

Seed Testing

Why Invest in a Seed Test?

Seed is the foundation of every crop and the best way to determine its quality is through a simple seed test. Without a seed test, once a seed issue is realized, significant costs will have been incurred and the yield potential of that crop or from re-seeding another crop will have declined. Environmental conditions in the year the seed is grown impact its quality. Seed grown and harvested in a drought year can have significant quality impacts, just as seed grown in a wet year. Furthermore, seed quality can change after long periods of storage and, therefore, seed testing is a meaningful investment and planning tool ahead of every season.

Seed Test Interpretation

Germination

Germination describes the percent of seed that is likely to germinate under optimal and standardized oxygen, light, moisture, and temperature conditions. Germination is an accredited test; cereals undergo a brief cold period to break dormancy and are then tested at 20°C for *seven* days. There is no pre-chill requirement in chickpea, lentil, or pea crops but the temperature is also held at 20°C with final counts performed *seven* days later. At the end of this test period, seeds are evaluated and placed into various germination categories including fresh, hard, abnormal, and dead seeds.

- **Fresh** seeds fail to germinate. These seeds will imbibe water regularly and initially appear to be capable of germination but then remain dormant. Fresh seeds may be viable but cannot be confirmed.
- **Hard** seeds fail to germinate. The seed coats of hard seeds will not be penetrated by water and remain intact at the end of the test period.
- **Abnormal** seeds germinate, but do not have adequate plant structures to maintain healthy growth such as missing roots or shoots.
- **Dead** seeds cannot produce any part of a seedling. They may imbibe water and crack the seed coat but will die before they will produce seedlings. Higher levels of seed-borne disease usually correlate to a higher percentage of dead seeds.

The germination test is useful, as it tells us the maximum potential of the seed lot under optimal conditions. This information can be used to determine if, under ideal growing conditions, a particular seed source should be planted at all. However, germination is only a single component of seed quality. When germination is poor, a different seed source may be selected. When germination is good, the decision to plant a seed lot should not be based on germination alone. Germination is largely influenced by late-season environmental conditions, and harvest weather that is too cold, too wet, too hot or too dry can all reduce germination.

Germination can also be negatively impacted by applications of pre-harvest glyphosate and therefore it is not recommended to plant seed that has been treated with pre-harvest applications of glyphosate as chemically

A chickpea seed lot with an *Ascochyta* infection of 0.1% (one infected seed in 1,000 seeds) and a planting density of three to four plants ft² poses the risk of 175 infected chickpea seedlings per acre. Such a level of early infection for an aggressive disease like *Ascochyta* can have a devastating impact on chickpea crops.

400 seeds are evaluated in a chickpea disease screen for *Ascochyta* and, therefore, a single seed with *Ascochyta* would result in an infection of 0.25%

damaged seed may show lower germination values, poor root development, and higher than acceptable levels of seedling mortality. Exceptional circumstances may result in a desire to test seed that has been treated with pre-harvest glyphosate that was applied at the proper timing. Seed labs can estimate germination of seed treated with pre-harvest glyphosate if the germination test is done in soil. Submitting a seed sample that received pre-harvest glyphosate will result in abnormal seedling development, inaccurate results, and the seed lab will have to redo the test, costing extra. The risks mentioned above are still valid, so it is recommended to source seed elsewhere instead of using treated with pre-harvest glyphosate.

Vigour

The vigour test measures a seed lot's ability to produce normal seedlings under adverse conditions. Unlike the germination test that is run under optimal conditions, vigour is most often measured using a cold stress test which evaluates the seedlings' ability to withstand cool temperatures (5°C for seven days) and accompanying stress that may be typical of early spring planting. Vigour in a seed lot is important because it may provide insight into how seedlings will perform under challenging conditions. Seed lots with higher vigour seed lots may have faster and more uniform seedling emergence in low-temperature soils or other stressful conditions.

Low vigour values may also provide an early warning of diminishing seed quality as seed lots will begin to drop in vigour before germination values start to fall. Conditions of seed development, maturation, storage, and seed aging, all impact vigour. Seeds developed under moisture stress, nutrient deficiency, or extreme temperatures are often characterized by light, shrivelled, and low-vigour seed. Similar to germination, vigour will also be negatively impacted by mechanical damage or improper storage.

The vigour test is not standardized among seed labs. While the cold stress test is common, the parameters and the stress used may vary between labs. Vigour tests from different labs should not be compared directly.

