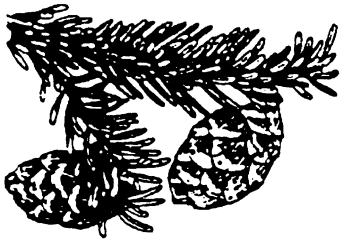
CANADIAN FOREST GENETICS ASSOCIATION
ASSOCIATION CANADIENNE DE GÉNÉTIQUE FORESTIÈRE

Tree Seed Working Group



NEWS BULLETIN

No. 55 June 2012

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CHAIR'S 'ARMCHAIR' REPORT

Hello! Summer hasn't yet reached the west coast, but I am envious of some of the temperatures seen out East. Such is the cost of our west coast maritime winter. Planning continues for the Canadian Forest Genetics Association (CFGA) meeting next year in Whistler (July 22–25). The meeting is a joint meeting of the CFGA, Western Forest Genetics Association (WFGA); IUFRO Population, Ecological and Conservation Genetics and IUFRO Breeding and Genetic Resources of Pacific Northwest Conifers. Additional details can be found here: www.forestgenetics2013.ca/ and a first announcement will be sent to the groups' mailing lists within the next month. A TSWG workshop and tour of our Tree Seed Centre (TSC) is planned for Monday, July 22nd. Summer usually arrives here by the end of July ☺.

Some of you are aware that I have been Acting Manager of the BC Tree Seed Centre since last October while Heather Rooke was on leave. I will be returning to my research and extension duties after Canada Day. I look back on the last 8.5 months with a different perspective of the place where I've worked for the past 20 years and thought I'd share some of my observations and experiences with you.

First, I'd like to thank all my colleagues (aka "coneheads") at the TSC who helped me wade through these uncharted waters and kept us afloat. This included Heather who offered valuable advice on the landscape and in dealing with the various fires that arose. It was particularly interesting to have a different perspective on the intricacies of interpersonal relationships at a facility that I've worked at for so long. I'd often heard how the TSC was first and foremost about the people, but the truth of that statement was only truly appreciated during my time as Acting Manager. A different perspective is valuable and one reason my signature quote was changed to

"*one way to change people is to see them differently*". It was more of a reminder to myself that my perception is a critical part of the process and certainly not based on the idea that everyone needs to change. I'm a closet appreciator of famous quotes and the following is something I often consider "*Mistakes in thinking are more commonly inadequacies in perception rather than errors in logic*". It highlights the need for good and open communication (talking AND listening) and the value of extension which unfortunately is the first thing to meet the sharp blade of the guillotine.

Another dramatic adjustment was the knowledge that whatever I had planned for that day would need to be abandoned within the first thirty minutes of opening my e-mails that morning. Forget any projects that needed a significant amount of dedicated time – it just wasn't going to happen when the fires needed to be put out. It certainly is a luxury I won't take for granted as I return to my former duties.

My perspective also took on a more business-like approach as the TSC functions in both a Stewardship and a cost-recovery world. I was formerly certainly more Stewardship centric, although that included a keen desire for process improvement. It was interesting to see how employees gravitated towards one of these poles with good reasoning. An interesting, but not new example is water use for our drying line and running water soak seed soaking activities. Currently this water is literally going down the drain, but technologies exist and are becoming more readily available to re-use this water and sanitize it as would be necessary with the seed soaking activity. From a Stewardship lens we should go ahead and do the right thing and set a good example. On the other hand our annual water bill is rather small and some of these improvements would take decades to recover costs. Some staff clearly saw these 'improvements' as not being cost-effective and not an area we should pursue. As a government facility do we 'Do the right thing"?, or Do we set a good fiscal management example through tighter controls of the public's money? An interesting discussion that precedes my tenure and continues – current status goes all the way back to Boy Scouts – *Be Prepared*.

