

Producing Soybeans in Missouri

*William J. Murphy and David R. Johnson, Department of Agronomy, and
Edward J. Constein, Department of Agricultural Engineering,
College of Agriculture*

Soybeans have become the major Missouri crop. The predicted 4,000,000 acres that will be harvested in 1972 is a record far exceeding the acreage of any other row crop. Average yields will give a harvest in excess of 100,000,000 bushels, and a possible net return to farmers of more than \$300,000,000.

Yields have been on an upward trend at a rate of about one-half bushel per acre per year. Farmers recognize the importance of the crop, and are fast changing from the old attitude that soybeans are a secondary crop receiving secondary attention. Many farmers are demonstrating that yields can be improved even more by using the best production and harvesting practices.

High soybean yields are not easily attained. Production practices discussed here must all be considered and followed in timely fashion or crop returns can be drastically affected. By the time planting is complete most of the vital decisions and preparations that influence success will have already been done.

Preparing Seedbed

Soybeans need a seedbed generally prepared the same as for corn. They can be successfully planted on conventional, plowed seedbeds and also on many minimum tillage seedbeds, however more care is needed than with corn.

Soybeans need more moisture to germinate than does corn (about 50% by weight as compared to 33%) and require good contact with surrounding soil particles.

Soybeans also are more sensitive to planting depth. They do not outgrow early weed competition as well as corn, and present soybean weed control chemicals are not generally as effective as those available for corn. So the final seedbed in the planted row needs to be relatively smooth for seed depth control and for a uniform coverage with weed control chemicals.

Fertility Needs and Applications:

Fifty bushels of soybean seed contains about one-third more potash (K_2O) and only one-third less phosphate (P_2O_5) than 150 bushels of corn grain. Being a legume, soybeans need lime for growth and for efficiency of inoculating bacteria to fix nitrogen from the air. Fertility needs are often applied to previous crops in the rotation. This practice is acceptable



Checking results of a good job of producing soybeans.

as long as enough fertilizer is applied for both crops. A 150-bushel corn crop plus a 50 bushel soybean crop removes about 100 pounds of P_2O_5 and 120 pounds of K_2O in the grain. Fertilizer can also be applied before or during seedbed preparation and in the row. UMC Guide 4420, "Soil Treatments for Soybeans," available at County University Extension Centers, gives more complete coverage of this subject.

Variety Selection:

Varieties best suited in Missouri vary from north to south. In most years mid- to full-season varieties yield highest. However, a grower with a sizeable acreage usually will benefit by growing varieties from more than one maturity group to spread the harvesting season. Early-maturing varieties sometimes give a marketing advantage because they can be sold before the bulk of the crop reaches market. Early harvest also helps if small grains are to be seeded.

UMC Special Reports on Missouri Soybean Yield Trials, available at County University Extension Centers, give information helpful in selecting the better varieties. The relative performance of different varieties varies from season to season depending on rainfall distribution. For this reason look at three- to five-year average yields for your area when deciding on a variety.

Seed Quality:

Seed with proven good germination (80% minimum), free of weed seed and trash, is essential regardless of variety. Seed size is relatively unimportant, if the seed is sound and not diseased. Small and medium sized seed may have less difficulty than large seed in emerging through a crust, and there are more seeds per bushel.

Don't take chances on seed quality. There is only a small difference in per acre cost of good seed and poor seed, or seed of unknown quality. Certified seed has guaranteed varietal purity and good quality.

Seed Treatment:

Good quality, high germinating soybean seed (80% germination or above) seldom shows benefit from seed treatment under Missouri conditions. But when seed of lower germination must be used, and if the seed shows an appreciable number of cracked seed coats, or when planting during cool, wet weather, seed treatment gives improved field germination and emergence.

Carefully follow dosage rates indicated on the label of the particular treatment used. Numerous trials have shown that inoculation with nitrogen fixing bacteria can be accomplished satisfactorily even though the seed is treated.

