

BULLETIN No. 78.

FEBRUARY, 1897.

ALABAMA

Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

Co-operative Fertilizer Experiments with
Cotton in 1896.

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MONTGOMERY, ALA.:
THE BROWN PRINTING COMPANY, PRINTERS.
1897.

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CO-OPERATIVE FERTILIZER EXPERIMENTS WITH COTTON IN 1896.

BY J. F. DUGGAR.

SUMMARY.

In 1896, in addition to experiments on the Station Farm, there were conducted under the direction of the Agricultural Department of this Experiment Station 27 fertilizer experiments with cotton in as many localities. Reports were received from 21 experimenters; 14 of the most conclusive of these reports constitute the basis for the greater part of the results here presented.

Florida soft phosphate, also known as "Natural Plant Food," proved inferior to high grade acid phosphate, pound for pound. When both phosphates were applied with cotton seed or cotton seed meal the average yield of seed cotton was 43 pounds per acre greater with acid phosphate than with the Florida soft phosphate.

The nitrogen contained in crushed cotton seed and cotton seed meal was equally valuable, pound for pound. The relative prices of cotton seed and cotton seed meal, which fluctuate considerably, must in each particular case determine which is the cheaper source of nitrogen and hence the more profitable fertilizer. On an average one pound of cotton seed meal proved as effective as 2^{1-16} pounds of crushed cotton seed. In other words 922 pounds of cotton seed meal proved equal in fertilizing value to 2,000 pounds of crushed cotton seed.

According to these results, which however may have been influenced by the unusual season, a farmer cannot afford to

sell cotton seed and buy cotton seed meal until the ton price of seed is at least 46 per cent. of the ton price of the meal; for example, with cotton seed meal at \$20 per ton, crushed seed are worth on the farm \$9.20 for fertilizing purposes.

In testing the needs of the cotton plant, 200 pounds per acre of cotton seed meal was used to furnish nitrogen, 240 pounds acid phosphate to supply phosphoric acid, and 200 pounds kainit to afford potash. These fertilizers were not as a rule applied singly, but by twos and threes.

The chief need of the soil was apparently phosphoric acid in three instances, potash in three cases, and nitrogen in five soils; on three of these fourteen soils, phosphoric acid, potash, and nitrogen were all about equally effective. A complete fertilizer, containing all three of the above mentioned fertilizer materials, was more effective on nine out of fourteen soils than was any combination of only two fertilizers.

Averaging the results for the fourteen tests, the increase over the yields of unfertilized plots were as follows: With a complete fertilizer, an increase of 454 pounds of seed cotton per acre; with a mixture of cotton seed meal and acid phosphate, an increase of 378 pounds; with a mixture of cotton seed meal and kainit, a gain of 375 pounds; and with a mixture of acid phosphate and kainit, 322 pounds. The average profits per acre from fertilizers were respectively \$6.04, \$5.63, \$5.78, and \$4.70.

The work of testing the manurial needs of different soils is being continued with cotton in 1897.

OBJECTS OF THE EXPERIMENTS.

The most careless observer cannot fail to notice that there are numerous distinct classes of soil within this State. These differ not only in chemical composition and in physical structure, but also in their ability to utilize for the benefit of crops growing on them the various kinds of commercial

fertilizers. Indeed there is no process by which one can positively determine the best fertilizer formula for a given soil until actual tests on it or on similar soils have thrown some light upon its needs. There are general principles, the application of which will usually be highly advantageous in compounding a promising formula, but an actual test is the only final and positive authority.

Hence it is that in fertilizer tests this Station, in 1896 and in previous years, has secured the co-operation of careful and progressive farmers located on the different soil belts of the State.

In the spring of 1896 small lots of carefully weighed and mixed fertilizers were sent to parties in twenty-seven localities. Accompanying the fertilizers were detailed instructions as to how to conduct the experiment. Blank forms for reporting results were furnished. Some of these experiments were visited as time could be spared. The King variety was used in all tests.

The three main objects of the experiment were as follows:

- (1) To learn if Florida soft phosphate can be profitably substituted for acid phosphate when used in connection with cotton seed or cotton seed meal.
- (2) To ascertain the relative fertilizing values of cotton seed and cotton seed meal.
- (3) To obtain information regarding the best combinations of fertilizers for cotton, growing on different classes of soil.

In order to make the work of caring for the experiment as light as possible, only eight plots were used in each test, except in cases where the experimenters volunteered to care for a larger number of plots. The small number of plots in most experiments rendered it impracticable to test each fertilizer separately and alone, which, however, will be done in future tests by discontinuing the use of Florida soft phosphate and cotton seed.

The directions sent to those having eight plots required each plot to be one-eighth of an acre in area, the width being sufficient for eight rows. Rows were $3\frac{1}{2}$ ft. apart and each experimenter was advised to so thin the cotton as to leave the same number of plants on each plot, preferable at distances of 18 inches between plants, a point which was not observed in all cases. However, the reports indicated that in general no wide differences existed in the number of plants growing on the several plots.

The directions stated that land employed for this test should be level and uniform, not manured in recent years, and not newground, or subject to overflow, and that it should be representative of large soil areas in its vicinity. The need of perfect uniformity of treatment for all plots (except as to kinds of fertilizers used) was emphasized.

Fertilizers were applied in the usual manner, that is drilled, ridges afterwards being thrown up above the fertilizers. In the few instances where lime was used, the directions required it to be spread broadcast after forming the beds.

Notes on the weather show that in most localities the season was abnormally dry, a circumstance which materially lessens the value of the results. Many of those who conducted this test made special note of the damage done by unusually hot weather in July and August.

THE FERTILIZERS USED.

The fertilizers used in this experiment cost, delivered in Auburn in less than car load lots, as follows:

| | <i>Per ton.</i> |
|--|-----------------|
| Acid phosphate, - - - - - | \$15.00 |
| Cotton seed meal, - - - - - | 20.20 |
| Kainit, - - - - - | 15.70 |
| Florida soft phosphate, - - - - - | 13.92 |
| Crushed cotton seed, (estimated) - - - - - | 8.56 |
| Slaked lime, - - - - - | 5.00 |

The above prices for acid phosphate and cotton seed meal are considerably higher than the prices paid for the same class of goods in 1897.

The separate fertilizer materials contained the following percentages of essential fertilizer ingredients, that is, nitrogen, phosphoric acid, and potash.

Composition of fertilizers.

| | Nitrogen. | Phosphoric acid. | Potash. |
|-----------------------------|------------------|------------------|------------------|
| | <i>Per cent.</i> | <i>Per cent.</i> | <i>Per cent.</i> |
| Acid phosphate..... | | 16.26* | ..... |
| Florida soft phosphate..... | | 29.26†† | ..... |
| Kainit..... | | | 12.80 |
| Cotton seed meal..... | 6.79† | 2.88 | 1.77 |
| Cotton seed..... | 3.13† | 1.27 | 1.17 |

*Available; this superphosphate was guaranteed to contain 14% available phosphoric acid, which is more than the percentage in most brands.

† Average of many analyses.

††Chiefly acid-soluble or "insoluble."

All the fertilizers employed are in common use and well known except Florida soft phosphate. This is ground phosphate rock which has not been treated with sulphuric acid, as have the acid phosphates or superphosphates. It contains a much higher percentage of phosphoric acid than acid phosphate because it has not been "diluted" by the addition of sulphuric acid, but this phosphoric acid is nearly all in such a condition that it is not easily dissolved. Other terms applied to Florida soft phosphate are raw phosphate, crude phosphate, and "Natural Plant Food."

In the eight-plot experiments, two plots were left unfertilized, these being plots two and six. The following table shows what kinds and amounts of fertilizers were used on certain plots; the number of pounds of nitrogen, phosphoric acid, and potash supplied per acre by each fertilizer mixture; and the percentage composition and cost per ton of each mixture, the latter being given in order that these mixtures may be readily compared with various brands of prepared guanos:

Pounds per acre of fertilizers, nitrogen, phosphoric acid, and potash used and composition of each mixture.

| Fertilizers per acre. | Mixture contains | | | Cost of mixture per ton. |
|--|------------------|------------------|-------------|--------------------------|
| | Nitrogen. | Phosphoric acid. | Potash. | |
| <i>Plot 1</i> | <i>Lbs.</i> | <i>Lbs.</i> | <i>Lbs.</i> | |
| 200 lbs. cotton seed meal } 240 lbs. acid phosphate } | 13.58 | 44.78 | 3.54 | ..... |
| In 100 lbs. of mixture... | 3.08 | 10.18 | .80 | \$17.36 |
| <i>Plot 3</i> | | | | |
| 200 lbs. cotton seed meal } 200 lbs. kainit } | 13.58 | 5.78 | 28.14 | |
| In 100 lbs. of mixture... | 3.39 | 1.44 | 7.35 | \$17.95 |
| <i>Plot 4</i> | | | | |
| 240 lbs. acid phosphate } 200 lbs. kainit } | ..... | 32.52 | 28.14 | |
| In 100 lbs. of mixture... | ..... | 8.87 | 6.39 | \$15.32 |
| <i>Plot 5</i> | | | | |
| 200 lbs. cotton seed meal } 240 lbs. acid phosphate } | 13.58 | 44.78 | 28.14 | |
| 200 lbs. kainit } In 100 lbs of mixture... | 2.12 | 6.97 | 4.39 | \$16.84 |

The above table shows that the mixture applied to plot 1 was rich in nitrogen and phosphoric acid; that applied to plot 3, in nitrogen and potash; that used on plot 4 was rich in phosphoric acid and potash; and the mixture applied to plot 5 contained considerable quantities of all three of these valuable ingredients, and hence is properly called a complete fertilizer.

