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ALABAMA

# Agricultural Experiment Station

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## Alabama Polytechnic Institute

AUBURN

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# Soy Beans in Alabama

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By
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# SOY BEANS IN ALABAMA

By E. F. Cauthen

Summary

The soy bean is a leguminous crop that is well adapted to many parts of Alabama.

In a fertilizer test on sandy land, for the production of hay, acid phosphate applied at the rate of 240 pounds per acre gave an average increase in yield of 504 pounds, and kainit applied at the same rate gave no increase. When 48 pounds of nitrate of soda was added to 240 pounds of acid phosphate and 240 pounds of kainit, neither the nitrate of soda nor kainit gave any increase in yield of hay.

In the production of grain neither acid phosphate, potash, nor nitrate of soda gave appreciable increases. On poor soil cotton seed meal gave sufficient increase to justify its use. Lime gave some increase.

In a comparison of acid phosphate and raw phosphate on seed production, the gain from the use of 320 pounds of acid phosphate per acre was .5 bushel, and from the use of 320 pounds of rock phosphate was 1.2 bushels. When similar amounts of acid phosphate and rock phosphate were used for hay production, the gain from the acid phosphate was 323 pounds of hay per acre and from the rock phosphate 243 pounds.

Experiments with disinfected seed planted on soil where soy beans had not been grown for many years and where beans had never been grown gave some inoculated plants. When disinfected seed were planted on land well supplied with barnyard manure, the plants bore many nodules the first year.

The largest yield of seed and straw came from drilling five pecks per acre. The yield of grain from three pecks was nearly as great as from five pecks. The plants of the Mammoth Yellow variety in thick seeded plots stood up better than those of the thin seeded plots.

Variety tests conducted for the past 11 years show that Blackbeauty stood at the head in seed production three years; Haberlandt two years; Mammoth Yellow, Sherwood, Tokyo, Hollybrook, and Biloxi one year each. During this 11 year period the four most pro-

ductive varieties of each year included Mammoth Yellow seven times; Blackbeauty and Hollybrook each five times; Edward, Haberlandt, Ebony, and Wilson each three times; Baird, Acme, Shanghai, and Swan each two times; Flat King, Peking, Sherwood, Virginia, Biloxi, and Otootan each one time.

The varieties leading in production of seed have coarse, erect stems and require from 115 to 135 days to mature seed. The early varieties never ranked high in seed or hay production.

The percentage of straw to grain differs with different varieties. Blackbeauty averaged 42 per cent of grain; Hollybrook, 40 per cent; Ebony, 38 per cent; Mammoth Yellow, 34 per cent; Biloxi, 29 per cent; Otootan, 26 per cent, and Barchet, only 18 per cent.

In 1917 in co-operation with the U. S. Department of Agriculture, 41 varieties and strains were grown,—28 of which yielded 50 per cent less grain than Mammoth Yellow, and none of which equalled it. The varieties differed widely in per cent of fat and protein—there being 10 per cent between the highest and lowest yielding varieties.

Soy beans make excellent hay and are easily cured. In a test of 10 varieties the average yield of hay ranged from 2332 pounds per acre to 5658 pounds. They required from 85 to 112 days from date of planting to date of mowing. The late varieties made the largest tonnage.

Mammoth Yellow and Biloxi are erect and make a somewhat woody hay. Some of the varieties like Ebony, Hollybrook, Wilson, and Otootan have an abundance of leaves and produce a good quality of hay.

The rate of seeding for hay of the Mammoth Yellow variety giving the largest tonnage was 45 pounds per acre drilled in 2½ foot rows. The thicker seeding gave a better quality of hay, having less coarse, woody stems.

Soy beans and cowpeas mixed at the rate of five pecks each and seeded broadcast produced an average of about 1¼ tons of excellent hay. The amount of hay was not greatly increased by combining the two legumes, though its quality and ease of curing were increased. When the rate of seeding was reduced from five pecks to 48 pounds per acre and sown broadcast, the yield was not reduced; but when the soy beans were seeded alone at the rate of 64 pounds per acre, the

yield of hay was about half that from the cowpeas when seeded alone.

The soy bean as a soil improving crop is shown by comparing the fertilizing effect of soy beans, cowpeas and corn on a following cotton crop. The average yield of seed cotton following corn was 1141 pounds; following cowpeas 1426 pounds; and following soy beans 1459 pounds. The increase due to the fertilizing effect of the cowpeas was 285 pounds seed cotton, and of the soy beans 318 pounds. If the value of the seed cotton is reckoned at 4 cents per pound, the fertilizing effect of the cowpeas would be $11.40 per acre; and of the soy beans $12.72.

The fertilizing effect of soy beans on a following hay crop is shown when a comparison is made of the yields of hay grown on corn lands, cowpea land and soy bean land. The average yields of hay made from a mixture of Red Rust Proof oats and Crimson Clover, from Blue Stem Wheat and Crimson Clover, and from Crimson Clover alone was 4249 pounds per acre when they followed soy beans; 4268 pounds per acre when they followed cowpeas; and only 3391 pounds after corn. The increase due to the fertilizing effect of soy beans was 858 pounds of hay, and of cowpeas 877 pounds. If the value of the hay is reckoned at $15 a ton, the fertilizing effect of the soy beans over the corn was $6.43 per acre, and of the cowpeas over the corn was $6.56.

In a comparison the fertilizing effect of a crop of corn and of soy beans on a following winter oat crop the increased yield of the soy bean land over corn land was 173 per cent.

The comparative average yield of corn, cowpea and soy bean grain based on an eight year period was 1677 pounds of corn, 611 pounds of cowpeas, and 721 pounds of soy beans.

The most common enemies to the soy bean are rabbits, nematodes, wilt, and root-rot.

A brief description of leading varieties is given.

# SOY BEANS IN ALABAMA

## Introduction

The soy bean, sometimes called "soya" or "soja" bean, is becoming an important crop in Alabama. It has been grown mostly in small patches; but since many farmers have become acquainted with its merits, it is becoming a field crop, and its acreage is rapidly increasing.

The increasing interest in soy beans is due largely to a changed system of cotton farming made necessary by the invasion of the boll weevil, and to the discovery of many uses for the bean and its products. In looking for crops that can partly take the place of cotton, the farmer has found that the soy bean and the peanut fills the place to a considerable extent.

The livestock farmer and feeder desires crops that can to some extent take the place of corn and expensive mill feeds. The soy bean and its products are meeting those needs. The bean is being used also for human food.

These, with other uses, have caused the price of the bean to advance in the past three years over 100 per cent. It seems safe to predict that the price will continue to be profitable, and that the growing of soy beans in those sections where they are well adapted will eventually become a prominent part of Alabama's cropping system.

## Climate and Soil Requirements

The soy bean is adapted to the soil and climatic conditions of Alabama. Any land that will grow good crops of corn and cotton will produce good crops of soy beans, but poor soil will not produce a profitable yield. The best soil is a clay loam or clay, well supplied with humus.

Soy beans resist drought and excessive rain better than corn. On heavy land they make a better crop than either cowpeas or peanuts.

For the Coastal Plain section of the State the peanut is probably a better paying crop than the soy bean, but for the Black Belt, Piedmont and Tennessee Valley sections the soy bean is probably a more profitable crop. The Mammoth Yellow variety does well in all these sections where the soil is not too poor. In extremely fertile valleys the plants grow large and do not yield seed in proportion to size of plants.

## Fertilizers for Soy Beans

In 1904 and 1906 fertilizer tests were made by Professor J. F. Duggar on sandy loam to determine the value of phosphoric acid, potash, and nitrogen on soy beans. The 1904 test followed an experiment in crimson clover which failed. The 1906 test (A) followed crimson clover cut for hay, and test (B) followed a crop of peanuts. The beans were planted about May 20, and mowed for hay about September 10.

Table I.—*Fertilizer Test for Hay*

*Yield of Soy Bean Hay When the Following Fertilizer Was Used Per Acre.*

| YEARS | 240 lbs. Acid Phosphate | 240 lbs. Kainit | 240 lbs. Acid Phosphate 240 lbs. Kainit | 240 lbs. Acid Phosphate 240 lbs. Kainit 48 lbs. Nitrate of Soda | No fertilizer |
|---|---|---|---|---|---|
| | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
| 1904 | 2240 | 1840 | 2320 | 2800 | 2560 |
| 1906 (A) | 4232 | 3296 | 4128 | 4528 | 4080 |
| 1906 (B) | 5232 | 4702 | 4752 | 4320 | 3552 |
| Average increase | 504 | —118 | 326 | 486 | ---- |

From the yield of hay in the three experiments recorded in Table I, acid phosphate gave an average increase of 504 pounds, and potash gave no increase. When the potash was combined with acid phosphate, no appreciable increase attributable to the kainit was secured. From the addition of 48 pounds of nitrate of soda to kainit and acid phosphate, no increase attributable to either potash or nitrate of soda was secured.

In the above experiments acid phosphate was the only fertilizer that paid for its use.

When the amount of acid phosphate in combination with the 240 pounds of kainit per acre was doubled, the increased yield of hay due to the phosphate was slightly more than double; but when the amount of kainit with 240 pounds of acid phosphate was doubled the increased yield due to potash was negligible.

