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Fertilizer Experiments With Cotton

By

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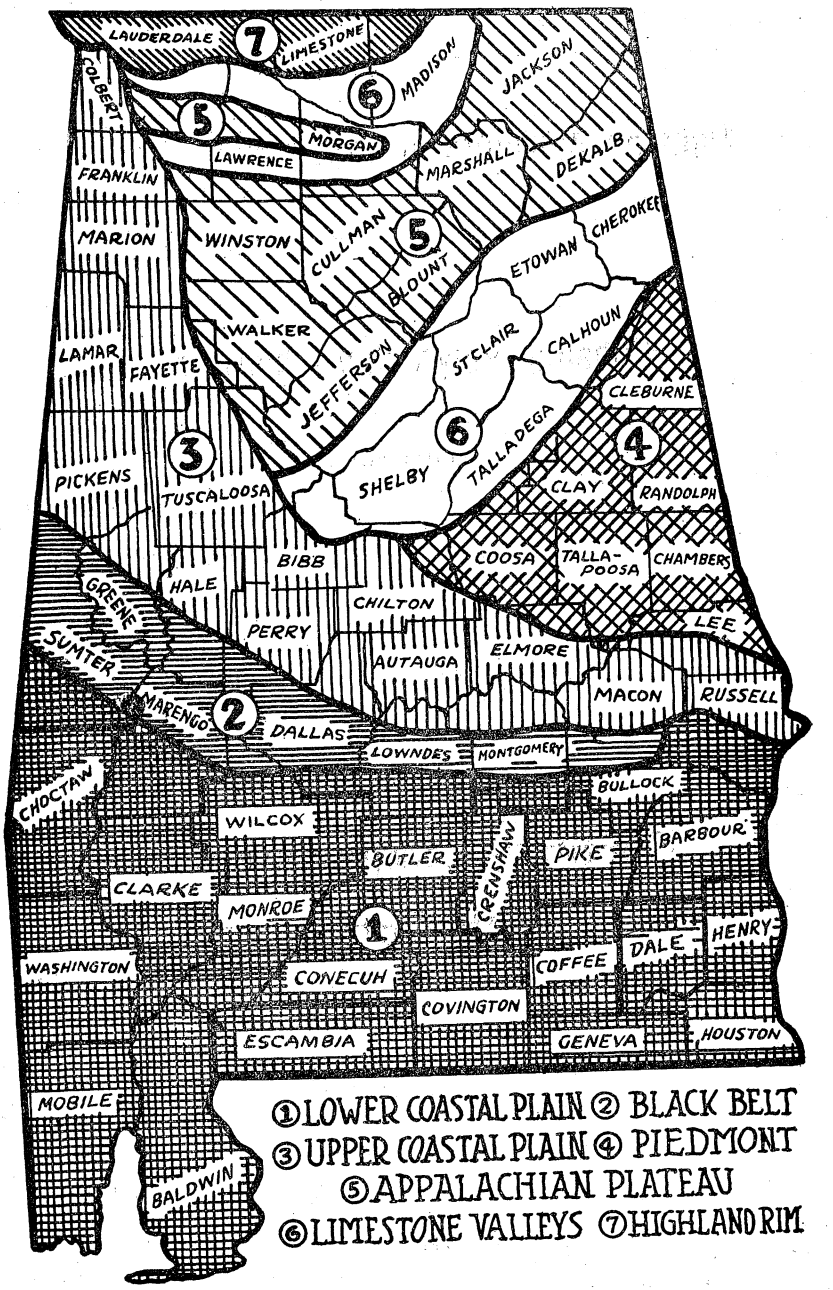
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CONECUH
COFFEE
COVINGTON
ESCAMBIA
GENEVA
HOUSTON
MOBILE
BALDWIN
①LOWER COASTAL PLAIN ② BLACK BELT
③UPPER COASTAL PLAIN ④ PIEDMONT
⑤APPALACHIAN PLATEAU
⑥LIMESTONE VALLEYS ⑦HIGHLAND RIM

SUMMARY

1. Alabama farmers who are interested in the contents of this bulletin should first determine by the map on page 2 the soil division on which they are located. Results and recommendations for their particular division should then be carefully studied.

2. Nitrate of soda has returned better profits than cottonseed meal in all sections of Alabama. Nitrate of soda is recommended, therefore, in the formulas for each section. It should be used in accordance with the directions on pages 21 and 22.

3. The gray soils over yellow subsoils of southeast Alabama have a high potash requirement and a relatively low phosphoric acid requirement. Results of experiments and fertilizer recommendations for this section are recorded in Table 1, page 8.

4. On all red soils, gray soils with red subsoils, and, in the southwest part of the Lower Coastal Plain, gray soils over yellow subsoils, the potash requirement is less than on the gray soils of southeast Alabama. The return from phosphoric acid on these soils is relatively low. (See Table 1, page 8.)

5. A comparison of the fertilizer results before and after boll weevils appeared shows that the returns from all kinds of fertilizers, except nitrate of soda, were reduced by weevils. (See Table 2, page 10.)

6. Taken as a whole, the lowest returns from commercial fertilizers were obtained on Black Belt Soils. (See Table 3, page 12.)

7. The fertilizer requirements of the Upper Coastal Plain are very similar to those of southwest Alabama. In this division nitrate of soda produced especially good results. (See Table 4, page 13.)

8. Soils of the Piedmont Plateau need little or no potash. The response to nitrate of soda and acid phosphate on these soils was very good. (See Table 5, page 15.)

9. Appalachian Plateau soils respond more to phosphate than do the sandy soils of south Alabama. Nitrate of soda produced very good results; but the need for potash is only moderate. The profits from the use of fertilizers on the Appalachian Plateau were greater

than the profits on any other soil. (See Table 6, page 16.)

