Alberta Seed Testing Standards

21/12/2016

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1.0 Introduction

Seed testing is done to assess seedlot attributes and determine overall quality and value for seedling production and storage. Seed testing standards are based on scientific evidence and provide set procedures for facilities to conduct tests in a uniform manner and ensure comparable results for seed owners. The seed testing standards described below are closely aligned with the International Rules for Seed Testing 2015 (ISTA 2015) and follow these procedures for sampling, moisture content determination, purity analysis, and seed weight determination. The germination testing standards are based on protocols developed at the Petawawa National Forestry Institute, the British Columbia Tree Seed Centre and the Alberta Tree Improvement & Seed Centre (ATISC) and all have been tested for highest performance at ATISC. Procedures and standards for the determination of seed equilibrium relative humidity are supported by the Genebank Standards for Plant Genetic Resources and Food & Agriculture (FAO 2013) and research at the Royal Botanic Gardens, Kew (Smith *et al*. 2003, Gold & Manger, 2008).

These standards have been developed for parties that have a working knowledge of seed testing and are familiar with seed testing materials, instruments and equipment. For a comprehensive description of general seed testing principles, procedures, equipment, and materials please refer to the International Rules for Seed Testing 2015 (ISTA 2015). It is strongly recommended that all seed testing facilities maintain a current copy of these rules on their premises, as they will be referred to in the Alberta Seed Testing Standards. Facilities will be expected to adhere to all rules in the Alberta Seed Testing Standards, including those referenced to ISTA (2015).

2.0 Seed Testing Facilities Approval Process

Only seed test results conducted at facilities approved for seed testing by the Government of Alberta (*Alberta*) will be accepted. Interested parties can apply for approval by contacting the Provincial Seed Officer at the Alberta Tree Improvement and Seed Centre. Applicants must submit copies of seed testing procedures used at their facilities, be subject to on-site audits by an *Alberta* representative, and conduct tests on seedlots supplied by *Alberta* with the results submitted to *Alberta* for accuracy evaluation. Approval will be granted when applicants can successfully demonstrate that tests can be conducted in accordance with these seed testing standards using appropriate equipment and materials and meet accuracy standards. Once approved, on-site facility audits will be conducted by *Alberta* once every three years or as determined necessary by *Alberta*. Facilities may also be required to conduct quality check tests on seedlots and may not be informed of the quality check prior to testing. The Provincial Seed Officer reserves the right to revoke testing facility approval due to failure to pass any quality checks.

Approved facilities testing Alberta seed will have until 1st January 2018 to submit proof of minimum equipment calibration (see Chapter 9) conducted within the last two years to the Alberta Provincial Seed Officer and will be expected to provide proof of continued updated calibration upon request and as part of the on-site facility audits.

3.0 Reporting Results

Seed test data and results must be provided to the Provincial Seed Officer for review and entry onto the Seed Information Management System (SIMS).

Data and results must be reviewed by the testing agency <u>prior</u> to submission for completeness, accuracy and adherence to testing and submission requirements.

4.0 Seed Sampling

The objectives of sampling are to obtain a sample that is suitable in size for testing and to obtain a sample that is representative of the lot being tested. All sampling should be done quickly with limited exposure to room air in order to minimize changes in seed moisture if this is to be tested. Seed practitioners are reminded that any movement and settling of seed in containers can easily bring empty lighter seeds to the surface, so mixing just before any samples are taken is important to ensure an accurate representation of the entire seedlot.

Primary samples are small portions of seed taken at random from the seedlot. All primary samples taken from one seedlot are then combined and mixed to form the *composite sample*.
Composite samples are reduced to a smaller subsample called the *submitted sample*.
Submitted samples are portions of seed that are submitted to the laboratory for testing.
Working samples are subsamples of the submitted sample and is the portion of seed on which a test is made.