## Fertilizer Test for Seed and Hay

The experiments recorded in Table II show in a general way the effects of fertilizing elements on soy

beans. The test of 1917 was made on a poor, deep, sandy soil, the fertility of which gradually increased from one side of the experiment to the other, as is shown by the gradual increase in yield of the check plots. The 1918 test was on a fertile, loamy soil and followed a heavy crop of crimson clover plowed under in March for soil improvement. The fertilizer, except lime, was applied in the drill at planting time and mixed with the soil. The lime was scattered broadcast over the plot and harrowed in the surface.

TABLE II.—*The Yield of Soy Bean Seed, Straw and Hay from the Use of Different Kinds of Fertilizers*

| FERTILIZER | | | 1917 | | 1918 | | |
|---|---|---|---|---|---|---|---|
| Plot No. | Am't. fertilizer per acre | KIND OF FERTILIZER | Yield of soy bean seed per acre | Yield of soy bean straw per acre | Yield of soy bean seed per acre | Yield of soy bean straw per acre | Yield of soy bean hay per acre |
| | Lbs. | | Bu. | Lbs. | Bu. | Lbs. | Lbs. |
| 1 | 00 | No fertilizer | 6.7 | 787 | 20.8 | 2424 | 5112 |
| 2 | 240 | Acid phosphate | 6.9 | 763 | 21.6 | 2664 | 5088 |
| 3 | 200 | Kainit | 10.0 | 1017 | 17.2 | 2736 | 4440 |
| 4 | 200 | Cotton seed meal | 13.9 | 1411 | 20.4 | 2208 | 4224 |
| 5 | 100 | Nitrate of soda | 9.4 | 960 | 21.5 | 2520 | 4944 |
| 6 | 2000 | Slacked lime | 11.7 | 1286 | 25.6 | 2688 | 4752 |
| 7 | 00 | No fertilizer | 11.7 | 1228 | 23.6 | 2724 | 4800 |
| 8 | 240 | Acid phosphate | 9.6 | 1152 | 23.2 | 2688 | 4848 |
| | 200 | Kainit | | | | | |
| 9 | 240 | Acid phosphate | 15.2 | 1488 | 19.2 | 2736 | 4320 |
| | 200 | Cotton seed meal | | | | | |
| 10 | 200 | Kainit | 17.3 | 1555 | 20.4 | 2232 | 3984 |
| | 200 | Cotton seed meal | | | | | |
| 11 | 2000 | Fine ground limestone | 21.5 | 1853 | 18.8 | 2484 | 4512 |
| 12 | 240 | Basic slag | 19.7 | 2203 | 21.2 | 2400 | 4680 |
| 13 | 00 | No fertilizer | 19.7 | 1929 | 18.6 | 2208 | 4800 |

Lime gave a small increase in grain; of the two forms of lime, (slacked and fine ground limestone) the former gave the better results. Acid phosphate, kainit and nitrate of soda gave no appreciable increase. On poor soil cottonseed meal increased the yield of grain sufficient to more than pay for its cost.

The large yield of grain, straw and hay in the 1918 test was due largely to the favorable seasons and the heavy cover crop of crimson clover plowed under in the spring for soil improvement.

### Acid Phosphate Versus Raw Phosphate

In Table III is found a comparison of the effect of acid phosphate and raw phosphate (finely ground untreated phosphate rock) on the production of soy bean seed. The experiment was conducted on a strong red soil. The plots received the same amount of fertilizer in the fall when they were planted in oats. When the oats were harvested in the spring, the land was plowed and fertilized again at the rate indicated in the table, and planted in soy beans. The low yield of beans is largely due to the late planting.

Table III.—*The Yield of Soy Bean Seed Per Acre from the Use of Acid Phosphate and Raw Phosphate*

| Rate per acre | 1909 | 1910 | 1914 | 1915 | 1916 | 1917 | 1918 | Average yield | Average increase |
|---|---|---|---|---|---|---|---|---|---|
| | Bu. | Bu. | Bu. | Bu. | Bu. | Bu. | Bu. | Bu. | Bu. |
| Acid Phosphate 320 lbs. | 5.5 | 8.5 | 4.5 | 10.7 | 6.7 | 9.6 | 7.4 | 7.6 | .8 |
| Raw Phosphate 320 lbs. | 7.2 | 8.3 | 4.8 | 11.3 | 7.9 | 9.9 | 8.5 | 8.3 | 1.7 |
| No Phosphate | 5.3 | 7.0 | 4.9 | 9.7 | 5.9 | 9.1 | 5.9 | 6.8 | -- |

From the application of 320 pounds of acid phosphate per acre, the average gain was only .8 bushels, and from the same amount of rock phosphate the average gain was 1.7 bushels.

Table IV.—*The Yield of Soy Bean Hay Per Acre from the Use of Acid Phosphate and Raw Phosphate*

| Rate per acre | 1904 | 1908 | 1912 | Average yield | Average increase |
|---|---|---|---|---|---|
| | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
| Acid Phosphate 320 lbs. | 2832 | 2256 | 1676 | 2255 | 323 |
| Raw Phosphate 320 lbs. | 2720 | 2192 | 1613 | 2175 | 243 |
| No Phosphate | 2800 | 1648 | 1348 | 1932 | --- |

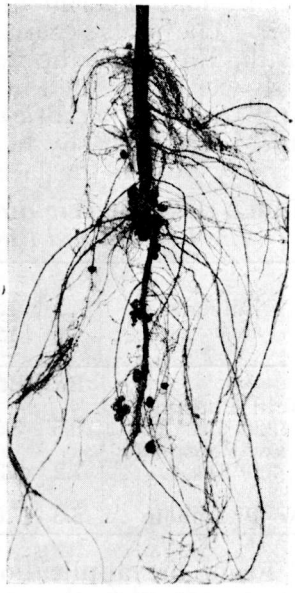
The yield of hay as a result of fertilizing with acid phosphate and rock phosphate is shown in Table IV. This experiment was conducted on the same land and followed the same plan as that reported in Table III.

The average increase from the use of 320 pounds of acid phosphate per acre was 323 pounds of hay and

from a similar amount of raw phosphate 243 pounds. In this experiment the acid phosphate proved slightly better fertilizer than rock phosphate. Neither fertilizer, however, gave a marked increase in yield.

### Inoculation

The soy bean like other legumes has the ability to utilize atmospheric nitrogen through the action of bacteria which live on its roots. These bacteria develop tubercles on the roots of the plants. If there are no tubercles present and the plants are pale green, it is an indication that inoculation is lacking or deficient.



Well Inoculated Plant

### Inoculation Experiments

In 1902 inoculation experiments were made in pots by use of soil from fields where soy beans had not been grown. With seed disinfected in 2 per cent solution of formalin, certain pots were planted June 18 without inoculation, and on August 12, 64 per cent of the plants had tubercles. About the same per cent of inoculation was secured from disinfected seed planted in cowpea and peanut soil. With disinfected seed planted in soil fertilized with cow manure, 100 per cent of the plants showed inoculation.

In 1903 similar experiments were made, using soil on which no legumes had been grown for six years. The plants bore many nodules. In one set of pots the soil was limed; in another set it was not limed. In those pots limed the plants bore more tubercles than those planted in unlimed pots.

In later years both disinfected and inoculated seed was planted on land where no soy beans had ever grown. Wherever tubercles were found, they were found on plants from both disinfected and inoculated seed alike.

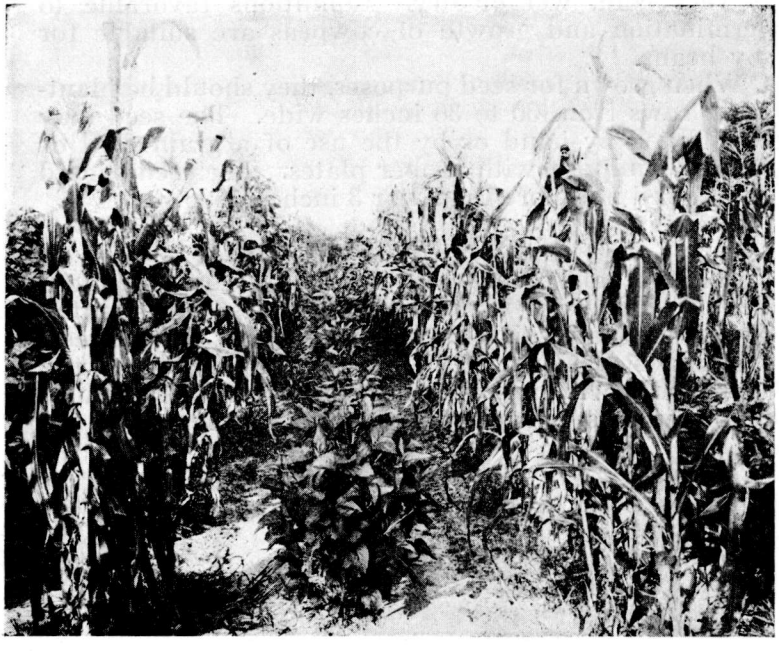
Land that has been well fertilized with barnyard manure or is naturally fertile and planted with seed harvested in the ordinary manner will probably need

no artificial inoculation, as there may be sufficient bacteria on the seed to inoculate the growing plants. If the land lacks humus or is poor, artificial inoculation may prove beneficial and should be done either before or at planting time.

