Seedlot Production

- Cone Collection
- Cone Processing
- Seed Processing
- Testing
- Registration
- Storage
- Pretreatment
- Sowing
- Cone + seed evaluations
- Cone + seed processing
- Seed Storage*
- Seed Testing*
- Registration*
- Pretreatment & distribution*
Quality Assurance (QA)

- “the evaluation, monitoring and management of information and practices related to activities in the Seed Handling System”

QA Foundations

- Avoid Physical contamination (debris)
- Avoid seedlot contamination (adaptation)
- Information Management (Organization)
- Handling a perishable product (Care)

germination, moisture content, fungal assays, cutting tests, observations, pellet assessment
Pre-collection Evaluations

- Monitoring of the condition of cones and seeds prior to harvest is important
  - determine crop size (plan for resources)
  - determine (possibly act on) Pest problems
  - determine maturity level

- Seed quality (GC and storability) is maximal at time of natural dispersal

- Dehydration of cones and seeds accompanies maturation

- Moisture content is related to damage potential (m.c. ↑ then risk ↑)
Cone Receipt & Storage

- Unload, rack (except Plili) and store cones
- Randomly sample and evaluate cones and seed
  - potential yield
  - pest or other problems
  - aid processing prioritization
- Goal is to slowly dry the cones (after-ripening)
- turn sacks (uniformity)
- Protect from sun, rain, animals
- Allow for good air-flow (1 sack depth*)
Cutting Tests

- Seed anatomy tests
- Vital to assessing seed maturity
- Embryo length in relation to corrosion cavity (> 90%)
- Megagametophyte ‘texture’ (coconut analogy)
- Categorize to needs
  - Viable
  - Damaged and discoloured
Cone Processing

- An initial screening separates released seed + debris from cones (avoid kilning free seed)
- Kilning overnight
  - Pli 60° C
  - Most 40° C
  - Cw, Hw, Abies spp. not kilned
- Tumble to remove seed (monitoring)

Remove Released Seed

Kilning (cone opening)

Tumbling (seed removal)
Seed Processing

- Remove abrasive, moisture and fungi containing material 
  ASAP (Purity)
- Anatomy differences determine method of dewinging (next slide)
- Possibly secondary cleaning
- Ensure viable seed not lost with debris
- Final cleaning to remove empty or dead seeds (Viability)
Wet vs. Dry
Final Cleaning and Blending

- clean to a minimum of 97% purity
- dry to a moisture content between 4-9.9%

Blending of TSC and other processors products before sampling and storage
Cone and Seed Processing

Before processing

After scalping

After dewinging

After final cleaning
What does a seed need to germinate?

- **Moisture**
- **Overcome Dormancy** (None in Cw)
- **Temperature Sums**

Properly stratified conifer seed does not have a light requirement.

Some broadleaf trees/shrubs have more specific requirements - light, alternating temperature and/or moisture, gases, nutrients, smoke.

Conifers are relatively simple to germinate (except Yc, Pw, Ba, Bn, Bl) >2% sowing.

Efficiency is the issue – large energy input!
Moisture testing and inventory management

- **Storage** (-18°C) at 4.0-9.9% (minimize metabolism)

- Seed needs a **minimum** of about 20% to overcome dormancy

- Soak durations equal in testing and sowing request preparation

<table>
<thead>
<tr>
<th>Species</th>
<th>Soak (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cw</td>
<td>none</td>
</tr>
<tr>
<td>Sx, Pl, Fd, Lw, Hw ++</td>
<td>24</td>
</tr>
<tr>
<td>Ba, Bg, Bl, BN</td>
<td>48</td>
</tr>
<tr>
<td>Yc</td>
<td>72</td>
</tr>
<tr>
<td>Pw</td>
<td>336 (2 wks)</td>
</tr>
</tbody>
</table>
Stratification Moisture Content
5-year average (2003-2007)

“Dormancy may be perceived as a strategy for optimizing the distribution of germination through space and time in order to maximize survival, but this seldom coincides with the nursery workers objectives”
Seed Dormancy

- failure of an intact viable seed to complete germination under favourable conditions

- **Physiological** or ‘embryo’ dormancy
  - No Dormancy - Cw
  - Low Dormancy - Hw, Sx, SS, Lw, Fd
  - Mid Dormancy - Pli, Hm, Bg, Py
  - Deep Dormancy - Yc, Pw, Ba, BI, BN