Those farmers who are more accustomed to the word ammonia than to the term nitrogen, can change the figures for nitrogen into their ammonia equivalents by multiplying by 1³⁻¹⁴.

Unless explained, the term "profit from fertilizers" as used in the following table, might be misunderstood.

Profit or loss, as there used, is simply the difference between the value of the increase attributed to the fertilizer and the cost of the latter. To make this more exact, the careful reader may subtract from the apparent profit certain small items, which, because variable, could not be incorporated in the table,—for example, cost of applying fertilizers and cost of picking and ginning the increase.

Again the actual profit per acre from cotton culture may be greater or smaller than the "profit from fertilizer." When on the unfertilized plot cotton is produced at a loss of say \$3 per acre, and when the tables show say \$10 as the profit from a certain fertilizer mixture, a part of this profit must go towards offsetting the loss that would have occurred without fertilizers, leaving the farmer in this case only \$7 in actual profit, although the fertilizer may have been beneficial to the extent of \$10 over and above its cost. On the other hand when cotton is produced at a profit on unfertilized land and when fertilizers also show a profit, the sum of these two items is very nearly the farmer's actual profit.

In determining the increase over the unfertilized plots the yield of each fertilized plot is compared with both unfertilized plots lying on either side, giving to each unfertilized plot a weight inversely proportional to its distance from the plot under comparison. When the fertilized plot has an unfertilized plot on only one side of it, this single unfertilized plot is used as a standard. This method of comparison tends to compensate for variations in the fertility of the several plots.

GROUP I. PHOSPHORIC ACID MOST EFFECTIVE.

EXPERIMENT MADE BY MR. D. CARMICHAEL, JR.,
 NEWTON, DALE COUNTY.

Soil for six inches, grey sandy loam; subsoil, red sand.

This piece of upland had been cleared for ten years, the original growth having been pine and scrub oak. In 1895 it was in cotton, in 1894 in watermelons, and in 1893 in sweet potatoes. Mr. Carmichael states that planting was done too late for best results. The rainfall was reported as sufficient up to August 12, after which it was deficient.

“The seasons were unpropitious; heavy rain on August 12 with storm damaged cotton one-third.”

The stand was uniform. The height of stalks on the different plots was as follows:

| | | | | | | |
|-----------|-------|--------|--|-----------|-------|--------|
| On plot 1 | - - - | 30 in. | \| | On plot 5 | - - - | 33 in. |
| “ “ 2 | - - - | 20 in. | \| | “ “ 6 | - - - | 19 in. |
| “ “ 3 | - - - | 26 in. | \| | “ “ 7 | - - - | 39 in. |
| “ “ 4 | - - - | 26 in. | \| | “ “ 8 | - - - | 41 in. |

The average yield of the unfertilized plots was 384 pounds per acre.

Newton experiment with cotton; results calculated to one acre.

| | | FERTILIZERS. | Seed cotton. | | Financial results. | | |
|----------|---------------------|--|----------------|----------------------------------|--|-------------------------------|--------------------------|
| Plot No. | Amount per acre | KIND | Yield per acre | Increase over unfertilized plot. | Value of increase at $2\frac{1}{2}$ c. per lb. | Cost of fertilizers per acre. | Profit from fertilizers. |
| | <i>Lbs.</i> | | <i>Lbs.</i> | <i>Lbs.</i> | | | |
| 1 | { 200 240 | Cot. seed meal. Acid phosphate. | 592 | 192 | 4.80 | \$ 3.82 | \$ 0.98 |
| 2 | 00 | No fertilizer | 400 | | | | |
| 3 | { 200 200 | Cot. seed meal.. Kainit..... | 480 | 88 | 2.20 | 3.59 | -1.39* |
| 4 | { 240 200 | Acid phosphate. Kainit..... | 608 | 224 | 5.60 | 3.37 | 2.23 |
| 5 | { 200 240 200 | Cot. seed meal.. Acid phosphate. Kainit..... | 640 | 264 | 6.60 | 5.39 | 1.21 |
| 6 | 00 | No fertilizer... | 368 | | | | |
| 7 | { 200 240 200 | Cot. seed meal.. Fla. soft phos... Kainit..... | 776 | 408 | 10.20 | 5.27 | 4.93 |
| 8 | { 472 240 200 | Crushed cot se'd Fla. soft phos... Kainit..... | 888 | 520 | 13.00 | 5.27 | 7.73 |

* Loss.

Whatever may be the explanation, the figures show for the plot receiving Florida soft phosphate a yield which is 136 pounds greater than that of the plot receiving an equal weight of acid phosphate.

Crushed cotton seed was here a better fertilizer than cotton seed meal to the extent of 112 pounds of seed cotton or \$2.80 per acre.

This soil was apparently more responsive to acid phosphate than to either cotton seed meal or kainit. The most

profitable mixture appears to have been the one consisting of crushed cotton seed, Florida soft phosphate, and kainit.

Tests had previously been made in three different years by Mr. J. C. Killebrew in the same locality. His results in two of the tests suggest a deficiency of all three valuable fertilizer ingredients, especially nitrogen, while in the third year they indicate that in the soil subjected to the test there is a greater need for phosphoric acid than for nitrogen and potash.

EXPERIMENT MADE BY MR. A. A. MCGREGOR,

TOWN CREEK, LAWRENCE COUNTY.

Soil, red loam upland; subsoil red.

The subsoil is reached at a depth of about five inches. The original forest growth of the neighborhood is reported as hickory and oak, including post oak. Cedars are common and pines spring up on uncultivated land. Directions were carefully followed in thinning the plants so as to leave one about every eighteen inches. When the plants were counted June 30, there were 1004 stalks on each of plots 3, 7, and 8, 996 on plot 5, 973 on plot 1, 945 on plot 4, 944 on plot 2, and 886 on plot 6. The following table gives the actual yields and the yields as corrected for a uniform stand of 1004 plants on each plot, the latter being used in determining the increase.

Even as early as June 8, decided differences in growth on the fertilized plots could be detected, the plot receiving the complete fertilizer (No. 5) being then ahead, a lead which it had lost before July 7, when the plot receiving only acid phosphate and cotton seed meal showed the best growth. At this date all plots which had received kainit had acquired a yellowish cast, which color was especially marked in the case of the plot having only mineral fertilizers.

In Mr. McGregor's judgment the dry hot weather of the

first half of August damaged the first four fertilized plots much more than the unfertilized plots, and injured them even more than it did the two plots receiving Florida soft phosphate, etc.

October 22, the height of four typical stalks in each plot was measured, the average height then being as follows: On the plot without kainit 35 inches; with complete fertilizer, including acid phosphate, 33 inches; with raw phosphate, cotton seed, and kainit, 30 inches; without cotton seed meal, 30 inches; with raw phosphate, cotton seed meal, and kainit, 27 inches; without acid phosphate only 24 inches; and without any fertilizer 20 and 18 inches. This crop seems to have had sufficient rain till the middle of July, from which time till August 23 the drought was severe.

The careful and detailed report rendered had been sufficient evidence of the thoroughness and accuracy of Mr. McGregor's test, even though opportunity to make a personal examination of the plots had been wanting.

Town Creek experiment with cotton; results calculated to one acre.

| | | FERTILIZERS. | Seed cotton. | | Financial results. | | | |
|----------|----------------|--------------------------|------------------------|----------------------------|------------------------------------|-------------------------------------|--------------------------------|---------------------------|
| Plot No. | Am't per acre. | KIND. | Actual yield per acre. | Cor-rect'd yield per acre. | In-crease over unfertilized plots. | Value of in-crease at 2½ c. per lb. | Cost of ferti-lizers per acre. | Profit from fertili-zers. |
| 1 { | Lbs. 200 | Cotton seed meal | Lbs. | Lbs. | Lbs. | | | |
| | 240 | Acid phosphate | 748 | 771 | 368 | \$ 9.20 | \$ 3.82 | \$ 5.35 |
| 2 | 00 | No fertilizer | 380 | 403 | | | | |
| 3 { | 200 | Cotton seed meal | 528 | 528 | 125 | 3.13 | 3.59 | -0.46* |
| | 200 | Kainit | | | | | | |
| 4 { | 240 | Acid phosphate | 512 | 542 | 172 | 4.30 | 3.37 | 0.93 |
| | 200 | Kainit | | | | | | |
| 5 { | 200 | Cotton seed meal | 650 | 657 | 319 | 7.88 | 5.39 | 2.49 |
| | 240 | Acid phosphate | | | | | | |
| | 200 | Kainit | | | | | | |
| 6 | 00 | No fertilizer | 268 | 305 | | | | |
| 7 { | 200 | Cotton seed meal | 558 | 558 | 253 | 6.32 | 5.27 | 1.05 |
| | 240 | Florida soft phosphate | | | | | | |
| | 200 | Kainit | | | | | | |
| 8 { | 472 | Crushed cotton seed . . | 636 | 636 | 331 | 8.27 | 5.27 | 3.00 |
| | 240 | Florida soft phosphate | | | | | | |
| | 200 | Kainit | | | | | | |

* Loss.