Inoculation of seed may be done either by scattering in the drill with the seed inoculated soil from a soy bean field, or by the use of bacterial cultures. Soy bean cultures may be obtained from commercial companies or from the U. S. Department of Agriculture, Office of Soil Bacteriology, Washington, D. C. The latter will furnish any farmer enough to inoculate two acres. Instructions how to use the cultures usually accompany each package.

### Cropping Systems

The growing of soy beans fits well into many of the cropping systems employed in the Cotton Belt. As a grain crop they may occupy some of the land formerly planted in cotton or corn. When winter oats and wheat are harvested in time to allow the stubble to be plowed, it may be planted in beans, either for seed, hay, or grazing.



**A Row of Soy Beans Growing in a Six Foot Corn Middle. The Beans are Easily Cultivated and Do Not Seem to Reduce the Yield of Corn.**

In the sections where many hogs are raised and the fields fenced for pasturing, the corn rows may be made six feet wide and a row of beans planted in the middle thus forming alternate rows of corn and beans. Both crops may be "hogged off." Where the bean harvester is employed, it will harvest the soy beans without damage to the standing corn.

### Preparation of Land for Soy Beans

The land for soy beans may be prepared as for cotton. It should be plowed in the early spring and harrowed once or twice before planting to destroy weeds and clods and to make a good seed bed. Where the land is smooth and well drained, the rows can be laid off and the beans planted on a level.

Stubble land should be plowed as soon as the grain is removed and the seed planted in moist soil either on a low bed or in drill slightly below the surface.

### Planting Soy Beans

Soy beans may be planted any time from April 15 to July 15. Prompt germination is important, and to secure it, the seed should not be planted when the soil is very cold, wet or dry. Conditions favorable to germination and growth of cowpeas are suitable for soy beans.

When grown for seed purposes, they should be planted in rows from 30 to 36 inches wide. The seed may be planted by hand or by the use of a grain drill or planter equipped with proper plates. The seed should be covered not more than 2 or 3 inches deep.

### Rate of Seeding

Table V. gives the rate of seeding the Mammoth Yellow variety for grain. The 1917 test was planted on gravely loam soil. The stand of plants in both tests was almost perfect. In the latter test the beans were over-ripe when they were harvested and sustained an estimated loss of 5 per cent from shattering.

TABLE V.—*Rate of Seeding Mammoth Yellow Soy Beans for Grain*

| Amount of seed planted per acre | 1917 | | 1918 | | Averages | |
|---|---|---|---|---|---|---|
| | Yield of grain per acre | Yield of straw per acre | Yield of grain per acre | Yield of straw per acre | Yield of grain per acre | Yield of straw per acre |
| | Bu. | Lbs. | Bu. | Lbs. | Bu. | Lbs. |
| 1 peck | 14.6 | 2684 | 7.5 | 2924 | 11.1 | 2804 |
| 2 pecks | 15.5 | 2926 | 8.6 | 2809 | 12.1 | 2867 |
| 3 pecks | 18.7 | 3520 | 9.1 | 2784 | 13.9 | 3152 |
| 4 pecks | 16.7 | 3432 | 10.2 | 2425 | 13.5 | 2928 |
| 5 pecks | 17.2 | 3630 | 10.9 | 2803 | 14.1 | 3216 |

The maximum average yield of grain and of straw came from seeding five pecks per acre. It is noticed that the yield of grain from three pecks was greater than from four pecks and nearly as much as from five pecks per acre. The usual rate when drilled and cultivated for grain is from two to three pecks per acre.

The plants of the thick seeded plots stood up better, than those of the thin seeded plots. This is an important consideration if the seed is harvested with machinery.

When soy beans alone are sown broadcast for hay, the usual rate of seeding is from one to two bushels per acre; when they are sown in combination with cowpeas the usual rate is one bushel of peas and one of beans. From the experiments that are recorded on page 111 the yield of hay can be increased, and its quality greatly improved by increasing the above rate of seeding.

## TILLAGE

The same implements used for cultivation of cotton can be used for cultivating soy beans. If the rows are uniform in width, a "Gee Whiz" cultivator may be used to make one trip to the middle while the plants are small; later cultivations can be made with scooter and scrape. The crop should receive frequent shallow cultivation till the plants begin to bloom.

## HARVESTING SOY BEANS

The time to cut for seed is when most pods are ripe and some leaves have fallen, just before the pods begin to burst and scatter the beans on the ground. If the pods are left on the plants to get completely ripe, the

seed shatter badly when harvested with binder or mower; but if the seed is to be harvested with a special soy bean harvester, the plants should stand until the pods become thoroughly ripe.

When only a patch is planted, the plants can be cut with a corn knife or sharp hoe, or pulled up, and cured in small piles and thrashed out with a flail. Where several acres are grown, they may be cut with a mower, self rake reaper, or binder, and raked or dumped into small piles to cure. As soon as they are cured, they should be put under a shed or thrashed.

The special bean harvester, of which there are several kinds now in use, has revolving arms working in a large box, which is mounted on wheels and drawn by two horses. While the machine is passing over a row, the revolving arms strike the plants and knock out the ripe beans, which are caught in the box. A team and two men harvest about five or six acres a day. The harvester is not started in the morning until after the dew dries off. When such a machine is used, probably 20 per cent of the crop is shattered on the ground, or is left on the plants. When such is the case, hogs should be permitted to run in the fields and gather them.

### Thrashing and Storing Seed

Where the acreage is small, the plants may be spread on a floor or wagon sheet to dry, after which they can be beaten out with a flail.

Soy beans can be thrashed with an ordinary grain thrasher, if the speed of the cylinder is reduced to about half of that for grain (about 300 revolutions per minute) and some of the spikes removed from the concave. The slowing down of the cylinder may be secured by building up the diameter of the drive pulley. If the speed is not reduced, many seed will be lost. The other parts of the separator must run at the normal speed, otherwise straw and chaff will clog the shaker and beater, and poor separation will result.

If the thrashed beans are stored damp or in a damp place, they will heat and become unfit for planting. By putting them in bags and piling the bags in such a way that good ventilation is secured, they may be kept without much injury for one or two years. However, long storing reduces their percentage of germination and a germination test of old seed should be made before planting them.

## Variety Tests for Seed

Up to the present time the Experiment Station has tested 30 different varieties or strains for seed production. Much larger numbers have been grown for observation purposes. Most of the varieties have been furnished by the U. S. Department of Agriculture. Many of them did not offer any great promise for this locality and were dropped after being tested one or two years.

In the table below is given the results of the variety test for 11 years. Some varieties only one year; others like Mammoth Yellow and Ebony, which were more promising, were included almost every year. No column of average yield is made, because many varieties were not planted every year, and obviously it would be unfair to average and compare varieties grown in different years. However, a variety may be compared with any other variety grown in the same year.

In the variety tests the beans were usually planted on one-thirty second acre plots, in rows three feet wide, sowed by hand and thinned to a uniform stand of three or four plants per foot. Each plot received frequent shallow cultivation until the pods began to appear.

A study of the table shows that no one variety has stood at the head of the list for all years. Variations in soils and seasons from year to year produce fluctuations in yield of a variety. During the 11 year period Blackbeauty stood at the head three years in production of seed; Haberlandt, two years; Mammoth Yellow, Sherwood, Tokyo, Hollybrook and Biloxi one year each. During the 11 year period the four most productive varieties for seed of each year included Mammoth Yellow seven times; Blackbeauty five times; Hollybrook five times; Edward, Haberlandt, Ebony and Wilson each three times; Baird, Acme, Shanghai, and Swan each two times; Flat King, Peking, Sherwood, Virginia, Biloxi and Otootan each one time.

