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Production
Varieties
Weed Control
Fertilization

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Soybeans

Soybeans are a good cash crop for the eastern counties of the State. Originally they were confined to the southeast counties; now they are being grown farther to the north and some to the west. New improved and adapted varieties, more knowledge about growing the crop, and soybeans being grown on acres taken out of corn contributed to this expansion.

The acreage of soybeans in South Dakota has fluctuated greatly over the past years. 259,000 acres harvested in 1958 was the high; 100,000 acres harvested in 1960 was the low. Since 1960, the acreage gradually increased to 149,000 acres in 1963. The 10-year average annual production (1954-63) was about 2,600,000 bushels representing an annual crop valuation of about $5 million.

AREA OF ADAPTATION

Soybeans are best adapted to the eastern two tiers of counties in South Dakota. Some beans are being grown in the area immediately west of these counties. When soybeans are grown out of their area of adaptation they became a very high risk crop. Eastern South Dakota is recognized as the western border of the soybean belt.

While the soybean plant is drought resistant and will make vegetative growth when moisture is lacking, this condition is not conducive to good pod setting. When humidity is low, the blossom tends to abort thus producing few pods and beans. High humidity and cooler temperatures during the blossoming stage favor good pollination and pod formation which in turn affect seed yields.

EXPECTED YIELDS

Soybean yields vary considerably from field to field and from season to season. This variation is due to soil fertility, soil type, weeds, cultural practices, variety, rainfall, and production practices. In 1963, the South Dakota state average yield was 24 bushels per acre with 35 to 40 bushels per acre not uncommon. In 1959, the average yield was 11.5 bushels per acre with many fields being a crop failure due primarily to drought conditions. However, with good cultural practices and adapted varieties, yields from 15 to 25 bushels per acre can be expected. In areas of adaptation and under favorable growing conditions, higher yields can be expected.

SOYBEANS IN THE ROTATION

Soybeans may occupy any place in a cropping system but usually take the place of a row crop. Do not use soybeans after plowing down alfalfa or another legume crop as corn will usually give a greater response. Soybeans may follow soybeans; however, this practice can increase erosion because soybeans leave the soil rather loose and unprotected. Small grains, flax if weeds are controlled, or even corn are all good crops to follow soybeans.

SOYBEANS FOR FORAGE

If cut when seeds are ½ to ¾ developed and properly cured, soybeans make excellent hay of high feeding value. Soybeans can be planted with other forage crops such as sudan, sorghum, millet or corn for silage. This mixture increases the total yield and improves the feeding value of the forage. When soybeans are used for hay or mixed with other forage crops, a later and taller variety is recommended.

PRODUCTION PRACTICES

Soybeans are not particularly simple and easy to produce. On the other hand, most farms are equipped with the machinery for raising them. Those attempting to grow soybeans for the first time should consider the problems and hazards involved before planting any extensive acreage.

Soybeans are grown in the corn belt, and are handled much the same as corn. Frequently, beans are planted and cultivated with corn planting and cultivating equipment in 40- or 42-inch rows. Some farmers use regular soybean planters that space the rows about 36 inches apart. Under such a system the main differences between soybean and corn production are in fertilization, weed control, seed inoculation, harvesting, and storage.

Recently there has been considerable interest in planting soybeans in narrower rows. Research indicates that yield can be increased by planting soybeans in narrower than 40-inch row spacings. Results from Iowa and Michigan indicate yield is not increased by planting rows closer than 12 to 14 inches in those states. In South Dakota, limited tests and observations indicate there is seldom any yield advantage from planting rows closer than 20 inches. Cultivation between rows can sometimes be done with a sugar beet cultivator.

Planting with narrower row spacings tends to cause the soybeans to grow taller and bear pods higher off the ground which facilitates harvesting. Rows spaced too closely cause too much shading; beans tend to grow too tall and lodge. Narrower row spacing also may make it more difficult to control weeds.
SEEDBED PREPARATION

Soybeans need a relatively firm, clean seedbed. Weeds are often a problem in soybeans so make every effort to kill as many weed seedlings before the beans are planted as possible. This can be accomplished by early spring plowing followed by disk ing and harrowing. Perform at least one tillage practice immediately before planting to pack the soil, kill weed seedlings, and conserve moisture. More uniform depth of planting can be secured on a firm seedbed which assures quick uniform germination.

