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AUBURN.

# EXPERIMENTS WITH COTTON

J. F. DUGGAR, AGRICULTURIST.

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# Experiments With Cotton.

BY J. F. DUGGAR.

## SUMMARY.

The group of varieties yielding most lint were Texas Oak, Griffin, Hawkins, Deering, Mell Cross No. 15, Jones Re-improved, Duncan, Hutchinson, Peterkin, Truitt and Whatley.

Seed of the same original stock, but grown for one year in different parts of the Cotton Belt, when planted at Auburn, showed no marked difference in productiveness.

The yields obtained by planting fresh, one-year-old and two-year old seed were nearly identical.

With late cultivation the yield of cotton was slightly larger than with ordinary cultivation.

Truitt cotton in narrow rows on upland of medium quality gave practically the same yields whether the single plants stood 12, 18 or 24 inches apart in the drill. The yield decreased when the distance between plants was increased to 30 or 36 inches. The crop matured earlier with thick planting.

Topped cotton plants yielded less than those not topped.

The use of 640 pounds of slaked lime, applied broadcast in 1896, failed to increase the crop that year. But cotton following broadcast cow peas, turned under in the spring of 1897, afforded a larger yield on the plot limed the previous year than on the plot not limed.

Subsoiling in January, 1896, was decidedly beneficial to the first crop of cotton, but afforded no increase in the second crop, grown in 1897.

A mixture of stable manure, cottonseed meal and acid

phosphate, applied without composting, afforded a slightly larger yield than did exactly the same materials made into compost about one month before using.

Composting increased the efficiency of Florida soft phosphate, but not of acid phosphate.

Slightly larger yields were obtained by bedding on all the fertilizer than by reserving one-fourth and applying this portion in the seed drill at planting time.

One hundred and fifty pounds per acre of cottonseed meal afforded a larger yield of seed cotton than 316 pounds of cottonseed or 70½ pounds of nitrate of soda. These amounts of the above-named fertilizers contained equal quantities of nitrogen; hence cottonseed meal was the source whence the most effective form of nitrogen was obtained.

Acid phosphate was more effective pound for pound than Florida soft phosphate, except when the crude phosphate was employed in compost.

A mixture of acid phosphate and Florida soft phosphate was less effective than an equal weight of acid phosphate, and more valuable than an equal weight of Florida soft phosphate.

Acid phosphate alone failed to increase the yield. Cottonseed meal was highly beneficial. Kainit, alone and in combination, greatly increased the yield. Kainit decreased the injury from "black rust," and this is apparently the explanation of the large increase in yield on the plots receiving kainit.

## The Weather in the Growing Season of 1897.

The rainfall for each month is recorded in Bulletin No. 88. There were several periods in May and in the first half of the summer when cotton suffered greatly from dry weather. However, up to the latter part of July there was every prospect for large yields. A severe drought, ending about the middle of August, followed by a week of rainy weather, resulted in great damage in shedding of forms and in the rapid spread of "black rust" on the leaves.

A second growth was made later in the season, but on the Station Farm a large proportion of the bolls then formed failed to open.

## Varieties.

In 1897 the number of varieties tested was 32, of which 17 were well-known varieties and 15 crosses originated several years ago by the station botanist, Prof. P. H. Mell. The parentage of these varieties was noted in Bulletin No. 56 of this Station.

The rows were 3½ feet apart. Thinning was done after counting the plants, so as to leave an equal number on each plot. The average distance between plants was 18 inches on all plots, except on those planted in Bates and Griffin, where a poor stand was obtained, the average distance between plants being nearly 24 inches with Griffin and nearly 40 inches with Bates. No corrections have been made for this very defective stand on these two plots, although it is evident that both varieties are at a disadvantage.

Peerless cotton was planted on 7 plots as a means of ascertaining the amount of any variations in the natural fertility of the field. The field was found to vary so much that one variety could not fairly be directly compared with all others.

However, the frequently repeated Peerless plots enable us to calculate approximately what would be the yield of each plot if planted with the Peerless variety. In so doing the actual yield of the Peerless plot on either side is given a weight inversely proportional to its distance from each plot for which the calculation is made. The amount by which any variety exceeds the calculated yield of Peerless on a given plot is believed to be the best measure of the natural productiveness of that variety under the weather conditions prevailing in 1897. Therefore in this bulletin the varieties are ranked in order of productiveness according to the amount of lint by which they exceed Peerless in that part of the field. The actual yields, both of seed cotton at the time of ginning, and of lint, are also given.

