours and cost data by size of cotton enterprise for 1959. Because of the rapid changes in production methods within the three-year period it would have been desirable to present data for the last year of the study in this manner, but the limited number of records prohibited breaking down the size categories to this extent. The much higher labor requirement on the small operations in 1959 is clearly evident in this table. This should be contrasted to the fact that the average number of hours of labor use in 1961 on the four farms having less than 50 acres of cotton was only 35 hours per acre, approximately the average of all farms studied. None of these four producers hand-picked their entire cotton crop.

Comparison of Harvesting Costs by Method of Harvesting

As a result of improvements made during the past decade in the design of mechanical cotton pickers, Missouri farmers are now making widespread use of machine picking. A mechanical picker requires a large investment. Consequently, several questions arise, such as: (1) What is the minimum cotton acreage or amount of lint production a farmer must have before he can justify owning a cotton picker? (2) Should a farmer whose cotton acreage is too small to justify owning a picker hire a custom picker or harvest by hand? Obviously, many factors influence the answers to these questions.

Although this study was not designed specifically to answer these questions, analysis of the 1959 and 1960 records reveals some interesting relationships. Table 9 gives

the per cwt. costs of lint harvesting for the different harvesting methods.

Costs are calculated two ways in this table: (1) labor and machine operation costs and (2) total harvesting costs. The labor and machine operation cost figures include the cash costs which are normally paid at harvest time (fuel, lubricants, repairs, etc.), plus all labor used in harvesting. For custom operations and hand picking these figures include the entire charges of the hired machines and labor. The labor and machine operation costs on custom picked enterprises was $2.46 higher per cwt. of lint produced in 1959 and $2.87 higher in 1960 than where the operators owned the picker. The charge by a custom operator must reward him for all his costs.

Total harvesting cost includes, in addition to the labor and machine operation costs, any defoliants used and the ownership costs on cotton pickers and trailers (depreciation, interest, and property taxes). These were the total harvesting costs on the farms studied and should serve as typical cost guides, on a per cwt. of lint basis, for custom picking and hand picking.

Caution is needed in applying the total harvesting cost data to a specific farm under the following two situations: (1) machine picking when the operator owns the picker and (2) machine picking plus hand picking.

Total cost per acre could vary considerably for the individual farmer using his own picker, depending upon the amount of use made of the picker and the presence or absence of artificial defoliation. A machine owner needs to have an adequate volume of business over which to spread the fixed ownership costs of the picker and trailers. Eight of the 11 farmers who picked their entire crop with their own picker in 1959 also did custom picking for other producers to help pay their ownership costs.

The high cost that can occur with ownership of a picker if there is an inadequate volume of business is illustrated by one farmer with only 7.6 acres of cotton in 1959 who owned one. Besides his own cotton he did less than 20 acres of custom work. His total harvesting costs were $14.35 per cwt. of lint. This producer would have had an appreciably higher net income had he employed a custom machine operator.

In the second situation, where both machine and hand picking were employed, the data must be used cautiously because this group includes varying proportions of hand and machine picking and a number of harvesting methods. On some farms the first bolls that opened were picked by hand and later cotton was machine picked; on other farms some fields were entirely hand picked and some were machine picked; in still other cases farmers hand-snapped the "bollies" after the cotton had been mechanically picked. Furthermore, some of the operators used their own pickers while others hired custom machine operators. As it was impossible, with the limited number of records, to determine the costs under each of these situations, they were all put in one category.

Total harvesting costs per cwt. of lint averaged lowest both years on the farms where the operator owned the mechanical picker, but not much lower than where custom machine operators were employed. Greater utilization of the owned pickers was apparent in the lower costs in 1960.

Generally speaking, the more labor involved in the harvesting operations the higher the total costs were per cwt. of lint and per acre (data not shown). On the farms where the entire crop was machine picked, the total harvesting costs averaged around $3.00 per cwt. of lint lower than where the crop was entirely hand picked.

The data do not lend themselves to determination of the minimum amount of cotton lint or the minimum acreage to justify owning a cotton picker, but the average costs certainly show why machine picking is replacing hand picking in Southeast Missouri. A point to remember when considering whether or not to buy a mechanical picker is that the higher the cotton yields obtained the lower is the minimum acreage that justifies owning a picker.

Another important consideration concerning whether or not to use a mechanical picker is the effect of machine picking on cotton grade. Some farmers have experienced lower grades on machine picked cotton. However, cotton specialists point out that poor adjustment of the mechanical picker and poor machine operation are the major causes of the grade lowering. Proper adjustment combined with a skilled operator can go a long way toward overcoming the problem. Waiting until the cotton is dried to the specified moisture content before picking is another highly recommended practice to help maintain cotton quality.