USE GOOD SEED

Plant seed of good quality and high germination. Use only sound seed free of mechanical injury. Soybean seeds that have severely cracked seed coats will not germinate satisfactorily; those that do germinate often produce abnormal or stunted seedlings. Certified seed of recommended varieties assures you of getting an adapted variety of high quality seed.

INOCULATE SEED

It is essential to inoculate the seed for successful results. The soybean is a legume and requires specific bacteria in order for nodules to form on the roots. The soybean, when properly inoculated, can get most of its nitrogen needs from the air. Commercial bacteria cultures are convenient to use and efficient. Use according to directions on the container.

DATE AND RATE OF PLANTING

The soybean, a warm weather crop, should not be planted in cold soil. Usually, beans are planted right after corn planting time. If planted later than June 10, they may not have time to mature unless an extra early variety is used. However, the idea of using an early variety in this manner does not work as well with soybeans as with other crops.

Plant seeds about 1 inch apart in the row. This is a better guide than pounds per acre. Medium size seed, such as Blackhawk (2600 seeds per pound), planted 1 inch apart in 40-inch rows, is about one bushel per acre. Good stand aid in weed control and there is less danger of seedlings not emerging because of soil crusting.

METHOD OF PLANTING

Row planting with a corn planter using soybean plates is the most popular planting method. Rows would be 36 to 40 inches apart. Some planters developed for soybeans place the rows 36 inches apart. This distance between rows allows the use of the same planting and cultivating equipment as for corn and other row crops. Plant narrower rows by going over the field twice with a corn planter, adapting a sugar beet planter, or using a grain drill with some of the feeder holes plugged.

Using furrow-openers on planters, set to operate shallow, is highly recommended. Their use is most important where top soil is dry. This assures uniform planting of 1 to 1½ inches in moist soil for quick emergence. Soybeans, like all row crops, are conducive to soil erosion. Plant on the contour if there is a slope of 2 to 6%. Do not plant on land that slopes more than 6%.

HARVESTING

"Direct combining" is the most common method of harvesting. Set the cutter bar as close to the ground as possible. Do not start harvesting until the moisture content of the beans is 14% or less. If harvesting is delayed until the beans are very dry (9-10%), excess shattering losses and cracking occur.

Avoid excessive harvesting losses. Four seeds per square foot on the ground, represents a loss of about one bushel per acre. Any loss over this should not be necessary. Lodged plants or branches are often missed in combining. A special attachment reel with extended fingers is available to help prevent some of this loss.

Splitting and cracking beans in the threshing operation results from running the cylinder too fast or threshing when beans are very dry. Damaged beans will not germinate normally and could cause problems in storage. Reduce cylinder speed as much as possible but still thresh out the beans. Adjust concave clearance so that beans are still threshed but cracking held to a minimum. Operate other combine parts at normal speed. Remember that continual adjustments are necessary. The combine setting in the forenoon when beans are tough could cause considerable damage in the afternoon.

All machinery companies provide an operator's manual for proper adjustment and operation of their combine. Do not fail to read and follow these instructions.

STORAGE

Cracked and damaged beans do not keep well. Do not store large quantities if moisture content is over 13%. Check the stored beans occasionally and if trouble is anticipated, move the beans, or, better still, run the beans over a fanning mill to remove the cracked beans and foreign material.

RECOMMENDED VARIETIES

Since there are fairly well defined soybean maturity areas in South Dakota, it is important to select the variety of the right maturity. In general, the later varieties are grown in the southern counties; select earlier varieties as you progress northward. There are some local areas with sandy soils or low altitude in the northeast counties where a later variety can be grown as compared to the surrounding area.
Since South Dakota lies in the northwestern corner of the soybean belt, select early to medium-early maturing varieties for each area. Following is a brief description of recommended varieties listed in order of maturity:

**Grant**, the earliest recommended variety, is adapted to the northern soybean area of the state. It has medium plant height, good lodging resistance, a high yield record, and has proven to be a superior early variety.

**Chippewa** is about 3 days later than Grant and about 5 days earlier than Blackhawk. It stands very erect and is a high yielder. The variety is adapted in the east central and northeast counties.