Another interesting phenomenon that I'm sure many of you have experienced is the centralization of common services for efficiency. This also pre-dates my temporary assignment by a year, but adjustments are still happening. It all seems reasonable on the surface, but we are a highly specialized facility that rarely fits the model these efficiency gains are based on. A large number of tours (and several for Executive types) have passed through our door this last year with that sole purpose in mind. Fortunately our facility, our processes, and various controls speak volumes about our unique nature in the public service and generally people leave our facility with that vision in mind. The highly dedicated staff help greatly in delivering that message, but people can be passionate about many things, so the evaluation comes back to our purpose "Excellence in Cone and Seed Services".

As we move out of our high times (15 000 hL of cones/year) of processing cones and seed we are facing a different future. Much more of our processing will come from seed orchard seed and the ominous resulting mid-term timber supply gap equates to less harvesting, less planting, and therefore less demand for seed. Our tree improvement program plays a huge role in diminishing the depth of our timber gap, but it isn't a magic bullet and provincially we still see a shrinking forestry sector. In BC (and probably elsewhere) it's no secret that mining is now King and even water brings in almost as much revenue to the crown as forestry. Interesting times ahead – thanks for listening.

Dave Kolotelo
TSWG Chairperson

EDITOR'S NOTES

This is another open issue which contains a variety of articles. Ben Wang, who is one of the original founders of the Tree Seed Working Group, continues to be actively involved in all matters related to seed. He reminds us of the difference between viability and germinability. Michele and Craig report results from a seed extraction trial following an equipment upgrade. Fabienne and Michèle provide an update on water activity work they are involved with and the development of new seed storage containers. Lindsay has been busy organizing and presenting seed conservation workshops in Alberta. Dale and Bernie present results from using alcohol separation to improve seedlot quality of white birch. Last but not least, Al talks about installing LED lights.

I hear that there was heavy flowering this spring on white spruce in Manitoba. I wish you all a great summer and hope that the seed gods bless you abundantly!

Dale Simpson
Editor

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

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

WHAT IS THE DIFFERENCE IN THE TERMINOLOGY BETWEEN VIABILITY AND GERMINABILITY?

It has bothered me that people sometimes use the term 'seed viability' in place of 'seed germinability'. In 1973, I made a distinction between these two terms (Wang 1973). Working with seed, we should be able to see that there is a difference between the two terms. A seed that is viable means it is living not dead, while a seed that is germinable means it is not only living but also capable of germinating. Seed viability is tested by indirect methods such as topographical tetrazolium, excised embryo, and x-radiogrphy whereas germinability is tested by a direct growth test by germination (ISTA 1998). Viability tests are prescribed for species with deeply dormant seed which require a long period of moist chilling and testing times exceeding two months (ISTA 1998). Viability tests often over-estimate germinability. Therefore, I would like to urge colleagues working on seed to consider the two terms and use them properly.

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WHITE SPRUCE SEED EXTRACTION TRIAL

In 2011, a trial was set up at the Atlantic Forest Seed Center (AFSC) to test different extraction temperatures and cone drying quantities on germination of white spruce (*Picea glauca)* seed. There were concerns that seed germination was being affected by the high temperatures used to extract the seed from the cones and possibly the volume of cones contained in burlap bags hung in drying sheds prior to extraction. A new computerized temperature control system for the kilns was installed at the AFSC and we wanted to ensure consistent temperatures were being used.

The cones were collected over a two-week period from our 1985 clonal seed orchard. Burlap bags containing either 16 L or 24 L of cones were hung in outdoor cone drying sheds for 20 weeks. Immediately after collection, 240 L of cones were sent to the J.D. Irving, Limited Seed Centre (JDI). These cones were dried for 6 weeks on screened trays following which they were placed in drawers in a kiln for 24 hours, and subsequently seed was extracted. This was considered one treatment. Following extraction, the seed were returned to the AFSC for testing.