The following table contains these data, and also figures indicating the percentage of lint in seed cotton and the relative earliness of each variety, as indicated by the percentage of the total crop obtained at the first picking, August 31:

*Yield per acre, relative earliness, percentage of lint, and relative productiveness compared with Peerless, of 32 varieties.*

| Plot No. | VARIETY. | Actual yield of seed cotton. | Percentage of total crop at first picking. | Percentage of lint. | Actual yield of lint per acre. | Gain (+) or loss (—) per acre over Peerless. | Calculated yield of Peerless, lint. |
|---|---|---|---|---|---|---|---|
| | | *Lbs.* | | | *Lbs.* | *Lbs.* | *Lbs.* |
| 16 | Texas Oak | 707 | 47 | 36.2 | 256 | +29 | 227 |
| 5 | Griffin Drought Proof Prolific | 970 | 44 | 31.0 | 301 | +28 | 273 |
| 7 | Hawkins Imp'd | 824 | 45 | 33.9 | 280 | +20 | 260 |
| 15 | Deering Small Seed | 672 | 63 | 35.7 | 240 | +16 | 224 |
| 29 | Mell Cross No. 15 | 627 | 48 | 32.4 | 206 | +12 | 194 |
| 1 | Jones Re-improved | 917 | 58 | 32.3 | 296 | +11 | 285 |
| 2 | Duncan Mammoth | 898 | 52 | 34.7 | 296 | +11 | 285 |
| 12 | Hutchinson Storm Prolific | 790 | * | 32.0 | 253 | +10 | 243 |
| 10 | Peterkin | 755 | 31 | 34.4 | 259 | + 9 | 250 |
| 8 | Truitt Imp'd P. Prolific | 824 | 60 | 31.8 | 262 | + 8 | 254 |
| 20A | Whatley Imp'd | 746 | 59 | 30.5 | 228 | + 7 | 221 |
| 31B | Mell Cross No. 3 | 650 | 40 | 31.0 | 197 | + 3 | 194 |
| 32B | Mell Cross No. 50 | 682 | 49 | 28.9 | 197 | + 3 | 194 |
| 22 | Mell Cross No. 38 | 712 | 55 | 31.7 | 226 | + 2 | 224 |
| 32A | Mell Cross No. 14 | 640 | 52 | 29.1 | 195 | + 1 | 194 |
| 33 | Mell Cross No. 7 | 669 | 66 | 29.7 | 195 | + 1 | 194 |
| 24 | Mell Cross No. 58 | 688 | 51 | 31.9 | 219 | 0 | 219 |
| 30 | Mell Cross No. 54 | 614 | 55 | 31.5 | 194 | 0 | 194 |
| 31A | Mell Cross No. 49 | 624 | 62 | 30 8 | 192 | — 2 | 194 |
| 14 | Dickson Cluster | 710 | 83 | 31.9 | 227 | — 3 | 230 |
| 6 | Hunnicutt Choice | 816 | 46 | 31.8 | 259 | — 4 | 263 |
| 35 | Mell Cross No. 55 | 613 | 75 | 30.8 | 189 | — 5 | 194 |
| 27 | Mell Cross No. 12 | 629 | 56 | 31.0 | 195 | — 5 | 200 |
| 4 | Bates Big Boll | 890 | 34 | 29.6 | 266 | —13 | 279 |
| 26 | Mell Cross No. 43 | 605 | 55 | 31.5 | 190 | —14 | 204 |
| 25 | Mell Cross No. 61 | 634 | 48 | 31.3 | 198 | —15 | 213 |
| 17 | Allen Improved Long Staple | 731 | 58 | 28.0 | 205 | —16 | 221 |
| 20B | Tyler | 707 | 61 | 28.5 | 202 | —19 | 221 |
| 21 | Mell Cross No. 76 | 661 | 51 | 31.2 | 197 | —25 | 222 |
| 34 | Mell Cross No. 11 | †520 | 80 | 31.9 | 157 | .... | .. |
| 19 | Allen's Hybrid Long Staple | 635 | 60 | 27.2 | 173 | —46 | 219 |
| 3 | Peerless (check) | 880 | 56 | 32.4 | 285 | 0 | 285 |
| 9 | Peerless (check) | 776 | 67 | 31.9 | 248 | 0 | 248 |
| 11 | Peerless (check) | 763 | 61 | 33.1 | 253 | 0 | 253 |
| 13 | Peerless (check) | 712 | 59 | 32 8 | 234 | 0 | 234 |
| 18 | Peerless (check) | 676 | 54 | 32.2 | 218 | 0 | 218 |
| 23 | Peerless (check) | 714 | 46 | 31.6 | 226 | 0 | 226 |
| 28 | Peerless (check) | 614 | 50 | 31 5 | 194 | 0 | 194 |
| .... | Peerless (average of 7 plots) | 735 | 56 | 32.2 | 237 | 0 | 237 |

†This plot is not comparable with others on account of a difference in preparation.

*The percentage of total crop gathered at first picking was not

Ranking the varieties according to their excess of lint cotton per acre over Peerless in each part of the field, the varieties heading the list are Texas Oak, Griffin, Hawkins, Deering, Mell Cross No. 15 (a cross between the W. A. Cook and Cherry Chester varieties), Jones Re-improved, Duncan, Hutchinson, Peterkin, Truitt, and Whatley.

As is usual in variety tests at all experiment stations there is a great difference in the rank of varieties tested in two different seasons, 1896 and 1897. In 1897 all varieties were seriously injured by "black rust," except the very late varieties, Bates and Peterkin, of which only about 5 per cent. of the plants appeared to be seriously damaged. This disease was most prevalent on the early varieties, Dickson, Deering, and Peerless.

