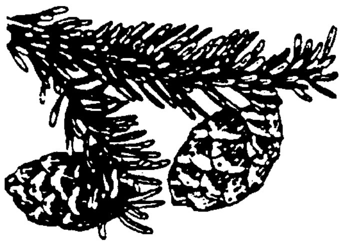
CANADIAN FOREST GENETICS ASSOCIATION
ASSOCIATION CANADIENNE DE GÉNÉTIQUE FORESTIÈRE



Tree Seed Working Group

NEWS BULLETIN

No. 59 July 2014

THIS ISSUE AT A GLANCE

CHAIR'S 'ARMCHAIR' REPORT

Hello. I'm hoping that everyone is having a good summer soaking up some sun or some football (world cup style). It's not looking to be the bumper cone crop we were hoping for in BC, but seed orchards are one year older and production continues to rise. This past sowing year, 62% of all seed used for sowing (262 million seedlings total) was obtained from seed orchards with coastal Douglas-fir, western white pine, and interior spruce all exceeding 94%. Species on the rise are interior Douglas-fir (currently 30%) and lodgepole pine (33%) which is the primary bottleneck species for obtaining the 75% objective set by the BC Forest Genetics Council. Genetic gain level objectives of 20% by 2020 seem to be on target. This year the BC Forest Genetics Council will be updating its five-year Strategic Plan and seed continues to be the focus of its efforts.

Personally, I'm quite excited about the upcoming year with me focusing efforts on improving our kilning regimes through some dedicated trials in a controlled temperature*humidity chamber, improving our extraction efficiency protocols, completing our water activity assessment of genetic conservation samples, and drafting a seed bank management plan. There have been many people contacting me with regard to water activity as I've been 'marketing' the benefits, but in some respects I feel like the blind leading the blind. Our experience thus far is in testing small genetic conservation samples across a wide range of species. I'm excited about the potential in seed drying regulation without heat, without risk of over drying, and as a means to minimize seed-to-seed variation in moisture status and increasing the efficiency of final specific gravity separation. Some are also interested in the use of water activity as a means to predict when seed physiological maturity (coming after anatomical maturity) has been reached and cone and seed processing can be most effectively initiated. I'm convinced this technology is something we can all benefit from and others have been saying that for years. I've included a summary article of online links for those interested in reviewing the technology further. If anyone is interested in further information or participation in an e-mail discussion on the application of water activity to operations, please let me know and I'll start the process.

I wrote an article for this issue of the News Bulletin on our recent BC Seed Orchard Association meeting in Salmon Arm, BC which attracted about 95 people from BC and elsewhere. It was a good meeting and I encourage all that attend similar meetings to contribute a small summary of the meeting or to pose key seed questions that came up. Speaking of meetings, the Canadian Forest Genetics Association (CFGA) has already started planning the next conference in Fredericton from August 17-20, 2015. Further details appear on the CFGA website http://www.cfga-acgf.com/ and in this issue. We are planning on having a Tree Seed Working Group workshop and I would like to encourage all tree seed processing facilities to make an effort to attend. The workshop will be kept open to all subjects, but I'm interested in using this unique opportunity to allow for some face-to-face discussions regarding the challenges we face in cone and seed processing – a conversation that doesn't happen often enough. It's never too early to start planning ☺.

For those making reference to rules for testing tree seed and not having enough shelf space, you will be happy to hear that both the International Seed Testing Association (ISTA) and the Association of Official Seed Analysts (AOSA) have made their rules available electronically. The following link provides details for non-members and the various member affiliations on how to obtain the electronic rules:
http://www.seedtest.org/en/international-rules-_content---1--1083.html#anchor_QHPOMM
The AOSA link to the electronic rules and other publications can be found here:
http://www.aosaseed.com/publications.htm
Many of the primary aspects of the rules have been harmonized between these organizations, but they still have their own identities, especially in their attitudes towards genetically modified organisms.

The lack of information surrounding resin vesicles found in conifer seeds has always amazed me. Last week we were further surprised to see that another genus, *Juniperus*, needs to be added to the list of Canadian genera displaying this trait along with *Abies*, *Thuja*, and *Tsuga*. Anyone else have a genus with resin vesicles? A good illustration can be found in Figure 3 of this publication by Shelagh McCartan and Peter Gosling:
http://www.natureinthedales.org.uk/species/plants/juniper/mccartan-gosling-2013-guidelines-on-collection-juniper.pdf
You can learn something new each day.

Best wishes for the remainder of the summer. I hope to see as many of you as possible in Fredericton next summer (hopefully) and/or at the BCSOA meeting in 2016.

David Kolotelo
TSWG Chair

EDITOR'S NOTES

Welcome to the summer edition of the News Bulletin. There are a number of interesting articles. Evaluating seed moisture via water activity has been gaining traction in the world of tree seed. Dave Kolotelo's article provides access to many useful references on this topic. Fabienne Colas provides details on how moisture content of stratified seed is controlled. Lindsay Robb presents interesting results from an evaluation of longevity of lodgepole pine seed collected from clones of various age classes. Dave returns to discuss the finer points of presenting germination and moisture content results. Barb Boysen announces the publication of Ontario's tree and shrub seed manual which is very practical and be useful to seed collectors.

