Seed Testing Methods for Reclamation Species

Native Prairie Restoration
Reclamation Workshop
Seed Quality Assessment

- Purity
- Germination
- Seed Health
- Vigour
Sample Preparation

- A test is only as good as the sample provided.
- The more suspect the quality, the more important the sampling.
- Mixing the sample properly is of key importance.
Seed Testing Rules

- “M&P” : Canadian Methods and Procedures for Testing Seeds – Canadian Food Inspection Agency
- AOSA Rules for Testing Seeds – Association of Official Seed Analysts
- International Rules For Seed Testing – International Seed Testing Association
Seed Technologist Organizations

- CSAAC – Commercial Seed Analysts Association of Canada: www.seedanalysts.ca

- SCST – Society of Commercial Seed Technologists: www.seedtechnology.net
Seed Lot Purity

- Weed contamination
- Other crop contamination
- Inert matter
- Disease bodies
- Percentage test and count of other species
The Percentage Test

Often called: the “Pure Seed Test in Canada, the “Purity” in the United States and Europe

Approximately 2500 Seeds are separated into fractions which may include:
- Pure Seed – used for planting
- Other Crops
- Weed Seeds
- Inert matter
- Ergot

Fractions are weighed and reported as a percent by weight.
Contaminants by Count

- Approximately 25,000 seeds analysed by weight
- Contaminants are retrieved and classified.
- Often reported to 25 grams in Canada with large seeds reported to 1000 grams
Verified Seed ID References:
Verified Seed ID References:
Opuntia – Found in Native Mixture
Specialized Equipment for Purity Tests
Germination

Pure Seed is planted at conditions prescribed in the seed testing rules.

- 200 Seeds for Canadian Rules
- 400 Seeds for AOSA and ISTA Rules
Germination

Seed is incubated at prescribed temperatures for a pre-set number of days before evaluation. Light may be required for some species.

Typical Temperature Regimes:

- 15/25C
- 20/30C
- 20C
Germination

Development of structures needed to produce a healthy normal plant under favourable field conditions.

Seedlings evaluated into four categories:

- Normal
- Abnormal
- Dead
- Fresh (Dormant)
Abnormal Seedlings

An abnormal seedling is a seedling that does not have all essential structures or is damaged, deformed or decayed that prevents normal development.

- Will it grow?
- Does seed treatment cause it to be a normal seedling?
- How do we decide what is abnormal?
Causes of Seedling Abnormalities

- Frost damage
- Heating damage
- Mechanical damage
- Chemical damage
- Declining Vigour
- Pathogenic infections
Dormancy

- Dormant Seed: Viable seeds which fail to germinate when provided prescribed germination conditions
- Fresh Seed: Seeds which have imbibed moisture but have failed to germinate and may be dormant.
- Hard Seed: Seeds which remain hard at the end of the test period because their impermeable seed coats prevent the absorption of water.
Dormancy

- Quiesscence: Water, light, Temperature, Gas
- Primary vs. Secondary Dormancy
- Seed coat Dormancy and Fresh Seed
- Chemical Inhibitors
- Maturity or Morphological dormancy
Dormancy Breaking Techniques

- Prechill and Stratification
- Predry or Preheating
- Prewashing
- Light
- Scarification
- KNO3
- GA3
- Ethylene
Special Considerations with Reclamation Species

- There are often no prescribed rules in the seed testing rules.
- Most often these species are perennial with the built in survival technique of extreme dormancy. Some methods prescribe a 6 month prechill period.
- Many species will never complete full germination potential under lab conditions.
Paired Tests

- Dormancy breaking used on one test
- Second test planted at a neutral temperature for 14-21 days. This is followed by the Tetrazolium test to determine the number of viable seeds left in the ungerminated ones
- This allows the end user to know which percent will develop rapidly and estimate the number with potential to develop over time as natural mechanical, chemical and temperature mechanisms induce dormancy breaking in the environment.
Tetrazolium or Viability Testing

