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Soybeans - Delta Branch Station

W. E. Ayres

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SOYBEANS

DELTA BRANCH STATION

By

W. E. AYRES

Fig. 1: Otootan Soybeans planted in 3 ft. rows on coco infested, buckshot soil yielding about 3 tons of hay per acre.

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SOYBEANS

DELTA EXPERIMENT STATION

By W. E. Ayres

The soybean (soy bean, soya bean, or soja bean) bids fair to become one of the leading crops of the Delta, if not the State. It is therefore proper that a portion, at least, of the available knowledge of the crop be summarized for the benefit and use of farmers and others interested. The aim of this resume is primarily to present the soybean information to the agricultural interests.

The soybean originated in Eastern Asia, probably in Manchuria, China, or Korea. It is referred to botanically as Glycine Hispida, Glycine Max, and Soja Max, the latter being the latest American nomenclature. Soybean literature is abundant, there being between 12,000 and 14,000 papers and volumes on the subject.

The importance of the crop is increasing very rapidly as indicated by Table 1 compiled from year books of the United States Department of Agriculture. In 1917 the United States only planted 460,000 acres for all purposes. This was a 50% increase over 1916 planting. Table 1 shows 168,000 acres for seed purposes. This was only 20% of the total 840,000 acres planted for all purposes. In 1924 2,566,000 acres were planted for all purposes. This is an increase of 736% over the 307,000 acres planted in 1916, and a 20% increase over 1923. The increase of the 1925 acreage over that of 1924 is more than 25%.

The growth of the soybean area in Mississippi has been very rapid. In 1920 only 4,000 acres are reported. The 1924 planting was 110,000 acres. This is an increase of 2,650% in 5 years, and a 144% increase over 1923. The 1925 increase is still greater. The growth of Delta acreage has been even more rapid than that of the State as a whole. The growth will, in all probability, increase even more in the future as mechanical harvesters are perfected, and oil mills in this section begin to crush the seed for oil and cake.

The soybean has been important in commerce for many years. In 1923 the United States imported 38,635,000 pounds of soybean oil and much cake and meal. The trade in soybean products between the Orient and other countries producing less cottonseed oil, meal, and cake than the United States is enormous.

TABLE I—ACREAGE, PRODUCTION, AND PER ACRE YIELD OF SOYBEAN SEED 1919-23

STATE	Thousands Of Acres Harvested					Five Year Average		
	1919	1920	1921	1922	1923	Acres	Bushels	Bushels Per Acre
North Carolina	82	91	113	100	105	98,200	1,641,000	16.6
Illinois	6	8	6	65	92	35,400	465,800	12.1
Missouri	6	7	4	15	70	20,400	254,200	14.0
Virginia	30	30	12	13	14	19,800	351,200	17.2
Ohio	2	8	8	31	50	19,800	279,800	10.6
Alabama	7	23	9	18	17	14,800	141,200	9.8
Indiana	2	3	4	20	40	13,800	184,200	13.0
Kentucky	7	8	6	6	6	6,600	88,800	13.4
Tennessee	2	5	8	6	6	5,400	46,400	8.2
Mississippi	8	1	2	8	8	5,400	73,800	13.5
Michigan		8	7	4	6	5,000	51,800	10.3
Wisconsin	1	4	4	7	4	4,000	36,000	9.5
Iowa				6	10	3,200	60,400	19.5
Georgia	2	2	1	3	7	3,000	34,800	11.4
Maryland				5	7	2,400	40,400	16.8
South Carolina	1	1	1	3	5	2,200	23,800	9.8
Delaware				2	3	1,000	15,000	14.9
Louisiana		1	1	1	1	800	11,000	13.9
Pennsylvania	2					400	7,200	18.0
West Virginia				1	1	400	6,000	15.0
United States	168	190	186	314	452	262,000	3,817,800	14.5

SOIL AND CLIMATIC CONDITIONS

Soybean growing is simpler than the production of any other common field crop. Soybeans may be grown successfully from the gulf coast to central Illinois. The varieties which are most profitable vary with the latitude, of course. The wettest arable Delta soils produce profitable crops of soybeans. Profitable crops were produced in 1924 when practically no rain fell from May to November. In 1923 when the rainfall was excessive, soybeans did well where other crops failed. The crop will stand much more extremely dry or extremely wet weather than either cotton or corn. IT IS THE DELTA'S SAFEST FEED CROP.

The soybean is adapted to practically all Southern soils. In the Delta it does well on all types of soil, from the worst buckshot to the lightest loam.

PRODUCING THE CROP

Seed Bed: A good seed bed is best but thorough disking is sufficient to produce good crops. There is little data available to indicate whether or not such preparation as should be practiced for corn is even desirable. At the Station good crops have been produced on land

which was only thoroughly disked but the plants seem better able to compete with weeds when a good, deep, seed bed is prepared. No soybeans or other crops should be planted amongst clods. The surface should at least be in good tilth, whether the seed bed is deep or not. On low lands soybeans should be planted on low beds, if planted in drills early.

Planting Dates: Soybeans may be safely planted in this latitude from March 25th to July 15th. Earlier planting will often survive since soybeans are hardy after the plants are a few days old. Any time after the plants are five days old they will stand a light frost—temperatures of 29 to 30 degrees F. or even less (nobody seems to know just how low a temperature they will stand). There are many volunteer beans on the Station which withstood a temperature of 28 degrees F. about March 10th. None of the volunteer crop on the Station was injured March 31, 1924, except those plants less than four days old. The frost was quite severe, as most planters will remember.

The early plantings are safest because of two factors. Soybeans tend to mature near a certain date (this date being dependent upon variety) regardless of the date of planting. Said another way, the difference between the dates of maturity of a certain variety planted on different dates is not nearly so great as the difference between the planting dates. Otooton beans planted May 9, 1923 only matured four or five days earlier than those planted June 22nd. The early plantings produce larger hay yields because of the longer growing period. The very early plantings get a better early start and are better able to compete with weeds and grass for space, plant food and moisture.

Early planting has another distinct advantage from the farm management standpoint. There are usually a few leisure days the last of March and the first of April on every cotton farm. The soybean crop must be planted during this time, compete with cotton planting for labor, or wait for planting until after all cotton is planted. If the land is to grow no other spring or summer crop than soybeans, it is best to plant them between the 25th of March and cotton planting time.

On land which grows oats, soybeans should either be planted with a grain drill in the oats during the above period, or planted on a well prepared seed bet immediately after the oats are harvested. Land growing other winter or spring crops should be planted as soon after the crops are off as possible. Good seed beds are very desirable for late plantings.

The Delta Station began a test of dates of planting in 1924. Unfortunately, no plantings were made until May 1st and no seed germinated after the June 1st planting. The yields of seed from duplicate

plots were as follows:

Laredos planted May 1st, 11.30 bushels; May 10th, 11.03 bushels; May 20th, 12.56 bushels; June 1st, 10.28 bushels; an average of 11.29 bushels per acre. Biloxi planted May 1st, 12.09 bushels; May 10th, 10.46 bushels; May 20th, 10.07 bushels; June 1st, 12.15 bushels; an average of 11.19 bushels per acre. Otootans planted May 1st, 4.47 bushels; May 10th, 4.70 bushels; May 20th, 4.07 bushels; June 1st, 7.62 bushels; an average of 5.22 bushels per acre.

This test is being continued with plantings made from March 15th to July 15th. Laredo, Virginia, Biloxi, and Otootan are the varieties used. It will be noted that Otootan and Biloxi produced more seed from the June 1st plantings in 1924. The early varieties usually produce more seed and more hay when planted early. Late varieties, such as Otootan, make more hay when planted early, but often the late plantings (May 20th to June 20th) produce more seed than early plantings.

Inoculations: Soybeans may be inoculated in various ways. The cheapest way is to obtain about a gallon of soil for each bushel of beans to be inoculated from a field known to be inoculated. This should be thoroughly dried in the shade, crushed and mixed with the beans. If the seed are moistened less soil will be required.

Pure cultures may be obtained from seedsmen or direct from the manufacturers. Full directions for using are sent with each bottle. The important point in using cultures is to be sure the source of supply is reliable. When seed are inoculated by either method, it is necessary to avoid direct sunlight. The seed must not be exposed to direct sunlight from the time they are inoculated until planted.

When soybeans have been grown on land previously, it is not necessary to inoculate the seed to be planted. The belief has been rather general in the South that all Southern soils were inoculated for soybeans. Most Southern soils are, but there were many soybeans failures in 1924, due to lack of inoculation. It is much safer to inoculate and the cost of inoculation is too small to justify the risk on land not known to be inoculated. Figure II shows nitrogen—adding nodules on a well inoculated plant.

Methods of Planting: Soybeans may be grown successfully alone, either in rows or broadcast. Good crops have been obtained on the Station from soybeans planted in oats, in corn, and from volunteer crops.

When soybeans are planted on land the first time, it is safer to inoculate the seed, plant in rows, and cultivate. This is especially true when the soil is thin, weedy, or grassy. After Delta land, or any other comparatively good land, has grown soybeans one year and becomes thoroughly inoculated, broadcast seeding is cheapest and safest.

