CIRCULAR 78 JULY 1937

Fertilizer and Crop Experiments on Certain Soils of the Black Belt

A PROGRESS REPORT

Alfalfa on Sumter soil at Black Belt Substation at Marion Junction, Ala. Top, no fertilizer—yield 1,350 pounds; bottom, 375 pounds of superphosphate and 50 pounds of muriate of potash per acre—yield 3,400 pounds. Photographed April 21, 1936.

AGRICULTURAL EXPERIMENT STATION

OF THE

ALABAMA POLYTECHNIC INSTITUTE

M. J. FUNCHESS, *Director*

AUBURN

Contents

Fertilizer and Crop Experiments on Certain Soils of the Black Belt[1]

A PROGRESS REPORT

THE BLACK BELT of Alabama is an area of approximately 340 square miles extending nearly across the middle of the State from east to west. The farming practices in this region are different in many respects from those in other sections of the State. Prior to the location of the Black Belt Substation and the Gastonburg Experiment Field, there had been very little experimental work on the soils of this area. The purpose of this circular is to report results of experiments on some of the soil types with some of the crops adapted to the Black Belt.

DESCRIPTION OF THE SOILS OF THE BLACK BELT

The upland soils of the Black Belt may be separated into two broad groups: (1) the soils that contain lime and are generally known as the prairie soils, and (2) the soils that are acid and are frequently referred to as the "Postoak or Flatwood" soils. The lime soils are the Houston and Sumter clays and the acid soils are the Oktibbeha, Vaiden, Eutaw, and Lufkin clays. All of these are heavy clays that are very sticky when wet and generally hard when dry. The lime soils do not shrink and crack so badly with prolonged drying as the acid soils, but are more subject to drouth. Each of these soil types may be recognized from the following details.

Houston Clay.—This soil is also known as "Black Prairie Land" and "Black Crawfish Land". The topsoil is black and grades into a yellowish white at about one to three feet where chalk occurs. This soil was very extensive over the rolling topography of the chalk belt before erosion removed most of the black surface material giving rise to the Sumter clay. Today the Houston clay occurs chiefly on the gentle slopes between the bottom depressions (Bell clay) and the eroded crests of the Sumter clay. The native vegetation associated with this soil is grasses; hardwood trees are seldom found on it.

Sumter Clay.—Locally this soil is sometimes called "Lime Land, White Prairie, or White Land". The color of the surface soil is a light gray to grayish white. Rotten chalk occurs within four to eight inches of the surface and does not hold water well in dry seasons. Therefore, this soil is subject to severe drouth. The native vegetation is grasses.

---

[1]The tests were conducted by K. G. Baker on the Black Belt Substation at Marion Junction, Ala., and by J. T. Williamson, F. E. Bertram, and J. W. Richardson on the Experiment Field at Gastonburg, Ala. The description of the soils of the Black Belt was prepared by G. D. Scarseth. The manuscript was prepared by D. G. Sturkie.

Oktibbeha, Vaiden, Eutaw, and Lufkin Clays.—These soils, known as "Postoak or Flatwood" soils, have certain characteristics in common. They are all very acid clays which were derived from a clay deposit overlying the chalk at depths from two to twenty feet or more. They are also woodland soils on which oaks predominate in the virgin state. The *Oktibbeha Clay* is red in color and overlies chalk to a depth of two to five feet. The *Vaiden Clay* is reddish brown in the surface soil and mottled red and yellow in the upper subsoil. The chalk is not so near the surface as in the Oktibbeha. This soil occurs intermediately between the Oktibbeha and the Eutaw. The *Eutaw Clay* is not so well aerated as the Vaiden and Oktibbeha. The chalk occurs at depths of about twelve feet and thus it has no influence on the properties of this soil. The color of the surface soil is brown and the upper subsoil is highly mottled with yellow and bluish gray colors.

The *Lufkin Clay* is frequently called "Flatwoods Land". It has a topography more nearly level than the other Postoak soils. The chalk deposit is at a depth of twenty feet or more below the surface and does not influence the soil in any way. This soil is extremely heavy and sticky with a gray-brown, mottled surface soil of about three inches and a plastic grayish blue subsoil.

Bell, Catalpa, and Leaf Clays.—These soils are found in depressions and along the streams of the Black Belt region and are known as "Bottom Lands". In the depressions of the lime soil areas a black, waxy soil is found that is called *Bell Clay*. It is not subject to overflow but is usually moist and very productive. Along the overflow lands near the streams is found a black soil that looks somewhat like the Bell and is called *Catalpa Clay*. It is built up by the sediments of the stream and is subject to overflow. Another bottom-land soil is called *Leaf Clay*. This soil is brown in the surface soil and yellowish in the upper subsoil with much gray mottling. The subsoil is a sticky, heavy clay. This soil is subject to flooding only with the extreme floods.

EXPERIMENTS WITH FERTILIZERS FOR VARIOUS CROPS ON HOUSTON, SUMTER, VAIDEN, EUTAW, AND LUFKIN SOILS

Experiments were begun in 1930 with fertilizers for various crops on five soil types in the Black Belt. These experiments were conducted on two lime soils (Houston and Sumter) and on three acid soils (Vaiden, Eutaw, and Lufkin). The experiments on the Houston, Sumter, Vaiden, and Eutaw were located on the Black Belt Substation at Marion Junction and those on the Lufkin were located on the Experiment Field at Gastonburg.

The experiments on the Lufkin soil were in a four-year rotation. The method of treatment and results are reported in Table 7 and discussed on Page 16.

The experiments on Houston, Sumter, Vaiden, and Eutaw soils were not conducted in a rotation; many of the crops were planted continuously on the same plots. The phosphate and potash were always applied at planting; the nitrogen was applied as a side dressing for corn, sorghum, and sagrain and as a top dressing in the spring on oats, barley, and grasses. For cotton, one fourth of the nitrogen was applied at planting and three fourths as a side dressing at the first cultivation.

