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Soybean Production in Missouri

Zane R. Helsel and Harry C. Minor
Department of Agronomy

In recent years, farmers in Missouri have grown soybeans on more than five million acres. Soybeans were the most economically successful crop for Missouri farmers in the 1970s and early 1980s. While yields in 1983-84 averaged about 20 , these yields were the lowest in recent soybean production history. Yields during more favorable years have ranged from 25 to 32 .

Although weather conditions in Missouri can greatly affect the productivity and economics of soybean production, many production practices can be managed to produce more favorable yields and better economical returns. This guide provides a brief overview of recommended production practices for soybeans in Missouri.

Site selection and soil type

While soybeans are produced on all soils in the state except for parts of the Ozarks, some soils and some areas are better adapted than others to soybean production. Soybeans, because of their long flowering period, have the ability to tolerate some drought stress, and thus can be planted on droughty soils. However, productivity will be best on heavier, deeper soils. Diseases are sometimes associated with wet, poorly drained soils. Drainage or irrigation where needed can greatly enhance soybean yields.

Rotation

Soybeans perform best when planted after a grass-type crop such as corn or grain sorghum. Data from other states indicate soybean yields may be 5 to 10 percent higher following corn than continuous soybeans. Similar, although inconclusive, results suggest potentially the same response following grain sorghum or wheat. Because of some disease or weed control problems, it is not wise to plant soybeans directly into or following a legume or grass hay crop. Yield reductions caused by disease are a potential problem in continuous soybean production.

Seedbed preparation

Regardless of the amount of tillage prior to planting, the seedbed or planting tool must create good seed-to-soil contact so moisture will move readily to the seed. Soybeans need more moisture to germinate than does corn. You must often be more careful when planting.

Soybeans are also sensitive to planting depth. Never plant deeper than 2-1/2 inches. The seedbed must allow planter units to operate easily and to provide uniform planting depth.

Soybeans are not a strong early competitor with weeds. You must control seedling weeds, if present, before planting.

Fertility needs

A bushel of soybeans contains about 3.2 pounds of nitrogen, 0.8 pounds of phosphate and 1.4 pounds of potash. A grain yield of 40 would remove about 125 pounds of nitrogen, 35 pounds of phosphate and 55 pounds of potash per acre from the field.

Much of the nitrogen comes from nitrogen fixation because soybeans are a legume. Therefore, you needn't apply nitrogen to soybeans. However, when planting in very sandy, low organic matter soil or when planting in cold soils, you could apply 20 pounds of nitrogen per acre pre-plant (or 10 pounds in band). If you haven't grown soybeans in a particular field within the last three or four years, you should use inoculant that contains rhizobia bacteria specifically for soybeans. You can apply it to the seed or in the row in a granular form. The inoculant should be kept cool and dry and applied to the seed within six hours of planting.

It is a common practice in Missouri to fertilize corn or other crops and then let soybeans "feed off" the extra nutrients left by that crop. This is an acceptable practice (and generally an economic practice) as long as you provide adequate nutrients for both crops. However, contrary to many beliefs, soybeans **do** respond to pre-plant fertilization on soils low in available phosphorus or potassium. In cases of low phosphorus or potassium, fertilize pre-plant or in fall.

A soil test is extremely beneficial to determine the needs of soybeans and other crops in the rotation. Banding fertilizer near the seed shows only limited benefits on soybeans and generally is not recommended. Soybeans are very sensitive to salt injury from band-applied fertilizers. Do not apply fertilizer in direct seed contact. Limit rates of potash to less than 25 pounds when banding near the seed. Soil acidity is another major limiting factor in soybean production. It is beneficial to maintain salt pH at 5.5 (water pH 6.0) or above to ensure good nitrogen fixation, nutrient availability and herbicide activity.

Soybeans seldom need micronutrients in Missouri. For information on soil testing, contact your local MU Extension center.

Variety selection

More than 300 soybean varieties are marketed in the state of Missouri. MU conducts performance evaluations on many of these varieties at more than 10 locations throughout the state each year. A special report from the Agricultural Experiment Station, entitled "Missouri Crop Performance. Soybean." provides information about yield, lodging, height, maturity and other characteristics. Because of the large volume of data in this report, confusion about which varieties are best often exists.