- Relation to Germination Test
- Steps: Precondition, Stain, Evaluation

Fig 4 Seed stain evaluation
Tripterocalyx - Preconditioning
Tripterocalyx - Preparation
Tripterocalyx - Evaluation
Tetrazolium of Poa species.
The Canada Seeds Act & Regulations

- The Seeds Act is an act of parliament respecting the Testing, Quality and Sale of Seeds in Canada.
- The Seeds Regulations are the working documents giving specifics to how the law should be carried out.
- Designed to protect buyers and sellers and Canada from poor quality seed and its complications.
The Grading System

- Whenever possible seed sold in Canada should be graded by an accredited seed grader in an authorized establishment based on analysis documents supplied by an accredited seed analyst in an accredited seed laboratory.
- The Department in charge: Canadian Food Inspection Agency. (CFIA)
- The Canadian Seed Institute (CSI) is a third party verification body which audits and accredits the establishments and people in the system.
Grade Tables

**TABLE XII**

Applicable to:

- Poa annua L.
- Poa pratensis L.
- Poa trivialis L.
- Cynodon dactylon L.
- Eragrostis gigantea Roth (= A. alba sect.)

<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRADE NAME</td>
<td>PRIMARY</td>
<td>PRIMARY PLUS SECONDARY</td>
<td>TOTAL WEED SEEDS</td>
<td>OTHER CROPS</td>
<td>MAXIMUM FOREIGN SEEDS</td>
<td>MINIMUM PERCENT PURE WEED</td>
<td>MINIMUM PERCENT PURE LIVING SEED</td>
<td>OTHER KINDS</td>
</tr>
<tr>
<td>1. Canada Foundation No. 1</td>
<td>0</td>
<td>5</td>
<td>0.2</td>
<td>1</td>
<td>2</td>
<td>85</td>
<td>70</td>
<td>75</td>
</tr>
<tr>
<td>2. Canada Foundation No. 2</td>
<td>1</td>
<td>20</td>
<td>0.5</td>
<td>2</td>
<td>3</td>
<td>75</td>
<td>60</td>
<td>65</td>
</tr>
<tr>
<td>3. Canada Registered No. 1</td>
<td>0</td>
<td>5</td>
<td>0.2</td>
<td>1</td>
<td>2</td>
<td>85</td>
<td>70</td>
<td>75</td>
</tr>
<tr>
<td>4. Canada Registered No. 2</td>
<td>1</td>
<td>2</td>
<td>0.5</td>
<td>2</td>
<td>3</td>
<td>75</td>
<td>60</td>
<td>65</td>
</tr>
<tr>
<td>5. Canada Certified No. 1</td>
<td>2</td>
<td>20</td>
<td>0.5</td>
<td>2</td>
<td>2</td>
<td>85</td>
<td>65</td>
<td>75</td>
</tr>
<tr>
<td>6. Canada Certified No. 2</td>
<td>4</td>
<td>50</td>
<td>0.8</td>
<td>4</td>
<td>3</td>
<td>75</td>
<td>55</td>
<td>65</td>
</tr>
<tr>
<td>7. Varietal Blend No. 1</td>
<td>2</td>
<td>20</td>
<td>0.5</td>
<td>2</td>
<td>2</td>
<td>85</td>
<td>65</td>
<td>75</td>
</tr>
<tr>
<td>8. Varietal Blend No. 2</td>
<td>4</td>
<td>50</td>
<td>0.8</td>
<td>4</td>
<td>3</td>
<td>75</td>
<td>55</td>
<td>65</td>
</tr>
<tr>
<td>9. Common No. 1</td>
<td>4</td>
<td>20</td>
<td>0.5</td>
<td>3</td>
<td>2</td>
<td>85</td>
<td>65</td>
<td>75</td>
</tr>
<tr>
<td>10. Common No. 2</td>
<td>8</td>
<td>100</td>
<td>1.0</td>
<td>5</td>
<td>3</td>
<td>75</td>
<td>55</td>
<td>65</td>
</tr>
</tbody>
</table>
Native Species on Grade Tables