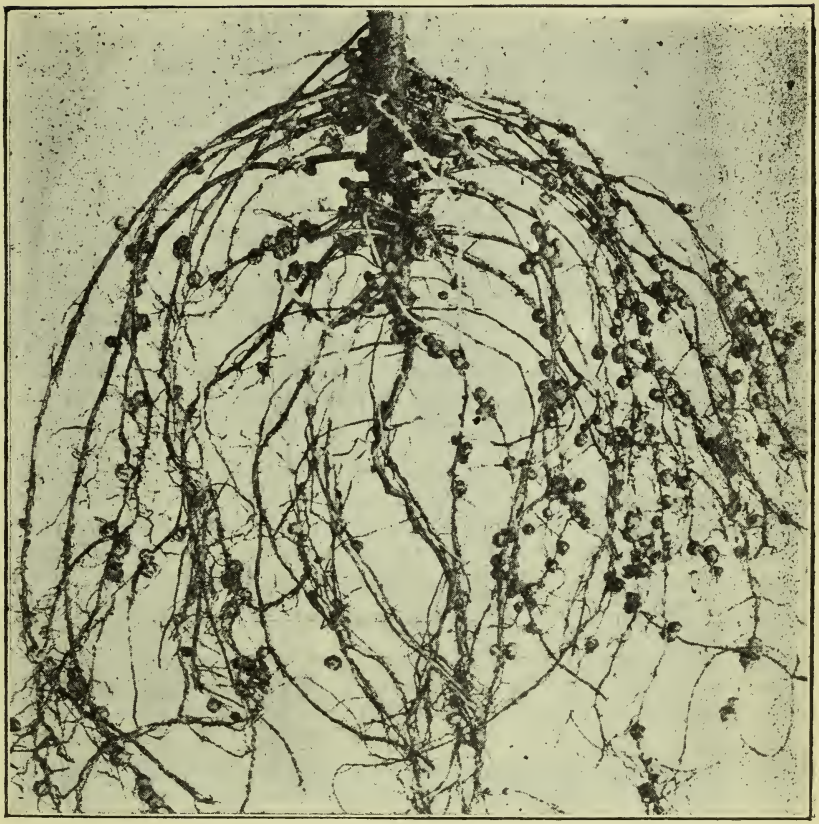

Fig. 2: Root of well inoculated soybean plant showing bearing nodules in abundance.

unless the land is badly infested with burrs or other rank growing weeds or grass. This is especially true if the beans can be planted before April 10th so they get started ahead of other vegetation.

If soybeans are planted broadcast on areas badly infested with coco, the rate of seeding recommended should be increased 50%. The soil should be thoroughly prepared and the beans planted between March 25th and April 10th. They must have an even start with coco. It is very important that sufficient moisture be present when the seeds are planted to insure prompt germination.

In the Delta, soybean rows should be about three feet wide. On poorly drained soil it is safest to plant on low beds, if early planting is practiced. Ordinary corn planters equipped with proper plates, plant soybeans satisfactorily. Where duplex hoppers are available, they are most satisfactory.

If soybeans are planted in rows on level land, seeding with the grain drill is the most economical method. Enough holes may be stopped to give the proper space between rows. In some areas two holes are left open and three stopped. This plants two rows eight inches apart, with 32 inches between the outside rows. In this way only one side of each row is cultivated. This method looks good, but the writer knows nothing about it in practice.

Depth of Planting: Before small seeded varieties were generally known, it was common knowledge that soybeans often germinated very poorly. This was especially true if they were not planted very shallow. The large seeded varieties often "break their necks" getting out of the ground, if planted a little too deep and a rain comes and a crust forms before the seeds germinate. It is difficult, at best, to get a stand of the large seeded varieties. Planting too deep increases this difficulty. Beans planted about an inch deep are more likely to produce stands than those planted at other depths.

The small seeded varieties, such as Laredo and Otootan, seem able to come through much deeper layers of soil than Mammoth Yellow and similar varieties. Land plowed from 5 to 7 inches deep and section harrowed in February 1925 has a perfect stand of volunteer Laredo Beans on it now. The 1924 crop was cut for hay and there was not an excessive amount of shattered beans on the ground. If the ground had been disked, it would be possible that the beans were brought to the surface by the disk. Volunteer plants have been dug up, which had come through three or four inches of soil. The above mentioned small seeded varieties have always given better and quicker stands than corn, when planted with the corn at the same depth. Too deep planting should be avoided even with small seeded varieties, but they may be planted with safety under average conditions up to 2½ inches, and probably deeper.

Volunteer Crops: In the spring of 1923, two acres of poorly drained, coco infested buckshot, Station land was planted in Laredo Soybeans for seed. They were cut with a mower October 12th. After they were hauled in the land was disked thoroughly and planted to Red Rust Proof Oats at the rate of 10 pecks per acre. Throughout the winter a volunteer stand of beans appeared after every warm spell of weather. These were killed by following freezes, but those which germinated after March 25th remained and were topped by the binder when the oats were cut.

Within three weeks after the oats were off the land, the soybeans had overcome all weeds and grass and were doing fine. They were cut for seed in October and the land again planted to oats. The winter of 1923-24 was very severe and the fall dry. Notwithstanding the severity of the winter, another volunteer stand appeared and produced a good crop.

Late in the spring of 1924 another buckshot area was planted to corn and soybeans. Otootans, Biloxis and Laredos were used. The stand of corn was very poor and hay scarce in the fall. The entire area was cut for hay. In February 1925, the land was plowed 5 to 7 inches deep and section harrowed. By March 25th a good stand was up on the entire Laredo area. Otootans have volunteered to some extent, but no full stands have been obtained, either on seed fields or where they have been grazed.

Two Hay Crops from Early Plantings: Oats in small areas of the volunteer Laredo field did not freeze out in 1924. These were cut with the mower. The oats were thin and the beans practically as tall as the oats. The cutting was done at different heights. There was no rain at all for six or eight weeks after the cutting was done, but those areas cut four inches high or higher, suckered and produced a better fall crop than those which were not cut. They seemed to withstand the dry weather better. The plants cut as low as two inches did not die for two or three weeks. It was evident that a rain would have saved them.

In 1925, a portion of the volunteer area was cut as nearly 4 inches high as possible on June 1st, and another portion on June 11th. Both areas bid fair to make good fall hay crops.

It seems entirely possible and practicable to expect two hay crops from plantings made prior to April 5th on good land, if the first cutting is made above the first branches. The first cutting should be made not later than June 20th. More experiments and observations are to be made and other varieties included in the work.

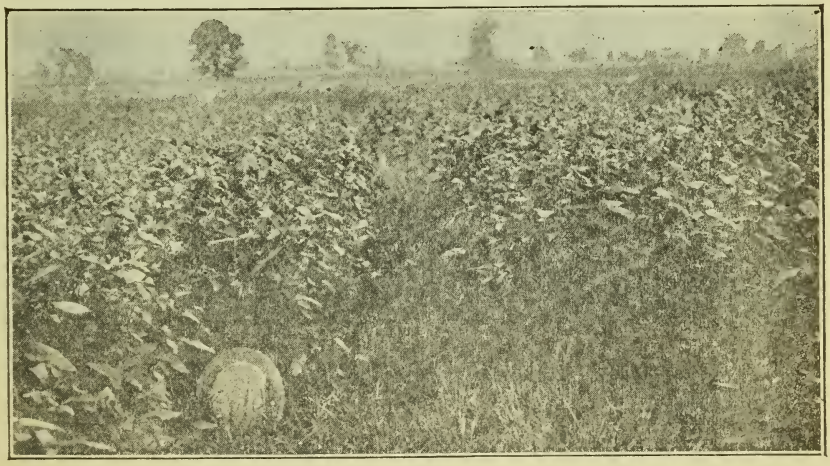

Fig. 3: Left, Laredo; right, Otootan Soybeans planted in fall oats with a grain drill, April 5, 1924. The oats were cut with a binder about June 1 t. Photographed September 1st.

Planting in Oats: The volunteer crops produced in good crops of oats led to tests with beans planted in fall sown oats. On March 20, 1924, plots of Laredos and Otootans were planted in fall sown oats with a grain drill. Other plots of the same varieties were planted April 1st and 10th. Figure III shows the plots planted April 1st. The photograph was made September 1st, following an extremely dry summer. Good stands were obtained from all plantings. The oats were cut about June 10th. There was no rain from the time the oats were cut until the beans were harvested. The first plantings were best until the middle of July, but the late plantings seemed to hold up best after the drought became extremely severe. The plantings made in oats in 1925 were in spring oats, all the fall planted oats having been winter killed. They were planted after the April showers. There was not enough moisture for germination, but enough to start them and cause them to fail to germinate. Plantings made with small seeded varieties between March 25th and April 10th on fall oats are comparatively safe. This method of handling facilitates feed production in that the beans do not compete with cotton for labor in the spring.

Fig. 4: Otootan Soybeans planted between the hills of corn with a duplex hopper on a Shawnee Planter.

Planting in Corn: Unless there is a special reason why it should not be done, every acre of Delta corn should be planted to beans at planting time. Table II shows that more grain—soybeans and corn—was produced where both soybeans and corn were planted together at corn planting time than where corn was planted alone. The plot on which the beans were planted in the corn, three weeks after planting the corn, produced the average record yield of grain but this would not be true if the beans could have been saved in 1922. The percentage of bean failures is too high when this is practiced and the labor cost too high. The yield of forage is also much less and the increased yield of future crops correspondingly less also.