10. The gray or yellow chert free soils, with heavy, yellow subsoils, of the Limestone Valley regions have a high potash requirement. They respond very well to acid phosphate and nitrate of soda. (See Table 7, page 18.)

11. Nitrate of soda produced greater returns on the red lands of the Limestone Valleys than on any other soils of Alabama. There is a strong need for phosphoric acid and a weak need for potash. (See Table 7, page 18.)

12. Acid phosphate produced greater returns on the Highland Rim—"Barrens"—than on any other Alabama soils. Potash, when used at a moderate rate, returned very good profits. (See Table 8, page 20.)

13. Experiments to determine the best time to apply nitrate of soda to cotton showed that early applications are more profitable than are late applications. (See Table 9, page 21.)

14. One ton of muriate of potash containing 50 per cent potash is equivalent to four tons of kainit containing 12.5 per cent potash. At present prices and freight rates muriate is cheaper than kainit.

FERTILIZER EXPERIMENTS WITH COTTON

By

J. T. WILLIAMSON AND M. J. FUNCHESS

INTRODUCTION

In 1911 the Alabama Legislature appropriated to the Alabama Experiment Station a sum of money to conduct local experiments with field crops, fruits, fertilizers, livestock, etc., in the several sections of the State. Reports of 226 fertilizer experiments with cotton which are recorded in this bulletin represent a part of the work that was made possible by this appropriation.

During the progress of this work, one or more experiments were placed in each county of the State. For various reasons a number of experiments were discarded, leaving only 57 counties represented. One hundred forty-three farmers cooperated with the Experiment Station in conducting these experiments. The results have been divided into groups in accordance with the several distinct soil divisions of the State. These soil divisions are shown on page 2. Average results of experiments are recorded in the tables which follow.

METHODS

A representative from the Experiment Station selected the land and measured the plots for each experiment. Fertilizers for each plot and instructions concerning their application were sent by the Experiment Station to the cooperator. Each experiment was inspected one or more times during the growing season. All fertilizers, except nitrate of soda, were applied in the drill before planting. Previous to 1920, the nitrate of soda was applied when the plants were six to eight inches tall. During and since 1920 the nitrate of soda was applied at the first cultivation after cotton was thinned to a stand.

VALUES ASSIGNED TO COTTON AND TO FERTILIZERS

The following prices for fertilizers are used throughout this bulletin.

Acid phosphate	$15.00	per ton
Nitrate of soda	55.00	" "
Cottonseed meal	45.00	" "
Kainit	15.00	" "

The assumed value of seed cotton is placed at six cents per pound, which equals approximately 13 cents per pound for lint cotton and $38.00 per ton for cotton seed. In each table there is presented a column showing profits when seed cotton is valued at 10 cents per pound, which is equivalent to 23 cents per pound for lint cotton and $45.00 per ton for cotton seed. (The lower value assigned to cotton is probably lower than the average price received by farmers during the last ten years, due to the abnormally high prices of 1918-20.)

The prices assumed for fertilizers are, roughly, equal to the average prices for fertilizers in normal times.

The tables contain a complete record of the yields, so that other values may be assumed and profits calculated by any one who cares to do so.

Calculations of Increases from the Use of Fertilizers

The increased yields attributed to fertilizers have been calculated in this bulletin as follows: the increase due to acid phosphate is obtained by subtracting the yield of plot six from that of plot nine; the increase due to 200 pounds of kainit is obtained by subtracting the yield of plot five from that of plot nine; the value of 100 pounds of kainit per acre is found by subtracting the yield of plot five from the yield of plot ten; and the value of cottonseed meal is obtained by subtracting the yield of plot eight from that of plot nine. To find the value of nitrate of soda, the yield of plot ten is subtracted from that of plot twelve. The figure thus obtained is added to, or subtracted from (as the case may be) the value of cottonseed meal which was obtained as explained above.

Experiments on the Lower Coastal Plain

Results on the Norfolk Soil Group.—The soils of southeast Alabama are different from those of southwest Alabama in many ways. In the southeastern section gray sandy soils with yellow sandy clay subsoils predominate. Fertilizer results obtained in a few counties in this section were different from those obtained on the red, heavier soils of this section, or on either gray or red lands of southwest Alabama. Consequently the results of the fertilizer experiments on gray soils with yellow subsoils in this section are presented separately from results obtained on all other

soils of the Lower Coastal Plain lands of south Alabama.

The area referred to as "southeast Alabama" lies east and south of a line drawn between Russell and Barbour counties, between the upper and lower halves of Bullock and Montgomery counties, thence southward between Crenshaw and Butler, Conecuh and Covington, and Escambia and Conecuh to the Florida line.

The average results obtained in twenty-four fertilizer experiments in these counties are presented in Table 1, under the heading "Norfolk Soil Group."

A study of this table reveals that a complete fertilizer is necessary for the largest profits. In the complete fertilizer, potash produced the largest profit, nitrogen in nitrate of soda was next, and phosphoric acid took third place. One dollar's worth of potash produced cotton worth nearly $6.00; one dollar's worth of nitrogen in nitrate of soda produced cotton worth $4.10, as aganist $1.97 for cottonseed meal; and one dollar's worth of phosphoric acid produced cotton worth $2.97.

Expressed in other terms, a ton of acid phosphate, costing $15.00, produced a half bale of cotton, worth about $45.00; a ton of cottonseed meal, costing $45.00, increased the yield a full bale, worth about $90.00; a ton of nitrate of soda, costing $55.00, increased the yield by two and one-half bales, worth about $225.00. These figures show very clearly that cottonseed meal should not be used as a fertilizer for cotton.

