

Chapter 4

Seed Grain Composition, Quality and Testing

by L. Ashlock, D. Longer and M. Smith

Arkansas is a major producer of soybean grain that is relatively high in oil and protein. In addition, much of the planting seed for the determinate southern soybean production region is produced by Arkansas seedsmen. The state's geographic location provides relatively cool conditions during seed maturation for varieties in maturity groups V, VI, VII and IV (with restrictions). The existing irrigation capabilities (due to the state's extensive rice acreage) provides an inherent advantage to Arkansas seedsmen.

Seed Composition – Grain

Soybean seed grown in Arkansas typically contains 18 to 19 percent oil and 42 percent protein. Therefore, a typical bushel (60 pounds) of soybean grain contains approximately 11 pounds of oil and 22 pounds of protein. The extraction of the oil and protein and the use of these compositional products are discussed in Chapter 18 of this publication.

Since Arkansas produces around 90 million bushels of grain annually, the direct processing and/or the export of soybean grain translates into a \$500+ million industry annually. At present, approximately 33 percent of the production (30 million bushels) is processed in the state, while 60 million bushels are exported annually.

Seed Quality – Planting Seed

Soybean producer checkoff monies are used to complement an extensive seed variety development

program directed by the University of Arkansas Experiment Station. More than 400 Arkansas seed producers produce between 4 and 5 million bushels of public and private label seed beans annually on about 200,000 acres. Certified soybean seed acreage accounts for 22 percent of all seed acres planted in Arkansas.

Six private companies have seed breeding programs and research units in Arkansas, and eight other companies have test plot locations in Eastern Arkansas. The annual income generated by the soybean seed industry approaches \$75 million annually.



Figure 4.1. Arkansas ranks 9th nationally in the production of soybeans.

Testing for Seed Quality

Most factors associated with seed quality are effectively determined by approved seed testing laboratories. Listed below are the main factors normally associated with seed quality. In addition to these factors, Extension Fact Sheets 2019 and 2141, available from your county Extension office, present more detailed discussions on seed quality.

Varietal Performance and Purity

An extensive variety evaluation (testing) program is conducted by the University of Arkansas. In addition, private companies and Extension demonstrations further evaluate varietal performance under local conditions. Based on relative yield performance across a wide range of environmental conditions, a group of varieties (over 100 representing maturity groups IV through VII) is considered adapted to Arkansas conditions and

is included in Cooperative Extension’s computerized variety selection program, *SOYVA*.

Before varieties are recommended for specific field conditions, genetic characteristics such as shattering, lodging, herbicide sensitivity, relative disease resistance and relative yield potential must be determined. Planting seed that is varietally pure is essential to obtain optimum yields while not contributing to present and/or future yield-limiting problems. Many problems, including nematodes, diseases, etc., are perpetuated because the varietal purity of planting seed is not maintained at the on-farm level.

Physical Purity

Many production problems including the spread of weeds, nematodes, etc., could be reduced if seed were subjected to approved testing procedures. These procedures determine the percentage by weight of (1) pure seed, (2) other crop seed, (3) weed seed and (4) inert matter. The physical purity percentages show the effectiveness of seed cleaning processes. When buying seed for planting, expect and demand a label (see Figure 4.2) showing these percentages as well as the germination percent (this is required by state and federal laws).



Figure 4.2
Seed label.



Management Tips

1. If you see significant differences in hilum color, then you probably have a mixture of varieties.
2. Soybean seed produced under severe “stress” may not appear as originally described (seed size may vary considerably).
3. Prior to planting, clean all seed and submit a sample to an approved seed testing laboratory (i.e., Arkansas State Plant Board).

Germination – Vigor Test

The standard germination test is conducted by private or public seed testing laboratories under controlled conditions and determines (by percentage) the number of seeds capable of producing “normal” seedlings during a specific period of time under near optimal conditions. Vigor tests are designed to predict field performance potential and to evaluate the extent of seed deterioration. Seed death is typically gradual and cumulative. As seed cells die, critical parts of the seed are unable to perform the essential functions associated with the complex process of germination. Some seed quality tests performed by the Arkansas State Plant Board are:

Standard Germination Test – Some 400 seed are picked at random, placed on a moistened germination towel, covered and placed in a germination chamber for 6 to 8 days at a constant 77°F or an alternating temperature of 68°-86°F. (The seed is kept at 68°F for 16 hours per day and 86°F for 8 hours per day.) Both the constant and alternating temperature regimes are acceptable in the Association of Official Seed Analysts (AOSA) rules and regulations for optimum soybean germination.