I hope that everyone continues to enjoy the remainder of the summer season.

Dale Simpson
Editor

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Comments, suggestions, and contributions for the News Bulletin are welcomed by the Chair and Editor.

All issues of the News Bulletin are available at: http://www.for.gov.bc.ca/hti/treeseedcentre/tsc/tswg.htm

WATER ACTIVITY ONLINE RESOURCES

There has been a flurry of activity recently with the use of water activity or equilibrium relative humidity as a tool for the drying and conservation of seed. Here is an overview of some of the available online resources to help better inform you of the concept and benefits of using water activity over moisture content. It's an exciting time for seed science and I hope that these links help those on the sidelines join the party!

Quebec / France

Baldet, P.; Colas, F. 2013. A water activity-regulated dryer: how to dry seeds or pollen with water and no heat. Tree Planters' Notes 56(2):43–49. http://www.rngr.net/publications/tpn/56-2

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Baldet, P.; Colas, F.; Bettez, M. 2008. Water activity in seed and pollen banks: an efficient tool to improve conservation of forest genetic resources. IUFRO – CTIA 2008 Joint Conference - Adaptation, Breeding and Conservation in the Era of Forest Tree Genomics and Environmental Change, 25–28 Aug 2008, Québec, Qc. p. 143. http://www.mern.gouv.qc.ca/activite/iufro-acaa/pdf/Baldet-afiche.pdf

Baldet, P.; Colas, F.; Bettez, M. 2009. Water activity—an efficient tool for seed testing. Canadian Forest Genetics Association, Tree Seed Working Group, News Bulletin 50:15–17. http://www.for.gov.bc.ca/hti/publications/tswg/TSWGNewsbulletin50.pdf

Colas, F.; Bettez, M. 2012. How water activity changed our lives! Canadian Forest Genetics Association, Tree Seed Working Group News Bulletin, 55:4–5. http://www.for.gov.bc.ca/hti/publications/tswg/TSWGNewsbulletin55.pdf

Kew Gardens

Gold, K. 2008. Post-harvest handling of seed collections. Millenium Seed Bank Project, Technical Information Sheet 04, 4 p. http://www.kew.org/sites/default/files/4_ppcont_014345_Post-harvest%20handling%20of%20seed%20collections.pdf

Gold, K.; Manger, K. 2008. Measuring seed moisture status using a hygrometer. Millenium Seed Bank Project, Technical Information Sheet 05 2p. http://www.kew.org/sites/default/files/05%20-%20Measuring%20seed%20moisture%20status%20using%20a%20hygrometer.pdf

Probert, R.J.; Manger, K.R.; Adams, J. 2003. Non-destructive measurement of seed moisture. Pages 367–388 (Chapter 20) *in* R.D. Smith, J.D. Dickie, S.H. Linington, H.W. Pritchard and R.J. Probert, eds. Seed conservation: turning science into practice. Royal Botanic Gardens, Kew, UK. http://www.kew.org/ucm/groups/public/do cuments/document/ppcont_013783.pdf

ISTA

Overview of 2010 ISTA Workshop on "Water Activity measurement Applied to Seed Testing" in Montagris, France, 12–15 Oct 2010. http://www.seedtest.org/en/report-on-ista-workshop-water-activity-measurement-applied-to-seed-testing-_content---1--1330--668.html

2012 ISTA Workshop. Craig McGill. Water Activity Measurements in Seed Testing https://www.seedtest.org/upload/cms/user/ISTA-June11-Seminar-1330-McGill.pdf

USDA

Karrfalt, R.P. 2010. Equilibrium relative humidity as a tool to monitor seed moisture. Pages 43–45 *in* L.E. Riley, J.R. Pinto, R.K. Dumroese, technical coordinators. National Proceedings: Forest and Conservation NurseryAssociations – 2009. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO, RMRS-P-62. http://www.fs.fed.us/rm/pubs/rmrs_p062.html

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A NEW METHOD TO CONTROL DRYING OF STRATIFIED SEED AT THE BERTHIER TREE SEED CENTRE

The Berthier Tree Seed Centre (BTSC) ships stratified seed to nurseries for the production of white spruce (WS, *Picea glauca*), eastern white pine (EWP, *Pinus strobus*), balsam fir (BF, *Abies balsamea*) and yellow birch (YB, *Betula alleghaniensis*) seedlings. Upon request, seeds of other species like red spruce (RS, *P. rubens*) can also be stratified.

Seed are first primed (soaked in running water) for 24 to 48 hours to increase their moisture content (MC). Following priming they are placed into open plastic bags (4 mil thick) for stratification. The duration varies among species: 21 days for WS, RS, BF, and YB and 28 days for EWP. When stratification is complete, MC of the stratified seeds is around 25–28%.

Except for BF, seed are sanitized by soaking for 3 hours in a 3% peroxide (H_2O_2) solution to eliminate seedborne pathogens.

Since stratified seed are sent throughout the province, and the sowing date can change they are then partially dried to facilitate their conservation until sowing. This avoids condensation in the bag and further curtails mold development, but has no impact on germination. The moisture content (MC) target after drying is 15 ± 1%, for all species.

