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Factors Affecting Soybean Yields

In the Delta Area of Mississippi

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Conclusions

These results indicate that a May 10 planting date and the use of rotations are closely followed by farmers who consistently produce yields of soybeans which are higher than the average for the area. Research at the Delta Branch Experiment Station[3] has shown that May 10 is the optimum average date for planting soybeans if good yields are to be made. The study indicates that this planting date results in higher yields under farm conditions.

The use of rotations is also important in producing high yields of soybeans. The principal effect of rotations is that of weed control. Soybeans that follow cotton, rice, or fallowed land have fewer weeds than those following soybeans or corn.

The use of recommended soybean varieties is associated with the high yields. Seventy-six percent of all farmers in the group with low average yields planted the recommended varieties. This does not mean that the recommended varieties are not superior to varieties that are not as well adapted to the area. Rather it indicates that these farmers are not getting the fullest benefit from improved varieties. A farmer who plants a good variety of soybeans at the wrong time and does not control weeds is likely to get low yields.

Use of one good practice alone will not insure high yields of soybeans. Combination of all practices used to produce soybeans determine yields in any one year. Weather permitting good yields of soybeans result when good varieties are planted at the correct time and weed control is effective.

Since production costs were virtually the same for the three yield groups, it follows that farmers who obtain the higher yields have higher net returns. A substantial increase in returns can be achieved with improved practices and management in soybean production.

[3]Hartwig, E. E., "Factors Affecting Time of Planting Soybeans in the Southern States," U. S. Dept. Agr. Cir. 934. July 1954.

FACTORS AFFECTING SOYBEAN YIELDS IN THE DELTA

By FRED T. COOK, JR.[2] and A. M. HEAGLER[2]

Soybean production in the Mississippi Delta has increased tremendously during the last 20 years. In 1940, only 24,400 acres of the crop were harvested for beans in the area. By 1959, this acreage had risen to 743,000, 30 times the 1940 acreage.

A part of this growth can be attributed to the need for profitable uses of land diverted from cotton production by acreage allotments. In some respects, however, soybeans are a natural supplementary crop. Except for harvesting, they can be produced with the same equipment used to produce cotton. Soybeans require only nominal amounts of labor since production of the crop is almost completely mechanized. In the Delta, little or no fertilizer is required and soybeans are not completely competitive with cotton for land. Soybeans grow well on heavy clay land that is not particularly suited to cotton production.

Increased yields of soybeans have no doubt contributed to their popularity. In the last 20 years, average yields in the Delta have virtually doubled, rising from 12 to almost 20 bushels. Most of this increase is a result of improved varieties and better management practices.

Despite the strides made in soybean production in the Delta, certain problems persist. Yields continue to vary widely from farm to farm and from season to season. Furthermore, research at the Delta Branch Experiment Station indicates that yields much higher than those currently realized in the area are possible if recommended production practices are followed.

Several possible explanations of yield variability among farms come to mind. The most obvious explanation is superior management on the part of producers with consistently high yields. But management is a nebulous thing when it comes to quantitative measurement.

Soil type may affect soybean yields as it does cotton yields. Associated with soil type is drainage, both surface and internal, always important in the production of any crop in the area.

Specific cultural practices, such as planting dates, number of cultivations, insect control, and others, may also affect yields. Inter-relationships among these operations and timeliness may be of particular importance.

Some of the major factors affecting soybean yields are evaluated here. Costs associated with soybean production in the Delta are presented.

Procedure

A stratified random sample of farms in 12 Delta counties was drawn from county ASC files and 214 farmers were interviewed. Farms with less than 150 acres of cropland were excluded from the sample in order to get operations with sizable bean acreages. From the 214 farmers, 512 separate observations of different fields were obtained. A separate observation was made for soybeans grown on each soil type and for each variety

[1]Study conducted jointly by the Farm Economics Division, Economic Research Service, U. S. Department of Agriculture and the Mississippi Agricultural Experiment Station.

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grown. Soybeans planted on land from which oats had been harvested in the same year were also handled as separate observations.

Method of Analysis

The study attempted to determine those practices used by producers obtaining high yields.