The number of normal seedlings is determined based on the following criteria:

- (a) Vigorous root system sufficient to anchor the seedling;
- (b) A sturdy hypocotyl (stem);
- (c) At least one cotyledon attached; and
- (d) An epicotyl that consists of at least one primary leaf and an intact terminal.

Accelerated Aging Test (AA) – This test is designed to measure the vigor of the seed and is used to predict field emergence under stress conditions associated with soil temperatures, soil crusting and adverse soil moisture.

The AA test consists of weighing out 1.34 ounces of seed and placing them in a 100 percent humidity environment at 106°F for 72 hours, after which 200 seed are picked at random and subjected to the same testing criteria used in the standard test. The number of normal seedlings is then expressed as percent.

Other tests are also performed by the seed testing laboratories to help determine seed quality and vigor. For details of those tests refer to Extension Fact Sheet 2019, *Measuring Soybean Seed Quality* (available from your county Extension office).

Suffice it to say that the vigor of seed will further help determine the true quality of seed and enable the grower to better determine the seeding rate to use in order to obtain the proper number of plants per acre.

At present, the Standard Germination Test is the only nationally recognized test for determining the germination of seed for labeling purposes. Soybean seed is relatively short-lived, and environmental conditions in Arkansas (i.e., warm temperature and high humidity) lead to rather rapid seed deterioration during the summer months. Growers are not encouraged to carry seed over from one year to the next but rather are encouraged to have all seedlots tested prior to planting.



Management Tip

All seedlots should be re-tested to determine germination and vigor within 30 days of July plantings.

Table 4.1. Suggested Planting Dates for Quality Seed Production¹

Varietal Maturity Group	Range in Planting Date	Optimum Planting Date
4	June - July 15	June 15 - July 1
5	May 15 - July 1	June
6	May - June 15	May 15 - June 15
7	May	May

¹At this time these planting dates should result in acceptable seed quality without undue sacrifice of yield.

Factors Affecting Seed Quality and Germination

Several of the factors that affect seed quality and germination include climate, harvest, storage, genetics, cleaning and seed treatments.

Climate

Climatic conditions, especially temperature and humidity, greatly affect seed quality. Hot, humid conditions during seed maturation (growth stage R 6.0 - 7.0) can greatly reduce seed quality, especially germination. These extreme conditions normally occur between July and early September. For these reasons, April planting of maturity groups IV and V is not recommended for soybean seed production. Listed in Table 4.1 are the suggested planting dates by varietal maturity group for seed production purposes.

Harvesting

Harvesting is probably the most critical phase of soybean seed production. Listed below are guidelines that are useful for producing good-quality seed for planting:

- **Clean the Combine** – Disassemble and clean the combine prior to harvesting planting seed. It is not unusual to clean out 1 to 2 bushels of seed, weed seed, trash and soil from the augers of a combine after it has emptied the grain hopper.

- **Harvest Timeliness** – Seed moisture at around 14 percent reduces cracking, but long-term seed storage at less than 14 percent helps maintain good germination. Delayed harvest accompanied by continued re-wetting of mature seed can result in a 20 percent loss in germination or worse. Fungal seedborne disease organisms can also reduce germination and usually impact seed at moisture content in excess of 13 percent.



Management Tip

Seed produced in warm, humid conditions may result in lower-than-normal germination. The use of a registered seed treatment (fungicide) may improve the germ test (sometimes up to 30 percent) if fungal seedborne organisms are the major contributor to the germination problem.

- **Reduce Mechanical Damage** – Use belt buckets rather than spiral elevators whenever possible. Use “bean ladders” or a spiral “let-down” inside bins. Rubber-coated beltrators and bucket elevators also reduce seed impact damage.
- **Storage** – Storing seed with less than 14 percent moisture is preferred. Warm and

humid conditions during winter months require periodic aeration to prevent temperature rises and moisture migration. (See Chapter 15.)

Exercise care in using heat to reduce seed moisture. Cool, dry air at temperatures less than 60°F forced through the seed at 2 to 3 cfm/bu is usually adequate and safe.

Hot weather affects seed quality. Storage temperatures in excess of 75°F cause the seed cotyledons to deteriorate. The respiration rate of soybean seed increases with increased temperatures up to 122°F.

- **Clean the Seed Conditioning Plant** – Thoroughly clean the seed plant facilities prior to handling each variety of seed since the storage bins, cleaning equipment and handling machines are sources of contamination.



Management Tip

Seed stored at a moisture level of 15 percent coupled to 86°F temperatures loses all viability in about 4 months while seed stored below 12.5 percent moisture and 68°F with a relative humidity of 60 percent should remain viable for up to 8 or 9 months.