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# Grades of Fertilizers for Corn and Cotton

A PROGRESS REPORT

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AGRICULTURAL EXPERIMENT STATION

OF THE

ALABAMA POLYTECHNIC INSTITUTE

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# Grades of Fertilizers for Corn and Cotton[1]

## A PROGRESS REPORT

IT IS generally recognized that low yields per acre of corn and cotton are closely associated with high costs of production. The cost of production has as much to do with profits or losses in the farming industry as the selling price of the products. Thus, with cheap cotton, it is possible for one farmer to make a profit on his cotton crop whereas his neighbor loses money because the former produces the cotton at a sufficiently low cost, while the latter does not. In Alabama a number of factors may influence the cost of corn and cotton production, but none of them is as important as the yield per acre.

The yield per acre of corn and cotton may be profitably increased by proper fertilization. What fertilizers will increase the yields of these crops most economically? There is no other question so important directly to the farming industry of Alabama as well as indirectly to the other industries of the State. This is true because corn and cotton are the principal crops grown and a large amount of money is spent each year for various grades of commercial fertilizers. Some of these grades are undoubtedly more efficient for the production of corn and cotton than others. It is not sufficient for a fertilizer to simply increase crop yields. The best fertilizer for a particular crop is the one which leaves the largest profit per acre after the cost of fertilizer has been deducted.

During the past six years, field tests have been conducted for the purpose of determining the best grade of fertilizer for corn and cotton when grown on the same land in alternate years. These tests were conducted at eight different places in the State as follows: Alexandria, Aliceville, Brewton, Monroeville, and Prattville Experiment Fields; Sand Mountain, Tennessee Valley, and Wiregrass Substations.

It is the purpose of this circular to present and discuss the results which have been obtained from the use of various grades of fertilizers for corn and cotton during the past six years.

### FERTILIZERS FOR CORN

In almost every section of Alabama many farmers use a complete fertilizer (one which contains nitrogen, phosphoric acid, and potash) for corn. It should be valuable to know whether or not the phosphate and the potash are needed in a fertilizer for corn. Furthermore, it is desirable to know the amount of nitrogen which will produce corn at the lowest cost

[1]The tests were conducted by R. C. Christopher, Fred Stewart, J. P. Wilson, J. T. Williamson, J. R. Taylor, F. E. Bertram, and J. W. Richardson on substations and experiment fields of Alabama. The manuscript was prepared by J. W. Tidmore.

per bushel. The average yields of corn obtained for each of the eight tests are shown in Table 1, so that the reader may make calculations of the profits or losses obtained from the use of a particular fertilizer at any or all of the substations or experiment fields where this test was conducted. In Table 2, the average yield and the cost and profit derived from the use of different grades of fertilizer are given from the average of the eight tests.

**Phosphate.**—It may be seen (Table 2) that during the past six years plots which received 600 pounds of a 6-0-0[2], a 6-6-4, a 6-8-4, and a 6-10-4 fertilizer each produced an average annual yield of approximately 34 bushels of corn per acre. In other words, plots which received 225, 300, or 375 pounds of superphosphate per acre did not produce any more corn than the one which received no phosphate. It should be mentioned, however, that the plot which received no phosphate for the corn had received 375 pounds of superphosphate the previous year for the cotton crop. Phosphate applied for the corn did not increase the yield; therefore, the expenditure for the superphosphate represented a loss each year. This loss was from $1.80 to $3.00 per acre depending on the amount of phosphate used.

**Potash.**—During the same six-year period, 600 pounds of a 6-10-2, a 6-10-4, and a 6-10-6 fertilizer each produced about 34 bushels of corn per acre. In these cases, the same quantity of nitrogen and phosphate was applied to each plot but the potash was varied from 2 to 6 per cent. Plot 7, which received no potash and no phosphate but received the same amount of nitrogen as the above mentioned plots, produced approximately the same amount of corn as those which received potash. Therefore, the amount of money which was spent for potash was lost. This loss varied in these tests from $0.40 to $1.20 per acre depending upon the amount of potash in the fertilizer.