Farms included in the study were divided into three groups based on the 5-year average yield of soybeans as reported by the farmer. Five-year average yields of 28 to 40 bushels placed the farm in the high-yielding group; those of 22 to 27 bushels in the intermediate-yield group, and those with yields of less than 21 bushels in the low-yielding group. Of the 214 farmers interviewed, 30 percent operated high-yield farms, 42 percent in intermediate-yield farms, and 28 percent low-yield farms.

The number of farmers in each group who used a particular practice was counted, and if a significant difference in percentage of use was found among groups, it was assumed that this practice had some effect on yield. But it cannot be assumed that when no difference was found, the particular practice did not affect yields. Some practices are universally used by all farmers and thus no difference is indicated. The management of a practice, such as timeliness, cannot be measured. Thus the effectiveness of any practice varies from farm to farm. A good example of this is in evaluating number of cultivations. The number can be important but the effectiveness of each cultivation is greatly influenced by the size and amount of weed and grass infestation at the time of cultivation.

Results

The average farm in the sample had 1,085 acres of cropland, of which 328 acres were used to produce cotton, 390 acres were planted to soybeans only, and an additional 37 acres of soybeans were planted after oats were harvested.

Of the items that affect soybean yields, the first to be explored are the variety and quality of seed, and the date and rate of planting. At the time this sudy was conducted, three soybean varieties—Lee, Jackson, and Hood—were recommended for the Mississippi Delta by the Experiment Station. Eighty-two percent of all farmers in the study planted only these recommended varieties. Eighty-five percent of the farmers with high yields planted these varieties and 75 percent of the farmers with low yields grew them. Although a majority of all farmers planted recommended varieties, this study indicates that farmers with high yields believed these varieties to be important contributors to high yields.

Quality of seed planted affects the stand density and yield. All farmers reported that they inoculated soybean seed if planted in a field that had not been planted to soybeans for several years. If they used home-grown seed, essentially all of these farmers cleaned it before planting. All purchased seed was cleaned. About 85 percent of all farmers interviewed checked the germination of seed before planting.

The date of planting was closely associated with yields. May 10 is the recommended planting date for the area. Ninety percent of the farmers with high yields planted their soybeans within 10 days of this date. Seventy percent of the farmers with intermediate yields planted in this period, and but 53 percent of the low yielding group planted during this time. Soybean specialists in the area consider time of planting one of the most important factors affecting yields, and the study bears this out. Among farmers with high yields who did not plant during this period, most indicated that they wanted to plant around May 10 but could not because of adverse weather. In the lower yield groups, a great deal of planting was done before May 10.

Most of the farmers interviewed planted one bushel—60 pounds—of seed per acre. There was so little variation from this that no evaluation of greater or lesser seeding rates could be made. The recommended seeding rate is about 40 pounds per acre, or one seed per inch of row. Of the farmers interviewed, more reported planting over 60 pounds per acre than under 60 pounds. Most farmers indicated that they seeded heavily to insure a good stand, but soybean specialists at the Delta Experiment Station believe that a too heavy plant population can contribute to lower yields.

Other practices such as fertilization irrigation, insect control, and use of herbicides were considered in the study. The number of farmers using any one of these practices generally was too low for a sound evaluation to be made. However, there was some evidence of positive relationship between use of herbicides and yields. Farmers with the higher yields used more herbicides than the other groups. It is felt that this indicates a greater concern for weed control among farmers in this group. Since only 11 per cent of the high-yielding group used herbicides and this on a limited basis, the effect of this practice on soybean yields could not be isolated.

Producers indicated that soil types greatly affect soybean yields. When yields were averaged for a 5-year period, little difference was found among soil types The soils were grouped into three types —sandy, loam, and clay or buckshot. The 5-year average yield for each soil type and for each yield group on these soils is presented in table 1. Variability of yields was greatest on sandy soils. In dry years, yields on sandy soils were low; in wet years, they were high. One farm reported a yield of 8 bushels per acre on sandy soils in a dry year and 42 bushels per acre on the same soils in a wet year. Loam soils had the next greatest variability in yield, and clay soils the least variation in yield over the 5-year period.