Where as much as 200 pounds of phosphate and 100 pounds of nitrate of soda are used, at least 200 pounds of kainit is needed to balance the fertilizer. On gray soils, with yellow subsoil, in southeast Alabama, the need for potash is very great. Each ton of kainit in a good complete fertilizer produced an increase of one bale of cotton on soils of this kind.

As a fertilizer for this territory, 200 pounds of acid phosphate, 100 pounds of nitrate of soda and 200 pounds of kainit (or 50 pounds of muriate) are recommended. Those wishing to vary from this recommendation should use more nitrate of soda. It is doubtful if more phosphoric acid or more potash will pay.

TABLE 1.—*Average Results of 88 Fertilizer Experiments with Cotton on the Lower Coastal Plain*

Plot No.	Amt. fertilizer per acre	KIND OF FERTILIZER	Norfolk Soil Group: Av. yield seed cotton per acre	Norfolk Soil Group: Increase over av. unfertilized plots	Norfolk Soil Group: Average profit from fertilizer at 6c*	Norfolk Soil Group: Average profit from fertilizer at 10c*	Greenville Soil Group: Av. yield seed cotton per acre	Greenville Soil Group: Increase over av. unfertilized plots	Greenville Soil Group: Average profit from fertilizers at 6c*	Greenville Soil Group: Average profit from fertilizers at 10c*
	Lbs.		Lbs.	Lbs.	6c*	10c*	Lbs.	Lbs.	6c*	10c*
1	200	Cotton seed meal	542	80	$ 0.30	$ 3.50	602	126	$ 3.06	$ 8.10
2	240	Acid phosphate	535	73	2.58	5.50	540	64	2.04	4.60
3		No fertilizer	451				453			
4	200	Kainit	606	144	7.14	12.90	541	65	2.40	5.00
5	200	Cotton seed meal	650	188	4.98	12.50	680	204	5.94	14.10
	240	Acid phosphate								
6	200	Cotton seed meal	714	252	9.12	19.20	685	209	6.54	14.90
	200	Kainit								
7		No fertilizer	475				492			
8	240	Acid phosphate	655	193	8.28	16.00	639	163	6.48	13.00
	200	Kainit								
9	200	Cotton seed meal	803	341	12.66	26.30	741	265	8.10	18.70
	240	Acid phosphate								
	200	Kainit								
10	200	Cotton seed meal	723	261	8.61	19.05	745	269	9.09	19.85
	240	Acid phosphate								
	100	Kainit								
11		No fertilizer	460				482			
12	100	Nitrate of soda	763	301	12.76	24.80	757	281	11.56	22.80
	240	Acid phosphate								
	100	Kainit								

* Seed cotton at 6 cts. lb. or 10 cts. lb.

Results on the Greenville Soil Group.—Results of 64 fertilizer experiments with cotton on soils of the Lower Coastal Plain, excluding the results on gray soils over yellow subsoils in southeast Alabama, are recorded under the heading, "Greenville Soil Group," in Table 1. These results will apply to all red soils, to all gray soils over red subsoils in the Lower Coastal Plain, and to all gray soils over yellow subsoils in the southwestern part of the State.

The calculated profits show that a complete fertilizer is best for the soils of this division. The highest return per dollar invested was obtained from the use of kainit at the rate of 100 pounds per acre in a complete fertilizer. Cottonseed meal, in this same fertil-

izer, gave the lowest return per dollar spent for fertilizer.

For one dollar invested nitrate of soda produced $2.49 worth of cotton; acid phosphate produced $1.87 worth of cotton; and cottonseed meal produced $1.36 worth of cotton.

On soils of this section, a ton of acid phosphate, valued at $15.00, produced 467 pounds of seed cotton, worth about $28.00; a ton of nitrate of soda, valued at $55.00, produced about 1½ bales of cotton, worth about $135.00; and a ton of cottonseed meal, valued at $45.00, produced about two-thirds of a bale of cotton, worth about $60.00, showing that nitrate of soda is much more profitable than is cottonseed meal. A ton of kainit, valued at $15.00, produced $78.00 worth of cotton. Kainit used at the rate of two hundred pounds per acre produced no more cotton than did 100 pounds, showing that the average soil of southwest Alabama does not need more than 100 pounds of kainit to the acre in a complete fertilizer.

A mixture of 200 pounds of acid phosphate, 100 pounds of nitrate of soda, and 100 pounds of kainit is a satisfactory fertilizer for this section.

Effect of Boll Weevil on Fertilizer Returns

Thirty-five of the 88 cotton fertilizer experiments conducted on the Lower Coastal Plain were conducted before boll weevils arrived, and 53 were conducted under boll weevil conditions. The returns from fertilizers before and after boll weevils arrived are shown in Table 2.

TABLE 2.—*Average Results from 35 Experiments Before the Boll Weevil Came and of 53 Experiments Under Boll Weevil Conditions on the Lower Coastal Plain*

