
Soy Beans--An Important Wisconsin Crop

R. A. MOORE AND E. J. DELWICHE



PEDIGREE EARLY BLACK SOY BEANS

Experiments conducted at the branch stations since 1907 have shown that this variety is best for northern conditions.

AGRICULTURAL EXPERIMENT STATION
OF THE UNIVERSITY OF WISCONSIN

MADISON, WISCONSIN

DIGEST

The Soy Bean Promises to Become a Leading Crop on the sandy soils of Wisconsin. For seed, hay, pasture, silage, and manure it may be grown with profit and advantage to the soil. Extensively grown in China and Japan since ancient times it has, within the past twenty-five years, become an important crop in the South and is now being introduced throughout the northern sections of our country. Pages 3 to 4

It Resembles the Ordinary Navy Bean in seed and general appearance. The plants, however, are much larger. It is especially adapted to warm climates, but can withstand frost better than corn, cow peas, or field beans. Northern grown seed from a variety especially adapted to our conditions should be sown. Page 5

All Classes of Ordinary Soil are adapted to its growth. As a legume it is particularly valuable on light sandy soils, which are often acid in nature and poor in nitrogen. Experiments have shown that the soy bean can be grown with profit as a substitute crop where clover and sugar-beets have been killed by drought or heat. Pages 5 to 6

Inoculation of the Soil with nitrogen-fixing bacteria is desirable and materially benefits the crop on sandy soils or where the soil is low in fertility. Bacteria-laden soil, scattered broadcast or drilled with the seed, gives the best results. The Station at Madison or any of the Sub-Stations in the various parts of the state will supply farmers with inoculated soil at the mere cost of sack and transportation. Pages 7 to 8

Proper Cultural Practices are Needed. The soil should be properly prepared and the time and method of planting be suited to the conditions of the soil, the length of the growing season and the purpose of the crop. Cultivation after seeding is beneficial under all conditions. Pages 9 to 10

As a Food the Soy Bean Ranks High. In crude protein and fat it is equal to linseed and cottonseed meal, and twice as rich as wheat bran. As a concentrated food it is valuable for hogs and sheep. Its use for dairy cows should be moderate, as too large allowances of soy beans may produce soft butter. For hay and pasturage it is excellent; as a soiling crop rather unsatisfactory; as a soil renovator highly beneficial. Pages 12 to 16

Variety Tests at Several Branch Stations show that, if intended for seed, "Wisconsin Early Black" is best for the northern half of the state. "Ito San" or "Medium Early Green" is recommended for forage. Experiments in breeding are being continued in the hope of further improving, acclimatizing and disseminating this valuable legume. Page 18

Soy Beans—An Important Wisconsin Crop

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WHY GROW SOY BEANS ON SANDY SOILS:—

Because they are more resistant to heat and drought than are clovers or alfalfa.

Because they may be substituted as a catch crop for clover when the latter kills out.

Because they rank with linseed and cotton seed meal as a concentrated feed for cattle, sheep and hogs.

Because they gather nitrogen from the air and store it in their roots, thus improving the soil in which they grow.

Because they may be grown on soil too acid for clover.

For the purpose of introducing a leguminous plant that would improve the sandy and worn out soils of the state and at the same time produce valuable forage, experiments with soy beans were undertaken by the agronomy department on the Experiment Station farm at Madison in 1899, and have been carried on continuously ever since. For the past eight years trials, likewise, have been conducted with different varieties at the branch experiment stations and county demonstration stations in the northern part of the state. Exceedingly favorable results have been secured, which lead us to believe that soy beans will become a staple crop on our light sandy soils. However, it is not expected that they will displace clover and alfalfa on lands where these crops can be grown to advantage.

Soy beans may be grown for five purposes:

For the production of seed,

For hay,

For hog pasture,
For silage, when mixed with corn, and
As green manure.

This crop can be grown readily, but, like many other plants, certain methods of culture must be followed in order to insure success. The object of this bulletin is to discuss briefly the cultural requirements of the soy bean, to furnish information in regard to the different uses to which the crop may be put, and to show the results secured with the pedigree varieties developed by the College especially for Wisconsin conditions.

THE SOY BEAN PLANT

The soy bean *Glycine hispida*, is a native of the Orient, where, since ancient times, it has been extensively cultivated. In China and Japan it is one of the leading crops, being used for human food, for feeding animals, and as green manure. Large quantities are also exported to Europe and more recently to our western coast states. The late Professor F. H. King stated that, in 1908, over one-half million tons of soy beans with a total value of over \$15,000,000, were shipped from three ports of Manchuria.



FIGURE 1.—TYPICAL SOY BEAN PLANT
From Farmers' Bulletin 372, U. S. Department of Agriculture.

as cattle feed in northern Europe.