The average (corrected) yield of the unfertilized plots was 354 pounds of seed cotton per acre.

Florida soft phosphate was decidedly inferior to acid phosphate.

Crushed cotton seed proved a better manure than did cotton seed meal, for this field which was cleared about 70 years before.

The most profitable mixture consisted of acid phosphate and cotton seed meal, which increased the crop sufficiently to pay for the fertilizers and leave a balance or profit of

\$5.35 per acre. When to the above mentioned mixture kainit was added, not only did the latter fail to return a profit, but it also failed to increase the yield.

It is evident that this soil required chiefly phosphoric acid and that it also needed nitrogen, but that no potash was needed in addition to the small amount (about $3\frac{1}{2}$ pounds) contained in 200 pounds of cotton seed meal.

EXPERIMENT MADE BY MR. J. R. McLENDON,
NAFTEL, MONTGOMERY COUNTY.

Soil, sand, 15 inches deep; subsoil, clay.

This piece of upland was cleared about 70 years ago. The original growth was oak and pine. The crop preceding cotton was peanuts.

Naftel experiment with cotton ; results calculated to one acre.

| Plot No. | FERTILIZERS. | | Seed cotton. | | Financial results. | | |
|----------|----------------|------------------------|-----------------|-----------------------------------|-----------------------------------|-------------------------------|--------------------------|
| | Am't per acre. | KIND. | Yield per acre. | Incr'ase over unfertilized plots. | Value of increase at 2½c. per lb. | Cost of fertilizers per acre. | Profit from fertilizers. |
| 1 { | Lbs. 200 | Cotton seed meal.... | 178* | ..... | ..... | \$ 3 82 | ..... |
| | 240 | Acid phosphate..... | | | | | |
| 2 | 00 | No fertilizer..... | 140 | | | | |
| 3 { | 200 | Cotton seed meal.... | 472 | 307 | \$ 7 67 | 3 59 | \$ 4 08 |
| | 200 | Kainit..... | | | | | |
| 4 { | 240 | Acid phosphate..... | 520 | 330 | 8 25 | 3 37 | 4 88 |
| | 200 | Kainit..... | | | | | |
| 5 { | 200 | Cotton seed meal.... | 560 | 345 | 8 62 | 5 39 | 2 23 |
| | 240 | Acid phosphate..... | | | | | |
| | 200 | Kainit..... | | | | | |
| 6 | 00 | No fertilizer..... | 240 | | | | |
| 7 { | 200 | Cotton seed meal.... | 440 | 200 | 5 00 | 5 27 | — 0 27 |
| | 240 | Fla. soft phosphate... | | | | | |
| | 200 | Kainit..... | | | | | |
| 8 { | 472 | Crushed cotton seed.. | 472 | 222 | 5 55 | 5 27 | 0 28 |
| | 240 | Fla. soft phosphate... | | | | | |
| | 200 | Kainit..... | | | | | |

* Plot 1, and possibly plot 2, was injured by a hedge and wood, near which this plot was located.

Where acid phosphate was used the crop was larger than where Florida soft phosphate was substituted.

The difference between the yields of the plots receiving cotton seed meal and crushed cotton seed is slightly in favor of cotton seed.

Both acid phosphate and cotton seed meal increased the yield. The former more than the latter. The effect of kainit cannot be measured on account of the injury to plot 1 from the presence of an adjoining hedge and wood.

GROUP II. POTASH MOST EFFECTIVE.

EXPERIMENT CONDUCTED ON FARM OF MR. F. C. McDONALD,
 $\frac{1}{4}$ MILE FROM RUTLEDGE, CRENSHAW COUNTY.

Soil, grey sandy upland; subsoil, yellowish.

The soil is reported as about 10 inches deep.

This field has been in cultivation about 35 years, the original growth being pine.

The land is nearly level and appears uniform, although the yields of the 2 unfertilized plots indicate considerable variation in fertility.

Rutledge experiment with cotton; results calculated to one acre.

| Plot No. | FERTILIZERS. | | Seed cotton. | | Financial results. | | |
|----------|----------------|------------------------|-----------------|-----------------------------------|-----------------------------------|-------------------------------|--------------------------|
| | Am't per acre. | KIND. | Yield per acre. | Incr'ase over unfertilized plots. | Value of increase at 2½c. per lb. | Cost of fertilizers per acre. | Profit from fertilizers. |
| 1 { | Lbs. 200 | Cotton seed meal..... | 680 | 128 | \$ 3 20 | \$ 3 82 | \$ -0 42* |
| | 240 | Acid phosphate..... | | | | | |
| 2 | 00 | No fertilizer..... | 552 | | | | |
| 3 { | 200 | Cotton seed meal..... | 864 | 290 | 7 25 | 3 59 | 3 66 |
| | 200 | Kainit..... | | | | | |
| 4 { | 240 | Acid phosphate..... | 832 | 236 | 6 90 | 3 37 | 3 53 |
| | 200 | Kainit..... | | | | | |
| 5 { | 200 | Cotton seed meal..... | 1080 | 462 | 11 55 | 5 39 | 6 16 |
| | 240 | Acid phosphate..... | | | | | |
| | 200 | Kainit..... | | | | | |
| 6 | 00 | No fertilizer..... | 640 | | | | |
| 7 { | 200 | Cotton seed meal.... | 1080 | 440 | 11 00 | 5 27 | 5 73 |
| | 240 | Fla. soft phosphate... | | | | | |
| | 200 | Kainit..... | | | | | |
| 8 { | 472 | Crushed cotton seed.. | 984 | 344 | 8 60 | 5 27 | 3 33 |
| | 240 | Fla. soft phosphate .. | | | | | |
| | 200 | Kainit..... | | | | | |

* Loss.

Florida soft phosphate, in a mixture containing cotton seed meal was almost as effective and economical as acid phosphate, pound for pound.

A mixture containing cotton seed meal afforded a larger crop than one containing crushed cotton seed.

A complete fertilizer was more profitable than any other. The soil responded more freely to kainit than to either phosphate or cotton seed meal, though both of the latter profitably increased the yield.

EXPERIMENT CONDUCTED BY JUDGE T. J. THOMASON,
KAYLOR, RANDOLPH COUNTY.

Soil, grey to a depth of 4 to 6 inches, slightly sandy; subsoil, yellow clay, and below this stiff red clay.

The field used is described as a kind of table land nearly level and about 60 feet above river bed, and retentive of fertilizers and moisture. It was in cultivation in 1892, and how much earlier was not known. The original growth was oak and hickory, chiefly white and red oaks.

The figures representing the height of plants indicate that there was a good growth of stalks on the unfertilized as well as on the fertilized plots. Corn occupied the land in 1895 and 1893, (whether with or without cowpeas is not stated), and oats in 1894.

“July and August were very unfavorable for cotton and nearly all the forms of these months were shed. During first of month of August cotton was almost scalded by excessive heat.”

Kaylor experiment with cotton; results calculated to one acre.

| | | FERTILIZERS. | Seed cotton. | | Financial results. | | |
|----------|----------------|--------------------------|-----------------|----------------------------------|-----------------------------------|-------------------------------|--------------------------|
| Plot No. | Am't per acre. | KIND. | Yield per acre. | Increase over unfertilized plot. | Value of increase at 2½c. per lb. | Cost of fertilizers per acre. | Profit from fertilizers. |
| | <i>Lbs.</i> | | <i>Lbs.</i> | <i>Lbs.</i> | | | |
| 1 | 200 | Cotton seed meal | 1016 | 216 | \$ 5.40 | \$ 3.82 | \$ 1.58 |
| | 240 | Acid phosphate | | | | | |
| 2 | 00 | No fertilizer. | 800 | | | | |
| 3 | 200 | Cotton seed meal | 1077 | 255 | 6.37 | 3.59 | 2.78 |
| | 200 | Kainit. | | | | | |
| 4 | 240 | Acid phosphate | 1067 | 223 | 5.57 | 3.37 | 2.20 |
| | 200 | Kainit. | | | | | |
| 5 | 200 | Cotton seed meal | 1125 | 259 | 6.47 | 5.39 | 1.08 |
| | 240 | Acid phosphate | | | | | |
| | 200 | Kainit. | | | | | |
| 6 | 00 | No fertilizer. | 888 | | | | |
| 7 | 200 | Cotton seed meal | 976 | 108 | 2.70 | 5.27 | -2.57* |
| | 240 | Florida soft phosphate | | | | | |
| | 200 | Kainit. | | | | | |
| 8 | 472 | Crushed cotton seed.. | 1117 | 229 | 5.72 | 5.27 | 0.45 |
| | 240 | Florida soft phosphate | | | | | |
| | 200 | Kainit. | | | | | |

* Loss.

