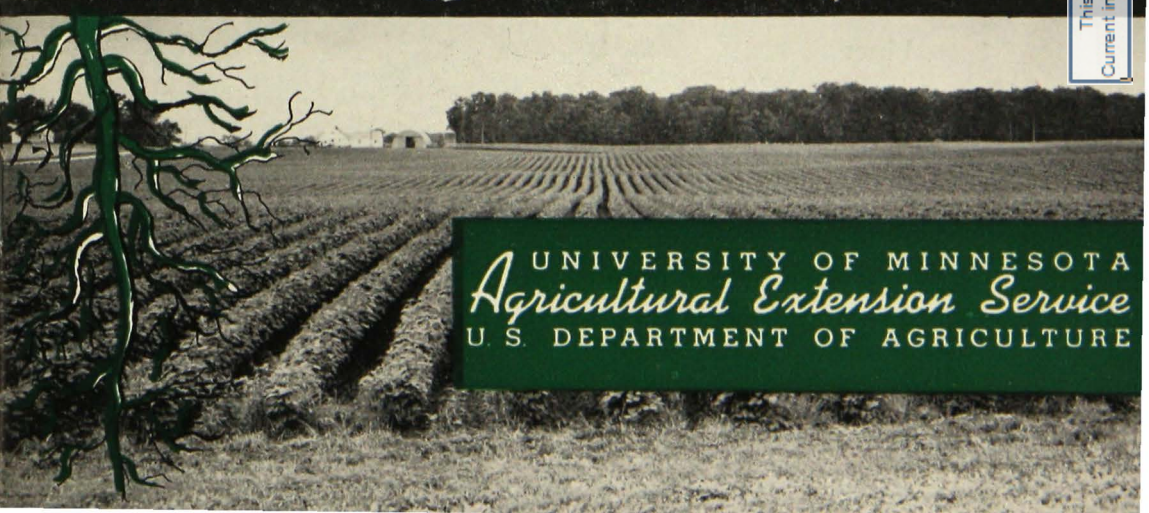
SOYBEANS for MINNESOTA



UNIVERSITY OF MINNESOTA
Agricultural Extension Service
U.S. DEPARTMENT OF AGRICULTURE

CONTENTS

SOYBEANS for MINNESOTA

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SOYBEANS ARE A MAJOR CASH CROP on Minnesota farms. Since first introduced to Minnesota in the 1930's, they have continually increased in importance. While other crops are in surplus, soybeans continue to move into consumption channels because of aggressive promotion programs at home and in foreign markets.

Almost all of the soybean crop, other than seed held for planting, finds its way into processing plants. Oil and meal are the two principal soybean products. Oil makes up a sixth or more of the bean and usually brings three to four times as much per pound as the meal. Therefore, soybeans with a high oil percentage are preferred by processors. Oil percentages vary not only with the variety but also with the location and year the soybeans are grown.

Most oil produced goes into human foods such as shortenings, margarines, and salad oils. Some soybean oil is used in industrial products such as paints, soaps, linoleum, and synthetic resins.

A high proportion of the soybean meal produced is used for animal feeds. It is of special value because of its high percentage of digestible protein. Relatively small amounts are used in human food in the United States. However, soybeans are in demand as a source of protein food in Asia and Europe. The meal is an important use of the soybeans we export. This new market provides a demand for soybeans with higher protein content.

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Growing, Harvesting, and Storing

CHOOSING THE VARIETY

Variety choice is one factor of soybean production that you can control. For a variety to be successful, it must mature and produce a good yield of harvestable, high-quality beans under average, local growing conditions.

Generally, the farther north the location, the earlier must be the variety. Thus, a variety that matures the last week in September can be used in the southern tier of Minnesota counties, but one that matures by September 1 is needed in the extreme northern counties. When late planting is necessary in the southern section, use an earlier maturing variety. If the variety is to be used for silage instead of grain, it can be 7 to 10 days later in maturity.

Through the cooperative breeding research of the Minnesota Agricultural Experiment Station, other state experiment stations, and the U. S. Department of Agriculture, new and better soybean varieties are constantly being developed for specific growing areas. Several varieties already released through this program have proved superior in one or more of the following characteristics: yield, standing ability, resistance to shattering, plant height, and oil content.

The soybean variety recommended by the Minnesota Agricultural Experiment Station for the several maturity zones of Minnesota are listed in Miscellaneous Report 24, *Varietal Trials of Farm Crops.* This report gives detailed results of extensive varietal testing throughout Minnesota. Recommendations for the best varieties to use in a given location are based on an annual review of the trial results.

USE GOOD SEED

Plant high-quality seed of adapted varieties. Good seed has (1) high varietal purity; (2) high purity from weeds and other crops (98.5 percent or above); (3) relative freedom from cracked and split seeds, stems, and dirt; (4) freedom from weeds and other crop seeds; (5) uniform size for accurate planting; and (6) high germination (85 percent or above). Certified seed assures varietal purity and meets high standards for the other quality factors. To utilize the advantages of improved varieties, seed of known varietal purity must be planted.

In selecting seed, whether purchased or home grown, give special attention to mechanical condition. Select sound seed. Seed having a high percentage of severely cracked seed coats will not germinate satisfactorily. Many plants from such seed are stunted and slow to develop.

Field studies were conducted to determine the effects of mechanical conditions on stand. Careful visual examination was used to decide between severely and slightly cracked seed coats. The results are shown in table 1.