Although the soy bean was grown in the United States as early as 1829, it attracted little attention until 25 years ago, when

some of the Experiment Stations began trials with the crop. Since then it has become important in the southern states and as far north as the southern part of the corn belt. Numerous tests have shown that soy beans can be grown in practically any latitude where corn will mature.

With the introduction and development of early maturing varieties and the demonstration by several Stations of the value of the soy bean as a grain and forage plant, its growth is now being rapidly extended throughout the northern sections of our country.

The soy bean, like clover, is a legume. It also has the power of taking nitrogen from the air to build up plant tissue, and enrich the soil upon which it is grown. In seed and general appearance it resembles the ordinary navy bean, especially in the early stages of growth. The common varieties are erect, bushy, and well-branched ranging from 18 inches to 4 feet in height; the early being more dwarf than the later sorts. The characteristic covering of fine hair over all parts of the plant distinguishes all varieties of soy beans from cowpeas. The latter has leaves which are smooth and glistening. The leaves of the soy bean are composed of three large leaflets, borne on long leaf stalks. Its small and inconspicuous flowers grow in clusters in the axils of the leaves. The short, hairy pods contain two or three round or slightly flattened seeds, varying in size from one-eighth to one quarter of an inch in diameter. The plant has a short, strong tap root with a rather scanty root system. The soy bean is especially adapted to warm climates, but is more resistant to frost than is corn, cow peas, or field beans. The length of season required for maturing varies greatly with different varieties, ranging from 90 to 120 days and even longer. Great care should be taken to get northern grown seed of a variety which will mature properly in the grower's locality.

SOILS ADAPTED TO SOY BEANS

Soy beans will grow on all classes of ordinary well-drained soil. The chief value of this crop in Wisconsin, will probably be as a legume for light, sandy soils, such as Jack pine land and scrub oak plains. On account of its resistance to drought and heat, the soy bean may be grown on these soils in seasons when the ordinary clovers would fail.

Experiments also show that soy beans will grow and develop

well on soils that are somewhat acid, which adapts them to the sandy regions, where oftentimes this condition prevails.

As the soy bean is an annual, a crop of forage superior in feeding value to clover, may be obtained in a single year and even if the season is dry. When drought occurs early in the spring and some other crop is ruined, soy beans may be planted as a catch crop, and a good yield of forage or grain be secured.

That soy beans will fill an important place as a substitute for clover on the areas of sandy soil in the state, has been conclusively shown by experiments conducted by the College on the Stations at Spooner, Crivitz, and Iron River, and by co-operative trials carried on with farmers in various localities of the state. At the Iron River Station, in 1910, owing to extremely hot and dry weather in June, the clover crop dried up just at blossoming time. It was cut for hay and but a light crop was obtained. As soon as the hay was removed, the land was plowed and planted to soy beans in drills two feet apart. The crop was cultivated two or three times during July. A yield of over one ton per acre of cured hay was secured. The same season at the Crivitz Sub-station, soy beans were planted June 16 on land where on account of dry, hot weather sugar beets had failed. The beans were cut September 15, giving a yield of over two tons of cured hay per acre.

This plant grows well on new sandy soils. In 1910, soy beans planted June 8 on freshly broken lands at the Spooner Branch Station, gave a yield of 2,500 pounds of hay per acre for the "Ito San" variety and 1,600 pounds for the "Early Brown." In 1911 at the Crivitz Station, "Early Black" planted on newly broken Jack pine land gave a total yield of one and one-half tons of well cured hay per acre and over 15.5 bushels of seed.

When soy beans are used as a first crop on newly cleared sandy lands, they help to solve the problem of protein feed for dairy animals; they also serve to maintain and even increase the nitrogen supply on such farms. This is very important in the production of profitable crops, on these soils. Good crops of corn can be secured even on these light soils provided there is sufficient nitrogen in the soil. Thus, by growing soy beans, not only is it possible to grow a valuable leguminous forage crop to be used as feed for stock but in direct contrast to non-leguminous crops such as oats, rye, buckwheat, the growing of it is a direct benefit to the soil.

In sections of the state with a rather long growing season, the

soy bean can be grown profitably for seed, even on clay soils. Where the growing season is short, it is important to bear in mind that the crop grows more rapidly and matures earlier on sandy soil than it does on heavier soils which of course are colder.

To secure immediate results where soy beans have not been grown before, the soil should be inoculated with the proper bacteria.

