



BEST MANAGEMENT PRACTICES

Chapter 9:  
Soybean Seed Testing and Seed  
Quality



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Optimizing soybean profitability starts with producing and purchasing high quality seed. Seed testing information is critical in this decision. This chapter discusses the standard tests that are required to be completed on seed offered for sale, and additional tests that might provide insights into production questions and quality assurance programs. Key components are provided in Table 9.1.

**Table 9.1. Key components in producing and testing seed quality.**

1. Seed production:
  - a. Soil test your field and apply the appropriate nutrients.
  - b. Harvest seed when the moisture content is between 12 to 16%.
2. Test the seed following approved protocols.
3. Adjust the seeding rate based on germination, purity, and seed-count.
4. Recognize that soybean seed stored over a year may have a very low vigor rate.

**Seed Tests**

***Seed testing***

Most of the seed tests mentioned below can be conducted at the SDSU Seed Testing Lab. For other seed testing laboratories and their services, one can check the Association of Official Seed Analysts or the Society of Commercial Seed Technologists websites. A germination test takes only 7-8 days, and the accelerated aging test takes 10 days to run. Purity analyses and noxious weed seed exams usually only take one to three days to complete. Make sure to ask for a seed count (free with germination test) so you can better calculate planting rates. Seed counts in soybeans can range from 1500 to >9000 seeds per pound.

When time is an issue, producers can request the germination assessment potential using the tetrazolium (TZ) test. The TZ test is a biochemical test that can provide estimated germination results in 24 hours. You do not need to send payment with the sample at SDSU. The lab bills clients for samples after testing is complete.

*Send samples to:*

SDSU Seed Testing Lab, Box 2207-A, Brookings, SD, 57007 (U.S. Postal Service)

or

SDSU Seed Testing Lab, 2380 Research Parkway, Brookings, SD 57006 (UPS/FedEx/Speedee)

Please indicate which tests you need, your name and mailing address, telephone number, and—if you wish to receive e-mail results for a faster turn-around—provide your email address. You can also find us on the Web at <https://www.sdstate.edu/agronomy-horticulture-and-plant-science/sdsu-seed-testing-lab>. Seed sample envelopes may be obtained from Extension Service offices or by contacting us directly. Growers of certified seed are to use the mailing bag supplied to them after field inspection.

### ***Required standard tests***

To legally sell soybean seed in South Dakota, a standard analysis, following Association of Official Seed Analysts Rules for Testing Seeds (AOSA Rules) protocols for germination, purity, and the noxious weed exam is required. A seed count on the label or seed bag is also usually present. This standard analysis plus a seed count provides information needed to determine the seeding rate. For example, the seeding rate for a seed lot with 80% labeled germination requires more seed per acre than a seed lot with a 90% labeled germination.

Not having a seed label or seed testing information puts the producers and their investment at risk. At a minimum, seed dealers and savvy producers will always have a germination test, vigor test, and a seed count performed prior to cleaning a soybean seed lot. You should also have a moisture test if you do not have a moisture meter on-site as too high moisture levels (>13-14%) can lead to deterioration in storage, and too low moisture levels (<10-11%) will cause splitting or mechanical damage during cleaning. It is always wise to know if the seed is worth cleaning before making that investment.

### ***Required tests for seed sale***

In South Dakota testing for purity, noxious weeds counts, and seed germination are required before seeds can be offered for sale. In other Midwest states, precise seed counts are required when sold in bulk containers (40,000 or 50,000 seed bag units).

*Purity analysis test:* This test provides information about the physical make-up of the seed lot (% pure seed, % inert, % other crop seed present, and % weed seed).

*Noxious weed seed examination:* In South Dakota, it is prohibited to sell soybeans if they contain prohibited noxious weed seeds. A noxious weed list is available at <http://legis.state.sd.us/rules/DisplayRule.aspx?Rule=12:36:03>. If restricted noxious weed seed are found, the seed lot may still be sold, but any restricted weed seed present must be indicated by name and the rate of occurrence (number per pound) on the seed label. South Dakota Foundation, Registered, or Certified classes of seed cannot contain prohibited or restricted noxious weed seeds.