Seed-borne Pathogens

Fungal screening for seed-borne pathogens is an important component of assessing seed quality as these diseases can have negative impacts on crop establishment, overall plant health, and ultimately crop yield. Evaluation of seed-borne pathogens is particularly important for diseases that have high rates of seed-to-seedling transmission. For example, *Ascochyta rabiei* carried on chickpea seed is readily transmitted to the seedling and can be highly destructive to the crop. Therefore, only chickpea seed lots with low infection levels (<0.3%) are acceptable for planting. Even if this threshold is met, a seed treatment is still recommended as the

likelihood of missing an infected seed is very high and even a very small percentage of *Ascochyta*-infected chickpea seed can result in significant seedling infection.

Seed treatments are an excellent tool to help protect cereal and pulse seedlings against early-season soil and seed-borne pathogens. Seed treatment selection should be based on the targeted pathogens of concern and should be applied by means to ensure thorough seed coverage and according to label instructions. Some seed treatments may not be compatible with certain seed-applied rhizobium inoculants, so it is recommended to consult with manufacturers for compatibility information. It is important to note that seed treatments alone cannot compensate for a poor seed lot and some seed lots simply have too high of disease levels to be used as a seed source. Guidelines have been developed to help inform decisions of acceptable thresholds for seed-borne pathogens, but guidelines are only guidelines. Soil moisture and temperature conditions following planting will also influence what infection levels are tolerable in a given year or location. There are no hard rules on acceptable levels of disease due to each producer having a unique situation and acceptable level of risk.

Table 1. Guidelines for seed-borne disease thresholds in cereal and pulse crops¹.

Major Pathogen	Threshold	Crop(s)	Comments
-----Cereals-----			
Common Root Rot <i>Cochliobolus sativus</i>	N/A	Barley, Durum, Oats, Wheat	Thresholds indicate the recommended level at or above a fungicidal seed treatment. A fungicidal seed treatment may be warranted at lower levels if there are additional risk factors. Combined disease levels should be considered when considering seed treatment options.
Seedling Blight/Root Rot <i>Fusarium spp.</i>	10%	Barley, Durum, Oats, Wheat	
<i>Fusarium graminearum</i>	2% ²	Barley, Durum, Oats, Wheat	
Loose Smut <i>Ustilago nuda</i>	2%	Barley	
-----Pulses-----			
<i>Ascochyta spp.</i>	0.3%	Chickpeas	Seed-to-seedling transmission of <i>Ascochyta rabiei</i> is high in chickpea; seed with levels above 0.3% should not be used. Seed treatment is always recommended even if seed levels are 0%.
	10%	Field Peas	Up to 10% infection should not significantly affect establishment of field peas.
		Lentils	A seed treatment should be used if infection levels are close to or exceed 5% for lentils grown in Brown and Dark Brown soil zones. Lentil seed with levels exceeding 10% should not be planted at all. Any level of seed-borne

			Ascochyta spp. is unacceptable for lentils grown in Black soil zone.
Anthracnose <i>Colletotrichum truncatum</i>	N/A	Lentils	Seed-to-seedling transmission of anthracnose is very low in lentils and infected residue provides a greater inoculum risk; however, it is still important to plant clean seed and accept zero tolerance in being planted into a field that has never grown lentil.
Seedling Blight/Root Rot <i>Fusarium spp.</i>	10%	Chickpeas	Thresholds for seed-borne Fusarium has not been established in pulses, but caution is warranted as levels reach 5%. Total <i>Fusarium</i> + <i>Botrytis</i> + <i>Sclerotinia</i> should not exceed 10%. Up to 10% of Botrytis + Sclerotinia infection should be tolerable, but significant seedling blight may occur at lower levels without seed treatment.
		Field Peas	
		Lentils	
Grey Mold <i>Botrytis spp.</i>	10%	Chickpeas	
		Field Peas	
		Lentils	
White Mold <i>Sclerotinia spp.</i>	10%	Chickpeas	
		Field Peas	
		Lentils	

¹ Adapted from [Saskatchewan Ministry of Agriculture guidelines](#)

² Additional information on [thresholds for Fusarium graminearum](#) is available from the Saskatchewan Ministry of Agriculture

Thousand Kernel Weight

The thousand kernel weight (TKW) is a measure of seed size and represents the weight, in grams, of 1,000 seeds. Seed weight may also be reported, which is the weight of a single seed, in milligrams, and is numerically equivalent to TKW. Most crops have a typical TKW range but it is important to note that TKW is unique to each individual seed lot and can vary substantially between varieties, fields, and growing seasons. For instance, smaller and lighter seed with lower TKWs is often a consequence of a drought season when limited moisture resources did not allow for optimal seed fill.