Influence of Harvesting Method on Total and Seasonal Labor Requirements

One of the most important revelations of this study is the tremendous influence of the method of harvesting on the total labor requirements of producing cotton (Table 9). Farmers who machine picked their entire cotton crop used only around 20 hours of labor per acre, whereas those who hand picked their cotton used an average of 105 hours of labor per acre in 1959 and 94 hours per acre in 1960. The lower hand labor in 1960 was due to the lower lint yields. On a per cwt. of lint basis this amounts to 3 to 4 hours of labor with machine picking compared to 14 to 15.5 hours where hand picking was employed.

The labor requirements per acre averaged less than 60 hours on the farms using both hand and machine picking, but the variation on the individual farms in this group was from around 25 hours to more than 100 hours per acre. This large variation was due primarily to the extent and purpose of the hand picking, and variation in lint yields.

Fig. 2A—Monthly Distribution of Labor Used for Cotton on Farms Where Cotton Was Hand Picked, 1960.

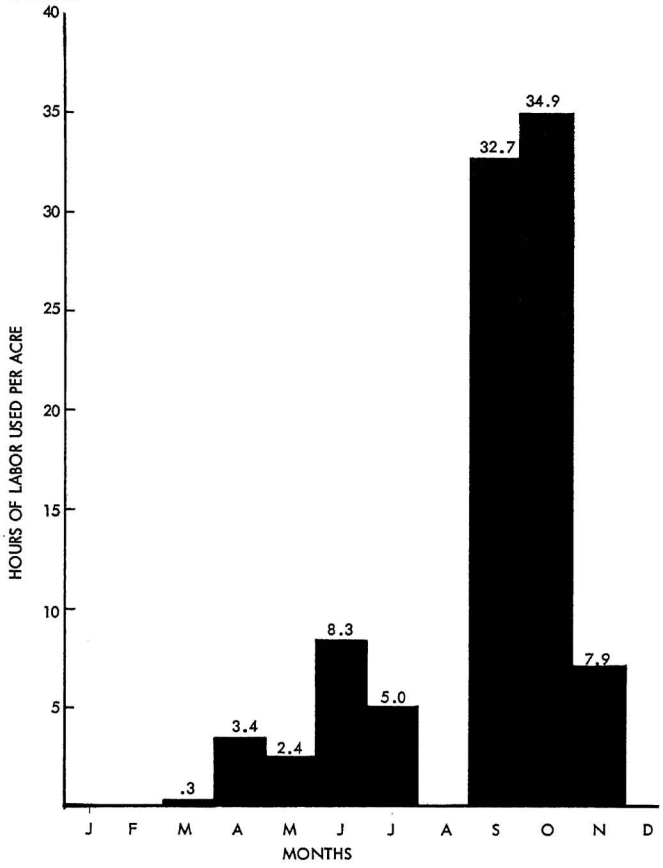


Fig. 2B—Monthly Distribution of Labor Used for Cotton on Farms Where Cotton Was Harvested Using Both Hand Picking and Machine Picking, 1960.

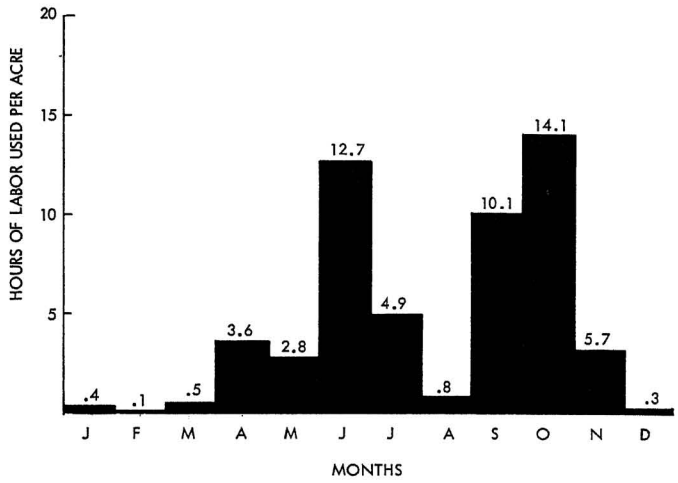


Figure 2 shows the impact of the method of harvesting on the monthly labor used per acre on farms studied in 1960. The May and June data are a little higher than would be expected in an *average* year because of the abnormally large amount of replanting that was required in 1960.