The following sampling intensities shall be used:

1-4 containers	3 primary samples from each container
5-8 containers	2 primary samples from each container
9-15 containers	1 primary sample from each container
16-30 containers	15 primary samples from the lot taken from randomly selected containers with no more than one sample per container
31-59 containers	20 primary samples from the lot taken from randomly selected containers with no more than one sample per container

Primary samples

The method for obtaining primary samples must meet ISTA (2015) standards. *Alberta* recommends the use of a trier/sampling stick or sampling by hand to achieve cheap but effective sampling. Primary samples taken by hand should be taken from the middle of the container if one sample is taken, the top & bottom if 2 samples are taken, the top/middle/bottom if 3 samples are taken, etc. to ensure a representative composite sample.

Composite sample

The primary samples are combined and thoroughly mixed to make a uniform composite sample. A random method must be used to reduce the composite sample to the required submitted sample size as indicated in Table 1.

The submitted sample is to be transported in an intact, hermetically sealed container with as little air as possible. Plastic Ziploc type bags are not recommended and are only acceptable for very short storage periods of <1 hour. Glass vials, rubber sealed glass jars or heat sealed foil bags are recommended as containers that are most often hermetically sealed at room temperatures, with the heat sealed foil bags being the most reliable and cost effective option. Every effort must be made to start germination tests within 2 weeks of receiving the submitted sample. Interim storage should be in refrigerated conditions. Moisture tests must be started within 24 hours of receipt of the submitted sample; however, samples must be brought to room temperature before containers are opened.

Table 1: Minimum weights for submitted samples and working samples for purity analysis by most common tree species.
For species not listed here, see Table 2 in Chapter 2 of the ISTA International Rules for Seed Testing 2015.

Species	Submitted sample size for tests including moisture content (g)	Submitted sample size for tests not including moisture content (g)	Working sample size for purity analysis (g)
Abies balsamea	50	40	20
Abies lasiocarpa	50	50	25
Betula papyrifera	10	10	3
Larix laricina	50	25	10
Larix sibirica	50	25	10
Picea engelmannii	50	16	8
Picea glauca	50	10	5
Picea mariana	50	6	3
Picea pungens	50	30	15
Pinus albicaulis	700	700	350
Pinus banksiana	50	25	9
Pinus contorta	50	25	9
Pinus flexilis	500	500	250
Pinus sylvestris	50	40	20
Populus spp.	5	5	2
Pseudotsuga menziesii	60	60	30

Note: Only moisture content (MC) testing requires a larger submitted sample and not *eRH* testing, as this test is non-destructive.

During and after all testing, any remaining seed from the submitted sample must be stored in a hermetically sealed container in a refrigerated area until all averages and tolerances have been calculated and are within acceptable ranges (excluding germination tests).

5.0 Seed Moisture

The objective of a moisture test is to determine the overall moisture of a seedlot to establish optimal conditions for storage and to maximize the lifespan of the seed. The two moisture testing methods below are not interchangeable, i.e. an eRH reading should not be converted to an MC for test result submissions and vice versa.

Moisture testing must commence within 24 hours of receipt at the testing facility.

Tip: Choosing the Method

For the registration of operational seed from the seven tree species listed in FGRMS (2016), section 15.7 (lodgepole pine, jack pine, white spruce, Engelmann spruce, black spruce, Douglas-fir, tamarack and their hybrids), the following moisture measurements are acceptable:

MC = 4-8%
eRH = 15-40% @ 20-30°C

For all other species, only the following equilibrium relative humidity (eRH) test range is acceptable for the registration of operational seed:

eRH = 15-25% @ 20-30°C

In Alberta, the ambient indoor air humidity rarely goes above 40% RH and usually stays within 10-25% RH for 4-5 winter months. Therefore, seed will quickly dry to acceptable levels with sufficient air circulation. The process may be sped up with the use of fans, dehumidifiers/air conditioning, desiccators and purpose built seed driers. The use of heat application >35°C and/or for longer than 24 hours to dry seed for storage is not acceptable as this can negate the benefits of drying the seed.

