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Cotton fertilizer experiments

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COTTON FERTILIZER EXPERIMENTS

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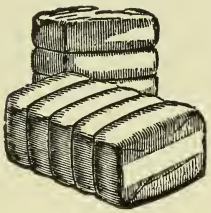

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
A. & M. COLLEGE, MISSISSIPPI
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RECOMMENDATIONS

For East Central Mississippi soils outside of the Prairie Belt: Use 600 to 900 pounds of an 8-6-4 fertilizer. This may be bought commercially or home-mixed as follows:

For 8% phosphoric acid: 300 pounds 16% superphosphate (acid phosphate).

For 6% nitrogen: 240 pounds nitrate of soda, or
180 pounds ammonium sulphate, or
240 pounds calcium nitrate, or
140 pounds leunasalpeter, or
80 pounds urea.

For 4% potash: 50 pounds muriate of potash, or
200 pounds kainit, or
50 pounds sulphate of potash.

For prairie soils: Use 600 pounds of an 8-8-0 mixture. If rust or leaf diesases are present, add 4% potash. This may be home-mixed by adding one-third more of the nitrogen carrier than is called for in a 6% mixture.

Legumes turned under offer a cheap source of nitrogen. Where this is done or where manure is used, reduce the amount of nitrogen in the fertilizer.

The opportunity for the greatest profit is lost by using small amounts.

Cotton is not produced on grass or blank spaces.

Advise with your county agent about your fertilizer practices.

FERTILIZERS*

Fertilizer investigations in 1927 were as a whole a continuation of experiments begun in previous years. This publication contains a report of the results of the following experiments with cotton: Analysis tests; amounts per acre; sources of nitrogen; sources of potash; and new materials. Reports of other phases of the fertilizer work will be published as sufficient data are accumulated to justify conclusions.

Methods of procedure in all these experiments were essentially the same as have been described in Bulletin 241. Summarized, they are as follows:

Land is selected for uniformity; each test is conducted on as many soil types as is practical; all treatments are repeated three or four times; plots are one-twentieth acre in size; border rows between each two plots are eliminated; the first and every fourth plot is a check plot used to measure the uniformity of the soil and as a basis for calculating the increase due to each treatment; all measurements, weights, applications, and harvesting are done by or under the personal supervision of a member of the Experiment Station staff.

FEEDING PLANTS.—The problem of fertilizers is one of feeding plants and the solution is found when we know: (1) What plant foods are needed in our soil; (2) What relative proportions of these foods should be used; (3) In what form these can be obtained most economically; (4) What amounts are most profitable; (5) How they should be applied; (6) What effect these fertilizers have on the future productivity of the soil.

In obtaining conclusive answers to these questions, one is led into very complex details involving chemical reaction, seasonal conditions, drainage, crop responses, diseases, the wide variation that exists in soils, and the economic value of the crop produced. The Experiment Station is investigating these as rapidly as the personnel and equipment will permit. Such recommendations as are made here are based on the experience gained from a large number of tests and represent the evidence as it is today.

PLANT FOODS.—Present information indicates that for Mississippi soils, phosphoric acid, nitrogen and potash are the only plant foods that when used return profitable yields. These three are usually the only plant foods carried in our fertilizing materials. The state law provides that the percentage of each of these contained in the material be printed on the bag. These percentages are stated in the order named above. An 8-6-4 fertilizer means one containing eight per cent phosphoric acid, six per cent nitrogen, and four per cent potash; that is, it contains eight pounds of phosphoric acid in one hundred pounds of the material, six of nitrogen, and four of potash. In the above fertilizer, we are interested only in the eighteen pounds of plant food contained. The other eighty-two of the one hundred pounds is composed of various materials which are usually worth-

*NOTE: J. F. O'Kelly and Roland Cowart have contributed material aid in conducting the experiments reported in this publication.

less as fertilizers. More or less of these materials are necessary as carriers of plant food, since they cannot be obtained in the pure state. One hundred pounds of an 8-6-4 fertilizer has the same value as two hundred pounds of a 4-3-2 fertilizer, or fifty pounds of a 16-12-8 fertilizer.