**Nitrogen.**—With uniform applications of phosphate and potash, the corn yields increased as the nitrogen content of the fertilizer was increased. The yields (Table 2) from Plots 2, 3, 4, and the check plots clearly show the influence of nitrogen on corn yields. For example, the plot that received 600 pounds per acre of a fertilizer which contained no nitrogen (0-10-4) produced an average yield of 15.1 bushels of corn per acre during the past six years. Plots that received 600 pounds per acre of fertilizer which contained nitrogen gave the following increases over the yield obtained with no nitrogen: 2-10-4, 7.1 bushels; 4-10-4, 13.8 bushels; and 6-10-4, 18.7 bushels per acre.

[2]Here and in subsequent formulas the first figure refers to nitrogen, the second to phosphoric acid, and the third to potash.

**TABLE 1.—The Six-Year Average Yield of Corn, Bushels per Acre, Produced at Five Experiment Fields and Three Substations When Various Grades of Fertilizers Were Used at the Rate of 600 Pounds per Acre (1930-1935).**

| Plot | Fertilizer $N$-$P_2O_5$-$K_2O$ | Experiment fields | | | | | Substations | | | Average |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Alexandria | Aliceville | Brewton | Monroeville | Prattville | Sand Mountain[1] | Tennessee Valley[1] | Wiregrass | |
| 1 | 6-10-4 (check) | 30.2 | 26.2 | 39.9 | 31.9 | 34.7 | 35.9 | 38.5 | 32.5 | 33.7 |
| 2 | 0-10-4 | 16.3 | 5.7 | 18.0 | 13.3 | 9.9 | 9.1 | 27.9 | 20.8 | 15.1 |
| 3 | 2-10-4 | 22.9 | 14.4 | 24.9 | 21.7 | 18.8 | 16.6 | 31.3 | 27.2 | 22.2 |
| 4 | 4-10-4 | 27.1 | 22.1 | 31.8 | 28.1 | 27.5 | 26.9 | 35.4 | 32.5 | 28.9 |
| 5 | 6-10-4 (check) | 28.5 | 28.8 | 36.0 | 32.7 | 34.7 | 37.1 | 37.2 | 36.3 | 33.9 |
| 6 | 6-10-2 | 29.7 | 29.1 | 35.0 | 32.8 | 35.4 | 36.2 | 37.0 | 37.4 | 34.1 |
| 7 | 6- 0-0 | 30.1 | 29.0 | 33.0 | 32.2 | 34.6 | 35.1 | 35.2 | 36.7 | 33.2 |
| 8 | 6-10-6 | 30.6 | 29.6 | 36.8 | 32.7 | 35.2 | 34.8 | 37.3 | 35.6 | 34.1 |
| 9 | 6-10-4 (check) | 29.9 | 29.6 | 38.8 | 32.7 | 34.5 | 35.0 | 37.8 | 34.5 | 34.1 |
| 10 | 6- 8-4 | 30.1 | 28.9 | 38.5 | 32.6 | 35.2 | 35.1 | 37.7 | 35.6 | 34.2 |
| 11 | 6- 6-4 | 29.4 | 28.9 | 37.9 | 32.2 | 34.8 | 35.4 | 38.3 | 34.7 | 34.0 |
| 12 | 4- 8-4 | 25.7 | 23.1 | 33.4 | 27.3 | 28.2 | 25.4 | 36.5 | 30.9 | 28.8 |
| 13 | 6-10-4 (check) | 29.2 | 28.1 | 37.2 | 32.3 | 35.3 | 35.6 | 36.9 | 33.8 | 33.6 |
| 14 | 3- 8-5 | 24.2 | 17.5 | 29.5 | 24.3 | 24.5 | 20.2 | 33.8 | 28.0 | 25.3 |
| 15 | 3-10-3 | 24.3 | 18.5 | 28.9 | 24.4 | 23.7 | 20.0 | 34.5 | 28.6 | 25.4 |
| 16 | 2-11-3 | 21.9 | 15.7 | 26.4 | 19.5 | 18.7 | 15.3 | 33.1 | 25.1 | 22.0 |
| 17 | 6-10-4 (check) | 30.1 | 27.7 | 40.4 | 31.8 | 36.1 | 35.3 | 37.6 | 31.4 | 33.8 |
| Average of checks | | 29.6 | 28.1 | 38.5 | 32.3 | 35.1 | 36.0 | 37.6 | 33.7 | 33.8 |

[1]Seven-year average—1929-1935, inclusive.