At the AFSC, 5 treatments were applied. Cones from each of the two volumes hung in burlap bags were placed in separate kilns with no heat and the seed was removed. Then, the kilns were heated to an average of 38°C for 24 hours and the remaining seeds were extracted from the cones. The fifth treatment used was dumping cones from 24 L bags in the kilns and operating the kilns for 24 hours at

an average temperature of 70°C. With all 5 treatments, the kilns were rotating when the cones were placed in them. Following the extraction treatments seed were cleaned and germination tested; both unchilled and moist chilled. Seed were tested by placing four replicates of 100 seed on moistened blotting paper in Petawawa Germination Boxes. The boxes were placed in a Conviron G30 germinator set for diurnal cycles of 28°C with light for 14 hours followed by 20°C without light for 10 hours. Relative humidity was maintained at 80%. The unchilled seed were in the germinator for 28 days while the moist chilled seed were in the fridge for 21 days followed by 21 days in the germinator (Table 1).

The 16 L bags contained more open cones than the 24 L bags. Fewer cones in the bags provide more room for them to dry and open while they are in the cone drying sheds. Germination was higher for chilled seed than unchilled seed. Germination of chilled and unchilled seed does not appear to have been negatively impacted by kiln temperature. This may be due to the kilns continually turning from the time the cones were placed in them, and the seed falling out of the cones and into a hopper below the kilns thus removing the seed from the heat. The new kiln temperature control system was much more energy efficient and consistently maintained temperatures in the kilns.

Table 1. Germination of white spruce seed subjected to several extraction treatments and cone storage volumes

Seed Centre	Storage Volume (L)	Kiln Temperature (°C)	MC (%)	Wt/1000 Seed (g)	Unchilled Germ. (%)	Chilled Germ. (%)
AFSC	16	35 – 45	5.6	2.54	89.25	97.25
AFSC	16	No heat	6.4	2.50	79.75	90.50
AFSC	24	35 – 45	5.2	2.40	74.25	90.50
AFSC	24	No heat	5.2	2.54	75.25	96.75
AFSC	24	70	5.5	2.50	76.00	94.00
JDI	40	30 – 33	5.3	2.35	84.00	93.50

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HOW WATER ACTIVITY CHANGED OUR LIVES!

Thanks to a collaborative project with Patrick Baldet (Cemagref, now changed to Irstea), in 2007, we began to work with a new tool, water activity, to evaluate the status of moisture in orthodox seed and pollen. The main advantages of this measurement technique are that it is rapid, easy to use, and non-destructive. For more details, see our previous articles in Tree Seed News Bulletins Bulletin 46 (p. 10–13) and Bulletin 50 (p.15–18). It's been five years now since water activity came into our lives and many things have already changed in our daily work!

Pollen

Every pollen lot harvested in Quebec is now dried in a pollen/seed dryer controled by water activity. This equipment was built thanks to plans provided by Irstea. Pressurized air is saturated with water in a tank, then released at a specific pressure which ensures a stable water activity. This equipment, which is not expensive to build (around $ 1500) is very practical and easy to use. As no heat is applied to the pollen, the drying is totally controlled and gentle.

Seeds

Water activity management is now applied at an operational scale at the Tree Seed Centre in Berthier. The Hilleshög seed dryer, used for the final drying of seeds during operational extraction, has been modified to incorporate water activity measures (Fig. 1). It is now equipped with a humidity control for the drying air. The relative humidity of the air is adjusted to our target of around 35% (water activity of 0.35). Before this

change, the air used in the dryer was taken from outside (sometimes very cold in winter), heated to 150°C and then cooled to 34°C before its introduction into the dryer. It was very energy consuming. The air is now taken from inside the building and not heated. Seeds are now dried less drastically and electricity costs in the Tree Ceed Centre have been substantially reduced.