ANALYSIS.—This set of three figures stating the percentage of plant food is known as the anaylsis of the fertilizer. The Station has conducted eighty-four trials over a period of three years, covering many soil types to determine the correct analysis for cotton. All these tests have been conducted under practical farm conditions, the cooperating farmers following their own practices in preparation, cultivation, etc.

These tests are reported under three heads as follows:

(1) Choctaw County Tests; (2) All Hill and Flat Woods Tests; (3) Prairie Tests.

TABLE 1—ANALYSIS TESTS, CHOCTAW COUNTY.
Average 3 years—15 Trials

Pounds of material applied per acre			Analysis 600 lbs. of	Pounds of seed cotton per acre		Dollars per acre
Acid phos.	Nitrate of soda	Mur. of potash		Yield	Increase	Net Profit
			Varying Phosphoric Acid			
150	160	50	4-4-4	1092	685	35.87
225	160	50	6-4-4	1130	719	37.38
300	160	50	8-4-4	1094	652	32.52
			Varying Nitrogen			
300	160	50	8-4-4	1094	652	32.52
300	240	50	8-6-4	1352	938	48.31
300	320	50	8-8-4	1393	966	47.79
			Varying Potash			
300	160	0	8-4-0	1071	636	32.42
300	160	25	8-4-2	1121	676	34.10
300	160	50	8-4-4	1094	652	32.52
300	160	75	8-4-6	1091	661	32.71
300	160	100	8-4-8	1084	657	31.89

In the Choctaw County tests, Table 1, the soil used was of the sandy clay hill type, commonly found in the Short Leaf Pine area of Mississippi. These results indicate:

Where phosphoric acid was varied, that the amount of this food used should be as great or slightly greater than the amount of nitrogen.

Where nitrogen was varied, that a great increase in profits is possible by using a fertilizer high in nitrogen. Six or eight per cent should be used.

Where potash was varied, that 2 per cent to 4 per cent is sufficient.

Based on these results, the proper proportion of the three plant foods for these soils should be 8-6-4.

An average of sixty-eight trials in the Hill and Flat Woods soils of East Central Mississippi is given in Table 2. All these tests were grouped together because the results of the individual tests are very similar and lead to the same conclusions.

TABLE 2.—ANALYSIS TESTS, HILLS AND FLAT WOODS
Average 3 years—68 trials

Pounds of material applied per acre			Analysis 600 lbs. of	Pounds of seed cotton per acre		Dollars per acre
Acid phos.	Nitrate of soda	Mur. of potash		Yield	Increase	Net Profit
			Varying Phosphoric Acid			
150	160	50	4-4-4	944	490	23.83
225	160	50	6-4-4	987	525	25.34
300	160	50	8-4-4	989	519	24.14
			Varying Nitrogen			
300	160	50	8-4-4	989	519	24.14
300	240	50	8-6-4	1108	640	29.50
300	320	50	8-8-4	1143	672	29.14
			Varying Potash			
300	160	0	8-4-0	898	428	19.33
300	160	25	8-4-2	965	498	23.18
300	160	50	8-4-4	989	519	24.14
300	160	75	8-4-6	1009	532	24.57
300	160	100	8-4-8	1028	542	24.52

A variation in phosphoric acid shows that the amount of this plant food should be only slightly greater than the amount of nitrogen.

A variation in the amount of nitrogen indicates a very high increase from the greater amounts.

A variation in potash indicates that around 4 per cent is most profitable. In some of the individual tests, no profit was obtained from the use of potash. In others, especially where rust and leaf diseases were present, amounts higher than 4 per cent were most profitable.

These results indicate a proportion of 8-6-4 as the most profitable on these soils.

TABLE 3.—ANALYSIS TEST, PRAIRIE SOILS
Average 2 years—16 trials

Pounds of material applied per acre			Analysis 600 lbs. of	Pounds of seed cotton per acre		Dollars per acre
Acid phos.	Nitrate of soda	Mur. of potash		Yield	Increase	Net Profit
			Varying Phosphoric Acid			
150	160	50	4-4-4	1001	372	15.04
225	160	50	6-4-4	1018	383	15.02
300	160	50	8-4-4	998	329	11.49
			Varying Nitrogen			
300	160	50	8-4-4	998	329	11.49
300	240	50	8-6-4	1137	491	18.92
300	320	50	8-8-4	1247	592	22.82
			Varying Potash			
300	160	0	8-4-0	1003	346	13.82
300	160	25	8-4-2	1020	360	13.77
300	160	50	8-4-4	998	329	11.49
300	160	75	8-4-6	1002	321	10.22
300	160	100	8-4-8	1046	351	11.52

Tests for two years on soil commonly known as "Black Post Oak of the Prairie Belt" are reported in Table 3. The soil represented is typical of a large area of the cotton soils of this belt.