## Classification of Lint.

The numbered samples of lint were classified by Mr. H. L. Bandy, a cotton buyer of Opelika, Ala. His classification was as follows:

*Good Middling*, $5\frac{7}{16}$c.—Duncan.

*Strict Middling*, $5\frac{5}{16}$c.—Jones and Texas Oak (latter rated at $5\frac{3}{16}$c.), Truitt, Peterkin, Mell Cross No. 3, and Mell Cross No. 55.

*Barely Strict Middling*, $5\frac{1}{4}$c.—Whatley.

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determined for the Hutchinson variety because of an error, which was discovered by the failure of the weight of seed cotton just before ginning to approximately agree with the sum of the weights of the several pickings. With all other varieties there was a close agreement between these 2 sets of figures, but with the Hutchinson there was a discrepancy of 12 pounds of lint cotton. The complete records in which the error occurs are therefore published here for this variety: First picking of one-sixteenth acre plot, 36.8 pounds of seed cotton; second picking, 20.7 pounds; third picking, 3.3 pounds; and fourth picking, 0.5 pound. The error is believed to be in the weight of seed cotton at first picking. The smaller weight (weight at ginning) is evidently correct for it is checked by the weight of lint, and is used in the above table for the Hutchinson, as well as for all other varieties.

*Middling*, $5\frac{3}{16}$c.—Bates, Griffin, Hunnicutt, Hawkins, Peerless, Hutchinson, Mell Cross No. 76, Mell Cross No. 38, Mell Cross No. 58, Mell Cross No. 61, Mell Cross No. 43, Mell Cross No. 12, Mell Cross No. 54, Mell Cross No. 49, Mell Cross No. 14, Mell Cross No. 50, Mell Cross No. 7, and Mell Cross No. 4.

*Barely Middling*, $5\frac{1}{8}$c.—Deering.

*Strict Low Middling*, $5\frac{1}{16}$c.—Dickson, Allen Imp. L. S., and Allen Hybrid L. S.

## Where to Get Seed.

This Station cannot offer seed either for sale or distribution. Our seeds for variety tests are purchased in small quantity from the grower, originator, or seed merchant, thus keeping the variety purer than if we saved our own mixed seed. Our stock was obtained originally from the following parties:

Allen Improved L. S. and Allen Hybrid L. S., from J. B. Allen, Port Gibson, Miss.

Hutchinson, from J. N. Hutchinson, Salem, Ala.

Duncan, Bates, Griffin, Hunnicutt, Hawkins, and Dickson, from Mark W. Johnson Seed Co., Atlanta, Ga.

Peerless and Peterkin, from H. P. Jones, Herndon, Ga.

Texas Oak, from M. G. Smith, Lightfoot, Ga.

Tyler, from K. J. Tyler, Aiken, S. C.

Deering Small Seed was donated by Maj. I. F. Culver, Commissioner of Agriculture, Montgomery, Ala.

## Seed from Different Latitudes.

In the early spring of 1896 seed of the variety King was bought from J. S. Blalock, Goldville, S. C., and planted the same year on the Station farm. Small quantities were also sent to the Experiment Station at Stillwater, Oklahoma, to Abbeville, in the southern part of Alabama, and to Dillburg, in the central or western part of this State. The seeds were planted in those localities in 1896, and after that crop was ginned some of the resulting seed were sent back to Auburn.

Hence the comparison below is between seed of the same original stock grown for only one year in different localities. The yields per acre were as follows:

*Seed from different latitudes.*

| Plot No. | SEED FROM | Yield of seed cotton per acre. |
|---|---|---|
| 1 and 7 | Goldville, S. C. | 950 |
| 2 and 6 | Abbeville, Ala. | 922 |
| 3 | Auburn, Ala. | 928 |
| 4 | Dillburg, Ala. | 948 |
| 5 | Stillwater, Okla. | 928 |

The differences are too slight to show any effect due to latitude or climate. Indeed, one year is doubtless too short a time for a seed to be modified by change of climate. A repetition of this test with seed grown for a longer time in different latitudes is planned.

## OLD VERSUS NEW SEED.

This is a repetition of an experiment conducted in 1896. In the test of the present year seed from the crop of 1896 is designated as fresh seed, that from the crop of 1895 as one-year-old seed, and that from the crop of 1894 as two-year-old seed. It will be understood that seed spoken of as one year-old is really when planted about a year and a half old, and so on for seed of other ages.

With favorable weather just after planting, a good and uniform stand was secured on all plots. No differences in germination were observed. The following table gives the average results of three experiments in two years:

*Yield of lint per acre produced by seed of different ages.*

| Age of Seed | Lint per acre | | | |
|---|---|---|---|---|
| | Whatley variety, 1896 | Gold Dust variety, 1896 | Dickson variety, 1897 | Average of 3 experiments |
| | *Lbs.* | *Lbs.* | *Lbs.* | *Lbs.* |
| Fresh | 272 | 242 | 259 | 258 |
| One year old | 237 | 248 | 269 | 254 |
| Two year old | 246 | 277 | 240 | 254 |

Old and fresh cottonseed were of about the same value for planting under conditions where a good stand was obtained.