*Germination test:* This test tells you the percent germination of normal seedlings, ones that can be expected to grow and produce plants in the field. Laboratory germination tests are conducted under favorable conditions, which do not always occur in the field. Occasionally there is some dormancy (hard seed) in soybeans and the report will show % germination and % hard seeds. Typically, hard seeds (having a water impermeable seed coat) are not present in South Dakota soybeans, but if present it will probably be less than 5% and of no concern for the farmer. A germination test on soybeans takes 7-8 days. Please note—not all viable seeds are capable of completing their life cycle. A vigor test, which is not required, might provide this information. Generally, seeds lose vigor before they lose their ability to germinate. **Vigor testing is critical in all soybean seed production schemes.** Seed moisture represents the amount of moisture in the seed. Seed moisture affects the seed germination and vigor.

### ***Additional tests that provide useful information***

***Vigor tests:*** Not required by law, but is crucial in a Quality Assurance program. Soybean seed vigor is relatively short-lived (1-2 years) and the vigor is easily reduced by mechanical damage (due to low seed moisture) or storage at too high of moisture content under warm/hot conditions for too long.

***Cold test:*** An excess moisture, field soil, and low temperature stress test that can be useful in determining the vigor level of soybean. (The cold test is not as consistent and reliable as the accelerated aging test as the variables are harder to control.)

***Accelerated Aging Test (AA):*** A high humidity, high temperature stress test that is an excellent indicator of vigor in soybean seed. This test should be conducted in conjunction with a standard germination test. AA test time is 10 days. This is the most widely used vigor test in soybean seed. High vigor soybean should have an AA test result within 15% of the standard germination test (assuming a germination of  $\geq 90\%$ ). Medium vigor is within 15-30% of the standard germination test, and the grower/seller needs to consider how much risk they want to take. If the AA test has a  $>30\%$  difference from the standard germination test, it is recommended they do not clean or plant the seed, but rather sell it as grain.

***Seed Count:*** This is not a required test, but is crucial in determining seeding rates. Seed counts in soybeans will vary from approximately 1500 seeds per pound to  $> 9000$  seeds per pound. Genetics and the environment (moisture availability) definitely influence seed size. Most varieties grown in South Dakota range from  $\sim 2300$  to 3300 seeds per pound.

***Herbicide tolerance/resistance trait test:*** Most commercial soybean varieties on the market today are tolerant to one of the herbicides (Roundup<sup>®</sup>, Dicamba<sup>®</sup>, Liberty<sup>®</sup>). There are different ways to check for the herbicide trait presence that are used by laboratories (seed bioassay, lateral flow strips, enzyme-linked immunosorbent assay (ELISA) tests, and Polymerase Chain Reaction (PCR) tests.

***Tetrazolium test (TZ):*** This is a rapid (24-48 hour) chemical viability test which can be used to estimate the results of the germination test. This test also has other uses assesses vigor and mechanical damage.

***Vigor:*** When evaluating a TZ test, the seed can be subdivided into high, medium, and low vigor seeds based on staining intensities, which can be related to seed vigor.

***Mechanical damage:*** Mechanical damage can be observed in the test, whether the seed breaks or bruises. This is useful in determining point of injury (mechanical damage) during harvest or during the seed conditioning (cleaning) process.

***Hilum check:*** Soybean varieties are almost always only one hila color. By examining seed hila color, varietal purity can be assessed. Hila colors are described as clear, yellow, tan, buff, brown, gray, imperfect black and black. The hila check is the most commonly used lab method to check for varietal purity.

### ***Additional tests run by plant breeders***

The peroxidase and hypocotyl color test are seldom run in routine testing of seed for sale, but plant breeders must provide the results in a Plant Variety Protection Act application. When there is doubt as to the proper identity of the variety, these are quick and inexpensive tests that can be also useful in variety determination.

***Peroxidase test:*** Only the seed coat is used in this chemical test. The test result will either be a positive (color change) or a negative (no color change) and it is used in helping distinguish varieties.

***Hypocotyl color test:*** This is a germination test run in soil with high light (or sun) exposure. The hypocotyl (stem) can either be a green, bronze, or purple color (which is also related to flower color). This test is used to help distinguish varieties.

### ***Seed diseases and tests***

There are several soybean seed diseases that cause seeding, seedlings, and production problems. Information on soybean diseases is available in Chapters 57-60.