The question of what the earliest safe date of planting is comes up every spring. As previously stated, soybeans withstand comparatively low temperatures after they are a few days old. Some experimenters in the Northern States believe soybeans will stand colder weather than corn. This has not been the observation of the writer, unless the cold weather comes after the plants are more than five days old. They are hardy enough, however, and will probably escape injury nine years out of ten, if planted as late as March 25th. It is cheaper to plant both at the same time, everything considered, if the corn is to be planted as late as March 10th. Occasionally the beans will get killed and the corn survive. When this happens the beans can then be dropped between the corn plants when the corn is thinned and covered as the corn is plowed.

TABLE II—CORN AND SOYBEANS IN COMBINATION 1921-2-3-4

Combination Used	Bushels of Grain per Acre				
	1921	1922	1923	1924	Average
Yield of Corn					
Corn 24" Beans between hills at planting	18.0	23.4	23.5	5.7	17.7
Corn alone 24" in the drill	21.1	34.9	28.4	12.4	24.2
Corn 24" Beans between hills 3 weeks later	20.9	33.5	28.6	6.9	22.5
Corn 24" Beans in alternate rows	12.9	24.1	18.8	6.9	16.0
Corn alone 24" in the drill	21.1	34.9	28.4	12.4	24.2
Yield of Threshed Soybeans					
Corn 24" Beans between hills at planting	3.32	(1)	14.16	4.02	7.17
Corn 24" Beans between hills 3 weeks later	Failure	Failure	10.02	4.08	4.70
Corn 24" Beans in alternate rows	5.40	(1)	8.35	4.03	5.93
Corn 12" Beans in alternate rows	3.85	(1)	8.80	6.17	6.27
Total Yield of Grain—Both Corn and Soybeans					
Corn alone 24" in the drill	21.10	.....	28.40	12.40	24.20
Corn 24" Beans between hills at planting	21.32	.....	37.66	9.72	24.87
Corn 24" Beans between hills 3 weeks later	20.9	.....	38.62	10.98	27.20
Corn 24" Beans in alternate rows	18.30	.....	27.15	8.73	21.03
Corn 12" Beans in alternate rows	18.90	.....	27.60	13.07	22.27
Corn alone 24" in the drill	21.10	.....	28.40	12.40	24.20

(1) A good crop of Mammoth Yellow Soybeans was produced but a few wet days followed by hot sun at harvest caused them all to pop out. Otootans were used in 1923 and 1924.

When corn and beans are both drilled in the same row the duplex hopper, which plants beans from one side and corn from the other, is a most economical and satisfactory means of doing the planting. Plates may be obtained for duplex hoppers of the various types of planters, which will either drop beans and corn in alternate hills, in the same hills, drop the corn in hills and drill the beans continuously, or drill both corn and beans. Plates which drop 3 to 4 grains of corn every 24 inches with 6 to 8 beans midway between seem most satisfactory, everything considered. Dropping the corn in hills and thinning to one plant facilitates uniform thinning with a minimum of labor and labor supervision. This also facilitates hoeing the corn without destroying the beans. This is, of itself, a very important factor. Those who expect to produce corn and beans together without hoeing or thinning should plant beans all along and one or two grains of corn every 24 inches on average land. Figure IV shows corn and beans planted with a duplex hopper. The corn has been thinned to one plant.

If a duplex hopper is not available the two may be planted together by mixing the corn and beans and planting through an ordinary corn hopper. A plate having larger holes than for corn alone should be used. A somewhat more nearly regular stand of corn and beans can be obtained by running two planters (one behind the other) and planting the corn with one and beans with the other. Either of these methods plants the beans and corn together rather than in separate hills. The former does not give uniform stands. The latter involves two operations and is rather expensive. The use of duplex hoppers is the economical and satisfactory way but by no means the only way to plant corn and beans together. Figure V shows a satisfactory yield of Cocke Prolific Corn and Laredo soybeans.

If corn is planted in checks—and most Delta corn should be so planted—with a regular check-row planter, or by hand, beans and corn should both be planted in every hill. There are check row planters made which have duplex hoppers and handle both corn and beans regularly. If the planter used does not have duplex hoppers, reasonable results may be obtained by mixing the corn and beans and planting together through ordinary hoppers.

If beans grown in corn must be utilized for hay, planting corn and beans in alternate rows is probably the best practice, unless plenty of hay-barn space is available. The rows should be three feet apart. The corn should be left 12 inches apart on good land and 18 inches on the thinner soils. Nitrate of Soda should be applied to the corn rows only. The bean rows should be planted so as to have a thick stand. The plants should stand as thick in these as where beans are planted alone in rows for hay.

Fig. 5: Cocke Prolific Corn and Laredo Soybeans planted with a duplex hopper April 12, 1924. Photographed August 20th.

TABLE III.—RESIDUAL EFFECT OF OTOOTAN SOYBEANS PLANTED IN CORN

Combination in 1923	Lbs. Seed Cotton Per Acre 1924			
	Actual Yield	Corrected Yield		Per Cent Increase
		Total	Increase	
Corn 24" in Drill Alone	1533.6	1500.2	.....	.....
Corn 24" and Otootans Between Hills at Planting	2186.8	2158.0	657.8	43.8
Corn 24" and Otootans Between Hills 3 Weeks After Planting	2227.3	2217.5	717.3	47.8
Corn 24" and Otootans in Alternate Rows	2326.1	2336.5	836.3	55.7
Corn 12" and Otootans in Alternate Rows	2187.6	2217.3	717.1	47.8
Corn 24" in Drill Alone	1466.7	1500.2	.....	.....
Average Increases	.....	.....	732.2	48.8

The purpose for which the beans are planted, the date the corn is planted, the variety of corn planted and the character of the soil all enter into the determination of what variety should be used.

If the beans are intended for pasture or hay more than one variety should be used. A portion of the area planted to Yellow Dent, Silvermine, or some other early variety of corn and Virginia Beans will furnish some early corn for grain and some early beans for fall pasture. This should be followed by a small area of Paymaster, or some other similar corn and Laredo, or Mammoth Yellow Beans. The main acreage should then be planted to Mosby, Cocke, or other high producing prolific corn and Otootan or Biloxi beans. There are two serious objections to Mammoth Yellows. They germinate poorly under many conditions and they pop out very badly after maturity.

If increased soil fertility is the aim, there are none better than Otootan and Biloxi. The former is considerably safer from the standpoint of obtaining stands. Table III shows an increase in cotton production of 732 pounds of seed cotton per acre in 1924, due to a heavy crop of Otootans in corn in 1923. This cotton at ten cents was worth $73.20 per acre. The increase will not be so great every year, but it is well worth considering. Figure VI shows the cotton produced on the plots which had soybeans the year before and on those which grew corn alone.

Fig. 6. Left, cotton grown in 1924 after corn alone in 1923 produced 1500.2 pounds per acre. Right, cotton on adacent plots following corn and soybeans produced 2232.4 pounds per acre or 732.2 pounds per acre more. An increase of 48.8 per cent in the cotton yield the following year is some encouragement to plant soybeans in the corn.

On areas infested with coco or other bad, low-growing grasses, Otootan is the best variety now available because of its ability to produce maximum shade in a minimum of time. Laredos rank next to Otootans in ability to produce shade. It is important on infested land to plant plenty of beans and to plant both corn and beans as early as is safe on a well prepared seed bed.

The viny varieties—Otootan and Laredo—planted in corn assist materially in preventing the growth of grass in the corn row early in the season. If the corn is kept clean until the beans are knee high, they will usually furnish sufficient shade to prevent the middles from growing up in grass and weeds. This facilitates working the following crop.

Rate of Seeding: The rate of seeding depends upon the variety and the method of seeding. There is very little experimental evidence to indicate what the proper rate of seeding is. Observations of the writer indicate that the rates recommended for the various varieties in Table V are approximately correct. Rates of seeding test failed in 1924 for lack of moisture to germinate the seed. Rates of seeding four varieties—Virginia, Laredo, Biloxi and Otootan—are being tested in 1925. Laredos are planted at the rate of 6, 9, 12, 15, and 18 pounds per acre in 3 foot rows. The other varieties were planted so as to have the same number of plants per acre as the Laredos at the above rates. This test will be continued until definite conclusions as to the proper rates of seeding are possible.

Cultivation: There is very little definite data regarding methods and amounts of cultivation which are most economical in the production of a crop of soybeans. Five years observation indicates that enough cultivation to keep down the weeds is all that will pay. Beans planted in rows on the Station have been cultivated the same as cotton but only half as often. Three cultivations are usually sufficient and two will do on clean land. On bad coco lands more cultivation is necessary for best results. With perfect stands no hoeing is necessary even on coco lands. On lands infested with burrs or Johnson Grass it is necessary to chop these weeds out one time. This should be done when the beans are about 10 to 12 inches high. If they are cleaned out at this size, weeds and grass have little chance of getting another start.

VARIETIES

Soybean varieties are very numerous and very diverse in their habits of growth, dates of maturity, yield, size of seed, color of seed and many other characteristics. The majority of varieties grow erect, but are branched with a well defined main stem or trunk, but some of the most valuable are very viny and tangle very badly. Soybean leaves are made up of three leaflets. There is great variation in the

color, size, and shape of the leaves of the various varieties. So insensibly do these leaf characters merge that they are useless in varietal differentiation, except in very rare cases. In this section the size of the leaflet varies from ¾ inches wide by 1⅝ inches long to 2 inches wide and 4½ inches long. The color is one of the various shades of green.