- Northern Wheatgrass
- Western wheatgrass
- Slender wheatgrass
- Streambank wheatgrass
- Fowl bluegrass
- Creeping bentgrass
Native Seed Not On Grade Tables

- Must meet minimum standards for the table applied
- Does not need to meet Percentage Pure seed requirements Inert matter
- Does not need to meet germination standards
- Must meet weed, crop and other contaminant standards.
Species NOT on the Grade Tables

- Seeds cannot be graded but must meet minimum purity standards of the table to which they apply.
- The table is chosen based on seeds per gram and type or use of seed.
- Contaminants still classified according to Canadian Rules.
Contaminants Classification

- Prohibited, Primary, Secondary as determined by the Weed Seeds Order.
- Other Crops – Schedule 1 off the Seeds Regulations. – Grade Tables
- Other Weeds
- Other Contaminants
The Weed Seeds Order:

Classes include:
- Prohibited noxious
- Primary noxious
- Secondary Noxious
- Other Weed Seeds
## Schedule I – The Weed Seed Order

Prohibited Noxious Weeds:

<table>
<thead>
<tr>
<th>Item</th>
<th>Latin Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Acroptilon repens (L.) DC. (=Centaurea repens L.)</td>
<td>Russian knapweed</td>
</tr>
<tr>
<td>2.</td>
<td>Aegilops cylindrica</td>
<td>Host Jointed goatgrass</td>
</tr>
<tr>
<td>3.</td>
<td>Carduus nutans L.</td>
<td>Nodding thistle</td>
</tr>
<tr>
<td>4.</td>
<td>Centaurea diffusa Lam.</td>
<td>Diffuse knapweed</td>
</tr>
<tr>
<td>5.</td>
<td>Centaurea solstitialis L.</td>
<td>Yellow star thistle</td>
</tr>
<tr>
<td>6.</td>
<td>Centaurea stoebe L. (=Centaurea maculosa Lam.)</td>
<td>Spotted knapweed</td>
</tr>
<tr>
<td>7.</td>
<td>Conium maculatum L.</td>
<td>Poison Hemlock</td>
</tr>
<tr>
<td>9.</td>
<td>Cuscuta spp.</td>
<td>Dodder</td>
</tr>
<tr>
<td>10.</td>
<td>Datura stramonium L.</td>
<td>Jimsonweed</td>
</tr>
<tr>
<td>11.</td>
<td>Eriochloa villosa Thub.</td>
<td>Kunth Woolly cup grass</td>
</tr>
<tr>
<td>12.</td>
<td>Euphorbia esula L.</td>
<td>Leafy spurge</td>
</tr>
<tr>
<td>13.</td>
<td>Halogeton glomeratus (M. Bieb.) C.A. Mey.</td>
<td>Halogeton</td>
</tr>
<tr>
<td>14.</td>
<td>Lepidium appelianum Al-Shehbaz (=Cardaria pubescens (C.A. Mey.) Jarm.)</td>
<td>Globe-pod hoary cress</td>
</tr>
<tr>
<td>15.</td>
<td>Lepidium draba L. subsp. chalepense (L.) Thell. (=Cardaria chalepensis (L.) Hand.-Mazz.)</td>
<td>Lens-pod hoary cress</td>
</tr>
<tr>
<td>16.</td>
<td>Lepidium draba L. subsp. draba (=Cardaria draba (L.) Desv.)</td>
<td>Heart-pod hoary cress</td>
</tr>
<tr>
<td>17.</td>
<td>Nassella trichotoma (Nees) Hack. ex Arechav.</td>
<td>Serrated tussock</td>
</tr>
<tr>
<td>18.</td>
<td>Odontites vernus (Bellardi) Dumort. subsp. serotinus (Dumort.) Corb. (=Odontites serotina Dumort.)</td>
<td>Red bartsia</td>
</tr>
<tr>
<td>19.</td>
<td>[Repealed, SOR/2009-161, s. 1]</td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>Solanum carolinense L.</td>
<td>Horse nettle</td>
</tr>
<tr>
<td></td>
<td>(Ball nettle)</td>
<td></td>
</tr>
</tbody>
</table>
When is a contaminant classified as “Other Crop”