THE CULTURE OF SOY BEANS

Soil Inoculation—It is well known that the ability of all legumes to obtain nitrogen from the air depends on the presence on the roots of the characteristic nodules, containing bacteria or germs. From experiments conducted throughout the state it has been found that when soy beans are grown on land for the first time, unless the seed or the soil has been inoculated with the proper nitrogen-fixing bacteria, few, if any, nodules will develop on the roots. There seems to be a limited number of bacteria in the soil, however, and if soy beans are grown a second year on the same field a few plants will be found with nodules on their roots. The third year the bacteria will have increased to such an extent and be so well distributed throughout the field that nodules will develop plentifully, and without artificial inoculation.

On rich soil no difference has been noted between plants grown on inoculated or uninoculated plots. It is evident, however, that even though the plants grown on uninoculated soil may be vigorous, they do not secure their nitrogen from the air, thus

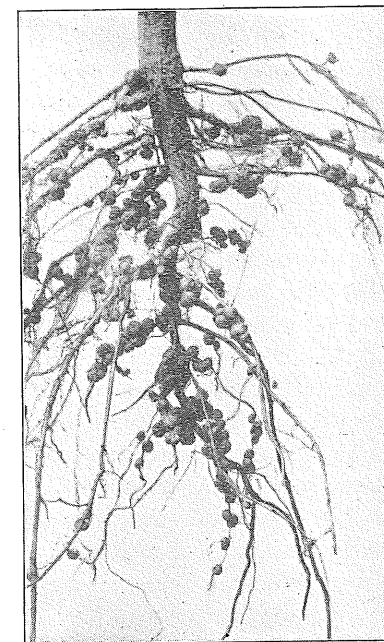


FIGURE 2.—A SOY BEAN NITROGEN FACTORY

Roots of this soil-restoring plant showing nodule development.

enriching the soil, but draw it from the soil, just as do non-leguminous crops, such as corn, oats, etc. On poor, sandy soil, inoculation produces the better crop.

Several cultures for inoculating soy bean seed, previous to seeding, are on the market. Experiments carried on at the Station during the past ten years show that soil inoculation is more certain in its results than the use of commercial cultures. If the grower desires to try such cultures, they may be obtained free of charge from the United States Department of Agriculture, Washington, D. C.

The best results have been secured when bacteria-laden soil was used for inoculation. It may be distributed by various methods. The seed may be merely dampened and mixed with the soy bean soil, and the mixture sown with a drill. A sack of soil is sufficient to inoculate two acres or more of land.

A better method is to distribute at the time of planting, the inoculated soil in the rows as the soy beans are planted. This is done by means of a fertilizer attachment on the drill. Provided much inoculated soil is available, results can be hastened by broadcasting from 500 to 1,000 pounds of the soil per acre.

It should be remembered that sunlight kills the legume bacteria. The soil for inoculation therefore should not be exposed to bright sunlight, and if it is broadcasted on the field, it should be harrowed in immediately, and a cloudy day or early morning should be chosen for the operation.

To aid the farmers of the state in inoculating their fields for the growth of soy beans, bacteria laden soil will be supplied from the Station at Madison and from the Branch Station farms at other points in the state at merely the cost of sack and delivery to the railroad station.

Soil Preparation.—The ground for soy beans should be prepared in the same manner as for corn or other cultivated crops. The soy bean, like other crops, responds to barnyard manure, but the application of manure is not so essential, since the plant is able to get its nitrogen largely from the air. The clay lands should be plowed in the fall and in the spring disked, harrowed, and made smooth by the drag and plunker. For light, sandy soils spring plowing is preferable. If the soil is loose, it is advisable to compact with the roller. On clay and sandy loam soils both spring and fall plowing are equally satisfactory.

Time and Method of Planting.—The time of planting will vary

for different localities and different seasons, depending on the conditions of the soil and length of the growing season. As a rule, soy beans should be planted immediately after corn, or at the same time, both plants requiring a warm soil for the very best germination. When intended for hay, soy beans may be planted later than for seed. Good crops of hay have been grown from beans planted after June 15, and in several instances as late as July 1.

Planting soy beans in drills, so as to allow intertillage, is the most successful method. In seasons of abundant rainfall, planting in solid drills has produced good results. The distance of planting varies with the purpose of the crop. If intended for seed, a distance of approximately 30 inches between rows, with plants every 2 or 3 inches, is best. If the crop is to be cut for hay it is preferable to plant the rows more closely together and to drop the seeds no more than two inches apart, or else to sow the beans broadcast. Narrow planting permits of cultivation only a few times early in the season, while wider planting allows cultivation until later in the season.

Soy beans may be planted with drills of different kinds. For small fields the ordinary garden drill does well if properly adjusted so as to drop at the desired distance. This can be done by running the drill over a plank floor. For larger fields a machine drawn by horses is preferable. When the ground is properly leveled and prepared, the corn planter may be used. If the wheels are set 44 inches apart, the beans may be planted 22 inches apart by straddling every other row. If the beans are to be planted 36 inches apart, it will be necessary to set the wheels at that distance. Most of the modern planters have special plates for drilling beans. If necessary, blank plates may be secured from the manufacturer of the planter used and a requisite number of holes bored so as to drop at the desired distance.