### Effect of Late Cultivation.

Peerless cotton planted April 19 was "laid by" July 12. One plot, however, was cultivated July 26, running a 22-inch heel scrape twice between each row.

The middle plot, not "laid by" until July 26, yielded 1,087 pounds of seed cotton per acre. Two adjacent plots "laid by" two weeks earlier, or at about the usual time, averaged 1,052 pounds. The difference of 25 pounds in favor of the plot cultivated late was more than sufficient to pay the cost of the extra cultivation.

### Distance Experiments.

Truitt cotton was planted April 19 on rather medium quality reddish rocky upland. This field had been in corn in 1896, and had also borne a light crop of Whippoorwill cow peas between the corn rows. The growth of this bunch variety of cow peas, planted late and in rather thick corn, had been too insignificant to noticeably improve the character of this soil, which has always been inclined to bake. The fertilization and cultivation of all plots was identical, except that

June 1 hoeing was done in such a way as to leave two plants in a place either 12, 18, 24, 30 or 36 inches apart. June 25 the stand was reduced to a single plant in a hill. The distance between all rows was 3 feet 4 inches. The stand was practically perfect.

Fertilizers were used as follows:

160 lbs. acid phosphate per acre.
160 lbs. cottonseed meal per acre.
20 lbs. muriate of potash per acre.

Total, 340 lbs. of a complete fertilizer per acre.

The yields were as follows:

*Yield per acre of seed cotton with single plants at different distances.*

| Plot No. | Distance | Yield of seed cotton per acre. |
|---|---|---|
| | | *Lbs.* |
| 1 | 12 inches by 40 inches | 928 |
| 2 | 18 " " 40 " | 838 |
| 3 | 24 " " 40 " | 910 |
| 4 | 30 " " 40 " | 856 |
| 5 | 18 " " 40 " | 936 |
| 6 | 36 " " 40 " | 848 |
| 7 | 12 " " 40 " | 917 |
| 8 | 18 " " 40 " | 910 |
| 9 | 24 " " 40 " | 926 |
| 10 | 30 " " 40 " | 900 |
| 11 | 36 " " 40 " | 858 |
| 12 | 18 " " 40 " | 917 |
| 13 | 18 " " 40 " | 960 |
| | Average for 12 inches (2 plots) | 922 |
| | " " 18 " (5 plots) | 912 |
| | " " 24 " (2 plots) | 918 |
| | " " 30 " (2 plots) | 878 |
| | " " 36 " (2 plots) | 853 |

The above table shows that with Truitt cotton in narrow rows there was practically no difference in yield between distances of 12, 18 and 24 inches in the drill. When the space was increased to 30 inches a decided reduction in yield followed. When the distance became 36 inches a further reduction occurred, which, however, was only slight. The yield per

plant increased rapidly as the space allowed to each was enlarged.

It should be remembered that the Truitt variety makes a large growth, and that its originator recommends thin planting for this variety. With Peerless, a smaller variety, planted in 1896 on a more sandy soil, best results were obtained by spacing either 12 or 18 inches in rows 42 inches apart.

The average percentages of the whole crop that were obtained at the first picking, August 26, were as follows: 42 per cent. for plants 12 inches apart; 38 per cent. for plants spaced 18 inches; 30 per cent. for plants 24 inches apart; 26 per cent. for plants spaced 30 inches; and 28 per cent. for plants 36 inches apart. These averages suggest that thin planting retarded opening and that very thick planting decidedly hastened the maturity of the plants. However, different plots planted at identical distances varied considerably in the percentage of the total crop which was open at the time of the first picking.

## Topping.

One plot of Truitt cotton planted April 19 in a part of the field used for distance experiments was topped July 22, and another plot was topped August 19. Two plots were not topped. The distance between plants was 18 inches, and the rows 3 feet 4 inches apart.

The following table gives the results:

*Topping vs. not topping cotton.*

| Plot No. | Treatment. | Yield of seed cotton per acre. | Per cent. of total crop at first picking, Aug. 26. |
|---|---|---|---|
| 13 and 15 | Not topped | 946 | 45 |
| 14 | Topped August 19 | 906 | 43 |
| 16 | Topped July 22 | 710 | 46 |

The results are decidedly in favor of the plants not topped. Topping early was apparently more injurious than topping after the first bolls had begun to open.

Topping did not hasten maturity.

### Subsoiling and Liming.

This is a continuation of an experiment begun in 1896 on red, rather stiff, shallow soil, inclined to bake and sensitive to drought. The surface is decidedly rocky.

"On January 29, 1896, one plot was broken to the usual depth, 3 or 4 inches, with a one-horse turn plow. In this furrow followed a scooter drawn by one mule, which loosened a part of the soil to an additional depth of 3½ inches. In this way the soil was loosened to a depth of about 7 inches without throwing up to the surface the clay of the subsoil, which is temporarily poorer than the surface soil.

"At the same time two other plots were broken with a one-horse turn plow in the usual way without the subsoiling scooter, and on one of these slaked lime was applied broadcast at the rate of 640 lbs. per acre."

The crop preceding the cotton of 1897 was broadcast cow peas, picked, and the vines plowed under in the early part of spring.