*Phomopsis seed rot (Diaporthe complex)*: This is a soybean seed disease that occurs when harvest is delayed by rainy, wet weather, and is more severe under warm conditions. Infected seed may look normal or it may be very symptomatic (shriveled, discolored whitish mold, cracked seedcoats). Severely infected seeds rarely germinate and need to be cleaned out of seed lots. Less infected seeds may germinate, but seedlings will be weaker. Phomopsis is a field fungus and will die out over time in storage. It is not unusual for an infected lot right out of the field to have a very low lab germination test, and then a few months later (2-4 months) increase in germination rate. Regardless, the seed lot will be of lower quality and seed life will be shortened.

*Purple Seed Stain (Cereospora kikuchii)*: Purple seed stain is very evident as the seedcoat and/or hilum are discolored purple. This disease does not directly reduce yield, but can cause a grain quality special grade indicated as “purple stained or mottled” when it appears in grain at a certain level of infection. Rarely is this disease severe enough in South Dakota to lower seed quality.

*Soybean Mosaic Virus (SMV)*: This virus is transmitted primarily by aphids. It can be seed transmitted, but seed transmission is thought only to be about 5% or less. Symptoms are expressed with either a brown or black mottling over the seedcoat. SMV can reduce seed yields, germination, and vigor when severe enough. In South Dakota, SMV has not been a significant problem to date.

*Bean Pod Mottle Virus (BPMV)*: Transmitted by the bean leaf beetle, this disease exhibits seed symptoms that are the same as SMV. Seed transmission of this disease can occur, but transmission is thought to be below 1%. BPMV can severely reduce yields in infected fields. Control can be achieved with seed or foliar insecticides that control/reduce bean leaf beetles.

To verify if a seed lot has SMV or BPMV, an Enzyme-Linked-Immuno-Sorbant Assay (ELISA) test can be conducted. This test is generally not needed if it is known that a seed field contained bean leaf beetles or aphids. Seeds that are infected with either virus cannot be separated from non-infected seed, and **there is no effective seed treatment to control either virus**. Planting infected seed does not automatically mean you will have the disease again. For SMV control, you should scout and control aphid infections if appropriate. For BPMV control, a seed insecticide and foliar-applied insecticide can be used to reduce bean leaf beetles. There is only a low level of genetic soybean resistance to SMV, while there is none to BPMV.

There are lots of seedling pathogens that can dramatically reduce seedling emergence or cause the death of emerged seedlings. Producers keep trying to plant earlier into colder and sometimes wetter soils, which only increases seedling emergence issues. A seed-applied fungicide is critical for control of early-season seedling diseases and should always be used. Many companies are also using seed-applied insecticides, whether needed or not. Talk to your local agronomist and seed dealer to determine appropriate seed treatments for your farm.

### **Producing and Purchasing High Quality Seed**

#### ***Fertility and moisture content***

High quality soybean seed production begins in the field. Soil fertility plays a crucial role in insuring the proper nutrients are present for quality seed/grain production. Another crucial factor is the seed moisture content at harvest. Soybeans should be harvested at 12-16% moisture content to minimize combine damage and subsequent cleaning and handling operation damage. Seed vigor and viability in soybeans is relatively (~ 1 year) short-lived and easily lost through improper handling during harvest and subsequent operations. Anything that causes mechanical damage to the soybean seed reduces vigor and viability.

The soybean seed structure with the hypocotyl (stem portion) and radicle (root) laying directly beneath the seed coat makes the seed exceptionally prone to mechanical damage during harvesting, handling, and cleaning operations. When soybean moisture is less than 10-11%, it is essential to handle seed beans as gently as possible. During harvest, you should stop every couple of hours and check for mechanical damage. One easy mechanical damage test you can run in the field in minutes is the Clorox soak test (see SDSU Extension article, “The Clorox® Soak Test,” at <https://extension.sdstate.edu/cloroxr-soak-test>). If damage is above recommended levels, the combine should be adjusted to reduce damage. When combining seed that will be used as seed, it is not recommended to use metal augers. Brush or plastic augers can reduce mechanical damage. Belt conveyors are the best choice for moving soybeans as they cause the least damage.