The variations in phosphoric acid indicate that a limited amount of this plant food can be profitably used on these soils. The amount should be equal or nearly equal to the amount of nitrogen used.

With an increase in nitrogen, profits were materially increased, the greatest profit being from eight per cent.

Potash variations on these soils indicate no increase in yield from its use and a consequent loss in profit. These tests were on soil free from rust. All soils where rust is present will respond profitably to the use of potash.

These tests indicate for these soils a fertilizer consisting of equal parts phosphoric acid and nitrogen, such as an 8-8-0, with 4 per cent potash added where rust or leaf diseases are present.

AMOUNTS PER ACRE.—To determine the most profitable amount of fertilizer to use, varying amounts were tried in each of the eighty-four analysis tests. Table 4 contains these results.

TABLE 4 AMOUNTS PER ACRE

Pounds of material applied per acre			Pounds per acre of 8-4-4	Pounds of seed cotton per acre		Dollars per acre
Acid phos.	Nitrate of soda	Mur. of potash		Yield	Increase	Net Profit
			Choctaw County			
300	160	50	600	1094	652	32.52
600	320	100	1200	1449	1051	49.95
900	480	150	1800	1686	1294	57.74
1200	640	200	2400	1765	1380	55.73
			All Hill and Flat Woods			
300	160	50	600	989	519	24.14
600	320	100	1200	1243	793	33.63
900	480	150	1800	1376	923	33.87
1200	640	200	2400	1428	982	29.71
			Prairie Soils			
300	160	50	600	998	329	11.49
600	320	100	1200	1251	610	19.89
900	480	150	1800	1421	760	20.61
1200	640	200	2400	1556	876	19.64

The indicated most profitable amount in each case is 1200 to 1800 pounds. An interesting fact is that 2400 pounds per acre was on an average more profitable than a 600-pound application. Twenty-four hundred pounds failed to produce a net profit in only a few instances.

These amounts tests were based on an 8-4-4 fertilizer. Results indicate that smaller amounts of an 8-6-4 would have given as good returns. The profit from 600 pounds of an 8-6-4 was very close to that from 1200 pounds of an 8-4-4. This further emphasizes the greater efficiency of an 8-6-4 fertilizer.

SOURCES OF PHOSPHORIC ACID.—No tests of sources of this plant food are reported here. It is considered advisable to obtain it from superphosphate (acid phosphate). This material is readily available and is usually the cheapest source of phosphoric acid. It usually contains 16 per cent phosphoric acid, but higher grades may often be obtained at a lower price per pound of phosphoric acid.

SOURCES OF NITROGEN.—Tests comparing six common carriers of nitrogen, conducted for three years are reported in Table 5.

TABLE 5—SOURCES OF NITROGEN

Treatment 600 Pounds 8-5-4	Average Increase Pounds of Seed Cotton per acre			
Source of Nitrogen	1925	1926	1927	Average
200 Nitrate of Soda	53	53	253	120
150 Ammon. sulphate	29	137	176	114
115 Leunasalpeter	137	20	207	121
200 Calcium nitrate	71	21	184	92
65 Urea	7	113	215	112
138 Cal. cyanamid	-100	92	133	42

These and other tests show a variation between seasons in the efficiency of these materials. On an average, all except calcium cyanamid have proven to be about equal in value when applied under cotton from seven to ten days before planting. These materials differ in the amount of nitrogen per 100 pounds, and thus should be bought and used on a basis of the amount of nitrogen contained.

It is advisable to use either of the first five materials mentioned in Table 5, or a combination of two or more. A selection should be made based on what material will supply the cheapest nitrogen.

SOURCES OF POTASH.—The results of two experiments conducted two years comparing potash carrying materials are given in Table 6.

