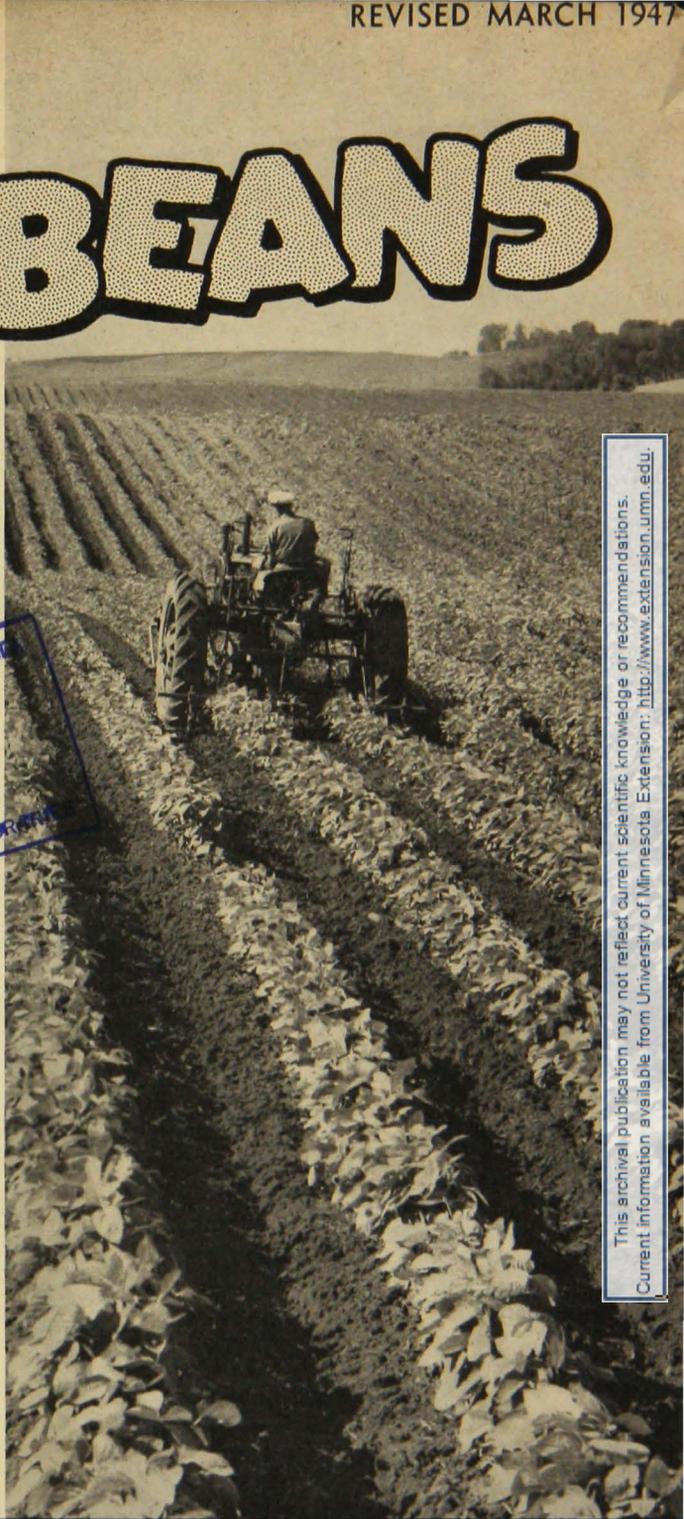


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# SOYBEANS

## FOR MINNESOTA

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U. S. DEPARTMENT OF AGRICULTURE

# *A Crop of Many Uses*

## **As a Cash Crop**

Soybeans as a grain crop are well adapted to the central and southern sections of Minnesota. The planting and harvesting operations do not seriously compete for labor with other crops. The use of the combine for harvesting has cut down the loss from shattering and lodging. Furthermore, it has reduced cost and eliminated practically all hand labor in the production of the crop. Soybeans produce particularly well in comparison with oats, barley, wheat, and flax on light soil not subject to erosion. Cash returns even on the best land compare very favorably with that received from other cash crops.