The ordinary grain drill may be adjusted for planting soy beans by stopping up some of the spouts and allowing the beans to run out at the desired distance. For example, with the ordinary six-foot drill the beans may be fed from the two outside and the middle spouts, thus making the rows 36 inches apart. Such a machine, however, is not so economical of seed as the corn planter or the special drill which drops at given distances.

The amount of seed required per acre when planted for seed

production will vary from one-third to one-half bushel. When planted in drills for hay, from one-half to two-thirds of a bushel should be used; the rows being placed 18 inches to 24 inches apart. If planted with a grain drill, all spouts open, one bushel and a half per acre is needed.

The depth of planting will vary considerably with the character of the soil, from one to two inches on heavy soils and somewhat deeper on lighter soils.

After Cultivation.—Where beans are grown for grain, cultivation should continue, much as in the case of corn, until the plants begin to blossom. It is advisable not to cultivate while the leaves are wet with dew or rain, since such practice is likely to spread the spores of fungus diseases, and thus injure the crop. Shallow cultivation is highly recommended. Where the crop is intended for hay, two or three cultivations during the early part of the season are usually all that are necessary to keep the weeds in check.

Harvesting.—Soy beans grown for hay should be cut when the pods are forming and before the plant begins to drop its leaves.

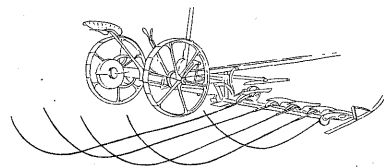


FIGURE 3.—COMMON MOWER WITH WINDROWING ATTACHMENT

If delayed too long, the lower leaves may drop off and thus the most valuable part of the plant be lost. The stems also become woody and consequently less palatable to stock. It is preferable to cut early rather than too late.

The crop may be cut with an ordinary mower. The beans should be cut early in the morning after the dew is off or late in the afternoon. If cut in the morning, they may be allowed to wilt until late in the afternoon of the same day, and then put up in small cocks. This work is often done by hand, as the leaves fall off readily. A horse rake, however, may be used when the vines are nicely wilted but not dried. As they shed water quite well in wet weather the small cocks may be left to cure for several days. If the weather is fair, the small cocks are turned over before noon and allowed to cure thoroughly. When the weather is unfavorable, it is advisable to bunch a number of cocks together, cover with a hay cap and allow to cure for several days. Soy bean hay has high feeding value, about equal to alfalfa if well cured; hence the importance of handling the crop properly so as to retain the leaves.

This in common with alfalfa, pea, clover, and other leguminous hays, should not be put up in unprotected stacks. If necessary to stack, cover the top and sides with canvas or boards. The best place to store is in the closed mow or barn. It should be handled as little as possible after curing, for there is danger if handled carelessly of losing the leaves.

Soy beans intended for seed should be allowed to ripen well and may be cut with scythe, mower, or bean harvester. Some

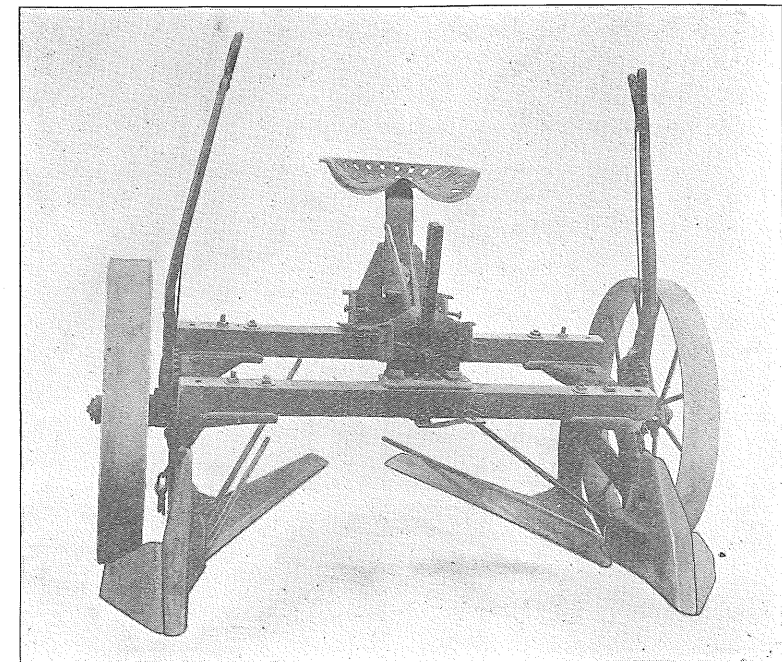


FIGURE 4.—SPECIAL TYPE OF BEAN HARVESTER

This machine with windrowing attachment, which is often used where the crop is harvested for seed, will cut two rows at once.