In general, varieties respond differently to various yield environments. Some varieties perform above average in all yield environments. Other varieties do very poorly in low-yield conditions but extremely well in high-yield conditions. Other varieties do just the opposite. Still others are below average under all yield conditions. These are most often the older varieties or those extremely susceptible to diseases. To determine how well varieties will perform on your farm, review variety test results from locations with yield environments similar to yours.

Genetics are improving soybean yields by about one-third bushel per acre per year. If you are using, for example, a 12-year-old variety, you are probably averaging about 4 bushels less per acre than you could get with the best new varieties on the market. However, not all new varieties are better than the older, standard varieties. Check yield trial results obtained under conditions similar to your own to determine if new varieties actually perform consistently better than older varieties in common use.

In general, full-season varieties provide best yields. However, early-maturing varieties may be economical if

you want to plant early fall-seeded crops or reach the market while prices are still slightly higher than the commonly depressed prices of October and November.

The number of days to maturity is not an adequate expression of relative maturity of soybean varieties in Missouri. Soybean maturity should be compared to so-called standard varieties. For example, new varieties are often discussed in terms of how many days earlier or later they are than a standard variety. For example, "X" variety may be Williams plus three days, indicating it matures about three days later than Williams variety at any particular location.

Other characteristics are important. Lodging is influenced by both management practices and by the genetics of variety. High seeding rates in a highly productive, high rainfall situation may produce lodging in almost all varieties. However, the genetics of some soybean varieties provide for good standability under most conditions. The soybean performance report provides lodging ratings for most varieties.

Disease and nematode resistance are also important characteristics in some areas in Missouri. While no soybean variety is resistant to all pests, researchers have developed many varieties with resistance to Phytophthora root rot, soybean cyst nematode, and several other less serious pests. The soybean performance report provides varietal resistance ratings to Phytophthora root rot and cyst nematode.

Charcoal rot is a serious soybean disease in Missouri. No varieties with resistance have been developed to date.

Seed quality

It is essential to use pure seed that is free of weed seed and trash and that has good germination (80 percent minimum). Seed size is relatively unimportant as long as the seed is in good physical condition and not diseased. Small- and medium-sized seed may emerge more easily through a crust than large seed. Genetically (not due to poor growing conditions), small-sized seeds may also emerge under slightly drier seedbed conditions than will larger seeds. With smaller seeds, there are more seeds per bushel, so seed costs per acre may be reduced.

Don't take chances on seed quality. There is only a small difference in per acre cost of good seed versus poor seed or seed of unknown quality. To be safe, buy certified seed or seed of comparable quality. Certified seed has guaranteed varietal purity, germination, and freedom from weed and other crop seeds.

If you must use saved or bin-run seed, obtain a germination and purity test by sending a pint sample to: Seed Control Lab, Missouri Department of Agriculture, P.O. Box 630, Jefferson City, Mo. 65103.

You can run as many as seven samples free of charge each year if the seed is for personal use.

Many producers also have questions about vigor testing soybean seed. Seed vigor can be depressed when soybeans are produced under stress conditions. When you're going to plant soybeans into a stress environment — such as cold, wet soils — you should know the vigor level of the seeds. While soybean vigor tests available today help determine vigor, their interpretation is affected by the actual stress environment incurred. Most vigor tests that report low results are accurate. You shouldn't use seeds with low vigor scores. In certain cases and some environments, even if a vigor test indicates a relatively good seed vigor, seed will show reduced emergence.

When vigor tests are unavailable and you question the potential vigor of the seed lot, plant this seed lot at a higher population. Plant in mid-to-late May or early June under nonstress conditions.

Seed treatment

Good-quality, high-germinating soybean seeds (80 percent germination or above) seldom benefit from fungicide treatment under good conditions for emergence and early growth. Seed treatment is recommended when you must use seed of lower germination, when the seed shows an appreciable number of cracked seed coats, or when you're planting during cool, wet weather. Under these conditions, seed treatment gives improved field germination and emergence. Remember, seed treatments are fungicides, so unless the reduced germination involves the action of fungi, seed treatment will not help.

Carefully follow dosage rates indicated on the label of the particular treatment used. You can still inoculate satisfactorily with nitrogen-fixing bacteria even though the seed is treated. When applying both seed treatment and inoculum, apply the fungicide treatment first. For best results, inoculate just before actual planting time.