Plot No.	Amt. fertilizer per acre	KIND OF FERTILIZER	Without Weevils: Av. yield seed cotton per acre	Without Weevils: Increase over av. unfertilized plots	Without Weevils: Average profit from fertilizers at 6c*	Without Weevils: Average profit from fertilizers at 10c*	With Weevils: Av. yield seed cotton per acre	With Weevils: Increase over av. unfertilized plots	With Weevils: Avcrage profit from fertilizers at 6c*	With Weevils: Avcrage profit from fertilizers at 10c*
	Lbs.		Lbs.	Lbs.			Lbs.	Lbs.		
1	200	Cotton seed meal	562	109	$ 2.04	$ 6.40	602	114	$ 2.34	$ 6.90
2	240	Acid phosphate	522	69	2.34	5.10	550	62	1.92	4.40
3		No fertilizer	426				471			
4	200	Kainit	563	110	5.10	9.50	556	68	2.58	5.30
5	200 240	Cotton seed meal Acid phosphate	688	235	7.80	17.20	662	174	4.14	11.10
6	200 200	Cotton seed meal Kainit	704	251	9.06	19.10	686	198	5.88	13.80
7		No fertilizer	472				497			
8	240 200	Acid phosphate Kainit	661	208	9.18	17.50	631	143	5.28	11.00
9	200 240 200	Cotton seed meal Acid phosphate Kainit	792	339	12.54	26.10	736	248	7.08	17.00
10	200 240 100	Cotton seed meal Acid phosphate Kainit	762	309	11.49	23.85	725	237	7.17	16.65
11		No fertilizer	461				495			
12	100 240 100	Nitrate of soda Acid phosphate Kainit	761	308	13.18	25.50	757	269	10.84	21.60

* Seed cotton at 6 cts. lb. or 10 cts. lb.

It is necessary to study returns from complete fertilizers only, because the largest profit was always obtained from plots receiving phosphoric acid, nitrogen, and potash. With no weevils present, a dollar's worth of acid phosphate returned $1.93 worth of cotton; after weevils arrived, $1.00 invested in acid phosphate produced an increase worth only $1.67. The increase from a dollar's worth of cottonseed meal before weevils were present amounted to $1.75 and dropped to $1.40 with weevils present. Results from potash were similar to those of acid phosphate and cottonseed meal in that there was a smaller return from kainit with weevils than without weevils. In contrast with cottonseed meal, kainit, and acid phosphate, nitrate of soda gave considerably better returns with weevils present than it

did before they came. Before the weevils arrived a ton of nitrate of soda applied to twenty acres of land increased the yield of seed cotton 2600 pounds. After weevils arrived a ton of nitrate of soda produced an increase of 2740 pounds of seed cotton, showing that, contrary to existing opinion, nitrate of soda is relatively more effective under present conditions than it was before boll weevils came into Alabama. Therefore, the presence of weevils increases rather than diminishes the efficiency of nitrate of soda. Cottonseed meal should not be used as a fertilizer for cotton under present conditions.

Experiments in the Black Belt

Fourteen fertilizer experiments were conducted in the Black Belt. The possible profits to be derived from fertilizers applied to cotton on Black Belt soils are indictated in Table 3. The highest profit per acre was obtained from a complete fertilizer. Per dollar invested kainit produced an increase worth $4.48; acid phosphate, $2.53; nitrate of soda, $1.79; and cottonseed meal only, $1.13. The following table shows the average results obtained in the Black Belt:

TABLE 3.—*Average Results of 14 Fertilizer Experiments with Cotton on the Black Belt*

Plot No.	Amt. fertilizer per acre	KIND OF FERTILIZER	Av. yield seed cotton per acre	Increase over av. unfertilized plots	Average profit from fertilizers at	
	Lbs.		Lbs.	Lbs.	6c*	10c*
1	200	Cotton seed meal	651	108	$ 1.98	$ 6.30
2	240	Acid phosphate	658	115	5.10	9.70
3		No fertilizer	545			
4	200	Kainit	668	125	6.00	11.00
5	200	Cotton seed meal	717	174	4.14	11.10
	240	Acid phosphate				
6	200	Cotton seed meal	723	180	4.80	12.00
	200	Kainit				
7		No fertilizer	546			
8	240	Acid phosphate	714	171	6.96	13.80
	200	Kainit				
9	200	Cotton seed meal	799	256	7.56	17.80
	240	Acid phosphate				
	200	Kainit				
10	200	Cotton seed meal	773	230	6.75	15.95
	240	Acid phosphate				
	100	Kainit				
11		No fertilizer	539			
12	100	Nitrate of soda	770	227	8.32	17.40
	240	Acid phosphate				
	100	Kainit				

* Seed cotton at 6 cts. lb. or 10 cts. lb.

An application of 240 pounds of acid phosphate in a complete fertilizer increased the yield by 76 pounds of seed cotton, equivalent to 633 pounds of seed cotton from a ton of phosphate. One ton of cottonseed meal in a complete fertilizer increased the yield by 850 pounds of seed cotton, while a ton of nitrate of soda, which cost but little more than the meal, produced an increase of 1640 pounds of seed cotton. A ton of kainit, when used at the rate of 200 pounds per acre, increased the yield by 820 pounds of seed cotton, returning a profit on the kainit of $34.00

Cotton production in the Black Belt is now only a mere fraction of what it was before boll weevils arrived. Fertilizer returns for cotton in the Black Belt were lower than on any other soils. Profits from large applications of fertilizer to cotton in this section are very uncertain.

A mixture of 200 pounds of acid phosphate, 100

pounds of nitrate of soda, and 200 pounds of kainit will give fair results under cotton in the Black Belt.

Experiments on the Upper Coastal Plain

Results of fertilizer experiments with cotton on the Upper Coastal Plain are recorded in Table 4. The 46 experiments are divided into two groups, based on the kind of soils on which the tests were conducted. Results obtained on gray soils over yellow subsoils are recorded in the column headed, "Norfolk Soil Group." In the column headed "Greenville Soil Group" are recorded the results obtained on red soils, or gray soils over red or reddish subsoils. These results are recorded in Table 4.