Measuring the TKW of a seed lot is important for calculating the optimal seeding rates for pulse and cereal crops as it provides a more precise measurement of seeds sown compared to bushels or weight. Providing that all seed quality factors are equal between two seed lots, the seed source with the higher TKW will require a heavier seeding rate to achieve the same optimal plant stand. This is because the bigger the seed, the higher the TKW and the fewer seeds per pound. Therefore, for the same weight (i.e. 60 pounds) of seed, fewer potential plants are being put in the ground.

Optimal Plant Stands and Seeding Rate Calculations

Targeted Plant Population

Plant population is an important factor for the establishment of competitive, high-yielding cereal and pulse crops. Optimal plant stands differ by crop, environment, and management factors but care should be taken to target appropriate plant densities for each individual crop and farm operation.

Table 2. Summary of target plant populations for select cereal and pulse crops

Crop	Plant Population Target (Range)	Typical TKW Range
	Plants ft ⁻²	Grams
Cereals		
Barley	22 (20–24)	30–50
Durum	20 (20–24)	41–45
Oat	24 (20–30) ¹	30–45
Wheat	24 (20–24)	30–40
Pulses		
Chickpea	4 (3–4)	220–425
Field Pea	8 (7–9)	125–300
Lentil	12 (10–14)	25–80

¹While a plant population of 20–30 plants ft⁻² is usually recommended, research has consistently shown the benefits of increased seeding rates, particularly in the presence of weeds such as wild oats. Next to early seeding, the seeding rate is one of the most powerful strategies available for reducing weeds.

Calculating Seeding Rate

Once the desired plant population is determined the seeding rate can easily be calculated based on specific seed quality parameters of each individual seed lot. Although this calculation is fairly straightforward, the seedling survivability rate can be difficult to estimate and will vary among farms and across the growing season. As a general rule of thumb for cereal and pulse crops, expected seedling survivability is approximately 5–15% lower than the germination rate with a lower survivability rate anticipated under adverse growing conditions.

Factors to consider when assigning seedling survivability include:

- Seeding date
- Soil temperature, moisture, and texture
- Seed handling and seeding speed
- Seeding depth
- Seed-placed fertilizer
- Seedling pests such as insects and soil-borne pathogens

Increased seeding rates will be required to overcome low seedling survivability; however, it is important to recognize that not all issues of poor quality seed can be corrected by increased seeding rates. For instance, large differences in vigour and germination values in a seed lot can be exacerbated by increasing seeding rates which may impose greater variability in establishment and lead to a more uneven plant stand. Similarly, increasing the seeding rate to overcome low germination of a seed lot with a high pathogen load will simply introduce more disease into the field.

Be wary of sub-par germination and vigour values on post-harvest seed tests. Germination and vigour levels can continue to decrease over winter while being stored and are also likely to be further compromised with further seed coat damage induced through additional handling during storage transfer and cleaning. It is a recommended practice to get seed tested again in the spring for germination, vigour, and TKW.

Value of Seed Testing in a Dry Year

Seed grown during a dry year typically boasts lower disease levels relative to an average or wet season, but reductions in seed-borne pathogen load do not guarantee high-quality seed. Particularly impacted are germination, vigour, and TKW with potential reductions in all categories.

- **TKW:** When seeds do not have adequate moisture resources during grain fill, final seed production is typically much lower than expected crop averages
- **Vigour:** Production of gibberellin hormone, responsible for regulating seed maturity and dormancy, is typically reduced under drought conditions and seed may demonstrate higher than anticipated levels of dormancy and lower vigour as a result. Grain, particularly pulses, harvested during very hot and dry conditions can be susceptible to micro-cracking on the seed coat leading to reductions in vigour before germination levels are noticeably affected.
- **Germination:** mechanical damage from typical harvest and handling activities is often increased under hot and dry conditions, especially when the seed moisture content is low and air temperatures are high. Such damage to the seed coat can have a significant negative impact on germination levels with pulse crops being the most prone to seed coat cracking and splitting.

Seeding rate (lbs/ac)=

$$\left(\frac{\text{Desired}}{\text{plant population ft}^2} \right) \left(\frac{\text{TKW}}{\text{g}} \right)$$

$$\frac{\text{seedling survival rate in decimal form}}{10.4}$$

Initial seed testing reports from the fall of 2021 are indicating low germination in some crops, particularly in field pea. Field pea samples experienced high levels of mechanical damage during harvest operations and some labs are reporting the majority of pea samples with sub-optimal germination levels.