The yield with Florida soft phosphate fell below that with acid phosphate, involving a financial loss when raw phosphate was used.

Crushed cotton seed was more effective and profitable than cotton seed meal.

A mixture of cotton seed meal and kainit was as effective and more profitable than a complete fertilizer, the acid phosphate in the latter being added at a financial loss.

It should be remembered that this soil, which seems to have failed to profit by an application of acid phosphate was already in a fairly fertile condition as shown by an average yield of 844 lbs. of seed cotton on the unfertilized plots.

EXPERIMENT CONDUCTED BY MR. J. N. THOMPSON,
3½ MILES S. W. OF PRIDE STATION, COLBERT COUNTY.

Soil, dark clay, with red subsoil.

Four or five feet below is flint rock, not solid. This piece of upland has been cleared for 50 years; the original growth was hickory, gum, dogwood, and maple.

It appears that no good rain fell after the land was broken till May 23. "The weather was entirely too dry and hot for very good result from fertilizers." The stand was poor and the plants died early.

The number and arrangement of plots in this experiment is explained in the table.

Pride Station experiment with cotton; results calculated to one acre.

| Plot No. | FERTILIZERS. | | Seed cotton. | | Financial results. | | |
|----------|----------------|------------------------|--------------------|----------------------------------|-----------------------------------|-------------------------------|--------------------------|
| | Am't per acre. | KIND. | Yield per acre | Incr'ase over unfertilized plot. | Value of increase at 2½ c. per lb | Cost of fertilizers per acre. | Profit from fertilizers. |
| 1 | 472 | Crushed cotton seed... | <i>Lbs.</i> 570 | <i>Lbs.</i> 30 | \$ 0.75 | \$2.02 | \$-1.27 |
| 2 | 200 | Cotton seed meal..... | 690 | 150 | 3.75 | 2.02 | 1.73 |
| 3 | 00 | No fertilizer..... | 540 | | | | |
| 4 | 240 | Acid phosphate..... | 630 | 102 | 2.55 | 1.80 | 0.75 |
| 5 | 200 | Kainit..... | 735 | 219 | 5.47 | 1.57 | 3.90 |
| 6 | 200 | Cotton seed meal..... | 825 | 318 | 7.95 | 3.59 | 4.36 |
| | 200 | Kainit..... | | | | | |
| 7 | 240 | Acid phosphate..... | 705 | 213 | 5.32 | 3.37 | 1.95 |
| | 200 | Kainit..... | | | | | |
| 8 | 00 | No fertilizer..... | 480 | | | | |
| 9 | 400 | Cotton seed meal..... | 735 | 285 | 7.12 | 5.84 | 1.28 |
| | 240 | Acid phosphate..... | | | | | |
| 10 | 200 | Cotton seed meal..... | 540 | 120 | 3.00 | 3.82 | -0.82 |
| | 240 | Acid phosphate..... | | | | | |
| 11 | 200 | Cotton seed meal..... | 495 | 105 | 2.62 | 5.39 | -2.77 |
| | 240 | Acid phosphate..... | | | | | |
| | 200 | Kainit..... | | | | | |
| 12 | 200 | Cotton seed meal..... | 510 | 150 | 3.75 | 5.27 | -1.52 |
| | 240 | Florida soft phosphate | | | | | |
| | 200 | Kainit..... | | | | | |
| 13 | 00 | No fertilizer..... | 330 | | | | |
| 14 | 200 | Cotton seed meal..... | 585 | 255 | 6.37 | 6.89 | -0.52 |
| | 240 | Acid phosphate..... | | | | | |
| | 200 | Kainit..... | | | | | |
| | 600 | Slaked lime..... | | | | | |
| 15 | 200 | Cotton seed meal..... | 495 | 165 | 4.12 | 3.70 | 0.42 |
| | 240 | Florida soft phosphate | | | | | |
| 16 | 472 | Crushed cotton seed.. | 495 | 165 | 4.12 | 3.70 | 0.42 |
| | 240 | Florida soft phosphate | | | | | |

GROUP III. NITROGEN MOST EFFECTIVE.

EXPERIMENT MADE BY MR. J. H. BRASWELL,
CASTLEBERRY, CONECUH COUNTY.

Soil, gray sand; subsoil, red sand.

The original growth was pine, which was removed about 25 years ago.

Castleberry experiment with cotton; results calculated to one acre.

| Plot No. | FERTILIZERS. | | Seed cotton. | | Financial results. | | |
|----------|---------------|--------------------------|-----------------|---|-----------------------------------|-------------------------------|--------------------------|
| | Am't per acre | KIND. | Yield per acre. | Increase over unfertilized at 2½c. plots. | Value of increase at 2½c. per lb. | Cost of fertilizers per acre. | Profit from fertilizers. |
| | <i>Lbs.</i> | | <i>Lbs.</i> | <i>Lbs.</i> | | | |
| 1 | 200 | Cotton seed meal | 744 | 376 | \$ 9.40 | \$ 3.82 | \$ 5.58 |
| | 240 | Acid phosphate | | | | | |
| 2 | 00 | No fertilizer | 368 | | | | |
| 3 | 200 | Cotton seed meal | 624 | 258 | 6.45 | 3.59 | 2.86 |
| | 200 | Kainit | | | | | |
| 4 | 240 | Acid phosphate | 584 | 220 | 5.50 | 3.37 | 1.13 |
| | 200 | Kainit | | | | | |
| 5 | 200 | Cotton seed meal | 664 | 302 | 7.55 | 5.39 | 2.16 |
| | 240 | Acid phosphate | | | | | |
| | 200 | Kainit | | | | | |
| 6 | 00 | No fertilizer | 360 | | | | |
| 7 | 200 | Cotton seed meal | 560 | 200 | 5.00 | 5.27 | -0.27* |
| | 240 | Florida soft phosphate | | | | | |
| | 200 | Kainit | | | | | |
| 8 | 472 | Crushed cotton seed . | 536 | 176 | 4.40 | 5.27 | -0.87* |
| | 240 | Florida soft phosphate | | | | | |
| | 200 | Kainit | | | | | |

* Loss.

The average yield was 364 pounds of seed cotton per acre. The land appears to have been remarkably uniform.

Florida soft phosphate was of far less benefit than acid phosphate, the use of the former involving a financial loss.

Cotton seed meal afforded a yield higher by 24 pounds per acre than did crushed cotton seed.

The most effective and profitable fertilizer was a mixture of cotton seed meal and acid phosphate, which returned a profit of \$5.58 per acre. When to this mixture kainit was added the yield was reduced, indicating that potash was either useless or harmful.

While both cotton seed meal and acid phosphate were needed, the former was somewhat more effective than the latter, as may be seen by the comparison below: The increase with the complete fertilizer (plot 5) exceeds the increase on the plot having no cotton seed meal (plot 4) to the amount of 82 pounds per acre,—a gain attributable to cotton seed meal.

In the same way the increase on plot 5 exceeds that on plot 3 by 42 pounds per acre, an increase ascribable to acid phosphate. The increase on plot 5 falls short of that on plot 1 by 74 pounds, a loss which appears to be due to the presence of kainit.

EXPERIMENT MADE BY MR. JNO. P. WATKINS,

BURNT CORN, MONROE COUNTY.

Soil, (4 to 6 inches deep), gray and sandy; subsoil dark red.

This test was made on upland which had been cleared for about 30 years. The original growth was "oak, hickory, etc., with a sprinkling of pines."

The late date of fertilizing and planting, May 7-8, may partly account for the average yield of only 132 pounds of seed cotton per acre on the unfertilized plots. It is also evident from this yield that the land was in a very impoverished condition.

Burnt Corn experiment with cotton ; results calculated to one acre.

| Plot No. | FERTILIZERS. | | Cotton seed. | | Financial results. | | |
|----------|----------------|------------------------|-----------------|-----------------------------------|-----------------------------------|-------------------------------|--------------------------|
| | Am't per acre. | KIND. | Yield per acre. | Incr'ase over unfertilized plots. | Value of increase at 2½c. per lb. | Cost of fertilizers per acre. | Profit from fertilizers. |
| 1 { | Lbs. 200 | Cotton seed meal,.... | 768 | 624 | \$ 15 60 | \$ 3 82 | \$ 11 78 |
| | 240 | Acid phosphate..... | | | | | |
| 2 | 00 | No fertilizer..... | 144 | | | | |
| 3 { | 200 | Cotton seed meal..... | 688 | 558 | 13 95 | 3 59 | 10 36 |
| | 200 | Kainit..... | | | | | |
| 4 { | 240 | Acid phosphate..... | 584 | 452 | 11 30 | 3 37 | 7 93 |
| | 200 | Kainit..... | | | | | |
| 5 { | 200 | Cotton seed meal..... | 692 | 566 | 14 15 | 5 39 | 8 76 |
| | 240 | Acid phosphate..... | | | | | |
| | 200 | Kainit..... | | | | | |
| 6 | 00 | No fertilizer..... | 120 | | | | |
| 7 { | 200 | Cotton seed meal..... | 572 | 452 | 11 30 | 5 27 | 6 03 |
| | 240 | Fla soft phosphate... | | | | | |
| | 200 | Kainit..... | | | | | |
| 8 { | 472 | Crushed cotton seed. | 500 | 380 | 9 50 | 5 27 | 4 23 |
| | 240 | Fla. soft phosphate... | | | | | |
| | 200 | Kainit,..... | | | | | |

The land appears to have been fairly uniform. All combinations of fertilizers returned a profit.