- It must be found on the grade tables in the Seeds Regulations.
- It may or may not be native to Canada.
- It may or may not be considered invasive.
- All other species are considered weeds!
3.3.7 Analysis of kinds not listed in the Seeds Regulations

a. Grade Standards. The Seeds Regulations (Section 6(2)) require that seed of kinds not listed in Schedule I shall meet the minimum purity standards* of the following Grade Tables:

<table>
<thead>
<tr>
<th>Kind or species</th>
<th>Number of seeds per gram</th>
<th>Grade Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field crops, other than grasses</td>
<td>15 or fewer</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>16 to 50</td>
<td>II</td>
</tr>
<tr>
<td></td>
<td>51 to 250</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td>251 to 600</td>
<td>VIII</td>
</tr>
<tr>
<td></td>
<td>601 or more</td>
<td>IX</td>
</tr>
<tr>
<td>Any grass (Poaceae)</td>
<td>1500 or fewer</td>
<td>XI</td>
</tr>
<tr>
<td></td>
<td>1501 or more</td>
<td>XII</td>
</tr>
<tr>
<td>Any seed or mixture for land recl:</td>
<td>all</td>
<td>XIII</td>
</tr>
<tr>
<td>purposes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herbs and vegetables</td>
<td>999 or fewer</td>
<td>XX</td>
</tr>
<tr>
<td></td>
<td>1000 or more</td>
<td>XII</td>
</tr>
<tr>
<td>Wildflower mixtures</td>
<td>all</td>
<td>XV</td>
</tr>
</tbody>
</table>

* It is not required for kinds not listed in Schedule I to meet standards for percent pure seed or percent pure living seed.

b. Analysis. For the determination of number of other species by count, use the quantity given in Part c, column 2, below, to conduct a full analysis (see Section 3.6.1). Retrieve and report impurities as required by the appropriate Grade Table as determined in Part a, above. If it is required to determine percentage by weight for any factor, use the percentage test quantity given in column 3 and follow the procedure of Section 3.5.

c. Working sample size. For kinds not listed in Schedule I of the Seeds Regulations, working sample size shall be determined according to seed size as indicated in the table below.

<table>
<thead>
<tr>
<th>No. of seeds per gram</th>
<th>Count of other species Working Sample Size</th>
<th>Percentage Test Working Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,000 grams</td>
<td>100 grams</td>
</tr>
<tr>
<td>2</td>
<td>25,000 seeds</td>
<td>2,500 seeds</td>
</tr>
<tr>
<td>3</td>
<td>5,000 or more</td>
<td>0.5 grams</td>
</tr>
</tbody>
</table>
### TABLE XIII