Flower Color: All varieties tested so far at the Delta Station have either white or purple flowers. Some varieties can be distinguished by the color of the flowers, but many varieties have flowers of both colors. The plants of the same variety often seem to vary in no other important character than flower color.

Pods: Varieties vary greatly in the size of the pods. Most pods are flat, or nearly so, and are between 1½ and 2½ inches long. The pods of a few varieties are nearly cylindrical. Some are less than 1½ inches long and some may have pods 3½ inches long. There are usually from 3 to 6 pods to the cluster at each node or joint.

Most varieties shatter rather badly if handled when dry. Several varieties pop out very promptly after maturity and are therefore lost to harvesting, unless gathered at the right time. Biloxi pops out very little if any, and shatters very little unless cut when thoroughly mature and handled when very dry. Otootan pops out very little and does not shatter badly. Laredo pops out and shatters much less than Mammoth Yellow, but more than the above varieties. Many Laredo selections are being tested in the hope that a strain may be found which pops and shatters little and has the other desirable characteristics of the parent variety.

Size, Shape and Color of Seed: The various varieties vary greatly in size. The largest seeded varieties sometimes run as low as 60,000 seed per bushel, while those having the smallest seed may have more than 700,000 seed per bushel of 60 pounds. The size of the seed varies much within the variety. Seed grown under favorable soil and moisture conditions are much larger than those of the same variety grown under adverse conditions.

The shape of the seed varies with the varieties from almost a sphere, in some varieties, to seed which are very thin and flat and elliptical in shape in other varieties. Figure VII shows the shape and relative size of the seed of 18 varieties. Table IV gives descriptive data on 51 varieties.

The color of the seed is variable. Yellow, black, brown and green are the common colors. Varieties with yellow seed are most numerous, but several of the most important varieties for this section are black and some are brown. One or two green seeded varieties look promising.

TABLE IV. DATA ON 51 VARIETIES OF SOYBEANS

Variety	Earliness Days to		Character of Variety				Introduced From
	Mature	Flower	Plant Type	Seed color	Seed Per Bushel	Percent Oil	
A. K.	110	53	Erect	Yellow	159,000	19.2	Manchuria 1912
Aksarben	110	43	Erect	Yellow	161,000	19.0	Manchuria 1913
Aksarben	110	43	Erect	Yellow	161,000	19.2	Manchuria 1913
Barchet	160	83	Viny	Brown	645,000	13.3	China 1908
Biloxi	165	88	Erect	Chocolate	112,000	20.1	China 1908
Black Beauty	Same as Ebony						
Black Eyebrow	110	38	Erect	Brown	148,000	19.9	Manchuria 1911
Chestnut	105	43	Erect	Russet	195,800	18.3	U. S. D. A. 1907
Chiquita	135	68	Semi-Viny	Yellow	242,000	17.6	China 1910
Columbia	125	53	Erect	Green	200,000	18.7	China 1908
Early Brown	110	43	Erect	Brown	182,400	17.7	Ito San E. Black
Easycook	125	53	Erect	Yellow	162,200	19.3	China
Ebony	120	48	Erect	Black	194,400	18.4	Korea 1900
Elton	110	38	Erect	Yellow	130,000	17.4	Siberia 1906
Guelph	115	48	Erect	Green	149,000	19.5	Japan 1889
Hoosier	115	38	Erect	Yellow	150,700	19.3	Manchuria 1911
Haberlandt	125	53	Erect	Yellow	144,000	19.4	Korea 1901
Hamilton	125	53	Erect	Auburn	123,800	19.2	Ohio Station
Habaro	110	40	Erect	Yellow	188,200	19.6	Siberia 1906
Hahto	130	58	Erect	Yellow	74,800	17.9	Japan 1915
Hollybrook	135	63	Erect	Yellow	157,400	18.2	T. W. Wood 1902
Ito San	105	43	Erect	Yellow	198,900	16.9	Japan 1890
Laredo	140	78	Viny	Black	466,500	14.0	China 1914
Lexington	125	53	Erect	Yellow	215,000	19.1	U. S. D. A. 1907
Mammoth	145	88	Erect	Yellow	128,700	18.6	Origin Unknown
Mammoth Brown	135	68	Erect	Russet	111,300	16.5	Origin Unknown
Manchu	115	38	Erect	Yellow	141,000	18.9	Manchuria 1913
Mandarin	100	38	Erect	Yellow	174,700	19.8	Manchuria 1911
Med. E. Green	Same as Guelph						
Med. E. Yellow	Same as Ito San						
Med. Green	Same as Guelph						
Med. Yellow	Same as Midwest						
Merko	120	43	Erect	Olive	294,600	16.4	Siberia 1906
Minnsoy	100	38	Semi-Viny	Yellow	221,700	16.3	Minn. Station
Midwest	115	48	Erect	Yellow	243,000	15.0	China 1901
Mikado	120	48	Erect	Yellow	185,200	18.2	Mongol Sel. 1905
Mongol	Same as Midwest						
Morse	130	58	Erect	Yellow	149,700	18.1	Manchuria 1906
Ogemaw	85	33	Erect	Chocolate	188,000	17.5	Blk. & Dwf. Brown
Otootan	170	98	Viny	Black	368,600	17.7	Hawaii 1911
Peking	120	53	Erect	Black	383,300	16.00	China 1907
Pinpu	105	38	Erect	Yellow	160,300	18.4	Manchuria 1910
Sable	Same as Peking						
Tar Heel Black	140	78	Erect	Black	163,200	18.6	China 1905
Tokio	145	74	Erect	Yellow	134,400	18.4	Japan 1901
Virginia	125	53	Semi-Viny	Olive	207,300	17.9	Morse Selection
Wilson 5	120	53	Viny	Black	301,400	15.2	Wilson Sel. 1912
Wilson	120	53	Viny	Black	301,400	18.4	Manchuria 1906
Wis. Black	100	45	Erect	Black	185,200	17.7	Wis. Station
Wea	110	38	Erect	Yellow	194,900	19.6	Manchuria 1911
Yokotenn	120	53	Erect	Yellow	170,000	19.9	Japan 1907

The data in this table are compiled from Station publications, books, and other reliable sources.

Earliness: Varieties vary greatly in the time required to mature Table IV shows that Ogemaw only requires 85 days to mature, while Otootan requires 170 days, or just twice as much time. The date of planting has much to do with the length of time required to mature. Otootans planted March 20th mature only 5 to 10 days earlier than the same variety planted June 15th. This lengthening of the period of growth is not so great with earlier varieties. Experiments at the Delta Station with four important varieties indicate that the first 3 or 4 plantings, which usually extend over a period of 30 to 45 days, are harvested together in normal years.

The spring of 1925 was abnormally dry. Soybeans did not behave ordinarily. Laredos which germinated about March 12th to 15th had many mature beans on them by June 25th. In other years Laredos, the same age, have not begun to bloom until the last of July or the first of August. Virginias planted from March 20 to April 1, 1925 were ready to cut for hay by July 1st. Ordinarily, they would not have been so far matured before August 15th. The dry hot weather seemed to speed up maturity in the soybeans the same as in cotton. Much of the early planted cotton was as far advanced July 1st as it would have been in normal years August 10th.

VARIETIES DESCRIBED: With soybeans as with other feed crops, yield of grain and forage is the most important factor in the selection of varieties. Earliness, habit of growth, shattering, popping out, character of forage produced, retention of leaves, etc., must also be considered. Table V shows hay yields of the varieties tested for hay. In Table VI grain yields are given for those tested for grain. Many other varieties are being tested in 1925 and it is hoped that high producing, early varieties adapted to this section will be found. The descriptions given below apply to Delta growth.

Barchet: A very tiny variety intermediate between Laredo and Otootan in its habit of growth; very late—usually matures only a few days before frost, regardless of the planting date; flowers purple; seed brown, oblong, and very small; 16.62 pounds equal 60 pounds of Mammoth in number of seed. The seed germinate well. A good variety for hay and soil improvement. It may be planted interchangeably with Otootan when seed are available.

Biloxi: An upright grower very similar to Mammoth, except that it grows taller and produces more hay and grain than Mammoth. Unless planted very thick, the stems are large and woody. The flowers are purple and the seed dark brown and large. 57.96 pounds of Biloxi equals 60 pounds of Mammoth in number of beans. Biloxi is a late variety, usually maturing about ten days or two weeks before frost. It is a heavy grain yielder and is well adapted to hogging or pasturing with other livestock. The beans do not pop out in the field and shatter very little in handling. It is excellent for planting in

corn, for pasturing, and is a good hay producer. The hay is rather stemmy and is not so well cleaned up by livestock as that produced from Laredo, Otootan, and other viny varieties. Since the seed are large it is not as easy to obtain a stand under unfavorable conditions as with the small seeded sorts. Everything considered, it is an excellent variety. Its high oil content makes it very desirable for crushing.

Ebony: There seem to be two black seeded varieties on the market as Ebony. The one here intended has seed which are very small and almost spherical (very similar to, and easily mistaken for, Otootan). The habit of growth is semi-viny, similar in many respects to Virginia. This variety has never been grown at the Delta Station, except for observation. The small size of the seed makes it inexpensive to plant. Maryland and Alabama have both found it a good early variety. It should not be expected to yield as well as the late varieties.