TABLE 9 - THE INFLUENCE OF METHOD OF COTTON HARVEST ON HARVESTING COSTS AND ON THE TOTAL HOURS OF LABOR USED IN COTTON PRODUCTION

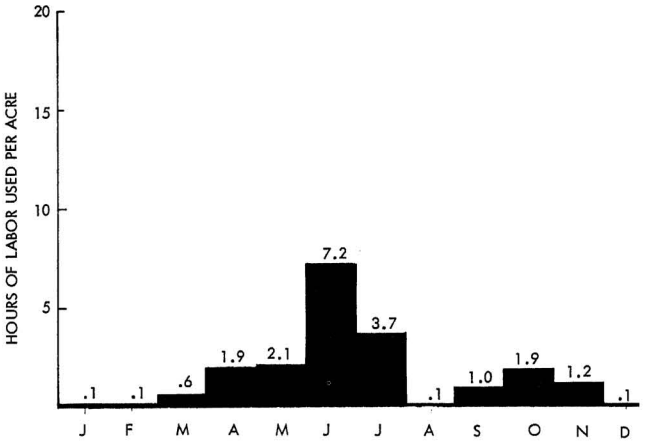
Method of harvesting	No. of Farms	Labor + Machine Operation Costs* Per cwt. lint	Total Harvesting Costs Per cwt. lint	Total Labor Used to Produce Cotton** Per acre	Total Labor Used to Produce Cotton** Per cwt. lint
1959					
Machine Picking Only:					
Custom Picked	5	$6.18	$6.45	20.1	3.0
Picker Owned***	11	3.72	6.27	22.0	3.8
Machine Picking + Hand Picking	17	7.46	7.60	58.5	8.3
Hand Picking Only	9	9.34	9.34	105.0	15.4
1960					
Machine Picking Only:					
Custom Picked	4	$5.93	$6.35	23.9	4.2
Picker Owned***	9	3.06	5.53	18.9	3.2
Machine Picking + Hand Picking	10	6.54	7.56	56.0	8.6
Hand Picking Only	4	8.87	8.87	94.0	14.3

*Includes entire custom charge, but excludes costs of defoliation, and ownership costs on pickers, trucks, and trailers.

**Includes labor used in all operations, not just harvesting.

***Of the 11 farmers in this specific group owning their own pickers in 1959, 8 did custom picking for other operators. In 1960, 5 of the 9 farmers did custom picking for others.

Fig. 2C—Monthly Distribution of Labor Used for Cotton on Farms Where Cotton Was Machine Picked, 1960.



Influence of Lint Yield on Costs and Returns

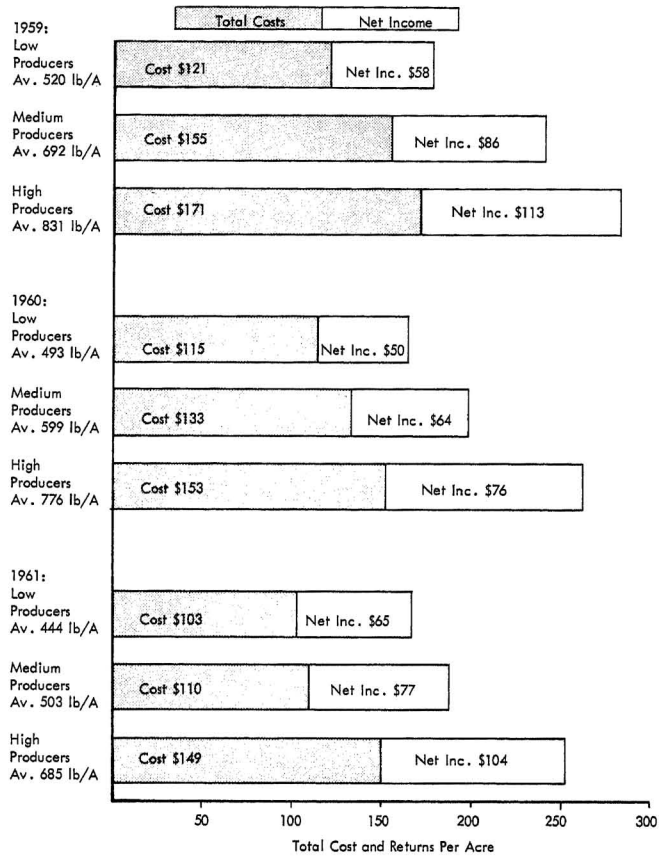
The importance of obtaining high cotton yields has constantly been stressed by Extension Service personnel and others working with cotton farmers. The results of this three-year study show that the emphasis is completely justified.

In Table 10 the 42 producers studied in 1959 are divided into three groups based on lint yields—the low, medium, and high producers—to show the relationships of yields to the various cost and return items. Similar patterns were also obtained for the producers in 1960 and 1961, but for the sake of brevity only 1959 results are presented in tabular form. Figure 3 gives the total cost and net returns per acre for each of the three years.

Farmers in the high yield category had higher total costs per acre than low yield producers every year. High labor and machinery costs were the main reason for the higher per acre cost, although they also had somewhat greater expenditures for fertilizer and other production materials, as well as higher marketing costs. Higher yields naturally result in higher per acre marketing costs and higher labor and machinery costs for harvesting, especially when hand picking or custom machine picking is used. The higher labor and machinery costs reflect to a certain extent the extra effort on the part of these producers to attain high yields.