harvest the crop with grain binder, and others with corn harvester. Both of these machines, however, shatter the beans and cause considerable loss. The bean harvester, which is often used, is mounted on wheels like a riding cultivator. It has knives that can be adjusted to run just beneath the surface of the ground, cutting the plant where it is soft. (See Figure 4). The machine will cut two rows at a time and place the beans in a windrow for curing and convenient for handling. To do good

work, the cutting blades must be kept sharp otherwise the plants will be pulled out by the roots instead of being cut off. This difficulty has been reported especially on light sandy soil.

When cut with a mower without windrowing attachment, the plants should be removed at every round out of the way of the team; for if trampled upon, a large percentage of the seed will be shelled out and wasted. After cutting, the beans are allowed to cure in windrows or bundles and are hauled as soon as dry.

Thrashing and Storing the Seed.—Provided the regular grain concaves are removed from the machine and blank concaves used in their place, soy beans may be threshed without much injury, with the ordinary thrasher. The thrasher cylinder should be run at less speed than when thrashing grains, while the separator should be run at the usual rate of speed. To accomplish this, a larger drive belt pulley is used and a correspondingly larger pulley on the opposite end of the cylinder.

The beans should be stored in barrels or shallow bins, or spread out on a floor where, from time to time, they can be shovelled over until they are thoroughly dry and hard. Later they may be safely stored more compactly. When stored immediately after thrashing the beans are apt to heat and mold. As soy bean seed loses its germinating power rather quickly, even when properly stored, it should always be carefully tested for germination before planting.

The dry beans will keep nicely for several years when not exposed to the elements. They can be fed whole to pigs and sheep, but for general use it is preferable to crack or grind them.

Tests have shown that it is often necessary to mix the beans with corn or peas to grind them into meal, as the beans are too soft to granulate well alone. Too large quantities should not be ground at a time as the high oil content will cause the meal to heat and turn rancid, making it unfit for feed.

SOY BEANS AS A PROTEIN CONCENTRATE

From Table I, which shows the amount of digestible nutrients in soy beans (seeds) and in other common concentrated feeds, it is evident that soy beans are especially rich in crude protein and fat. Indeed they rank with cotton-seed meal and linseed meal, and contain more than twice as much crude protein as wheat bran.

The results of actual feeding trials conducted at several experiment stations show plainly their value for various classes of animals. Being rich in crude protein they should never be fed alone but used with feeds like corn and barley which are low in crude protein.

TABLE I.—AVERAGE DIGESTIBLE NUTRIENTS IN SOY BEANS AND OTHER CONCENTRATES¹.

Feeding stuff.	Total dry matter in 100 pounds.	Digestible nutrients in 100 pounds.		
		Crude protein.	Carbo-hydrates.	Fat.
	Lbs.	Lbs.	Lbs.	Lbs.
Soy beans.....	88.3	29.1	23.3	14.6
Cotton seed meal, (choice).....	92.6	35.8	23.2	8.0
Linseed meal, (old process).....	90.2	30.2	32.0	6.9
Wheat bran.....	88.1	11.9	42.0	2.5
Oats.....	89.6	8.8	49.2	4.3
Barley.....	89.2	8.4	65.3	1.6
Dent corn.....	89.4	7.8	66.8	4.3

¹Henry, Feeds and Feeding.

Soy Beans for Hogs.—Experiments conducted by Professors Humphrey and Fuller at this Station² have shown that as a supplement to corn meal for growing and fattening pigs, ground soy beans were from 8 to 10 per cent more valuable than wheat middlings. In trials at the Indiana Station³ they proved to be fully equal in value to linseed meal as a supplement to corn in fattening pigs.

Soy Beans for Dairy Cows.—Trials at the Massachusetts⁴ and Tennessee⁵ Stations have shown that as a protein-rich concentrate for dairy cows, ground soy beans are slightly superior to cotton-seed meal. Too large an allowance of soy beans, however, may produce soft butter, for at the Kansas Station⁶ it was found that when soy beans formed half the concentrates of the ration, the butter was so soft that it was impossible to work it satisfactorily even when chilled with ice water.

Soy Beans for Sheep.—Trials at the Wisconsin Station showed that soy beans were superior to oats for lambs when fed with shelled corn. The soy beans produced larger gains for a given amount of feed and a heavier clip of wool as well.

² Wisconsin Experiment Station Reports 1904, 1905, and 1906.

³ Indiana Experiment Station Bulletin 108.

⁴ Massachusetts Experiment Station Report, 1893.