Florida soft phosphate proved decidedly inferior to acid phosphate. With cotton seed meal the yield was 72 pounds greater than with crushed cotton seed.

The most profitable mixture consisted of cotton seed meal and acid phosphate.

On the plot receiving kainit in addition to the above named mixture, the yield was reduced.

Analyzing the increase in crop we find that with cotton seed meal added to the other two fertilizers there was a gain

of 114 pounds; with acid phosphate added to the other two, an increase of only 8 pounds; with kainit added to the other two, a loss of 58 pounds. The above figures show the effects of the several fertilizers when all used together; the showing made by plot 4 is decidedly more favorable to acid phosphate and kainit for on this plot these two fertilizers without nitrogen afforded a fair profit, which, however, was not equal to the profit obtained on either of the plots receiving cotton seed meal.

EXPERIMENT MADE BY MR. J. T. ROBERTSON,
LEGRAND, MONTGOMERY COUNTY.

Soil, yellowish, or reddish clay, with a little sand.

The surface had suffered from washing, and the soil was quite shallow. This experiment was conducted on gently sloping upland, which had become much impoverished by about 70 years of cultivation. The original growth was oak, hickory, and pine.

The crop suffered for want of rain after the middle of July. The stand was defective.

LeGrand experiment with cotton; results calculated to one acre.

| FERTILIZERS. | | Seed cotton. | | Financial results. | | |
|-------------------|----------------------|--------------------|----------------------------------|-----------------------------------|-------------------------------|--------------------------|
| Am't per acre. | KIND. | Yield per acre. | Incr'ase over unfertilized plot. | Value of increase at 2½ c per lb. | Cost of fertilizers per acre. | Profit from fertilizers. |
| <i>Lbs.</i> 00 | No fertilizer..... | <i>Lbs.</i> 112 | <i>Lbs.</i> | | | |
| {200 | Cotton seed meal... | 704 | 592 | \$14.80 | \$3.82 | \$10.98 |
| {240 | Acid phosphate..... | | | | | |
| {200 | Cotton seed meal... | 680 | 568 | 14.20 | 3.59 | 10.61 |
| {200 | Kainit..... | | | | | |
| {240 | Acid phosphate..... | 408 | 296 | 7.40 | 3.37 | 4.03 |
| {200 | Kainit..... | | | | | |
| {200 | Cotton seed meal... | 712 | 600 | 15.00 | 5.39 | 9.69 |
| {240 | Acid phosphate..... | | | | | |
| {200 | Kainit..... | | | | | |
| {200 | Cotton seed meal... | 664 | 552 | 13.80 | 5.27 | 8.53 |
| {240 | Fla. soft phosphate. | | | | | |
| {200 | Kainit..... | | | | | |
| {472 | Crushed cotton seed | | | | | |
| {240 | Fla. soft phosphate. | 648 | 536 | 13.40 | 5.27 | 7.13 |
| {200 | Kainit | | | | | |

The yield with Florida soft phosphate fell slightly below that with acid phosphate.

The yields with cotton seed meal and crushed cotton seed were practically identical.

As regards the needs of this soil, the figures speak plainly.

Nitrogen was the element chiefly needed by this soil. Wherever cotton seed meal was used there was a large increase in yield, and this increase occurred whether the other ingredient of the fertilizer mixture was phosphate or kainit.

EXPERIMENT MADE BY MR. C. C. L. DILL,
DILLBURGH, PICKENS COUNTY.

Soil, dark sandy loam; subsoil, red clay.

This test was conducted on high table land which had been cleared for 50 or 60 years. The original growth was oak, hickory, and pine.

In regard to rainfall Mr. Dill writes:

"We have had droughts before but none that did so much injury."

Dillburgh experiment with cotton; results calculated to one acre.

| Plot No. | FERTILIZERS. | | Seed cotton. | | Financial results. | | |
|----------|--------------------|------------------------|--------------------|-----------------------------------|-----------------------------------|-------------------------------|--------------------------|
| | Am't per acre. | KIND. | Yield per acre. | Incr'ase over unfertilized plots. | Value of increase at 2½c. per lb. | Cost of fertilizers per acre. | Profit from fertilizers. |
| 1 | <i>Lbs.</i> 200 | Cotton seed meal.... | <i>Lbs.</i> 600 | <i>Lbs.</i> 360 | \$ 9 00 | \$ 3 82 | \$ 5 18 |
| | 240 | Acid phosphate..... | | | | | |
| 2 | 00 | No fertilizer..... | 240 | | | | |
| 3 | 200 | Cotton seed meal.... | 592 | 348 | 8 70 | 3 59 | 5 11 |
| | 200 | Kainit. | | | | | |
| 4 | 240 | Acid phosphate..... | 576 | 328 | 8 20 | 3 37 | 4 83 |
| | 200 | Kainit. | | | | | |
| 5 | 200 | Cotton seed meal.... | | | | | |
| | 240 | Acid phosphate..... | 640 | 388 | 9 70 | 5 39 | 4 31 |
| | 200 | Kainit..... | | | | | |
| 6 | 00 | No fertilizer..... | 256 | | | | |
| 7 | 200 | Cotton seed meal.... | | | | | |
| | 240 | Fla. soft phosphate... | 632 | 376 | 9 40 | 5 27 | 4 13 |
| | 200 | Kainit. | | | | | |
| 8 | 472 | Crushed cotton seed. | | | | | |
| | 240 | Fla. soft phosphate .. | 560 | 304 | 7 60 | 5 27 | 2 33 |
| | 200 | Kainit..... | | | | | |

The land was apparently uniformly poor, the yields of the unfertilized plots being 240 and 256 pounds of seed cotton per acre.

Florida soft phosphate, when combined with cotton seed meal, was practically equal to acid phosphate, pound for pound.

Cotton seed meal afforded a larger yield than did crushed cotton seed.

Cotton seed meal had a greater effect than any of the other fertilizers.

The increased yields obtained by adding each fertilizer in turn to the other two were 60 pounds of seed cotton per acre for cotton seed meal, 40 pounds for acid phosphate, and 28 pounds for kainit.

While the complete fertilizer gave the largest yield, it did not afford the largest profit. A mixture of acid phosphate and cotton seed meal was most profitable.

EXPERIMENT MADE BY MR. W. T. WEBB,

ALPINE, TALLADEGA COUNTY.

Soil, (4-6 inches deep), brown; subsoil, red.

This valley land had been in cultivation 50 years or more. The original growth was pine, oak, and hickory. The preceding crop was corn and cowpeas; it is notable that the crop of cow peas of 1895 did not furnish sufficient nitrogen for the following cotton crop. The most unusual point in the care of the crop was the use of a two-horse harrow in the first cultivation. The smoothing harrow, run obliquely to the rows, and covering a space of eight or ten feet has been elsewhere found useful in the early cultivation of cotton as well as of corn. However, with cotton it should be used with judgment, since under some conditions it may seriously damage the stand.

Plot 1 was more seriously troubled with "rust" than any other plot, although no plot was exempt. The stand was quite uniform.

Alpine experiment with cotton; results calculated to one acre.

| | | FERTILIZERS. | Cotton seed. | Financial results. | | | |
|----------|----------------|--------------------------|-----------------|----------------------------------|-----------------------------------|-------------------------------|--------------------------|
| Plot No. | Am't per acre. | KIND. | Yield per acre. | Increase over unfertilized plot. | Value of increase at 2½c. per lb. | Cost of fertilizers per acre. | Profit from fertilizers. |
| | | Lbs. | Lbs. | Lbs. | | | |
| 1 | 200 | Cotton seed meal | 1720 | 808 | \$ 20.20 | \$ 3.82 | \$ 16.38 |
| | 240 | Acid phosphate | | | | | |
| 2 | 00 | No fertilizer | 912 | | | | |
| 3 | 200 | Cotton seed meal | 1616 | 746 | 18.65 | 3.59 | 15.06 |
| | 200 | Kainit. | | | | | |
| 4 | 240 | Acid phosphate | 1256 | 428 | 10.70 | 3.37 | 7.33 |
| | 200 | Kainit | | | | | |
| 5 | 200 | Cotton seed meal | 1400 | 614 | 15.35 | 5.39 | 9.96 |
| | 240 | Acid phosphate | | | | | |
| | 200 | Kainit | | | | | |
| 6 | 00 | No fertilizer | 744 | | | | |
| 7 | 200 | Cotton seed meal | 1248 | 504 | 12.60 | 5.27 | 7.33 |
| | 240 | Florida soft phosphate | | | | | |
| | 200 | Kainit. | | | | | |
| 8 | 472 | Crushed cotton seed . | 1312 | 568 | 14.20 | 5.27 | 8.93 |
| | 240 | Florida soft phosphate | | | | | |
| | 200 | Kainit. | | | | | |

Irregularities in the soil render a part of the results of this test inconclusive, though the figures suggest the need of nitrogenous fertilizers.