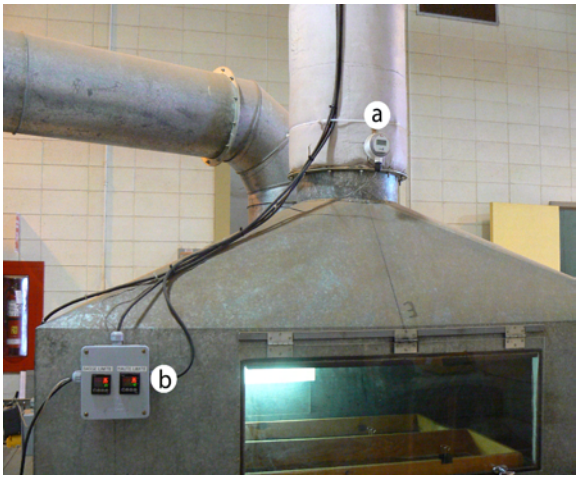

Figure 1. Last section of the Hilleshög seed dryer. a) measurement of the air relative humidity and temperature with a probe connected to b) a control for high (42%) and low (33%) limits of relative humidity. Photo: MRNF.

For small seedlots stored for conservation, stabilization at the optimal water activity value for conservation is made with the pollen/seed dryer controlled by water activity. Water activity is also used to evaluate the quality of each new seedlot in the bank, as well as the quality of seedlots stored in the bank for different periods of time. Tests are then performed according to the test frequency schedule.

Seed Storage Container

As mentioned in Bulletin 54 (p. 8-10), we have been working on the development of a new container for long-term conservation. A new formulation which combines high density polyethylene (HDPE) and a nano clay has been developed at the CTMP (Centre de technologie minérale et de plasturgie, Thetford Mines, Québec). This formulation was selected after many tests (permeability, mechanical properties, etc.). The challenge to improve the moisture barrier properties is that the nano clay has to be well distributed throughout the polymer in order to limit water diffusion through the polymer. A first prototype was produced in March with a conventional lid (Fig. 2).

Figure 2. Prototype of the new container, square bottle, 60 ml. Right: HDPE only, Left : HDPE + 7% nano clay which creates the brown color. Photo: MRNF.

To test the barrier properties of the new container, we chose white spruce (*Picea glauca*) seeds. Our previous work, mainly on hydric characterization and on long-term conservation, showed that white spruce seeds are very sensitive to humidity changes. Testing will be conducted in Québec and in France over a one-year period using the same protocol.

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ALBERTA SEED CONSERVATION WORKSHOP

This spring the Alberta Tree Improvement and Seed Centre ran its first workshop on seed conservation. The two-day workshop has been held twice due to high demand and the 20 participants so far have included restoration ecologists, horticulturalists, and academic researchers from across northern Alberta. The course was offered at no charge and covered five main topics of seed bank science:
1) Seed-air moisture relations,
2) Assessing, collecting and post-harvest handling,
3) Seed longevity,
4) Seed storage behaviour, and
5) Germination and dormancy.

Although there is no 'Bible to all things Seed', by the end of the workshop everyone had the tools and confidence to be able to understand how to make good collections, handle seed correctly, and be able to pick out and understand useful bits of information from the myriad of confusion and outdated information that exists online and in the industry. Among many other things, the first day included an introduction to water activity measurements, understanding equilibrium relative humidity, and how this can be useful without expensive equipment. A cut testing lab taught seed morphology and how cut tests can be used in the field and in the greenhouse to determine seed quality and germination strategies. Participants also learned about tools to help detect recalcitrant seeds and were introduced to longevity to enable them to better understand and interpret journal publications and government reports. The two days wrapped up with a paper-based lab, solving germination problems using minimal data; an exercise that builds confidence by having participants apply the material they have learned.

Having trained seed science students and colleagues from around the world for the last four years, it was a challenge to create only two days of material and exercises that would be interesting yet practical enough to benefit the wide range of experience in attendance. The general workshop will be run once a year at the beginning of April as demand dictates. As requested, there will be a separate workshop and date for any interested oil sands/oil and gas staff in November this year. Ties with academia are encouraged, as it would be great fun to do a strictly academic version in the future.

Participation is first-come-first-served so if you are interested in attending or have questions, please feel free to contact me.