## TABLE VI.—*Yields of Grain of Different Varieties*

| Varieties | Yield of seed per acre (bushels) | | | | | | | | | | | Lbs. of straw per acre | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 | 1914 | 1915 | 1916 | 1917 | 1918 | 1917 | 1918 |
| Acme 14954 | ---- | ---- | 12.5 | ---- | ---- | ---- | 5.2 | 12.0 | 8.0 | ---- | ---- | ---- | ---- |
| Arlington 22899 | ---- | ---- | ---- | ---- | ---- | ---- | 2.4 | 3.2 | 6.6 | 10.9 | 12.7 | 1680 | 1160 |
| Austin 17263 | ---- | 5.1 | 8.8 | 11.2 | 8.6 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Biloxi 125 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 15.0 | 22.5 | 2520 | 2700 |
| Baird 22333 | ---- | 9.8 | 9.6 | 14.6 | 11.3 | 9.7 | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Barchet 23232 | ---- | 4.6 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 9.0 | 10.8 | 3060 | 2300 |
| Blackbeauty | ---- | ---- | 9.6 | 14.3 | 15.3 | 23.5 | 11.6 | 16.0 | 4.4 | 14.0 | 16.0 | 1320 | 1160 |
| Ebony 17254 | ---- | 9.6 | 8.9 | 12.4 | 14.2 | 19.4 | 5.2 | 10.3 | 11.6 | 15.3 | 16.3 | 1722 | 1425 |
| Edward 14953 | 5.4 | 11.2 | 8.5 | ---- | 10.6 | 15.5 | 5.2 | 9.4 | 16.2 | ---- | ---- | ---- | ---- |
| Flat King 17252 | ---- | 9.1 | 9.0 | ---- | 17.3 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Hollybrook 17278 | ---- | ---- | 11.3 | 10.2 | 13.3 | 21.5 | 4.8 | 10.3 | 12.9 | 26.0 | 20.8 | 2400 | 1850 |
| Haberlandt | ---- | ---- | 12.6 | 16.6 | 18.3 | 12.3 | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Ito San 186 | ---- | ---- | 3.2 | ---- | ---- | ---- | ---- | ---- | ---- | 9.9 | ---- | 1422 | ---- |
| Mammoth Yellow | 9.1 | 9.2 | 10.6 | ---- | 17.8 | 17.0 | 5.4 | 13.4 | 11.5 | 19.3 | 18.0 | 2283 | 2162 |
| Medium Green 92 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 7.0 | ---- | ---- | ---- | ---- |
| Medium Yellow | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 5.6 | 7.2 | ---- | 1728 | ---- |
| Morse 19186 | ---- | ---- | ---- | ---- | ---- | ---- | 4.0 | ---- | 7.5 | ---- | ---- | ---- | ---- |
| Otootan | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 15.0 | 21.3 | 3600 | 3875 |
| Peking 17852 | ---- | ---- | ---- | ---- | ---- | ---- | 5.6 | 8.9 | ---- | ---- | ---- | ---- | ---- |
| Peking 152 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 9.8 | 7.4 | 1452 | 1480 |
| Rueland 20797 | ---- | ---- | ---- | ---- | 15.0 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Shanghai 14952 | 6.2 | 4.8 | 8.9 | ---- | 15.3 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Sherwood 17862 | ---- | 15.4 | 9.7 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Swan 22379 | ---- | 3.6 | 7.1 | 12.4 | 12.9 | 17.8 | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Tar Heel | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 4.5 | ---- | ---- | ---- | ---- |
| Tokyo 17267 | 5.4 | 11.0 | 13.0 | ---- | 12.2 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Wilson (black) 19183 | ---- | ---- | ---- | ---- | ---- | ---- | 5.6 | 11.7 | 5.4 | 10.0 | 12.0 | 1320 | 1280 |
| Wilson (yellow) | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 24.0 | ---- | 2760 | ---- |
| Virginia 32906 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 15.5 | 14.6 | 1806 | 1275 |
| Chinese 20797 | ---- | 4.8 | ---- | ---- | ---- | 8.0 | ---- | ---- | ---- | ---- | ---- | ---- | ---- |

The list of productive varieties is rather long, and the matter of making a choice of a variety by the beginner may be confusing.

He will make no mistake in choosing for this latitude the Mammoth Yellow, which is a rank growing variety and produces yellow seed. It requires about 135 days to mature a crop of seed. Hollybrook produces a smaller plant, has smaller yellow seed, and requires about 10 days less than Mammoth Yellow to mature its seed. Blackbeauty is very much like Hollybrook, except in color of seed, which is black.

The varieties which lead in seed production have rather coarse, erect stems and are medium late. The early varieties never rank high in seed production; nor are they well suited for hay. When it is desired to get an early crop for grazing purposes, Ito San, Swan, Sherwood and other early varieties described in Table VII. may be planted. They will bridge over the period till the later varieties like Mammoth Yellow, Hollybrook and Blackbeauty, etc., are ready for grazing.

### Soy Bean Straw

The percentage of straw to grain differs with different varieties. In 1917 and 1918 Mammoth Yellow averaged 66 per cent of straw, and Otootan averaged 74 per cent. The dwarf varieties have a lower percentage of straw than those that have a tendency to form a semi-vine upwright growth. Blackbeauty averaged for two years 42 per cent of grain; Hollybrook, 40 per cent; Ebony, 38 per cent; Biloxi, 29.5 per cent; and Barchet (an upright vine-like variety) only 18 per cent.

The amount of straw from each variety is not in proportion to yield of grain. The percentage of straw depends upon the habit of growth of the variety—the late vine-like varieties yielding the highest percentages and the largest amounts per acre.

In 1917 and 1918 the variety tests were planted on fertile sandy soil and made a rank growth. The Arlington No. 22899 made 1420 pounds of straw per acre, and Otootan 3737 pounds, and Mammoth Yellow 2222 pounds.

Chemical composition and feeding experiments of soy bean straw show that it is a good roughage. The hulls and small stems are readily eaten by cattle and sheep. Lambs fed a ration of soy bean straw, shelled corn, and linseed meal made a fair gain.*

* Ohio Bulletin No. 245.

TABLE VII.—*Variety Characters of Beans*

| Varieties | Color of blooms | Average number of days from planting to | | Color of seed |
|---|---|---|---|---|
| | | Blooming | Ripening | |
| Acme | Purple | 65 | 111 | Yellow |
| Austin | White | 59 | 118 | Yellow |
| Biloxi | White and Purple | 100 | 150 | Brown |
| Baird | Purple | 70 | 105 | Brown |
| Barchet | Pinkish | 102 | 144 | Dark brown |
| Blackbeauty | Pink and Purple | 55 | 110 | Black |
| Chinese | Pink | 90 | 155 | Dark brown |
| Ebony | White and Purple | 72 | 117 | Black |
| Edward | Pink | 67 | 130 | Greenish |
| Hollybrook | Purple | 70 | 115 | Yellow |
| Haberlandt | Purple | 80 | 130 | Yellow |
| Ito San | Purple | 49 | 82 | Yellow |
| Mammoth Yellow | White and Purple | 68 | 133 | Yellow |
| Morse | | 90 | 118 | Olive |
| Otootan | Pink | 103 | 151 | Brown |
| Peking | Pink | 80 | 120 | Black |
| Shanghai | White | 65 | 119 | Black or red'sh |
| Swan | White | 55 | 110 | Yellow |
| Tokyo | Purple | 65 | 118 | Green |
| Wilson | Purple | 87 | 120 | Black |
| Sherwood | | 57 | 103 | Yellow |

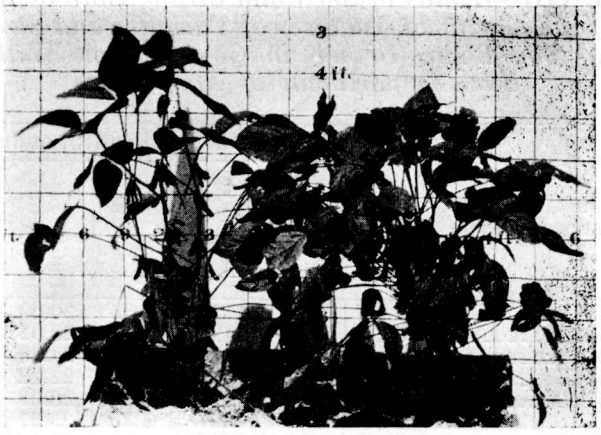
VARIETY TEST OF SOY BEANS FOR GRAIN AND OIL

In 1917 in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, the Experiment Station grew 41 varieties and strains of soy beans. The seed came originally from different sources, and they were grown for the purpose of getting data on habit of growth, adaptability, yield of grain, chemical composition, etc. They were planted May 15 on sandy soil in rows 3½ feet wide and thinned to a uniform stand. The plots were small and planted in duplicate. Below is a table showing the results of one year's test:

TABLE VIII.—*Yields of Seed and Straw, Date of Ripening, and Chemical Analyses of Varieties and Strains of Soy Beans Grown in Co-operation With U. S. Department of Agriculture*