**TABLE 2.—The Six-Year Average Yield of Corn and the Returns When Various Grades of Fertilizers Were Applied at the Rate of 600 Pounds per Acre at Five Experiment Fields and Three Substations (1930-1935).**

| Plot | Fertilizer $N\text{-}P_2O_5\text{-}K_2O$ | Per acre | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Yield | Increase over 0-10-4 | Value of increase[1] | Cost of nitrogen | Profit from nitrogen[2] | Cost of fertilizer[3] | Loss due to minerals[4] | Cost of increased yield per bushel[5] |
| | | Bu. | Bu. | $ | $ | $ | $ | $ | $ |
| 11 | 6- 6-4 | 34.0 | 18.9 | 14.17 | 3.70 | 10.47 | 6.32 | 2.62 | 0.33 |
| 10 | 6- 8-4 | 34.2 | 19.1 | 14.32 | 3.70 | 10.62 | 6.92 | 3.22 | 0.36 |
| Check | 6-10-4 | 33.8 | 18.7 | 14.02 | 3.70 | 10.32 | 7.52 | 3.82 | 0.40 |
| 6 | 6-10-2 | 34.1 | 19.0 | 14.25 | 3.70 | 10.55 | 7.12 | 3.42 | 0.37 |
| Check | 6-10-4 | 33.8 | 18.7 | 14.02 | 3.70 | 10.32 | 7.52 | 3.82 | 0.40 |
| 8 | 6-10-6 | 34.1 | 19.0 | 14.25 | 3.70 | 10.55 | 7.92 | 4.22 | 0.42 |
| 7 | 6- 0-0 | 33.2 | 18.1 | 13.57 | 3.70 | 9.87 | 3.70 | 0 | 0.20 |
| 2 | 0-10-4 | 15.1 | ---- | ---- | ---- | ---- | 3.80 | 3.80 | ---- |
| 3 | 2-10-4 | 22.2 | 7.1 | 5.32 | 1.24 | 4.08 | 5.04 | 3.80 | 0.71 |
| 4 | 4-10-4 | 28.9 | 13.8 | 10.35 | 2.48 | 7.87 | 6.28 | 3.80 | 0.46 |
| Check | 6-10-4 | 33.8 | 18.7 | 14.02 | 3.70 | 10.32 | 7.52 | 3.80 | 0.40 |
| 12 | 4- 8-4 | 28.8 | 13.7 | 10.27 | 2.48 | 7.79 | 5.68 | 3.20 | 0.41 |
| 14 | 3- 8-5 | 25.3 | 10.2 | 7.65 | 1.85 | 5.80 | 5.26 | 3.41 | 0.52 |
| 15 | 3-10-3 | 25.4 | 10.3 | 7.72 | 1.85 | 5.87 | 5.46 | 3.61 | 0.53 |
| 16 | 2-11-3 | 22.0 | 6.9 | 5.17 | 1.24 | 3.93 | 5.14 | 3.90 | 0.75 |
| Check | 6-10-4 | 33.8 | 18.7 | 14.02 | 3.70 | 10.32 | 7.52 | 3.82 | 0.40 |

[1]Corn was valued at 75 cents per bushel.
[2]Only the cost of the nitrogen was used here since the phosphate and potash did not increase the yield.
[3]Cost of fertilizer ingredients: nitrate of soda, $33 per ton; superphosphate, $16 per ton; and muriate of potash, $33 per ton.
[4]The loss is due to the cost of the phosphate and potash.
[5]In this calculation, the cost of all fertilizer ingredients was considered. The increased yield was based on the yield produced on the plot which received the 0-10-4 fertilizer.

There would be little if any interest in these increased yields unless they could be economically produced. How much profit was obtained from these fertilizer treatments? This question can be answered by subtracting the cost of the fertilizer from the increased value of the corn crop. As shown in the preceding paragraphs, the phosphate and potash in these fertilizers did not increase the corn yield; therefore, they were not needed. Accordingly, only the cost of the nitrogen is considered at present. Corn was valued at $0.75 per bushel, and nitrate of soda at $33 per ton. It will be seen that in the case of the fertilizer which contained 2 per cent nitrogen, this nitrogen increased the value of the crop by $5.32 per acre and the nitrogen cost was $1.24 per acre. There was, therefore, a profit of $4.08 per acre more than was obtained on the plot which received no nitrogen. By similar calculations, it will be seen that there were profits of $7.87 and $10.32 when fertilizers containing 4 and 6 per cent nitrogen, respectively, were used.