Alfalfa.—The yields obtained on Houston soil are reported in Table 1 and those on Sumter in Table 2. The largest yields were made on the Sumter soil. The yields of alfalfa on Houston were not large enough to make it a profitable crop and on Vaiden and Eutaw alfalfa was a complete failure. Alfalfa was not planted on Lufkin, but it is known that it will not grow on this soil. The Houston soil appears to be unsuited to alfalfa chiefly because of poor drainage in the winter and early spring. The yields on Sumter show that alfalfa was one of the most productive crops to grow on this soil.

In the experiments on Sumter soil, Table 2, the largest yield, 3 tons, of hay was obtained with 750 pounds of superphosphate and 50 pounds of muriate of potash per acre. The yield with 375 pounds of superphosphate and 50 pounds of muriate of potash was nearly as large as that with 750 pounds of superphosphate and 50 pounds of muriate of potash, thus the increase in yield from the 750-pound application of phosphate over that of the 375 pounds was not sufficient to pay for the cost of the extra phosphate. The increase in yield from 375 pounds of superphosphate and 50 pounds of muriate of potash over that of no fertilizer was 4,390 pounds of hay per acre, and that from 375 pounds of superphosphate was 2,860 pounds. It is evident that phosphate and potash were needed on this soil. **On Sumter soil, alfalfa should be fertilized with 375 pounds of superphosphate and 50 pounds of muriate of potash per acre, or its equivalent, annually. The fertilizer should be applied at the time of planting and each year thereafter it should be applied in the fall.**

Barley.—The results (see Tables 1, 2, 3, and 4) show that barley was not a satisfactory crop on any of the soils tested. **If barley is grown, it should be fertilized with 375 pounds of superphosphate at planting on all of the soils tested. In addi-**

tion to the phosphate, an application of nitrate of soda should be made in the spring on the Vaiden and Sumter soils.

Velvet Beans.—Velvet beans produced a very small yield (386 to 619 pounds) on the Houston and Sumter soils (Tables 1 and 2) but they made an excellent yield (1,003 to 1,896 pounds) on the Eutaw (Table 4). They were planted in corn and greatly reduced the yield of the corn. There was very little increase in the yield from any fertilizer tested on the Houston and Sumter soils. On Eutaw soil phosphate increased the yield. Velvet beans were not grown on Vaiden and Lufkin soils.

As a general rule, velvet beans should not be grown in corn on account of the reduction of the yield of corn, but if velvet beans are grown they should not be fertilized on Sumter and Houston soils. On Eutaw soil they should be fertilized with 375 pounds of superphosphate. It is believed that velvet beans should be fertilized on Vaiden and Lufkin soils as on Eutaw.

Bur, Red, and Sweet Clovers.—Common southern bur clover, red clover, annual yellow sweet clover, and biennial white sweet clover failed in nearly all trials made in the Black Belt regardless of fertilizer treatments. Some of these plants occur naturally in many waste places but they failed when tested under cultivated conditions.

Corn.—Corn produced yields of 30 to 44 bushels on all the five types of soils when it was fertilized properly or grown after a crop of vetch. Without fertilizer or vetch, the yield was very low (11 to 15 bushels) on Sumter, Vaiden, Eutaw, and Lufkin soils, but on Houston soil it was very satisfactory (26 bushels).

The results of fertilizer tests on Houston, Sumter, Vaiden, and Eutaw soils are reported in Tables 1, 2, 3, and 4, respectively. The yields produced by corn which received 225 pounds of nitrate of soda, 375 pounds of superphosphate, and 50 pounds of muriate of potash compared with those produced by corn which received 225 pounds of nitrate of soda and 50 pounds of muriate of potash show that the phosphate increased the yield of corn 12.8 bushels on Sumter, 4.9 bushels on Houston, 11.4 bushels on Eutaw, and 19.1 bushels on Vaiden. Potash was needed on Sumter but not on Eutaw, Vaiden, and Houston. Nitrogen increased the yield sufficiently to return a profit only on the Vaiden and Eutaw soils. Lime was very profitable on the Vaiden and Eutaw soils. Lime increased the yield of corn 6.2 bushels on the Vaiden and 6.5 bushels on the Eutaw. **According to these results, corn should not be fertilized on Houston soil. Corn should be fertilized with 375 pounds of superphos-**

FIGURE 1.—Corn after vetch on Vaiden soil at Black Belt Substation at Marion Junction, Ala. Top, no fertilizer to vetch—yield of green vetch 235 pounds, corn, 9 bushels; bottom, 750 pounds of superphosphate and 50 pounds of muriate of potash per acre to vetch (the soil was limed in 1930). Yield vetch, 4,200 pounds; yield of corn, 49 bushels. Photographed July 11, 1932.

phate and 50 pounds of muriate of potash per acre on Sumter soil. On Vaiden and Eutaw and possibly on Lufkin, corn should be fertilized with 225 pounds of nitrate of soda and 375 pounds of superphosphate per acre. The Eutaw, Lufkin, and Vaiden soils should be limed. When corn is grown after vetch

the application of nitrogen is unnecessary. When fertilizer is used, the phosphate and potash should be applied at planting and the nitrogen as a side dressing when corn is 35 days old.

The fertilizer studies on Lufkin soil were conducted in a four-year rotation and are reported in Table 7 and discussed on Page 16.

Cotton.—The results of fertilizer tests on Houston, Sumter, Vaiden, and Eutaw soils are shown in Tables 1, 2, 3, and 4, respectively. These results show that cotton without fertilizer made a yield of 353 pounds of seed cotton on Houston soil and 181 pounds on Sumter, 292 pounds on Vaiden and 479 pounds on Eutaw. The application of 225 pounds of nitrate of soda, 375 pounds of superphosphate, and 50 pounds of muriate of potash increased the yield 271 pounds on Houston, 328 pounds on Sumter, 441 pounds on Vaiden, and 505 pounds on Eutaw. The lime soils do not appear to be so well suited to cotton as the acid soils.