Mechanical injury of seed usually occurs in harvesting when the seed is low in moisture. Improper combine adjustment can cause serious injury to the seed. Serious mechanical injury can usually be detected by visual examination and verified by laboratory germination. If you intend to plant

Table 1. Effect of mechanical condition of seed upon the stand and vigor of soybeans (average of six replications, Michigan State University)

Mechanical condition of seed	Vigorous	Moderately vigorous	Weak	Stand total
Number cracked seed coats	72	6	2	80
7 percent cracked seed coats	69	5	2	76
100 percent slightly cracked seed coats	41	12	4	57
100 percent severely cracked seed coats	23	15	5	43

your own beans have a germination test conducted by the State Seed Laboratory, St. Paul, or another qualified laboratory.

SOIL PREPARATION

Soybeans require a seedbed similar to that for corn. It is important to kill weeds and provide a firm seedbed. These conditions favor rapid germination, seedling emergence, and good root development.

Fall plowing is desirable on fine-textured soils. It may be necessary to harrow or cultivate just before planting to control germinated weeds.

Many growers plow in the spring successfully. This practice leaves a cover on the soil during the fall and winter, thus reducing soil erosion. This also helps conserve moisture by holding snowfall.

When spring plowing is practiced it is advisable to plow as close to planting time as possible. Press the seed firmly in contact with the soil. However, it is unnecessary to firm the whole field to attain good contact. The shorter the time between seedbed preparation and planting, the better chance the soybeans have of competing with weeds for sunlight, moisture, and plant nutrients.

Minimum tillage has shown promise as a method of seedbed preparation. Plow-plant wheel track planting and other minimum tillage variations produce yields equal to those obtained with conventional tillage. Minimum tillage saves time and money, lessens soil compaction, leaves the soil loose between the rows to absorb more water, and makes soil conditions favorable for quick germination and good root development.

FERTILIZATION

Whether or not soybeans respond to fertilization depends on the nutrient status of the soil. If you are uncertain of the amount of available plant nutrients in your soil, have the soil tested. Generally, if the soil tests less than 150 pounds per acre of potassium (medium level or below) or less than 15 pounds of phosphorus per acre (medium or below), soybeans should be fertilized. Apply the amount of fertilizer that the soil test indicates.

If relatively small amounts of fertilizer are indicated (up to 125 pounds per acre), application may be made with the planter attachment. The soybean is susceptible to fertilizer damage. Therefore, be sure that no fertilizer contacts the seed, particularly if it contains much potassium or nitrogen and potassium. If a soil test shows that the amount of fertilizer needed is more than 125 pounds per acre, broad-

cast the fertilizer and plow it under or work into the soil.

Soybeans are a legume crop. Thus, the plant gets part of its nitrogen from the air. But in soils where legume crops are not grown often, use some nitrogen in the fertilizer. Some nitrogen also helps on acid soils where nitrogen fixation may be poor. Seed inoculation before planting usually lessens the need for fertilizer nitrogen.

Soybeans respond well to potash when soil supplies are low. Minnesota experiments showed yield increases of over 8 bushels of soybeans per acre from the use of potassium on potash-deficient soils (figure 1). Potassium-deficiency symptoms include a yellowing of leaf edges in the early stage with a spreading of the chlorosis and firing of the leaves in more advanced stages.

On high-lime areas of Minnesota, soybeans don't do well because of iron deficiency (figure 2). Stunted plants and yellow leaves with green midrib and veins are signs of this condition—called iron chlorosis. It can be cured by a solution of 10 pounds per acre of ferrous sulfate sprayed on the plants. Apply when the weather is cool. Mist the spray on the plants when they are 4 to 6 inches high. Varieties differ in their susceptibility to iron chlorosis.

Soybeans do better on soils that are not too acid. Lime acid soils to a pH of 6.5.

Fertilizers may affect seed quality as well as yield. Phosphate fertilizers

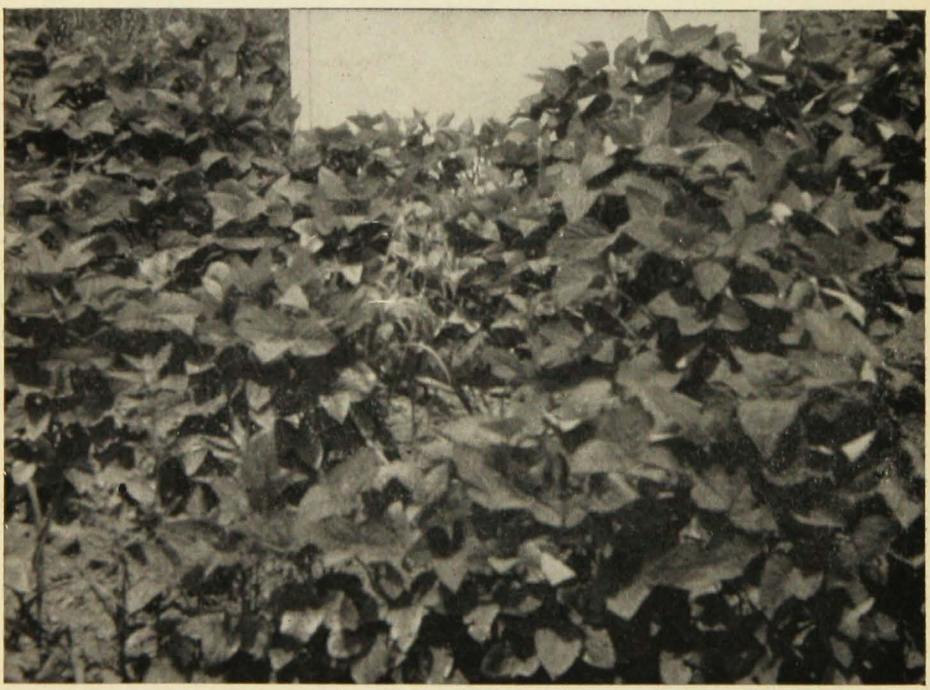


Fig. 1. Soybeans at right indicate the results of applying potassium to potash-deficient soil.