If the most profit per acre is desired from average land in Alabama, there can be no question as to the amount of nitrogen which should be used up to 36 pounds (225 pounds of nitrate of soda or its equivalent) per acre; this amount of nitrogen, without phosphate and potash, increased corn yields by an average of 18.1 bushels per acre and gave a profit of $9.87. In this instance the increased yield of corn was produced for approximately 20 cents per bushel. On the other hand, when 600 pounds per acre of complete fertilizers were used the increased yield of corn cost from 33 to 75 cents per bushel depending on the grade of fertilizer used (Table 2, column 10). The loss, due to the use of phosphate and potash, for each of the several grades of fertilizer is shown in the ninth column of Table 2.

**Recommendations for Corn Fertilization.**—*For corn, on average soils of Alabama which have been well fertilized with phosphate and potash for other crops, 36 pounds of nitrogen per acre (225 pounds of nitrate of soda or its equivalent), applied 30 to 40 days after planting, is the only fertilizer needed.* This statement is based on the fact that 12 pounds of nitrogen per acre which cost $1.24 produced an increased yield of 7.1 bushels of corn, 24 pounds of nitrogen which cost $2.48 produced an increased yield of 13.8 bushels, and 36 pounds of nitrogen which cost $3.70 produced an increased yield of 18.7 bushels. It may be seen from these figures that the first, second, and third increments of nitrogen (each equivalent to 75 pounds of nitrate of soda which cost $1.24) produced 7.1, 6.7, and 4.9 bushels of corn, respectively. It is possible that additions of phosphate may be necessary for the most profitable production on bottom land if corn is grown each year. In South Alabama, on recently cleared land, or on land which has never received any phosphate, phosphate must be applied in addition to nitrogen for satisfactory corn production.

## FERTILIZERS FOR COTTON

For cotton production, many different grades of complete fertilizers are used. Some of these fertilizers must be more efficient than others. It was the purpose of the test, discussed below, to determine the most economical grade of fertilizer for cotton in Alabama. This test was conducted at eight different places in the State on tiers of plots adjacent to the corn plots previously discussed. The data in Table 3 show the average yield of cotton at each of the eight locations, so that the reader may make calculations of the profits or losses obtained from the use of a particular grade of fertilizer at any or all of the substations or experiment fields where this test was conducted. In Table 4 the average yield, the cost of fertilizers, and the value of the cotton produced by the various grades of fertilizers are given. Seed cotton was valued at 4 cents per pound.

**Phosphate.**—It will be seen in Table 4 that a 6-6-4 fertilizer produced an average of 1183 pounds of seed cotton per acre during the past six years, whereas a 6-8-4 produced 42 pounds more than a 6-6-4 and only 16 pounds per acre less than the 6-10-4 when each was used at the rate of 600 pounds per acre. Naturally, the question arises as to whether or not these differences are sufficient to pay for the differences in the cost of the fertilizers. In these calculations, no charge was made for picking and ginning the increased yield of cotton since it was assumed that the increased yields of seed were sufficient to pay these charges.

The 6-10-4 fertilizer used cost 60 cents per acre more than the 6-8-4. When the value of the cotton and the cost of the two fertilizers are considered, there is a difference of only four cents per acre in favor of the 6-10-4 fertilizer. Likewise, in comparing the efficiency of the 6-6-4 and the 6-8-4 and after considering the costs involved, there is a difference of $1.08 per acre in favor of the 6-8-4.

**Potash.**—In this test 600 pounds per acre of complete fertilizers were used which contained 6 per cent nitrogen and 10 per cent phosphoric acid, while the potash content was varied from 2 to 6 per cent. It will be observed (Table 4) that the fertilizer which contained 2 per cent potash produced an average of 51 pounds of seed cotton per acre less than the fertilizer which contained 4 per cent potash. After considering the cost of the potash in the two fertilizers, the one which contained 4 per cent potash was more valuable than the one which contained 2 per cent by $1.64 per acre. The plot which received the fertilizer containing 6 per cent potash produced about the same amount of seed cotton per acre as the plot which re-