The largest increase in yield was usually produced from phosphate. The yields produced by cotton fertilized with 225 pounds of nitrate of soda, 375 pounds of superphosphate, and 50 pounds of muriate of potash per acre compared with the yields produced by cotton fertilized with 225 pounds of nitrate of soda and 50 pounds of muriate of potash show that phosphate increased the yield of seed cotton 235 pounds on Houston, 196 pounds on Sumter, 584 pounds on Vaiden, and 533 pounds on Eutaw. A comparison of the yields from 225 pounds of nitrate of soda, 375 pounds of superphosphate, and 50 pounds of muriate of potash per acre with those from 225 pounds of nitrate of soda and 375 pounds of superphosphate show that potash increased the yield 155 pounds on Houston, 307 pounds on Sumter, 103 pounds on Vaiden, and did not increase the yield on Eutaw. Nitrogen and lime were profitable only on Vaiden and Lufkin soils.

Due to the low yields, it is usually recommended that cotton not be grown in the Black Belt especially on the lime soils. If cotton is grown on Houston and Sumter soils, it should be fertilized with 375 pounds of superphosphate and 50 pounds of muriate of potash per acre. On the Vaiden and Lufkin soils it should be fertilized with 225 pounds of nitrate of soda, 375 pounds of superphosphate, and 50 pounds of muriate of potash (600 pounds of a 6-10-4 fertilizer) per acre. On Eutaw soil it should be fertilized with 375 pounds of superphosphate per acre. The Vaiden and Lufkin soils should be limed.

The results on the Lufkin soil were obtained in a four-year rotation and are shown in Table 7 and discussed on Page 16.

Cowpeas.—Usually cowpeas did not make a very large yield in the Black Belt. They frequently shed their leaves and often a disease of the foliage developed which reduced the yield. The results of the fertilizer studies reported in Tables 1, 2, 3, and 4 show that cowpeas on the Sumter soil responded to phosphate and potash and on the Houston, Vaiden, and Eutaw they responded to phosphate. Lime increased the yield 1,540 pounds on the Vaiden and 1,454 pounds on the Eutaw. **Cowpeas should be fertilized with 375 pounds of superphosphate and 50 pounds of muriate of potash per acre on Sumter soil and with 375 pounds of superphosphate on Houston, Eutaw, and Vaiden soils. Vaiden and Eutaw soils should be limed.**

No fertilizer tests have been made on Lufkin but it is believed that cowpeas should be fertilized on Lufkin the same as on Vaiden.

Lespedeza.—Lespedeza failed in all tests made on Houston and Sumter soils. On the Vaiden, Eutaw, and Lufkin soils it made excellent growth. The fertilizer studies reported in Tables 3 and 4 show that lespedeza needed phosphate and lime. **Lespedeza should be fertilized with 375 pounds of superphosphate on Vaiden and Eutaw soils and the land should be limed. No fertilizer tests were made on Lufkin soil but it is believed that lespedeza should be fertilized the same on Lufkin as on Vaiden and Eutaw.**

Black Medic.—This crop succeeded only on the Sumter soil where it made excellent yields. On this soil phosphate and potash produced a large increase in yield. **Black medic should be fertilized with 375 pounds of superphosphate and 50 pounds of muriate of potash per acre on Sumter soil.**

Oats.—On the Houston and Eutaw soils the yield of oats was low (13 to 20 bushels). In the tests there were only two years that oats made a satisfactory crop on these two soils. On the other hand, there was not a failure in the five years of the test on Vaiden and Sumter soils. On the Lufkin soil there were two failures in seven years. From these results, it seems that oats should be planted on the Vaiden and Sumter and possibly on the Lufkin but not on the Houston and Eutaw soils.

The results of the fertilizer experiments on Houston, Sumter, Vaiden, and Eutaw soils are reported in Tables 1, 2, 3, and 4. These results show that phosphate has produced the largest increase in yield. The increased yield from 375 pounds of superphosphate (comparing 225 pounds of nitrate of soda, 375 pounds of superphosphate, and 50 pounds of muriate of potash with 225 pounds of nitrate of soda and 50 pounds of muriate of

FIGURE 2.—Oats on Vaiden soil at Black Belt Substation at Marion Junction, Ala. Top, no fertilizer—yield of oats, 15 bushels; bottom, 225 pounds of nitrate of soda, 750 pounds of superphosphate, and 50 pounds of muriate of potash per acre—yield, 69.4 bushels. Photographed April 21, 1931.

potash) has been 5.7 bushels on the Eutaw, 8.1 bushels on the Houston, 13.4 bushels on the Sumter, and 15.8 bushels on the Vaiden. Potash did not increase the yield in any of the tests. Nitrogen increased the yield on the Vaiden and Sumter soils sufficiently to return a profit. Oats did not respond to an application of lime on the Vaiden and Eutaw soils.

In addition to the tests discussed above, another fertilizer test was conducted on Sumter soil. In this experiment, various sources of nitrogen, time of application of fertilizer, and different ratios were tested. The results are reported in Table 5.

It is seen that oats responded to nitrogen and phosphate. A comparison of the yields on Plots 2 and 7 shows that 225 pounds of nitrate of soda (6 per cent nitrogen in fertilizer)

FIGURE 3.—Oats on Sumter soil at Black Belt Substation at Marion Junction, Ala. Top, no fertilizer—yield 21.4 bushels; bottom, 600 pounds of 6-10-4 fertilizer—yield, 54.4 bushels. Photographed May 13, 1932.

increased the yield 19.2 bushels. The increase was produced at a cost of 20.5 cents per bushel. By comparing the yields of Plots 6 and 7, it is found that the 10 per cent phosphate (375 pounds of superphosphate) increased the yield 22.2 bushels at a fertilizer cost of 12.7 cents per bushel. Potash did not increase the yield.

On this highly calcareous soil nitrate of soda was a better source of nitrogen than sulfate of ammonia or Ammo-Phos.

Much of the nitrogen from sulfate of ammonia is lost as a gas into the air. The fall application of nitrogen was not desirable.

Oats should be fertilized with 375 pounds of superphosphate per acre at planting and top dressed in the spring with 225 pounds of nitrate of soda on the Sumter and Vaiden soils. On the Houston and Eutaw soils 375 pounds of superphosphate should be applied at planting and no top dressing given in the spring.