Fig. 2. Light colored plants in center two rows show iron chlorosis. This is caused by an iron deficiency in high-lime Minnesota soils.

may increase the protein and phosphorus content of the seed. Potash may reduce the number of shriveled seed and increase the oil percentage.

INOCULATION

The most economical way to get the nitrogen required for a soybean crop is to have the bean plants manufacture their own supply. The safest way to insure good nodulation on the roots and manufacture of nitrogen is to annually inoculate the soybean seed with proper bacterial culture. This is good low-cost insurance. Follow the manufacturer's directions.

SEED TREATMENT

Generally, seed treatment is not recommended because it usually doesn't increase yields. However, there are certain advantages from seed treatment. It increases stands, especially if seed is not of the highest quality and if weather at planting time is not favorable to rapid germination. Moreover, if seeds are badly weathered, if seed coats are broken, or if seeds are injured internally, seed-treatment chemicals protect them from invasion by soil-borne fungi.

On the average, seed treatment increases stand about 20 percent. If seed treatment is used properly, therefore, planting rates can be reduced about 20 percent and the stand still be the same as with untreated seed.

Materials recommended for treating soybean seed are: Thiram, Chloronil, and Captan. Follow manufacturer's directions carefully for dosage and method of application. If you desire to treat and inoculate the seed, make treatment several weeks before plant-

ing time. Then apply inoculant just prior to planting.

PLANTING

Time

For most of Minnesota, the best time for planting soybeans is from about May 15 to June 1. Very early varieties usually produce mature seed in southern Minnesota when planted as late as July 1. This late planting is sometimes practiced after removing a crop of early canning peas or as an emergency crop.

Mid- or late-May plantings are best. They allow adequate seedbed preparation for weed control and still permit the use of high-yielding, full-season varieties.

Row Spacing

The most common spacing of soybean rows on Minnesota farms is 40 inches. This, of course, is convenient because it is the same as for corn production. However, experiments at several Minnesota locations showed that increased yields of 3 to 8 bushels per acre can be expected from narrower row spacings (figure 3). This is particularly true with early or midseason varieties. Later, taller-growing varieties give only slight gains in narrower spacings. The advantage of narrow

Fig. 3. Narrower row spacing (right) can increase yields of early or midseason soybean varieties from 3 to 8 bushels an acre.

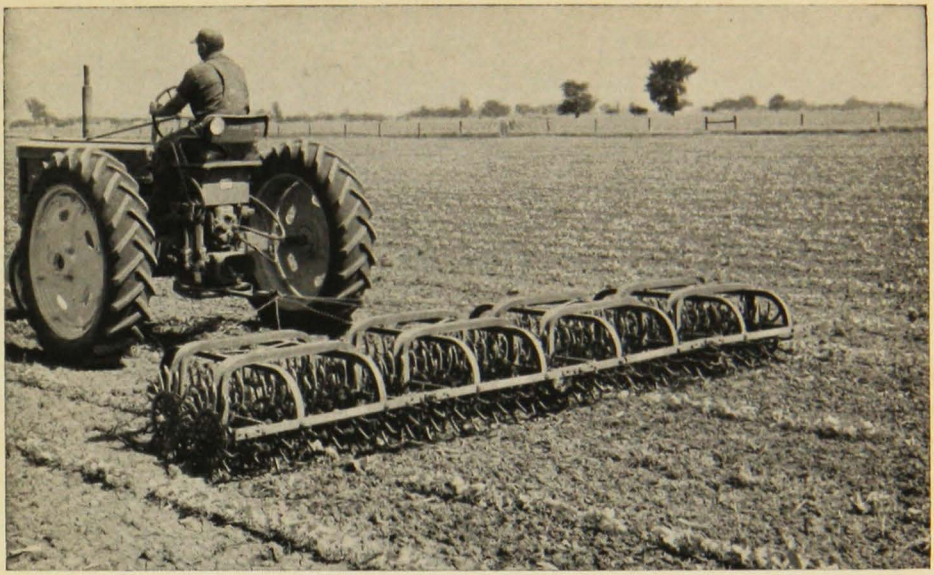


Fig. 4. You can use a rotary hoe to kill weeds in soybeans. A spiketooth harrow is equally effective.

spacings is apparent in the central or northern counties or wherever it is desirable to plant the early, short-growing varieties.

There are numerous ways to provide narrow row spacings: (1) Use sugar beet planting equipment, (2) place the planter shoes 36 to 38 inches apart on the regular corn planter, or (3) sow with a grain drill with part of its spouts stopped. In all cases provision must be made for operation of cultivation equipment.

Selective herbicides may make it feasible to plant soybeans in spacings that are too narrow for cultivation. Experiments with row spacings and herbicides showed that weeds may be controlled and good yields obtained in 6-inch or 12-inch row spacings. In the few instances when the herbicides are ineffective, timely use of the rotary hoe or harrow can often control early weed growth (figure 4).

Rates

Experiments showed that planting rates may vary within rather wide limits without greatly affecting yield. About one plant per inch of row where the rows are spaced at 40 inches apart appears adequate. Approximately 60 pounds of medium size seed (2,800 seeds per pound) of good germination (90 percent or above) gives this plant spacing. Varying that amount 15 pounds, either up or down, doesn't usually affect yield much.

Very heavy rates of seeding tend to cause more spindling stems and greater lodging. Very light rates often result in poor seedling emergence, more weeds within the row, more low podding, and low branching on the stem.