Inoculation:

Nitrogen fixing bacteria (*Rhizobium japonicum*) need to be introduced by inoculating the seed, unless one is confident that the bacteria are already present in the soil. Adding nitrogen fertilizer seldom benefits well inoculated soybean plants, but uninoculated plants do not obtain enough nitrogen from the soil alone to make top yields.

Rhizobia live in the soil for a number of years; no definite time limit can be stated. Inoculation would not likely be needed if well nodulated soybeans had been grown on the field in the past five years. Inoculating after a three-year time span is recommended, considering the low cost of inoculant.

Purchased inoculation cultures may be applied to the seed at the time of planting, or seed can be bought that has received one of several types of pre-inoculation during seed processing. The latter method is usually satisfactory although there have been a few failures in establishing nodules when pre-inoculation was done far in advance of planting.

Row Width

Results from row-width tests in Missouri comparing 38-inch and 30-inch rows have usually shown a 5 to 7 percent yield increase for the 30-inch rows. Row widths as narrow as

7 inches may increase yields 15 to 20 percent when weeds are controlled. Late-planted beans, or those grown under low fertility where plants are small and do not fill in the rows, sometimes show a greater percentage increase. "Thinline" varieties such as Amsoy and Amsoy 71 also seem to have some added advantage from narrow rows.

The profitability, if any, of switching to narrow rows varies with different farmers depending on—

- acreage grown
- cost of making necessary machinery changes
- whether the change fits other crops on which machinery may be used
- the possibility of added costs for weed control chemicals
- need for necessary capital to make other improvements.

It is unlikely that rows much narrower than 30 inches will be practical for many Missouri farmers until chemical weed control becomes more dependable.

Rate of Planting:

High fertility, chemical weed control, good quality seed, and rotary hoes for "breaking crusts" have reduced the need for thick planting. Rate-of-planting tests have shown that soybeans produced the same yield over a wide range of plant populations, if the plants do not lodge. High plant populations give decreased stem diameters and increased lodging. On the other extreme, thin stands will branch enough so that some low branches may not get into the combine.

Thirty-five to 45 pounds of seed per acre with 40-inch rows, 45 to 55 pounds for 30-inch rows, 55 to 65 pounds for 20-inch rows, and 65 to 75 pounds per acre for 10-inch rows are rates that avoid extremes of lodging and low branches. Adjust within the ranges given for differences in seed size and germination.

Increase seeding rates by 10 percent when a rotary hoe will be used. On soils that crust heavily, and where a rotary hoe is not available to break the crust, increasing the seeding rates about 30 percent helps insure a stand. Closer spaced seed helps break the crust, even though the thicker stand will be a disadvantage after emergence.

Depth of Planting:

Best emergence is usually attained from planting 1 to 1½ inches deep. Plant shallow when planting earlier, deeper when planting late; shallow under moist soil conditions, deeper under dry conditions; shallow on heavy soils, slightly deeper on light, well drained soils.

Heavy gumbo soils with a dry seedbed on top and moisture 2 or more inches deep pose a real "guessing game." Placing the seed in moisture is usually best if the weather remains dry, but is disastrous if a heavy rain occurs. Except when planting late, the best chance is probably to barely cover the seed and depend on rain on such soils.

Careful adjustment of all machinery, especially planters and herbicide applicators, is important. Poor emergence results from deep planting but soybeans are susceptible to some herbicides if planted too shallow or if overdoses of herbi-

cides occur. Avoid planting in depressed rows, such as are given by furrow-openers, as this can result in over concentration of weed control chemical in the zone around the germinating seedling.

Date of Planting:

Soybeans yield well over a wide range of planting dates. Date-of-planting tests have shown considerable variance in results from season to season and for different locations in Missouri. The timing and amount of rainfall especially in the pod filling stage has a large effect on final yield. May 1 to June 10 for Central and North Missouri and late April to June 1 for Southeast Missouri Delta are favorable planting periods. Seedlings made early in these periods tend to give slightly higher yields in most years. So, considering that weather can delay planting, it seems wise to plant as early in this favorable period as is feasible.