For years, MC was not systematically determined since drying was monitored with a *Dole*® moisture tester. Following ISO certification of BTSC, MC is determined for each stratified seedlot to ensure quality control of this activity. Since the *Dole*® could not be calibrated its use was discontinued and a simple method to control seed drying after stratification was developed; weighing seeds at different steps of the process (Fig. 1).

The first 3 weighings are necessary to determine the MC at the end of stratification. Seed are dried by placing them on racks in the Hilleshög dryer that is now controlled by water activity instead of temperature. Monitoring the drying of the stratified seed requires measuring MC by weighing a representative sample of the stratified seeds from the seedlot because weighing a complete drying rack is impossible. After a series of calculations, we determine the mass that the sample has to reach to meet the 15% MC target. The seedlot is dried and the sample is continually weighed until its mass corresponds to the target mass that was previously determined. We assume that when the sample reaches its target mass the entire seedlot has reached the target MC. Then, the seedlot is packed and shipped to the nursery.

For this year, all the calculations were made using Excel spreadsheets which proved to be suboptimal because two users could not use the sheets simultaneously. The objective is to introduce those calculations in the SEMENCES System to facilitate data entry for 2015.

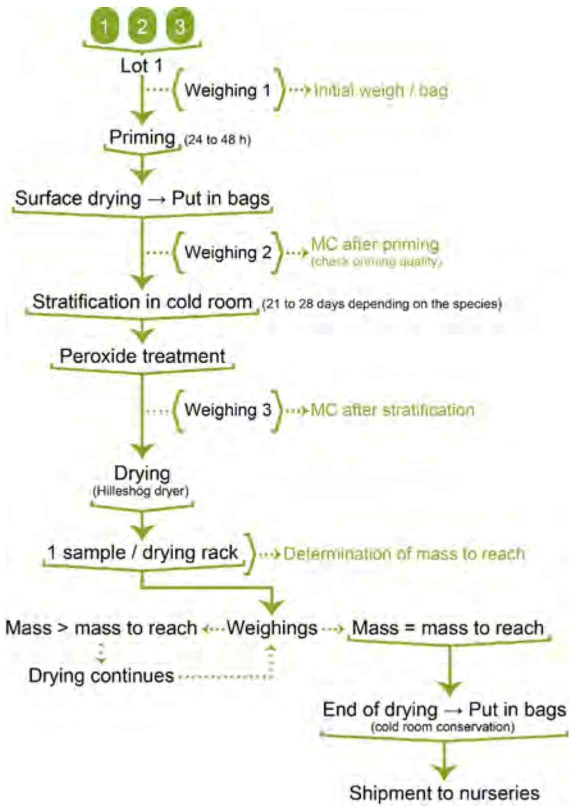

Figure 1. Steps of the complete process of stratification and drying.

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SEED LONGEVITY IN LODGEPOLE PINE (*Pinus contorta*) CONE CLASSES

Introduction

Lodgepole pine (*Pinus contorta* var. *latifolia*) usually produces serotinous cones in Alberta. These cones will open during a fire event, which breaks the resin binding the scales, or the scales will also open eventually over time but the cones are often held unopened on the tree for more than 10 years. The cones are medium brown in colour when 'new' eventually becoming completely grey over time.
Because the cones are held on the tree for years, cone harvests have the ability to provide seed from many different years of production. The Alberta Tree Improvement & Seed Centre (ATISC) usually collects cones from 2 of 4 classifications (Eremko et al. 1989).
Cones collected:

- Class 1: Cones are brown, bronze or gold coloured on all faces and tightly closed. Current year cones.
- Class 2: Cones are partially weathered (up to 66%) but closed. Cones are brown, bronze or gold on one face and grey on other faces.

Cones not collected:

- Class 3: Cones are closed and mostly or entirely grey (weathered) on all faces (67-100%).
- Class 4: Partially opened, open or damaged cones.

In general, ATISC conservation harvests include only cones from class 1 whenever possible, but will include class 2 or occasionally class 3 cones if necessary. Class 1 cones are estimated to be up to 4 years old, class 2 cones 4–7 years old, and class 3 cones are usually over 5 years old but this depends on where they are on the tree, local weather, etc. (J. Quinn, personal communication, 2013). So a cone that is 5 years old may be class 3 on one tree but can be class 2 on another tree.

In the past, tests have been conducted by ATISC comparing the germination of newly collected seed from each of the first 3 classes of cones and results have not shown any significant differences between these classes. However, seeds age and die over time and the speed at which this happens is unpredictable in wild conditions where moisture contents and temperatures are highly variable. Analysis of real-time lodgepole pine seed ageing under seed bank conditions at ATISC has shown lodgepole pine to be the longest lived economically important tree species in Alberta, with a common potential p50 value (time in cold storage to 50% viable - equivalent to LD50 in dose response tests) of 100+ years. This value varies among seedlots depending on initial seed quality and maturity, local climate, and both between and within population differences.

The purpose of this trial was to identify any major differences in seed storage longevity between 'newer' and 'older' lodgepole pine cones. By comparing bulk cone samples from the same population and harvested during the same year, this should negate the variability between different populations and maturity. With such a long average life-span, it is unlikely that any differences would have a practical effect on reforestation seed with a common turnaround of 5–15 years, but may affect operations for long-term *ex situ* conservation (50+ years).