All plots were prepared alike in 1897 in the usual way, using a one-horse turn plow.

The results for both years are given below:

*Yield per acre of seed cotton on plots limed, subsoiled and not treated in* 1896.

| Treatment in 1896 | Seed cotton per acre | | |
|---|---|---|---|
| | 1896 | 1897 | Average for 2 years |
| | *Lbs.* | *Lbs.* | *Lbs.* |
| Neither limed nor subsoiled | 637 | 723 | 680 |
| Subsoiled | 776 | 730 | 753 |
| Limed | 653 | 821 | 737 |

The application of 640 pounds of lime, which is a much

smaller amount than that usually applied, was followed by an insignificant increase of the first crop and by considerable increase of the second crop after liming. The average increase for the two years is 57 pounds of seed cotton per acre. The combined increase for the two years is 114 pounds of seed cotton.

The better effect of lime in 1897 than in 1896 is probably due to the fact that in 1897 cotton followed broadcast cow peas, thus giving the lime a supply of vegetable matter to decompose.

The increase attributable to subsoiling was 139 pounds of seed cotton the first year and only 7 pounds the second year after subsoiling, the average annual increase per acre being 73 pounds of seed cotton. The total increase attributable to subsoiling is 146 pounds of seed cotton per acre, which is sufficient to pay a profit over the cost of subsoiling.

Light soils would probably not be benefited by subsoiling. If subsoiling is practiced, it should be done early enough in the winter to allow the rains to moisten and settle the deeply stirred soil before planting time.

### Composting versus Mixing in the Furrow.

April 16, on land previously broken with a turn plow, rows were laid off $3\frac{1}{2}$ feet apart with a shovel plow. In these furrows were placed the fertilizer, composts and manure referred to below.

On each of plots 1, 2, 3, 4 and 5 were used, either fresh or in compost, 150 pounds per acre of cotton seed meal and 240 pounds per acre of either acid phosphate or Florida soft phosphate. Each of these plots also received stable manure, fresh or composted, at the rate of 1,500 pounds per acre. To plots 2 and 5 the stable manure was applied fresh, being removed from the mules' stalls and put in the ground the same day, April 16. On plots 1, 3 and 4 compost was applied. This compost had been made March 18 by taking fresh horse manure at the rate of 1,500 pounds per acre from the same stalls as above, and immediately mixing it with cotton seed meal and phosphate. The three lots of compost were kept on

a board floor and given only sufficient moisture to insure active fermentation without leaching. In other words, the composts were kept under the most favorable conditions for about one month, or until April 16, when composts, fresh manures and commercial fertilizers were placed in the drill. Low beds were then thrown up above the fertilizers. Peerless cotton was planted April 19 in a seed bed, that was too loose on all plots.

The following table shows the character of fertilization and the yields of seed cotton:

*Composting vs. mixing in the furrow.*

| Plot No. | Amount per acre. | FERTILIZERS. | Composted. | Applied. | Yield of seed cotton per acre. |
|---|---|---|---|---|---|
| | *Lbs.* | | | | *Lbs.* |
| 1 | 1,500 | Stable manure | March 18 | April 16 | 1,050 |
| | 240 | Acid phosphate | | | |
| | 150 | Cottonseed meal | | | |
| 2 | 1,500 | Fresh stable manure | * | April 16 | 1,144 |
| | 240 | Acid phosphate | | | |
| | 150 | Cottonseed meal | | | |
| 3 | 1,500 | Stable manure | March 18 | April 16 | 1,081 |
| | 240 | Acid phosphate | | | |
| | 150 | Cottonseed meal | | | |
| 4 | 1,500 | Stable manure | March 18 | April 16 | 1,125 |
| | 240 | Florida soft phosphate | | | |
| | 150 | Cottonseed meal | | | |
| 5 | 1,500 | Fresh stable manure | * | April 16 | 1,093 |
| | 240 | Acid phosphate | | | |
| | 150 | Cottonseed meal | | | |
| | | *Averages.* | | | |
| 2 and 5 | ..... | Materials not composted | | | 1,119 |
| 1 and 3 | ..... | Compost of acid phosphate, etc | | | 1,065 |
| 4 | ..... | Compost of Florida soft phosphate, etc | | | 1,125 |

*Not composted.

The figures in the above table show plainly that there was no advantage in composting acid phosphate, stable manure, and cottonseed meal, but that on the other hand the plots receiving this compost yielded 54 pounds of seed cotton per acre less than the plots to which the same fertilizing materials were

applied in the fresh condition. The result for a somewhat similar comparison between composting and mixing in the furrow was made on lighter soil in 1896, and the result agreed with those of the present season in showing a decreased yield on the plots receiving compost.

The figures in the table show that when composted a pound of the cheaper Florida soft phosphate was slightly more effective than a pound of the more costly acid phosphate. Doubtless the decaying vegetable material of the stable manure has made the raw or crude Florida soft phosphate more soluble and hence of more value to the plant than it would be if used without an abundant supply of vegetable matter. The raw phosphate contains about twice as much total phosphoric acid as acid phosphate, but most of it is classed as insoluble.