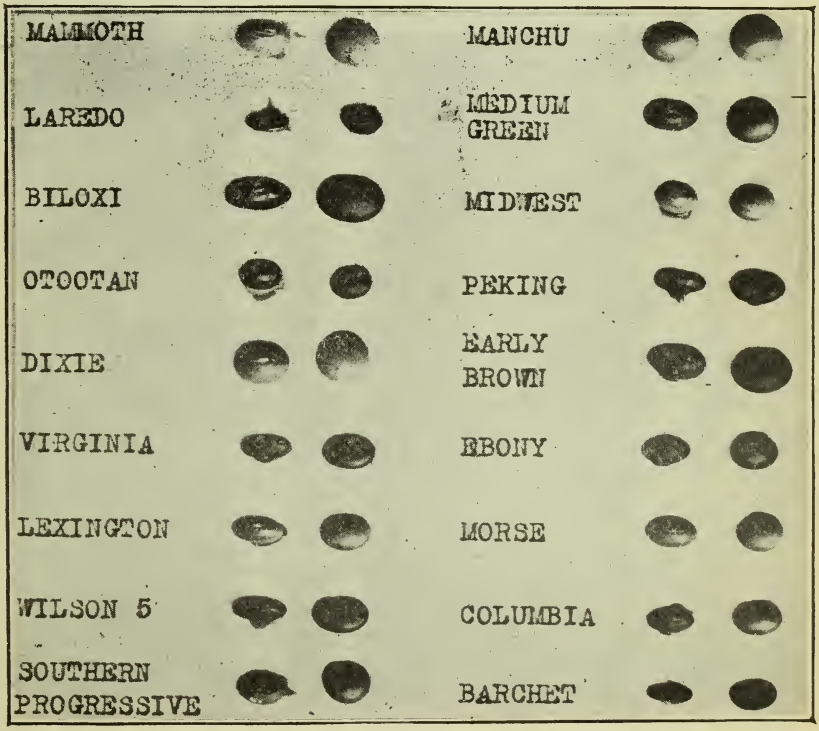

Fig. 7: Seed of 18 varieties of soybeans. Note shape and size.

TABLE V YIELDS OF VARIOUS HAY CROPS

Crop and Variety	Pounds of Air Dry Hay Per Acre		
	1922	1923	Average
VARIOUS CROPS COMPARED—FLAT BUCKSHOT SOIL			
Mammoth Soybeans	3,300	1,010	2,155
Whippoorwill Peas	*	*	*
Mung Beans	2,730	2,030	2,375
Early Speckled Velvet Beans	*	560	280
Japanese Sorghum	12,780	5,580	9,180
VARIETIES OF SOYBEANS—FLAT BUCKSHOT SOIL			
Wilson	4,100	2,620	3,360
Virginia	5,320	3,500	4,410
Laredo	5,360	2,960	4,160
Mammoth	7,610	1,440	4,525
Barchet	5,250	.....	.....
Biloxi	7,360	3,120	5,240
Otootan	7,280	4,170	5,725
VARIETIES OF COWPEAS—LOAM SOIL			
Whippoorwill	3,560	1,300	2,430
New Era	3,460	1,490	2,475
Brabham	3,220	1,860	2,540
Groit	2,960	1,350	2,150
Victor	3,440	.....	.....
Clay	3,060	1,580	2,320
Unknown	3,940	1,720	2,830

*Failure

TABLE VI SOYBEAN VARIETY TEST FOR SEED 1923-24

Variety	Bushels per Acre			Pounds Required to Seed an Acre			Rank in Earliness
	1923	1924	Average	Broadcast (1)	In Drills (1)	In Corn	
Peking	10.11	6.50	8.31	74.10	18.53	12.35	2
Virginia	9.70	11.93	10.82	78.05	19.51	13.01	3
Mammoth—01	20.92	13.51	17.22	150.00	37.50	25.00	10
Mammoth	21.31	11.64	16.48	150.00	37.50	25.00	11
No. 37254 U. S. D. A.	11.52	12.91	12.22	111.80	27.95	18.63	7
No. 44210 U. S. D. A.	7.94	14.55	11.25	128.90	32.23	21.48	5
No. 37261 U. S. D. A.	8.72	7.72	8.22	128.90	32.23	21.48	6
No. 46687 U. S. D. A.	5.41	11.40	8.41	144.90	36.23	24.15	4
No. 37396 U. S. D. A.	12.81	10.94	11.88	144.90	36.23	24.15	8
Biloxi	33.42	13.84	23.63	144.90	36.23	24.15	12
Otootan	22.79	7.51	15.15	64.95	16.24	10.83	13
Laredo	12.01	10.43	11.22	42.05	10.51	7.01	9
Wilson	7.96	9.06	8.51	66.10	16.53	11.02	1

(1) On areas heavily infested with bad grass these rates should be increased 50 per cent.

Laredo: This variety was introduced from China in 1914. Under favorable conditions it is strictly a viny variety. In dry seasons, on poor soil, it is slender and erect. The habit of growth is shown in Figures 5, 8, and 10. In this section it matures 10 days or two weeks earlier than Mammoth Yellow, usually maturing in 135 to 145 days. The seed are very small, flat, black, and oblong. 16.82 pounds of Laredo equals 60 pounds of Mammoth in number of beans. The flowers of some plants are white while other plants have purple flowers.

The increase in popularity and acreage enjoyed by Laredo Soybeans has been phenomenal. A small sample was obtained from W. J. Morse, of the Bureau of Plant Industry, U. S. Department of Agriculture in the spring of 1921. These were planted in rows on bad buckshot land on the Station farm along with 20 other varieties. The yield was 35 bushels per acre. Many of the other varieties produced less than 10 bushels under identical conditions. In the spring of 1922, two acres of flat, coco infested, buckshot land was planted to Laredos in rows. This produced an enormous tonnage of forage and 25 bushels of beans per acre. A volunteer crop on the same area in 1923 produced 26 bushels per acre. It is a good seed producer.

Laredo is one of the Delta's most popular hay varieties. It produces an average yield of high quality hay. The stems are fine and the percent of grain high. It is early enough to be harvested in warm weather—usually the latter part of September—and late enough to be productive. For planting in corn on coco land, it ranks next to Otootan. If the beans in the corn must be cut for hay the corn and Laredos should be planted before April 20th, or the beans may ripen ahead of the prolific varieties of corn.

Fig. 8: Left, Laredo; Right, Otootan. Note relative growth.

Laredo germinates better, under unfavorable conditions, than any other variety tested. Perfect stands have been obtained when Biloxi failed to germinate and Otootan produced slightly broken stands under identical conditions. It is an excellent variety for the Delta. Seed should be bought from reliable dealers. Arlington, Peking, and Wilson may be mistaken for Laredo.

Lexington: A bushy, medium early, (about as early as Virginia), greenish yellow seeded, small seeded variety. A very popular variety in the north central south. It has only been grown in the observation test at the Delta Station. 32.0 pounds of seed will plant as far as 60 pounds of Mammoth.

Mammoth Yellow: This is the old standard variety in the South. Until recent years, the terms Mammoth and soybeans were synonyms in the mind of the average southern farmer, because it was the only soybean grown generally. The plants are erect and the period of maturity 140 to 150 days. Figure IX shows the habit of growth when planted in wide rows. Planted in narrow rows, fewer lateral branches are produced and the plants are more nearly erect. The seed are large, there being only 2,473 per pound against 8,826 of Laredos and 8,930 Barchets per pound. The flowers are white. Mammoth is a good producer of both hay and grain. The hay is rather stemmy, unless the stand is very thick. When planted for grain, it is essential that harvesting be done in time. If allowed to become slightly over ripe,

Fig. 9: Left, Mammoth; right, Virginia. Note relative growth.

the pods will all pop open and the beans be lost. This habit probably accounts for frequent failures to obtain stands with this variety. Much seed is harvested before mature. If such seed is not properly stored it heats and loses its vitality. Bad stands result. All large seeded varieties break their necks "more or less" in getting out of the ground, if conditions are unfavorable. Good stands of Mammoth can be obtained, however, if the seed are sound, good seed beds are prepared, the seed are planted 1½ inches deep or less, and weather conditions are favorable.

Morse: Very similar in most respects to Lexington. It is 5 to 10 days later than Lexington and the seed are a little larger.

Otootan: This variety was introduced by C. E. McClelland from Hawaii in 1911. For some reason its many good qualities were not quickly detected. It was planted first at the Delta Station in 1921. From the beginning, it looked promising for hay and to plant in corn. The frontispiece and Figure VIII show its habit or growth at the Delta Station. Otootan is strictly a viny variety under average Delta conditions. Planted late on poor soil in an extremely dry season, the plants produced are slender and erect. In number of seed, 21.2 pounds is equivalent to 60 pounds of Mammoth. The seed are black and nearly spherical. The seed of Black Beauty, Ebony, and Cloud are easily mistaken for Otootan. Those unfamiliar with the size and shape of the seed may mistake Peking, Wilson, and Arlington for Otootan. Seed should be purchased from reputable dealers.

With normal weather in the Delta, Otootan matures just before frost, if planted between March 15th and June 15th. An abnormally early frost may catch any Otootan crop before maturity. The early plantings produce very heavy crops of hay of good quality. The trouble with Otootan for hay is its late maturity. Just before frost the days are cool and short, making it hard to cure dense growths of hay crops. If cut earlier, less grain is obtained, the hay yield is smaller, and that produced has a lower feeding value. Later plantings produce higher percentages of grain but less hay. Otootan shatters and pops out very little.