Applicable to: Mixtures of forage seeds composed of seeds of two or more kinds listed in Tables VIII to XII, except mixtures of seeds designated by the seller as lawn or turf mixtures or ground cover mixtures.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grade Name</strong></td>
<td><strong>Primary</strong></td>
<td><strong>Primary Plus Secondary</strong></td>
<td><strong>Total Weeds</strong></td>
<td><strong>Sweet Clover</strong></td>
<td><strong>Other Crops</strong></td>
<td><strong>Brassica Crops Including S. alba</strong></td>
<td><strong>Maximum Percentage of Ergot Bodies</strong></td>
<td><strong>Minimum Percentage of Germination</strong></td>
<td><strong>Reed Canarygrass</strong></td>
<td><strong>Kentucky Bluegrass &amp; Canada Bluegrass</strong></td>
</tr>
<tr>
<td>1. Canada Certified No. 1 Forage Mixture</td>
<td>0</td>
<td>10</td>
<td>100</td>
<td>25</td>
<td>2% by weight</td>
<td>4</td>
<td>1</td>
<td>55</td>
<td>70</td>
<td>75</td>
</tr>
<tr>
<td>2. Canada Certified No. 2 Forage Mixture</td>
<td>0</td>
<td>20</td>
<td>200</td>
<td>50</td>
<td>3% by weight</td>
<td>6</td>
<td>2</td>
<td>50</td>
<td>60</td>
<td>65</td>
</tr>
<tr>
<td>3. Common No. 1 Forage Mixture</td>
<td>0</td>
<td>10</td>
<td>100</td>
<td>50</td>
<td>3% by weight</td>
<td>8</td>
<td>1</td>
<td>55</td>
<td>70</td>
<td>75</td>
</tr>
<tr>
<td>4. Common No. 2 Forage Mixture</td>
<td>5</td>
<td>20</td>
<td>200</td>
<td>100</td>
<td>5% by weight</td>
<td>10</td>
<td>2</td>
<td>50</td>
<td>60</td>
<td>65</td>
</tr>
</tbody>
</table>

i. For any seed or mixture of seeds for land reclamation, soil conservation, green cover, wildlife grazing or habitat, wetland restoration and similar purposes where the kinds or species are not set out in Schedule I, seed shall meet the minimum weed seed and other crop seed standards set out in Table XIII. (6(2)(h))

ii. A Canada Certified No. 1 Forage Mixture or a Canada Certified No. 2 Forage Mixture may contain more than one variety of a kind or species. (7(1)(f))

iii. Despite the kinds and species of seeds set out in Table XIII to Schedule I, column 5 of that Table does not apply to mixtures that contain 1% or more of sweet clover seed. (7(8))

iv. Notwithstanding Table XIII to Schedule I, Common No. 1 Forage Mixture may contain one primary noxious weed per 25 g where there is present, singly or combined, 10% or more of common timothy, dwarf timothy, Canada bluegrass, Kentucky bluegrass or redtop seed. (7(9))

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*Canadian Food Inspection Agency – November 14, 2007*
% Pure Living Seed

- Pure Seed % multiplied by the Germination

- Example:
  Pure seed 95.1% x 90.0% Germination
  = 86% Pure Live Seed (whole number)
The Seed Testing Report

- Lab must be accredited for your crop kind
- CFIA Accreditation Number
- Signed by an Accredited Seed analyst member of the Commercial Seed Analysts Association of Canada
- Must contain lab number, crop kind, lot identifier, Date tests completed etc.
## Analyzed According to Canadian Methods & Procedures for Testing Seed

### Barley 

<table>
<thead>
<tr>
<th>Total Grams Analyzed</th>
<th>Per 25g</th>
<th>Date Received</th>
<th>Purity Date</th>
<th>Per 25g</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td></td>
<td>Dec 26, 2013</td>
<td>Jan 25, 2014</td>
<td></td>
</tr>
</tbody>
</table>

### Prohibited Noxious: 0 |

### Other Crop Seeds:  
- (Elymus trachycaulus) Brome/Wheatgrass
- (Agropyron cristatum/Desertorum) Cutleaf/Rye/Wheatgrass