For narrower row spacings, the pounds of seed planted per acre should be increased. In 24-inch spacings, for

instance, use 90 to 100 pounds of medium size, good-germinating beans per acre. Sow solid-drilled beans at about 120 pounds per acre. Always adjust the actual pounds per acre to the size and germination percentage of the seed.

Depth

Plant soybean seed as shallow as is consistent with placing it in moist soil. This requires careful preparation of the seedbed so that it is fairly firm and well supplied with moisture near the surface. If the soil is very loose, the cultipacker or similar implement may be used to advantage just prior to planting.

Under most conditions, planting seed at 1-inch depth is satisfactory. Do not plant seed deeper than 3 inches. Poor seedling emergence may be encountered in fine-textured soils due to the formation of a thick crust following hard, beating rains. Sandy soils tolerate slightly deeper planting because surface crusts do not usually form. However, where hard crusts form on the soil surface, they may be broken with a rotary hoe, harrow, weeder, or cultipacker.

WEED CONTROL

Weeds may be responsible for one or more of the following conditions in soybeans: lower yields, delayed maturity, increased lodging, shorter plants, increased harvest difficulties, and less quality.

Weed control begins with the use of high-quality seed and soil preparation. Obtaining a good stand of soybeans can help control weeds. Yield losses due to weed competition were up to 20 percent less in stands of 13 to 15 plants per foot of row compared to stands of seven plants per foot of row in Iowa State University Experiments. One important factor in weed control is to kill the weeds early—when they begin to sprout. Cultivation should start early.

After planting and before the soybean seedlings emerge, go over the field with a rotary hoe or similar equipment to break crust and kill small weeds. Use a rotary hoe until plants are 6 inches tall. Little damage is done to the stand if this type of cultivation is used when plants are slightly wilted.

If a rotary hoe or similar equipment is not available, you must cultivate early and carefully to hurt the weeds and avoid covering the bean plants. Cultivating should be shallow and level. Avoid ridging as ridges make harvesting difficult.

Herbicides show promise for weed control in soybeans. A preemergence spray over the row in a 12- to 14-inch band may help in early weed control. This is especially true when wet conditions delay cultivation or where large acreages are involved.

Details of how to control weeds are available in Extension Folder 212, *Cultural and Chemical Weed Control in Field Crops.* This folder presents up-to-date information based on numerous weed control trials throughout Minnesota.

HARVESTING

The success of the crop is often determined at harvest. The best crop can be so poorly harvested that losses from unharvested or damaged beans remove any chance for profit.

Soybeans are ready for harvest at 14 percent moisture. Beans lower in moisture (8 to 10 percent) are subject to mechanical damage as well as

increased shattering losses. Local elevators can run a moisture test on bean samples as a guide to the best harvesting time.

Common harvesting losses can be placed in three categories: (1) preharvest losses, (2) gathering losses, and (3) threshing and separating losses.

The major **preharvest loss** is from shattering. This increases as beans lose moisture. Timely harvest, selection of shatter-resistant varieties, and earlier morning harvesting to extend harvest hours each day may minimize these losses.

Gathering losses may make up from 80 to 90 percent of total losses. They can account for 5 to 25 percent of the total crop according to Ohio State University researchers. To prevent this, remember:

- Reel speed should not exceed ground or forward speed more than 10 percent. A reel moving faster than forward speed results in increased shattering.

- Reel position affects losses. The lower the bats the more pods are struck causing more shattering. When properly positioned, shattering is minimized and no cut beans are carried over the reel.

- Cutter bar height is important. Losses can be reduced by using: (1) taller growing varieties, (2) varieties carrying the pods 2 or more inches above the soil surface, (3) varieties with good lodging resistance, and (4) better weed control. Also avoid ridging when cultivating. Set the cutter bar at the height that gets most beans.

Threshing and separating losses can be reduced by proper adjustment of the combine (figure 5). Remember

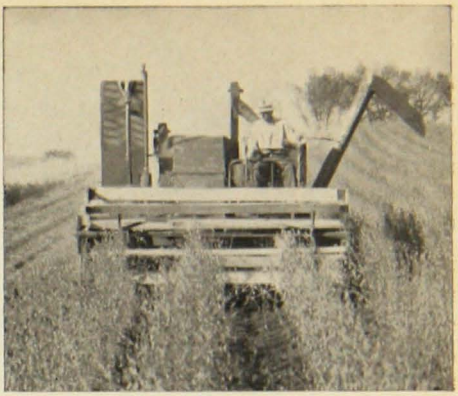


Fig. 5. When combining soybeans, proper mechanical adjustment and a proper rate of speed help cut field losses.

that a proper setting at 10:00 a.m. may not be correct at 3:00 p.m. on the same day. An operator's manual provided with the combine gives basic information on adjustments. Use these instructions only as a guide and make additional adjustment necessary to prevent field losses and seed cracking. Proper adjustment is very important with soybeans being harvested for seed. Remember:

- Cylinder losses are reduced by adjusting the speed and distance between cylinder and concave. Use only enough concave bars or teeth to thresh beans from the pod. Overthreshing results in split and cracked beans and seed coat damage.

- Straw rack losses are usually small. Overloading the combine, caused by excessive ground speed for operating conditions, can increase these losses.

- Cleaning shoe losses are held to a minimum when the chaffer, chaffer extension, and cleaning sieve are prop-

erly adjusted. The amount and direction of the fan blast through the cleaning shoe is important. Direct most of the fan blast toward the forward third of the chaffer. Maintain a "live" chaffer by using enough blast, but too much will blow beans out the back end of the combine.