Moisture Content

The moisture content of seed in Alberta is defined as the quantity of water in a sample expressed as a percentage of the weight of the original sample, also called a wet weight basis. A balance (weighing scale) capable of gram weights to at least 3 decimal places must be used. Moisture content is determined using the low constant temperature oven method: 103°C ± 2° for 17 hours ± 1 hour. The oven must be capable of drying samples in accordance with section 9.1.4.2 of ISTA (2015) and only metal sample containers should be used.

Sampling
Tests are carried out in duplicate on two independently drawn working samples weighing 4 to 5 grams each. For very small seedlots of less than 200 grams, reduced sample sizes and/or sample numbers are found in Table 2.

Table 2: Acceptable reduced sample sizes for moisture content testing on very small seedlots.

Total seed in seedlot	Sample size
50 to 200 grams of seed	Use two 1-gram samples
30 to 50 grams of seed	Use two 0.5-gram samples
10 to 30 grams of seed	Use one 0.5-gram sample
<10 grams of seed	Moisture content testing is not mandatory. Water activity measurement recommended. Special emphasis should be given to proper handling procedures, drying times, and stirring/mixing.

Seed cannot be exposed to the ambient air for longer than two minutes from the time it is removed from the submitted sample container until it has been placed in the drying containers and weighed. Each container and its lid must have matching labels.

For large tree/shrub seed (thousand seed weight > 200g), the seed must be cut in half and 2 samples consisting of 5 seeds each are acceptable for testing, e.g. whitebark pine (see Table 9A in ISTA (2015) for a list of species that must be cut before moisture testing).

Method
Containers and lids should be wiped with alcohol and dried before each use. The sample is evenly distributed over the surface of the container. The empty container and lid is weighed and this weight recorded. The sample is placed into the container and the seed, container and lid weight recorded. The samples, containers and lids are dried at 103°C ± 2° for 17 hours ± 1 hour. At the end of the drying period, the lid must be placed on the container before being moved to a desiccator (with appropriate desiccant) to a maximum of 30 minutes. After cooling, the container with its lid intact plus the seed inside are reweighed. All weights are recorded in grams to three decimal places.

Calculation
The following formula is used to calculate moisture content:

$$\frac{\textit{loss of weight}}{\textit{initial weight}} * 100 = \frac{M2 - M3}{M2 - M1} * 100$$

where M1 = weight of the container and its cover
M2 = weight of the container, cover, and contents before drying
M3 = weight of container, cover and contents after drying

The average of the two replicates is the percentage moisture content of the submitted sample, rounded to 0.1%. The average MC submitted for registration and storage must be a value of 4.0-8.0% MC.

Tolerances
The difference between the two replicates is rounded to 0.1%. If the difference between the two replicates is greater than 0.3% then the test is out of tolerance and must be repeated.

If the duplicate results of the second test are within tolerance limits as above, report the second result. If the results of the second test are outside tolerance limits, then the first and second test results are compared for tolerance (≤ 0.3%). If they are within tolerance then an average of the first and second tests is reported. If the two tests are out of tolerance then the equipment should be checked, instructions reviewed and the whole test repeated from the beginning.

Equilibrium Relative Humidity

Seeds are 'hygroscopic', meaning that they absorb (and lose) water relatively quickly in their environment. This transfer of water back and forth will eventually reach an equilibrium between the seed and the environment. The relative humidity of the air in an enclosed environment containing seeds at equilibrium is called the equilibrium relative humidity, written as '% eRH'. In much the same way that evaporation is used to measure seed moisture content, a type of hygrometer called a water activity meter is used to measure equilibrium relative humidity. Measuring seed moisture in this way is usually a fast, accurate and non-destructive method.