The effect of rotations on soybean yields was intensively explored. Fifty-two percent of the farmers in the high-yielding group reported that they attempted to follow a definite rotation with soybeans. An additional 21 percent of this group used some rotation. Thirty-seven percent of the farmers in the intermediate-yield group tried to follow a definite rotation, and another 12 percent used it to a limited extent. Only 17 percent of the low-yield group had a rotation program. Rotations with a specific crop, such as cotton or rice, had no apparent advantage in terms of soybean yields. For purposes of this study, fallow was considered as a component of a rotation. All farmers who used rotations said that yields were somewhat higher on rotated than on non-rotated fields.

Definite rotations were more often used on farms with little variation in soil types. Farmers are naturally reluctant to move cotton to less desirable soils for the sake of a rotation. Farms with fairly uniform soils are more easily adapted to a rotation system. Farmers who used rotations in producing soybeans did so primarily as a weed-control measure. Fields that have been in cotton, rice, or were fallowed usually have less weed infestations than fields that have been in soybeans for a number of years. Many farmers felt that soybeans grown in rotation with

Table 1.—Average yields of soybeans, by yield groups and soil types, 1955-59

Yield group	Number of farms	Soil group		
		Clay	Loam	Sand
		Bushels	Bushels	Bushels
Farms with high yields	64	31.3	31.4	30.5
Farms with intermediate yields	90	24.2	25.7	23.6
Farms with low yields	60	18.4	19.2	18.6
All farms	214	24.3	25.4	24.4

such crops as cotton and rice improved the yields of these crops, but no evaluation of this phase of the rotation was made.

Specialized equipment, such as double disk openers, planter press wheels, rotary hoes, and stalk shredder attachments, used to produce soybeans were found on so few farms that their effect on yield could not be evaluated.

Many farmers indicated that certain specific operations or combinations of specific operations involved in seedbed preparation, planting, and cultivation would result in higher soybean yields. A complete breakdown of every operation involved in producing a soybean crop for each soil type was obtained from each operator included in the study. No operation or combination of operations was found to have a specific relationship to yields.

The only significant differences in operations were between soil types. On sandy soils, disking and bedding were usually done after March 15. Seedbed conditioning is usually done in sandy soils with a harrow or tumbling stalk cutter-harrow combination tool. Planting is done on a bed. On sandy soils, the crop is usually cultivated five times. On clay soils, if possible, disking and bedding is usually done before March 15. The other practices are about the same except that usually the soybeans are cultivated only four times. Loam or mixed soils are usually handled the same as clay soils except when the farm has a predominance of sandy soils. Then the loam soils are tilled like sandy soils. Little deep plowing, moldboarding or subsoiling was done on fields to be planted in soybeans.

Performance rates for each operation were obtained and used to determine costs of producing an acre of soybeans to each of the three soil types. Those operations found to be most common for each soil type were used to develop these costs. Individual farm operations that vary from this mode would naturally change these production costs. Table 2 presents the costs associated with producing an acre of soybeans on sandy, loam, and clay soils. The table points out that total costs of production vary little among soil types, despite differences in seedbed preparation and cultivation associated with each soil. Clay soils have higher seedbed preparation costs than sandy soils, but cultivation and weeding are less than the clay soils. This tends to equalize costs among soil types.

Table 2.—Production cost for one acre of soybeans, clay, loam, and sandy soils

Item	Unit	Price	Soil Group: Clay		Loam		Sand	
			Quantity	Amount	Quantity	Amount	Quantity	Amount
		Dollars		Dollars		Dollars		Dollars
Tractor operation	hours	1.79	2.6	4.65	2.6	4.65	2.6	4.65
Equipment operation	hours	——	2.6	2.99	2.6	3.37	2.6	2.24
Combine	hours	6.14	.6	3.68	.5	3.07	.5	3.07
Haul	bushels	.05	24.3	1.22	25.4	1.27	24.4	1.22
Seed	bushels	4.50	1.0	4.50	1.0	4.50	1.0	4.50
Weeding	hours	.35	1.8	.63	2.3	.80	2.3	.80
Labor	hours	.50	5.4	2.70	5.6	2.80	4.9	2.45
Interest on operating capital[1]	———	——	——	.46	——	.48	——	.44
Total specified costs	———	——	——	20.83	——	20.94	——	19.37

[1]Six percent for 6 months.