Row width

The potential benefits from narrowing the row widths in soybean production depend on the location in the state, the particular soil and weather conditions encountered, planting date and the varieties used. Averaged over all conditions in the state, yields from drilled rows have averaged about 2 to 3 bushels higher than from 30-inch rows.

Relative benefits for narrow rows are normally greatest as you go further north in Missouri, plant in a highly productive environment, or have a late planting date. Other benefits can be ascribed to drilled or solid-seeded soybean planting. For part of the year, erosion control is improved. Other advantages include ease of harvesting, potential moisture conservation, and late-season weed control. Some disadvantages include potential extra costs for slightly more seed, not being able to cultivate to control weeds, and the. possible need for equipment modifications or new equipment.

Seeding rate

High fertility, chemical weed control, good-quality seed, and rotary hoes for "breaking crusts" have reduced the need for thick planting. Experiments show soybeans produce the same yield over a wide range of plant populations as long as the plants do not lodge. High plant populations give decreased stem diameters and increased lodging. At the other extreme, plants in thin stands may produce large branches that tend to break off or be lost at harvest.

For normal planting dates, a final stand of 40,000 plants per acre would normally be sufficient to give maximum yields if plants in the final stand were uniformly distributed. Since this often does not occur and a good canopy is so important in aiding weed control, suggested seeding rates are designed to provide earlier canopy coverage. Early canopy coverage also stimulates growth in soybean plant height and can lead to higher pods and reduced harvest losses.

Recommended seeding rates for soybean production in Missouri are provided in Table 1. Also included are adjustments to planting rate based on conditions occurring at planting time or planned situations for the particular soybean crop. In using the seeding rate recommendation, plant soybeans by number of seeds per foot of row, instead of pounds per acre, because seed size of varieties varies greatly. This variation affects total pound seeding rate per acre and cost of seed per acre. The number of seeds per pound is indicated on the seed tag of most quality seed sold in Missouri today. From this information, you can determine the number of bushels (and cost) needed to plant the soybean acreage based on the number of seeds per foot of row that will be planted.

Table 1
Recommended soybean seeding rates.[1]

Row width	Approximate pounds per acre[2]	Seeds per foot of row	Seeds per acre	Expected plants per foot of row[3]	Expected plants per acre[3]
38 to 40 inches	40	9	130,000	6.8	100,000
30 inches	45	8	140,000	6	105,000
19 to 20 inches	55	6	160,000	4.5	120,000
14 to 15 inches	60	5	175,000	3.8	130,000
10 inches	65	3.6	190,000	2.7	140,000
6 to 8 inches	70	2.7	200,000	2.0	150,000

[1]Decrease seeding rate per acre by 10 percent:

- **If you live in the Bootheel**
- **If lodging has been a problem**
- **If planting under ideal conditions**
- **If you have excellent quality seed**

[2]Assuming about 3,000 seeds per pound[3]Assuming about 90 percent germination and 75 percent field emergence.

Planting depth

Soybean plants emerge best when seeds are planted 1 to 1-1/2 inches deep. Plant shallow when planting early, deeper when planting later; shallow under moist conditions, deeper under dry conditions; shallow on heavy soils, slightly deeper on light, well-drained soils. Remember, never plant deeper than 2-1/2 inches.

Heavy gumbo soils with a dry seedbed on top and moisture 2 or more inches deep pose a real problem. It's usually best to place the seed in moisture if the weather remains dry, but that's disastrous if heavy rains fall. Except when planting late, the best choice on gumbo soils is to barely cover the seed and wait for rain.

Careful adjustment of all machinery, especially planters and herbicide applicators, is important. Planting speed can greatly affect seed placement. Drive no faster than will permit uniform depth control. Poor emergence results from deep planting. Conversely, soybeans are susceptible to some herbicides if planted too shallow or if too much herbicide is applied. Avoid planting in depressed rows, such as those made by furrow openers, because rainfall can lead to a concentration of weed control chemicals in such rows.

Planting date

Soybeans yield well over a wide range of planting dates. The timing and amount of rainfall, especially in the pod filling stage, has a significant effect on final yield. May 1 to June 10 for southwest, central and north Missouri, and late April to June 1 for the Southeast Missouri Delta are favorable planting periods. Planting later in June could result in a loss of 1 bushel per acre per week. After July 1, a loss of about 3 per week occurs. Seedings made early in the recommended periods tend to give slightly higher yields in years of

average or above average rainfall. So, considering that weather can delay planting, it is wise to plan for planting as early in this favorable period as is feasible. On consistently droughty soils, planting soybeans later in the recommended period often gives good results, as soybeans benefit from more reliable late season rainfall.