Full season varieties respond to early planting better than early maturing varieties. Yields drop as planting is delayed beyond these most favorable dates. Full season varieties have consistently yielded higher than early maturing varieties when planted in late June and early July. Chemical weed control is especially important on early plantings.

Double Cropping:

Planting soybeans following small grain harvest in all probability will continue to increase, even though the late planting date does not permit top yields. Advantages are low per-acre production costs, and good annual returns per acre of land when the soybean crops succeeds. Problems include the need to plant immediately after the small grain is harvested, and uncertainty in obtaining a stand of soybeans at this time unless soil moisture supplies are good.

Such double-cropping is usually successful in the Southeast Delta, but chances of failure progressively increase further north because of a shorter growing season. Success is uncommon in extreme North Missouri, and in Southwest Missouri the usual condition of dry soil with a low likelihood of rain at wheat harvest time limits success. Under these least favorable situations, it is probably wise to attempt double cropping only in those years when there is sufficient soil moisture immediately after small grain harvest to insure prompt germination of soybean seed.

Burning straw immediately after small grain harvest has become a common practice where soybeans are to be seeded. This permits seeding the soybeans sooner and at lower cost with reduced seedbed preparation conserving soil moisture. Thus better stands of soybeans emerge faster and are better able to utilize the remaining short season to produce higher yields. More effective weed control is possible with chemical weed applications and/or cultivation when there is no straw to interfere.

Such burning does destroy the organic matter that the small grain stubble could return to the soil, and can pose some danger to the persons doing the burning, and to the general public, especially in vehicles traveling nearby roads. When practiced on sloping fields, it can make the soil more

susceptible to erosion, and sometimes fence posts and trees on field boundaries are damaged.

No-till planting operations that would retain the advantages of burning and avoid its disadvantages may have possibilities in the future, but to date the problems of weed control in no-till small grain stubble plantings have not been solved.

Weed Control:

Weed control is one of the most important, if not the most important, management practices for high yielding soybeans. Most soybean herbicides are applied prior to or at planting time. UMC Guide 4436, "Chemical Weed Control Recommendations for Soybeans" and UMC Guide 4904, "Herbicide Response of Common Weeds" will help in making decisions in the selection and application of herbicides. Copies may be obtained at County University Extension Centers.

Even when chemical weed control materials work successfully, there are many occasions when one or two rotary hoeings can be helpful. At least one cultivation will usually be needed for season-long weed control. Flat sweeps or rotary cultivators operated just deep enough to destroy weeds and break any crust that has formed will give the least damage to the soybean roots. Ridging should usually be avoided, since soybeans combine best if the soil surface is left flat.

Irrigation:

Response of soybeans to irrigation under Missouri's climatic conditions has been erratic. Results are sometimes spectacular, but it is doubtful that over a period of years irrigation will pay on soybeans if they are the only crop being irrigated. Soybeans benefit most from irrigation during the pod filling stage, which usually comes after the moisture needs for crops such as corn have been filled. So double use of the irrigation system may often be possible, thus making soybean irrigation very profitable, especially in years when late summer is dry.

Irrigating prior to pod filling may stimulate early vegetative growth and lodging resulting in a yield decrease. Since the soybean root system is not as extensive as corn, having ample moisture late in the season is even more important for soybeans than corn. Soybeans are more easily damaged than corn by over-irrigation.

Growth Regulators:

Growth regulators are chemicals that can be sprayed on crops, resulting in improved agronomic characteristics, quality or yield. Growth regulators are being used extensively in horticultural crops and most agricultural chemical companies are presently testing potential growth regulators for use on soybeans.

At the time of this printing triiodobenzoic acid (Regim-8) is the only growth regulator being marketed for use on soybeans. Regim-8 reduces the height of the soybean plants and is effective in reducing lodging in situations where soybeans tend to develop excessive vegetative growth and become especially tall.