**TABLE 3.—The Six-Year Average Yield of Seed Cotton, Pounds per Acre, Produced at Five Experiment Fields and Three Substations When Various Grades of Fertilizers Were Used at the Rate of 600 Pounds per Acre (1930-1935).**

| Plot | Fertilizer $N$-$P_2O_5$-$K_2O$ | Experiment fields | | | | | Substations | | | Average |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Alexandria | Aliceville | Brewton | Monroeville | Prattville | Sand Mountain[1] | Tennessee Valley[1] | Wire grass | |
| 1 | 6-10-4 (check) | 1,070 | 898 | 1,371 | 1,106 | 1,143 | 1,430 | 1,577 | 1,536 | 1,266 |
| 2 | 0-10-4 | 592 | 460 | 625 | 553 | 527 | 596 | 1,220 | 1,005 | 697 |
| 3 | 2-10-4 | 817 | 670 | 883 | 834 | 771 | 861 | 1,310 | 1,237 | 923 |
| 4 | 4-10-4 | 946 | 824 | 1,003 | 989 | 949 | 1,143 | 1,421 | 1,414 | 1,086 |
| 5 | 6-10-4 (check) | 1,049 | 971 | 1,084 | 1,145 | 1,141 | 1,407 | 1,422 | 1,525 | 1,218 |
| 6 | 6-10-2 | 1,039 | 945 | 983 | 1,055 | 1,143 | 1,337 | 1,439 | 1,581 | 1,190 |
| 7 | 6-10-4 | 1,040 | 951 | 1,038 | 1,085 | 1,150 | 1,320 | 1,346 | 1,597 | 1,191 |
| 8 | 6-10-6 | 1,107 | 1,015 | 1,241 | 1,172 | 1,169 | 1,308 | 1,433 | 1,529 | 1,247 |
| 9 | 6-10-4 (check) | 1,097 | 996 | 1,256 | 1,191 | 1,133 | 1,317 | 1,476 | 1,485 | 1,244 |
| 10 | 6- 8-4 | 1,083 | 980 | 1,180 | 1,064 | 1,150 | 1,317 | 1,478 | 1,545 | 1,225 |
| 11 | 6- 6-4 | 1,018 | 958 | 1,063 | 1,048 | 1,154 | 1,291 | 1,440 | 1,489 | 1,183 |
| 12 | 4- 8-4 | 897 | 818 | 1,005 | 944 | 971 | 1,075 | 1,435 | 1,364 | 1,064 |
| 13 | 6-10-4 (check) | 1,053 | 938 | 1,146 | 1,114 | 1,173 | 1,361 | 1,453 | 1,480 | 1,215 |
| 14 | 3- 8-5 | 822 | 754 | 924 | 873 | 850 | 942 | 1,384 | 1,255 | 976 |
| 15 | 3-10-3 | 879 | 757 | 935 | 894 | 864 | 974 | 1,405 | 1,277 | 998 |
| 16 | 2-11-3 | 823 | 665 | 901 | 772 | 774 | 829 | 1,422 | 1,196 | 923 |
| 17 | 6-10-4 (check) | 1,119 | 924 | 1,257 | 1,068 | 1,171 | 1,398 | 1,585 | 1,565 | 1,261 |
| Average of checks | | 1,078 | 945 | 1,223 | 1,125 | 1,152 | 1,383 | 1,502 | 1,518 | 1,241 |

[1]Seven-year average—1929-1935, inclusive.

**TABLE 4.—The Six-Year Average Yield of Seed Cotton and Returns When Various Grades of Fertilizers Were Applied at the Rate of 600 Pounds per Acre at Five Experiment Fields and Three Substations (1930-1935).**