### ***Cleaning soybean seed***

When cleaning soybean seed, they are much more prone to damage if the temperature is below freezing. Seed cleaning operations should not be done when soybeans are frozen. If soybean seed is un-cleaned, stored in bins and if the moisture is less than 10-11%, you may want to turn on aeration fans if the relative humidity (RH) is high enough for seeds to absorb moisture from the air prior to cleaning. Raising the moisture content can reduce mechanical damage during the cleaning operation.

When cleaning a low seed quality soybean seed lot (due to mechanical damage), cleaning will at best not damage it further, but you still will have a low quality seed lot. Planting of low quality seed lots can result in stand failures, over—or under—planting rates, and cause lower yield potential. Low quality seed lots will not store as well or as long as high quality seed lots. These seed lots typically deteriorate more rapidly and by planting time many will not meet in-house testing standards.

Soybeans have an inherently short lifespan (1-2 years) when compared to cereal grains (2-5 years). In general, when vigor test (accelerated aging) results are 30% lower or more from the standard germination test results, it is recommended to sell that seed as grain, and purchase another seed lot with higher vigor.

### ***Purchasing soybean seed***

There are many seed sources in the market. Check with your local agronomist for a variety with the appropriate maturity group and traits for your region or field. It may be an herbicide-resistant variety, a conventional variety (non-GMO), or an approved organic seed source (also a conventional variety). Most soybean seed sold in South Dakota is not certified. If you are interested in growing seed, there are several varieties in the South Dakota Certification program, both herbicide-resistant (Roundup Ready®) and conventional.

Almost all varieties (public or private) are protected under the Plant Variety Protection Act (PVP-94) and have a utility patent (Roundup Ready trait) which means they cannot be saved, replanted, or sold by the farmer. The exception to that are the conventional soybeans; they can be saved and replanted on your own farm only. Over 90% of the seed currently sold and planted in the state are Roundup Ready. Seed quality is crucial and it is recommended that you purchase seed from reputable producers.

### ***Leftover unplanted seed***

Often a producer purchases more seed than he/she plants, or the weather causes a change in planting plans and they wind up with some quantity of unplanted seed. Most soybean seed sold has been treated with a fungicide and therefore cannot be sold as grain. Due to the inherently short seed lifespan of soybean, seed should not be saved more than one year before planting. If it is saved for next year, it should be kept in a cool and dry environment. One to three months prior to planting, an accelerated aging test (vigor test) must be run to determine if it is still suitable for planting. If the vigor has dropped, the seeding rate should be increased. If the seed is not suitable, it must be disposed of properly.

Planting low quality seed can result in stand failures, over—or under—planting rates, and cause lower yield potential. In addition, low quality seed does not store as well as high quality seed. These seed lots typically deteriorate more rapidly and by planting time many will not meet in-house testing standards. Soybeans have an inherently short lifespan (1-2 years) when compared to cereal grains (2-5 years).

### References and additional information

Association of Official Seed Analysts (AOSA). Available at <http://www.aosaseed.com/>

SDSU Plant Diagnostic Clinic. Available at <https://www.sdstate.edu/agronomy-horticulture-plant-science/sdsu-plant-diagnostic-clinic>

SDSU Seed Testing Lab. Available at <https://www.sdstate.edu/agronomy-horticulture-and-plant-science/sdsu-seed-testing-lab>

Society of Commercial Seed Technologists (SCST). Available at <http://www.seedtechnology.net/>

South Dakota Crop Improvement Association. Available at <https://www.sdstate.edu/agronomy-horticulture-plant-science>

South Dakota Department of Agriculture. Available at [http://sdda.sd.gov/Ag\\_Services/Agronomy\\_Services\\_Programs/Seed\\_Program/default.aspx](http://sdda.sd.gov/Ag_Services/Agronomy_Services_Programs/Seed_Program/default.aspx)

The Clorox® Soak Test. April 2012. SDSU Extension. Available at <https://extension.sdstate.edu/clorox-soak-test>

### Acknowledgements

Support provided by South Dakota Seed Testing Laboratory.

Turnipseed, B. 2013. Soybean seed testing and seed quality. In Clay, D.E., C.G. Carlson, S.A. Clay, L. Wagner, D. Deneke, and C. Hay (eds). *iGrow Soybeans: Best Management Practices for Soybean Production*. South Dakota State University, SDSU Extension, Brookings, SD.

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