To plant in corn, there is no better variety than Otootan. It makes rapid growth and chokes out weeds and grass in the row early in the season. Its habit of running over the entire row and middle and staying green until frost makes it ideal to plant in corn, or alone, on areas infested with coco or other bad low-growing grasses.

Stands are easily obtained with Otootan. When conditions are extremely unfavorable Laredo germinates better than Otootan. Laredo volunteers much more readily than Otootan, but fair stands of volunteer Otootans have been obtained. Otootan is one of the best varieties to

plant in oats in late March or early April. It is a little more vigorous grower than Laredo and is better able to compete with any weeds that may be left over after the oats are cut.

Peking: An early, semi-viny, small seeded, black seeded variety which offers some promise for extremely early hay. The seed are easily mistaken for Laredo, although they are larger and not nearly so flat. In number of beans, 29.64 pounds is equivalent to 60 pounds of Mammoth.

Virginia: An early, high producing, semi-viny variety. The seed are brown, small—31.21 pounds equals 60 pounds of Mammoth in number of beans—oblong, germinate well. The flowers are purple. The plants grow upright to a height of 30 to 40 inches, after which the ends of the branches and the main stems twine. Figure IX shows the relative growth of Mammoth and Virginia in wide rows.

Virginia produces a good yield of hay of good quality. Planted between March 25th and June 1st, the hay will be ready to harvest between July 25th and August 15th, in normal seasons. This period is very satisfactory on cotton plantations for harvesting at least a part of the hay crop, since it does not compete with cotton picking for labor. Virginia is becoming a popular hay variety. In addition to the above good qualities, the seed are cheap and abundant.

Wilson: Under normal Delta conditions, Wilson is a viny variety similar in character of growth to Laredo. It is very early and produces much less hay than Laredo or Virginia. It matures hay 10 to 15 days earlier than Virginia. The seed are small, 26.43 pounds being equal in number to 60 pounds of Mammoth, black, slightly flattened, oblong and are quite easily mistaken for Laredo. This variety has no place in this section except for extremely early hay or as a catch crop to plant very late. With favorable seasons, Peking and Wilson will make hay planted as late as July 20th.

Fig. 10: Laredos broadcasted May 10th. Photographed September 1, 1924.

USES OF SOYBEANS

The uses of soybeans are many. Probably no other common Southern field crop can be profitably used in so many various ways. In the Orient it is grown primarily for its seed but not so in the United States and especially in the South. From 16 to 25% of the American acreage is harvested for seed and the balance used for other purposes. In the Delta probably less than 10% of the acreage, on the average, is harvested for seed.

Plowing down soybean fields as green manure will pay well but not so well, perhaps as letting the crop mature and feeding as hay. pasturage, silage, or as a soiling crop (cutting and feeding green).

SOYBEANS FOR HAY: As a Delta hay crop the soybean is hardly excelled, if equalled. Yields are very satisfactory and the feeding value high. The protein content is high because of the nature of the plant and high proportion of grain produced. Delta farmers can grow no other hay, economically, which is so nearly "both corn and fodder" as the soybean produces. Feeding tests indicate that Alfalfa hay is not equal in feeding value to soybean hay. This is especially true when the beans produce an average grain crop.

Idle work mules or horses can be kept in good condition on soybean hay alone. Work animals should receive ¾ to 1¼ pounds of corn per day for each 100 pounds of live weight in addition to the hay. But it is possible to maintain animals doing light work on good soybean hay alone.

Harvesting and Curing Soybean Hay: Soybeans should be cut for hay as soon as the top pods are well formed. Cut at this stage few leaves will be lost and the beans are at their best regarding palatability, and the quantity of total digestible nutrients contained in the hay. If cut earlier the yield is less and the plants more watery and harder to cure. If cut later more leaves will be lost in handling and the stems become woody and less palatable and digestible.

The length of the possible harvest period is much greater than with cowpeas. Soybeans may be cut much earlier or left uncut much later than indicated above and still produce hay of fair quality. This enables soybean hay producers to extend the harvest period to avoid bad weather and to care of shortages of labor.

Due to less moisture in the green plants soybean hay is much easier cured than cowpeas. It should be cut after the dew is off and let lie in the swath until thoroughly wilted when it should be raked into windrows. Leave in the windrows 12 to 24 hours and make into high narrow cocks. A better quality of hay is obtained if most of the curing is done in the cock. Well made cocks will stand much wet weather with little damage. If hay loaders are to be used the wind-

rows may be made large by rolling two or three small ones together with a side delivery rake and letting the hay cure in the windrows. Much less labor is required and cheaper hay is obtained. If labor is expensive, it is doubtful if the increase in quality will justify the expense of cocking. The hay should not be stacked or housed until it is absolutely well cured.

Very heavy growths of Laredo, Otootan, and other viny varieties often are very troublesome to cut, due to the practical impossibility of preventing the cut vines of each swath from choking the blade when the next swath is being cut. This is especially true when the seed are permitted to mature and many, if not most, of the leaves have fallen. This trouble can be prevented by having a side delivery rake follow the mower and move the cut swath out of the way.

Yields of Soybean Hay: Table V shows the yields of various crops in 1922 and 1923. These crops were planted after oats each year. Because of dry weather all crops planted after oats at the Delta Station in 1924 failed. On flat buckshot soil Japanese sorghum has averaged 9,180 pounds per acre; Mung Beans, 2,375; Mammoth soybeans, 2,125 pounds; and Early Speckled Velvet Beans only 280 pounds per acre. Whippoorwill Peas failed both years. This type of soil will not grow peas profitably. Unfortunately, Otootan and Laredo Soybeans were not used in this test. But the soybean variety tests were conducted on land very similar and the treatment was in every way identical. In

Fig. 11: A good stand of broadcast Otootans. The hat is on the ground.

the latter test Otootan soybeans averaged 5,725 pounds of hay per acre. The latter hay contained at least 15 bushels of grain. This makes the Otootan soybean compare favorably with sorghum hay, and the effect on the soil is all in favor of the soybeans. The variety test of cowpeas has been conducted on well drained loam soil. For this reason the hay yield should be greater than that of soybeans. The reverse is true. The best variety of soybeans has produced 100% more hay than the best variety of peas. In addition to the increase in yield the soybean hay had 5 to 15 bushels of beans on it. There was practically no grain in the pea hay. The leaves were nearly all lost from the peas if they were not cut exactly at the right time. Soybeans held their leaves well. Table V represents only average yields. Figures I and X show fields of Otootans and Laredos which produced 30 to 40% more than the average yields shown in the table.

Most Delta planters are familiar with Laredos, Otootans, and Biloxis as good varieties. Virginia is another varity worth consideration. It is semi-viny, very early, and a good producer of both hay and grain. Farmers who expect to use soybeans exclusively for hay should plant ¼ of the acreage to Virginia, ½ to Laredo, and ¼ to Otootan or Biloxi. The Virginias may be harvested before cotton picking time, the Laredos in September or October, and the others just before frost. This so distributes the harvest seasons as to avoid bad weather on at least a part of the crop. It is very probable that when more data and experience are available the recommendations for Virginia will be strengthened even more. Its earliness is especially desirable and it has considerable ability to produce both hay and grain.

Planters should buy Laredo and Otootan seed from reputable growers or dealers, since there are others which have black seed and may be mistaken for Laredos and Otootans.

THE DELTA SHOULD CERTAINLY RAISE ITS HAY: Soybeans Are Safe for That Purpose.

Soybean Straw as Hay: The straw obtained when soybeans are threshed for seed has much value as a roughage. For wintering dry dairy cattle, beef cattle, and idle mules, it will replace good hay, especially where some grain is used. For sheep and milking dairy cattle it is excellent roughage.

Analyses indicate that it contains 3 times as much digestible matter as corn fodder, or stover, and more than 3 times as much digestible protein as oat and wheat straw. Good soybean straw should be worth half as much as good alfalfa or soybean hay for feeding anything except mules or horses doing hard work. It contains too much indigestible material to be adapted to the latter purpose but may be used.

Soybeans in Corn for Hay: Soybeans should be planted alone for hay but it is often necessary to harvest everything available in order to have enough forage. Soybeans planted in alternate hills with corn usually produce a heavy tonnage. If the corn stalks are large and the beans heavy an ordinary mower cutter bar will not handle them. Most manufacturers provide bush or ditch bank blades for their machines. These handle beans and corn stalks very nicely so far as the cutting is concerned. Where the growth of viny varieties is heavy the same trouble is often experienced as when cutting rank beans alone, but may be avoided in the same way.

Where shredders are available the entire crop of corn stalks and beans may be run through the shredder. The ears are separated from the forage by the shredder. The remainder may either be blown into the barn or baled.

If the whole crop of beans and corn is ground as it comes from the field an excellent product is the result. If this is done extreme care is necessary to see that the mass is dry enough not to damage in storage.

If the mixed crop is not to be ground or shredded the corn should be snapped, before the crop is cut, and stored in the crib. The corn stalks may be thrown out of the hay or hauled in with it. The mixture of stalks and hay fill space very rapidly. Unless an abundance of storage space is available it will be necessary to resort to the baler.

Fig. 12: Laredo Hay from a volunteer crop.

SOYBEANS FOR GRAIN: Growing soybeans for the grain produced is profitable especially on thin soils where the increase of soil fertility, due to the residual effect of the soybeans, is important. The yield of grain will compare favorably with that of corn on much of the buckshot soil in the Delta and the grain is much more valuable. Figure XIII shows soybeans in 3 foot rows for grain.