⁵ Tennessee Experiment Station Bulletin 80.

⁶ Kansas Experiment Station Bulletin 125.

SOY BEANS FOR ROUGHAGE

Soy Beans for Hay.—The soy bean makes valuable hay when properly cured, and all farm animals eat it with great relish. When soy beans are grown for hay, it is well to sow or drill them quite thickly so that fine stems with an abundance of leaves will be produced.

The following table shows the nutrients in soy bean hay compared with other common roughages:

TABLE II.—AVERAGE DIGESTIBLE NUTRIENTS IN SOY BEAN HAY AND OTHER ROUGHAGES.¹

Feeding stuff.	Total dry matter in 100 lbs.	Digestible nutrients in 100 lbs.		
		Crude protein.	Carbo-hydrates.	Fat.
Soy bean hay.....	83.5	10.6	40.9	1.2
Alfalfa hay.....	91.9	10.5	40.5	0.9
Red clover hay.....	84.7	7.1	37.3	1.8
Oat hay.....	86.0	4.7	36.7	1.7
Timothy hay.....	86.8	2.3	42.4	1.3
Corn fodder with ears.....	57.8	2.5	34.6	1.2

¹Henry, Feeds and Feeding.

All Experiment Stations agree that this crop possesses very high feeding value and the table shows that soy bean hay is superior to clover and oat hay and about equal to alfalfa.

Soy Beans for Silage.—Experiments at this Station² have shown that when the soy beans are ensiled alone, on account of the high protein content and rather low content of carbohydrates, the silage has a rank odor which permeates the entire dairy stable, and may taint the milk, cream, or butter. This fault did not occur when soy beans were grown in mixture with corn, at the Spooner Station, and the mixture ensiled together, or where soy beans and corn were grown separately and put into the silo together, using about one ton of soy beans to three tons of corn.

When grown with corn, the seed was planted with a corn planter, using one-third beans and two-thirds corn. The fodder was harvested with a corn binder and cut into silage as a mixture. The medium early green varieties were found most valuable for this purpose. The silage was good, but the chief objections were that the beans were so shaded by the corn that slender

²Wis. Expt. Sta., Report, 1904.

plants, which dropped their leaves early, were produced, leaving only a relatively small amount of forage. Some difficulty was also experienced in harvesting, as all the plants were not sufficiently tall to be securely bound with the corn binder.

Soy Beans as Pasture for Hogs.—A co-operative experiment to determine the value of soy beans as a pasture for hogs was carried on by the departments of agronomy and animal husbandry at the Experiment Station, to determine if soy beans would be readily eaten by hogs in the field during the ripening period.

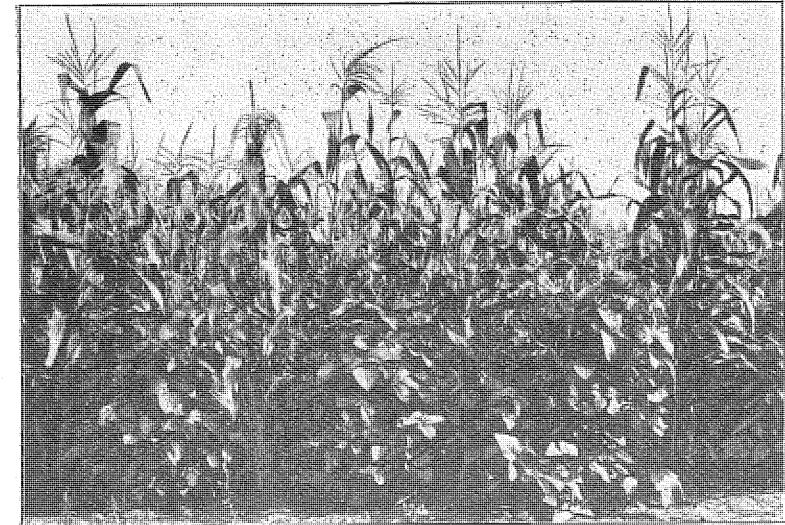


FIGURE 5.—CORN AND SOY BEANS FOR SILAGE.

When cut and put in the silo with corn (one ton of soy beans to three tons of corn), no objection can be raised to soy beans as a feed for dairy cows.

The beans were grown in drills and cultivated until the pods began to form. When the pods had turned yellow, the hogs were turned in and left to harvest the crop. On account of the newness of the feed, the hogs did not take kindly to the beans at first. After a day or two, however, they ate the beans readily and made rapid gains. The first frost opened the remaining pods and let the seed drop on the ground; the pigs followed up their harvesting closely and ate the beans from the ground.

Sowing the beans in rows for pasture lessens the loss from trampling. A good plan to follow when planting on rich land for hog pasture is to put rape in each alternate row so as to add

to the variety of diet. A blue grass or clover field in close proximity to the soy bean field is also important.