Full-season varieties respond to early planting better than early-maturing varieties. Medium-season and moderately full-season varieties, when planted in late June and early July, also yield consistently higher than early-maturing varieties. Early-maturity varieties planted late will be short and will pod so close to the ground that harvest losses are higher. Frost damage threatens extremely full-season varieties.

Weed control

Weed control is one of the most important, if not the most important, management practices for high-yielding soybeans. Even when chemical weed control materials are fairly successful, on many occasions one or two rotary hoeings can help. Rotary hoe just as weeds emerge and, if possible, in the afternoon and when soil is dry. Rowed soybeans usually need at least one cultivation for season-long weed control. Unless weeds are present, cultivation does not improve yields except when the soil is heavily compacted. Flat sweeps or rotary cultivators operated just deep enough to destroy weeds and break any crust that has formed cause the least damage to soybean roots. Avoid ridging because soybeans combine best if the soil surface is left flat.

Disease and nematode control

The soybean cyst nematode and other nematodes — along with several diseases such as charcoal rot and Phytophthora root rot — often cause serious yield losses in some soybean fields. Varieties resistant to the soybean cyst nematode are now available. If you know of or suspect a cyst nematode problem in your fields, submit a soil sample through your local MU Extension center to the plant diagnostic labs at either the Delta Center in Portageville or the Plant Pathology Department at MU in Columbia. Varieties resistant to numerous races of Phytophthora root rot, a disease commonly found on heavy, poorly drained soils, are also available.

In the case of the soybean cyst nematode and, to some extent, many other diseases, rotation to another crop is often beneficial to reduce the level of the pathogens in the soil. Use of a resistant variety and crop rotation often effectively controls many soybean diseases.

Pod and stem blight is a disease that can lead to reduced seed quality when harvest conditions are unfavorable. Foliar fungicides are a means of controlling this disease.

However, the use of foliar fungicides on soybeans can usually only be recommended on seed production fields and then only during years when climate is favorable for development of diseases. Visit your local MU Extension center for a point system to determine the need for foliar fungicide application.

Insect control

With the exception of southeast Missouri, insects normally don't pose a serious threat to soybeans in Missouri. Even in the Bootheel, problems are localized and vary from year to year. Crop rotation often reduces the incidence of some of the insects. When insect infestations occur, consult your local MU Extension center for identification and recommendations for control. Particularly with the foliar feeding insects, soybeans in the early growth stages can withstand considerable defoliation before control becomes economical. Apply insecticides only when necessary to control insect problems.

Double cropping

It's popular to plant soybeans after harvesting small grain, even though the late planting does not permit top yields. Advantages are low per-acre production costs and good annual returns per acre when the soybean crop succeeds. However, you must plant immediately after you harvest the small grain and you must have good soil moisture.

Double cropping is usually successful in the Southeast Missouri Delta, but chances for failure increase progressively farther north because of a shorter growing season. Failure is common in extreme northern Missouri. In southwest Missouri, dry soil with a low likelihood of rain at wheat harvest limits success. Under these less favorable conditions, try double cropping only when there is sufficient soil moisture immediately after small grain harvest to ensure prompt germination of soybean seed. When double cropping, choose the fullest season variety available that will mature before frost. Increase seeding rate by 20 percent compared to full-season production and use narrow rows if possible. Make an effort to get excellent seed-to-soil contact.

Irrigation

Response of soybeans to irrigation under Missouri's climatic conditions has been erratic. Yields have often increased an average of 8 to 13 on soils of limited moisture holding capacity, especially when other conditions have been favorable and the pod filling period has been dry. But on soils with high moisture-holding capacity or with good rains during pod filling, the response to irrigation is much less dramatic.

Soybeans benefit most from irrigation during the pod filling stage, which usually comes after the moisture needs for crops such as corn have been met. Thus, it is often possible to use the irrigation system for corn and soybeans during the same year, making soybean irrigation more profitable, especially in years when the late summer is dry.