Fig. 13: Soybeans in 3 foot rows for seed.

Time of Harvesting: The uniform habit of maturing assists materially in harvesting soybeans for grain. Unlike cowpeas, the plants reach definite size, according to variety, date of planting, climatic and other conditions, and then come to full maturity in short order. Before all of the pods are mature most of the leaves yellow and fall off. The best time to harvest, except when field harvesters or threshers are to be used, is when ½ to ¾ of the leaves have fallen and ¾ to 4-5 of the pods have begun to lose, or have lost their green color. Laredos and Otootans should be cut as soon as the beans in the top pods begin to turn pink. If cut much earlier the vines will be harder to cure and much immature grain will result. The latter cannot be separated from the good beans and the quality of the product is materially lowered. If left too long most varieties shatter badly and many pop out to the extent of ⅔ of the yield in a very few days. The stage of maturity at which soybeans should be cut varies with variety, date of maturity, and the condition of the weather at harvest time. If the weather is moist and cool they may be allowed to stand much longer than if the weather is hot and dry. Biloxis and Otootans are both very late and pop out very little. They may be left until fully mature. If the straw is to be used to replace hay for work animals the plants should be cut earlier than indicated above in order to retain more leaves and prevent extreme woodiness in the straw.

If regular soybean harvesters are to be used the plants should be permitted to fully mature.

Methods of Harvesting: The common method in use in this section today is very much the same as the ordinary haying operation, except that the soybeans are permitted to mature as indicated above. Following the mower with the side delivery rake as suggested in the discussion of "Harvesting and Curing Soybean Hay" is usually economical in cutting heavy growths of the viny varieties for seed.

It seems safe to predict that not many years hence soybean harvesters will be evolved which will much more economically harvest seed than is possible through the mower, rake, and thresher route.

Curing and Storing Unthreshed Seed: The curing process is the same as for hay except that the cut vines or plants should be raked into small windrows almost immediately after they are cut to prevent shattering. This is accomplished very satisfactorily when the side delivery rake follows the mower, but if cutting is not facilitated by raking as the cutting is done, the raking may be done a few hours later. The latter practice will waste more beans than the former because both the mower and the mower team will pass over the cut beans in addition to the rake team.

Most of the curing should be done in tall narrow cocks made from 24 to 48 hours after windrowing. The cured seed and straw should be housed if possible. If shed and barn room are not available, threshing from the field is safest and is most economical at any time weather will permit. If this is not practical stacking is the only resort.

The principle to be followed in stacking is the same as for hay and other materials. Long narrow stacks are best. It takes a good man to make stacks which will protect the beans. No stack should be allowed to remain uncovered. Canvasses are expensive but may be used if available. The cheapest roof is made from cheap roll roofing with 1 x 6 boards under the laps to nail to. Wires should be stretched over the top of the paper roof every 4 to 6 feet and weighted at each end to prevent blowing off.

Only common sense and experience can tell a man when the cut material is ready to house or stack. The common error is to haul before it is dry enough but 24 hours in the windrows and 48 hours in the cock is usually sufficient time before hauling in good haying weather. Less time is necessary if left longer in the swath and windrows than recommended above. The stage at which the beans are cut will have much to do with the time required to properly cure them.

Threshing: Threshing the viny varieties from field, barn, or stack is slow, difficult, and expensive regardless of the machine used. Seventy-five bushels per day is much above the average with any type of threshing machine used in this section. Any ordinary grain separator can be adjusted to thresh beans. To prevent cracking the beans it is necessary to change pulleys so as to reduce the cylinder speed at least half and maintain the regular speed on all other parts of the machine.

It is usually necessary to remove ½ to ¾ of the concaves or to use thin concaves. Special bean attachments can be bought for most grain threshers. These are said to be satisfactory and economical. Special machines are built which do satisfactory work. If not more than an acre or two are grown, it is probably more economical to beat them out than to rearrange and set up a thresher.

Soybean Harvesters: There are four or five patented machines which thresh the beans from the fully matured standing plants. Most of these are made to harvest from rows and are best adapted to bush varieties. Figure XIV shows the most common type. Such a machine works perfectly on bush varieties planted in rows from 32 to 42 inches wide. It is not perfectly adapted to viny varieties but does a good job even on Otootans and Laredos if the growth is not exceedingly rank.

The machines are simply small threshers on wheels. Most of them have only the cylinder, though some have straw elevators and one or two are equipped with cleaners. The machine illustrated in Figure XIV is drawn by two mules and operated by a driver and a man to throw the straw out of the box. In rank viny varieties it is desirable to have two teams, so they can be alternated, or to use four mules. It usually pays to make two trips per row on the viny varieties, if they are large and have lodged to any extent. The second trip should be made in the opposite direction to the first. Two men with one of these machines can harvest from 2 to 6 acres per day depending upon conditions.

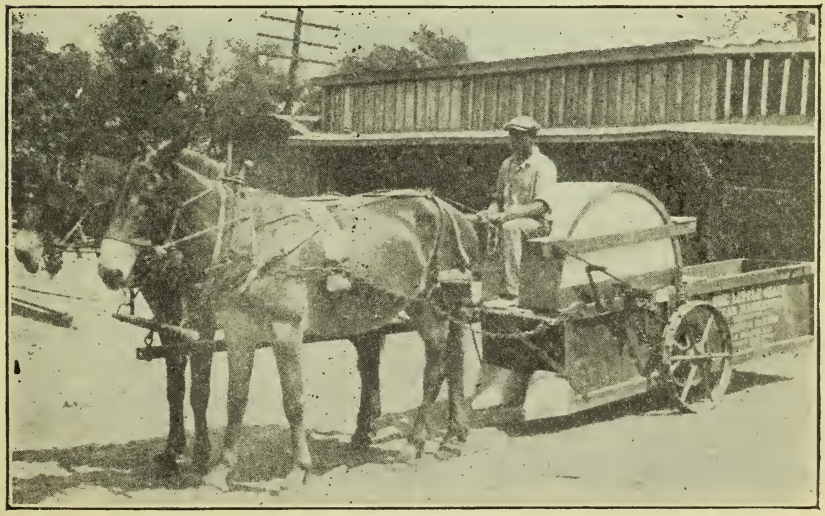

Fig. 14: The row type of harvester is used extensively in the southeast.

The loss of beans is as small, if not smaller, with machines of this type than the loss in handling when the beans are cut with a mower and threshed. The use of the harvester is very much more economical for all areas which it will handle. The use of harvesters is facilitated by growing 2 or 3 varieties having different dates of maturity so as to lengthen the harvest period.

The machine shown in Figure XV is intended for broadcast beans. The principle of this machine can be made to do the work whether it is perfected now or not. The broadcast principle will facilitate means of raising viny varieties within reach of the cylinder or beater. This is probably the weakest point in the construction of the row machines. There is little doubt but that perfectly working machines for both row and broadcast seeding will be available at reasonable prices within a few years. The principle is too valuable not to be worked out. The broadcast machine shown in Figure XV is made for tractor power. The tractor is driven on the harvested area, thus preventing loss from shattering which occurs when the power unit must move over unharvested beans. It is equipped with screens and bagging apparatus.

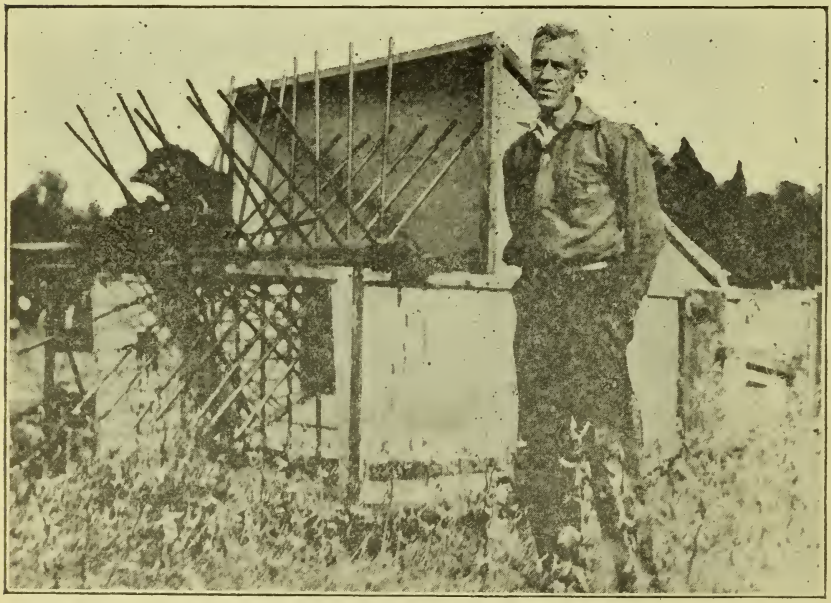

Fig. 15: The broadcast harvester promises much for the future.

Other Methods: Side delivery attachments for mowers are sometimes used to rake the cut beans into small piles and out of the way of the team and wheels when the next swath is cut. This will not work satisfactorily where viny varieties are used and heavy yields are obtained. The self rake reaper is often used but has the same shortcomings as the side delivery mower. Upright varieties may be cut with a grain binder and shocked as oats or wheat. All these methods require the threshing operation after the beans are cured. The grain combine handles the upright varieties very successfully.