A capacitance or dew point hygrometer that has been calibrated in the last 24 months (see Section 8) is used to determine equilibrium relative humidity. The hygrometer should be set to a 'water activity' type of measurement. The measurements given by the meter are identical to equilibrium relative humidity (eRH). However, water activity is expressed on a decimal basis, i.e. on a scale from 0 to 1 and the units are 'a_w ',

whereas equilibrium relative humidity is expressed as a percentage, i.e. 0 to 100% eRH. In simple terms, this means that the water activity reading should be multiplied by 100 or in effect, the decimal is moved 2 places to the right.

e.g. a reading directly off the meter might be 0.226 a_w → this is reported as 22.6% eRH

All eRH measurements must only be taken when the seed and equipment is 20-30°C; however, the temperature does not need to be reported with the eRH.

Sampling

Sampling requirements are similar to those for **Moisture Content** testing:

- Tests must be carried out in duplicate on two independently drawn working samples. Seeds must fill at least 20% of the volume of the container used with the meter.
- As noted in Table 1, the submitted sample size can be the smaller value but only if the eRH test will be non-destructive.
- As with sampling for **Moisture Contents**, large tree/shrub seed where the thousand seed weight often exceeds 200g (e.g. whitebark pine & hazel nuts) must be cut in half before testing. Due to the normally high value of these seeds, only 1 sample consisting of 5 seeds need be tested and again, this should be noted with the submitted result.
- For very small seedlots where two independent samples are not possible following the 20% volume rule above, it is acceptable to use the entire seedlot in only one working sample but this should be noted with the result. If the seedlot size is so small that a single sample volume of the testing container is less than 20%, the volume should be approximated and also noted with the result.

e.g. 17.5% eRH, 1 sample, 10% filled

Method

- Seeds must be approximately the same temperature as the equipment and air in the room. As per FGRMS (2016), section 15.7, eRH measurements are only acceptable when taken between 20-30°C.
- Wipe containers with alcohol and dry before each use. The seeds are evenly distributed over the surface of the sample container and fill at least 20% volume of the container (see *Sampling* above).
- Measurements may be taken on instruments set on full (actual measurement) or 'quick mode' (estimated/extrapolated measurement). Quick mode is to be set at no less than 5 minutes and all submitted measurements must wait for the final reading.
- If choosing to use a full equilibrium measurement, the time to completion (10-30 minutes) is mostly dependent on the stable temperature of the seeds inside the chamber, so using seeds at room temperature and positioning the meter away from drafts/heaters/fans will help.

Calculation

The hygrometer will give a reading of water activity (0 to 1.0 aw) when used on the correct setting. This is converted to equilibrium relative humidity (eRH) by multiplying the water activity measurement by 100.

e.g. $0.278a_w$ X 100 = 27.8% eRH

The reported eRH is the average reading of the two samples to one decimal place, e.g. 23.2% eRH.

Tolerances

The difference between the two replicates should be rounded to 0.1%. If the difference between the two replicates is greater than 3.0% then the test is out of tolerance and must be repeated.

6.0 Purity Analysis

The objective of purity analysis is to determine the percentage composition by weight of pure seeds versus seeds of other species and debris (inert particles) that make up the sample.

A working sample as prescribed in Table 1 (column 4) must be drawn from the submitted sample, weighed and recorded in grams to three decimal places. For species not listed in Table 1, see Table 2A Part 2 in Chapter 2 of ISTA (2015). For species not listed here either, a working sample of a weight estimated to contain at least 2,500 seeds should be used.

The working sample is then separated by hand, sieve or blower into two components: pure seed of the test species, and seed of other species or debris. For clear definitions of pure seed, other seed and inert matter, see Chapter 3, section 3.2 of ISTA (2015). The two components must then be weighed and recorded in grams to three decimal places.

The sum of the weights of the two component fractions must be compared to the original weight of the purity working sample for any gain or loss. If a discrepancy of more than 5% of the original sample weight is found, the test must be discarded and a re-test is required.

The pure seed percentage should be reported and is calculated by the following formula:

$$\text{Pure seed (\%)} = \frac{\text{weight of pure seed fraction}}{\text{total working sample weight}} \times 100$$

Pure seed percentage is rounded and reported to one decimal place.