In the southern states, soy beans are used extensively as pasture for hogs. They mature at about the same time as corn, are often grown with corn and the entire crop pastured, or "hogged down." At the Iowa Station, 80 pound pigs "hogging down" corn and soy beans gained over 1.5 pounds each daily while those on corn alone gained less than 1.2 pounds. In this trial an acre of corn and soy beans produced 619 pounds of pork.

Soy Beans as a Soiling Crop.—Several tests were made at the Wisconsin Station to determine the value of soy beans as a soiling crop. The green beans were fed to sheep, cows, horses and young stock, but without good results. The animals would merely eat the beans and leaves, leaving the larger portion of the plant untouched.

Soy Beans as a Soil Renovator.—The soy bean has the property of drawing heavily upon the atmospheric nitrogen to build up plant tissue. The roots with numerous nodules attached are high in nitrogen and, when decayed, enrich the soil upon which the plants have been growing. The entire plants are occasionally turned under on worn out soils, the aim being to enrich the soil for other crops.

VARIETY TESTS AT MADISON

The following table shows the yields of soy beans secured in variety tests conducted at the Station Farm, and the growing period for each.

TABLE III.—YIELDS PER ACRE AND LENGTH OF GROWING PERIOD.

Variety.	Yield per acre in bushels.				Growing period, days.			
	1902	1903	1904	Av.	1902	1903	1904	Av.
Ito San.....	33.7	33.1	15.6	27.5	136	133	149	137
Early Brown.....	16.5	40	20.3	25.6	138	134	148	140
Med. Early Black.....	14.3	40	10.6	21.3	133	135	149	137
Med. Early Green.....	22.3	24.1	21.3	22.5	150	155	152	152
Med. Early Yellow.....	38	21	16.6	25.2	142	150	144	145
Michigan Green.....	26.7	26.6	.....	26.6	162	158	.....	160
Wisconsin Early Black.....	23	18.6	20	20.5	122	122	139	127
Wisconsin Black.....	17.3	20.5	17.3	18.7	131	125	146	134

It is found that approximately 135 days are required to mature soy beans for seed production on the clay loam soils in

southern Wisconsin. The cutting stage is reached in about 90 days. The "Ito San" variety gave the largest yield of beans per acre, closely followed by "Michigan Green," "Early Brown" and "Medium Early Yellow."

The "Medium Early Green" is a very leafy variety and is most desirable for hay and silage in southern Wisconsin.

EXPERIMENTS IN NORTHERN WISCONSIN

Experiments are now in progress at the Branch Stations at Ellis Junction and Spooner to determine the best varieties for

TABLE IV.—SOY BEAN YIELDS AT IRON RIVER SUB-STATION.

Year.	Variety.	Date planted.	Date harvested.	Yield per acre.	
				Hay.	Seed.
1906.....	Ito San.....	June 12	Sept. 20	3,830	Did not ripen.
1907.....	Early Black.	May 26	Sept. 12	3,200	12 bushels.
1908.....	Early Black.	May 29	Sept. 15	3,500	15 bushels.
1909.....	Early Black.	June 1	Sept. 15	4,000	17 bushels.
1910.....	Early Black.	May 27	Sept. 10	4,500	29 bushels.
Average.....	.....	.....	.....	3,860	18.25 bushels.

different parts of the northern half of the state. Soy beans were also grown for five years at the Iron River Sub-station and the yields obtained there are given in the following table.

These results were obtained on well inoculated sandy soil without the addition of any manure. While the yields were not large,

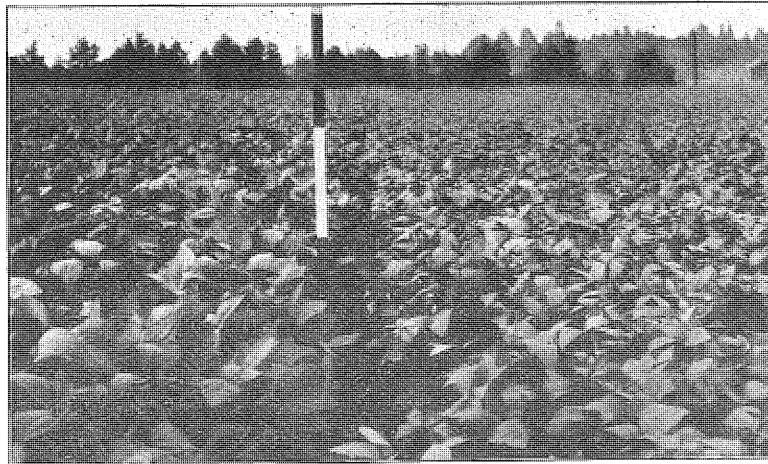
TABLE V.—YIELD OF SOY BEANS, SPOONER BRANCH STATION, 1910.