Cleaning: Regardless of the method of harvesting and threshing most seed must be recleaned before being marketed. This operation is rather simple and inexpensive. Any substantial cleaner equipped with proper screens and a good fan will do the job. An ordinary fanning mill will remove most of the stems, leaves, and other trash but short pieces of stems have to be screened out.

In the Delta the removal of small particles of buck shot soil is vey difficult. There seems to be no economical way of removing the particles which go through the same screen as the beans. Beans which are to be sold for feed need not have this soil removed. It will go through seeders with the beans and furnish inoculation for areas which have never grown beans before. It is necessary, however, to determine the percentage of soil the beans contain in order to figure values properly.

Storing Seed: Unless the beans are perfectly dry when housed they should be spread on a floor and shoveled daily until fully dry. Deep and poorly ventilated bins should be avoided. The germination of the seed is ruined easily by heating. This accounts for many of the poor stands of the large seeded varieties in the past. The dry beans should be bagged and the bags stacked with air spaces between for ventilation. Weevils seldom attack soybeans and rats do not eat them as readily as they do other grain.

SOYBEANS FOR SOIL IMPROVEMENT: Few crops offer so much to the Delta for soil improvement as soybeans either plowed under, or grazed and the residue plowed under. Every ton of dry hay or residue turned under adds approximately 50 pounds of nitrogen to the soil. The roots which produce the hay add approximately the same amount of nitrogen to the soil. Roughly speaking, soybeans add 100 pounds of nitrogen to the soil for every ton of hay produced, provided, of course, they are grazed or turned under. Theoretically, a two ton crop of soybeans so used is worth more than 1,000 pounds of nitrate of soda.

Table III shows the residual effect of soybeans planted in corn in 1923 on the 1924 cotton crop. The soybeans made an excellent growth and were grazed by hogs and cattle. Since this only represents one year, nothing but the average of all should be taken seriously. But an average increase in the succeeding cotton crop of 48.8% or 732 pounds of seed cotton worth $73.20 per acre is very well worth considering seriously before deciding to buy nitrate of soda to make cotton with which to buy all corn and hay used on the plantations and thereby lower the price of cotton and increase the price of feeds.

The above increased yields indicate that the theoretical value of the soybean for soil building may not be any greater, if as great, as the practical value. The crop grazed off the above land in 1923 would have averaged 1½ tons of hay per acre. The 1924 increase did not exhaust the plant food added by the beans. The bean crop was not grazed and turned under until March, 1924. Since the season was so dry, during the summer of 1924 it is evident that little benefit was derived from anything but the leaves and roots of the 1923 soybeans in 1924. Corn is growing on the same land in 1925. The bean plots are not suffering from drought as much as the plots which grew corn alone in 1923. It is quite evident that the effect of a good soybean crop will last from three to five years.

Table II gives the yields of corn and soybeans on the above mentioned plots in 1923 as well as on an adjacent area similarly planted in 1924. The area used in 1921 and 1922 was not adjoining that of other years. It was stiffer and the drainage poorer. The total grain yield has always been greater where both soybeans and corn were planted, except in 1924. The average yield of corn was greater on the plots on which the beans were planted three weeks later than the corn because the beans failed two years and therefore did not reduce the corn yield. It is much safer in the Delta to plant both corn and soybeans in every row at corn planting time. On land where moisture is usually the limiting factor in corn production, it is probably safer to plant the corn in wide rows and plant a row of beans between. The bean planting should not be too long delayed. The bean rows should be planted when the corn is, or within a week or 10 days thereafter.

Old soils low in organic matter and nitrogen are greatly benefitted by any legume. If the whole crop is plowed under the results are much better in the long run than if the crop is cut for hay. It is not practical to grow soybeans and turn under the whole crop but the grain may be harvested or grazed and the straw and residue turned under. When a market is developed for soybeans for crushing many areas in the Delta may be used profitably, while they are being built up, to grow soybeans for grain. The Biloxi variety looks most promising, at present for this purpose.

SOYBEANS FOR SOILING: Many farmers plant sorghum and other crops to feed green. Alternate rows of sorghum and some upright variety of soybeans will furnish a balanced ration and a maximum of feed. Hogs, cattle and idle mules will do well on the combination, or on soybeans alone.

SOYBEANS FOR SILAGE: Many experiment Stations have used soybeans alone and in combination for silage. When used alone, soybeans often produce silage with an unpleasant odor, unless very tightly packed. Equal parts of corn and soybeans, or sorghum and soybeans, produce silage which is both palatable and nourishing. Such silage is very economical for cattle and sheep and for wintering idle mules.

SOYBEAN PESTS

There are few agricultural crops which are not troubled by pests of some sort. The soybean is as nearly pest free as any of the common farm crops. To date no pest has assumed any great economic importance in soybean culture in the State. Many destructive diseases are said to attack the soybean in the Orient but there seems to be little published concerning them. Available information indicates that soybeans are affected less by destructive diseases and insect pests than most other forage and feed crops.

INSECTS: Army worms, grass worms, grasshoppers, Mexican Bean Beetles, and many other insects attack soybeans. So far grasshoppers have given more trouble in the Delta than any other insect.

Grasshoppers: Soybeans grown near oat fields, ditch banks and other areas not plowed in winter or early spring are quite apt to be injured by grasshoppers about the middle of June, if no precautions are taken. Often when oats are cut these insects migrate promptly to nearby corn and soybeans and prove very distructive.

The simplest and cheapest remedy is prevention. Below are given formulae for poison mash which may be used on ditch banks and other places where the grasshoppers first appear. The bait should be sown broadcast late in the afternoon.

No. 1. Wheat Bran 100 pounds
Crude Arsenic 5 pounds
Amyl acetate (technical grade) 3 ounces.
Molasses 2 gallons
Water 10 gallons (or enough to make a wet but not a sloppy mash)

No. 2. Bran 100 pounds.
Paris Green 4 pounds
Lemons 2 dozen (well ground)
Molasses 2 gallons
Water enough to make crumbly mass (about 10 gallons).

No. 3. Sawdust 85 pounds
Shorts 15 pounds
White arsenic 5 pounds (or
Sodium Arsenite 1½ pints)
Salt 5 pounds
Water 10 gallons.

No. 4. Sawdust 100 pounds
Salt 5 pounds
Sodium Arsenite 1 quart
Water 10 gallons
Molasses 1 gallon

In making up the baits the dry ingredients should be mixed thoroughly. The other materials should then be dissolved in the water and the two combinations mixed together. Keep livestock away from the bait.

If the grasshopper infest large areas, 1 part of Calcium Arsenate mixed with 10 parts lime, or 1 part of lead arsenate mixed with 12 parts lime, applied with regular dusting machines at the rate of 6 to 8 pounds per acre in the same way as poison is applied to cotton for boll weevil control, will effectively control them.

If dusting machinery is not available and spraying can be done the formula may be used:

Calcium Arsenate ¾ pound.
Hydrated lime, 1½ pounds
Water 50 gallons.

Mexican Bean Beetle: Where this beetle is found it is very destructive to garden beans as well as soybeans. This pest occurs in Alabama and several states farther east. Its westward progress has been very slow, but there are scattered infested areas in some east Mississippi counties. The above dust and spray mixtures will control the best if properly applied. This beetle feeds primarily on the underside of the leaves. It is necessary that the machines used to apply the spray or dust be equipped with nozzles, which direct the dust or spray upward from near the ground.

Web Worms: These little pests have been very destructive on the Station farm once or twice. It is necessary to begin control measures when the lavae or worms are small. The spray or dusting recommended for grasshoppers will control this pest if applied while the worms are young and feeding—before they web up.

Other Chewing Insects: The dust or spray recommended for grasshoppers will control any insect which undertakes to defoliate soybeans, if applied as for grasshoppers.

DISEASES: Many bacterial and fungus diseases are known to attack soybeans. Fortunately, however, few of these have been reported in the State.

Southern Blight: This disease, caused by the fungus Sclerotium Rolfsii, is rather widespread in the State. Many Delta fields were infected in 1924. In some small areas the loss was 25 to 30% of the crop. Little is know about the disease. There is no known control except crop rotation and little is known of what crops may be safely used.

It is hoped that resistant strains may be developed but no work has been reported so far. What little work has been reported on varietal susceptibility indicates that some varieties are somewhat tolerant, but not entirely resistant.

Mosiac: Soybean Mosiac was found in Connecticut as early as 1915. It has since been reported from several other states. It is rather widely distributed in the Delta.

The disease is characterized by crinkling or curling of the leaves. The symptoms resemble those which characterize mosaic diseases in general. The affected plants are stunted. The leaves are greatly puckered, usually puckering toward the upper side of the leaf. No remedy has been found so far.

Rootknot: In many sections nematodes cause severe rootknot injuries to soybeans. Nematodes are usually present where cotton wilt occurs. In sections where rootknot occurs or is suspected nematode resistant varieties should be used. The Laredo is the only resistant variety known to be adapted to the Delta section.

RABBITS: Where rabbits abound they usually give a great deal of trouble until the soybeans are rather large. The damage is usually worst nearest the woods or other hiding places. Where rabbit damage is feared the edge of the field, where they are most likely to give trouble should be planted twice as thick as where no damage is expected. Since they have the habit of feeding on the same area successively, rabbits are said to be easily poisoned. Arsenicals should be dusted or sprayed on the areas which the rabbits are damaging. The arsenicals should be diluted with lime to the strength recommended for grasshoppers. Poisoned corn, potatoes, or apples on the areas frequented by the pests are sometimes worth while.

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