| Plot | Fertilizer $N\text{-}P_2O_5\text{-}K_2O$ | Per acre | | | | | |
|---|---|---|---|---|---|---|---|
| | | Yield | Less than 6-10-4 | Value of cotton[1] | Cost of fertilizer[2] | Value of cotton less cost of fertilizer | Loss based on 6-8-4[3] |
| | | Lbs. | Lbs. | $ | $ | $ | $ |
| 2 | 0-10-4 | 697 | 544 | 27.88 | 3.80 | 24.08 | 18.00 |
| 3 | 2-10-4 | 923 | 318 | 36.92 | 5.04 | 31.88 | 10.20 |
| 4 | 4-10-4 | 1086 | 155 | 43.44 | 6.28 | 37.16 | 4.92 |
| Check | 6-10-4 | 1241 | --- | 49.64 | 7.52 | 42.12 | ---- |
| 11 | 6- 6-4 | 1183 | 58 | 47.32 | 6.32 | 41.00 | 1.08 |
| 10 | 6- 8-4 | 1225 | 16 | 49.00 | 6.92 | 42.08 | ---- |
| Check | 6-10-4 | 1241 | --- | 49.64 | 7.52 | 42.12 | ---- |
| 6 | 6-10-2 | 1190 | 51 | 47.60 | 7.12 | 40.48 | 1.60 |
| Check | 6-10-4 | 1241 | --- | 49.64 | 7.52 | 42.12 | ---- |
| 8 | 6-10-6 | 1247 | +6 | 49.88 | 7.92 | 41.96 | 0.12 |
| 16 | 2-11-3 | 923 | 318 | 36.92 | 5.14 | 31.78 | 10.30 |
| 15 | 3-10-3 | 998 | 243 | 39.92 | 5.46 | 34.46 | 7.62 |
| 14 | 3- 8-5 | 976 | 265 | 39.04 | 5.26 | 33.78 | 8.30 |
| 12 | 4- 8-4 | 1064 | 177 | 42.56 | 5.68 | 36.88 | 5.20 |
| Check | 6-10-4 | 1241 | --- | 49.64 | 7.52 | 42.12 | ---- |

[1]Seed cotton valued at 4 cents per pound.
[2]Cost of fertilizer ingredients: nitrate of soda, $33 per ton; superphosphate, $16 per ton; and muriate of potash, $33 per ton.
[3]After deducting the cost of the fertilizer, the grades of fertilizers indicated were less efficient than the 6-8-4 by the amounts shown in the last column.

ceived fertilizer containing 4 per cent potash. This means that there was a loss of 16 cents per acre when the 6-10-6 fertilizer was used instead of the 6-10-4.

**Nitrogen.**—Six hundred pounds per acre of complete fertilizers were used which contained 10 per cent phosphoric acid and 4 per cent potash, while the nitrogen content was varied from 0 to 6 per cent. The 0-10-4 fertilizer made an average yield of 544 pounds of seed cotton per acre less than the 6-10-4, the 2-10-4 made 318 pounds less than the 6-10-4, and the 4-10-4 made 155 pounds less than the 6-10-4.

It is obvious that the most economical fertilizer for cotton in this test was the one which produced the most cotton at the lowest cost or the one which gave the greatest net returns per acre. In making such calculations, it is necessary to place a value on the cotton produced by each of the fertilizers used in the test and to consider the cost of each fertilizer. After deductions were made for cost of fertilizers, it was found (Table 4) that the fertilizer which contained no nitrogen gave $24.08 worth of cotton per acre, the fertilizer which contained 2 per

cent nitrogen gave $31.88 worth of cotton, the fertilizer which contained 4 per cent nitrogen gave $37.16 worth of cotton, and the fertilizer which contained 6 per cent nitrogen gave $42.12 worth of cotton. It should be remembered that in each of the above cases the cost of the fertilizer has been deducted. Therefore, other factors being equal, the returns per acre depend upon the amount of nitrogen in the fertilizer provided that sufficient phosphate and potash are used. These returns varied from $24.08 to $42.12 per acre. The difference in returns from the 4 and 6 per cent nitrogen was $4.96 per acre in favor of the latter.

In the last column of Table 4 is shown the extent to which the various grades of fertilizers used in the test are less efficient than a 6-8-4 fertilizer. Again, it is well to point out the fact that a given figure in this column may not be applicable to all conditions in the State, but the differences between the efficiencies of the various grades of fertilizers are comparable for a given locality. For example, if a 6-8-4 fertilizer produces 1225 pounds of seed cotton per acre the same amount of a 3-8-5 should produce approximately 976 pounds; this difference represents a loss of approximately $8 per acre.

**Popular Cotton Fertilizers.**—Near the end of Table 4 is shown the inefficiency, when compared with a 6-8-4, of four grades of fertilizers which are very popular for cotton in Alabama. When used at the rate of 600 pounds per acre, these fertilizers were less efficient than the 6-8-4 by the following amounts of seed cotton per acre: 4-8-4, 161 pounds; 3-8-5, 249 pounds; 3-10-3, 227 pounds; and 2-11-3, 302 pounds.