| Bureau of Plant Industry Number | Date of ripening | Yield per acre | | Chemical analyses* | | |
|---|---|---|---|---|---|---|
| | | Bushels of grain | Pounds of straw | Water per cent | Fat per cent | Protein |
| 30598-A | 9-10 | 8.8 | 1716 | 5.36 | 20.69 | 38.75 |
| 30746-A | 8-15 | 10.2 | 1420 | 5.20 | 23.02 | 33.40 |
| 35622 | 9- 7 | 9.7 | 2323 | 6.34 | 24.30 | 29.90 |
| 35125 | 9- 7 | 10.5 | 1214 | 6.19 | 22.22 | 33.00 |
| 36576 | --- | 14.3 | 1069 | 7.29 | 23.38 | 32.60 |
| 36651 | 8-15 | 11.0 | 607 | 7.36 | 23.37 | 30.50 |
| 36829 | 9- 7 | 7.9 | 1610 | 6.21 | 24.18 | 32.60 |
| 36830 | 9-10 | 14.1 | 2059 | 6.70 | 23.33 | 35.25 |
| 36846 | 8-15 | 11.7 | 673 | 6.28 | 24.59 | 31.05 |
| 36901 | 8-17 | 10.8 | 607 | 6.33 | 23.42 | 32.05 |
| 36847 | 8-20 | 10.3 | 633 | 6.65 | 24.03 | 32.40 |
| 36903 | 8-15 | 11.9 | 594 | 6.11 | 23.14 | 32.60 |
| 36904 | 8-13 | 10.1 | 766 | 7.61 | 21.74 | 34.05 |
| 36905 | 8-15 | 8.8 | 396 | 7.00 | 23.96 | 33.20 |
| 36915 | 8-12 | 9.7 | 475 | 7.40 | 22.85 | 33.10 |
| 37042 | 9-10 | 9.2 | 1567 | 5.80 | 23.64 | 33.55 |
| 37047 | 9-19 | 14.8 | ---- | 6.27 | 19.85 | 40.25 |
| 37062 | 8-12 | 9.9 | 449 | 7.53 | 23.45 | 32.70 |
| 37077 | 9- 7 | 5.3 | 1531 | 7.73 | 22.32 | 33.10 |
| 37230 | 8-15 | 11.0 | 819 | 6.50 | 23.81 | 34.05 |
| 37232 | 8-15 | 6.4 | 307 | 7.00 | 22.54 | 34.95 |
| 37239 | 9-19 | 7.5 | 1399 | 7.01 | 23.37 | 32.80 |
| 37244 | 9-24 | 12.8 | 1610 | 6.18 | 19.92 | 35.00 |
| 37245 | 9-10 | 5.7 | 1505 | 6.66 | 21.88 | 32.60 |
| 37246 | 9-17 | 11.0 | 1716 | 5.50 | 23.36 | 35.11 |
| 37250 | 9-17 | 17.2 | 2138 | 6.34 | 21.70 | 38.05 |
| 37262 | 9-24 | 11.9 | 2191 | 6.42 | 19.20 | 39.80 |
| 37272 | 9-17 | 11.4 | 1426 | 5.55 | 22.59 | 37.10 |
| 37298 | 9-15 | 15.8 | 1954 | 6.36 | 20.38 | 38.20 |
| 37335 | 9-15 | 16.1 | 1690 | 6.79 | 21.76 | 38.10 |
| 37344 | 9-19 | 18.8 | 1584 | 7.61 | 19.70 | 37.40 |
| 37570 | 8-12 | 10.8 | 620 | 6.17 | 22.69 | 36.10 |
| 37571 | 8-16 | 9.9 | 515 | 6.03 | 23.58 | 32.10 |
| 38218 | 9-17 | 8.8 | 1768 | 6.28 | 21.54 | 39.00 |
| 38451 | 9-19 | 18.9 | 2560 | 6.52 | 19.94 | 37.90 |
| 38455 | 9-17 | 10.6 | 1478 | 6.15 | 20.36 | 38.40 |
| 38462 | 9-19 | 19.4 | 2930 | 6.43 | 15.32 | 37.85 |
| 40114 | 9-20 | 6.8 | 1448 | 6.25 | 21.19 | 33.75 |
| 40115 | 9-20 | 9.7 | 1531 | 6.27 | 21.33 | 35.55 |
| 37301 | 9-19 | 11.4 | 1954 | 6.70 | 21.63 | 34.45 |
| Mammoth | 9-22 | 23.3 | 2297 | 6.10 | 23.60 | 35.05 |

*Reported by Bureau of Plant Industry, U. S. Department of Agriculture.



Dwarf and Cluster Habits of Some Varieties

The early varieties are dwarf in habit of growth, woody, and hard to harvest. The percentage of straw to beans is, in some dwarf varieties, less than 50; in the larger varieties it ranges from 60 to 75 per cent. The straw of dwarf varieties is not eaten closely by stock on account of its hard, woody nature.

The yield of seed from 28 strains and varieties fell 50 per cent below that of Mammoth Yellow; only four strains came within 25 per cent of Mammoth Yellow; none equalled it. From the standpoint of yield of seed and straw or hay, only four or five varieties offer any promise. They are being tested further.

In per cent of fat, many of the low yielding varieties and strains compare favorably with Mammoth Yellow. Fourteen varieties contain more protein than Mammoth Yellow. The protein content ranges from 29.9 in No. 35622 to 40.25 per cent in 37047.

### Soy Beans for Hay

The soy bean makes an excellent hay when harvested at the proper time. Its feeding value seems to be equal to that of alfalfa and cowpea hay. The average of 23 analyses shows that it contains 16 per cent crude protein, 24.9 per cent fiber, 39.1 per cent nitrogen-free extract, and 2.8 per cent fat.* When used for this purpose, it should be cut after the pods begin to form, and before they are fully grown. If the cutting is

*See page 640 "Feeds and Feeding," Henry and Morrison.

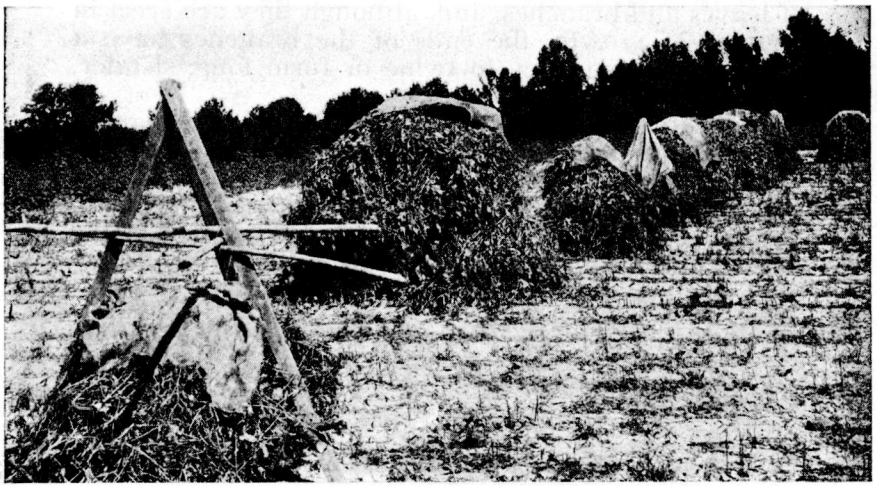
done too late, the stems become woody and the leaves shatter badly.

Soy beans can be mowed and cured in the same way as cowpeas. The plants should lie in the swath about two days, and then raked into windrows or thrown into small racks or on curing frames. If left in the swath or exposed to direct sunshine too long, the leaves dry and fall off badly, and the quality of the hay greatly deteriorates. After remaining in cocks, or windrows or on racks four or five days, the hay is cured, and should be promptly stored.

Some of the varieties are better suited for hay production than others. Those that have large, coarse, woody stems and short branches make a hay that is not closely eaten by stock. Nearly all the early varieties tested have a dwarf habit of growth, and therefore, do not lend themselves to hay production. Those varieties that require 125 days or more to mature seed give the largest yields of hay; those that have a vine or semi-vine habit of growth make the best quality of hay.

### Variety Tests for Hay

Table IX. shows the relative yield of hay of 10 leading varieties. They were planted in three foot rows at the rate of one bushel per acre, fertilized, and cultivated as a variety test.



Curing Soy Bean Hay on Racks

TABLE X.—*Yield of Hay of Varieties in* 1917 *and* 1918

| Varieties | Year | Mammoth Yellow | Wilson | Arlington | Barchet | Hollybrook | Ebony | Blackbeauty | Otootan | Biloxi | Virginia |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Lbs | Lbs | Lbs | Lbs | Lbs | Lbs | Lbs | Lbs | Lbs | Lbs |
| Yield per acre | 1917 | 3660 | 2460 | 2580 | 2100 | 3500 | 3300 | 2700 | 5560 | 4140 | 2220 |
| | 1918 | 2392 | ---- | 3380 | 2912 | 3276 | 3536 | ---- | 5756 | 4940 | 2444 |
| Average yield | ---- | 3026 | ---- | 2980 | 2506 | 3388 | 3418 | ---- | 5658 | 4540 | 2332 |

In the above table the average yield of hay ranges from 2332 pounds per acre to 5658 pounds. At $25.00 per ton the money value from the lowest yielding variety, Wilson, is $29.15 per acre; for the highest yielding variety, Otootan, it is $70.73 per acre.

Named in order in which they reached haymaking stage are Wilson, Virginia, Ebony, Hollybrook, Blackbeauty, Arlington, Barchet, Mammoth Yellow, Biloxi and Otootan. They required from 85 to 112 days from date of planting to date of mowing for hay.

Mammoth Yellow and Biloxi grow erect and are coarse; Ebony, Blackbeauty, and Hollybrook have slender stems and many branches; the other varieties grow three or four feet in height with an abundance of leaves and branches, and, although they are erect in manner of growth, the ends of the branches have a considerable tendency to twine or form long, slender, weak vine-like stems.

In 1918 wheat stubble land was plowed and planted June 20th in Mammoth Yellow soy beans. The rows were 30 inches wide and seed dropped in drill. At time of planting a mixture of 160 pounds of acid phosphate and 60 pounds of cotton seed meal was applied in the drill. The beans were given two cultivations. They were cut September 17th and cured on racks.