Table 4.—*Average Results of 46 Fertilizer Experiments with Cotton on the Upper Coastal Plain*

Plot No.	Amt. fertilizer per acre	KIND OF FERTILIZER	Norfolk Soil Group				Greenville Group			
			Av. yield seed cotton per acre	Increase over av. unfertilized plots	Average profit from fertilizers at		Av. yield seed cotton per acre	Increase over av. unfertilized plots	Average profit from fertilizers at	
	Lbs.		Lbs.	Lbs.	6c*	10c*	Lbs.	Lbs.	6c*	10c*
1	200	Cotton seed meal	637	177	$ 6.12	$13.20	768	183	$ 6.48	$13.80
2	240	Acid phosphate	582	122	5.52	10.40	672	87	3.42	6.90
3		No fertilizer	448				564			
4	200	Kainit	588	128	6.18	11.30	629	44	1.14	2.90
5	200	Cotton seed meal	725	265	9.60	20.20	825	240	8.10	17.70
	240	Acid phosphate								
6	200	Cotton seed meal	715	255	9.30	19.50	805	220	7.20	16.00
	200	Kainit								
7		No fertilizer	469				592			
8	240	Acid phosphate	647	187	7.92	15.40	712	127	4.32	9.40
	200	Kainit								
9	200	Cotton seed meal	782	322	11.52	24.40	878	293	9.78	21.50
	240	Acid phosphate								
	200	Kainit								
10	200	Cotton seed meal	800	340	13.35	26.95	883	298	10.83	22.75
	240	Acid phosphate								
	100	Kainit								
11		No fertilizer	464				600			
12	100	Nitrate of soda	805	345	15.40	29.20	918	333	14.68	28.00
	240	Acid phosphate								
	100	Kainit								

* Seed cotton at 6 cts. lb. or 10 cts. lb.

Fertilizer results in this division are very similar to those obtained on similar soils of the Lower Coastal Plain. On both divisions 100 pounds of kainit produced a greater increase than did 200 pounds. When used at the rate of 100 pounds, one dollar's worth of kainit made an increase worth $6.00 on the Norfolk soil group, and $4.64 on the Greenville soil group. On the Norfolk group, a dollar's worth of nitrate of soda produced an increase worth $3.05, and on the Greenville group the increase was worth $4.39. One dollar's worth of cottonseed meal produced only $1.80 worth of cotton on Norfolk soil group and $2.21 on Greenville soil group, showing that nitrate of soda is more effective than cottonseed meal.

On the soils of this division of Alabama, it is recommended that a fertilizer composed of 200 pounds of acid phosphate, 100 pounds of nitrate of soda, and 100 pounds of kainit per acre be used. At present prices this fertilizer should return a profit of $20.00 to $25.00 per acre.

Experiments on the Piedmont Plateau

Nine satisfactory experiments were conducted in the Piedmont Section, results of which are recorded in Table 5. The outstanding results of these experiments are the high returns from nitrate of soda and the low returns from potash. The Piedmont soils are richer in potash than those of any other section of Alabama. It appears that from the large amount of potash present in these soils cotton can secure nearly all of the potash needed for full growth. Table 5 follows.

TABLE 5.—*Average Results of 9 Fertilizer Experiments with Cotton on the Piedmont Plateau*

Plot No.	Amt. fertilizer per acre	KIND OF FERTILIZER	Av. yield seed cotton per acre	Increase over av. unfertilizer plots	Average profit from fertilizers at	
	Lbs.		Lbs.	Lbs	6c*	10c*
1	200	Cotton seed meal	664	200	$ 7.50	$15.50
2	240	Acid phosphate	602	138	6.48	12.00
3		No fertilizer	466			
4	200	Kainit	508	44	1.14	2.90
5	200	Cotton seed meal	751	287	10.92	22.40
	240	Acid phosphate				
6	200	Cotton seed meal	674	210	6.60	15.00
	200	Kainit				
7		No fertilizer	468			
8	240	Acid phosphate	596	132	4.62	9.90
	200	Kainit				
9	200	Cotton seed meal	716	252	7.32	17.40
	240	Acid phosphate				
	200	Kainit				
10	200	Cotton seed meal	772	308	11.43	24.50
	240	Acid phosphate				
	100	Kainit				
11		No fertilizer	459			
12	100	Nitrate of soda	816	352	15.82	29.90
	240	Acid phosphate				
	100	Kainit				

* Seed cotton at 6 cts. lb. or 10 cts. lb.

An application of 200 pounds of kainit per acre on the Piedmont Plateau reduced the yield of cotton. When applied at the rate of 100 pounds per acre there was a fair increase in yield. A ton of kainit applied over twenty acres of land at 100 pounds per acre would increase the yield by 420 pounds of seed cotton, or 21 pounds per acre. At present prices, a light application of kainit would return a small profit, but it is doubtful if it pays to use any potash fertilizer on the average Piedmont land. On the other hand, a ton of nitrate of soda, costing $55.00, produced an increase in seed cotton of 3280 pounds. At this rate a dollar spent for nitrate of soda returned $3.57. One dollar's worth of cottonseed meal increased the yield by $1.60. Acid phosphate produced fair returns on these soils. For one dollar's worth of phosphate there was an increase in yield worth $2.90.

A fertilizer composed of 300 pounds of acid phosphate and 100 pounds of nitrate of soda will give good results on the red lands of the Piedmont. On the gray sandier soils acid phosphate may be reduced to 200 pounds per acre. Neither kainit nor cottonseed meal should be used at present prices.

Experiments on the Appalachian Plateau

Seventeen fertilizer tests with cotton were conducted on the Appalachian Plateau. The outstanding results of these experiments are the high returns from phosphoric acid and nitrogen. The highest profit per acre from the use of fertilizers was obtained in the Appalachian Plateau. Results of these experiments are recorded in Table 6.