Variety.	Date planted.	Date ripe.	Total yield of cured hay per acre.	Total yield seed per acre.
Ito San.....	June 8.....	Did not ripen	2,500	.....
Early Brown.....	June 8.....	Did not ripen	1,620	.....
Early Black.....	June 8.....	September 9	1,525	245 pounds.

they show the adaptability of this early variety to northern Wisconsin conditions. It should be noted that good yields were obtained every season. On account of drought in two of the seasons above given, clover failed to return a paying crop on the same class of soil.

Variety Tests at Spooner.—In 1910 tests were begun in one-eighth acre plots on virgin Jack pine soil at the new Branch Station at Spooner. "Ito San," "Early Brown," and "Wisconsin Early Black" were the varieties tried. On account of delays in getting the land prepared, the planting was made June 8. Owing to dry weather during the growing season the crop was light. "Early Black" was ripe on September 9 and was the only variety which reached maturity before a killing frost. Table V gives the yields obtained.

At the Ellis Junction Branch Station in Marinette County, in 1911, a variety test was made with "Early Green," "Ogemaw," "Ito San," "Brown," and "Early Black" soy beans, planted



INOCULATION INCREASED YIELD AT SPOONER.

The treated soil produced 438 pounds of seed an acre, while the untreated portion produced but 234 pounds.

May 29. "Early Black" was ripe September 5 and the "Ogemaw," September 13. The other varieties did not mature. On account of drifting sand which covered a part of the field, the relative yields per acre are not considered reliable enough to publish. From the actual results obtained, "Ogemaw" showed somewhat greater yield per acre than "Early Black."

Varieties Recommended.—If intended for seed the "Wisconsin Early Black" is best for the northern half of the state. If grown for forage, "Ito San" or "Medium Early Green" will usually give a heavier yield per acre and are to be recommended for that purpose. The Early Black is a safe variety to

plant for seed in localities, which, on the average, are free from killing frost from June 1 to September 10. On sandy soil this variety matures in 90 to 105 days, depending on the amount of heat received during the growing season. On clay soils, soy beans will require from a week to twenty days longer to mature.

Breeding Soy Beans.—Breeding-work at the Station farm which had for its purpose the improvement of soy beans for Wisconsin conditions was started in 1899 and at the Branch Stations in upper Wisconsin in 1907. The aim was to breed certain strains from the parent stock that would be earlier in maturing, heavier yielders, more uniform in ripening, and would retain their foliage for a longer period of time. The centgener process of breeding whereby the individual plant could be studied was used later and the seed from those particular plants which showed desirable characteristics saved for dissemination. The "Early Wisconsin Black," the "Ito San," and the "Medium Early Green" have been improved by the above method and further developed at the state experiment stations and demonstration farms and upon the farms of members of the Wisconsin Agricultural Experiment Association.

TABLE VI.—YIELDS OF PEDIGREE EARLY BLACK SOY BEANS AT SPOONER STATION FOR 1911-1913.

Variety	Yield per acre 1911	Yield per acre 1912	Yield per acre 1913	Average yield per acre	Days maturing 1912
Pedigree 1	14.6	12.4	24.6	17.2	107
" 2	13.3	9.7	24.6	15.9	107
" 3	10.0	9.4	19.6	13.0	104
" 7	12.6	9.3	24.5	15.4	107
" 16	13.3	10.6	26.0	16.6	110
" 17	13.3	10.4	21.3	15.0	107
" 25	16.6	10.6	27.6	18.2	107
" 30	7.3	8.7	20.1	11.0	104
" 35	12.0	8.7	24.5	15.0	104
" 36	13.3	11.1	25.4	16.6	107
Michigan Brown.....	14.1	*4.8	16.8	9.4	107

*Poor stand.

This table shows the yields of several pedigree strains of Early Black soy beans at the Spooner Branch Station for three years, 1911-1913.

In 1911 and 1912 the soy beans were planted rather late and on new breaking where the ground was rough, which accounts for the low yields. The yields for 1913, on account of the abundant rainfall, were probably above normal for this Jack-pine soil.

From our experience and experiments with soy beans we have found: that soy beans bring the best returns when planted on rich soils but that they can be grown for hay and seed on sandy soils which do not grow the clovers well; that soy beans are high in feeding value; that soy beans are great nitrogen gatherers and may be used with profit in the improvement of our sandy and sandy loam soils. We recommend this crop to the careful consideration of the Wisconsin seed growers, stockmen and general farmers.

AGRICULTURALEXPERIMENT STATION OF THE UNIVERSITY OF WISCONSIN

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