- **Physical** seed coat or ‘membrane’ dormancy is associated with Pw and Yc

Lots of Variability within a species
### Stratification Durations

<table>
<thead>
<tr>
<th>Species</th>
<th>Stratify (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cw</td>
<td>0</td>
</tr>
<tr>
<td>Sx, SS, Fd, Lw,</td>
<td>21</td>
</tr>
<tr>
<td>Pli, Py, Bg</td>
<td>28</td>
</tr>
<tr>
<td>Ba, Bl, Bn, Yc</td>
<td>92 - split</td>
</tr>
<tr>
<td>Pw</td>
<td>112+</td>
</tr>
</tbody>
</table>
Stratification increases Vigour

Germination Capacity (%)

Germination Temperature (°C)

- 0 wks
- 3 wks
Temperature

- If adequate moisture is available and dormancy is overcome then temperature is the **rate limiting factor**
- Biological limits exist (30-35° C) that depends on moisture content and species
- Increased germination temperatures result in **faster, more uniform germination** that also reduces the window of opportunity for pests
- Soil or grit temperature more useful
Testing

- **Conduct Standard tests (Seedlots)**
  - **Purity**
  - **Moisture content**
    - Average seed weight 100 seeds
    - Germination (possibly several tests)
    - Total seedlot weight
    - X-ray, possibly fungal assays
  - Identify/schedule seed for retesting GC
    - (18 months –Cw, Yc to 48 months SS)
  - ISTA/ AOSA are primary guides

- **Conduct QA tests (samples– ie SRQ)**
  - SRQ GC + mc, unkilned seed
  - Returned seed, pellet assessment
  - Cutting tests, observations
Random Representative

ISTA/AOSA Guidelines

Primary Samples

Composite Sample

Submitted (Moisture)

Working (5 g)

Submitted (Purity, SDWT100, GC)

Working (Purity)

Pure Seed

Debris

Working (SDWt100, GC)

1. Seed between 4 – 9.9% moisture content before freezer storage (-18 C)
Seeds per Gram

- Calculated variable accounting for seed weight and seedlot purity
- Seeds per Gram = \( \frac{\text{Purity} \, (\%)}{\text{Seed Wt} \, 100} \)
- \( \text{i.e.) } \text{SPG} = 98\% / 0.21 \text{ 100-seed weight} = 467 \text{ seeds per gram} \)
- SPG is influenced by seed size, moisture content and purity
- part of Sowing Guideline calculations
- Orchard produced seed on average 15% larger
- \( \text{Pli} - 34\%; \text{Sx} - 18\% / \text{Cw} + \text{Yc} - \text{little difference} \)
<table>
<thead>
<tr>
<th>Species</th>
<th>Germination Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>BN</td>
<td>81 to 89% 1.25</td>
</tr>
<tr>
<td>HW</td>
<td>78 to 92% 2.25</td>
</tr>
<tr>
<td>CW</td>
<td>1.25 to 1.75</td>
</tr>
<tr>
<td>PW</td>
<td>1.75 to 2.25</td>
</tr>
<tr>
<td>SX</td>
<td>2.25 to 2.75</td>
</tr>
<tr>
<td>LW</td>
<td>2.75 to 3.25</td>
</tr>
<tr>
<td>HM</td>
<td>3.25 to 3.75</td>
</tr>
<tr>
<td>SXS</td>
<td>3.75 to 4.25</td>
</tr>
<tr>
<td>FDI</td>
<td>4.25 to 4.75</td>
</tr>
<tr>
<td>FDC</td>
<td>4.75 to 5.25</td>
</tr>
<tr>
<td>PLC</td>
<td>5.25 to 5.75</td>
</tr>
<tr>
<td>SS</td>
<td>5.75 to 6.25</td>
</tr>
<tr>
<td>PLI</td>
<td>6.25 to 6.75</td>
</tr>
</tbody>
</table>

GC =85%, 95% CL
se=1.2 → 81 to 89%
se=2.2 → 78 to 92%
Resin Vesicles

Present in Hw, Hm, Cw and all *Abies* spp.

