



Arizona Seed Production for Small-Scale Producers: Germination Requirements

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“Germination” means the emergence and development from the seed embryo of those essential structures that, for the kind of seed in question, are indicative of the ability to produce a normal plant under favorable conditions.” (3 A.A.C. 04). In biological terms, this is the stage of plant development where the seedling emerges from the seed coat or similar. In seed production, germination is the process to test the percentage of seedling emergence from a pre-determined number of seeds in a controlled environment. The germination rate is expressed as an emergence percentage.

The Federal Seed Act (FSA) as administered by the United States Department of Agriculture, Agricultural Marketing Service (AMS) is the primary regulation for germination requirements in the United States. The Federal Seed Act is located in the Federal Code of Regulations, and can be found in its entirety at <https://www.ecfr.gov/current/title-7/subtitle-B/chapter-I/subchapter-K>. The AMS is responsible for the enforcement of the FSA.

“The FSA is a truth-in-labeling-law that regulates agricultural and vegetable seed shipped in interstate commerce. It requires that seed shipments between States are labeled with certain quality information necessary for seed buyers to make informed choices. Truth-in-labeling laws like the Federal Seed Act protect seed buyers from contaminated, mislabeled, or unfit seed and create a level playing field within the seed industry where the same rules apply for all seed businesses.” (AMS).

What Are Germination Standards?

A good definition of the word “standard” in understanding seed germination is “something set up and established by authority as a rule for the measure of quantity, weight, extent, value, or quality” (Merriam Webster). In this case the Federal Government and the State of Arizona are the

established authorities. The value is the percentage of seeds that germinated in a testing environment. The use of the word “standard” does not mean the seeds will germinate at the exact same time or the plants will grow up to look the same. It means if the seeds are planted and treated correctly, they could expect to have a set percentage of seed germination.

Another term that is important in relation to germination standards is “interstate”. Seed are grown and sold all over the United States by many seed companies. The federal germination standards are in place to ensure that farmers and gardeners all over the country have the same results when planting seeds. Arizona standards are in alignment with the federal government regulations. This means that an Arizona seed producer must follow the same germination guidelines as noted in federal and state rules or regulations to sell and ship seeds out of state, as well as throughout the state of Arizona.

Why is Germination Testing Important?

Imagine you are a small-scale farmer who is planting a field with seeds or starting seeds in the greenhouse for later planting. You have done the math, and know you need a certain number of seeds to germinate and grow for you to take the produce to market. You plant the seeds and only a few germinate, or worse, none germinate. After ruling out other factors that may influence germination, you find the seeds are bad. There may be time to re-plant with different seeds, but it also may be too late for that crop, which will affect your farm’s income. This scenario can impact producers on any scale, from large producers to backyard gardeners. Seeds that don’t germinate when planted and cared for in an appropriate way, can cause loss of trust in seed companies, affect farm revenue, and lead to complaints filed with the state and AMS.

What Happens During Germination Testing?

In Arizona, germination testing cost is the requirement of the seed labeler (A.A.C. R3-4-406). The seed is received by the seed labeler from the farmer, and then a set amount is sent to a laboratory for testing. In cases of direct marketing of seeds, the farmer is responsible for germination testing costs and works directly with the laboratory. At the laboratory, germination can be tested in several different ways. The University of Iowa Seed Lab has a good page describing protocols for these tests (see references for link). Once the tests are completed, the results are available and can be printed on the seed packet label for future sales. It is important to

note that seed germination rates can decrease over time as the seed ages.

Low Germination Rates Don't Always Mean Throwing Away Seed

What happens if the germination results from the laboratory seed tests come back at percentages lower than federal approved standards? Since the FSA is a truth-in-labeling law, as long as the seed labeler notes the low percentage on the seed label, the seed can still be sold (7 CFR 201.29). It is a noticeable industry practice for some seed companies to offset the low germination percentage with extra seed in the packets.