Methods

The population used in this trial was from Sibbald Meadows (51.04946 °N, -114.9006 °W), harvested in January 2013. Approximately 30 cones were chosen for each of cone classes 1, 2, and 3. Cones in class 2 were estimated at 1/2 to 2/3 weathered/grey (Fig. 1), as these should be easily distinguished by cone pickers in the field. Seeds were extracted from cones in the usual manner – a brief dip in 80°C water until the resin seal breaks and then kilned at 60°C for 8 hours. Cones were then tumbled and the seeds cleaned.

Figure 1. Three cone classes used in the trial. (from left to right) Class 1 – closed and 100% brown. Class 2 – closed and 50–66% grey. Class 3 – 100% grey.

An initial, fresh germination test was conducted for each cone class using 200 seeds (4 reps) for class 1, 100 seeds (4 reps) for class 2 and 50 seeds (2 reps) for class 3. The differences in seed numbers were due to a large variation in the number of extracted seeds from the approximately 30 cones for each class.

All germination tests were set up in Petawawa Germination Boxes on moist Kimpak® according to ATISC standard germination testing protocols and placed in 2°C for 21 days of cold stratification. No soaking, rinsing or sterilisation was employed. Stratified seeds were germinated at 25°C. Seeds were considered 'germinated' when the radicle was at least 2 times the length of the seed. Germinated seeds were counted and removed every seven days.

The tests were ended after 21 days and the remaining seeds were cut tested to determine the number of empty seeds. To enable appropriate analysis and comparison, empty seeds were removed from any statistical calculations.

Artificial ageing tests were conducted following a standard protocol for wild seeds (Newton et al. 2009) by rehydrating seeds for 2 weeks at 47% RH, 20°C and then ageing at 60% RH, 45°C (Probert et al. 2009, Mondoni et al. 2011). A sample of 50 seeds was taken for each cone class at intervals of 1, 2, 5, 9, 20, 30, 50, 75, 100, and 125 days under ageing conditions. Standard single replicate germination tests were conducted on each sample. In this way, 11 data points were obtained for each cone class over time, enabling the statistical analysis of any decline in viability using probit analyses based on seed viability equations (Ellis and Roberts 1980).

In addition, fresh germination totals were also compared between the 3 cone classes by using Chi-square statistical tests. All statistical analyses were performed using Genstat 12.0.

Results

There was little statistical difference in initial seed germination between the three cone classes and all classes showed high, acceptable levels of germination ranging from 88–98% (Fig. 2).

For all three cone classes, seed viability significantly declined with increasing duration of the ageing treatment (Fig. 3). However, there was a wide variation between the classes in the calculated p50 value, i.e., the time taken for viability to fall to 50% germination (Table 1).

Table 1. The p50 value (time to 50% germination) for each cone class under artificial ageing conditions

Cone class	p50 Value (days)
1	92.53
2	53.45
3	40.17

Conclusions

Results showed that although the initial germination differed only slightly between seeds from the 3 cone classes, their potential longevity in storage was significantly affected by cone age. Cone classes 2 and 3 resulted in seed longevities of approximately half that obtained from class 1 cones.

This may not be such as issue if it is known that the seeds will be used quickly, e.g., a 10-year turnaround is not uncommon for the majority of operational reforestation seed. However, the

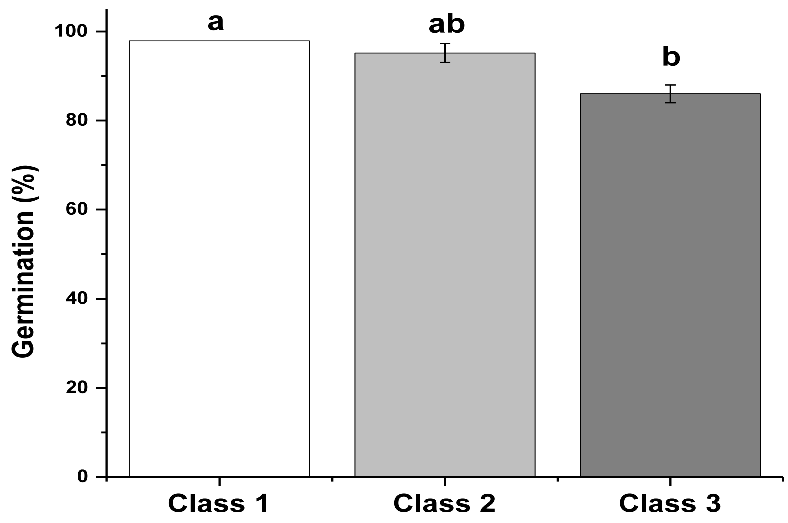

Figure 2. Initial germination (± S.E.) of seeds from cone classes 1, 2, and 3. Different letter designations indicate significant differences at $p<0.05$.