Soybeans Following Oats

The above discussion refers only to soybeans that are not double-cropped. In the Mississippi Delta, it is common practice to plant soybeans following oats, that is, after the oat crop is harvested. Yields of soybeans planted after oats showed no significant difference between the three groups of farmers in the study. Yields ranged from 12 to 24 bushels per acre. The average yield for all farms in the study was 18 bushels per acre for soybeans produced in this way. As previously stated, farms that had high average yields for regular soybean production did not have higher yields than either of the other two groups on soybeans produced after oats. There were no indicated differences in practices or operations among yield groups.

Seedbed preparation did not differ significantly by soil type for beans planted following oats. Ninety-three percent of all farmers burned the oat straw, disked twice, and planted flat. These soybeans were usually cultivated three times, and a minimum of hand weeding was done. Table 3 presents the costs and returns from 1 acre of soybeans following oats.

The Effect of Yield on Returns

Table 4 presents the costs and returns associated with average yields of high, intermediate, and low-yielding farms included in the study. Average production varies from 31 bushels per acre on high-yielding farms to 18.7 bushels per acre on low-yielding farms.

The preharvest costs associated with each yield group were intensively investigated, and no significant differences in costs were found among groups. As stated elsewhere, there was an indication that farmers with high yields gave more consideration to weed control than other yield groups, but this could not be measured in terms of more cultivations or hoeings.

Combine costs were found to vary somewhat with yields, but these variations were small. It is felt that the high-yielding producers probably manage harvesting, along with other practices, more efficiently and this would tend to offset somewhat higher harvesting costs associated with higher yields.

Since production costs were virtually the same for the three yield groups, it follows that farmers who obtained high yields had higher net returns. As shown

Table 3.—Production costs and returns for 1 acre of soybeans planted following oats.

Item	Unit	Price	Quantity	Amount
		Dollars		Dollars
Soybeans	bushels	1.96[1]	18.0	35.28
Expenses:				
Tractor operation	hours	1.79	1.9	3.40
Equipment operation	hours	——	1.9	1.46
Combine	hours	6.14	.5	3.07
Haul	bushels	.05	18.0	.90
Seed	bushels	.50	1.0	4.50
Weeding	hours	.35	1.1	.38
Labor	hours	.50	3.2	1.60
Interest on operating capital[2]	——	——	——	.37
Total Specified costs	——	——	——	15.68
Returns to land, management and general overhead	——	——	——	19.60

[1]1959 seasonal average price per bushel received by farmers as reported by Mississippi Crop Reporting Service.

[2]Six percent for 6 months.

in table 4, returns to the high-yielding group were larger by $11.93 per acre than returns for the intermediate yield group and $22.89 per acre higher than the low yielding group.

This study indicates that yields can be increased by better management rather than added physical inputs.

Table 4.—Costs and returns for soybeans, with different levels of yield, Yazoo-Mississippi Delta, 1959.

Item	Unit	Price	Yield Group					
			High		Intermediate		Low	
			Quantity	Amount	Quantity	Amount	Quantity	Amount
		Dollars		Dollars		Dollars		Dollars
Income:								
Soybeans	bushels	1.96[1]	31.0	60.76	24.5	48.02	18.7	36.65
Expenses:								
Preharvest	acres	15.49	1.0	15.49	1.0	15.49	1.0	15.49
Combine	hours	6.14	.6	3.68	.5[2]	3.19	.5	3.07
Haul	bushels	.05	31.0	1.55	24.5	1.23	18.7	.94
Total specified costs	———	——	——	20.72	——	19.91	——	19.50
Returns to land, management and general overhead	———	——	——	40.04	——	28.11	——	17.15

[1]1959 seasonal average price per bushel received by farmers as reported by Mississippi Crop Reporting Service.

[2]Performance rate actually 0.52 hours per acre.