Certain production costs are fixed in total no matter what yield is obtained. Interest on investment in land, taxes, and machine ownership costs are examples of these. The ability to spread these fixed costs over more bales of cotton (units of production) is the major reason why farmers should strive for high yields. The importance of this is evident in this study. Producers in the high yield

Fig. 3—A Comparison of Lint Yields with Total Cost and Net Returns per Acre on Farms Studied in 1959, 1960, and 1961.



category had higher per acre costs but they had lower costs per cwt. of lint produced. Even total labor and machinery cost per cwt. of lint was a little lower for the high yield producers.

Net returns per acre were much higher every year on the farms in the high yield category than on those in the low yield group. Figures 4 and 5 show net returns per acre in 1959 and 1960 on the individual farms are plotted (each dot represents a farm) in relation to the lint yield received on the individual farms. This gives a clear picture of the close relationship between yields and net income.[4] The line in these figures represents the level of net returns that could be expected most frequently at the various yield levels based on the results of the farms studied. For example, in 1959, a farmer producing 900 pounds of lint per acre would most likely have received a net return of $125 per acre.

Factors other than high yields are important in determining the net returns from cotton production, but the profitability of attaining high yields is certainly evident in this study.

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[4]Correlation coefficients of .66 in 1959 and .84 in 1960 were obtained between the lint yields and net income per acre on the farms studied.

TABLE 10 - COMPARISON OF COTTON YIELD (LBS. OF LINT) PER ACRE TO VARIOUS COST AND RETURN ITEMS ON 42 MISSOURI FARMS IN 1959

	Low Producers (In Terms of Lint/A)	Medium Producers (In Terms of Lint/A)	High Producers (In Terms of Lint/A)
Number of Farms	14	14	14
Yield Variation on Farms in Group (Lbs. of Lint/A)	415-589	623-735	739-1029
Average Yield of Group (Lbs. of Lint/A)	520	692	831
Costs Per Acre: (Dollars)			
Total Labor & Machine Cost	66.25	88.60	103.47
Fertilizer Cost	9.33	11.74	10.67
Total Materials Cost (Includes Fertilizer)	15.99	18.15	17.25
Total Costs	120.85	155.44	170.94
Returns Per Acre: (Dollars)			
Lint Receipts/Acre	163.36	221.27	259.99
Total Receipts/Acre	178.93	241.04	283.52
Net Returns to Management	58.08	85.60	112.58
Costs and Returns Per Cwt. Lint: (Dollars			
Total Labor & Machinery Cost/ Cwt. Lint	12.82	12.83	12.37
Total Materials Cost/Cwt. Lint	3.05	2.64	2.08
Total Cost/Cwt. Lint	23.29	22.39	20.39
Net Returns/Cwt. Lint	11.17	12.23	13.56
Efficiency:			
Returns/$100 Spent for Land, Labor, and Capital	148.49	156.54	171.10

Fig. 4—The dots show where each farm stood in yield per acre and net returns in 1959. Note that as yield goes up there is a decided upward trend in net income. Increased investment to raise the yield paid off.

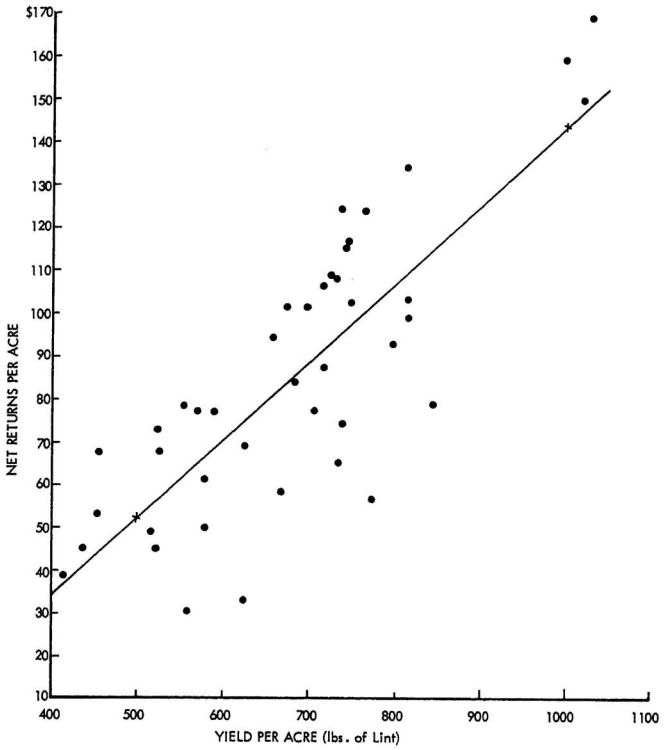
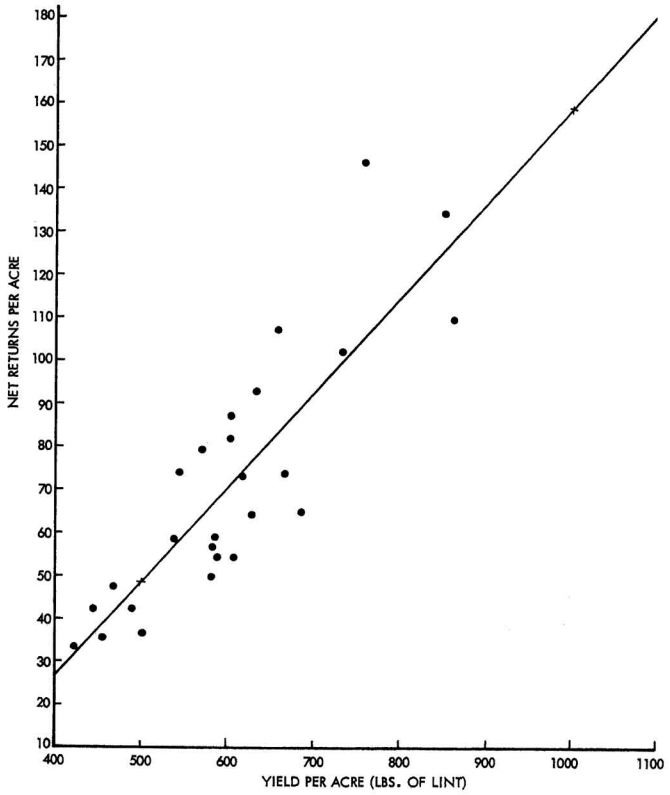