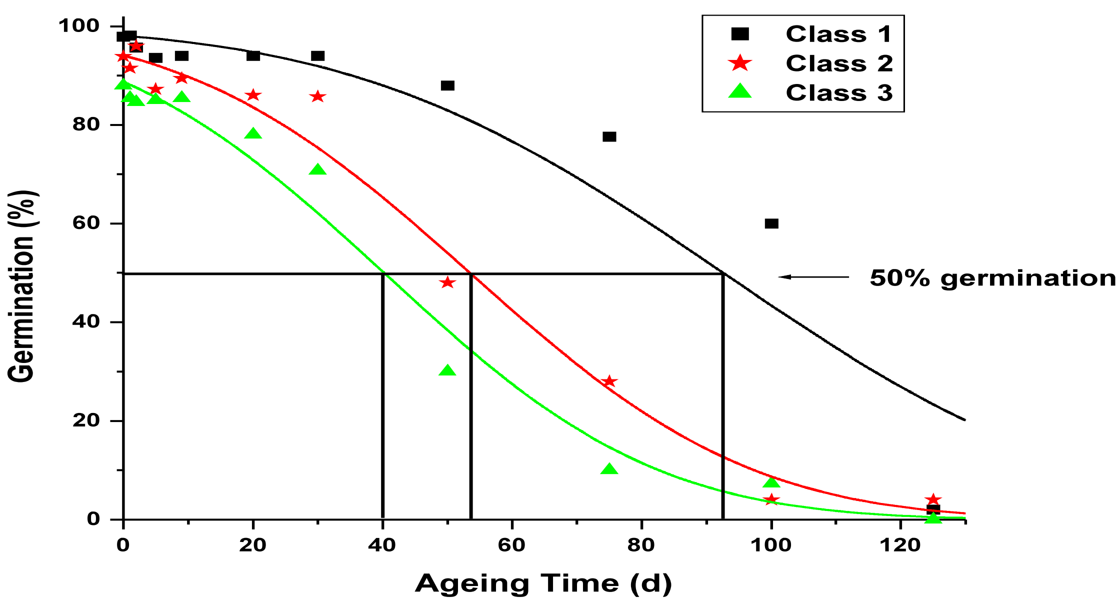

Figure 3. Survival curves fitted by probit analyses for each of the three cone classes tested.

analysis of lodgepole pine seed longevity over time in storage at ATISC demonstrated that although 52% of seedlots tested had p50 values of >100 years, 28% of seedlots that initially tested over 90% for germination had p50 values ranging from 46–85 years in storage. Long-term *ex situ* seed storage goals are generally accepted as 50+ years and so 46–85 years may seem to be a sufficient storage time. However, it is important to note that these seed lots are already over 35 years old and many similarly older seedlots are still in use. Old data records are lacking details but if we assume that these shorter lived seedlots were only harvested from 'new' class 1 cones, then the possibility exists of halving this already short lifespan to 23–43 years if we then collect class 2 and class 3 cones from the same population instead. As the ultimate use of research and conservation seed collections is often unclear, these are important factors to consider when collecting seed.

There are arguments that seed storage for research and long-term conservation (and arguably reforestation seed as well) should be of as high quality as possible in order to ensure that certain genetic traits are not lost as a seedlot dies. In this experiment, probit analyses were conducted using 50% seed death values; however, values of 15% death (p85) are often used by many seed banks to monitor and make decisions on seed recollection and regeneration. Currently ATISC has no such 'flag' limit in place to initiate these decisions. Genetically-regulated differences in flowering time, dormancy, and maturation date are commonly observed in non-domesticated populations and these are all contributing factors to seed longevity (Walters 1998). It is especially important that *ex situ* storage conditions do not impose "domesticated" genetic changes by simply over-sowing when seedlots decline in viability without giving thought to the possible consequences.

ATISC lodgepole pine collections will continue to avoid classes 2 and 3 whenever feasible; however, the nature of collecting from felled trees in logged populations or the expense of helicopter collections means that this will not always be possible. Therefore, future samples taken for long-term *ex situ* conservation will now only include class 1 cones.

References

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Newton R.; Hay F.R.; Probert R.J. 2009. Protocol for comparative seed longevity testing. Technical Information Sheet_01. Royal Botanic Gardens Kew, Kew. http://www.kew.org/sites/default/files/1_ppcont_014163_Protocol%20for%20comparative%20seed%20longevity%20testing_0.pdf

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Walters, C. 2003. Optimising seed banking procedures. Pages 723–743 *in* R.D. Smith, J.B. Dickie, S.H. Linington, H.W. Pritchard and R.J. Probert, eds, Seed conservation: turning science into practice. Royal Botanic Gardens, Kew. 1023 p.

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PUBLICATION PERILS

I wanted to touch on two specific variables found in the tree seed literature that are not always derived or presented in a consistent manner: germination and cone moisture content. Germination capacity, usually presented as a percentage of seeds which germinate normally, is used as an indicator of seedlot quality and aids in practical decisions such as how much seed is needed to produce a certain number of seedlings. This operational germination is not solely a population characteristic as it can be influenced by collection timing, cone handling practices, cone and seed processing efficiency, and the pretreatment applied to the seed. It represents the actual proportion of seeds which will germinate and be able to produce a seedling.

