Seed Viability Assessment and Best Management Practices for Small-Scale Seed Savers

What are seed viability assessments and best management practices (BMPs)?

Seed viability assessments are the use of various standardized testing procedures to establish whether seed lots are sufficiently viable for agricultural use or sale. BMPs are recommended production practices that encourage high seed viability.

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What criteria should be evaluated in seed viability assessments?

Determining both germination rate and seed vigor helps to understand overall seed viability

What factors influence seed viability?

Seed maturity at harvest, presence of diseases, inherited genetics, and storage conditions including: time, temperature, moisture, and light all impact seed viability. In addition some seeds require specific treatments for germination, such as stratification and scarification.

Why are they important?

Growing and saving seeds requires investments of both time and money. Whether for home or farm-scale, ensuring you are working with high quality seeds that have acceptable germination rates and seedling growth is critical to the success of all gardens and farms.

In addition, for those wishing to expand into small-scale market seed production or exchange, viability assessments ensures you are providing your customers and friends with a high quality product.

Best management practices regarding seed handling and storage are easy and practical to achieve. After many hours invested in producing and saving your seeds, it is vital to care for them properly.

Lastly, seed viability assessments are an important component to re-localizing our seed production industry, preserving heirloom and hard-to-find cultivars, and fostering regional food security and sovereignty.

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Germination Testing

Germination testing is useful for assessing viability of seeds you may have produced or saved from other sources, perhaps for extended periods. The most common assessment is the wet paper towel test. It is easily performed at home with materials that are readily available. While this method is suitable for home growers and small-scale seed savers, it is not recommended for those wishing to expand into commercial seed production. For this we strongly recommend an official seed-testing laboratory.

Wet Paper Towel Test

1. Count a sample of the seed to be tested. A 100 seed sample is the standard, however, with difficult-to-handle seeds or with seed for which size can become an issue (too small or too large) fewer may suffice. The sample should represent a random sample of the seeds you are testing. DO NOT HIGHGRADE SEEDS (i.e., include broken or damaged seeds if they are present if your seed lot).
2. Place the counted seeds on a moistened (not excessively wet) paper towel, easier to do in row, and gently roll or fold with the seeds inside.
3. Place the rolled or folded paper towels in a plastic bag (ziplocks work well) or in a container assuring moisture will be retained. Be sure to label and date individual test to avoid confusion later.
4. Keep tests in a stable environment (i.e., no large temperature changes) for the required germination period; do not keep in direct sunlight except for seeds needing light to germinate. It is possible to find out the optimal germination temperature for each given crop you wish to test.
5. First count should be performed within 3 to 10 days (see table on next page). However, some seeds (flowers, herbs) may require extended germination time. To perform the first count, gently unroll or unfold the paper towels and count the seeds that germinated. Germination is described as once the radicle has grown 2x the length of the seed. Remove all seeds that have germinated, noting the total and re-rolled or folded the paper towel.
6. Repeat step 5 for a second count and calculate total seeds germinated from both counts.
7. Calculate germination rate using the following equation:

   (# seeds germinated)/(total # seeds tested)*100 = germination rate percent

Important Notes

If possible, run multiple tests from the same seed lot and average the results; this will provide the most accurate germination rate. If the paper towel is too wet or too dry the test will not work. If at the end of the germination period your sample has dried, become rotten, or shows disease growth, discard and, repeat with your moisture level adjusted accordingly. Seeds that require light to germinate should be placed on top of a few layers of moistened paper towel inside a sealed container. If the second count is higher than the first count, this might indicate that the first count was too early or the seed vigor is decreasing. Always try to have references for each crop you test.