Space does not permit a discussion of the inefficiency of each of these grades. The 3-8-5, as a fertilizer for cotton, will be briefly discussed since it is the most popular grade used in the State. From the data presented in Table 4, it was calculated that the 3-8-5 was less efficient than the 6-8-4 by $8.30 per acre. The quantity of 3-8-5 used in Alabama during 1935 was approximately 114,404 tons or 39 per cent of the total mixed fertilizers used in the State. This quantity would be sufficient to fertilize 381,346 acres if used at the rate of 600 pounds per acre. Now, if this fertilizer had been replaced by a good cotton fertilizer (6-8-4) the increase in the value of the cotton crop after paying for the fertilizer, would have been approximately $3,000,000. It is recognized that very few farmers use a 3-8-5 or any other grade of fertilizer at the rate of 600 pounds per acre; therefore, the difference between the efficiency of a good grade of fertilizer and a poor one becomes even greater than the figures above indicate.

On the other hand, if it is desired to "side dress" cotton with 75 pounds of nitrate of soda or its equivalent per acre, a 4-8-4 fertilizer would be a satisfactory mixture provided that

600 pounds of it were used per acre. These materials would supply 36 pounds of nitrogen, 48 pounds of phosphoric acid, and 24 pounds of potash per acre.

**Recommendations for Cotton Fertilization.**—*Most of the fertilizers which have been used for cotton contained more phosphate and less nitrogen than were needed. In the light of the results discussed above, the best fertilizer for cotton on average Alabama soils is one that supplies at least 36 pounds of nitrogen, 48 pounds of phosphoric acid, and 24 pounds of potash per acre. To supply these amounts of plant food, it would require 225 pounds of nitrate of soda or the equivalent, 300 pounds of superphosphate, and 48 pounds of muriate of potash or a 6-8-4 fertilizer applied at the rate of 600 pounds per acre.* This amount of fertilizer per acre may seem excessive since the average amount of low grades of fertilizers used in Alabama is about 300 pounds per acre. Tests which have been in progress at three places during 1934 and at six places during the past year show that 600 pounds per acre of a 6-8-4 fertilizer produced 221 pounds of seed cotton per acre more than a 300-pound application. After considering the cost of these amounts of a 6-8-4 fertilizer and the value of the seed cotton (4 cents per pound), the 600-pound application was more profitable than the 300-pound application by $5.38 per acre.

If a 6-8-4 fertilizer is used at the rate of 600 pounds per acre, it should be applied in a wide stream at the bottom of the furrow marking the row and mixed thoroughly with the soil, which should be bedded at least a week before planting. Allow time for a rain to fall and settle the bed. In the event that 300 pounds of 6-8-4 is used (even though it is not the most profitable rate) it may be applied in any manner in which 300 pounds of any other grade of fertilizer may be applied.

In using a 6-8-4 fertilizer at any rate up to 600 pounds per acre, a farmer is saved the time and expense of "side dressing" cotton. This fertilizer contains sufficient nitrogen and the cotton which received it should not be "side dressed".

The same amount of plant food as contained in a 600-pound application of 6-8-4 may also be supplied by an application of 600 pounds of a 4-8-4 fertilizer and a side application of 75 pounds per acre of nitrate of soda or its equivalent.

In the event that a farmer uses a 3-10-3 fertilizer under cotton at the rate of 600 pounds per acre, the cotton should be "side dressed" with approximately 112 pounds per acre of nitrate of soda or its equivalent. This fertilizer treatment would supply the correct amount of nitrogen, too much phosphoric acid, and too little potash; therefore, this treatment would not be the most profitable one that could be used.

A very large proportion of the mixed fertilizers used in Alabama is a 3-8-5. If this material is used at the rate of 600

pounds per acre and the cotton is "side dressed" with 112 pounds per acre of nitrate of soda or its equivalent, this treatment would supply the recommended amounts of nitrogen and phosphoric acid, but the potash application would be 6 pounds of potash more than was required. However, this would be a more profitable fertilizer for cotton than the 3-8-5 without the "side dressing" by about $8 per acre.