About one-eighth of the area of plot 6 was struck by lightning which probably accounts for part of the difference between the yields of the 2 unfertilized plots.

The heavy shrinkage in yield where cotton seed meal was omitted (plot 4) indicates a need of nitrogen.

GROUP IV.—PHOSPHORIC ACID, POTASH, AND
COTTON SEED MEAL ABOUT EQUALLY
EFFECTIVE.

EXPERIMENT MADE BY DR. JOHN GORDON, HEALING SPRINGS,
WASHINGTON COUNTY.

Soil, gray sandy loam ; subsoil yellow sandy clay.

The soil is 4 to 6 inches deep and very porous. The test was made on pine land cleared 10 years before. This is the only report in which we find that the crop was injured by excessive rains.

Healing Springs experiment with cotton ; results calculated to one acre.

| Plot No. | FERTILIZERS. | | Seed cotton. | | Financial results. | | |
|----------|----------------|------------------------|-----------------|-----------------------------------|-----------------------------------|-------------------------------|--------------------------|
| | Am't per acre. | KIND. | Yield per acre. | Incr'ase over unfertilized plots. | Value of increase at 2½c. per lb. | Cost of fertilizers per acre. | Profit from fertilizers. |
| 1 { | Lbs. 200 | Cotton seed meal.... | 316* | 88 | \$ 2 20 | \$ 3 82 | \$-1 62† |
| | 240 | Acid phosphate..... | | | | | |
| 2 | 00 | No fertilizer..... | 224* | | | | |
| 3 { | 200 | Cotton seed meal.... | 660* | 434 | 10 85 | 3 59 | 7 26 |
| | 200 | Kainit | | | | | |
| 4 { | 240 | Acid phosphate..... | 704 | 476 | 11 90 | 3 37 | 8 53 |
| | 200 | Kainit | | | | | |
| 5 { | 200 | Cotton seed meal.... | 952 | 722 | 18 05 | 5 39 | 12 66 |
| | 240 | Acid phosphate..... | | | | | |
| | 200 | Kainit | | | | | |
| 6 | 00 | No fertilizer..... | 232* | | | | |
| 7 { | 200 | Cotton seed meal.... | 1160 | 932 | 23 30 | 5 27 | 18 03 |
| | 240 | Fla. soft phosphate... | | | | | |
| | 200 | Kainit | | | | | |
| 8 { | 472 | Crushed cotton seed. | 1320 | 1092 | 27 30 | 5 27 | 22 03 |
| | 240 | Fla. soft phosphate... | | | | | |
| | 200 | Kainit | | | | | |

* Defective stand. † Loss.

The two unfertilized plots agree very closely in yield, the average being 228 pounds of seed cotton per acre. After the second plowing many plants died on the unfertilized plots and on plots 1 and 3.

Raw phosphate when applied along with cotton seed meal and kainit, appeared to be more effective and profitable than acid phosphate. Crushed cotton seed afforded a larger yield than did cotton seed meal. The soil responded freely to all fertilizing materials, whether applied in groups of two or three together.

A deficient stand on two fertilized plots and the unfavorable season render it impossible to determine which element was most deficient in the soil.

This is Dr. Gordon's fourth test of fertilizers on cotton. Previous results were either inconclusive or suggestive of a deficiency of all three essential fertilizer ingredients.

EXPERIMENT MADE BY PROF. J. B. ESPY,
ABBEVILLE, HENRY COUNTY.

Soil, red clay, eight inches deep; subsoil, loam.

This piece of upland had been in cultivation about 20 years, yielding in 1895 22 bushels of corn per acre. The original forest growth was oak and hickory.

On each plot the same number of plants was left. The crop was injured by drought. Prof. Espy writes in regard to the effect of fertilizers on leaf diseases: "The plots on which kainit was used rusted less than the rest."

Abbeville experiment with cotton; results calculated to one acre.

| | | FERTILIZERS. | Seed cotton. | | Financial results. | | |
|----------|----------------|----------------------------|-----------------|-----------------------------------|-----------------------------------|------------------------------|--------------------------|
| Plot No. | Am't per acre. | KIND. | Yield per acre. | Increase over unfertilized plots. | Value of increase at 2½c. per lb. | Cost of fertilizers per acre | Profit from fertilizers. |
| | | Lbs. | Lbs. | Lbs. | | | |
| 1 | 472 | Crushed cotton seed . . . | 900 | 288 | \$ 7.20 | \$ 2.02 | \$ 5.18 |
| 2 | 200 | Cotton seed meal | 1140 | 534 | 13.35 | 2.02 | 11.33 |
| 3 | 00 | No fertilizer | 600 | | | | |
| 4 | 240 | Acid phosphate | 1230 | 624 | 15.60 | 1.80 | 13.80 |
| 5 | 200 | Kainit. | 1080 | 468 | 11.70 | 1.57 | 10.13 |
| 6 | 200 | Cotton seed meal | 1380 | 762 | 19.05 | 3.59 | 15.46 |
| | 200 | Kainit. | | | | | |
| 7 | 240 | Acid phosphate | 1350 | 726 | 18.15 | 3.37 | 14.78 |
| | 200 | Kainit | | | | | |
| 8 | 00 | No fertilizer | 630 | | | | |
| 9 | 400 | Cotton seed meal | 1530 | 912 | 22.80 | 5.84 | 16.96 |
| | 240 | Acid phosphate | | | | | |
| 10 | 200 | Cotton seed meal | 1440 | 834 | 20.85 | 3.82 | 17.03 |
| | 240 | Acid phosphate | | | | | |
| 11 | 200 | Cotton seed meal | 1620 | 1026 | 25.65 | 5.39 | 20.26 |
| | 240 | Acid phosphate | | | | | |
| | 200 | Kainit | | | | | |
| 12 | 200 | Cotton seed meal | 1410 | 828 | 20.70 | 5.27 | 15.43 |
| | 240 | Florida soft phosphate | | | | | |
| | 200 | Kainit. | | | | | |
| 13 | 00 | No fertilizer | 570 | | | | |
| 14 | 200 | Cotton seed meal | 1725 | 1119 | 27.97 | 6.89 | 21.08 |
| | 240 | Acid phosphate | | | | | |
| | 200 | Kainit. | | | | | |
| | 600 | Slaked lime | | | | | |
| 15 | 200 | Cotton seed meal | 1260 | 648 | 16.20 | 3.70 | 12.50 |
| | 240 | Florida soft phosphate | | | | | |
| 16 | 472 | Crushed cotton seed . . . | 1320 | 702 | 17.55 | 3.70 | 13.85 |
| | 240 | Florida soft phosphate | | | | | |

The yields on the three unfertilized plots indicate that the land was of uniform quality. This soil, which averaged 600 pounds of seed cotton per acre without fertilizers, responded generously to every fertilizer, whether applied singly, two by two, or all together. A complete fertilizer carried the yield to more than a bale per acre, an increase of more than 250 per cent. over the yield of the unfertilized plots, and returned a profit of \$20.26 per acre.

The following analysis of results of plots 2 to 11, inclusive, shows the relative increase in yield of seed cotton per acre attributable to the different fertilizers:

Cotton seed meal increased the yield when added—

| | |
|------------------------------------|-------------|
| To the unfertilized plot, | by 534 lbs. |
| To kainit plot, | " 294 " |
| To acid phosphate plot, | " 210 " |
| To kainit and acid phosphate plot, | " 300 " |

Average increase for cotton seed meal, 384 lbs.

Acid phosphate increased the yield when added—

| | |
|--------------------------------------|-------------|
| To the unfertilized plot, | by 624 lbs. |
| To kainit plot, | " 258 " |
| To cotton seed meal plot, | " 300 " |
| To kainit and cotton seed meal plot, | " 264 " |

Average gain for acid phosphate, 361 lbs.

Kainit increased the yield when added—

| | |
|-------------------------------------|-------------|
| To the unfertilized plot, | by 468 lbs. |
| To acid phosphate plot, | " 102 " |
| To cotton seed meal plot, | " 228 " |
| To acid phos. and cotton meal plot, | " 192 " |

Average increase for kainit, 247 lbs.

All fertilizer materials were effective, acid phosphate being slightly more important than cotton seed meal and kainit and decidedly more useful than Florida soft phosphate. The latter appears to have been more effective when employed with crushed cotton seed than when used with the meal.

Crushed cotton seed was decidedly less valuable than cotton seed meal when both were used singly, but when with each Florida soft phosphate was applied, cotton seed exerted a greater effect than did the meal. In the latter case it is

probable that the phosphate hastened the decomposition of the seed and was in turn made more soluble by the large amount of decomposing organic material afforded by the seed.

Slaked lime was employed at a slight profit. When to a mixture of 200 lbs. of cotton seed meal and 240 lbs. of acid phosphate there was added an additional 200 lbs. of cotton seed meal, an increase in yield occurred, but this was no more than sufficient to pay the cost of the extra fertilizer.