## **Grain for Feed**

Relatively few soybeans are threshed out and fed whole, or ground as a protein concentrate. The oil in soybeans, which runs from 17 to 20 per cent by weight, is generally worth more for varnish, paint, salad oil, and shortening purposes than for livestock feed.

Feeding tests with dairy cattle have shown ground soybeans to be about equal to cottonseed and linseed meals. When fed to fattening hogs in amounts sufficient to supply the needed protein, whole or ground soybeans will produce undesirably soft and flabby carcasses. However, after the oil has been removed, the resulting product, soybean meal, has about the same percentage of digestible protein as cottonseed meal and a little higher percentage than linseed meal. Soybean meal makes a satisfactory high-protein feed for all classes of livestock.

## **Emergency Hay**

When first grown in Minnesota, soybeans were used largely as a forage crop. A sizeable acreage was planted with corn for silage. This practice has been largely discontinued because of the difficulty encountered in planting, cultivating, and harvesting.

Soybeans have proved to be a very desirable emergency high-protein hay crop when alfalfa and clovers fail. However, they should not be substituted for clovers or alfalfa in a planned rotation. A farm management study in Winona County during the period 1935-1940 showed the cost per 100 pounds of total digestible nutrients to be 91 cents for soybean hay as compared with 50 cents for alfalfa hay.

Soybeans make the best-quality hay when cut before the lower leaves start to drop and when the pods are about one-third filled. On the basis of dry matter consumed soybean hay has about the same feeding value as alfalfa hay of like grade, but there is more waste in feeding soybean hay because of the coarse stems left by most classes of livestock. As a result, soybean hay is commonly given a value which is equal to 85 per cent of the price of alfalfa hay.

Soybean hay can be cured in several ways. After cutting, the plants may be allowed to wilt in the swath and then be moved by hand into cocks that will weigh about 100 pounds when dry. Or, cut hay may be allowed to dry fairly well in the swath and later be raked into medium-sized windrows when the hay is damp from dew. The raking can

be done effectively with a side-delivery rake. A windrow of desirable size may be made from a 7-foot swath or two 5-foot swaths. The hay is left in the windrow until it is dry enough to stack or haul to the haymow. With either of the above methods of curing a good deal of dirt is likely to stick to the plants. A hay loader used to pick up the windrows will cause a rather large loss of leaves from shattering. Less dirt is likely to be picked up and a more leafy, better-quality hay may be made if the soybeans are cut with a binder, bound loosely, and allowed to dry in long 6-bundle shocks.

### Pasture

Soybeans provide a large amount of pasturage over a short period of time if the plants are allowed to form seed before being pastured. Young plants are destroyed when grazed off close to the ground. Soybeans have little value as a continuous pasture compared to clovers, alfalfa, rape, small grains, or grasses.

### Straw

Soybean straw from bundle threshing may be fed successfully to sheep and horses. At the Southeast Experiment Station, breeding ewes have been wintered on 2 pounds of corn silage per head a day and all the soybean straw that they could consume.

### Green Manure

Well-nodulated soybeans plowed under are a good but an expensive green manure. The crop is high in nitrogen and decomposes rapidly under favorable conditions. The nitrogenous compounds of the plant are rapidly converted into nitrates, a form of nitrogen that is readily available to plants and quickly leaches out of the soil. Unless a crop is to be planted at once after soybeans are plowed down, plowing should be delayed until late in the fall when low soil temperatures slow down decomposition. Late-maturing varieties have some advantages as a green manure crop because more leaves are retained late in the season.

## *Soybeans and the Soil*

Soybeans have been overrated by growers as a soil builder. Little organic matter is added to the soil by the crop unless a considerable portion of top growth is turned under. No minerals are added. This is true, of course, of any crop. However, the minerals removed from the soil during the growing period of the soybeans are made very readily available to the succeeding crop by the decomposition of plowed-under plants.