TABLE XI.—*Rate of Seeding and Yield of Hay Per Acre*

| | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
|---|---|---|---|---|---|---|---|---|
| Seed per acre | 45 | 60 | 80 | 100 | 120 | 140 | 160 | 180 |
| Yield of hay | 3680 | 3200 | 2752 | 2848 | 2400 | 2096 | 1888 | 1936 |

In the table it is noticed that the yield of hay gradually decreased as the rate of seeding increased. The large yield of hay from the small rate of seeding is explained by the unfavorable weather conditions of August, which was dry. The thickly seeded plants did not make a large growth, but they made a very fine quality of hay—being free from coarse, woody stems.

The 30 inch width of row commends itself because its middle is easy to cultivate with one furrow of a harrow or scrape and two rows can be mowed at one trip with a five foot blade. The mowing is made easy, if the rows are uniform in width and laid by level; the curing may be hastened by removing dividing board from mower and allowing the beans to fall over the whole swath.

### Mixture of Cowpeas and Soy Beans for Hay

Cowpeas and soy beans when seeded together form a mixture that produces an excellent quality of hay. The advantages of a mixture over either crop alone are that the combined yield is, in many cases, increased; that the curing of the cowpeas is made easier because of the stemmy nature of the soy bean, and that, as a result of the better curing, the quality of the hay is improved. However, either crop alone makes excellent hay when harvested at the right stage and properly cured.

To secure an increase in yield when soy beans are seeded with cowpeas, they must not be planted on too poor land or suffer from an unfavorable season. When the conditions are not favorable to prompt growth, weeds and grass choke the beans and their growth is not proportionate to the cowpeas.

The time from planting to proper haymaking stage is about 70 or 80 days. The mixture is harvested and made into hay in the same way that cowpea hay is made. The stems of the beans hold the cowpea vines apart, and the mixed hay cures more rapidly than cowpea hay alone. Care should be exercised in handling the hay to prevent the loss of leaves, which form a very valuable part of the hay.

## Heavy Seeded Mixtures of Soy Beans and Cowpeas

In Table XII. it is seen that soy beans sowed broadcast at the rate of 10 pecks per acre gave an average yield of 2467 pounds of cured hay per acre. By mixing 5 pecks of soy beans with 5 pecks of whipoorwill cowpeas and sowing them broadcast the yield of cured hay was increased 203 pounds per acre. When the amount of soy beans mixed with 5 pecks of cowpeas was reduced from 5 to 3 pecks,—the average yield of hay was slightly increased—280 pounds per acre. A mixture of 5 pecks of Mammoth Yellow beans and of three pecks of Iron cowpeas gave an average increase of 352 pounds of hay over the yield of 10 pecks of soy beans planted alone.

In Table XII. it is shown that 10 pecks of Mammoth Yellow soy beans alone sown broadcast did not yield per acre 467 pounds as much cured hay as 10 pecks of Whippoorwill cowpeas planted in a similar way. When the rate of seeding of soy beans was reduced from 10 to 7½ pecks per acre, the yield of hay fell off 329 pounds per acre.

TABLE XII.—*Heavy Seeded Mixtures of Soy Beans and Cowpeas for Hay*

| Varieties | Amount of seed per acre | How planted | Yield cured hay per acre | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1910 | 1911 | 1912 | 1913 | Averages | Increase of averages |
| | | | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
| Mammoth Yellow Beans | 10 pks. | Broadcast | 2464 | 5488 | 2288 | 1495 | 2934 | 467 |
| Mammoth Yellow Beans and Whippoorwill Peas | 5 pks. 5 pks. | Broadcast | 2256 | 5320 | 1488 | 805 | 2467 | --- |
| Mammoth Yellow Beans and Iron Peas | 5 pks. 3 pks. | Broadcast | 2200 | 4640 | 1408 | --- | 2747 | 280 |
| Mammoth Yellow Beans and Whippoorwill Peas | 3 pks. 5 pks. | Broadcast | 2336 | 5200 | 2480 | 1260 | 2819 | 352 |
| Mammoth Yellow Beans | 10 pks. | Broadcast | 2196 | 5860 | 1200 | 1425 | 2670 | 203 |
| Whippoorwill Peas | 10 pks. | Broadcast | 2256 | 5320 | 1488 | 805 | 2467 | --- |
| Mammoth Yellow Beans | 7½ pks. | Drilled | 1744 | 4540 | 1392 | 875 | 2138 | 329 |

LIGHT SEEDED MIXTURES OF SOY BEANS AND COWPEAS

Soy beans planted broadcast at the rate of 64 pounds per acre gave an average yield of 1252 pounds of cured hay and Iron cowpeas seeded at the same rate and manner gave an average yield of 2546 pounds per acre, or an increase of 1602 pounds. When 48 pounds of Mammoth Yellow soy beans were mixed with the same weight of Iron cowpeas and sowed broadcast, the average yield of cured hay was 2868 pounds per acre—an increase of 1616 pounds over the yield from the seeding of 64 pounds of soy beans alone or an increase of 322 pounds over the yield from the seeding of 64 pounds of Iron cowpeas.

TABLE XIII.—*Light Seeded Mixtures of Soy Beans and Cowpeas for Hay.*

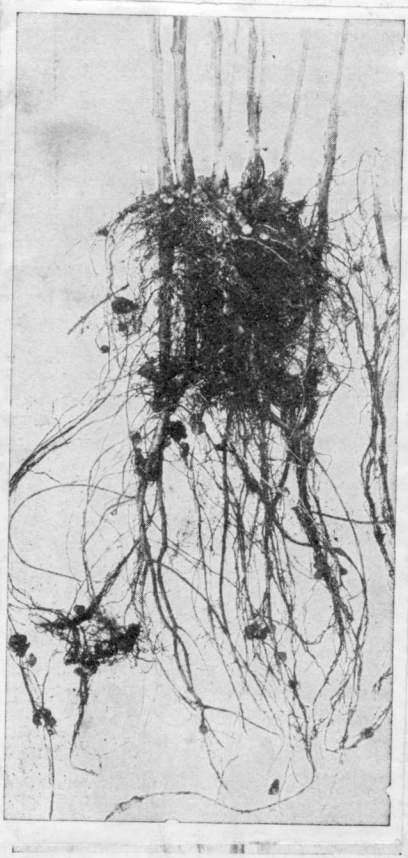
| Varieties | Amount of seed per acre | How planted | Yield of cured hay per acre | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1914 | 1915 | 1916 | 1917 | 1918 | Average | Increase of averages |
| | Lbs. | | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
| Mammoth Yellow Beans | 64 | Broadcast | 608 | 1424 | 1712 | ---- | 1264 | 1252 | ---- |
| Iron Cowpeas | 64 | Broadcast | 2080 | 1840 | 4344 | 1552 | 2912 | 2546 | 1294 |
| Mammoth Yellow Beans | 48 | | | | | | | | |
| Iron Cowpeas | 64 | Broadcast | 1888 | 1968 | 4416 | 2240 | 3568 | 2868 | 1616 |
| Mammoth Yellow Beans | 64 | In drill | 352 | 1448 | 1291 | 1424 | 2416 | 1368 | ---- |
| Iron Cowpeas | 64 | In drill | 1488 | 2416 | 4624 | 3200 | 3120 | 2970 | 1602 |
| Mammoth Yellow Beans | 48 | In drill | 1328 | 2240 | ---- | 3376 | ---- | 2315 | 947 |
| Iron Cowpeas | 48 | | | | | | | | |

When 64 pounds of soy beans was planted in the drill and cultivated two or three times, the yield of hay was 1368 pounds per acre; when 61 pounds of Iron cowpeas was planted in the same way and given the same treatment, the yield of hay was 2970 pounds per acre; but when 48 pounds of soy beans was mixed with the same amount of Iron cowpeas and planted together, the average yield of hay was only 2315 pounds per acre.

When the rate of seeding soy beans is reduced to about one bushel per acre, a wide difference in yield between soy beans and cowpeas is observed. The average yield of hay from 64 pounds of Iron cowpeas per acre was greater by 1294 pounds than from the same amount of soy beans. When planted in drill and given two cultivations, the cowpeas exceeded the soy beans by an average of 1602 pounds.

Cowpeas, being a vine plant, covered the ground and choked out grass and weeds, while the soy beans, being an erect plant, permitted the grass and weeds to grow and was itself choked by them. To secure the maximum yield and quality of hay from soy beans, the seeding must be on good soil and sufficiently thick to keep down weeds.

The advantage of drilling soy beans for hay comes from freedom of weeds and an improved quality of hay. On strong land the same results to some degree are secured from thick, broadcast seeding of beans.



Well Inoculated Plants—Nodules Growing Even On the Shaded Surface of the Soil

## The Soy Bean As a Soil Improving Crop

The importance of the soy bean as a nitrogen gatherer and a soil improvement crop is scarcely less than that of the cow-pea. Even when the crop is harvested for hay or seed, the amount of nitrogen in the soil is not reduced, as in the case of a corn crop, but is considerably increased. It leaves the land in a splendid physical condition for any following crop.