Germination Test Guidelines

Crop	Temp (°C)	First Count (Days)	Second Count (Days)	Light	Stratification	Reported Seed Life (Years)
Onion (*Allium cepa)*	20	7	14			1
Leek (*Allium porrum)*	20	7	14			2
Dill (*Anethum graveolons*)	20-30	7	21			3
Celery (*Apium gravelons)*	15-25	10	21	Yes	Yes	3
Beet (*Beta vulgaris*)	20-30	3	10		Yes	4
Swiss Chard (*Beta vulgaris*)	20-30	3	10		Yes	4
Cabbage (*Brassica oleracea*)	15-25	4	10	Yes	Yes	4
Kale (*Brassica oleracea*)	15-25	4	10	Yes	Yes	4
Pepper (*Capsicum annuum*)	20-30	7	14			2
Cucumber (*Cucumis sativus*)	20-30	4	7			5
Squash (summer/winter) (*Cucurbita* spp.)	20-30	4	7			4
Carrot (*Daucus carota*)	20-30	5	14			3
Lettuce (*Lactuca sativa*)	20		7	Yes	Yes	6
Tomato (*Lycopersicon esculentum*)	20-30	4	14			4
Parsley (*Petroselinum crispum*)	15-25	10	28			1
Bean (*Phaseolus vulgaris*)	25		7			3
Pea (*Pisum sativum*)	25		7			3
Radish (*Raphanus sativus*)	20	4	7			5
Spinach (*Spinacia oleracea*)	15	7	21		Yes	3

Table adapted from: CFIA, 2012

Vigor Testing

Seed vigor testing subjects seeds to potentially damaging conditions and measures whether any reduction in viability has occurred. High quality seeds will retain high germination rates following exposure to detrimental environments.

Vigor Testing Techniques

There are three common techniques used to test seed vigor:

Cold Test: The technique may be of particular interest to seed savers in the temperate Pacific Northwest. The idea is based on mimicking early spring field conditions by exposing seeds to excess moisture and low temperatures. Seeds should be sown in wet soil (70% water holding capacity) and incubated at temperatures between 5-10°C for a specific period of time. After the specified cold period, the temperature is raised to the normal temperature recommended for germination, and held at this temperature for the germination period, prior to calculating germination rates. Vigorous seeds should not show any significant reduction in germination rates.

Accelerated Aging Test: High temperature and relative humidity are applied to seeds prior to performing a germination test. The test is conducted in professional laboratories using dedicated accelerated aging chambers.

Seedling Vigor Classification Test: After germination, seedlings are examined for visual defects and deficiencies and are graded as strong, weak, or abnormal. This test requires specialized knowledge of seedling morphology; those interested in learning more should consult the *Seed Vigor Testing Handbook*, prepared by the Association of Official Seed Analysts (AOSA).

Purity testing is another common test used and determines the amount of debris and other non-crop seeds present. Purity testing is based on a percentage by weight and is best left to a professional laboratory.

Best Management Practices

Storing Seeds
The general rule for storing seeds, after ensuring that they are properly dry, is to keep them cool, dry, and dark. Before proceeding with the following recommendations, seeds should be placed in breathable containers (e.g. envelopes, cloth bags) labeled with cultivar name and date. Environmental stability greatly increases seed life.

Moisture: Moisture in this case refers to the moisture content found within a seed. Moisture content greatly influences the long-term viability of seeds. Dr. Harrington (1963), a well-recognized authority on seed storage BMPs, states that the life of a seed is doubled for every 1% decrease in seed moisture content (SMC). While the small-scale seed saver cannot test SMC it does indicate the importance of properly drying seeds and storing them in a dry environment. Paper bags or envelopes should be used to store seeds when SMC is unknown to assure seeds can release moisture without spoiling. Seeds that are properly dried they can be stored in airtight containers, such as sealable jars. If moisture is a concern silica gel can be added (1:1 ratio to seeds by weight) to the bottom of your seed storage container. Use silica gel with caution, as seeds will die if they become too dry (i.e., <3%). Beans and peas benefit from slightly higher SMC, they are best stored in containers that allow air circulation.

Humidity: 70% or lower relative humidity (RH) is ideal. However temperature greatly influences acceptable humidity levels. A simple hygrometer is affordable and allows one to monitor relative humidity. Keep RH as stable as possible.

The following formula is used for maintaining optimal humidity and temperature for seed storage:

$°F + RH \leq 100$

Temperature: Heat, especially when combined with high humidity, can severely degrade seed viability. Heat increases the speed of a seeds internal function and promotes detrimental microorganism activity. Keep seeds cool, ideally place storage containers in a refrigerator. Always keep temperature as stable as possible.