A few "rules of thumb" may help cut losses to a minimum.

1. Four to five beans left on the ground per square foot = 1 bushel loss.

2. A forward speed of 2.5 miles per hour may result in about a 200-pound loss per acre. A speed of 5 miles per hour may result in a 350-pound loss per acre.

If beans are at 10 percent moisture you will harvest 3 percent fewer bushels than when beans are at 13 percent moisture. Harvesting losses will be higher from shattering and seedcoat cracking. You lose at harvest and in marketing when your beans are too dry.

STORAGE

Soybeans may be stored safely for short periods in the fall and winter with moisture content as high as 14 percent. For longer storage and carryover into the warm spring and summer months, the moisture content should not exceed 12 percent. Beans low in foreign material and in percentage of splits stay in good condition longer than dirty or carelessly handled beans. As with any other grain, tight, weatherproof bins are essential to proper storage.

Soybeans and the Soil

ADAPTATION

Soybeans are adopted to nearly all soils but produce best on more fertile soils. They are preferred to corn as a crop on wet lands, chiefly because they can be planted later. Soybeans are relatively drought resistant (in this respect better than corn) and do well on sandy soils. They can be grown on peats and mucks.

EFFECT ON SOIL

Chemical

Soybeans, like any other crop, remove nutrients from the soil—how much depends upon the yield, use, and method of handling. Figure 6 indicates the amount of nitrogen, phosphorus, and potassium removed by an average yield of soybeans compared to that removed by average yields of corn, alfalfa, and oats.

When the grain is sold off the farm, large amounts of phosphorus and potassium are removed without being returned in any manner. The soybean plant manufactures about enough nitrogen for its own use and doesn't contribute particularly to the nitrogen content of the soil. The grain used for processing and the seed held for planting contain large amounts of nitrogen;

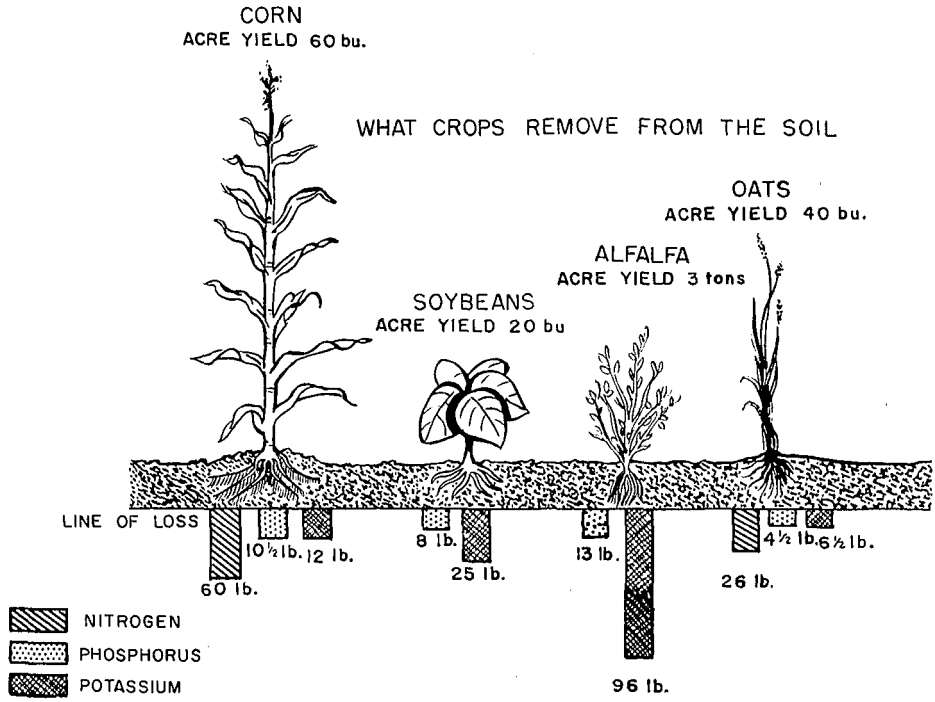


Fig. 6. Plant nutrients are removed from the soil by soybeans. Amounts removed by average yields of corn, alfalfa, and oats are shown for comparison.

the straw contains little. With 1¼ tons of straw containing only 15 pounds of nitrogen, little can be returned to the soil when the straw remains in the field. Furthermore, only about 10 percent of the plant is roots so little nitrogen is contributed from there.

Physical

Soybeans mellow the soil following their use. This physical condition is especially suitable as a seedbed for small seeded legumes and flax. Because of the favorable structure it isn't necessary to plow for most crops following soybeans, except where the straw is very heavy or the weed situation bad.

CROPPING SEQUENCES

Soybeans can be used as the row crop in any rotation. In the rotation soybeans should not follow soybeans or other legumes—mainly because of disease difficulties. Frequently, the crop follows small grains or corn, but cornstalks should always be plowed under.

Soybeans can be beneficial to crops that follow it. It has been shown that corn and oats are better following soybeans than when following corn. Because of good soil structure and weed control provided by soybeans, flax is a suitable crop to immediately succeed soybeans in the crop rotation.

Special Uses

EMERGENCY HAY CROP

Soybeans are a desirable emergency, high-protein hay crop when alfalfa and clovers fail. You can expect 2 to 3 tons per acre. This crop makes the best quality hay if cut when the lower leaves start to drop and when the pods are about half filled.

On the basis of dry matter consumed, soybean hay has about the same feeding value as alfalfa hay of a like grade. However, there is more waste in feeding soybean hay because of the coarse stems left by livestock. As a result, soybean hay is commonly given a value equal to 85 percent that of alfalfa hay. The use of crushers or crimpers to crack the stems results in higher quality hay because of more rapid drying and better utilization of stems.