### One-fourth of Fertilizer in Seed Drill.

This is a repetition with slight changes of an experiment conducted in 1896. For each of three plots equal quantities of fertilizers were weighed out, viz:

150 lbs. cottonseed meal per acre.
240 lbs. acid phosphate per acre.
30 lbs. muriate of potash per acre.

Total, 420 lbs. complete fertilizer per acre.

From the fertilizers intended for two plots there was reserved one-fourth to be applied in the seed drill in immediate contact with the seed. On the middle plot all the fertilizer was drilled as usual in the "marking off" furrow, under the seed bed; three-fourths of the fertilizers for the other two plots was also placed in that position.

The plot receiving all its fertilizer in the "marking off" furrow yielded 1,132 pounds of seed cotton per acre; the plots with one-fourth of the fertilizer in the seed drill averaged 1,098 pounds per acre, a loss of 34 pounds of seed cotton per acre following a division of the fertilizer. A similar result was reached in 1896.

## Relative Values of Cottonseed, Cottonseed Meal and Nitrate of Soda.

Such quantities of cottonseed, cottonseed meal and nitrate of soda as contained equal amounts of nitrogen were used on different plots, and on all plots 240 pounds of acid phosphate and 30 pounds of muriate of potash per acre were also applied. The amounts used per acre were 316 pounds of air dry cottonseed, or 150 pounds of cottonseed meal, or 70½ pounds of nitrate of soda. The cottonseed were bagged and moistened about a month before they were applied to the field. All fertilizers were put in the drill April 16.

The results are shown in the following table:

*Results with different forms of nitrogen.*

| Plot No. | Amount per acre | Fertilizers | Yield seed cotton per acre | Per cent. of crop at first picking | Per cent. of "rusted" plants |
|---|---|---|---|---|---|
| | *Lbs.* | | | | |
| 6 | 150 | Cottonseed meal..... | 1,074 | 35 | 10 |
| | 240 | Acid phosphate..... | | | |
| | 30 | Muriate of potash..... | | | |
| 7 | 316 | Cottonseed, rotted..... | 858 | 45 | 20 |
| | 240 | Acid phosphate..... | | | |
| | 30 | Muriate of potash..... | | | |
| 8 | 70½ | Nitrate of soda..... | 1 035 | 40 | 10 |
| | 240 | Acid phosphate..... | | | |
| | 30 | Muriate of potash..... | | | |

In this test cottonseed meal proved the best of the three fertilizers compared. As a partial offset, there undoubtedly remains in the soil a portion of the fertilizing material of the cottonseed which may be expected to benefit the succeeding crop. "Rust" was more abundant on the plot receiving cottonseed, the amount on this plot being estimated at twice that on either of the other plots.

## Relative Values of Different Phosphates.

Equal weights of Edisto high grade acid phosphate, Florida soft phosphate and Tennessee crude phosphate were compared. At the suggestion of the Station Chemist, Prof. B. B. Ross, a mixture of one-half acid phosphate and one-half Florida

soft phosphate was prepared as follows: Equal quantities of the two phosphates were thoroughly mixed and moistened about one month before being applied to the soil. The mixture was then allowed to dry thoroughly, after which it was pulverized as thoroughly as practicable. This was done in order that reverted phosphate might be formed from some of the phosphoric acid previously existing in an insoluble form in the Florida soft phosphate.

Florida soft phosphate was compared with an equal weight of acid phosphate in a fertilizer mixture containing no vegetable matter and also in combination with cottonseed meal, the decomposition of which, if enough meal is used, is probably favorable to the effective action of the crude phosphate.

The following table presents the data of these experiments:

*Results of comparisons of different phosphates.*

| Plot No. | Fertilizers. | | Yield of seed cotton per acre. |
|---|---|---|---|
| | Amount per acre. | KIND. | |
| | *Lbs.* | | *Lbs.* |
| 8 | 240 | Acid phosphate | 1,035 |
| | 70½ | Nitrate of soda | |
| | 30 | Muriate of potash | |
| 9 | 240 | Florida soft phosphate | 967 |
| | 70½ | Nitrate of soda | |
| | 30 | Muriate of potash | |
| 10 | 240 | Florida soft phosphate | 792 |
| | 150 | Cottonseed meal | |
| | 30 | Muriate of potash | |
| 11 | 120 | Acid phosphate | 892 |
| | 120 | Florida soft phosphate | |
| | 150 | Cottonseed meal | |
| | 30 | Muriate of potash | |
| 12 | 240 | Acid phosphate | 972 |
| | 150 | Cottonseed meal | |
| | 30 | Muriate of potash | |
| 13 | 120 | Acid phosphate | 946 |
| | 120 | Florida soft phosphate | |
| | 150 | Cottonseed meal | |
| | 30 | Muriate of potash | |
| 15 | 240 | Acid phosphate | 1,132 |
| | 150 | Cottonseed meal | |
| | 30 | Muriate of potash | |
| 17 | 240 | Tennessee phosphate | 1,116 |
| | 150 | Cottonseed meal | |
| | 30 | Muriate of potash | |

Although variations in fertility of the field undoubtedly affected the yields on certain plots, some of the comparisons originally intended are practicable. With acid phosphate, in combination with other commercial fertilizers, the yields were larger than with Florida soft phosphate in a similar combination.