This actual germination capacity may not be a good variable to use when trying to explain geographic variation in either germination or degree of dormancy due to the above mentioned influences. The most significant factor is the proportion of viable seeds in your sample and many studies looking at geographic variation or a treatment response have corrected the germination % for the proportion of viable seeds in the sample. For example, a seedlot achieves 85% germination, but it was determined that only 90% of the seeds are viable. So the actual germination is 85%, but the viable seed germination is 85/90 or 94%. This represents the germination of the seedlot if cone and seed processing had removed all of the non-viable seeds. It more readily allows for comparisons between seedlots by removing variability that is due to processing inefficiency.

The two most common methods to account for viable seed proportions are: 1) to x-ray all seeds before testing and eliminate all non-viable seeds or 2) to dissect all ungerminated seeds at test completion and categorize them into viable and non-viable seeds. The latter method will result in a decrease in the actual sample size for germination capacity estimation and it is possible that some seeds may have deteriorated during the test causing an overestimate of non-viable seeds, but this method allows for a comparison between actual and viable seed germination results. Germination results may be presented either way in the literature and attention to the format will help reconcile differences and draw appropriate conclusions.

The sample size used is a significant germination test variable and most studies use four replicates of 100 seed that are advocated by the International Seed Testing Association (ISTA) and the Association of Official Seed Analysts (AOSA). In the literature, studies using as little as four replicates of 25 seeds can be seen and the focus is generally on the final germination result, not its derivation. The precision and accuracy of germination results will increase with increased sample sizes. Other variations include whether abnormal germinants are excluded or included in the germination capacity, the germination environment temperature regime, duration of the germination test, and whether seed was imbibed before placement in germination dishes or whether water was taken up from the media to 're-charge' the seed. This last factor will mainly impact the rate of germination rather than germination capacity.

Cone moisture content is an interesting variable as you see cone moisture content presented on a fresh-weight [**fw**] and a dry-weight [**dw**] basis. For those who are looking at cone development which starts at high hydration levels with an unlignified product, moisture content has generally been performed on a fresh weight basis. For those primarily dealing with mature, 'woody' coniferous cones, presentation of moisture content has generally been on a dry-weight basis similar to that used in the wood sciences. The two results present different perspectives on the moisture status of cones with the fresh weight basis indicating the proportion of total weight accounted for by water and by definition cannot exceed 100%. Moisture content presented on a dry-weight basis provides an assessment of the amount of water relative to the amount of solids and can exceed 100%. As a comparison a structure that has twice the mass of water as solids would have a moisture content based on fresh weight of 67% and a moisture content based on dry weight of 200%. The pertinent question for the fresh weight determination is what proportion of the total mass is water and for dry weight determination it is what is the mass of water in proportion to the mass of solids.

The good news is that the same data are used for determining moisture content based on a fresh-weight [**fw**] or dry-weight [**dw**] basis and converting between them is relatively simple. This may be useful if you want to compare your current results to past published results of a different format. To assist with this I'm including the equations that convert between the two forms of moisture content (**MC**) determination and that do not require the actual fresh or oven-dry weights. The moisture content results should be entered in decimal (not percentage) format to simplify the conversion process. Equation 1 calculates moisture content based on dry-weight using the fresh weight results and Equation 2 calculates moisture content based on fresh weight from dry weight moisture content results.

Equation 1. **MC[dw] = (MC[fw]) / (100-MC[fw])**
Equation 2. **MC[fw] = (MC[dw] / (100+MC[dw])**

Attention to the details of a germination or moisture content test will ensure that the comparisons made or conclusions drawn are based on a proper interpretation of the results.

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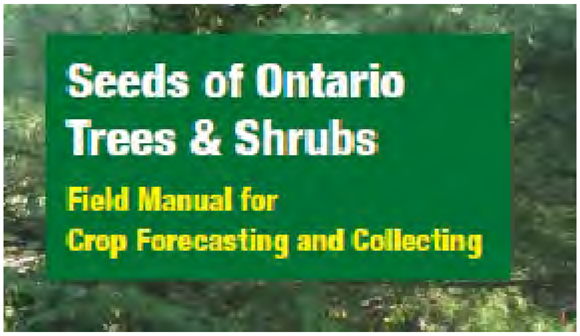
SEEDS OF ONTARIO TREES AND SHRUBS FIELD MANUAL

The Forest Gene Conservation Association (FGCA) is excited to announce the publication of the new ***Seeds of Ontario Trees & Shrubs** – Field Manual for Crop Forecasting and Collecting*.



Work on the Ontario's Natural Selections seed source certification program started in 2000 with the Certified Seed Collector Workshop which relied on the 1996 *A Seed Manual for Ontario*. Almost 20 years later this new, full colour, 276 page manual is the result of increasing interest in the restoration of our many native woody plants from trees to shrubs to vines. It was a collaborative effort by the FGCA, the Ontario Tree Seed Plant, Trees Ontario, and many experienced collectors across Ontario.

We are promoting it among the reforestation sector but also to landowners. In southern Ontario they are the stewards of most of our forests. They can help by providing access to their woodlots or by monitoring and reporting flower and seed crops to help us track how the increasingly aberrant weather systems are affecting our forests.

Last year was a great seed year for many species, possibly due to the drought the year before. But experienced collectors know that such years don't often happen back to back. This year we will be watching closely to notice if and where good seed crops are developing, so we can help supply high quality, locally-adapted seed to the nurseries that grow for native reforestation programs such as the 50 Million Tree Program.