7.0 Thousand Seed Weight (TSW)

This test determines the weight of 1000 seeds of a sample.

Only pure seeds are used, as per the definition given in the Purity Analysis section above; however, seed from the official purity analysis may not be used to determine TSW due to the possibility of moisture changes in seeds during longer exposure to ambient conditions. For this reason, TSW tests should be completed quickly to minimize weight errors.

Eight (8) pure seed replicates of 100 seeds must be drawn randomly from the submitted sample. Each replicate weight is recorded in grams to three decimal places and the mean weight determined from these 8 replicates. The mean weight of 100 seeds is then used to calculate the weight of 1000 seeds. Variance, standard deviation and coefficient of variance must be calculated using the following formulas:

Variance $= \dfrac{n(\Sigma x^2) - (\Sigma x)^2}{n(n-1)}$

where : x = weight of each replicate in grams
n = number of replicates
Σ = sum of

Standard deviation $s = \sqrt{Variance}$

Coefficient of variation $CV = \dfrac{s}{\bar{x}} \times 100$

where: $\bar{x}$ = average (mean) weight of 100 seeds

If the coefficient of variation does not exceed 4.0 then the thousand seed weight is accepted and is reported to 3 decimal places. For grass seed the coefficient of variation must not exceed 6.0. An Excel tool can be provided for the above calculations upon request.

If the limit is exceeded, eight more replicates must be drawn and weighed. The standard deviation must then be calculated using all 16 replicates and any replicate that diverges from the mean by more than twice the standard deviation must be discarded. The remaining replicate weights are then used to determine the weight of 1000 seeds.

TIP: Calculations

An Excel tool can be provided for the above calculations upon request.

8.0 Germination Testing

The objective of the germination test is to determine the germination potential of a seedlot. In Alberta the percent germination is the estimated viability of a seedlot, tested under specified conditions and within a specified period of time. Each test must consist of four hundred seeds which are drawn from the working sample and then randomly divided into four replicates of 100 seeds.

TIP: Required tests?

As per FGRMS (2016, a registered seedlot owner may choose whether or not to do a germination test on their seed or to do different germination tests. However, for a test result to be recorded with the registered seedlot by the Provincial Seed Officer, the testing rules in this chapter must be followed.

Equipment & materials

Testing facilities are permitted to use only the following materials and equipment for germination tests:

- covered germination containers that allow for adequate and uniform spacing of seeds and replicates

- germination/incubation cabinets that can control temperature and light
  - temperature must be evenly distributed to ensure that all samples have a temperature within the prescribed limits for the test/treatment ±2°C

- suitable substrates:
  - clean paper that has an open and porous nature and the capacity to hold sufficient water for the duration of the test period, e.g. germination paper, filter paper (grade 3 recommended) or Kimpak/Versapak cellulose wadding;
  - water agar; or
  - sand that meets ISTA regulations for grain size, pH & conductivity (only recommended for seeds >5mm)

Seeds for each replicate are placed on moist substrate in a germination container using either forceps or suction equipment. Germination containers that hold multiple replicates must not contain more than one replicate of the same seedlot.

Tests must be supplied with sufficient water for germination and not allowed to dry out; however, testers should be mindful of not drowning the seeds, especially small ones. This can be achieved by providing high humidity in the incubators or by using test containers with tight fitting lids, e.g. Hoffman boxes. Required initial moisture regimes are:

- Kimpak/Versapak – approximately 0.152mL per square centimeter of dry media.
  → length x width of media in cm then multiply by 0.152

- germination sand - water amounts are dependent on seed size
  → seeds >5mm, use 10ml water per 50g of sand
  → seeds <5mm) use 5ml water per 50g of sand

  Note: This amount of water seems small; however, sand has a very low moisture holding capacity and seeds can easily absorb water from this media.

Small amounts of additional water may be added later in the test if required due to evaporation. Refer to Table 3 for germination treatments, conditions and treatments required.