Many farmers may wish to buy the separate fertilizer ingredients and mix these materials on the farm in such proportions as to require no side dressing. If this is the case, the following materials should be mixed and applied per acre: 175 pounds of sulfate of ammonia or its equivalent (this amount of sulfate of ammonia would require about 200 pounds of limestone which should be included in the mixture) 300 pounds of superphosphate, and 48 pounds of muriate of potash. This mixture would weigh 723 pounds (including the limestone) and would supply exactly the same amount of nitrogen, phosphoric acid, and potash as would be supplied by the use of 600 pounds per acre of a 6-8-4 fertilizer. The above mentioned mixture will be satisfactory on light or on heavy textured soils. In the event that a farmer had a fairly heavy soil and wanted to use nitrate of soda or its equivalent instead of sulfate of ammonia and the limestone, the following materials should be mixed and applied per acre: 225 pounds of nitrate of soda or its equivalent, 300 pounds of superphosphate, and 48 pounds of muriate of potash. This mixture would weigh 573 pounds and would be equivalent to 600 pounds of a 6-8-4 fertilizer in every respect. If a farmer does not wish to use fertilizer at this rate per acre, the mixtures given above may be applied on the desired number of acres. For convenience the quantities of various fertilizer materials per acre which should be mixed to supply the same amounts of nitrogen, phosphoric acid, and potash as would be supplied by 200-, 300-, 400-, 500-, and 600-pound applications of 6-8-4 are shown in Table 5.

On sandy soils, it would be risky (on account of leaching caused occasionally by excessive rainfall in the spring) to apply all of the nitrogen in the form of nitrate of soda or any other nitrate before planting. It is suggested, therefore, that for "home mixing" the following materials be mixed and applied per acre before planting: 50 pounds of nitrate of soda or its equivalent, 300 pounds of superphosphate, and 48 pounds of muriate of potash. If this mixture (398 pounds) is used the cotton should be side dressed with 175 pounds of nitrate of soda or its equivalent after thinning the cotton. The above mixture plus the side dressing indicated will supply exactly the same amounts of nitrogen, phosphoric acid, and potash as contained in 600 pounds of a 6-8-4 fertilizer.

It is recognized that relatively few farmers use more than 300 pounds of fertilizer per acre for cotton even though this is

**TABLE 5.—Amounts of Materials for "Home Mixing" a Cotton Fertilizer Which Will Be Equivalent to the Applications of 6-8-4 Indicated.**

| Pounds of 6-8-4 desired per acre | Materials to mix so that the mixture will be equivalent to the amounts of 6-8-4 shown in the first column | | |
|---|---|---|---|
| | Pounds per acre | | |
| | Nitrate of soda[1] | Superphosphate | Muriate of potash |
| 200 | 75 | 100 | 16 |
| 300 | 112.5 | 150 | 24 |
| 400 | 150 | 200 | 32 |
| 500 | 187.5 | 250 | 40 |
| 600 | 225 | 300 | 48 |

[1]If it is desired to use sulfate of ammonia instead of nitrate of soda, the amounts given for nitrate of soda should be multiplied by 7 and divided by 9 to find the amount of ammonium sulfate to be used. One pound of limestone should be included in the mixture for each pound of sulfate of ammonia.

not the most profitable rate of application. When the farmer wishes to use less than 600 pounds of fertilizer per acre the ratio of nitrogen, phosphoric acid, and potash should be in the proportion of 6-8-4. For example, if only 300 pounds of a mixed fertilizer and no "side dressing" are to be used the mixture should be a 6-8-4 or its equivalent. If it is desirable to use 300 pounds of a 3-8-5 fertilizer per acre before planting the cotton, approximately 60 pounds of nitrate of soda or its equivalent should be used per acre as a "side dressing". This fertilizer treatment will be approximately equivalent to a 300-pound application of 6-8-4 fertilizer. In the event that a 3-8-5 fertilizer is to be used, the cotton should be "side dressed" with approximately 20 pounds of nitrate of soda or its equivalent for each 100 pounds of 3-8-5 applied before planting.

## SUMMARY

The results of field tests to determine the best grade of fertilizer for corn and cotton in a two-year rotation are given and discussed. These results may be briefly summarized as follows:

(1) Phosphate and potash, when used in mixed fertilizers, did not increase corn yields.

(2) Thirty-six pounds of nitrogen (225 pounds of nitrate of soda or its equivalent) should be used per acre for corn.

(3) The best fertilizer mixture for cotton is one which supplies 36 pounds of nitrogen, 48 pounds of phosphoric acid, and 24 pounds of potash per acre. These amounts of plant nutrients may be supplied by 600 pounds of a 6-8-4 fertilizer, or by 600 pounds of a 4-8-4 and a side application of 75 pounds of nitrate of soda or its equivalent.