This new manual will be used as the main reference in our continuing Certified Seed Collector Workshops led by Trees Ontario, the FGCA, and the Ontario Tree Seed Plant. We also plan to have it online in 2015 where we can make updates and additions.

To purchase a copy of *Seeds of Ontario Trees & Shrubs*, contact the Ontario Tree Seed Plant (877-861-8881) or the FGCA (fgcaontario@gmail.com). Copies can be purchased at **$55.00** each (including shipping and handling).

Bulk purchase pricing for 15 or more is available, as well as special pricing for Certified Seed Collectors. See example below of two pages.

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www.fgca.net

BC SEED ORCHARD ASSOCIATION MEETING

The British Columbia Seed Orchard Association (BCSOA) hosted its biennial meeting in Salmon Arm on June 17–18, 2014. It was a successful meeting with a total of 95 people attending from BC, Alberta, United States, and three individuals from Norway. About a quarter of the participants were associated with the NorthWest Seed Orchard Managers Association and joint meetings have become more common between our aligned groups. The organizing committee consisted of Tia Wagner [chair] (Vernon Seed Orchard Company); Mike Brown (PRT Growing Services); and Gary Giampa, Hilary Graham, and Penny May with the Seed Production section of our provincial Tree Improvement Branch.

The first day started with a tour of Skimikin Nursery (private nursery facility) highlighting their growing facilities and the species-specific challenges of growing seed orchard seed. Grafting techniques were also demonstrated as Skimikin nursery also produces grafts for some of the orchards. The usual debate of potted grafts vs. field grafts occurred with no clear winner declared. I was also fortunate to see a good crop of whitebark pine seedlings that are being grown for a research trial looking at geographic variability and blister rust resistance. Our lunch break took place at a local winery (Recline Ridge) which is one of the most northern wineries in North America at just under 51° Latitude. Interesting talks were presented on grape varieties grown, cultivation techniques employed, and the inspiration for their Northern wines.

The Skimikin Seed Orchard complex (provincial seed orchard facility), which maintains many genetic tests for a variety of species, was the afternoon tour site. The site occupies 90 ha and includes seven interior spruce (*Picea glauca* x *engelmannii*) orchards, two western white pine (*Pinus monticola*) orchards and three lodgepole pine (*Pinus contorta* var. *latifolia*) orchards. The afternoon started with a review of orchard safety from Carol Reid of the Farm and Ranch Safety and Health Association (FARSHA). Emphasized points were proper employee safety training and considerations when using ladders and lifts. Our afternoon technical speakers were Vicky Berger – western white pine blister rust resistance trials and the large lodgepole pine clone bank congregation being assembled at Skimikin, Jim Corrigan – pest management in conifer seed orchards with an emphasis on pests which have previously not been described as seed orchard pests, and Greg O'Neill – interior spruce provenance variation and assisted migration concepts. Stephen Joyce (seed production manager) and Hilary Graham (site supervisor) lead the seed orchard tours of the complex. The evening was filled with a lovely dinner and entertainment supplied by a Vernon band, Cod Gone Wild, specializing in Newfoundland and Celtic music.

The second day of the meeting was dedicated to indoor presentations on a variety of topics. Stephen Joyce provided an overview of "Seed Orchard Seed (A-class) Supply and Demand". The key point for me is how we can become so fixated on a key performance indicator like % of A-class seed that we lose track of our actual seedling gains in a reforestation system that has been expanding since 2009. Mario Lanthier (CropHealth Advising & Research) provided a very educational and entertaining session on "Nutrient Deficiencies in Conifer Plants". This session included an overview of conifer nutritional needs and interpreting results from soil and foliage mineral analyses. The session was quite interactive and real-life conifer nutritional problems were addressed together or in table teams. A highly valuable session for those wanting to make sure they are getting the most out of their nutritional analysis results.

Guy Burdikin (West Fraser Timber Ltd.) provided a silvicultural perspective on the use of A-class seed. Benefits in terms of reduced site brushing, reaching free-to-grow sooner, and reducing liability, especially with road deactivation planning were emphasized. Future challenges will be our wood supply which has been decimated by the Mountain pine beetle (*Dendroctonus ponderosae*) and the associated disturbance of an even age class structure, the diminishing availability of natural stand lodgepole pine crops, and the use of orchard seed for rehabilitation planting as an underplanting. The area of the province being discussed does not have a supporting orchard due to relatively low growth rates and needs, but some superior provenance stands have been identified and assigned a genetic worth of 3. One of the superior stands has been thinned and rows incorporated to allow for vehicle access to maximize collection opportunities. Kat Spencer (Alberta Tree Improvement and Seed Centre) and Jean Paul Bielech (Huallen Seed Orchard contract manager) presented an overview of Alberta tree improvement. Interesting discussions surrounded provincial differences in minimum effective population size for seedlot registration (BC=10, AB=18), the lack of orchard seed sale incentives in AB other than for restoration of oil and gas sites, and the prices paid to cone collectors in AB due to a lack of labour.