Tests in Minnesota where weeds were no problem indicated that drilling gives the highest forage yields. Sow the soybeans at the rate of 2 bushels per acre. Also consider planting the later-maturing varieties as they are likely to give higher forage yields than the earlier ones.

SILAGE

A combination of sudangrass and soybeans seeded together makes good silage. When this combination is used, drill 10 to 15 pounds of sudangrass with 1 bushel of soybeans. This should be ensiled when the sudangrass is headed but before frost. Cut and handle this crop similarly to corn for silage.

Always use a preservative when ensiling soybeans alone. Ground grain, molasses, or sodium metabisulfite are satisfactory preservatives.

GRAIN FOR FEED

Relatively few soybeans are threshed and fed whole or ground as a protein concentrate. The oil in soybeans, which runs from 17 to 20 percent by weight, is generally worth more for food and industrial products than for livestock feed.

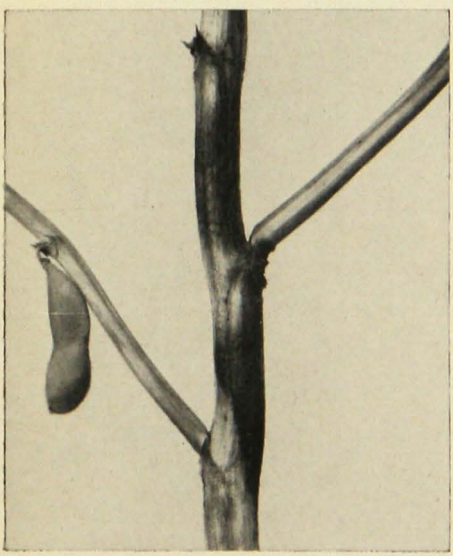
Feeding tests with dairy cattle showed that ground soybeans are about equal to cottonseed and linseed meals. When enough is fed to fattening hogs to supply needed protein, whole or ground soybeans produce undesirable soft and flabby carcasses.

After the oil is removed, however, 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.

Diseases of Soybeans

Several diseases of soybeans are common in Minnesota. Fortunately, none are extremely serious or epidemic at the present time. Potentially, however, they are a real cause for concern. As more soybeans are grown the

Fig. 7. Damping-off and root rot affect soybean seedlings. A healthy seedling is shown (second from left) for comparison.



diseases probably will become more severe, causing greater losses.

Details on the most common diseases are presented in tabular form in table 2. It gives a brief description of each disease, its cause and development, the best treatment now recommended, and other pertinent remarks. With the exception of brown spot, for which no photograph is available, the diseases are illustrated in figures 7 to 14.

Fig. 8. Stem canker of soybeans. Note black areas on main stem.

Table 2. Diseases of soybeans

Description	Causes and development	Treatment	Remarks
DAMPING-OFF AND ROOT ROT—Decay of seed and death of seedlings before emergence. Damping-off after emergence; brown roots and stem bases with lesions at ground level. Rotting and destruction of roots (figure 7).	*Fungi.* Soil-borne. Develops at all stages of growth. Usually occurs in proportions of rows or patches 3 to 30 feet in diameter in fields. In severe epidemics entire fields must sometimes be reseeded.	*Crop rotation.* Use the best quality seed. Seed treatment.	If seed treatment is used with bacterial inoculant, chemical should be applied weeks to several months before planting. Inoculant should be applied immediately prior to planting.
STEM CANKER—Wilting of entire plant before leaves begin to mature. Brown-to-black canker at attachment of first leaves above ground level (figure 8).	*Fungus.* Lives in soil, seed, and plant debris. Symptoms do not appear until mid-August, when the leaves of plants start to turn color.	*None.*	The disease appears late, varieties are early, season is short, so little damage is sustained in Minnesota. Very destructive in southern part of Corn Belt.
BROWN STEM ROT—Sudden browning of leaves between lateral veins (figure 9). Brown discoloration inside of stem becomes conspicuously brown (figure 10).	*Fungus.* Soil-borne. Enters plants through roots. Symptoms often appear in warm period following cool weather in late August.	*Do not plant soybeans in one field more often than once in 4 years.* Rotate with corn and cereal crops.	Disease new in Minnesota. Develops late in season. Little damage in Minnesota but destructive in central Corn Belt states.
BACTERIAL BLIGHT—Angular, yellow, water-soaked leaf spots, becoming brown in center (figure 11). Leaves become yellow; shred and fall prematurely. Brown spots on stems in severe infections.	*Bacteria.* Favored by temperatures near 75° F. and wet, humid weather. Bacteria are seed-borne and live on debris in fields. Plants infected at all stages of growth.	*Crop rotation.* Avoid cultivating when the leaves are wet because bacteria are spread by machinery.	Bacterial blight is one of the most common diseases in Minnesota. Losses estimated up to 5 bushels per acre in severe epidemics.