The fertilizer studies with oats on the Lufkin soil were conducted in a four-year rotation and are reported in Table 7 and discussed on Page 16. **It is believed that if oats are not grown in a rotation they should be fertilized on Lufkin soil as on Vaiden.**

Pasture Plants.—Dallis grass produced excellent sods on all the soil types. It responded to an application of phosphate and nitrogen on the Houston and Sumter and to phosphate, nitrogen, and lime on the Eutaw, Vaiden, and Lufkin soils. Dallis grass is well suited to these soils and is the basic pasture grass for use on them.

Kentucky bluegrass was tested for only a few years but the results indicate that it might be grown on the Houston and Sumter soils if phosphate is used. It did not succeed on the Vaiden and Eutaw soils. **It should be fertilized with 375 pounds of superphosphate per acre.**

White Dutch clover made excellent growth on the Houston soils but it did not succeed on the Sumter, Vaiden, and Eutaw. **On the Houston soil it should be fertilized with 375 pounds of superphosphate per acre.**

Black medic made excellent growth on the Sumter soils but did not succeed on the Houston, Eutaw, and Vaiden. Apparently, it is suited to the well-drained lime soils but not to the poorly drained lime soils or to the acid soils. **It should be fertilized with 375 pounds of superphosphate and 50 pounds of muriate of potash per acre on the Sumter soil.**

Lespedeza grew well on the Eutaw, Lufkin, and Vaiden soils but it failed on the Sumter and Houston soils. It is adapted for use on the acid soils but not on the lime soils. **It should be fertilized with 375 pounds of superphosphate per acre and the soil should be limed.**

Orchard grass failed on the lime soils (Houston and Sumter), but it made satisfactory growth on the acid soils where the land was well drained. **It should be fertilized with 375 pounds of superphosphate per acre on the Vaiden soil.**

Austrian Winter Peas.—Austrian winter peas were practically a failure on the Houston and Eutaw soils each year they were tested. On the Vaiden and Sumter they produced a satisfactory crop four years out of six. Austrian winter peas should be planted only on well-drained areas. **When Austrian winter peas are grown they should be fertilized with 375 pounds of superphosphate and 50 pounds of muriate of potash on Sumter and with 375 pounds of superphosphate on Eutaw, Vaiden, Lufkin, and Houston. The Vaiden, Eutaw, and Lufkin soils should be limed.**

Peanuts.—Peanuts made very high yields in the tests on Vaiden, Eutaw, and Lufkin soils (Tables 3, 4, and 6). They were grown for only one year (1936) on the Houston soil (Table 1) and were not grown on the Sumter. The yield for one year on the Houston was 1,531 to 2,187 pounds per acre. Peanuts appeared to be an excellent crop to grow on all of the soils of the Black Belt. They have produced very good yields in all tests made. On the Houston soil the largest increase in yield was produced from phosphate, and on Vaiden and Eutaw the largest increase was from phosphate and lime. Potash did not increase the yield on Vaiden and Eutaw.

Peanuts should be fertilized with 375 pounds of superphosphate on Houston soil. The Vaiden, Eutaw, and Lufkin soils should be limed and fertilized with 375 pounds of superphosphate.

Sagrain.—This crop, which is a grain sorghum, did not produce so large a yield of grain as did corn. Therefore, for grain it is preferable to grow corn. The results obtained with Houston, Sumter, Vaiden, and Eutaw soils are reported in Tables 1, 2, 3, and 4. On all of the soils the chief need was phosphorus. Potash was needed on the Houston and Sumter but it was not needed on the Vaiden and Eutaw. Nitrogen increased the yield sufficiently to pay only on the Vaiden soil. Lime was not profitable. **Sagrain should be fertilized with 375 pounds of superphosphate on all of the soils at the time of planting. Fifty pounds of muriate of potash should also be added on Houston and Sumter soils. On Vaiden and Lufkin soils, 225 pounds of nitrate of soda should be applied as a side dressing.**

Sorghum.—The results of fertilizer experiments on Sumter, Houston, Vaiden, and Eutaw soils are reported in Tables 1, 2, 3, and 4. It should be noted that sorghum made an excellent yield on all these soils.

The largest increase in yield was obtained from the use of phosphate. By comparing the yield from 225 pounds of nitrate

FIGURE 4.—Peanuts on Vaiden soil at Black Belt Substation at Marion Junction, Ala. Top, no fertilizer—yield 42 bushels; bottom, 750 pounds of superphosphate and 50 pounds of muriate of potash per acre (the soil was limed in 1930)—yield 88 bushels. Photographed July 11, 1932.

of soda, 375 pounds of superphosphate, and 50 pounds of muriate of potash with that from 225 pounds of nitrate of soda and 50 pounds of muriate of potash, it is seen that 375 pounds of superphosphate increased the yield $3\frac{3}{4}$ tons on Houston and Sumter soils, 5 tons on Vaiden, and $6\frac{1}{2}$ tons on Eutaw. These increased yields were very profitable. The 750-pound application of superphosphate did not produce a large enough increase in yield over the 375-pound application to pay for the extra phosphate.

The returns from an application of 50 pounds of muriate of potash were profitable. The increase in yield due to potash was ¾ of a ton on Eutaw, 1½ tons on Vaiden, 1 ton on Houston, and 1½ tons on Sumter.

Nitrogen did not increase the yield sufficiently to return a profit on Houston and Sumter. The increased yield from 225 pounds of nitrate of soda was 3½ tons on Vaiden and 4 tons on Eutaw.

On the acid soil, Vaiden, lime at the rate of 2 tons per acre applied in 1930 increased the yield 1,325 pounds of green sorghum per acre annually over a period of six years.

Sorghum should be fertilized with 375 pounds of superphosphate and 50 pounds of muriate of potash at planting on Sumter, Houston, Vaiden, and Eutaw soils. On Vaiden and Eutaw soils, in addition to the fertilizer applied at planting, sorghum should be side dressed with 225 pounds of nitrate of soda per acre. The Vaiden and Eutaw soils should be limed.