Irrigation prior to flowering may stimulate early vegetative growth and lodging. Lodging during pod-fill can decrease yield. Because the soybean root system is not as extensive as that of corn, it is even more important for soybeans to have ample moisture late in the season. Excess irrigation more easily damages soybeans than corn.

Harvesting

Timely, careful harvesting means extra bushels of soybeans. Soybeans are relatively easy to thresh, but the challenge is to get all the soybeans into the combine. Each four to five beans per square foot left in the field, either on the ground or in pods, means 1 bushel per acre loss. A loss of 2 to 3 percent is acceptable.

About 80 percent of harvest losses are associated with the combine header. Shattering, which occurs because of low moisture content, is one major cause of losses. Major losses also occur if you cut too high, allowing low pods and branches to go unharvested. A recent survey of Missouri farms indicated an average 5 to 6 percent loss from cutting too high. Row crop headers, built-in flexible cutterbar headers, and floating cutterbar attachments aid in cutting below the bean pods and reducing these losses.

Proper combine adjustment reduces field losses and losses in crop quality. Make full use of the operation manual and other information or training your combine dealer might provide. You can also maintain crop quality and reduce yield losses by using equipment or attachments that can be adjusted easily or automatically.

Forward speeds of 2-1/2 to 3-1/2 miles per hour normally result in the lowest harvesting losses. Weed-free,

level ground permits lower cutting heights and means fewer beans left in the field. You can reduce losses by driving slower when you encounter heavy weed infestations.

Complete harvest as quickly as possible after beans first reach combine maturity. Late harvesting at low moisture content can cause high shattering losses.

If the soybeans have dried to low moisture-content levels, harvest when the beans are "tough." Soybeans give up and re-absorb moisture more easily than other crops. You can reduce shattering by harvesting soybeans when the relative humidity of the air is high.

For short-term storage (from harvest to about January), moisture content should be 13 percent or lower. For long-term, storage the moisture content should be 11 or 12 percent. If drying is necessary, natural air drying or an air drying temperature rise of 10 degrees Fahrenheit or less is recommended to avoid cracking and loss of viability.

Producing soybean seed

Marketing high-quality, good-germinating seed requires additional effort from seed producers. Some items that require special attention are as follows:

- Plant seed fields on land that did not grow soybeans the previous year, unless you grew the same variety. Volunteer plants are not a big problem with soybeans, but they can be sufficient to give varietal mixtures.
- Give special attention to genetic purity, freedom from weed seeds, and overall quality of the seed planted. Certified seed growers must use foundation or registered seed. Producers of noncertified seed can ensure varietal purity by planting certified seed.
- Avoid early planting. Even though yields may be higher, the quality of seed produced from early plantings is often poorer. Delay planting seed fields until 10 days to two weeks after early planting begins (late May to early June).
- Make every effort to control weeds. Seed fields usually benefit from one more cultivation than is ordinary in production fields. Even with good results from chemical weed control and succeeding cultivations, there will often be some "escapes" of hard-to-kill weeds. "Flat weeding" with a hoe to remove these weeds before they make seed is justified for the seed producer.
- Start harvest as soon as the beans reach 13 percent moisture. Harvest as much of the crop as possible at 12 percent moisture or above to avoid cracked seed coats and "splits." Stagger planting dates of the same variety. Use varieties with different maturity dates. As a rule of thumb, a 10-day delay in planting date during the main planting season results in a 5-day delay in maturity.
- Consider using foliar-applied fungicides during the reproductive stages if heavy pathogen infection is predicted.
- Pay special attention to combine adjustments, keeping cylinder speed as low as possible while still doing a good job of threshing. Rotary combines will handle the seed more gently and reduce splits.
- If possible, avoid harvesting during hot, dry afternoons when pods and beans tend to be brittle. Many good seed producers harvest only at night and in the morning.
- 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 reduce seed coat cracks.
- Avoid using auger elevators. They increase seed damage.

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Related MU Extension publications

- G4415, Drilled Soybeans in Missouri
  http://extension.missouri.edu/publications/DisplayPub.aspx?P=G4415
- G4450, Soybean Cyst Nematode: Diagnosis and Management
  http://extension.missouri.edu/publications/DisplayPub.aspx?P=G4450
- PS6, Common Soybean Insects
  http://extension.missouri.edu/publications/DisplayPub.aspx?P=PS6

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