Table 2 (continued). Diseases of soybeans

Description	Causes and development	Treatment	Remarks
BROWN SPOT—Reddish-brown spots mostly on lower leaves. Infected leaves turn yellow and fall (not illustrated).	*Fungus.* Develops during wet, humid weather in June. Fungus overwinters in infected leaves in fields. Plants seldom infected after midseason.	*Crop rotation.* Avoid cultivating when the leaves are wet because fungus is spread by machinery. Plow under infected plant parts.	Easily confused with bacterial blight. Microscopic examination necessary for definite identification.
DOWNY MILDEW—Green spots on upper surface of leaf; grey tufts of moldy growth on lower surface (figure 12). Leaves turn yellow and fall.	*Fungus.* Develops during cool, wet weather in early part of the season. Fungus is seed-borne and can overwinter on dead leaves in the field.	*Crop rotation.* Plow under infected plant debris.	Severe infection results in defoliation and reduction in yield. Seeds of some varieties become infected and seed coats are injured.
MOSAIC—Mottled green and yellow, crinkled, and distorted leaves (figure 13). Yellow, light-green, and bronze discolorations of leaves. Stunting and yellowing of entire plant.	*Viruses.* Caused by several viruses, some seed-borne, some transmitted by insects, some spread mechanically.	*None practical.*	Infected plants scattered throughout fields. Symptoms of some viruses are identical to 2,4-D injury. Severely infected plants produce no seed.
PURPLE SEED STAIN—Purple discoloration on portions of seed. Wrinkles and cracks in coat in discolored area (figure 14).	*Fungus.* Develops on seed in pods late in the fall after plants are ripe. Develops especially when crop stands during periods of cold wet weather.	*Crop rotation.* Avoid planting infected seed. Seed treatment.	Seed quality reduced. Seed down graded in the trade. Seedling blight sometimes results from infected seed.

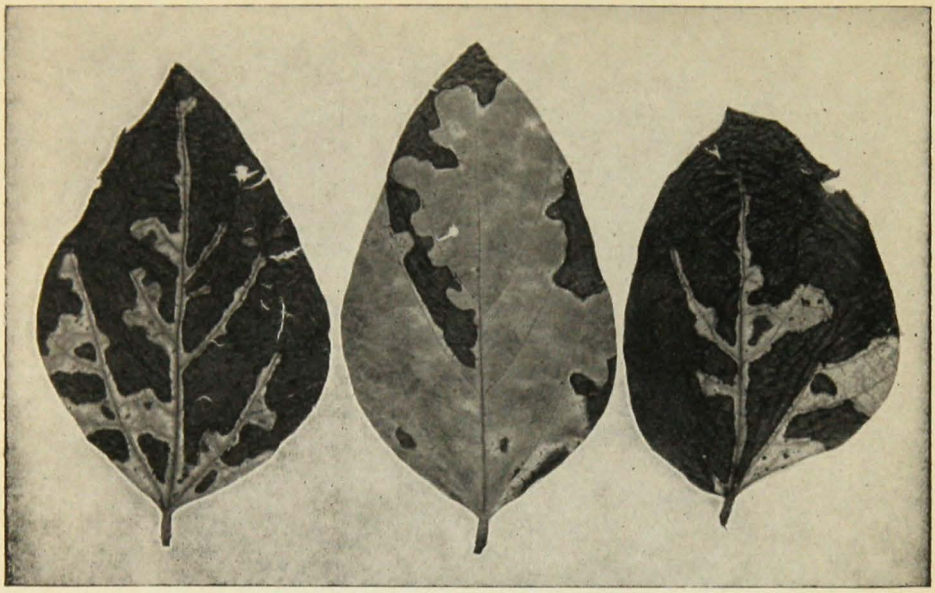


Fig. 9. Leaf symptoms of brown stem rot.

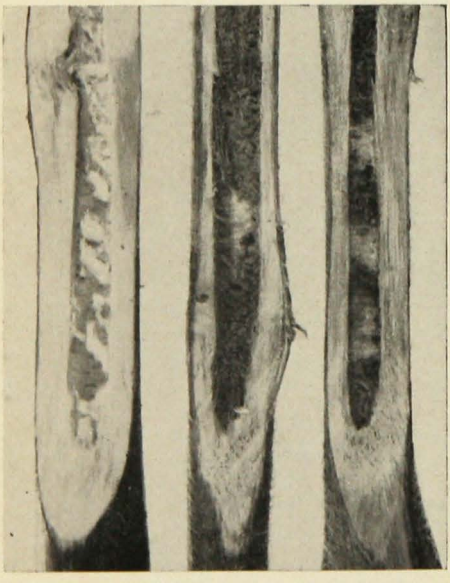


Fig. 10. Cutaway section of healthy soybean plant (left) compared with two plants attacked by brown stem rot.

Fig. 11. Soybean leaves showing effects of bacterial blight.

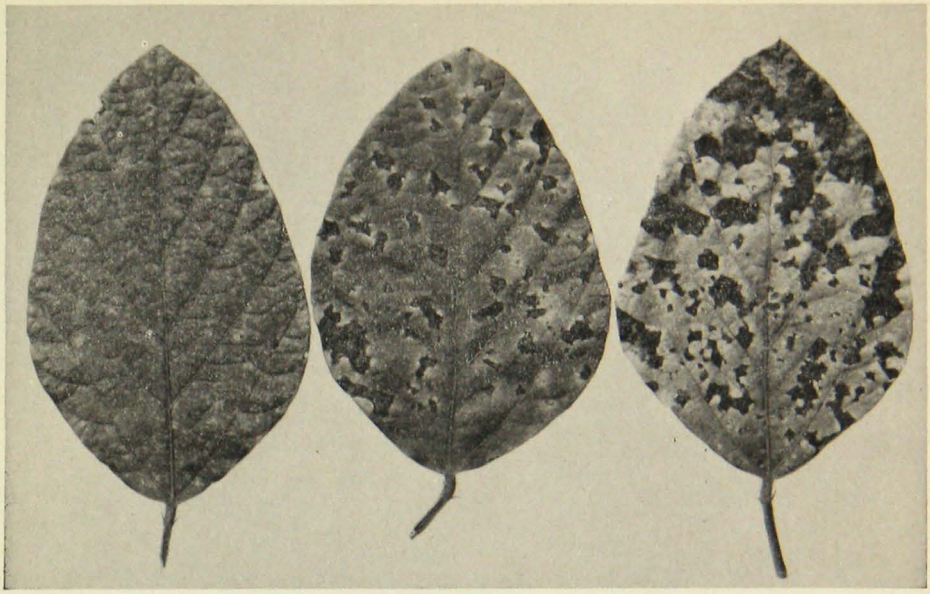


Fig. 12. Downy mildew. Effects of fungus are just beginning to show on soybean leaf at far left.