No fertilizer experiments were conducted on Lufkin soil. From the results in Table 6, it is evident that sorghum will make a large yield on Lufkin soil. In this experiment the sorghum received 600 pounds of a 6-10-4 fertilizer per acre. **It is believed that sorghum should be fertilized on Lufkin soil in the same manner as is recommended for Vaiden and Eutaw soils.**

Soybeans.—The results (Tables 1, 2, 3, and 4) show that soybeans were an excellent crop to grow on any of the soils. The yields were lowest on Sumter soil (1,600 to 3,000 pounds). Phosphorus has been the most needed element in most cases. It may be seen by comparing the yields from 375 pounds of superphosphate and 50 pounds of muriate of potash with those from 50 pounds of muriate of potash that the increase in yield from an application of 375 pounds of superphosphate was 1,482 pounds of hay on Houston soil, 1,205 pounds on Sumter, 972 pounds on Vaiden, and 1,690 pounds on Eutaw. It was not profitable to double the rate of phosphate. The increase in yield from potash was 210 pounds on Houston, 486 pounds on Sumter, 83 pounds on Eutaw, and 0 on Vaiden. An application of 2 tons of lime in 1930 increased the yield 862 pounds of hay on Eutaw and 1,415 pounds on Vaiden per acre annually over a period of four to six years.

Soybeans should be fertilized with 375 pounds of superphosphate and 50 pounds of muriate of potash per acre on Sumter

soils. On Vaiden, Eutaw, Houston, and Lufkin soils, they should be fertilized with 375 pounds of superphosphate. The Vaiden, Eutaw, and Lufkin soils should be limed.

Hairy Vetch.—Hairy vetch grew very poorly except where it was properly fertilized. Under good fertilizer treatment, it did not always succeed. Usually vetch did not make sufficient growth to be turned under until late in the spring. It responded to phosphate on all of the soils and to potash on Sumter, and to lime on Vaiden, Eutaw, and Lufkin. Without lime on Vaiden and Eutaw, it did not make a growth large enough to justify growing the crop.

If vetch is grown it should be fertilized with 375 pounds of superphosphate and 50 pounds of muriate of potash on Sumter and 375 pounds of superphosphate on the other soils. The Vaiden, Eutaw, and Lufkin soils should be limed.

THE EFFECT OF FERTILIZERS AND VETCH ON YIELDS OF CROPS IN A FOUR-YEAR ROTATION ON LUFKIN SOIL

This experiment was conducted on the Gastonburg Field on Lufkin clay soil. A four-year rotation of cotton, oats followed by soybeans, vetch followed by corn, and soybean hay in the order named was used. The fertilizer treatments and seven-year average yields of crops are shown in Table 7.

It may be noted (comparing Plots 5 and 6) that where 300 pounds of nitrate of soda, 600 pounds of superphosphate, and 75 pounds of muriate of potash per acre were used in the four years the yield was increased by 367 pounds of seed cotton, 15.5 bushels of oats, 3,961 pounds of green vetch, 10.8 bushels of corn, and 445 pounds of soybean hay. When the phosphorus fertilization was doubled (comparing Plots 9 and 10), the yield per acre was increased by 398 pounds of seed cotton, 14.2 bushels of oats, 7,425 pounds of green vetch, 14.4 bushels of corn, and 615 pounds of soybean hay. When the phosphate was doubled and the soil was limed (comparing Plots 12 and 13), the yield per acre was increased by 767 pounds of seed cotton, 12.3 bushels of oats, 8,848 pounds of green vetch, 17.6 bushels of corn, and 1,819 pounds of soybean hay.

The value of vetch may be determined by comparing the yields of Plots 10 and 15. The results show that omitting the vetch crop decreased the cotton yield approximately 100 pounds of seed cotton and the corn yield approximately 14 bushels. The yields of the other crops were not affected. In this experiment the vetch failed only one year out of seven on the limed plots.

FIGURE 5.—Vetch on Vaiden soil at Black Belt Substation at Marion Junction, Ala. Top, no fertilizer—yield 950 pounds of green vetch; bottom, 750 pounds of superphosphate and 50 pounds of muriate of potash per acre (the soil was limed in 1930)—yield 11,834 pounds of green vetch. Photographed April 21, 1931.

The results show that it is possible to make satisfactory yields of crops on this soil when proper fertilization is practiced. **With this rotation, which was designed to make use of several feed crops as well as cotton, the land should be limed and phosphate should be used on all crops. The cotton should receive a complete fertilizer, such as a 6-10-4, and the corn and oats should receive nitrogen in addition to phosphate. In this rotation corn received nitrogen from the vetch. If vetch is not used, corn should be side dressed with a nitrogen fertilizer. Vetch and soybeans should be fertilized with 200-400 pounds of superphosphate per acre.**

TIME OF PLANTING SUMMER CROPS

This test was conducted on the Gastonburg Field on Lufkin clay soil. The results are reported in Table 6. It may be noted that the April planting always made larger yields than the June planting. Early planting was very essential for soybeans, sweet potatoes, peanuts, and late Crotalaria spectabilis. Cowpeas, Sudan grass, sagrain, sorghum, early Crotalaria spectabilis, and Sesbania made nearly normal yields when planted late. **It is recommended that summer crops be planted as early as possible on the Black Belt soils.**

SUMMARY

The results of fertilizer experiments on Houston, Sumter, Vaiden, Eutaw, and Lufkin soils with alfalfa, barley, velvet beans, bur clover, red clover, white clover, sweet clover, corn, cotton, cowpeas, Dallis grass, Kentucky bluegrass, orchard grass, lespedeza, black medic, oats, Austrian winter peas, peanuts, sagrain, sorghum, soybeans, and hairy vetch are discussed. Results from experiments with time of planting some of the summer crops are also given.

The crops that were more generally suited to all types of soils were corn, peanuts, soybeans, sorghum, and Dallis grass. These crops appear to be especially well adapted to the conditions in the Black Belt.

On the Sumter soil, oats and alfalfa produced excellent yields when properly fertilized.

On the Vaiden soil, oats yielded well.

On the acid soils, Vaiden, Eutaw, and Lufkin, lespedeza produced excellent crops.

Phosphate was needed on all the soil types for most of the crops tested. Phosphorus should be the most important element of any fertilizer for crops of the Black Belt. There was a need for potash on the Sumter soil for most crops. Potash was not needed on the other soil types except for cotton and sorghum.