Table 6.—*Average Results from 17 Fertilizer Experiments with Cotton on the Appalachian Plateau*

Plot No.	Amt. fertilizer per acre	KIND OF FERTILIZER	Av. ield seed cotton per a cre	Increase over av. unfertilized plots	Average profit from fertilizers at	
	Lbs.		Lbs.	Lbs.	6c*	10c*
1	200	Cotton seed meal	655	183	$ 6.48	$13.80
2	240	Acid phosphate	647	170	8 40	15.20
3		No fertilizer	474			
4	200	Kainit	534	62	2.22	4.70
5	200	Cotton seed meal	808	336	13.86	27.30
	240	Acid phosphate				
6	200	Cotton seed meal	709	237	8.22	17.70
	200	Kainit				
7		No fertilizer	469			
8	240	Acid phosphate	681	209	9.24	17.60
	200	Kainit				
9	200	Cotton seed meal	823	351	13.26	27.30
	240	Acid phosphate				
	200	Kainit				
10	200	Cotton seed meal	849	377	15.57	30.65
	240	Acid phosphate				
	100	Kainit				
11		No fertilizer	472			
12	100	Nitrate of soda	854	382	17.62	32.90
	240	Acid phosphate				
	100	Kainit				

* Seed cotton at 6 cts. lb. or 10 cts. lb.

For one dollar invested, acid phosphate returned $3.80; cottonseed meal returned $1.89; nitrate of soda returned $3.21; kainit, at the rate of 200 pounds per acre, returned only $0.60; and kainit, at the rate of 100 pounds per acre, returned $3.28.

By using the right kind of fertilizers, farmers of this section may very profitably increase their cotton yields. In Table 6, for example, it is shown that the profit from the fertilizers applied to plot 12 was $17.62.

On the heavier soils of this division, 300 pounds of acid phosphate, 100 pounds of nitrate of soda, and 100 pounds of kainit will return good results. On the lighter sandy soils, 200 pounds of acid phosphate will usually be sufficient to balance 100 pounds of nitrate of soda and 100 pounds of kainit. If it is desired to apply fertilizer at a heavier rate than indicated, nitrate of soda and acid phosphate should be increased in the proportions recommended above. More than 100 pounds of kainit will not pay.

Experiments on Limestone Valley Soils

The Limestone Valley soils of Alabama are found chiefly in those areas commonly known as the Tennessee River Valley and the Coosa River Valley. The soils in these two valleys are very similar in origin, composition, and fertilizer needs, as shown by a number of experiments. Consequently, all fertilizer experiments conducted in these two valleys are brought together in Table 7.

TABLE 7.—*Average Results of 22 Fertilizer Experiments with Cotton on Limestone Valley Soils*

Plot No.	Amt. fertilizer per acre	KIND OF FERTILIZER	Decatur Soil Group: Av. yield seed cotton per acre	Decatur Soil Group: Increase over av. unfertilized plots	Decatur Soil Group: Average profit from fertilizers at 6c*	Decatur Soil Group: Average profit from fertilizers at 10c*	Colbert Soil Group: Av. yield seed cotton per acre	Colbert Soil Group: Increase over av. unfertilized plots	Colbert Soil Group: Average profit from fertilizers at 6c*	Colbert Soil Group: Average profit from fertilizers at 10c*
	Lbs.		Lbs.	Lbs.	6c*	10c*	Lbs.	Lbs.	6c*	10c*
1	200	Cotton seed meal	619	106	$ 1.86	$6.10	510	120	$ 2.70	$ 7.50
2	240	Acid phosphate	589	76	2.76	5.80	513	123	5.58	10.50
3		No fertilizer	460				399			
4	200	Kainit	523	10	—0.90	—0.50	536	146	7.26	13.10
5	200 240	Cotton seed meal Acid phosphate	735	222	7.02	15.90	612	222	7.02	15.90
6	200 200	Cotton seed meal Kainit	682	169	4.14	10.90	650	260	9.60	20.00
7		No fertilizer	542				384			
8	240 200	Acid phosphate Kainit	618	105	3.00	7.20	671	281	13.56	24.80
9	200 240 200	Cotton seed meal Acid phosphate Kainit	791	278	8.88	20.00	772	382	15.12	30.40
10	200 240 100	Cotton seed meal Acid phosphate Kainit	800	287	10.17	21.65	734	344	13.59	27.35
11		No fertilizer	538				387			
12	100 240 100	Nitrate of soda Acid phosphate Kainit	866	353	15.88	30.00	760	370	16.90	31.70

* Seed cotton at 6 cts. lb. or 10 cts. lb.

The soils of these valleys may be divided into two distinct groups, each having specific fertilizer needs. The typical red lands of these valleys together with the chocolate colored soils are grouped in the "Decatur Soil Group." The other group is composed of soils having gray or yellow chert free soils over yellow subsoils. It is called the "Colbert Soil Group."

The soils of these two groups—the red lands and the gray or yellow lands—respond to phosphate in a very striking manner. One dollar's worth of acid phosphate applied to cotton on the red land returned $3.63 and on the gray or yellow lands it returned $4.07. On the red lands, a dollar spent for nitrate of soda returned $5.21, and on the gray or yellow soils it returned $4.10. Returns from cottonseed meal were

much better on the red than on the gray lands. On the red soils, a dollar spent for cottonseed meal returned $2.31 and on the gray soils it returned only $1.35. The soils of the two divisions differ widely in their response to potash. On the gray-yellow soil group, kainit at the rate of 200 pounds per acre was profitable; on the red lands, 200 pounds of kainit produced less cotton than did 100 pounds. When used at the rate of 200 pounds per acre on gray soils one dollar invested in kainit returned $6.40 and on the red lands it returned only $2.24. One hundred pounds of kainit per acre on the red lands gave an increase worth $5.20 for each dollar invested, and on the gray lands the return per dollar invested in kainit was $9.76.

The cherty gray soils over yellow subsoils, belonging to the "Clarksville Series," need only 100 pounds of kainit per acre.