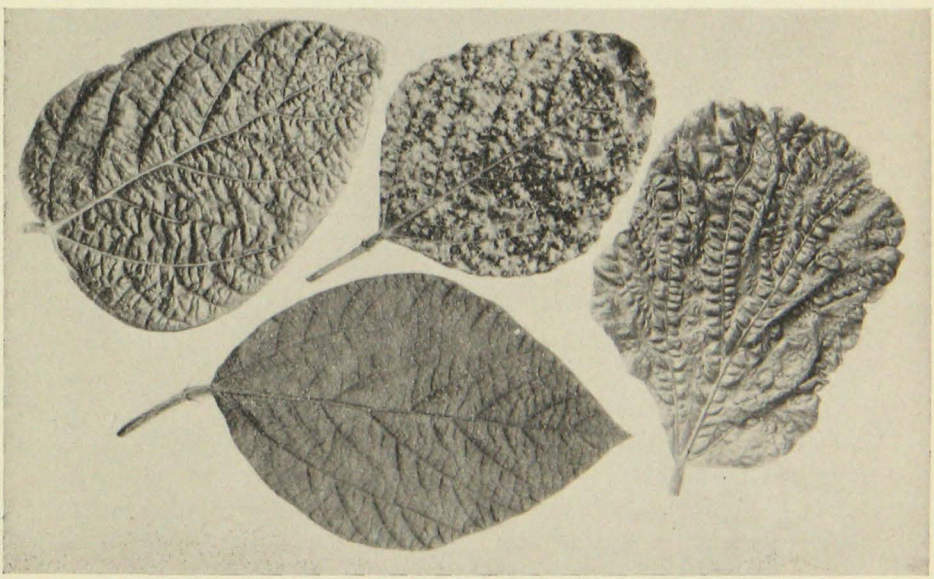


Fig. 13. Mosaic on soybeans can be identified by the distinctive crinkling and distortion of leaves. Compare appearance of three leaves at top with healthy leaf at bottom.

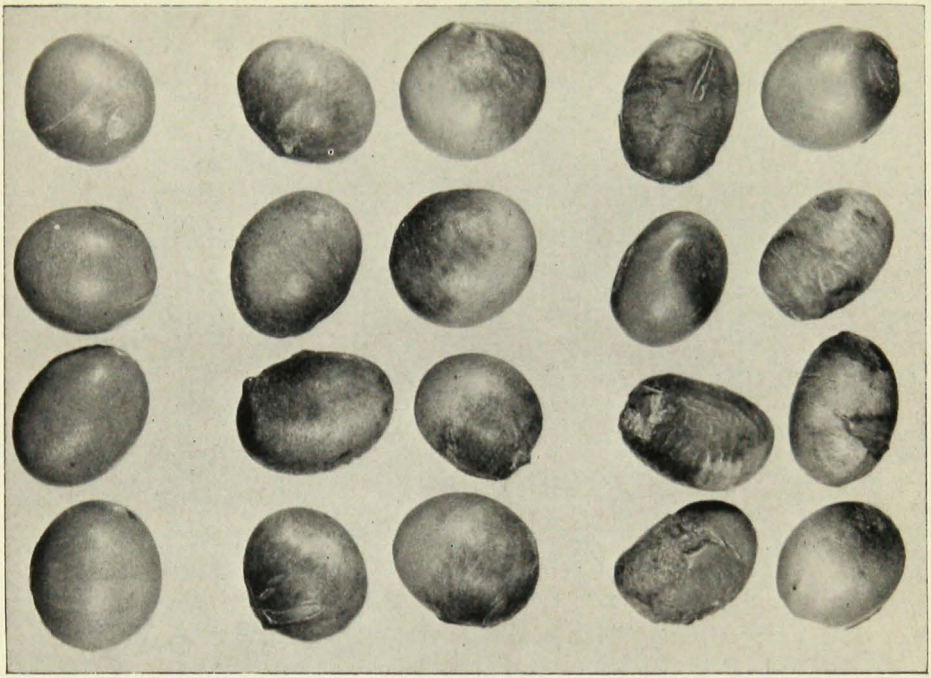


Fig. 14. Purple seed stain. Healthy seeds (row at left) are shown for comparison.

Use adapted varieties—Follow University recommendations.

Use good seed—Certified seed guarantees variety of high quality.

Use proper crop sequence—To reduce losses from root rot and other diseases, plant soybeans after small grains or corn. Avoid planting soybeans after soybeans, other legumes, or flax.

Plan for high fertility—Follow a good crop rotation. Use fertilizer and lime as needed. Prevent erosion. Provide proper drainage.

Inoculate with nitrogen-fixing bacteria—Inoculate seed just before planting.

Plant in narrow rows—Use narrower row spacing for high yields.

Kill weeds early—Use preemergence herbicides or rotary hoe when weeds are small.

Harvest carefully—Combine at 10 to 14 percent moisture. Reduce cutter-bar losses. Check cylinder speed and other fittings.

Store properly—Test beans for moisture. Moisture content should not be over 12 percent for long storage. Remove foreign matter; clean beans keep best. Continue to check stored beans.

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