Lime was needed on all of the acid soils, Vaiden, Eutaw, and Lufkin, for nearly all crops. The increase in yield from lime was especially large when legumes were grown.

Applications of nitrogen fertilizers increased the yields of non-legumes on all soils. The returns from nitrogen were not profitable except with oats on Sumter, sorghum and corn on Eutaw, and all non-legumes on the Vaiden and Lufkin.

Early planting of the summer crops was very desirable.

TABLE 1.—The Yields of Crops Produced on Houston Clay Soil When Various Fertilizers Were Used at the Rate per Acre Shown.

Fertilizer treatment, Pounds per acre: Nitrate of soda	Superphosphate	Muriate of potash	Yield per Acre							
			Non-Legumes							
			5-yr. ave. 1932-1936 Sorghum (Green wt.)	4-yr. ave. 1932-1935 Sagrain	5-yr. ave. 1932-1936 Oats	4-yr. ave. 1932-1935 Barley	3-yr. ave. 1932-1934 Corn	3-yr. ave. 1933, 1934, and 1936 Corn interplanted with velvet beans	4-yr. ave. 1932-1935 Corn after vetch[1]	5-yr. ave. 1932-1936 Cotton
			Lbs.	*Bus.*	*Bus.*	*Bus.*	*Bus.*	*Bus.*	*Bus.*	*Lbs.*
	None[2]		27,649	16.9	12.0	5.5	26.1	12.6	22.5	353
0	375	50	33,597	25.7	17.0	8.2	33.8	16.9	34.5	571
225	0	50	28,116	19.3	13.2	6.6	30.6	14.1	20.1	389
225	375	0	34,242	26.6	21.0	12.0	34.1	19.0	33.6	469
225	375	50	35,799	32.7	21.3	12.9	35.5	19.2	34.9	624
225	750	50	41,778	35.4	21.5	11.0	39.5	23.7	36.6	669
			Legumes							
			5-yr. ave. 1932-1936 Alfalfa hay	5-yr. ave. 1932-1936 Soybean hay	1-yr. ave. 1933 Cowpea hay	3-yr. ave. 1933, 1934, and 1936 Velvet bean seed	1-yr. ave. 1936 Peanuts	5-yr. ave. 1932-1936 Vetch (Green wt.)	5-yr. ave. 1932-1936 Austrian winter peas (Green wt.)	5-yr. ave. 1932-1936 Black medic (Green wt.)
			Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
	None[2]		537	2,914	1,005	534	1,531	1,411	529	427
0	0	50	607	2,551	795	585	1,844	1,155	311	304
0	375	0	1,093	3,823	1,335	452	2,012	4,926	1,794	998
0	375	50[2]	1,248	4,033	1,770	619	2,187	5,057	645	1,282
0	750	50	1,348	4,271	2,085	432	1,965	5,754	578	2,292

[1]No fertilizer was applied to the corn following vetch.
[2]Yields given are the average of two plots.

TABLE 2.—The Yields of Crops Produced on Sumter Clay Soil When Various Fertilizers Were Used at the Rate per Acre Shown.

Yield per Acre — Non-Legumes

Fertilizer treatment, *Pounds per acre*: Nitrate of soda	Super-phos-phate	Muriate of potash	6-yr. ave. 1931-1936 Sorghum (Green wt.)	5-yr. ave. 1931-1935 Sagrain	6-yr. ave. 1931-1936 Oats	4-yr. ave. 1931-1935 Barley	4-yr. ave. 1931, 1933-1935 Corn	2-yr. ave. 1934-1936 Corn inter-planted with velvet beans	5-yr. ave. 1931, 1933-1936 Corn after vetch[1]	5-yr. ave. 1931, 1933-1936 Cotton
			Lbs.	*Bus.*	*Bus.*	*Bus.*	*Bus.*	*Bus.*	*Bus.*	*Lbs.*
	None[2]		15,787	8.2	13.3	6.4	13.7	8.8	12.6	181
0	375	50	24,030	20.9	20.4	8.1	24.7	15.3	26.1	468
225	0	50	17,692	9.7	16.4	7.7	15.7	9.3	14.7	313
225	375	0	21,342	17.0	33.1	11.5	23.3	14.3	23.7	202
225	375	50	25,267	22.7	29.8	11.6	28.5	14.4	28.0	509
225	750	50	27,298	22.9	30.2	11.9	30.0	15.9	28.9	549

Yield per Acre — Legumes

Nitrate of soda	Super-phos-phate	Muriate of potash	6-yr. ave. 1931-1936 Alfalfa hay	5-yr. ave. 1931, 1933-1936 Soybean hay	2-yr. ave. 1933 and 1936 Cowpea hay	2-yr. ave. 1934 and 1936 Velvet bean seed	6-yr. ave. 1931-1936 Vetch (Green wt.)	6-yr. ave. 1931-1936 Austrian winter peas (Green wt.)	4-yr. ave. 1931-1933 and 1936 Black medic (Green wt.)
			Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
	None[2]		1,384	1,682	812	386	1,302	1,604	605
0	0	50	1,669	1,852	1,043	462	1,332	1,834	886
0	375	0	4,244	2,571	1,756	412	5,850	5,243	4,088
0	375	50[2]	5,774	3,057	2,688	552	8,611	7,241	5,393
0	750	50	6,150	3,125	2,588	532	9,542	6,504	5,662

[1]No fertilizer was applied to the corn following vetch.
[2]The yields given are the average of two plots.

TABLE 3.—The Yields of Crops Produced on Vaiden Clay Soil When Various Fertilizers Were Used at the Rate per Acre Shown.