### Primary Noxious: 1
- (Panicum virgatum) Redtop

### Secondary Noxious: 2
- (Cynodon dactylon) Bermuda Grass
- (Bromus inermis) Smooth Brome

### Total Primary 1

### Total Other Crop Seeds <1%

### Total Primary & Secondary Noxious 5

### Other Weed Seeds:  
- (Hordeum jubatum) Wild Barley 6
- (Avena sp.) Oat 4
- (Achillea millefolium) Yarrow 1

### Percentage Test: 2.0539g

- Pure seed % 86.4
- Other crop % 0.5
- Weed Seed % 0.7
- Inert matter % 12.4
- Ergot (included in Inert) % 0.2
- Germination: 57
- Dormant Seed % 19
- Germ + Dorman % 68
- Pure living % 72

### Total Noxious & Other Weed Seeds 15

### Advisory Tests & Remarks:

- Tetrazolium 200 seeds tested Dec 27, 2013
- % Viable: 72%

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**SENIOR MEMBER OF**

Morgan Webb
New Prohibited: Serrated Tussock

- Problem weed from South America
- Due to its size it will likely be more of a contaminant of forage grasses.
- Trade issue to the United States.
New Prohibited: Jointed Goatgrass

- Rarely been found in Canadian samples
- May enter in winter wheat from the western United States.
New Prohibited: Wooly Cupgrass

- Eriochloa villosa
- Common in the mid-western United States
- Rarely found in Canada
New Primary – Giant Foxtail

- Spreading in southern Ontario and Quebec
- Can be confused with Green Foxtail
Reclassified– Johnson Grass

- Reclassified from Primary to Prohibited Noxious.
- Established in southern Ontario.
Reclassified - Field Bindweed

- Reclassified from primary noxious to prohibited.
- Considered to widespread to remain on the prohibited list.
Reclassified – Tansy ragwort

- *Senecio jacobea*
- Reclassified to Primary from Prohibited noxious
- Rarely seen
Reclassified – Purple Loosestrife

- *Lythrum salicaria*
- Widespread mostly as an ornamental.
- Loves moist places
Added to Secondary Noxious: Sterile Oat and Stickseed Removed

- No picture of Avena sterilis
- Stickseed

Boraginaceae

Lappula squarrosa
AOSA – United States: Reports of Analysis

- Purity is the Term for the percentage test. Pure Seed, Other Crop, Weed Seeds Inert only. 2 decimal places
- Weeds and Crops Classified according to the Uniform classification AOSA
- All Contaminants listed in 2500 seeds
- 25000 Search is for noxious weeds only.
- 400 Seed Germination
Never Judge a Book By It’s Cover

Start with the best –
TEST YOUR SEED!
Seed Health

- Fusarium
- Common root rot
- Ascochyta
- Anthracnose
- Sclerotinia
- Botrytis
- Blackleg
- Smut
- Septoria
- Alternaria
Fusarium

- There are Many Species of Fusarium
- Fusarium graminearum is a banned pest in Alberta.
- Tolerance
- DNA and Plate (Incubation) Tests
Fusarium Species

Three Species Cause Head blight in Canada
F. graminearum, F. culmorum, and F. avenaceum

Two can produce DON (vomitoxin)
F. graminearum  F. culmorum
Ustilago nuda – True Loose Smut

- The only plant disease referred to in the Canada Seeds Act.
- Must have a test or seed must be sold treated.
- Applies to all generations of seed.
Vigour Tests

- Measures the ability of the seed lot to develop under diverse conditions.

Tests Include:
- Cool Stress
- Accelerated Ageing
- Conductivity
- Tetrazolium
- Emergence Test
Hiltner – The Emergence Test!

Used on cereals which may be damaged by:

- Sprouting
- Seed treatment
- Threshing damage
- Frost
- Fusarium or other fungi
Vigour Vs. Germination

- Vigour declines before Germination so it is a good indicator the germination is failing.
- Accredited “Official” Germination is the best comparison of lots and will stand up in a law court.
- Vigour is more real world conditions though more likely to vary than the germination test.
Other Seed Lab Services

- Grader Training
- 1000 Seed weight
- Tetrazolium chloride
Never Judge a Book By It’s Cover

Start with the best –
TEST YOUR SEED!