**Blackhawk** is 5 to 6 days earlier than Hawkeye, stands well, bears pods not too close to the ground, and has given uniformly high yields. It is adapted primarily to the region bounded by Brookings and Kingsbury counties on the north and Turner and Lincoln counties on the south. It can be grown in the more favorable soybean areas in the northeastern counties.

**Lindarin** is a high yielding variety, grows medium in height, and has good lodging resistance with spreading foliage. The variety has resistance to seed shattering and the seeds are usually of high quality and high in oil content. Lindarin matures about 4 days earlier than Hawkeye and a few days later than Blackhawk. Area of adaptation is in the southeast counties with the northern boundary being the center of Moody and Lake counties.

**Harosoy**, a Canadian variety, is about 3 days earlier than Hawkeye. Its yield has been comparable to that of Hawkeye but under some conditions it may have a tendency to lodge. The area of adaptation is in the eastern counties south of Highway 16.

**Hawkeye** is a medium late variety recommended for the southeast counties but is grown farther north in the state when used for a forage crop. Hawkeye stands erect, has good lodging resistance, bears pods high enough for convenient combining, and has given high yields.

**Ford**, a late variety for South Dakota, is recommended only for the very southeast area of the state. It is about 4 days later than Hawkeye. The plant is tall, erect, and has a good lodging resistance. Ford is a high yielding variety and usually produces uniformly high quality beans.

**Chippewa 64, Lindarin 63, Harosoy 63 and Hawkeye 63** are new varieties which are very similar to the original parent, the important difference being that Phytophthora root rot resistance has been added. Phytophthora root rot is not a serious disease problem of soybeans in South Dakota as yet. However, Harosoy 63, Hawkeye 63 and Lindarin 63 have outyielded the original parent by 3 to 5 bushels per acre at the Southeast Research Farm, indicating that there may be some root rot present at that location. Root rot is of concern to many of the soybean producing states to the east. Certified seed growers may find it to their advantage to raise these root rot resistant varieties if they plan to market their seed outside of the state.

**WEED CONTROL**

Early season weed control is very important. Soybeans are good weed competitors if they germinate first. However, soybeans do not germinate when the soil is cool, but some weeds do. Consequently, some weeds get the upper hand.

For many years soybeans were planted and cultivated with corn planting and cultivating equipment. Good weed control was difficult to obtain as cross cultivation could not be performed. More recently, better annual weed control has been obtained by use of rotary hoe, flextine harrow, and herbicides. While the use of corn planting equipment made it essential to plant soybeans in 40- to 42-inch rows, these newer implements and herbicides can be used on soybeans planted in narrower rows. Even though these newer weed control methods are very helpful, it is frequently necessary to use at least one row-crop cultivation in order to get good weed control.

**ROTARY HOE**

The rotary hoe controls annual weeds early in the season. Its efficiency depends on using it at a speed of 8 to 10 miles per hour when the weeds are just emerging. Use a shield over the hoe or behind the tractor driver's head as a protection from flying clods and stones. It is most effective if the soil is crusted as a result of drying after a rain, but is also effective on moist soil. It may cover small plants growing in furrows, wheel tracks, or loose soil. If crop plants are large, use the rotary hoe during the heat of the day to prevent breaking the plants.

A much larger acreage can be rotary hoed than can be row-crop cultivated in the same length of time. Although several hoeings are generally required to replace one row crop cultivation, two hoeings can be made for about the same cost as the first row crop cultivation. The rotary hoe is generally not effective if weed seedlings are big enough to develop a green color.

**FLEXTINE HARROW**

The flextine harrow can be used in much the same way as the rotary hoe except that it must be operated at 2 miles per hour or less. The rotating action of the
flexible tines makes it an effective implement for killing weed seedlings. As with the rotary hoe, a much larger acreage can be covered than with the row-crop cultivator. Several harrowings are generally required to replace one row crop cultivation but three harrowings cost about the same as the first row crop cultivation. It is not effective if weed seedlings are taller than \( \frac{1}{4} \) inch.