Yield per Acre — Non-Legumes

Nitrate of Soda (Fertilizer treatment, *Pounds per acre*)	Super-phosphate	Muriate of potash	1-yr. ave. 1936 Orchard grass (Green wt.)	6-yr. ave. 1931-1936 Sorghum (Green wt.)	3-yr. ave. 1931-1933 Sagrain	6-yr. ave. 1931-1936 Oats	4-yr. ave. 1932-1935 Barley	4-yr. ave. 1932-1935 Corn	4-yr. ave. 1932-1933, 1935-1936 Dallis grass (Green wt.)	5-yr. ave. 1931-1935 Corn after vetch[1]	6-yr. ave. 1931-1936 Cotton
			Lbs.	*Lbs.*	*Bus.*	*Bus.*	*Bus.*	*Bus.*	*Lbs.*	*Bus.*	*Lbs.*
	None[2]		1,008	10,112	11.2	7.8	2.1	11.5	3,430	7.4	292
0	375	50	2,503	14,903	16.9	12.2	2.2	23.4	3,518	22.4	549
225	0	50	1,348	11,678	8.5	9.5	1.3	10.0	5,649	5.6	149
225	375	0	6,195	18,718	25.5	29.0	5.6	27.6	7,095	20.5	630
225	375	50	6,455	21,893	24.1	25.3	6.8	29.1	7,387	21.7	733
225	750	50	5,888	22,770	25.8	29.4	8.2	28.7	7,812	20.5	830
225	750	50 L[3]	5,418	24,095	18.7	28.8	11.6	34.9	9,291	36.8	934

Yield per Acre — Legumes

Nitrate of Soda	Super-phosphate	Muriate of potash	6-yr. ave. 1931-1936 Soybean hay	5-yr. ave 1931-1934 and 1936 Cowpea hay	3-yr. ave. 1931-1933 Sesbania (Green wt.)	6-yr. ave 1931-1936 Peanuts	6-yr. ave. 1931-1936 Vetch (Green wt.)	6-yr. ave. 1931-1936 Austrian winter peas (Green wt.)	4-yr. ave. 1933-1936 Common lespedeza (Green wt.)	2-yr. ave. 1935-1936 Tennessee 76 lespedeza (Green wt.)	4-yr. ave. 1933-1936 Kobe lespedeza (Green wt.)	4-yr. ave. 1933-1936 Korean lespedeza (Green wt.)
			Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
	None[2]		1,810	1,436	7,072	1,276	397	345	3,733	3,718	3,127	952
0	0	50	1,861	1,250	6,210	1,305	472	304	3,306	2,658	2,797	1,062
0	375	0	3,079	1,887	9,795	1,621	1,948	3,109	6,156	6,926	6,031	2,890
0	375	50[2]	2,833	1,805	9,735	1,504	1,767	1,601	6,336	7,185	6,004	2,035
0	750	50	2,727	1,973	13,650	1,478	2,008	1,291	7,322	8,618	7,005	3,676
0	750	50 L[3]	4,142	3,513	15,735	1,960	8,136	5,772	6,394	7,826	7,503	4,640

[1]No fertilizer was applied to the corn following vetch.
[2]The yields given are the average of two plots.
[3]Two tons per acre of ground limestone was applied in 1930; none since that date.

TABLE 4.—The Yields of Crops Produced on Eutaw Clay Soil When Various Fertilizers Were Used at the Rate per Acre Shown.

Fertilizer treatment, Pounds per acre			Yield per Acre: Non-Legumes								
Nitrate of soda	Super-phos-phate	Muriate of potash	4-yr. ave. 1933-1936 Sorghum (Green wt.)	3-yr. ave. 1933-1935 Sagrain	4-yr. ave. 1933-1936 Oats	3-yr. ave. 1933-1935 Barley	4-yr. ave. 1933-1936 Corn	4-yr. ave. 1933-1936 Cotton	3-yr. ave. 1933-1935 Corn after vetch[1]	2-yr. ave. 1934 and 1936 Corn inter-planted with vel-vet beans	4-yr. ave. 1933-1936 Dallis grass (Green wt.)
			Lbs.	*Bus.*	*Bus.*	*Bus.*	*Bus.*	*Lbs.*	*Bus.*	*Bus.*	*Lbs.*
	None[2]		20,813	10.4	9.1	2.2	15.2	479	15.1	3.4	3,568
0	375	50	27,109	23.9	18.8	5.9	21.2	958	26.7	8.2	5,389
225	0	50	21,994	8.8	13.7	1.5	16.0	451	12.4	2.5	6,810
225	375	0	33,391	24.8	20.6	5.3	30.7	1,038	25.8	7.8	8,820
225	375	50	35,034	23.3	19.4	6.0	27.4	984	29.5	7.0	9,414
225	750	50	34,714	25.4	22.4	7.9	28.3	1,282	34.0	9.8	8,959
225	750	50 L[3]	34,440	26.5	20.6	5.3	34.8	1,218	43.7	8.9	11,055

Fertilizer treatment, Pounds per acre			Yield per Acre: Legumes							
Nitrate of soda	Super-phos-phate	Muriate of potash	4-yr. ave. 1933-1936 Soybean hay	2-yr. ave. 1933 & 1936 Cowpea hay	5-yr. ave. 1932-1936 Vetch (Green wt.)	5-yr. ave. 1932-1936 Austrian winter peas (Green wt.)	4-yr. ave. 1933-1936 Kobe lespedeza (Green wt.)	4-yr. ave. 1933-1936 Common lespedeza (Green wt.)	3-yr. ave. 1933-1934 and 1936 Peanuts	2-yr. ave. 1933 & 1936 Velvet bean seed
			Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
	None[2]		1,910	1,204	419	216	4,669	5,628	1,463	1,115
0	0	50	2,021	1,117	308	166	4,182	5,427	1,543	1,003
0	375	0	3,628	2,955	3,547	1,219	8,264	10,077	2,078	1,469
0	375	50[4]	3,711	2,910	3,021	905	9,073	10,754	1,953	1,546
0	750	50	3,942	3,113	4,590	1,495	10,063	11,446	1,753	1,797
0	750	50 L[3]	4,804	4,567	6,777	1,259	10,377	12,855	2,010	1,896

[1]No fertilizer was applied to the corn following vetch.
[2]The yields given are the average of two plots.
[3]Two tons per acre of ground limestone was applied in 1931; none since that date.
[4]The yields given are the average of three plots.

TABLE 5.—Yields of Oats Produced with Fertilizers of Different Analysis, with Various Sources of Nitrogen, and with Fertilizers Applied[1] at Different Times on Sumter Clay Soil.