TIP: Tiny seeds

For tiny seeds such as aspen and labrador tea, germination on filter/germination paper placed on top of moist Kimpak can help wick moisture to the seeds and prevent drowning, and also make counting easier.

Assessment & recording

Figure 1 is an example of a germination test sheet that can be used to record and submit results. Testers may use and submit their own variation of the test sheet but it must contain all of the information shown in Figure 1.

Germinants are assessed during the germination phase as indicated in Table 3. For any species not included in Table 3, assessment should occur at least every 7 days to a minimum of 28 days and 2 weeks with no germination.

Only germinated seedlings are removed and counted every assessment day until the end of the test, when any remaining seeds/seedlings are categorized. A seed is classed as 'germinated' and removed when the radicle/seedling has elongated to at least 4 times the length of the seed.

At the end of the test after all germinated and abnormal seedlings have been removed and recorded, any seeds that have germinated, i.e. radicle visible, but not achieved the 4x seed length rule are to be classified as 'low vigour'. Ungerminated seeds must be cut tested and classified into either 'empty' or 'filled ungerminated'. An 'abnormal' seedling is any seedling that falls into the abnormal category according to Section 5.2.8 of ISTA (2015).

Therefore, there are five categories to complete and submit for every germination test.

Seedling visible:

i) germinated – radicle visible and is at least 4x the length of the seed
ii) low vigour – radicle visible but not at least 4x the length of the seed
iii) abnormal – any germinated seed that fits the ISTA abnormal definition

Ungerminated seeds:

iv) empty – little/no embryonic and megagametophyte/endosperm material
v) filled ungerminated – no radicle visible and embryonic and megagametophyte/endosperm material present OR seeds with mouldy and/or liquefied material inside

Each category is to be reported as a percentage of the total number of seed in the test, rounded to one decimal place. The sum of the percentage of these five categories must equal 100.

Tolerance Limits

To find the maximum tolerated range, use the reported total germination percentage to the nearest whole number. Locate this number in either of the first two columns in Table 4 (below) and read the maximum tolerated range in the third column. If the maximum tolerated range between replicate percentages is exceeded, the germination test must be repeated using the same methods.

The results for this second test are then compared using Table 5C Part 1 of ISTA (2015). Do not use Table 4 (below) when more than one test is performed. It is advised to read section 5.8.1 Tolerances in ISTA (2015). If the range between the two tests is in tolerance then the average of the two tests should be reported. If the range

is out of tolerance then a third test is conducted and the tolerances compared using Table 5D Part 1 of ISTA (2015). Again, if the three tests are in tolerance then the average of the three is reported.