Germination Standards for Selected Vegetable Crops (chart adapted from the Arizona Administrative Code and the FSA) [In addition, there are standards for flowers, trees and shrubs]

Vegetable Seed Variety	Botanical/Scientific Name ¹	Germination Rate (%)
Artichoke	<i>Cynara cardunculus</i> L.	60
Asparagus	<i>Asparagus officinalis</i> L.	70
Asparagusbean or yard-long bean	<i>Vigna unguiculata</i> L.	75
Bean, garden	<i>Phaseolus vulgaris</i> L. var. <i>vulgaris</i>	70
Bean, lima	<i>Phaseolus lunatus</i> L.	70
Bean, runner	<i>Phaseolus coccineus</i> L.	75
Beet	<i>Beta vulgaris</i> L. subsp. <i>vulgaris</i>	65
Broadbean	<i>Vicia faba</i> L. var. <i>faba</i>	75
Broccoli	<i>Brassica oleracea</i> L. var. <i>italica</i> Plenck	75
Brussels sprouts	<i>Brassica oleracea</i> L. var. <i>gemmifera</i> Zenker	70
Burdock, great	<i>Arctium lappa</i> L.	60
Cabbage	<i>Brassica oleracea</i> L. var. <i>capitata</i> L.	75
Cabbage, tronchuda	<i>Brassica oleracea</i> L. var. <i>costata</i> DC.	70
Cardoon	<i>Cynara cardunculus</i> L.	60
Carrot	<i>Daucus carota</i> L. subsp. <i>sativus</i> (Hoffm.) Arcang.	55
Cauliflower	<i>Brassica oleracea</i> L. var. <i>botrytis</i> L.	75
Celeriac	<i>Apium graveolens</i> L. var. <i>rapaceum</i> (Mill.) Gaudin	55
Celery	<i>Apium graveolens</i> L. var. <i>dulce</i> (Mill.) Pers.	55
Chard, Swiss	<i>Beta vulgaris</i> L. subsp. <i>vulgaris</i>	65

Vegetable Seed Variety	Botanical/Scientific Name ¹	Germination Rate (%)
Chicory (Raddichio)	<i>Cichorium intybus</i> L.	65
Chinese cabbage	<i>Brassica rapa</i> L. subsp. <i>pekinensis</i> (Lour.) Hanelt	75
Chives	<i>Allium schoenoprasum</i> L.	50
Citron (Melon)	<i>Citrullus lanatus</i> (Thunb.) Matsum. & Nakai var. <i>citroides</i> (L.H. Bailey) Mansf.	65
Collards	<i>Brassica oleracea</i> L. var. <i>viridis</i>	80
Corn, sweet	<i>Zea mays</i> L. subsp. <i>mays</i>	75
Cornsalad	<i>Valerianella locusta</i> L. Laterr.	70
Cowpea	<i>Vigna unguiculata</i> L. Walp. subsp. <i>unguiculata</i>	75
Cress, garden	<i>Lepidium sativum</i> L.	75
Cress, upland	<i>Barbarea verna</i> (Mill.) Asch.	60
Cress, water	<i>Nasturtium officinale</i> R. Br.	40
Cucumber	<i>Cucumis sativus</i> L.	80
Dandelion	<i>Taraxacum officinale</i> F.H. Wigg.	60
Dill	<i>Anethum graveolens</i> L.	60
Eggplant	<i>Solanum melongena</i> L.	60
Endive	<i>Cichorium endivia</i> L. subsp. <i>endivia</i>	70
Gherkin, West India	<i>Cucumis anguria</i> L. var. <i>anguria</i>	not defined
Kale	<i>Brassica oleracea</i> L. var. <i>viridis</i> L.	75
Kale, Chinese	<i>Brassica oleracea</i> L. var. <i>alboglabra</i> (L.H. Bailey) Musil	75
Kale, Siberian	<i>Brassica napus</i> L. var. <i>pabularia</i> (DC.) Rchb.	75
Kohlrabi	<i>Brassica oleracea</i> L. var. <i>gongylodes</i> L.	75
Leek	<i>Allium porrum</i> L.	60
Lettuce	<i>Lactuca sativa</i> L.	80
Melon	<i>Cucumis melo</i> L. subsp. <i>melo</i>	75
Mustard, India	<i>Brassica juncea</i> L. Czern.	75
Mustard, spinach	<i>Brassica rapa</i> var. <i>perviridis</i> L.H. Bailey	75
Okra	<i>Abelmoschus esculentus</i> L. Moench	50
Onion	<i>Allium cepa</i> L. var. <i>cepa</i>	70
Onion, Welsh (Bunching Onions)	<i>Allium fistulosum</i> L.	70
Pak-choi	<i>Brassica rapa</i> L. subsp. <i>chinensis</i> L. Hanelt	75