With a mixture of these two kinds of phosphates the yields were larger than with an equal weight of Florida soft phosphate, but smaller than with an equal weight of acid phosphate.

### Experiment with Fertilizers.

The field used for this experiment was in corn in 1895, in wheat in 1896. A few months after wheat harvest buckwheat was sown. This crop failed almost completely, and was followed by rye in the fall of 1896, which was pastured in March, 1897. A thick stubble was turned under a few days before cotton was planted. This field had received liberal applications of fertilizers, chiefly acid phosphate and cottonseed meal, with all crops of recent years. The soil of this field is a red loam, containing more clay than most soils in this immediate vicinity. The surface is nearly covered with flint stones.

After the land was turned rows 3½ feet apart were laid off with a shovel plow. In these furrows the fertilizers were drilled, after which beds were thrown up over the lines of fertilizer. These beds were then flattened with a harrow and Peerless cotton was planted April 19.

At the final thinning 560 plants were left on each fifteenth-acre plot, which is at the rate of 8,400 plants per acre.

June 29 plants on all plots were in bloom, but the blooms were few on the unfertilized plots. There was promise of a large crop, estimated at a bale per acre, on the best plots, until the 1st of August. From August 1 to August 15 shedding of bolls went on rapidly as the result of a dry season, which, broken only by light showers, had extended over more than a month.

It was doubtless during the last week of this drought that a leaf disease became widely spread over this field. During a

week of almost continuous rain, beginning August 16, this leaf disease spread so rapidly that the leaves died in large areas over the field, and a large percentage of the plants dropped every leaf. The appearance of the affected plants seemed to justify the local name of "black rust" for the disease which, although not carefully observed in its early stages, was apparently the same as the disease described by Prof. G. F. Atkinson in Bulletin No. 41 of this Station as "yellow leaf blight," or "mosaic disease."

August 21 an estimate was made of the percentage of seriously diseased plants on each plot. At that date the plot receiving 240 pound per acre of acid phosphate, and the plot supplied with both acid phosphate and cottonseed meal, had been most injured. Next in extent of injury were the unfertilized plots.

The plots least injured were Nos. 4 and 6, the one treated with kainit alone, the other with kainit and cottonseed meal. The next healthiest plots were Nos. 1 and 7, the former being the cottonseed meal plot, the latter the cottonseed meal and acid phosphate plot.

The results on plot 10 are considered unreliable, because a part of this plot consisted of a strip of land which in the preceding year had received treatment different from the balance of the field, and because the growth of plants and the prevalence of leaf disease were so different on the two portions of this plot.

The following table gives the yield of seed cotton per acre; the calculated* increase; the value of the increase at 2 cents per pound of seed cotton ($5\frac{1}{4}$ cents per pound for lint and $7.50 per ton for seed); the actual cost of fertilizers delivered in Auburn in carload lots; and the "profit from fertilizers," or difference between value of increase and cost of fertilizers:

*Increase of plots 4–7 inclusive is calculated by giving to the figures for each unfertilized plot a weight inversely proportional to its distance from each in turn of the fertilized plots.

*Yield of seed cotton, increase per acre, and financial results from use of different fertilizers.*

| Plot No. | Fertilizers. Amount per acre. | Fertilizers. Kind. | Seed cotton. Yield per acre | Seed cotton. Increase over unfertilized plots. | Financial results. Value of increase at 2c per lb. | Financial results. Cost of fertilizers per acre. | Financial results. Profit from fertilizers. |
|---|---|---|---|---|---|---|---|
| | *Lbs.* | | *Lbs.* | *Lbs.* | | | |
| 1 | 200 | Cottonseed meal | 1,024 | 310 | $6.20 | $1.90 | $4.30 |
| 2 | 240 | Acid phosphate | 774 | 60 | 1.20 | 1.32 | —.12* |
| 3 | ..... | No fertilizer | 714 | ..... | ..... | ..... | ..... |
| 4 | 200 | Kainit | 1,075 | 354 | 7.08 | 1.38 | 5.70 |
| 5 | 200 | Cottonseed meal | 849 | 120 | 2.40 | 3.22 | —.82* |
| | 240 | Acid phosphate | | | | | |
| 6 | 200 | Cottonseed meal | 1,099 | 363 | 7.26 | 3.28 | 3.98 |
| | 200 | Kainit | | | | | |
| 7 | 240 | Acid phosphate | 919 | 175 | 3.50 | 2.70 | .80 |
| | 200 | Kainit | | | | | |
| 8 | ..... | No fertilizer | 751 | ..... | ..... | ..... | ..... |
| 9 | 200 | Cottonseed meal | 1,011 | 260 | 5.20 | 4.60 | .60 |
| | 240 | Acid phosphate | | | | | |
| | 200 | Kainit | | | | | |
| 10 | 200 | Cottonseed meal | 1,077 | ..... | ..... | 3.90 | ..... |
| | 240 | Acid phosphate | | | | | |
| | 100 | Kainit | | | | | |

*Loss.