Although the soybean plant is a legume, it may cause a net loss of nitrogen from the soil on which it is grown unless part of the top growth

is plowed under. The following table from Bulletin 256, University of Illinois, illustrates this point:

Table 1. Use of Soybean Crop and Nitrogen Loss or Addition to Soil

Use of soybeans (normal crop)	Lbs. nitrogen lost or added per acre
Green manure .....	88+
Hay, manure returned .....	26+
Seed, straw left .....	16+
Seed, straw removed .....	— 3
Hay, sold off farm .....	—30

As a general rule clovers and alfalfa are more valuable for soil improvement than soybeans even though liming may

Table 2. Plant-Food Elements Added or Removed by Various Crops  
(Straw and Stalks Returned)\*

Crop	Acre yield	Added nitrogen	Removed per acre				
			Nitrogen	Phosphorus	Potash	Calcium	Magnesium
					Pounds		
Corn .....	40 bu.	—	40	7	8	0.4	2.8
Oats .....	40 bu.	—	26	4.5	6.5	0.8	1.6
Wheat .....	25 bu.	—	36	6	7.5	0.5	2
Soybeans (grain) .....	20 bu.	16	—	8	25	2.8	3
Soybean hay (sold off farm) .....	2¼ tons	—	30	13	40	72	31
Alfalfa hay (sold off farm) .....	3 tons	—	—	13	96	120	24
Red clover hay (sold off farm) .....	2 tons	—	—	10	60	64	18

\* Data from University of Illinois.

be necessary to correct soil acidity before seeding the former crops.

As shown in table 1, the manner in which the crop is handled affects the nitrogen added or removed from the soil. All legumes are heavy users of phosphorus, potash, and calcium, and soybeans are no exception. Soybeans are more able than many other crops to take minerals needed for growth from the soil. As a result it is often necessary, on soils that tend to be deficient in phosphorus and potash, to add these elements before a successful crop can be grown following soybeans.

## Inoculation Is Insurance

Proper inoculation of soybean seed insures the grower against loss from his soil of at least part of the nitrogen needed to produce a crop. Well-nodulated soybean plants may obtain as much as two thirds of their nitrogen requirements from the air. Inoculation of soybean seed in the proper manner will usually assure good nodulation by supplying the bacteria capable of changing the free nitrogen of the air into a form available to the soybean plant. Inoculation will frequently increase yields of hay and grain on soils which are sufficiently high in mineral nutrients but are low in nitrates. On

soils high in nitrates uninoculated soybeans will secure needed nitrogen from the soil and no increase in yields may result from inoculation. The Wisconsin Experiment Station reports increases from inoculation ranging from 60 pounds on the richer soils to as much as 324 pounds on the medium-light soils.

The Michigan Station reports that nodules on the roots of soybeans on fertile soil may not notably increase yield but do increase the per cent of protein in the stems and leaves and in the seed, as shown in table 3.

In acid soils bacteria that form nodules on the roots of soybean plants disappear in a few years. Under favorable conditions the bacteria have been found in the soil as long as 18 years after a soybean crop was grown. Since cost is very small, seed inoculation is good practice in order to insure a well-nodulated crop.

Table 3. Effect of Nodulation on Protein in Various Parts of Soybean Plant\*

	Nodules	Without nodules
Leaves and stems .....	17.38	11.08
Seed-Agemaw .....	42.20	35.39
Medium-green plants .....	36.45	31.23

\* Taken from Bulletin 224, Michigan State College.



FIG. 1. Well-nodulated soybean roots.

## Produce Well on Most Soils

Relatively large yields of soybeans as compared to corn and small grains are secured on soils rather low in fertility. Soybeans will give a fairly satisfactory yield on alkaline spots where corn and barley produce little.

Soybeans will also yield well on soils too acid for the successful production of red clover. However, when soils are strongly acid larger yields of soybeans are commonly secured if lime is added. The advantage of liming is less for soybeans than for red and sweet clovers and alfalfa.

Soybeans are not as sensitive to drouth and high moisture conditions as corn. They react less favorably to commercial fertilizers than do other farm crops. Consequently, fertilizer applied in a rotation can more profitably be

put on companion crops for new seedings or on special crops such as corn, canning crops, sugar beets, or potatoes.