Vegetable Seed Variety	Botanical/Scientific Name ¹	Germination Rate (%)
Parsley	<i>Petroselinum crispum</i> (Mill.) A.W. Hill	60
Parsnip	<i>Pastinaca sativa</i> L. subsp. <i>sativa</i>	60
Pea	<i>Pisum sativum</i> L. subsp. <i>sativum</i>	80
Pepper	<i>Capsicum</i> spp.	55
Pumpkin	<i>Cucurbita pepo</i> L., <i>C. moschata</i> Duchesne, and <i>C. maxima</i> Duchesne	75
Radish	<i>Raphanus sativus</i> L.	75
Rhubarb	<i>Rheum x hybridum</i> Murray	60
Rutabaga	<i>Brassica napus</i> L. var. <i>napobrassica</i> (L.) Rchb.	75
Sage	<i>Salvia officinalis</i> L.	60
Salsify	<i>Tragopogon porrifolius</i> L.	75
Savory, summer	<i>Satureja hortensis</i> L.	55
Sorrel	<i>Rumex acetosa</i> L.	65
Soybean	<i>Glycine max</i> L. Merr.	75
Spinach	<i>Spinacia oleracea</i> L.	60
Spinach, New Zealand	<i>Tetragonia tetragonoides</i> (Pall.) Kuntze	40
Squash	<i>Cucurbita pepo</i> L., <i>C. moschata</i> Duchesne, and <i>C. maxima</i> Duchesne	75
Tomato	<i>Solanum lycopersicum</i> L.	75
Tomato, husk	<i>Physalis pubescens</i> L.	50
Turnip	<i>Brassica rapa</i> L. subsp. <i>rapa</i>	80
Watermelon	<i>Citrullus lanatus</i> (Thunb.) Matsum. & Nakai var. <i>lanatus</i>	70
All Others		50*

*The germination standard for all other vegetable and herb seed for which a standard has not been established shall be 50 percent

¹Terms defined 7 CFR 201.

Frequently Asked Questions:

I am a very small Arizona seed producer and only sell the seed in the state. Do I need to follow state and federal germination testing rules and regulations to sell only in Arizona?

Yes, it is required to follow state and federal germination testing rules and regulations regardless of the size of your operation. Not following the state rules and regulations have potential consequences from both the state and AMS.

From Arizona Administrative Code R3-4-409: "The Department may assess the following penalties against a dealer or labeler for each customer affected by a violation listed below: \$50 for the first offense, \$150 for the second offense, and \$300 for each subsequent offense within a three-year period:

1. Failure to complete the germination requirements on agricultural, vegetable, or flower seed intended for wholesale or commercial use within nine months prior to sale, exposing for sale, or offering for sale within the state, excluding the month in which the test was completed. This penalty does not apply to a violation under subsections (A) (2), or (3):
2. Failure to complete the germination requirements for agricultural, ornamental, or vegetable seed intended for retail purchase within the 15 months prior to the sale, exposing for sale, or offering for sale within the state, excluding the month in which the test was completed; and
3. Failure to obtain any license required by this Article."

Can I do germination tests at my farm without sending them to a laboratory?