Pests: Insects, bacteria, and fungi can all damage seeds in storage. The best possible way to ensure pests do not cause any damage is keeping seeds in cold storage; freezing can kill some pests. Freezing can damage seeds and should only be done if seeds are properly dry. Be sure to keep seeds safe from rodents.

Special Considerations

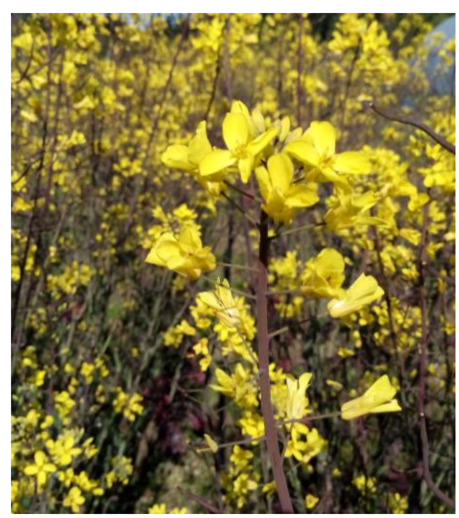
Ensuring proper germination assessment does require special considerations for certain seed cultivars. If attempting to germinate a new cultivar of seed for the first time, it is recommended to search for any specific seed germination requirements; often, seed catalogues will contain this information. It addition to specific temperature, time, and light requirements some seeds require the following techniques:

Stratification: For certain seed types, a process known as stratification can greatly increase their germination rate. Stratification is a process that uses temperature variation to shock dormant seeds into germination. Stratification can be achieved in two ways:

Natural Stratification: This techniques requires winter temperatures to remain below 0° C for a minimum of three weeks. The mild winters of the Pacific Northwest do not work well with this technique. However, if you live somewhere with suitable winter temperatures, you can simply sow some trays using a standard potting mix. Cover the seeded trays with a layer of coarse grit or horticultural sand and place them outside for the winter. Seeds should germinate when temperatures begin to warm in the spring.

Artificial Stratification: This is a simple process of mimicking natural stratification using refrigeration. The temperature should remain between 0-5°C for a period of time determined by a seed's degree of dormancy. Typically, shallow dormancy requires 3-4 weeks, intermediate dormancy 4-8 weeks, and deep dormancy 8-20 weeks. Small seeds should be stratified in lightly moistened vermiculite. Store seeds in a plastic bag during the stratification process, turning from time to time to distribute oxygen. Once seeds germinate they can be planted as normal.

Scarification: This is a special process required in addition to stratification for some particularly hard-coated seeds. A small, shallow razor or knife cut allows water to enter thus hastening germination. **These processes are only required for a few varieties of plants and should never be done unnecessarily.**



Work Cited

- Association of Official Seed Analysts. *Seed Vigor Testing Handbook*. 2002
- Canadian Food Inspection Agency. *Canadian Methods and Procedures for Testing Seed*, 2012
- Harrington, James F. *Value of Moisture Resistant Containers in Vegetable Seed Packaging,*1963.
- Hatch, D. *Collecting and Storing Seeds from Your Garden*. Oregon State University, 2003.
- Hryckk, Paul. *Seeds of Diversity*. (https://www.seeds.ca/), n.d.
- Jason, Dan. *Saving Seeds: As if Our Lives Depended on It*. Salt Spring Seeds, 2006.
- Jeffery, Josie. *Seedswap: The Beginers's Guide to Saving and Swapping Seeds*. Shambhala Publications, 2012.
- McVicar, Jekka, and Marianne Majerus. *Seeds: The Ultimate Guide to Growing Successfully from Seed*. Globe Pequot, 2003.
- Rogers, Marc. *Saving Seeds: The Gardener's Guide to Growing and Storing Vegetable and Flower Seeds*. Storey Publishing, 1990.
- Romer, James. *Life Expectancy of Vegetable Seeds*. Iowa State University, 1999.
- Seefeldt, Steve. *Procedures for the Wet paper Towel Germination Test*. University of Alaska Fairbanks, 2012.