The result of this experiment is in perfect accord with those of tests conducted at Abbeville in 1890, 1891 and 1892. The evidence seems quite sufficient to justify a positive statement that the cotton crop on the farm of the South East Alabama Agricultural School is increased by all three of the essential fertilizer constituents and that their order of effectiveness is (1) phosphoric acid, (2) nitrogen, and (3) potash.

EXPERIMENT MADE BY MESSRS. M. C. QUINN SMITH AND B. W. GRESHAM, ON THE FARM OF THE FORMER NEAR PRATTVILLE, AUTAUGA COUNTY.

Soil red clayey loam.

This test was made on nearly level upland which had been in cultivation for perhaps 50 years, having been in cotton during most of the past 20 years. The original growth was pine, oak, and hickory.

On most plots the number of stalks was 980, and on no plot did the number greatly differ from this. The rainfall was decidedly deficient.

A notable point in the cultivation of this crop was that it was grown with less hoeing than usual, a saving in this respect being effected by running a 14-inch scrape across the rows immediately after barring off.

Prattville experiment with cotton; results calculated to one acre.

| Plot No. | FERTILIZERS. | | Seed cotton. | | Financial results. | | |
|----------|----------------|------------------------|-----------------|-------------------------------|------------------------------------|-----------------------------------|----------------------|
| | Am't per acre. | KIND. | Yield per acre. | Cost of fertilizers per acre. | Value of increase at 2½ c. per lb. | Incr'ase over unfertilized plots. | Profit from fertili- |
| | <i>Lbs.</i> | | <i>Lbs.</i> | <i>Lbs.</i> | | | |
| 1 | 200 | Cotton seed meal..... | 552 | 208 | \$5.20 | \$3.82 | \$1.42 |
| | 240 | Acid phosphate | | | | | |
| 2 | 00 | No fertilizer..... | 344 | | | | |
| 3 | 200 | Cotton seed meal.... | 512 | 196 | 4.90 | 3.59 | 1.41 |
| | 200 | Kainit..... | | | | | |
| 4 | 240 | Acid phosphate..... | 472 | 184 | 4.60 | 3.37 | 1.23 |
| | 200 | Kainit..... | | | | | |
| 5 | 200 | Cotton seed meal..... | 640 | 380 | 9.50 | 5.39 | 4.11 |
| | 240 | Acid phosphate..... | | | | | |
| | 200 | Kainit..... | | | | | |
| 6 | 00 | No fertilizer..... | 232 | | | | |
| 7 | 200 | Cotton seed meal..... | 432 | 200 | 5.00 | 5.27 | -0.27* |
| | 240 | Fla. soft phosphate... | | | | | |
| | 200 | Kainit..... | | | | | |
| 8 | 472 | Crushed cotton seed . | 440 | 208 | 5.20 | 5.27 | -0.07* |
| | 240 | Fla. soft phosphate.. | | | | | |
| | 200 | Kainit..... | | | | | |

*Loss.

In this test raw phosphate was decidedly inferior to acid phosphate. Crushed cotton seed and cotton seed meal afforded practically the same yields.

A complete fertilizer, containing cotton seed meal, acid phosphate, and kainit was the most effective and profitable fertilizer used. Whenever any ingredient of this mixture was omitted there was a large shrinkage in yield.

Cotton seed meal and acid phosphate were somewhat more effective than kainit, although the last fertilizer made a better show in the dry season of 1896 than it did in previous tests on other Autauga County soils which were apparently quite similar to Mr. Smith's. The difference is probably due in large part to the unusual weather condition in 1896.

The following experiments are regarded as inconclusive, although some of them convey suggestions which are doubtless valuable :

Experiment made by Mr. E. J. Beasley, Red Level, Monroe County.

Experiment made by Mr. J. J. Blackstock, agent for Hirsch Bros., at Hirsch Crossing, Russell County.

Experiment made by Prof. Geo. P. Bondurant on farm of North Ala. Agrl. School, Athens, Limestone County.

Experiment made by Mr. T. M. Roundtree, or farm of S. W. Ala. Agrl. School, Evergreen, Conecuh County.

Experiment made by Mr. G. W. Freeman, on the farm of the N. E. Ala. Agricultural School, Albertville, Marshall County.

Experiment made by Mr. M. W. Borum, Harpersville, Shelby County.

Experiment made by the Tuskegee Normal and Industrial Institute, Tuskegee, Macon County.

The following tables give the yields of seed cotton per acre in the seven experiments just enumerated.

*Red Level and Hirsch Crossing experiments with cotton ; results
calculated to one acre.*

| Plot No. | FERTILIZERS. | | Red Level. | | Hirsch Crossing. | |
|-------------|----------------------|--|-----------------------------|--|-------------------------------|--|
| | Am't per acre. | KIND. | Yield of seed cotton. | Increase over un- fertilized plots. | Yield of seed cot- ton. | Increase over un- fertilized plots. |
| | <i>Lbs.</i> | | <i>Lbs.</i> | <i>Lbs.</i> | <i>Lbs.</i> | <i>Lbs.</i> |
| 1 | 200 240 | Cotton seed meal.... Acid phosphate..... | 784 | 208 | 712 | 40 |
| 2 | 00 | No. fertilizer..... | 576 | | 672 | ..... |
| 3 | 200 200 | Cotton seed meal.... Kainit..... | 632 | 95 | 952 | 260 |
| 4 | 240 200 | Acid phosphate.... Kainit..... | 576 | 76 | 736 | 24 |
| 5 | 200 240 200 | Cotton seed meal.... Acid phosphate.... Kainit..... | 616 | 154 | 720 | -12* |
| 6 | 00 | No fertilizer..... | 424 | | 752 | ..... |
| 7 | 200 240 200 | Cotton seed meal.... Fla. soft phosphate... Kainit..... | 536 | 112 | 472 | -280* |
| 8 | 472 240 200 | Crushed cotton seed.. Fla. soft phosphate... Kainit..... | 560 | 136 | 784 | 32 |

*Loss.

Yields of seed cotton in experiments made at Athens, Evergreen, Albertville, Harpersville, and Tuskegee.

| | | FERTILIZERS. | Athens | Evergreen. | Albertville | Harpersville | Tuskegee. |
|----------|----------------|------------------------|----------------------|----------------------|----------------------|-----------------------|-----------------------|
| Plot No. | Am't per acre. | KIND. | Seed cotton per acre | Seed cotton per acre | Seed cotton per acre | Seed cotton per acre. | Seed cotton per acre. |
| | Lbs. | | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
| 1 | 472 | Crushed cotton seed | 750 | 870 | 667 | 915 | |
| 2 | 200 | Cotton seed meal | 825 | 1065 | 791 | 675 | 1230 |
| 3 | 00 | No fertilizer | 765 | 750 | 600 | 495 | 828* |
| 4 | 240 | Acid phosphate | 810 | 900 | 652 | 540 | 945 |
| 5 | 200 | Kainit | 615 | 900 | 682 | 495 | 915 |
| 6 | 200 | Cotton seed meal | 615 | 1110 | 731 | 480 | 907 |
| | 200 | Kainit | | | | | |
| 7 | 240 | Acid phosphate | 1350 | 945 | 836 | 705 | 1050 |
| | 200 | Kainit | | | | | |
| 8 | 00 | No fertilizer | 1260 | 875 | 296 | 585 | |
| 8 | 400 | Cotton seed meal | 1350 | 810 | 701 | 630 | |
| | 240 | Acid phosphate | | | | | |
| 10 | 200 | Cotton seed meal | 1275 | 1440 | 521 | 825 | 960 |
| | 240 | Acid phosphate | | | | | |
| 11 | 200 | Cotton seed meal | 1335 | 930 | 806 | 780 | 667† |
| | 240 | Acid phosphate | | | | | |
| | 200 | Kainit | | | | | |
| 12 | 200 | Cotton seed meal | 885 | 945 | 1140 | 870 | |
| | 240 | Florida soft phosphate | | | | | |
| | 200 | Kainit | | | | | |
| 13 | 00 | No fertilizer | 765 | 720 | 697 | 630 | |
| 14 | 200 | Cotton seed meal | 1065 | 900 | 1080 | 780 | |
| | 240 | Acid phosphate | | | | | |
| | 200 | Kainit | | | | | |
| | 600 | Slaked lime | | | | | |
| 15 | 200 | Cotton seed meal | 975 | 645 | 1125 | 690 | |
| | 240 | Florida soft phosphate | | | | | |
| 16 | 472 | Crushed cotton seed | 825 | 705 | 1057 | 705 | |
| | 240 | Florida soft phosphate | | | | | |

* Average of two plots; arrangement of plots slightly different from that in other experiments.

† Injured by trees standing near.

In the experiment at Red Level a mixture of cotton seed meal and acid phosphate was decidedly advantageous, but variations in fertility as shown by the yields of the two unfertilized plots were too great to justify any further conclusions.

The wide variation in the yields of plots 3 and 8 at Athens was due to the fact that the first five or six plots were located on higher land than were any of the others.

In the experiment at Evergreen we should conclude that nitrogen was chiefly needed, were it not for the figures opposite plots 9 and 10, and for the small yield on plots 15 and 16.