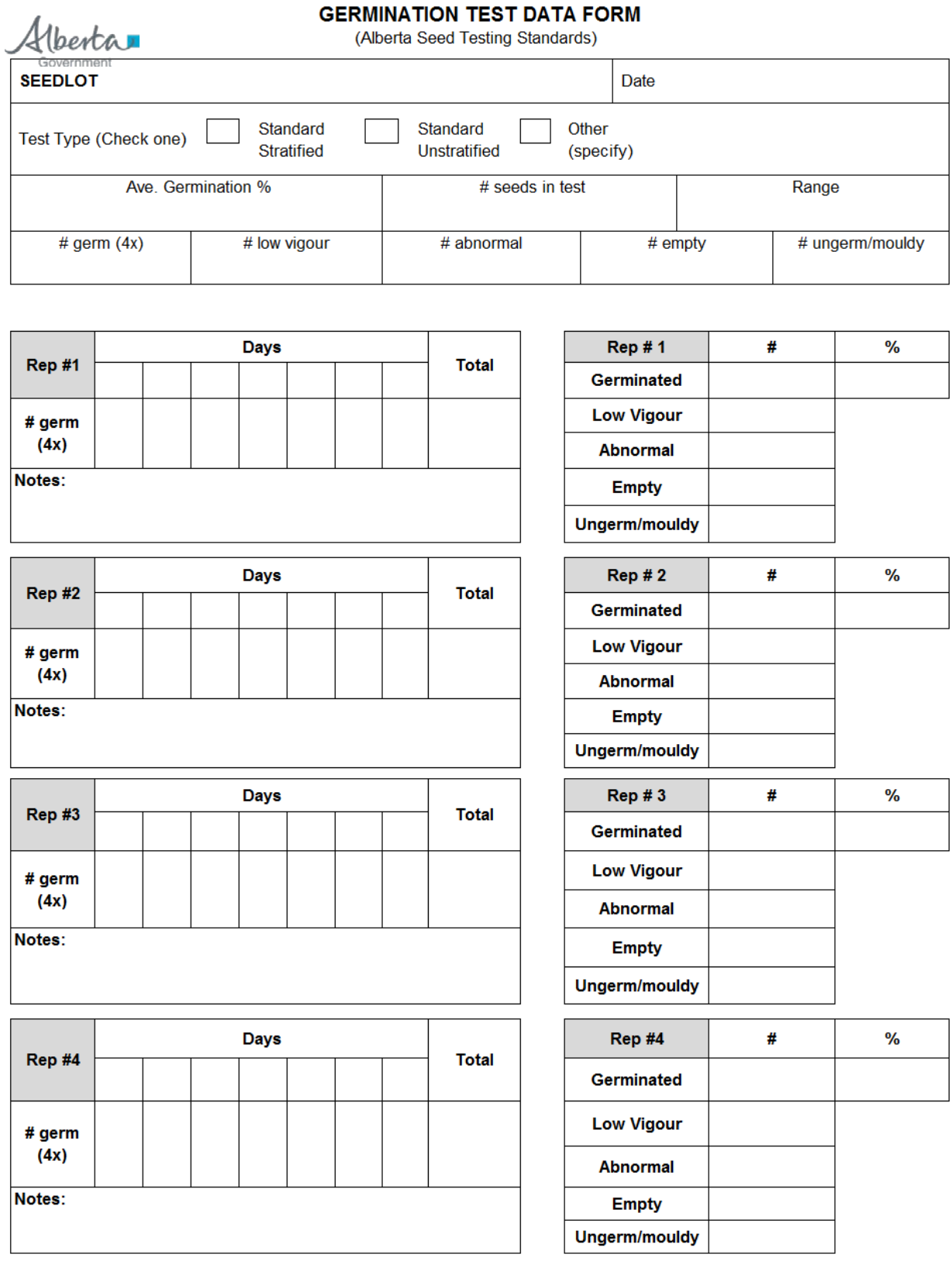
If the results of the three tests are found to be out of tolerance, then the germination should be reported as an average of the two tests closest to acceptable range.

Table 3: Germination testing prescriptions.

Species	Species Code	Suggested Media	Light (hours)	Germination Temperature (°C)	First Count (days)	Final Count (days)	Treatments	Test type required
Abies balsamea	Fb	Any	12	25	7	28	Cold stratification at 2-5°C for 21 days.	Unstratified and stratified tests.
Abies lasiocarpa	Fa	Germination protocols under development						
Betula papyrifera	Bw	Any	12	25	7	21	Cold stratification at 2-5°C for 32 days.	Unstratified and stratified tests.
Larix laricina	Lt	Any	12	25	7	21	Cold stratification at 2-5°C for 21 days.	Unstratified and stratified tests.
Larix sibirica	Ls	Any	12	25	7	21	Cold stratification at 2-5°C for 21 days.	Unstratified and stratified tests.
Picea engelmannii	Se	Any	12	25	7	21	Cold stratification at 2-5°C for 21 days.	Unstratified and stratified tests.
Picea glauca	Sw	Any	12	25	7	21	Cold stratification at 2-5°C for 21 days.	Unstratified and stratified tests.
Picea mariana	Sb	Any	12	25	7	21	Cold stratification at 2-5°C for 21 days.	Unstratified and stratified tests.
Pinus albicaulis	Pa	Sand	12	25	3	21	Distilled/deionized water soak for 48 hours. Warm stratification at 20°C for 84 days. Cold stratification at 2-5°C for 112 days.	Stratified test only.
Pinus banksiana	Pj	Any	12	25	7	21	Cold stratification at 2-5°C for 21 days.	Stratified test only.
Pinus contorta	Pl	Any	12	25	7	21	Cold stratification at 2-5°C for 21 days.	Stratified test only.
Pinus flexilis	Pf	Sand	12	25	7	21	Distilled/deionized water soak for 48 hours. Cold stratification at 2-5°C for 70 days.	Stratified test only.
Populus balsamifera	Pb	Kimpak plus filter paper	12	25	3	10	None.	Unstratified test only.
Populus tremuloides	Aw	Kimpak plus filter paper	12	25	3	10	None.	Unstratified test only.
Pseudotsuga menziesii	Fd	Any	12	25	7	21	Cold stratification at 2-5°C for 21 days.	Stratified test only.