There are additional state and federal seed regulations that need to be completed (usually seed vigor, seed purity and noxious weed counts). Due to these tests, a licensed seed testing laboratory with trained personnel should be used. A seed producer can always do informal germination testing at the farm but should look towards the laboratories to make sure you meet the required labeling guidelines.

Can I pass the cost of the germination laboratory testing requirements to the seed consumer?

That is a common practice in the seed industry and is a business decision for your farm.

What are the consequences of not germination testing my seed?

This can be complex as the seed may be reported by a consumer to the state and then to AMS. Once reported, the state will follow up with the seed labeler and dealer (see https://apps.azsos.gov/public_services/Title_03/3-04.pdf for the definition of seed dealer and labeler) to review the records and conduct testing of the seed in question. The AMS can also investigate the complaints (see reference list for link to AMS complaint process).

What does the AMS seed complaint process look like?

State Submissions: the state will evaluate seed samples and business records when notified of an issue.

Public Submissions: Members of the public can submit seed suspected of being in violation of the Federal Seed Act.

If a seed company is found in violation, there are several possible outcomes (AMS Complaint website)

- No Action: No interstate shipment was involved or there was no FSA interstate violation.
- Warning: (Minor violations and technical violations): These violations include omitting the test date on the seed label, using common names instead of the correct kind name, using abbreviations for variety names, and using the brand in place of the variety name.
- Formal Charge: (Serious Violations): These violations include misrepresenting germination or purity information, misrepresenting noxious weed-seed content, misrepresenting the kind and/or variety name, and a history of repeated minor or technical violations.

How many seeds do I need to test to meet federal and state standards?

Vegetable seeds are 400 seeds per sample. The information on all seed sampling is found at 7 FCR 201.39.

Can you recommend a laboratory for seed testing?

AMS has a list of Accredited Seed Entities which includes seed testing labs. See resources for link to accredited labs.

How much does a germination test cost?

This will depend on the laboratory, the tests ordered, the complexity of the sample, the shipping distance and how you want the reports delivered.

What is the difference between seed germination and seed viability?

Depending on the person, farm or laboratory they can be used interchangeably. However, germination can refer to the seedling breaking out of the seed coat (or whatever biological process is applicable) and viability can be all the way to the seedling getting its first or second true leaves to determine how well the seedling grows (both roots and shoot). Some laboratories will only test seed viability. This can depend on who you are working with so verify your working definitions as you go through the testing process with your chosen lab.

References

Agricultural Marketing Service (AMS) complaint process: <https://www.ams.usda.gov/rules-regulations/fsa>

AMS Accredited Seed Entities <https://www.ams.usda.gov/sites/default/files/media/LSoOfficialListingASP.pdf>

Arizona Administrative Code: https://apps.azsos.gov/public_services/CodeTOC.htm#ID3

Arizona Crop Improvement Association: <http://arizonacrop.org/>

Arizona Department of Agriculture - Seed Crops: <https://agriculture.az.gov/plantsproduce/what-we-grow/seed-crops>

Federal Seed Act: <https://www.ecfr.gov/current/title-7/subtitle-B/chapter-I/subchapter-K>

Merriam Webster Dictionary – “Standard”: <https://www.merriam-webster.com/dictionary/standard>

United States Department of Agriculture, Agricultural Marketing Service, <https://www.ams.usda.gov/rules-regulations/fsa>

University of Iowa Seed Lab <https://seedlab.iastate.edu/testing-methods/>

3 A.A.C. 04. Arizona Administrative Code, Chapter 4, Department of Agriculture – Plant Services Division
https://apps.azsos.gov/public_services/Title_03/3-04.pdf

7 CFR 201.29. United States Code of Federal Regulations
<https://www.ecfr.gov/current/title-7/section-201.29>

7 FCR 201.39 <https://www.ecfr.gov/current/title-7/subtitle-B/chapter-I/subchapter-K/part-201/subject-group-ECFRb62eece0db97b60>

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