Fig. 5—The dots show where each farm stood in yield per acre and net returns in 1960. Again the marked upward trend of income with yield is obvious.



Costs and Returns of Producing Two Bales of Cotton Per Acre

Only a few years ago a goal of two bales of cotton per acre seemed unattainable. Yet, today some Missouri producers are surpassing this yield level. Missouri cotton specialists believe that the techniques and practices are available which, if properly adopted, would make the production of two bales per acre commonplace most years on Missouri farms.

To get this technology properly adopted farmers must be aware of the economic rewards of attaining two bales per acre, and must learn what technology is necessary and how to use it. This study sheds some light on the net returns that can be expected by producers achieving two bales of cotton per acre. A companion publication, University of Missouri Extension Circular 760, acquaints farmers with the techniques and practices which specialists believe need to be adopted to attain this yield.

Eleven producers in this study had yields of more than 800 pounds of lint per acre. Four exceeded 1000 pounds per acre. A comparison is presented in Table 11 of the costs and returns of these 11 farmers with the costs and returns of 15 producers with yields of approximately one bale per acre. This specific comparison is shown because there are still farmers who feel one bale per acre is a good yield. Here, some actual farm records tell the story—much higher goals are paying off handsomely.

The relationships of costs and yields discussed in the previous section are also evident in this comparison. Total cost per acre averaged more than $75 higher on the farms achieving two bales per acre than on the farms with yields of only one bale per acre, but total costs were actually $2.28 lower per cwt. of lint produced.

Net returns to management averaged $70 per acre higher on the two bales per acre farms. Putting this another way, the farmers who achieved two bales per acre received more net returns from one acre of cotton than the farmers with lint yields of one bale achieved on two acres. These data clearly show that Missouri cotton producers will be rewarded economically if they raise their yield goals to two bales per acre and diligently strive to attain that yield level.

It may seem surprising in this comparison how little difference existed between one and two bale farms in expenditures for the "income-stimulating cost" items of fertilizer and seed. In fact seed costs averaged higher on the one bale farms. This doesn't mean these income-stimulating costs are any less important; rather, it points out

TABLE 11 - COTTON PRODUCTION COSTS AND RETURNS ON FARMS WITH LINT YIELD APPROXIMATELY ONE BALE AS COMPARED TO FARMS WITH LINT YIELDS APPROXIMATELY TWO BALES

Item	Farms with lint yields 440-520 lbs./A.	Farms with lint yields over 800 lbs./A.*
Number of Frams Studied	15	11
Average Lint Yield	475	908
Costs Per Acre:		
Labor Costs	$ 19.05	$ 66.75
Machine Operation Costs	23.83	26.68
Machine Ownership Costs**	16.43	19.62
Total Labor and Machine Costs	59.31	113.05
Fertilizer Cost	9.67	11.09
Seed Cost	3.33	3.09
Other Materials	2.79	4.24
Total Materials	15.79	18.42
Ginning, Bagging and Other Marketing Costs	18.40	35.65
Land Charges (Total)	15.80	19.58
Total Costs Per Acre***	109.54	187.03
Costs Per Cwt. Lint Produced:		
Labor and Machine Costs (Total)	$ 12.46	$ 12.51
Total Costs Per Cwt. Lint Produced***	22.96	20.68
Returns Per Acre:		
Lint Receipts	$151.70	$289.62
Total Receipts (Lint + Cottonseed)	168.71	316.28
Net Returns to Management	59.17	129.25
Returns Per Cwt. Lint Produced:		
Lint Receipts	$ 31.81	$ 31.84
Total Receipts (Lint + Cottonseed)	35.38	34.78
Net Returns to Management	12.42	14.10
Efficiency:		
Returns Per $100 Charged for Land, Labor, and Capital	155.93	171.77

*Top yield on individual farm in this group was 1156 pounds per acre.