The soybean crop, even more than clovers and alfalfa, has a very noticeable tendency to improve soil structure. There is no advantage in plowing weed-free soybean ground in preparing a seedbed for a crop to follow. In fact, some soils are loosened to the extent that erosion may become a serious problem. Unless packed the seedbed may be too loose for small grains and flax, and more especially for grasses and small-seeded legumes. The use of a cultipacker has helped in getting and maintaining stands of legumes and grasses.

Fall-plowing soybean ground that is fine in texture has a tendency to make such ground "puddle" or "run together" and work hard in the spring.

# *Growing and Harvesting*

## **Choosing the Variety**

Plant breeders are constantly working to improve the agronomic and chemical qualities of soybean varieties. A particular variety which is recommended now may be replaced in a few years by another which is superior. Desirable qualities in a soybean variety for Minnesota include good yielding ability, early maturity, medium plant height, resistance to lodging and shattering, and high oil content. Other characteristics being equal, the variety having a high oil content is preferable.

At present the market price of soybeans is influenced by color, moisture content, splits, damaged kernels, foreign material, and objectionable odor. The chemical qualities have not been considered. Varieties with a high oil content of good quality are, of course, worth more to the processor than varieties with low oil content of low quality. In time this higher value may be reflected in market price.

Varieties grown for hay only may be somewhat later in maturing than those grown for grain. A greater tonnage of hay may be expected of late-maturing beans.

Information on the latest recommended varieties for various maturity zones in Minnesota can be secured from county agricultural agents or from Folder 22, available from the Bulletin Room, University Farm, St. Paul 1.

## **Inoculating the Seed**

The most common method of inoculating soybean seed is to use a commercial inoculant, following the directions for use on the container. An

inoculant prepared especially for soybeans is essential. Clover and alfalfa inoculants are worthless when used on soybean seed.

A second method of inoculation is by transfer of soil. From 200 to 500 pounds of soil from a field that produced well-inoculated soybeans the previous year will be sufficient to inoculate an acre of ground if the soil is spread evenly and worked into the surface of the seedbed.

Perhaps an easier method than by soil transfer is to apply inoculated soil to the surface of the soybean seed. To help the soil stick the seed may be dampened with a sugar solution made by dissolving 2 or 3 ounces of sugar in 1 quart of water. Thorough stirring will help to dampen every bean. The seed should not be wet. A quart of soil containing nodules may be mixed with a bushel of dampened seed.

The use of artificial heat or strong sunlight to dry inoculated seed will weaken or destroy the bacteria placed on the seed. Seed should be planted within 24 hours after being inoculated.

## **Prepare Seedbed Well**

The two main causes of soybean crop failure are poor stands and weed competition. Soybeans do not offer the same opportunity to kill weeds after the crop is up as does checked corn. Consequently, before the beans are planted, it is essential to cause as many as possible of the weed seeds in the top few inches of the seedbed to germinate in the short time available.

Weed seeds that are near the surface of a fall-plowed field will germinate earlier than weeds that are moved to the surface by spring plowing.

Germination of weed seeds in the spring is speeded up by raising the temperature of the soil through cultivation. The longer the time between the first working and planting the better the opportunity of destroying the weed seedlings. The most successful growers work their soybean fields for the first time when they start work on their corn ground and delay planting beans until after the corn has been planted.

The shorter the time between the last working and planting the better chance the soybean plants have of controlling the weeds through competition for sunlight, moisture, and plant food. If it is necessary to use spring plowing for soybeans, plowing just as near planting time as possible will probably prove most satisfactory. When ground is spring-plowed a special effort must be made by disking or cultipacking, or both, to prepare a firm seedbed.

A good seedbed is firm below and mellow on top.

### **Early Planting Best**

Early, but not too early, planting gives best results. While it is true that soybeans show more resistance to spring frost than corn, frost injury is more damaging to young soybean plants. On the other hand, soybeans are not injured as much by a fall frost as corn when both crops are frosted at the same stage of maturity.

The usual practice is to give the soybean seedbed a final working after corn planting is completed and then plant soybeans for grain. Soybeans for hay may be planted as late as July 1 in the southern one third of the state.