**COSTS OF CULTIVATION**

If labor is not considered, rotary hoeing costs 45 cents per acre, the flextine harrow, 21 to 24 cents and the row-crop cultivation, about 66 cents. If labor is worth \$1.25 per hour, the costs increase to 67 cents, 35 cents, and 91 cents per acre, respectively. The first row crop cultivation takes longer than others and the cost would be some higher than the 66 or 91 cents quoted here. Consequently, two rotary hoeings or three harrowings can be done for approximately the same cost as the first row crop cultivation.

**PRE-EMERGENCE SPRAYING**

Amiben and CDAA have been tested rather extensively for weed control in soybeans. A newer chemical trifluralin is available, but has not been tested in South Dakota.

**Amiben** is sold as a liquid containing 2 pounds active ingredient per gallon and as “Amiben Granular” containing 10% active ingredient. Numerous broad-leaved and grassy annuals can be controlled with this herbicide. The beans are sometimes stunted, but yield is seldom reduced. Good weed control is obtained if \( \frac{1}{2} \) to 1 inch of rain falls within a week to 10 days after application. The chemical is ineffective if no rain falls, but the soil must contain enough moisture to cause weeds to germinate. If the top layer (1 to 1½ inches) of soil is too dry to cause weed seeds to germinate, satisfactory weed control will be obtained after a good rain, even though it may be 2 or 3 weeks after treatment.

An over-all application frequently makes it unnecessary to cultivate; band treatments require two cultivations to kill weeds between the rows.

On most soils apply 2 to 3 pounds active ingredient per acre on the area treated. On heavy clay or high organic matter soils, use 3 pounds per acre. Apply in 12 to 15 gallons of water per acre at planting time or as soon after planting as possible. Apply in 12- to 14-inch bands over the row and hoe or harrow and cultivate once, or cultivate twice to control weeds between rows. If beans are planted in narrow rows that cannot be cultivated, apply 3 pounds per acre as an over-all spray. The chemical normally controls weeds for 6 weeks to 3 months.

**CDAA** is sold under the trade name “Randox” as a liquid containing 4 pounds active ingredient per gallon or as “Granular Randox” containing 20% active ingredient. It controls most annual grasses. Sprays give good control if applied to warm soil (\( 60^\circ \) to \( 65^\circ \) F.) and if a minimum of \( \frac{1}{2} \) to \( \frac{3}{4} \) inch of rain falls during the first week after application. CDAA generally gives better weed control on heavy soils high in organic matter than on light soils low in organic matter. It is relatively volatile and relatively emulsifiable in water. Therefore, it must be leached into the soil before it volatilizes. Heavy rain (2½ inches) may leach sprays beyond the root zone of weed seedlings.

Granules are effective over a wider range of conditions. They are effective if applied to cool soil, they are not rendered ineffective by heavy rains, and they are effective if rain is not received for 10 days or 2 weeks.

Rainfall records during 1952-1961, indicate that the rainfall at soybean planting time would have been adequate to activate CDAA sprays and give good weed control in eastern South Dakota 5 out of the 10 years. Granules would have been effective 7 or 8 years.

CDAA spray has a repulsive odor and is very irritating to the skin. The fumes irritate the eyes. Granules are much less irritating to handle. If you use a spray, wear goggles and protective clothing when spraying. You may want to use rubber gloves and a respirator when putting the chemical into the sprayer.

Use 4 pounds of active ingredient per acre of CDAA to replace the first cultivation for controlling annual grassy weeds. Granules are recommended in preference to sprays. Apply in 8- to 14-inch bands over the rows. Follow up with the needed cultivations with rotary hoe or flextine harrow and row-crop cultivator. An over-all application seldom replaces more than the first row-crop cultivation. Since cultivations are generally required to give good weed control, they will control weeds between rows and there is no point in making over-all treatments.

**Trifluralin** is sold under the trade name of “Trelan” as a liquid containing 4 pounds active ingredient per gallon. Tests in other states indicate that it is effective for the control of annual grasses and some broad-leaved annual weeds. It is not effective on cocklebur, velvet leaf, and ragweed, however. Although rainfall is helpful for leaching it into the soil, mechanical incorporation is essential to get the herbicide near the roots of germinating weeds.