The value of the soy bean crop toward maintaining soil fertility is increased when it is harvested by stock or when it is fed and the manure returned to the land. The easy method of harvesting by pasturing and the increased fertility of the land should not be overlooked by farmers.

The comparitive fertilizing effect of a corn crop, cowpeas and soy beans drilled and cultivated when followed by a cotton crop is shown in the following table:

TABLE XIV.—*Comparative Fertilizing Effect of Soy Beans, and Corn on a Succeeding Cotton Crop*

| Crops | Yield of seed cotton per acre. | | | |
|---|---|---|---|---|
| | 1911 | 1914 | Averages | Increase due to legumes |
| | Lbs. | Lbs. | Lbs. | Lbs. |
| After Corn | 1303 | 979 | 1141 | ---- |
| After Cowpeas | 1890 | 962 | 1426 | 285 |
| After Soy Beans | 1910 | 1008 | 1459 | 318 |

Only the grain from the corn, cowpeas and beans were harvested. All the stover and straw of the corn, cowpeas, and soy beans were left on the land and plowed under the next spring for soil improvement.

Cotton followed corn, cowpeas, and soy beans, and received no nitrogenous fertilizer.

From the corn land the average yield of seed cotton was 1141 pounds per acre; from the cowpea land, 1426 pounds; and from the soy bean land, 1459 pounds. The cowpea land gave an average increase over the corn land of 285 pounds, and the soy beans land an average increase of 318 pounds. In money value, the fertilizing benefit from the cowpeas to the following cotton crop, if the seed cotton be calculated at 4 cents a pound, was $11.40 and from the soy beans $12.72 per acre..

In 1909 a mixture of Crimson Clover and Red Rust Proof oats, of Crimson Clover and Blue Stem Wheat, and of Crimson Clover alone were planted after corn, cowpeas, and soy beans. The yield of cured hay is shown in the table below:

TABLE XV.—*Comparative Fertilizing Effect of Soy Beans, Cowpeas and Corn on a Following Hay Crop*

| Crops | Yield of cured hay per acre | | | | |
|---|---|---|---|---|---|
| | Red Rust Proof Oats and Crimson Clover | Blue Stem Wheat and Crimson Clover | Crimson Clover | Average of 3 kinds | Increase due to legumes |
| | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
| After Corn | 4373 | 3512 | 2289 | 3391 | ---- |
| After Soy Beans | 5137 | 4722 | 2889 | 4249 | 858 |
| After Cowpeas | 4709* | 5305 | 2791 | 4268 | 877 |

In the above table it is noticed that the average yield of hay following cowpeas and soy beans is 877 and 858 pounds greater respectively than when it follows corn. When the hay was valued at $15.00 a ton, the fertilizing effect of the cowpeas was $6.56 per acre, and of soy beans $6.43.

In 1906 an experiment was conducted to secure data on the fertilizing effect of corn, cowpeas, and soy beans on a succeeding winter oat crop. The increase in yield of oats due to cowpeas, even where the seed had been picked, was about 300 per cent over the yield from the corn land. The increase in oats due to soy beans, which were gathered in such a way as to leave only the stubble, was 173 per cent over the yield from the corn land.

The Ohio Experiment Station found that the average yield of wheat following soy beans was 10.3 bushels greater than that following corn.*

COMPARATIVE YIELD OF GRAIN FROM SOY BEANS, CORN AND COWPEAS

The comparative yield of grain from corn, cowpeas, and soy beans is shown in Table XVI. These crops were planted at the same time, fertilized alike, and received

(*See p. 592 bul. 312, Ohio Agri. Experiment Station.)

good culture. In each case the grain was carefully harvested and weighed, and in the table is recorded the actual weight of grain or seed not including the weight of husks, cowpeas and soy bean hulls.

TABLE XVI.—*Comparative Yield of Grain Per Acre of Corn, Cowpeas, and Soy Beans.*

| Crops | 1908 | 1909 | 1910 | 1913 | 1914 | 1915 | 1916 | 1917 | Av. |
|---|---|---|---|---|---|---|---|---|---|
| | Lbs | Lbs | Lbs | Lbs | Lbs | Lbs | Lbs | Lbs | Lbs |
| Corn | 1664 | 1572 | 1604 | 2294 | 464 | 1322 | 1699 | 2800 | 1677 |
| Cowpeas | 1020 | 1080 | 870 | 432 | 320 | 530 | 920 | 1318 | 811 |
| Soy Beans | 864 | 500 | 805 | 423 | 376 | 700 | 1084 | 1019 | 721 |

In the column of averages it is noticed that the pounds of shelled corn per acre more than doubles the pounds of soy beans or cowpeas. If the legumes are grown only for their grain, their yield does not compare favorably with corn as a grain crop.

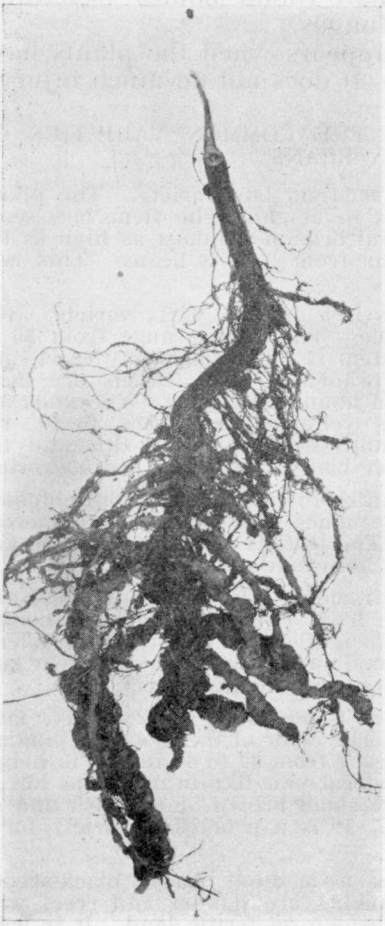
The analysis of the soy bean grain shows that it has about four times as much digestible protein, one-third as much carbohydrates, and over three times as much fat as corn grain. Soy beans or soy bean meal, fed as a supplement with corn to growing stock or those requiring a high protein ration, produce a gain about equal to that obtained from the feeding of equal amounts of shorts, tankage or cottonseed meal in combination with grain. For dairy cattle, ground soy beans show a slightly higher feeding value than cotton seed meal.* In feeding experiments of fattening hogs, soy beans supplemented with corn gave about the same gain that was secured from feeding tankage and corn.**

When one considers the fertilizing effect of a crop of soy beans on the land for any following crop, and the ease with which the crop is grown and the high feeding value of the bean as a concentrated feed, the true value of the corn and the bean crop to the farmer may be seen in its real light.

### ENEMIES OF THE SOY BEAN

Probably the greatest enemy to the growing of the soy bean is rabbits. They are very fond of the young, green, tender foliage. Where only a small patch is planted, the rabbit has been known to destroy it entirely. It is suggested that the farmer plant enough for the rabbits and for the farm.

*Tenn. Bul. No. 80.
**Ind. Bul. 126, 137.



Diseased Soy Bean Root Showing the Effects of Nematodes

A very small eel-like worm, called nematode, (Heterodera radicicola) sometimes attacks the soy bean root and causes irregular enlargements on it. The enlargements are mistaken by some for nodules caused by nitrogen - gathering bacteria, peculiar to this plant. Where the soil is badly infested with this insect, the farmer is advised to plant some other crop that is not susceptible to its attack.

The soy bean suffers from a disease that attacks the underground part of the plant and causes the leaves and stem to wilt. When the plant is examined, it is noticed that the bark is soft, and the woody part of the stem dark. This darkening of the stem is due to a microscopic fungus (Fusarium trocheiphilum-Smith), which is said to be the same organism that produces the wilt of cowpeas. When a field becomes infested with this disease, it should not be planted in soy beans or cowpeas susceptible to wilt.

Root rot attacks the soy bean plant and causes a wilting of the leaves, followed by the death of the entire plant. When the plant is pulled up, a mat of white fluffy mold is usually found on the stem directly below the point where the stem enters the ground. On

it may later appear small round bodies (sclerotia) which perpetuates the fungus.

Leaf spot sometimes appears when the plants have about reached maturity. It does not do much injury.

## BRIEF DESCRIPTION OF THE COMMON VARIETIES OF SOY BEANS

ACME 14954.—This is a medium late variety. The plants range from 25 to 36 inches in height. The stems are semi-vined with 3-6 slender lateral branches almost as high as the main stems. The pods bear from 2 to 3 beans. This is a prolific variety.

ARLINGTON 22899.—This is a medium early variety. The color of the bloom is purple. The plants range from 36 to 48 inches in height. The stem is fine, moderately erect, and has many long ascending branches. The leaflets are large heart shaped and furnish an abundant foliage. The pods are 2 to 2½ inches in length, yellowish and very fuzzy; the seed remain in the pods until they are fully ripe and the over-ripe pods do not shatter badly when they are harvested.

AUSTIN 17263.—This is an early variety with white blooms. The plants range about 30 inches in height with numerous bunchy and woody stems. The leaflets are broad at base and pointed. Its seed is rather large and yellow.