### **Plant Thick and Shallow**

Planting soybeans one inch apart in the row has given highest grain and hay yields. The number of pounds of seed per acre will vary with the size

of the seed and with the distance between rows. Yields of row-planted soybeans will increase as the rows are narrowed from 42 inches to 21 inches, providing equipment is available for cultivating the narrow rows.

On the majority of farms row planting will give greater satisfaction for both grain and hay than solid drilling with rows 6 inches apart because the crop can be kept freer of weeds. Trials have shown that soybeans in cultivated rows stand up better than when they are drilled solid and mature from 7 to 10 days earlier. Solid drilling is recommended when the beans are to be used for hay only and are planted late in June following several workings of the seedbed to kill weed seedlings. Broadcasting is not recommended as a means of planting soybeans.

As mentioned previously, soybeans have a tendency to loosen the soil and make erosion a serious problem on rolling land. On such land it is advisable to plant row beans on the contour.

Soybeans should be planted as shallow as possible and yet covered well. Planting 1 to 2 inches deep will usually give better stands than planting deeper. The quicker the plants can emerge the less chance there is of having a soil crust form and the less opportunity weeds have of getting ahead of the planted crop. Because of the nature of the soybean sprout, a crust may often cause the young plants to "break their necks" in attempting to reach the surface. If a crust forms so as to endanger the emergence of soybean seedlings, it should be broken with a cultipacker, a weeder, a disk, or a disk grain drill. Work just deep enough to break the crust without stirring the soil too much or breaking the seed sprouts.

### **Planting Not Difficult**

The common grain drill is gaining in popularity as a means of planting soybeans in rows. Holes may be plugged

so that the beans are planted in rows 24, 30, 36, or 42 inches apart, depending upon the cultivating equipment.

The majority of soybeans in Minnesota are planted with either a two-row or four-row corn planter. Special plates are necessary in order to drop soybeans an inch apart in the row. Before going into the field it is advisable to check thickness of planting by running the planter for a short distance on a hard surface. Thickness of planting may also be checked by jacking up one wheel, turning the wheel two or three exact revolutions, measuring the circumference of the wheel, so as to be able to calculate the distance the planter would be traveling when in the field, and counting the number of seeds dropped by the planter.

If sugar-beet drills and cultivators are available they can be used successfully for planting and cultivating soybeans.

### Cultivate to Control Weeds

Cultivation should start early. Cultivating with a harrow or weeder after the soybeans are planted, but before the seedlings are close enough to the surface to be injured, will help to control weeds. Either of these implements or a rotary hoe may be used when the plants are from 3 to 8 inches high. Little damage will be done to the stand if this type of cultivation is used when the plants are slightly wilted, as during the warm part of the day.

Soybeans planted in rows also may be cultivated by an ordinary corn cultivator or a beet cultivator. Two or three cultivations are usually sufficient and can be completed before blooming. If soybeans are cultivated when in bloom

the plants should be disturbed as little as possible in order not to interfere with the setting of seed.

Cultivation should be shallow and care taken to avoid ridging. Since most varieties of soybeans pod close to the ground, ridges increase the number of pods left in the field at harvest. This is particularly true with varieties that tend to lodge.

### Harvest at 14 Per Cent Moisture

Recommended varieties may be allowed to ripen in the field and dry to 14 per cent moisture before combining. The moisture in beans varies greatly with the humidity and needs to be carefully watched if the crop is to go directly from the field into storage. Some varieties will shatter when drier than 14 per cent.

When harvesting is done with a binder the crop should not be fully ripe because of danger of shattering. It may be harvested before fully mature and allowed to dry in the shock. Harvesting too early will result in loss of yield. Maximum yield is reached at full maturity, which is indicated by approximately a 14 per cent moisture content.

Studies show that the increase in popularity of the combine for harvesting soybeans for grain is justified. In addition to costing less on an acre basis, combining will result in salvaging a larger per cent of the grain crop. It was found in a study made at the University of Illinois in 1929 that 19.3 per cent of the beans was lost when the binder-thresher method of harvesting was used and only 9 per cent when the combine method was used.

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