Since the herbicide must be incorporated mechanically, it will generally be applied before plant-
ing. It may be incorporated with disk harrow, power driven rotary hoe or harrow. It could be applied in bands if sections of power driven rotary hoe were mounted in front of each planter shoe.

For those who wish to apply it on an experimental basis, apply ½ pound active ingredient per acre on light textured soils, ¾ pound on medium textured soils or 1 pound on heavy soils. Apply as an over-all spray. Incorporate immediately after spraying. Use a disk or a spiketooth harrow with spikes set at a 45° to 90° angle to work the herbicide into the soil to a depth of 1 to 3 inches.

POST EMERGENCE SPRAYING

Only one chemical is suggested for spraying soybeans after they come up. It contains 4(2,4-DB) which kills broad-leaved weeds. It has not been tested in South Dakota, but has been tested in other states. Some farmers may wish to try it on an experimental basis.

4(2,4-DB) is formulated as a special formulation for use in soybeans by two companies. It controls cockleburs and suppresses pigweed. It is sold under the two trade names “Butyrac 175” and “Butoxone SB.” Both are liquids—the first contains 1.75 pounds 4(2,4-DB) acid equivalent per gallon and the second contains approximately the same amount.

For those who wish to apply this herbicide on an experimental basis, use 2 to 3 ounces acid equivalent per acre in 10 to 12 gallons of water 7 to 10 days before soybeans bloom. This is equivalent to 1 gallon of chemical on 10 acres of soybeans.

COST OF HERBICIDES

The cost of band application is very small if applied with a planter attachment; however, applications with a field sprayer after planting cost about 75 cents per acre.

Liquid amiben costs about $10.15 per gallon or $5.10 per pound of active ingredient. Granules cost 58 cents per pound of product or about $5.80 per pound active ingredient. A spray application of 3 pounds active ingredient per acre (1½ gallons) costs $15.30 for each acre treated while an application of granules costs $17.40 per acre. If 12- to 14-inch bands are sprayed over 40-inch rows only ½ of the field is treated so the cost is $5.10 per acre for spray and $5.80 for granules. For 8-inch bands the costs would be $3.06 (spray) and $3.48 (granules) on 40-inch rows or $6.12 and $6.96 per acre for granules.

Liquid CDAA costs $7.65 for a gallon containing 4 pounds active ingredient. One gallon will treat one acre. If the herbicide is applied in 12- to 14-inch bands over the rows, the cost of herbicide for each acre in the field is $2.55. With 8-inch bands the cost is $1.53 per acre of field for 40-inch rows and $3.06 for 20-inch rows.

Granules of CDAA contain 20% active ingredient and cost 44 cents for a pound of granules or $2.20 for a pound of active ingredient (CDAA). A granular application of 20 pounds of CDAA granules (4 pounds active ingredient) costs $8.80 for herbicide on each acre treated. If they are applied in 12- to 14-inch bands over the rows, the cost for each acre in the field is $2.93. In 8-inch bands the cost is $1.76 for 40-inch rows and $3.52 for 20-inch rows.

Trifluralin costs $34 for a gallon containing 4 pounds active ingredient or $8.50 a pound. The herbicide would cost $6.35 to $8.50 per acre on medium textured soils and about $10.65 per acre in heavy soils. Since mechanical incorporation is essential, it probably will be applied as an over-all treatment.

4(2,4-DB) costs $11.80 for a gallon which is enough for 10 acres. The cost per acre is $1.18.

FERTILIZER USE

Soybeans resemble legumes in their nutrient needs. Proper inoculation of seed will usually assure that the crop will be able to supply its own nitrogen needs.

Soybeans are relatively heavy users of phosphate and potash. Experimental data indicate soybean response to fertilizer is rather inconsistent. Some evidence suggests it is more profitable to apply fertilizer to other crops in the rotation and let soybeans obtain their nutrient needs of these two elements from residual carryover and overall soil supplies. This may be the case in the more fertile soils.

It is generally believed that, where soil tests rather low in either or both P or K, economical soybean yield increases can result from fertilizer applications. Make applications at planting time as a starter with a planter attachment. Recommended phosphate (P₂O₅) rates for soils testing low would be 30 pounds of P₂O₅. Recommended potash (K₂O) rates for soils testing low would be 20 pounds of K₂O.