Harvesting:

Timely, careful harvesting means extra bushels of beans. Soybean harvest should begin at about 14 percent moisture content or higher if drying facilities are available. Beans store well at 13 percent. When beans may be used for seed, storage at 12 percent moisture content will maintain better germination.

Harvest losses increase significantly when beans are harvested at moisture contents below 11.5 percent. A study in Ohio found average losses increased 1 percent per day for beans harvested below 10 percent. Beans that become too dry before harvest not only are lower in quality because of "splits" but the same number of beans gives fewer bushels. For example, one bushel, or 60 pounds, at 13 percent moisture content will weigh only 58 pounds at 10 percent. A 30-bushel-per-acre yield would drop to 29 bushels per acre.

The major cause of harvesting losses are associated with shattering, cutting too high and missing low bean pods, lodged stalks, and stalks cut but lost at the header rather than going through the machine.

Some shattering and splits caused by low moisture contents can be reduced by harvesting when the beans are "tough," either in the morning or late in the afternoon.

Forward speeds should be 2½ to 3½ miles per hour. Slow forward speeds and level ground aid in keeping the cutter bar below the bean pods. Automatic header control devices are helpful.

Reel tip speed should be slightly (about 25%) faster than ground speed. If the reel speed is too high it will fan the stalks. A speed too slow will drag over the stalks. Either causes shattering. Reel position should be set just deep enough to control bean movement into the combine.

The operators handbook should be followed for initial cylinder speed and concave clearance settings but continuous adjustments should be made to meet changing crop conditions. Tough beans demand high cylinder speeds for good threshing. However, high speeds at low moisture content levels cause excessive splits and lower bean quality.

Surveys indicate often as many as 10 percent of the beans are left in the field after harvest. Careful combine adjustment and operation can usually cut this to 3 percent or less.

A check on losses can be made by counting the beans on the ground in several representative areas. Every four to five beans (depending on size) per square foot represents a loss of one bushel per acre. A check in the field before combining will show preharvest loss so actual harvesting losses can be determined.

When losses are high, a check on stubble height, cylinder speed and clearance, reel speed and position, and the tail-

ings can indicate where adjustments need to be made.

Some weedy fields may require using a desiccant if they are to be harvested soon after maturing. Clearance on materials may change, but currently Paraquat is the only desiccant available with full clearance for use, although Diquat, Dow General, and Endothal can be used on beans for seed purposes only.

Producing Soybean Seed

Additional effort is required by seed producers in order to be able to market high quality, good germinating seed. Some items that require especial attention are:

1. Seed fields should be on land that has not grown soybeans the previous year, unless the same variety was grown. Volunteering of soybeans is not a big problem, but can be sufficient to give varietal mixtures.

2. Give special attention to the genetic purity, freedom from weed seeds, and overall quality of the seed planted. Certified seed growers must use foundation or registered seed. Producers of non-certified seed can insure varietal purity by planting certified seed.

3. Avoid early planting. Even though yields may be as good or better, quality of seed produced from early plantings is often poor. So delaying planting of seed fields 10 days to two weeks after early planting can start is advisable.

4. Make every effort to control weeds. Seed fields will usually benefit from one more cultivation than is ordinarily given production fields. Even with good results from chemical weed control and succeeding cultivations, there will usually be some "escapes" of hard to kill weeds in the soybean rows. "Flat weeding" with a hoe to remove these weeds before they make seed is justified for the seed producer.

5. Start harvest as soon as the beans reach 13 percent moisture, and harvest as much of the crop as possible at 12 percent moisture or above to minimize cracked seed coats and "splits." Staggered planting dates of the same variety, and use of varieties with different maturity dates can help.

6. Pay especial attention to combine adjustments, keeping cylinder speed as low as possible while still doing a good job of threshing.

7. If possible avoid harvesting during hot dry afternoon periods when pods and beans tend to be brittle. Many good seed producers harvest at night and in the morning hours.

8. In moving beans from the combine to storage, and in handling and conveying them while cleaning, drop the beans as few times and as short a distance as possible to minimize seed coat cracks.

9. Avoid using auger elevators; they increase seed damage.