**Machine ownership costs include interest on interest on investment, depreciation, and property taxes.

***Total cost will exceed total of individual items listed as miscellaneous costs are not shown in this table.

the importance of doing a good job in all aspects of production. A farmer may apply enough fertilizer to attain two bales per acre, but not come close to achieving this yield because of planting too late, poor drainage, inadequate weed and insect control, or for a number of other reasons.

Comparison of Price Received for Lint With Costs and Returns

The price a farmer receives for his cotton lint is obviously a very important factor in determining his net income. The price received is influenced by many things, including weather during the growing season and at harvest (the two have major influence on cotton quality), governmental programs, and the marketing forces that affect the general price level of cotton.

The price of lint, as affected by both the prevailing government program and lint quality, had a very definite bearing on the income of the farms studied. The two alternative governmental program in effect in 1959 provided for a minimum support schedule, based on upland-middling 1", of $34.00 (alternative A) and $27.63 (alternative B, which permitted more acreage at reduced support) per cwt. of lint. In 1960 the same program was in effect but the support rates were reduced to $31.83 and $25.47.

This decline was reflected in the reduction in the average receipts per cwt. of lint from $31.51 in 1959 to $30.34 in 1960. In 1961 a mandatory acreage control program was adopted which resulted in tighter acreage controls but an increased support price of $33.20 per cwt., upland middling 1". This had the obvious impact of raising the price of cotton, even for that moving through regular marketing channels. The average price received by the farmers studied in 1961 for all cotton produced was $33.25. Much of this increase can be attributed to the direct and indirect effects of the change in price support level, but part of it was due to the high quality of cotton produced in Missouri in 1961.

Only a little over 5 percent of all cotton produced in Missouri in 1961 went into the government loan program, whereas 36 percent of all cotton produced in the U. S. went into the loan program. Most of the cotton produced in Missouri, because of its high commercial quality, sold for $4 to $8 per bale higher than the loan rate. This price premium varied with the grade of cotton.

If the farmers studied had received the same price per cwt. of lint as they did in 1960 the average receipts per acre would have been reduced nearly $16 per acre. This higher price due to the higher loan rate and higher quality made up for much of the reduction in lint yields in 1961.

To study the importance of lint price, the 1959 records were placed in two groups based on which governmental program alternative they operated under. Then they were further divided into groups of low, middle, and high producers, based on average price received per cwt. of lint (Tables 12 and 13). Results showed the importance of receiving high lint prices, and at the same time pointed out the interdependence of various factors in cotton production.

The A program provided smaller acreage allotments than the B program, but a $3.47 per cwt. higher lint price (based on upland-middling 1"). This price differential varied somewhat with lint grade, but a surprising result of this study was that the average lint price was only $1.11 higher on the A farms than on the B farms. Furthermore there was a much larger variation in the average lint price among the individual farms in program A. Individual average price variation amounted to $10.58 per cwt. on the A farms and only $3.52 on the B farms. Better and more consistent lint quality was thus clearly evident on the B farms, but the reasons for this situation are not apparent.

The data in Table 12 on the program A farms form a pattern approximating the expected relationships between lint prices and various cost and returns items. One would expect, since these farmers were operating under the same program, that the higher the average lint price the higher the lint quality would be. A positive relationship between lint quality and lint yield would also be expected, but this would not necessarily be true under all conditions. Consequently, one would expect higher costs per acre on the high lint price farms (income stimulating costs and yield associated costs) and also higher net returns per acre. The data on the A program farms illustrate these relationships. Net returns were $28.12 higher per acre on the high lint price farms than on the low price farms.

On the B farms, however, these expected relationships did not exist in 1959. Lint yields were highest on the low lint price farms. Furthermore, net returns per acre averaged higher on the low lint price farms than on the farms in any other group in either the A or B program.

A number of factors contributing to this unexpected result must be explained so that the low price-high income relationship is not misinterpreted. The small number of farms in the B program in 1959 creates a situa-

tion where one unusually high income or unusually low income farm in any category greatly influences the average. This partly explains the B program situation. In addition, the average size of farms in the low and high price groups (B program) was much larger than for any of the other groups. Consequently, the net returns in these two categories were influenced by the economies of large scale production, particularly lower labor and machinery costs per acre. It is evident, therefore, that the B farm results show the influence of factors other than price and should be used discretely.