Table 4: Maximum range of tolerance between four replicates of 100 seeds in one germination test.

If the average germination percentage is:	or:	The maximum tolerated range between replicates is:
99	2	5
98	3	6
97	4	7
96	5	8
95	6	9
93 to 94	7 to 8	10
91 to 92	9 to 10	11
89 to 90	11 to 12	12
87 to 88	13 to 14	13
84 to 86	15 to 17	14
81 to 83	18 to 20	15
78 to 80	21 to 23	16
73 to 77	24 to 28	17
67 to 72	29 to 34	18
56 to 66	35 to 45	19
51 to 55	46 to 50	20



GERMINATION TEST DATA FORM

(Alberta Seed Testing Standards)

Alberta Government

SEEDLOT					Date
Test Type (Check one) ☐ Standard Stratified ☐ Standard Unstratified ☐ Other (specify)					
Ave. Germination %		# seeds in test			Range
# germ (4x)	# low vigour	# abnormal	# empty	# ungerm/mouldy	

Rep #1	Days							Total
# germ (4x)								
Notes:								

Rep # 1	#	%
Germinated		
Low Vigour		
Abnormal		
Empty		
Ungerm/mouldy		

Rep #2	Days							Total
# germ (4x)								
Notes:								

Rep # 2	#	%
Germinated		
Low Vigour		
Abnormal		
Empty		
Ungerm/mouldy		

Rep #3	Days							Total
# germ (4x)								
Notes:								

Rep # 3	#	%
Germinated		
Low Vigour		
Abnormal		
Empty		
Ungerm/mouldy		

Rep #4	Days							Total
# germ (4x)								
Notes:								

Rep #4	#	%
Germinated		
Low Vigour		
Abnormal		
Empty		
Ungerm/mouldy		

Figure 1: Germination test data form.

9.0 Equipment Calibration

Balances

All approved facilities testing Alberta seed and submitting moisture contents, purity analyses or 1000 seed weights will have until 1 January 2018 to submit proof to the Provincial Seed Officer of balance calibration conducted on site and within the last three years.

Facilities will be expected to produce proof of continued triennial calibration upon request and as part of the on-site facility audits.

Proof will consist of a calibration certificate for each balance used or a summary report including serial numbers and produced by an experienced, trained technician using certified traceable weights.

Water Activity Hygrometers

Water activity meters must be calibrated at least once every 2 years, since all humidity measuring devices drift substantially each year. At least 3 calibration points between 0-60% RH should be used with commercial, pre-mixed and certified calibration salt solutions.

Facilities will be expected to produce proof of continued biennial calibration upon request and as part of the on-site facility audits.

Proof will consist of a sticker on each meter/probe with the date and initials of the employee who performed the last calibration. The initials will serve as certification that the calibration occurred on that date and as per the above standards.

TIP: Calibration solutions

If packaged in sealed glass vials, calibration salt solutions will last years stored at room temperature.

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