TABLE 6—SOURCES OF POTASH

Treatment 600 pounds 8-6-4	Increase per acre Pounds seed cotton		
Source of potash	1926	1927	Average
Trona	225	375	300
Sulphate	243	462	303
Kainit	222	430	326
	2nd Test		
Muriate	393	639	516
Trona	351	457	404
Sulphate	430	551	490
Kainit	454	631	543

These tests were on soil where rust is present and which shows a high response to potash. The results indicate that the four materials tested are all highly efficient. Kainit leads in pounds of increase. It is advisable to use the form which will supply the cheapest potash.

METHODS OF APPLICATION.—A definite plan must be worked out in individual cases to fit soil and weather conditions, and adjusted to the available tools. A few points of consideration are:

High quantities of fertilizer in direct contact with seed will kill young plants. Do not place in a narrow band and then plant directly on this. See that fertilizer is well mixed in the bed.

Fertilizer should be applied 7 to 14 days before planting.

Side dressing should be made early, preferably immediately after chopping, that is, at "dirting." It is usually best to apply all fertilizer before planting to avoid the delay in side applications often experienced.

MISCELLANEOUS MATERIALS.—Various materials are on the market, carrying one or more plant foods. Tables 7 and 8 show a comparison of Ammophos, Nitropo, and Nitrophoska with a fertilizer of the same analysis mixed from super-phosphate, nitrate of soda, and muriate of potash.

EFFECT ON FUTURE PRODUCTIVITY.—This question has not been definitely answered and theories are advanced tending to credit or discredit certain materials. In practice, however, some benefit to immediately

TABLE 7 MISCELLANEOUS MATERIALS

Treatment 600 pounds 8-6-5	Increase pounds seed cotton per acre over 8-6-0 from acid phos. and nit. soda		
Materials	1926	1927	Average
Ammonium phosphate and Muriate of potash	403	424	413
Acid phosphate Nitrate of soda and Muriate of potash	393	639	506
Acid phosphate and Nitropo	413	566	489

TABLE 8—HIGH VS. LOW ANALYSIS MATERIALS

Treatment	1927 yield per acre
600 pounds 8-4-4 from Acid phosphate Nitrate of soda and Muriate of potash	1270
150 pounds 32-16-16 Nitrophoska	1187

succeeding crops may be expected. The unused nitrogen is often leached from the soil by drainage waters.

Such materials as ammonium sulphate tend to render soils permanently more acid. It is therefore not advisable to use this material in high quantities year after year on soils that are already acid in nature. This acid effect may be overcome by the application of limestone.

SUMMARY.—In a complete mixture, greatest net profits are obtained where the amount of nitrogen equals or very nearly equals the amount of phosphoric acid used.

Potash is needed where rust is present and on many other soils. Four per cent should be used on these soils and on all soils where it is not known that it is not necessary.

Potash did not return a profit on the Prairie soils tested.

Superphosphate (acid phosphate) is recommended as the source of phosphoric acid.

The readily soluble forms of nitrogen, such as nitrate of soda, ammonium sulphate, leunasalpeter, calcium nitrate, and urea are highly efficient and about equally effective as sources of nitrogen. Calcium cyanamid, as used in these tests, has not been satisfactory.

Kainit, muriate, sulphate and trona are all efficient potash carriers.

High quantities of fertilizer are profitable. There is more danger in using too little than in using too much fertilizer.

Ammophos 20-20 was not as efficient as a source of phosphoric acid and nitrogen as a mixture of superphosphate (acid phosphate) and nitrate of soda.

Nitropo was about as efficient as a source of nitrogen and potash as a mixture of nitrate of soda and muriate of potash.

In a one-season test, 150 pounds of nitrophoska (32-16-16) was about as efficient as 600 pounds of an 8-4-4 composed of superphosphate, nitrate of soda and muriate of potash.

List of Cooperating Farmers

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J. B. Ray, Weir, Mississippi.
J. B. Hardee, Eupora, Mississippi.
C. F. Ferguson, Eupora, Mississippi.
W. C. Butler, Longview, Mississippi.
J. I. Cummins, Longview, Mississippi.
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W. D. Bell, Brooksville, Mississippi.
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W. H. Ottley, Steens, Mississippi.
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