BAIRD.—This is an early variety. The beans are small and reddish. The plants range from 15 to 20 inches in height. The stems are small and upright and have very few lateral branches. Its leaves are small and subject to a brown rust and early shedding. It is not a promising variety.

BARCHET 23232.—This is a late semi-vine variety, later than the Mammoth Yellow. The color of the bloom is pinkish. The plants are slender and vary from 32 to 40 inches in height and send out from 2 to 6 lateral vine-like branches as tall as the main stem. Its pods are small brown or blackish and do not shatter when over-ripe. It is a promising variety for a late hay crop.

BLACKBEAUTY.—This is a medium early, black-seeded variety. The stem and branches are slender and erect with a tendency to twine when grown on fertile land. It is leafy and retains them well until its pods are ripe. Its pod stems are very short and do not grow in large clusters; its flowers are pink or purple; and its seed are black.

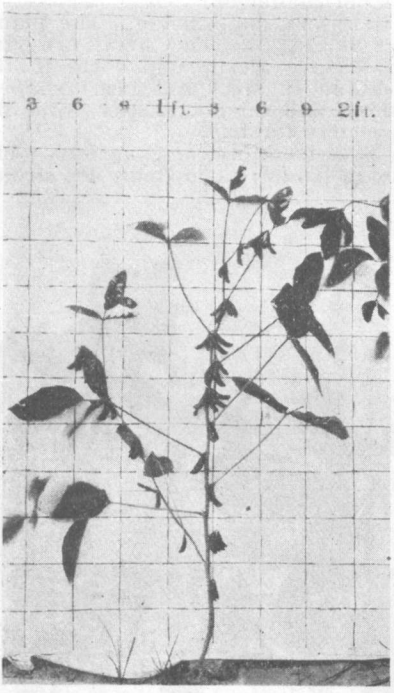
BILOXI.—The stem is strong, woody, making a rank growth that resembles Mammoth Yellow. It varies from 40 to 48 inches in height, and is erect and easy to mow. Its pods are brown and very fuzzy; and its seed are brown and medium size. It is a good variety for seed and hay, if planted early.

CHINESE 20797.—This variety is very late. The bean is small and dark in color and does not shatter badly. The stems range from 36 to 45 inches, all vine-like but strong enough to give them an upright form and make the mowing for hay easy. The leaves are small and abundant. The variety is promising for hay but not for seed.

EBONY.—This is a small black seeded medium late variety. On good soil the stems have a tendency to twine. It has both purple and white blooms. The leaves are small, dark and crimpled. The pod is very small, and contains two or three black seed. This variety is promising as a hay crop and yields seed well.

EDWARD SOY.—Under this name is described a late variety resembling Mammoth Yellow. The plant varies from 30 to 40 inches in height, having a strong woody upright stem with many strong upright lateral branches bearing fruit. The pods are large, containing two or three yellow beans. This makes a good variety for hay and seed in the Gulf States.

HABERLANDT.—This is a low medium early variety with coarse, stiff plants, having a tendency to branch heavily but not to twine. Its seed grow close about the stems which makes it somewhat difficult to harvest. It is a good variety for seed production.



Hollybrook Plant

HOLLYBROOK 17278—Hollybrook is about two weeks earlier than the Mammoth Yellow. Its blooms are white; its seed medium in size and yellow. The plants are slender and range from 24-36 inches in height. Generally there is only one main upright woody stem, and very few lateral branches. The pods are small with two or three beans to the pod. This variety is not very desirable for hay but makes heavy yields of seed.

ITO SAN SOY—This is a well known very early variety. The seed is similar in size and color to the Mammoth Yellow. The plants are medium size, about 14 to 16 inches in height, erect in habit, with coarse stems. This is an excellent variety to use where very early grain is wanted.

MAMMOTH YELLOW.—Mammoth Yellow sometimes called mammoth, is a late variety requiring 120 to 130 days to mature seed. The plants range from 27 to 36 inches in height. The stems are rather coarse, erect, and woody, having many rather stiff lateral fruit bearing branches. Its abundant leaves are large, dark, and crinkled; its flowers white. The pods are

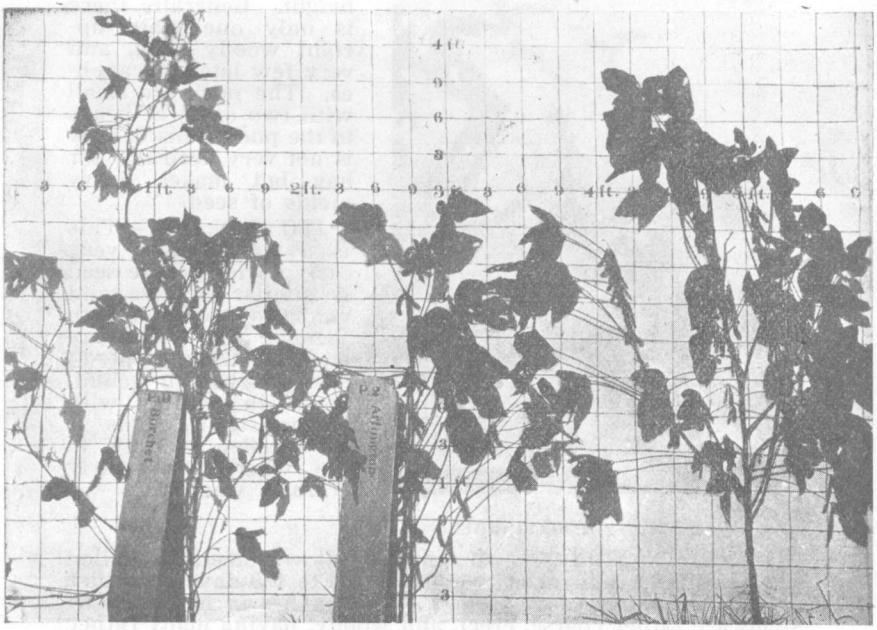
fuzzy, and yellow when ripe, bearing two or three medium size, yellow beans. This variety makes a satisfactory crop of both seed and hay, and being a rank growing variety may be used very satisfactorily for a green manure crop. It is well adapted to the Gulf States.

OTOOTAN.—This is a very late variety. The plants vary from 40 to 45 inches in height. The stems are rather fine, almost vine-like with considerable tendency to lodge when the plants are about grown. The branches spring out from 4 to 6 inches above the ground, an advantage in mowing. It has an abundance of leaves and cures readily. Its pods are brown and fuzzy and have two or three large brown beans. It is a promising variety for hay production and soil improvement.

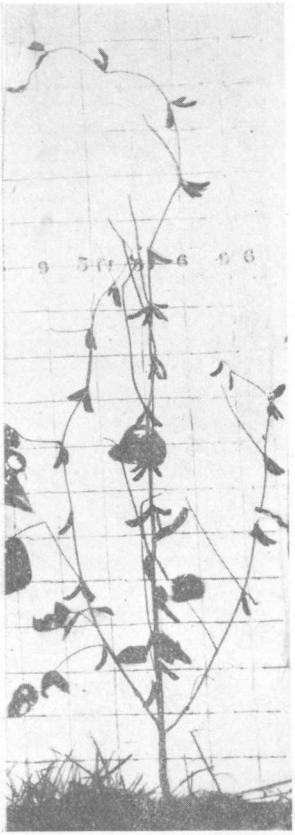
PEKIN 152.—The variety is early. The blooms are white and purple. The plants range from 24 to 36 inches in height. The plant is perfectly erect with rather fine stem and small, pale yellow foliage. This variety ranks well both as a seed and as a hay crop. The seed is black and small. There is practically no loss of seed from shattering.

RUELAND 20797.—This is a very late variety. The plants range from 36 to 40 inches in height. The stems are vine like, barely strong enough to give an upright form to the plants. The leaves are medium in size, and heart shaped. The beans are dark and small and do not shatter from the pods. This is a promising variety for hay.

SHANGHAI 14952.—This is a medium early variety. The plants range about 30 inches in height. The stems are strong,



Plants of Three Leading Varieties. From Left to Right: 1. Barchet; 2. Arlington; 3 Mammoth Yellow.



Plant of Wilson Variety

upright and woody; bearing rather weak lateral branches. The pods are medium to large and covered with brown fuzz. This variety proved to be promising.

SWAN 22379—This is a promising early variety. The blooms are white in color. The plants range from 20 to 30 inches in height. The stems are bunchy. The leaves are medium in size and heart shaped.

TOKYO 17267.—This is a medium early variety. The bloom is purple and appears about August 10 to 15. The plants range from 12 to 15 inches in height. The stems are low, woody, and spreading, and bear many lateral branches. The pods are medium in size and have two or three large green beans per pod. This is a promising dwarf variety.

VIRGINIA 32906.—It is an early variety. The color of the bloom is purple. The stem is semi-vine like, and beans small. This variety is good for hay.

WILSON (BLACK) 19185.—This is an early variety, the stem ranging from 36 to 40 inches in height. The stems are fine and erect with long ascending branches. Only a few of the branches are near the ground, which is an advantage in mowing. This variety makes abundant foliage and a fair production of seed. The seed is black and medium in size.