TABLE 12 - A COMPARISON OF PRICE RECEIVED FOR LINT WITH VARIOUS COSTS AND RETURNS ITEMS OF 29 MISSOURI FARMERS IN GOVERNMENTAL PROGRAM A IN 1959

	Low Producers in Terms of Lint Receipts/ Cwt. of Lint	Medium Producers in Terms of Lint Receipts/ Cwt. of Lint	High Producers in Terms of Lint Receipts/ Cwt. of Lint
Number of Farms	10	9	10
Average Acres Per Farm	45.2	32.5	35.6
Variation in Price Received/ Cwt. of Lint	25.66-31.24	31.61-33.27	33.36-36.24
Average Price Received/ Cwt. of Lint	28.94	32.24	34.45
Average Lint Yield/Acre (lbs.)	646	736	690
Costs Per Acre: (Dollars)			
Total Labor and Machinery Cost	77.55	104.31	99.52
Total Cost	136.20	175.90	161.52
Returns Per Acre: (Dollars)			
Lint Receipts	186.45	237.63	237.60
Total Receipts	202.25	261.28	258.69
Net Returns to Management	69.05	85.37	97.17
Costs and Returns Per Cwt. Lint: (Dollars)			
Total Costs	21.34	23.43	23.47
Total Receipts	31.48	34.62	37.49
Net Returns to Management	10.66	11.19	14.02

TABLE 13 - A COMPARISON OF PRICE RECEIVED FOR LINT WITH VARIOUS COST AND RETURNS ITEMS OF 13 MISSOURI FARMERS IN GOVERNMENTAL PROGRAM B IN 1959

	Low Producers in Terms of Lint Receipts/ Cwt. of Lint	Medium Producers in Terms of Lint Receipts/ Cwt. of Lint	High Producers in Terms of Lint Receipts/ Cwt. of Lint
Number of Farmers	4	5	4
Average Acreage Per Farm	112.3	57.7	138
Variation in Price Received/ Cwt. of Lint	29.17-30.08	30.23-31.22	31.41-32.69
Average Price Received/ Cwt. of Lint	29.63	30.67	31.96
Average Lint Yield/Acre (Lbs.)	724	637	634
Costs Per Acre: (Dollars)			
Total Labor and Machinery Cost	55.73	80.66	69.15
Total Cost	125.41	138.26	135.48
Returns Per Acre: (Dollars)			
Lint Receipts	214.33	195.40	202.81
Total Receipts	234.31	212.89	221.61
Net Returns to Management	108.91	74.65	86.13
Costs and Returns Per Cwt. Lint: (Dollars)			
Total Costs	17.62	21.90	21.58
Total Receipts to Management	32.38	33.47	34.97
Net Returns to Management	14.76	11.57	13.39

Comparison of Fertilizer Use With Costs and Returns

A sound program of commercial fertilizer applications is a major factor in attaining high cotton yields.

The yield response of cotton to fertilizer in any particular year depends on many things, including weather (particularly rainfall), type of soil, level of nutrients already in the soil, previous crop, and other production practices followed by the farmer. Although the farmer has limited knowledge about some of these factors (particularly weather) he must consider all of them in determining the amount of fertilizer to apply on his cotton. He can use soil tests to obtain information about the nutrient level in his soil. Soil moisture checks can be made at the time of planting. These do not provide information about future weather, but they do give an idea as to the start the cotton will likely get.

Fertilizer expenditures on individual farms in this study varied from $3.33 to $22.54 per acre. Many different kinds and analyses of fertilizers were used, making it im-

possible to analyze the response to fertilization based on the quantity of nutrients applied.

To study the relationship of fertilizer use to costs and returns, the farms were divided into three groups in 1959 and 1960 based on fertilizer expenditures—low, medium, and high. To eliminate as much as possible the variation in response due to differences in soil texture, only farms with sandy loam soils are included. There were not enough farms with soils of other textural properties to expand the analysis.

In both years the farmers in the high fertilizer-use group spent more than twice as much per acre for fertilizer as did the farmers in the low-use group. The response, however, was not entirely consistent in the two years on the sandy loam soils. In 1959, the average lint yield was 128 pounds higher on the medium fertilizer-use farms than on the low-use farms, and increased only an additional 25 pounds from the medium to the high-use farms. The response was different in 1960, in that lint yields averaged 130 pounds higher on the high-use farms than on the low-use farms, but the yields on the medium use farms averaged 15 pounds lower than those on the low-use farms. Differences in other production practices and the limited number of farms studied were probably factors contributing to this situation.