Plot	Fertilizer treatment Basis—600 Lbs. per A.	Source of nitrogen	Yield per Acre *Bushels*					5-year average	Increase over no fertilizer
			1932	1933	1934	1935	1936		
1	0	—	21.4	6.9	28.6	10.8	38.0	21.1	—
2	0-10-4	Ammonium sulfate	25.9	19.9	37.6	21.1	61.4	33.2	12.1
3	3-10-4	Ammonium sulfate	38.0	23.6	45.9	24.3	71.3	40.6	19.5
4	6-10-4	Ammonium sulfate	44.3	30.1	51.7	27.6	74.1	45.6	24.5
5	6-10-0	Ammonium sulfate	51.1	24.5	52.6	29.1	77.0	46.9	25.8
6	6- 0-4	Ammonium sulfate	29.5	18.4	31.1	25.0	47.1	30.2	9.1
7	6-10-4	Nitrate of soda	54.4	38.3	54.1	37.0	78.3	52.4	31.3
8	6-10-4[2]	Ammo-Phos	35.7	24.7	52.3	29.6	68.2	42.1	21.0
9	6-10-4[3]	Ammo-Phos	41.0	20.5	44.7	25.4	66.9	39.7	18.6
10	6-10-4[4]	Ammonium sulfate	43.1	19.8	50.0	21.3	67.9	40.4	19.3

[1]Phosphate and potash applied at planting, nitrogen applied in spring as top dressing except as shown.
[2]Nitrogen from Ammo-Phos as top dressing.
[3]Nitrogen from Ammo-Phos at planting.
[4]All fertilizer applied at planting.

TABLE 6.—The Four-Year Average Yield of Various Summer Crops When Planted at Different Dates[1] on Lufkin Clay Soil (1932-1935).

Crop	Average yield per acre			
	April planting		June planting	
	Hay	Seed	Hay	Seed
	Lbs.	*Bus.*	*Lbs.*	*Bus.*
Otootan soybeans[5]	4,187	3.8[2]	2,597	3.7[2]
Laredo soybeans[5]	2,589	4.6	1,737	5.5
Cowpeas[5]	1,696	2.3	1,516	—
Sudan grass[6]	3,644	—	3,110	—
Texas seeded cane[6]	34,763[3]	—	31,691[3]	—
Sagrain[6]	23,265[3]	—	19,688[3]	—
Sweet potatoes[6]	——	305.0	——	160.0
Spanish peanuts[5]	——	58.3	——	44.0
Alabama runner peanuts[5]	——	47.6	——	35.3
Crotalaria spectabilis[5] (Late)	33,998[3]	13.2	16,680[3]	3.5
Crotalaria spectabilis[5] (Early)	19,210[3 4]	16.1	18,450[3 4]	15.0
Sesbania[5]	8,685	5.5	7,800	2.8

[1]April planting about April 20 and June planting about June 5.
[2]No seed mature in 1933 and 1934.
[3]Green weight.
[4]Average 2 years—1934 and 1935.
[5]Fertilized with 600 pounds per acre of a 1.5-10-4 fertilizer.
[6]Fertilized with 600 pounds per acre of a 6-10-4 fertilizer.

TABLE 7.—Seven-Year Average (1930-1936) Yield of Various Crops Grown in a Four-Year Rotation on Lufkin Clay Soil with Different Fertilizer Treatments.

Plot No.	Fertilizer treatment*	Yield per Acre					
		Seed cotton	Oats[1]	Summer legume hay after oats[2]	Winter legume preceding corn (Green wt.)	Corn[3]	Soybean hay
		Lbs.	*Bus.*	*Lbs.*	*Lbs.*	*Bus.*	*Lbs.*
1	None	310	10.4	1,375	1,356	11.8	2,625
2	N P	689	26.6	1,523	4,804	20.4	3,060
3	N K	411	22.5	1,544	1,633	14.4	3,048
4	P K	708	11.2	1,564	5,619	22.5	3,423
5	None	467	11.6	2,129	2,021	14.4	3,346
6	N P K	834	27.1	1,814	5,982	25.2	3,791
7	N P 2K	869	24.5	1,802	6,038	25.1	3,718
8	N 2P 2K	1,010	23.1	1,951	9,620	29.6	4,299
9	None	607	11.6	1,975	2,729	17.3	3,706
10	N 2P K	1,005	25.8	2,107	10,154	31.7	4,321
11	N 4P K	1,124	26.0	2,165	12,121	33.4	4,487
12	N 2P K L	1,251	23.5	2,341	11,054	33.6	4,918
13	None	484	11.2	1,560	2,206	16.0	3,099
14	N 2P K[4]	980	—	1,980	7,514	32.9	3,626
15	N 2P K[4]	901	24.7	2,062	——	17.8	3,486
16	N 2P K[4]	960	24.4	1,823	——	15.7	3,425
17	None	392	11.1	1,540	1,600	12.9	2,897
Ave.	Check plots	452	11.2	1,716	1,982	14.5	3,135

[1]Seven-year average of 5 crops—winter killed 1929-30 and 1932-33.
[2]Cowpeas in 1932 and 1934; soybeans all other years.
[3]Seven-year average of 6 crops—failure 1930, due to drought.
[4]No oats are planted on Plot 14 and no winter legume on Plots 15 and 16.
*N = 300 lbs. sodium nitrate; P = 600 lbs. superphosphate; K = 75 lbs. muriate of potash per rotation; and L = 4000 lbs. oyster shell dust—applied when experiment was started. Excepting Plots 14, 15, and 16, the fertilizers are applied as follows: ⅓ nitrogen to cotton, ⅔ to oats; ⅓ phosphorus and potash to cotton, ⅔ to winter legume. Plot 14 gets ½ nitrogen to cotton, ½ to corn; ⅓ phosphorus and potash to cotton, ⅔ to winter legume. Plot 15 gets ⅓ nitrogen to cotton, ⅔ to oats; ⅓ phosphorus and potash to cotton, ⅓ to summer legumes after oats, ⅓ to soybeans. Plot 16 gets ⅓ nitrogen to cotton, ⅔ to oats, ⅔ phosphorus and potash to cotton, ⅓ to soybeans.