A fertilizer containing 200 to 300 pounds of acid phosphate, 100 pounds of nitrate of soda, and 100 pounds of kainit is recommended for the red lands of these valleys. The chert free gray lands will give good returns from a mixture containing 200 pounds of acid phosphate, 100 pounds of nitrate of soda, and 200 pounds of kainit.

Special mention is made of the results obtained on red land near Russellville, Franklin County. The two experiments in question were conducted on land that had formerly been pastured, and had carried a good growth of lespedeza. As an average of two years' results, 240 pounds of acid phosphate increased the yield 400 pounds of seed cotton; 200 pounds of kainit increased the yield 118 pounds; and 200 pounds of cottonseed meal increased the yield only 28 pounds. Putting these results another way, $1.80 worth of acid phosphate produced an increase worth $24.00; the return from seventy-five cents worth of kainit was $7.08; while cottonseed meal was used at a loss.

Lespedeza is well adapted to the soils of the Tennessee Valley. The full use of this crop as a means of increasing the humus and nitrogen content of these soils, together with a liberal use of acid phosphate and potash fertilizers, should produce splendid crops of cotton at a minimum cost on lands of this kind.

Experiments on the "Barrens" of the Highland Rim

The average of six cotton fertilizer experiments conducted on Clarksville silt loam soil of the Highland Rim, locally known as "Barrens," together with the calculated profits are recorded in Table 8.

Table 8.—*Average Results of 6 Fertilizer Experiments with Cotton on the Highland Rim*

Plot No.	Amt. fertilizer per acre	KIND OF FERTILIZER	Av. yield seed cotton per acre	Increase over av. unfertilized plots	Average profit from fertilizer at	
	Lbs.		Lbs.	Lbs	6c*	10c*
1	200	Cotton seed meal	713	200	$ 7.50	$15.50
2	240	Acid phosphate	657	144	6.84	12.60
3		No fertilizer	513			
4	200	Kainit	510	—3	—1.68	—1.80
5	200 240	Cotton seed meal Acid phosphate	845	332	13.62	26.90
6	200 200	Cotton seed meal Kainit	738	225	7.50	16.50
7		No fertilizer	554			
8	240 200	Acid phosphate Kainit	726	213	9.48	18.00
9	200 240 200	Cotton seed meal Acid phosphate Kainit	897	384	15.24	30.60
10	200 240 100	Cotton seed meal Acid phosphate Kainit	904	391	16.41	32.05
11		No fertilizer	471			
12	100 240 100	Nitrate of soda Acid phosphate Kainit	836	323	14.08	27.00

* Seed cotton at 6 cts. lb. or 10 cts. lb.

The outstanding result of these tests is the marked response to phosphoric acid. One dollar spent for acid phosphate produced an increase in yield worth $5.30, which is the highest return for acid phosphate in the State. One dollar spent for cottonseed meal returned $2.38, while a dollar spent for nitrate of soda returned $2.25. This is the only section of Alabama where nitrate of soda was not much more profitable than was cottonseed meal; and here the two have given identical returns. One dollar's worth of kainit, at the rate of 200 pounds per acre, produced an increase

worth $2.08, but when used at the lighter rate of 100 pounds per acre, the return was $4.72 per dollar spent.

A fertilizer composed of 200 or 300 pounds of acid phosphate, 100 pounds of nitrate of soda, or the equivalent in cottonseed meal, and 100 pounds of kainit, will give good returns on the "Barrens."

When to Apply Nitrate of Soda to Cotton

The average results of 24 experiments, conducted away from Auburn, comparing the value of nitrate of soda when applied to cotton at different stages of growth, are recorded in Table 9.

Table 9.—*Average Results Obtained from Applying Nitrate of Soda to Cotton at Different Stages of Growth*

		Av'age 10 Expts. 1920–22		Average 24* Expts. 1914-22	
Amt. Nitrate of soda per acre	TIME OF APPLICATION	Yield seed cotton per acre	Increase over average of no nitrogen plots	Yeild seed cotton per acre	Increase over average of no nitrogen
Lbs.		Lbs.	Lbs.	Lbs.	Lbs.
0		444		499	
100	At planting time	634	151		
25	At planting time	655	172		
75	At time of fiirst cultivation				
100	At time of first cultivation	635	152	649	134
100	When squares first appeared	622	139	647	132
0		508		517	
100	When first blooms appeared	601	118	627	112
100	Three weeks after first bloom appeared	594	111	623	108
100	At planting time	782	299	750***	235
100	When first bloom appeared				
0		497		529**	

*Includes 1920-22 expts.

**Average 19 expts.

***Previous to 1920 first application was made at time of first cultivation, and second application made three weeks after first blooms appeared.

The results of 24 experiments show that nitrate of soda should be applied early. The ten tests of 1920-22 indicate that when 100 pounds per acre is used it should all be applied either at planting time, the time

of the first cultivation after thinning, or, perhaps better, one-fourth at planting time and three-fourths at the time of first cultivation. However, application of all nitrate of soda at planting time causes grass and weeds to grow so rapidly that chopping and cultivation become difficult and expensive. If a small part of the nitrate of soda is applied at planting time it may be either mixed with the seed and applied through the planter, or it may be mixed with the acid phosphate and potash and the mixture applied in the drill just before planting.