Mike Crawford (US Bureau of Land management) discussed frost protection options and reviewed the cost analysis used in purchasing equipment to avoid late spring frosts severely impacting crops. Rocky Oster lead a group discussion on new and emerging technologies in seed orchards including his pollen vacuum developments. Dan Cress (Regentics Forest Genetics Consulting) provided an overview of activities in the Pacific Northwest with an emphasis on seed orchard pests. Anne Berland, a recent graduate student from the University of Victoria presented her work on "Climate Impacts on Seed and Cone Production in Provenance Trials in British Columbia". Lodgepole pine seed orchard seed production continues to be a very significant problem in BC and this research helps in locating future orchard sites that may increase seed production. Last (maybe least) I presented a talk on "Cone Maturation, Collection, Storage and Handling" as a review of information on the topic. Collection timing was an area of emphasis, but I tried to stress the importance of the post-collection handling methods, environment, and duration as keys to maximizing seed quantity and quality. A pdf version of my Powerpoint presentation will be available at this link over the summer (http://www.for.gov.bc.ca/hti/treeseedcentre/tsc/workshops&presentations/index.htm) . There is a provincial initiative to refresh our webpage delaying this migration, so if you would like to see the presentation sooner just send me a quick note to that effect.

The next BCSOA meeting will occur in June 2016 on the coast and will focus on the provincial Tree Seed Centre. Suggestions always appreciated.

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GENEBANK STANDARDS

In late 2013 FAO published *Genebank Standards for Plant Genetics Resources for Food and Agriculture*. The standards were prepared under the guidance of the FAO Commission on Genetic Resources for Food and Agriculture. The Standards are voluntary and cover both seed and vegetatively propagated planting material. The Standards aim for the conservation of plant genetic resources under conditions that meet recognized and appropriate standards based on current and available technological and scientific knowledge. Although the Standards were developed for agriculture seed they are applicable to tree seed as well. The Standards can be downloaded from the following website: http://www.fao.org/agriculture/crops/thematic-sitemap/theme/seeds-pgr/gbs/en/

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TREE SEED WORKING GROUP WORKSHOP 2015

There will be a workshop in conjunction with the Canadian Forest Genetics Association conference which will be held in Fredericton, NB August 17–20, 2015. The workshop will be held in the morning of August 17 with tours of the National Tree Seed Centre and Atlantic Forest Seed Centre tentatively scheduled for the afternoon.

Dale Simpson

UPCOMING MEETINGS

Canadian Forest Genetics Association
Theme: Integrating Tree Breeding, Silviculture, and Growth and Yield
August 17–20, 2015 Fredericton, NB

RECENT PUBLICATIONS

Bezdeckova, L.; Prochazkova, Z.; Matejka, K. 2014. Practical implications of inconsistent germination and viability results in testing stored *Fagus sylvatica* seeds. Dendrobiology 71:35–47.

Colas, F.; Lamhamedi, M.S. 2014. Production of a new generation of seeds through the use of somatic clones in controlled crosses of black spruce (*Picea mariana*). New Forests 45(1):1–20.

Doerken, V.M.; Jagel, A. 2014. Orientation and withdrawal of pollination drops in Cupressaceae s. l. (Coniferales). Flora (Jena) 209(1):34–44.

Fernando, D.D. 2014. The pine reproductive process in temperate and tropical regions. New Forests 45(3):333–352.

Guerrant, E.O., Jr.; Havens, K.; Vitt, P. 2014. Sampling for effective *ex situ* plant conservation. International Journal of Plant Sciences 175(1):11–20.

Hughes, J.S.; Fortin, M.-J.; Nealis, V.; Regniere, J. 2014. Pollen cone production in jack pine: spatial and temporal patterns subject to natural disturbance by the jack pine budworm. Canadian Journal of Forest Research 44(3):195–211.

Javanmard, T.; Zamani, Z.; Afshar, R.K.; Hashemi, M.; Struik, P.C. 2014. Seed washing, exogenous application of gibberellic acid, and cold stratification enhance the germination of sweet cherry (*Prunus avium* L.) seed. Journal of Horticultural Science & Biotechnology 89(1):74–78.

Kellner, K.F.; Riegel, J.K.; Swihart, R.K. 2014. Effects of silvicultural disturbance on acorn infestation and removal. New Forests 45:265‑281.

Klooster, W.S.; Herms, D.A.; Knight, K.S.; Herms, C.P.; McCullough, D.G.; Smith, A.; Gandhi, K.J. K.; Cardina, J. 2014. Ash (*Fraxinus* spp.) mortality, regeneration, and seed bank dynamics in mixed hardwood forests following invasion by emerald ash borer (*Agrilus planipennis*). Biological Invasions 16(4):859–873.

Liu, Y.; Kermode, A.; El-Kassaby, Y.A. 2013. The role of moist-chilling and thermo-priming on the germination characteristics of white spruce (Picea glauca) seed. Seed Science and Technology 41(3):321–335.

Moreira, X.; Abdala-Roberts, L.; Linhart, Y.B.; Mooney, K.A. 2014. Masting promotes individual- and population-level reproduction by increasing pollination efficiency. Ecology 95(4):801–807.

Pukacka, S.; Ratajczak, E. 2014. Factors influencing the storability of *Fagus sylvatica* L. seeds after release from dormancy. Plant Growth Regulation 72(1):17–27.