Kainit alone was most profitable. Cottonseed meal, used alone, was second in point of profit. A combination of both kainit and cottonseed meal afforded a larger yield than either alone, but the cost was also greater, giving to this combination the third place as regards profit.

The following analysis of the above table brings out clearly the effect of each fertilizer under four different conditions:

**Cottonseed meal** apparently increased the yield of seed cotton per acre when added—

| | Pounds. |
|---|---|
| To unfertilized plots | 310 |
| To kainit plot | 9 |
| To acid phosphate plot | 60 |
| To kainit and acid phosphate plot | 85 |
| Average increase from cottonseed meal | **116** |

**Kainit** apparently increased the yield of seed cotton per acre when added—

| | Pounds. |
|---|---|
| To unfertilized plots | 354 |
| To acid phosphate plot | 115 |
| To cottonseed meal plot | 53 |
| To acid phosphate and cottonseed meal plot | 85 |
| Average increase from kainit | **151** |

**Acid phosphate** apparently increased the yield of seed cotton per acre when added—

| | Pounds. |
|---|---|
| To unfertilized plots | 60 |
| To kainit plot | —179 |
| To cottonseed meal plot | —190 |
| To kainit and cottonseed meal plot | —103 |
| Average *decrease* from acid phosphate | **103** |

The favorable effects of kainit and cottonseed meal and the unfavorable effects of acid phosphate are probably not indications that this soil is notably lacking in potash and nitrogen and abundantly supplied with phosphoric acid. The most profitable fertilizer in 1897 was the one which was best able to fortify the plant against the attacks of the prevalent leaf disease. Under the weather conditions of 1897 kainit and cottonseed meal were best able to do this. Their favorable effect was doubtless due largely to the fact that they tended to delay maturity or to keep the plant growing longer than was the case with acid phosphate. On the other hand, acid phosphate

hastened maturity to such an extent that when unfavorable weather occurred in August the plants fertilized with phosphate had reached such a stage of fruiting that they were unable to resist disease to the same extent as the less completely developed plants on other plots.

That there is some correspondence in 1897 between yield, late maturity and freedom from disease is suggested by the data in the following table, which shows the yield in pounds of seed cotton per acre, percentage of total crop gathered at first picking, August 26, and percentage of plants seriously injured by "rust" as estimated August 21:

*Relation between yield, earliness, and amount of "rust."*

| Plot No. | Fertilizer. Amount per acre. | Fertilizer. Kind. | Yield of seed cotton per acre. | Percentage of crop at first picking. | Percentage of seriously diseased plants. |
|---|---|---|---|---|---|
| | *Lbs* | | *Lbs.* | | |
| 1 | 200 | Cottonseed meal | 1,024 | 24 | 20 |
| 2 | 240 | Acid phosphate | 774 | 26 | 90 |
| 3 | ..... | No fertilizer | 714 | 30 | 80 |
| 4 | 200 | Kainit | 1,075 | 22 | 10 |
| 5 | 200 | Cottonseed meal | 849 | 44 | 90 |
| | 240 | Acid phosphate | | | |
| 6 | 200 | Cottonseed meal | 1,099 | 25 | 10 |
| | 200 | Kainit | | | |
| 7 | 240 | Acid phosphate | 919 | 34 | 15 |
| | 200 | Kainit | | | |
| 8 | ..... | No fertilizer | 751 | 27 | 80 |
| 9 | 200 | Cottonseed meal | 1,011 | 40 | 75 |
| | 240 | Acid phosphate | | | |
| | 200 | Kainit | | | |

Apparently this red soil was not particularly deficient in potash. For in 1897, in a part of the same field, with identical previous treatment, kainit, alone and in every combination, failed to increase the yield of corn over that of the unfertilized plots.

Our results in the above table seem to confirm those of

Dr. G. F. Atkinson (published in Bulletin Nos. 27, 36 and 41 of this Station) in showing the favorable effects of kainit in checking the disease which that authority designated as yellow leaf blight. But kainit at the rate of 200 pounds per acre was not a preventive of the form of leaf disease which was most abundant on the Station farm in 1896, a disease which effected little injury in comparison with that wrought by the widely prevalent disease of the present year.

A careful inspection of the field where the fertilizer experiments were conducted in 1897 led to the conclusion that the fertilizer was by no means the only factor in determining the extent and distribution of the disease. The belts in which the disease was most serious were not well defined, but extended diagonally across certain parts of the field, embracing plots differently fertilized. The fact that certain irregular areas were especially liable to this disease, regardless of the kind of fertilizer used, is not necessarily in conflict with the tendency of kainit to check the disease under certain conditions.

The subject of diseases of cotton is under investigation by the Station Biologist, Prof. F. S. Earle, and the Agriculturist will co-operate as far as possible in that work.

We are not prepared to advise farmers to buy kainit simply for its "rust resisting" properties. On soils deficient in potash it is a profitable fertilizer, and apparently it may also some years be profitable for cotton in fields inclined to rust, even if no marked deficiency of potash is indicated by other crops. Unfortunately destructive outbreaks of rust cannot be foretold. The minimum amount of kainit that can be effectively used for rust has yet to be determined.