Table 14 gives average costs and returns on the farms in the groups. In addition, an "adjusted" net return figure is presented, because the farmers in the low-

TABLE 14 - COMPARISON OF FERTILIZER USE TO COSTS AND RETURNS OF COTTON PRODUCED ON MISSOURI FARMS HAVING SANDY LOAM SOILS, 1959 AND 1960

	Low in Fertilizer Cost Per Acre	Medium in Fertilizer Cost Per Acre	High in Fertilizer Cost Per Acre
	1959		
Number of Farms	8	8	8
Variation in Fertilizer Cost ($)	3.33- 7.19	8.16-11.17	11.55-17.88
Average Fertilizer Cost/Acre ($)	6.00	9.94	14.10
Average Lint Yield/Acre (Lbs.)	597	725	750
Costs Per Acre: (Dollars)			
Total Cost	134.52	150.06	162.06
Returns Per Acre: (Dollars)			
Lint Receipts	197.55	211.16	230.80
Total Receipts	215.68	237.62	252.51
Net Returns to Management	81.16	87.69	90.44
Adjusted Net Returns to Management*	62.71	93.90	84.65
	1960		
Number of Farms	5	5	5
Variation in Fertilizer Cost ($)	7.64-10.47	11.23-13.56	14.01-22.54
Average Fertilizer Cost/Acre ($)	8.99	12.28	18.61
Average Lint Yield/Acre (Lbs.)	578	563	708
Costs Per Acre: (Dollars)			
Total Cost	137.90	133.55	150.71
Returns Per Acre: (Dollars)			
Lint Receipts	171.75	167.16	222.32
Total Receipts	191.66	185.56	243.91
Net Returns to Management	53.76	52.02	93.20
Adjusted Net Returns to Management*	53.70	52.08	81.15

*Adjusted Net Returns represents the net returns which would have occurred if average lint receipts per cwt. lint had been the same in each of the three groups. 1959 returns were adjusted based on an average lint price of $30 per cwt.; 1960 returns were adjusted to $29.70 per cwt.

use group in 1959, and the high-use group in 1960 had appreciably higher average lint prices than did the farmers in the other groups. Part of the price difference is undoubtedly due to cotton quality (which may or may not be due to the level of fertilization in this case) and part of it is due to the government program alternative followed by specific farmers. The adjusted net returns are those net returns which would have occurred had the farmers in each group received the same average price per cwt. of lint. The 1959 returns were adjusted to $30.00 per cwt., and 1960 returns were adjusted to $29.70 per cwt.

Both net returns figures are presented because each has its advantages and disadvantages. To the extent that cotton quality and price were affected by fertilizer use no adjustment was justified, but as the objective was to study only the affects of fertilizer it was desirable to take out the affects of other price influencing factors, particularly governmental programs. In reality the adjusted returns took out the influence of both quality and the governmental programs on lint price.

The adjustments for price differences made high rates of fertilization more profitable in relation to low rates in 1959, but made them relatively less profitable in 1960. Even though not all of the income difference can be attributed to fertilizer (or any single production practice), there is no doubt that high rates of fertilization were profitable in 1959 and 1960. The data, however, point up the interdependence of all factors of production.

Appendix

Methods and Assumptions Used in Calculating Costs and Returns

1. Actual farm cost data were used whenever available.
2. Labor charges were figured as follows if actual rate paid by a farmer was not available:
   (a) Hand labor for chopping, etc.—50 cents per hour in 1959; 60 cents in following years.
   (b) Cotton picking labor—$3.00 per cwt. of seed cotton.
   (c) Tractor operators—80 cents per hour.
   (d) Mechanical picker operators—$1.00 per hour.
3. Machinery charges
   (a) Fixed ownership costs—total interest on machinery investment, taxes, and depreciation on machinery —were proportioned on the basis of acreages of various crops on the individual farms. Secondary data on the hours of use of different machines on various crops were used in this calculation.

   If operators used their machines for custom work in addition to use on their own cotton a further adjustment was made so that the charge was only for use on the operator's cotton.

   An interest charge of 5 percent was made on machinery investment attributed to cotton.

   (b) Operating costs such as fuel, lubricants, and repairs were figured on a per hour of use basis.

   Tractor costs were varied depending upon size of tractor and kind of fuel used. They were calculated on the following basis:

Size of Tractor	Kind of Fuel: Gasoline	Kind of Fuel: Diesel Fuel or L.P. Gas
	per hour	per hour
2 plow	$ .65	----
3 plow	.80	.65
4 plow	.95	.75
5 plow	1.15	.95

   Machinery pulled by tractors (other than cotton pickers) was charged at 45 cents per hour regardless of kind of machinery. This charge to cover repairs, lubricants, and other maintenance costs is about average for the variable costs of all tractor-pulled machines used in cotton growing.

   For owned mechanical pickers two charges for variable costs were made: Detachable pickers mounted on tractors were charged at $4.50 per hour for the picker plus a charge for the tractor. The two-row picker with built-in power unit was charged at $8.00 per hour.

   Actual machinery expenses vary a great deal among farms depending upon repair facilities and repair and maintenance practices. These charges are in reality "averages" based on other research studies.

   (c) Custom machine picking was charged at $2.50 per cwt. of seed cotton.
4. The charge for land included the total land taxes and an interest charge. The interest charge was 5 percent of the fair market value of the land, as reported by the farmers. The tax rate used was that reported by the farmers.

■ ■ ■

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