Function not known ??
- protection against excessive drying
- may inhibit germination (dormancy)

Damage to resin vesicles will reduce germination
Seedlot Registration

1. Receive Request for Registration  
   (paper or electronic)

2. Receive cones and/or seed

3. Blend Seedlot

4. Test Seedlot
   - Confirm Moisture Content & Purity Results are within range
   - Confirm Germination & Potential Seedlings

5. Confirm Seedlot Weight

6. Confirm GW and Ne

7. Acknowledge Registration Complete

Complete
Seed Storage

- Moisture < 9.9%
- minimal metabolic activity (-18°C)
- seedlot deterioration estimated as
  - $\Delta GC / \Delta time$
- retest species deteriorating faster more often
- Gene Conservation
Seed Preparation & Shipping

Activities

- Scheduling
- Manage changes
- Withdraw seed
- Prepare seed
  - soak and stratify
  - pellet
  - send dry
- Monitor (esp. Yc, Ba, Bl, Pw)
- Label and ship seed
Seed Soaking
Stratification, Monitoring & Shipping

- Seed is surface-dried prior to chilling
- Stratification in plastic bags
  - Top of bag open
  - 2 to 4 mil bags allow for oxygen exchange
- Monitoring
  - fungi /pre-germination
  - Equilibrating moisture (close opening – shake)
- Communication with nurseries
- Arrange efficient shipping to nursery
Sowing request QA schematic

2007 SRQ Quality Assurance

Pelleting (40)
- Cw Pellet Assessment (30)
- DR Pellet Assessment (10)
- Cw germination testing (30) 4X100
- DR germination testing (10) 4X100

White Pine
- Target MC to 37%
- Monitoring Weekly "Agitation"
- QA Moisture Content LAB- first bag Check QA box
- Pw Germination Testing 4X100

Abies G64
- only full strat SRQ's
- Monitoring Weekly
- QA Moisture Content LAB- check QA box
- G64 Germination Testing 4X100

Yellow cedar
- Warm strat Target 44% mc
- Monitor, reweigh, add moisture M.W. F during warm strat spreadsheet
- QA Moisture Content LAB- check QA box
- G52 Germination Testing 4X100

Other Species
- Surface Dry Calibration
- QA Moisture Content LAB- check QA box
- Germination Testing 4X50, except Abies sp 4X100

2007 Objectives
1) 40 Pellet assessments
2) 240 germination tests
3) 200 manual mc tests LAB
4) 250 calibration mc tests SP

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Quality Assurance Germination Results

- Thank you to nurseries for supplying GC information
- Bl, Pw exhibited largest falldowns
- Yc testing improvements required
Tree Seed Centre

“Our Mission”
Excellence in Cone and Seed Services

Overview
Facilities
The Tree Seed Centre facility includes: offices, core
preparation weighing, cone and seed processing and
distribution areas, dedicated seed laboratory, coolers, and
long-term storage vaults.

Seedlot registration & certification
All seed destined for commercial distribution must be
registered. Requirements for natural stand, seed orchard
and non-BC sections are legislated in the Chief Forester’s
Standards for Seed use.

Seed storage
Seed storage involves maintenance of optimum storage
conditions for conifer tree seed. The provinces inventory
includes an operational component used for reforestation
and a contingency for catastrophic losses. Storage is
supported by a dedicated seed bank for gene conservation.
Management of the dynamic inventory (seed sales and returns)
and ensuring the seedlot balances are accurate is also the role
of this area.

Withdrawal requests
Seed is primarily requested for reforestation (soil seed
requests), and we also facilitate distribution of seed for
research and other purposes. Requests are either sent daily
or processed at the facility.

Testing
Testing uses standardized sampling, testing and evaluation
practices to quality seed characteristics. Seedlot results
are available for moisture content, purity, germination, seeds
per gram, and possibly fungal assays. In addition to
standard tests, the testing area also plays a vital role in
Quality Assurance and research.

Cone and seed processing
Involves detailed seedlot evaluation, conditioning of cones,
the extraction of seed from cones (cone processing) and
this removal of debris and non-viable seed (seed
processing).

Cone and seed improvement
Conducts applied and basic research on tree seed
improvement and generates quality assurance programs
and performs education, extension and communication
activities.

Administration
Fee schedule
Supply seed prices
Operational tree requirements
Inventory
Species average table
Client reports
Information management
Quality processing

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Links
International Seed Testing Association
Association of Official Seed Analysts

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http://www.for.gov.bc.ca/hti/treeseedcentre/index.htm