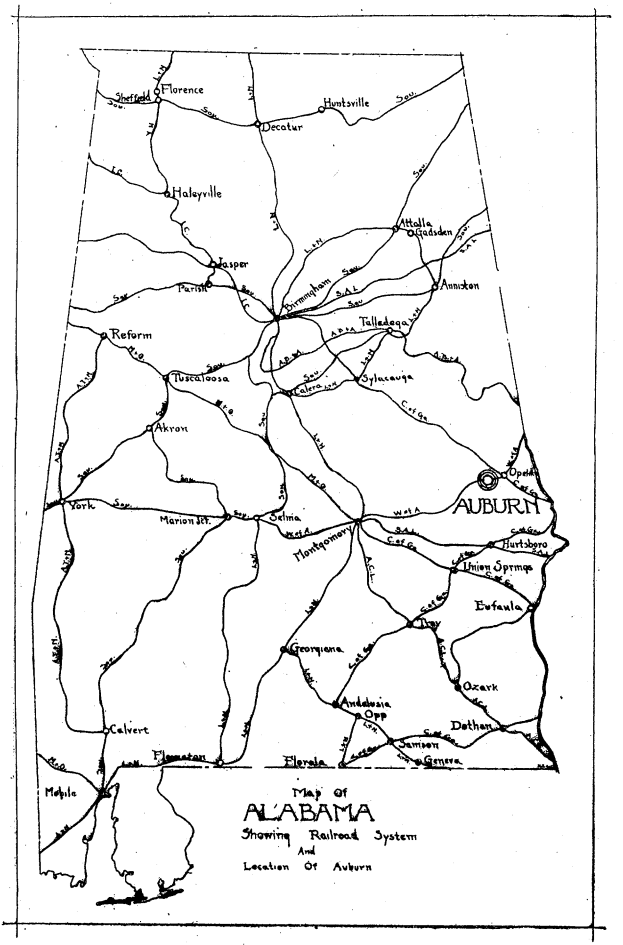
The average increase from 200 pounds of nitrate of soda per acre was much larger than from only 100 pounds per acre. For example, the greatest average increase from 100 pounds of nitrate of soda was 172 pounds of seed cotton per acre; and in the same experiments, the increase from the 200 pound application was 229 pounds . This increase represents a profit of $7.57 per acre from 100 pounds, and $12.44 per acre from 200 pounds. Stated in another way, 10 acres of land fertilized with nitrate of soda at the rate of 200 pounds per acre would return a profit of $48.70 more than the same ten acres fertilized with only 100 pounds of nitrate of soda per acre.

Table 10.—*GENERAL SUMMARY*

Average Increase Per Acre, Per Ton and Gross Return Per Dollar Invested in Fertilizers from 202 Fertilizer Experiments with Cotton, 1911-1921, Inclusive

Kind and amount of fertilizer per acre.	Basis of Value	Assumed value of seed cotton per pound.	Lower Coastal Plain: Norfolk Group	Lower Coastal Plain: Greenville Group	Lower Coastal Plain: No Weevils Present	Lower Coastal Plain: Weevils Present	Black Belt	Upper Coastal Plain: Norfolk Group	Upper Coastal Plain: Greenville Group	Piedmont Plateau	Appalachian Plateau	Limestone Valley: Colbert Group	Limestone Valley: Decatur Group	Highland Rim
ACID PHOSPHATE (240 pounds per per in a complete fertilizer)	Per acre—lbs.		89	56	58	50	76	67	73	87*	114	122	109	159
	Per ton—lbs.		742	467	483	417	633	559	608	725	950	1016	908	1324
	Per dollar invested	6c	2.97	1.87	1.93	1.67	2.53	2.23	2.43	2.90	3.80	4.07	3.63	5.34
		10c	4.94	3.11	3.22	2.78	4.22	3.72	4.06	4 85	6.33	6 78	6.06	8.83
COTTON SEED MEAL (200 pounds per per in a complete fertilizer)	Per acre—lbs.		148	102	131	105	85	135	166	120	142	101	173	171
	Per ton—lbs.		1480	1020	1310	1050	850	1350	1660	1200	1420	1010	1730	1710
	Per dollar invested	6c	1.97	1.36	1.75	1.40	1.13	1.80	2.21	1.60	1.89	1.35	2.31	2.28
		10c	3.29	2.27	2.91	2.33	1.89	3.00	3.69	2.67	3.16	2.24	3.85	3.80
NITRATE OF SODA (100 pounds per acre in a complete fertiltzer	Per acre—lbs.		188	114	130	137	82	140	201	164	147	127	239	103
	Per ton—lbs.		3760	2280	2600	2740	1640	2800	4020	3280	2940	2570	4780	2060
	Per dollar invested	6c	4.10	2.49	2.84	2 99	1 79	3 05	4.39	3.57	3.21	2 77	5.21	2.25
		10c	6 84	4 15	4.73	4.98	2.98	5.09	7.31	5.96	5.35	4.62	8.69	3 75
KAINIT (200 pounds per acre in a complete fertilizer.)	Per acre—lbs.		153	61	104	74	82	57	53	-35	15	160	56	52
	Per ton—lbs.		1530	610	1040	740	820	570	530	-350	150	1600	560	520
	Per dollar invested	6c	6.12	2 44	4.16	2.96	3.28	2.28	2.12	-1.40	0.60	6.40	2.24	2.08
		10c	10.20	4 07	6.93	4.93	5.47	3 80	3 53	-2.33	1.00	10 67	3.73	3.47
KAINIT (100 pounds per acre in a complete fertilizer.)	Per acre—lbs.		73	65	74	63	56	75	58	21	41	122	65	59
	Per ton—lbs.		1460	1300	1480	1260	1120	1500	11.60	420	820	2440	1300	11.80
	Per dollar invested	6c	5.84	5.20	5.92	5.04	4 48	6.00	4.64	1.68	3.28	9.76	5.20	4.72
		10c	9 73	8.67	9.87	8.40	7.47	10.00	7 73	2.80	5.46	16 27	8.67	7 87

*This value obtained from a camparison of Plots 1 and 5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