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IMPROVING THE QUALITY OF WHITE BIRCH (*Betula papyrifera*) SEED. II

It is very difficult to remove dead, damaged, and empty white birch (*Betula papyrifera*) seed by air aspiration because the seed are winged and light. Several trials were initiated at the National Tree Seed Centre to evaluate improvement in seedlot quality by de-winging the seed and using air aspiration to remove the debris and empty seed. A preliminary trial on 12 seedlots demonstrated that germination of de-winged seed increased to 74.1% compared to winged seed at 35.8% (Daigle and Simpson 2001). Another 17 seedlots were de-winged which resulted in an improvement in germination. After 10 years in storage at -20 C, germination of the de-winged seed of the 17 seedlots was still high (Simpson and Daigle 2011) demonstrating that the de-winging procedure did not negatively impact the seed.

One challenge with air aspiration is preventing the removal of lighter filled seed. The Seed Centre uses floatation in absolute ethanol to separate filled from empty seed in *Larix*, *Picea*, *Pinus*, and *Tsuga*. This technique has also been used for birch (Björkroth 1973) so it was decided to try it on a number of seedlots. There was a substantial improvement in germination with de-winged seed ranging from 0 to 73% and de-winged + alcohol separated seed ranging from 41 to 97% for the same seedlots (Simpson and Daigle 2003). A supplementary test to evaluate the impact of the duration of seed in alcohol showed that germination did not decrease (Simpson and Daigle 2003).

The impact of alcohol separation on the storability of white birch seed was conducted by germination testing seed stored for 10 years at -20°C that had been de-winged + alcohol separated and comparing the results with those obtained prior to storage.

Methods

Four seedlots with poor germination were chosen. A sample of winged seed from each seedlot was retained for testing. The remaining seed were placed in a cotton bag and gently rubbed to break off the wings. The contents were then transferred onto a fine mesh sieve to separate the crushed wing debris from the seed. This process was repeated several times until seed were completely de-winged. The de-winged seed were carefully blown in an aspirator to remove light debris as well as some empty seed. Following this the seed were immersed in absolute ethanol and stirred to ensure any heavy seed had an opportunity to sink. When most of the seed had completed sinking in the column (15 seconds) the "sinkers" were collected in a strainer and rinsed under running tap water for 15 to 30 seconds. The wet seed were laid on coffee filters to dry for 24 hours.

Germination tests were set up by sowing 4 replicates of 50 seed each on moistened Kimpak™ in Petawawa Germination Boxes. The boxes were placed in a germination cabinet for 21 days and subjected to diurnal cycles of 20 C and darkness for 16 hours followed by 30 C and light for 8 hours. Relative humidity was maintained at 85%. Germination was assessed at 14 and 21 days. Germinants, classified as high vigor (cotyledons green and separated with a well developed radicle and hypocotyl), were removed at each assessment time. After 10 years of storage, germination tests were repeated following the same procedures as above.

Results and Discussion

Germination of the seed was improved ten fold by de-winging plus alcohol separation (Table 1). Germination of treated seedlots ranged from 81.0 to 91.5%. After 10 years in storage at -20 C, germination of the treated seed was just over 4% higher than that prior to storage and ranged from 86.5 to 94.5%. Two seedlots had germinants that were classified as being abnormal due to decay. Two percent of the germinants were abnormal in one seedlot while the other had 1.5%.

The results demonstrate that using absolute ethanol to remove dead and empty de-winged white birch seed substantially improved germination and the alcohol treatment did not damage the seed as is evidenced by high germination both before and after 10 years in storage. These results will be validated by another set of seedlots that were treated in the same manner and are scheduled for germination testing in 2013.

Table 1. Germination (%) of four winged and de-winged plus alcohol separated white birch seedlots before and after ten years of storage at -20 C

	Germination before storage		Germination 10 years
Seedlot	Winged	De-winged + alcohol	De-winged + alcohol
25	10.0	87.0	89.5
83	10.0	91.5	94.5
141	6.5	81.0	86.5
148	8.0	88.0	94.0
Mean	8.6	86.9	91.1

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ENLIGHTENING PROJECTS IN ANGUS, GREEN TOO!