At Albertville, manures applied in previous years obscured the results. In spite of this disadvantage, the results of Mr. Freeman's careful work suggest that the soil was deficient in all three essential fertilizer ingredients, especially in nitrogen.

FLORIDA SOFT PHOSPHATE VERSUS ACID PHOSPHATE.

By averaging the results of the 14 experiments which afford definite indications, we find that the complete fertilizer that contained acid phosphate was more effective than the one in which Florida soft phosphate was used. The average difference in favor of the acid phosphate was 43 pounds of seed cotton per acre.

Viewed from another standpoint, there were 11 experiments in which acid phosphate afforded larger yields, and three tests in which the crude phosphate stood ahead of its competitor. In this comparison it should be remembered that equal quantities of the two phosphates were used and that the Florida soft phosphate contained at least 60 per cent. more phosphoric acid than did the high grade acid phosphate employed.

It may be claimed that the raw phosphate will have a greater effect in the second year after application than will acid phosphate. However, few farmers would be willing to

wait so long for a large part of their returns from fertilizers. Crude phosphate has been found to be most effective when used in combination with some organic fertilizer, a condition which has been afforded in these tests by employing cotton seed meal or cotton seed in connection with it.

RELATIVE FERTILIZER VALUES OF COTTON SEED AND COTTON SEED MEAL.

Frequent letters of inquiry reach the Alabama Experiment Station asking on what terms a farmer can afford to sell his cotton seed and buy cotton seed meal as a fertilizer. One of the objects of the co-operative fertilizer experiment described in this bulletin was to get answers to this question from all of the soils used in the test.

In deciding on the amounts of cotton seed and meal to be compared, quantities of each were employed which would afford equal amounts of nitrogen, as indicated by the analyses then available. A more nearly complete compilation of analyses published since this experiment was planned indicates that it would have been more strictly accurate to have used 434 pounds of cotton seed per acre instead of 472.

Disregarding the tests classed as inconclusive, we find that of the remaining experiments 7 give larger yields with cotton seed and 7 afford heavier crops with cotton seed meal. Combining the results of these 14 experiments we find that crushed cotton seed afforded an average of 10 pounds per acre of seed cotton more than did the meal. This difference in yield in favor of the seed is amply sufficient to counterbalance the fact that there was used as fertilizer 38 pounds per acre of crushed cotton seed in excess of what was necessary to supply the required amount of nitrogen. After making this allowance, we find that cotton seed and cotton seed meal were on an average equally effective when such quantities of each were compared as contained equal amounts of nitrogen. A pound of nitrogen was just as valuable in one as in the other.

But the market prices of cotton seed and meal are not governed wholly by the relative amounts of essential fertilizer ingredients in each. Whether it is more profitable to sell seed and buy meal, or apply seed to the land, depends on the relative prices of these two materials. The average figures for 14 experiments in 1896 showed that one ton of seed was equal to an amount of meal containing a like quantity of nitrogen, which we find to be 922 pounds of meal; from this it follows that 1 pound of meal was equal to 2.06 pounds of seed. Hence we get the price per ton of seed at which the farmer could afford to swap seed for meal by dividing the price of meal by 2.06 (2.13). For example, assuming a price of \$20 per ton for cotton seed meal and dividing this by 2.06 we have \$9.22 per ton as the relative fertilizer value of seed. Of course, to this price of seed should be added the cost of getting the seed to the oil mill. To put the average results of fourteen tests made in 1896 into still another form, we may say that a ton of crushed cotton seed was worth on the farm as fertilizer 46 per cent of the cost of a ton of cotton seed meal.

The preceding are only average results, and individual soils and crops may be more responsive to the one or to the other source of nitrogen. For example, on certain compact clay or prairie soils deficient in vegetable matter, cotton seed may be the more valuable because of its effect on the mechanical condition of the soil. On the other hand we can scarcely doubt that cotton seed meal has some advantage under conditions when it is necessary that the fertilizer should exert its effect quickly. In this connection attention is called to the fact that the fertilizers for this test were applied later than is customary, the great majority of them being put in the ground in April, while in a few cases they were not applied till May. This may have been a greater disadvantage to the cotton seed than to the meal.

A discussion of this subject necessarily turns largely on the chemical composition of the materials compared. Hence, the following figures calculated from many analyses compiled in Bulletin No. 33 of the Office of Experiment Station, U. S. Department of Agriculture, are added:

| | Nitro- gen. <i>Lbs.</i> | Phosphoric Acid. <i>Lbs.</i> | Pot- ash. <i>Lbs.</i> |
|------------------------------------|-------------------------------|------------------------------------|-----------------------------|
| 2,000 lbs. of cotton seed contains | 62.6 | 25.4 | 23.4 |
| 922 lbs. of c. s. meal contains | 62.6 | 26.5 | 16.3 |

AVERAGE RESULTS WITH COTTON SEED MEAL, ACID PHOSPHATE, AND KAINIT.

In the table below the results of the 14 experiments which give fairly conclusive results are summarized and averaged. The figures in the table represent the increase in seed cotton over the unfertilized plots.

Increased yield in pounds of seed cotton per acre resulting from different fertilizer mixtures.

| LOCALITY. | INCREASE OVER UNFERTILIZED PLOT WITH | | | |
|---------------------|--------------------------------------|--------------------------|--------------------------|--|
| | { C. S. meal Acid phos } | { C. S. meal Kainit } | { Acid phos. Kainit } | { C. S. meal Acid phos. Kainit } |
| | <i>Lbs.</i> | <i>Lbs.</i> | <i>Lbs.</i> | <i>Lbs.</i> |
| Newton | 192 | 88 | 224 | 264 |
| Town Creek..... | 368 | 125 | 172 | 319 |
| Rutledge..... | 128 | 290 | 236 | 462 |
| Kaylor..... | 216 | 255 | 223 | 259 |
| Tuscumbia..... | 120† | 318 | 213 | 105 |
| Castleberry..... | 376 | 258 | 220 | 302 |
| Burnt Corn..... | 624 | 558 | 452 | 566 |
| LeGrand..... | 592 | 568 | 296 | 600 |
| Dillburgh..... | 360 | 348 | 328 | 388 |
| Alpine..... | 808 | 746 | 428 | 614 |
| Healing Springs ... | 88 | 434 | 476 | 722 |
| Abbeville..... | 834† | 762 | 726 | 1026 |
| Naftel..... | ..... | 307 | 330 | 345 |
| Prattville..... | 208 | 196 | 184 | 380 |
| Average..... | 378* | 375 | 322 | 454 |

*Average of 13 tests.

†Plot 10.

The average amounts of seed cotton by which the fertilized plots exceeded the unfertilized were: 378 lbs. per acre with a mixture of cotton seed meal and acid phosphate; 375 lbs. per acre with a mixture of cotton seed meal and kainit; 322 lbs. per acre with a mixture of acid phosphate and kainit; and 454 lbs. with a complete fertilizer.

Crediting the respective fertilizer mixtures with these increments at $2\frac{1}{2}$ cents per pound, and deducting the cost of the fertilizers, there remains an average profit of \$5.63 for the first mixture, \$5.78 for the second, \$4.70 for the third, and \$6.04 for the complete fertilizer. The largest profit came from the heaviest application of fertilizers, 640 lbs. per acre.

By subtracting in turn from the average gain of the complete fertilizer the gain of each plot receiving its fertilizers in pairs, we find that the average relative increase attributable to cotton seed meal is 132 lbs., to acid phosphate 79 lbs., and to kainit 76 lbs. of seed cotton per acre.

LIST OF PUBLICATIONS OF THE ALABAMA AGRICULTURAL
EXPERIMENT STATION.

1. Bulletins Nos. 1-10, 1883-1885.
2. Bulletins Nos. 1-9, 1885-1887.
3. Bulletins Nos. 1-8, for 1887.
4. Bulletins Nos. 1-5, for 1888.

The above bulletins were issued in the early formative period of the Experiment Station partly in conjunction with the Commissioner of Agriculture, whose office was then located at Auburn.

5. Bulletins Nos. 1-77 of the current series. These represent the regular bulletins of the Station since the formation under the Hatch fund.

6. Annual Reports of the Agricultural Experiment Station, 1-8, 1888-1896.

By recent action of the Station Council the above bulletins have been arranged in volumes as follows:

Vol. I. To include all bulletins issued in the first four series and before the foundation under the Hatch Act.

Vol. II. To include bulletins 1-21 of the current series, 1888-1890.

Vol. III. To include bulletins Nos. 22-58 of the current series, 1891-1894.

Vol. IV. To include bulletins Nos. 59-75 of the current series.

Indices of these bulletins have been published and will be sent to parties applying for them until the issues are exhausted.

In addition to the early bulletins grouped under Vol. I, the following bulletins and annual reports are out of print and cannot be furnished: Nos. 3, 4, 5, 7, 8, 9, 20, 22, 24, 35, 36, 37, 40, 41, 42, 43, 44, 45, 47, 48, 49, 50, 51, 54, 57, 60, 61, 62, 63, 67, 72, 73, 74.

The following annual reports are exhausted: 1, 3, 5, 6, 7.

Anyone having copies of the bulletins which are exhausted will confer a favor by returning them to Librarian Alabama Experiment Station.