As experienced seed managers, everyone expects us to be have expert knowledge and experience in all aspects of tree flowering, seed development, extraction, storage, germination, and the silvics of the native species we handle. We are proud to be our Ministry's centre for all of that and more, but collateral to that is the maintenance and operation of the facility where we live and carry out our magic.

Besides the specialized extraction and seed cleaning equipment, seed plant staff are responsible for the operation and basic maintenance of building systems such as boilers, freezers, dust collection, and ventilation systems to name a few. In recent years lighting has become a particular interest and concern.

Our cone storage warehouse was constructed in 1986 and at the time was viewed as state of the art with advanced material handling systems and high voltage fluorescent lighting. With a 35ft ceiling, changing a light bulb was not a simple task! In the early days the local fire department appreciated the opportunity to train on their "new" ladder truck while changing our lamps. Those types of practical field level arrangements are no longer possible. As the fixtures aged, ballast replacements requiring an electrician became part of every relamping. Because of the heights involved, a lifting device with fall arrest equipment and operator training all became part of the cost of maintenance. It also became a logistical problem, moving loaded cone trays to provide access.

It seemed that within days of relamping, a ballast or bulb would fail and we would be back in the dark, especially problematic during our busy winter months when the days are short. In the spring of 2010, after some research it became apparent that LED lighting technology had advanced to become an attractive option. We selected Rudd Lighting as the brand that would provide us with a fixture which we could change out "like for like" removing the 25-year-old fluorescent fixtures and replacing them with 347 volt High Bay LED's. We were able to find several dealers in Ontario who quoted and met all the purchasing rules associated with such a purchase. The capital proposal was well received as in addition to the reduced maintenance costs the project was viewed as very green with an estmated 90% reduction in electricity consumption. With funding in place we were able to move ahead and in the summer of 2010 we replaced all of our warehouse fluorescents with the LED's.

The project has been a big success on many fronts! First, the quality and quantity of light is far superior; hard to describe but it is a much more "pleasant" light. The lights are instant on in all temperatures so there is no more waiting an hour for the lights to warm up and stop flickering on a cold January morning. The LED's are guaranteed maintenance free for 20 years. Electricity consumption is estimated to be 10% of what it was with the old fixtures. An added bonus is that fewer fluorescent lamps and ballasts, which are not currently recyclable here, are going to the landfill.

So what did it cost? Total cost for the project was $20,000 which sounds like a lot and amounts to $1000 per fixture (20 in the warehouse) but when you consider it was costing us approximately $5000 per year for lamps and ballasts for the old fixtures the maintenance payback will be 5 years plus the convenience of no maintenance. The electricity savings have been more difficult to capture so far but with a 90% reduction in electricity usage it is just the right thing for us to do.

The warehouse project was so successful that in the spring of 2011 a proposal was put forward to convert the lighting in our freezer buildings to LED. Although there were not the same lamp height maintenance issues the fluorescent lights were difficult to get warmed up and there were ongoing concerns with flickering and overall illumination. In the summer of 2011 we were fortunate enough to be able to convert all freezer fluorescent lighting to comparable LED. Again far better lighting in the cold environment, reduced maintenance costs, and reduced electrical consumption. A true win win!

Next on the horizon we are currently discussing conversion of all of our exterior lighting to LED. We have several specialized exterior lighting situations as part of our overall facility safety and security so the search for appropriate LED options is proving to be a bit more complex. We are hopeful the conversion will be completed this fall.

Yes, I am very pro-LED! If you have any questions about LED conversion please feel free to contact me.
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UPCOMING MEETINGS

Forest Nursery Association of BC
Sep 24–27, 2012 Campbell River, BC
www.fnabc.com/

Whitebark Pine Ecosystem Foundation
early September Kimberley, BC
www.whitebarkpine.ca

Atlantic Forest Nursery Managers Meeting
late Sep/early Oct Saint-Modeste, QC
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RECENT PUBLICATIONS

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