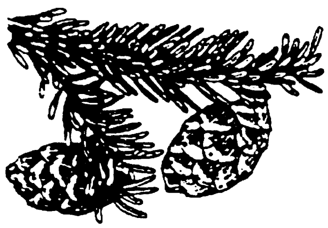
CANADIAN TREE IMPROVEMENT ASSOCIATION/
ASSOCIATION CANADIENNE POUR L'AMÉLIORATION DES ARBRES



Tree Seed Working Group

NEWS BULLETIN

No. 42 December 2005

CONE AND SEED PROCESSING

THIS ISSUE AT A GLANCE

CHAIR'S 'ARMCHAIR' REPORT

Seasons greetings to everyone! This edition of the News Bulletin focuses on **Cone and Seed Processing (CSP)**. How many people have visited a processing facility in the last year? If it has been several years it may be time to get re-acquainted and see what is possible with your collections. Thank you to everyone who has contributed to the News Bulletin – you are the people who keep it alive.

Cone and seed processing is a topic not well represented in the scientific literature. This is partly due to the complications of altering a specific processing variable and controlling all other variables in an operational setting. This should not be used as an excuse to abandon scientific principles, but it must be realized that all variables cannot be controlled in operational processing. The lack of published work is also a testament to the reduced number of people dedicated to working in this area of research. Processing facilities are always looking to improve procedures and efficiencies, but advancements are often specific to a certain facility's equipment, the species, and origin of seedlots that facility processes. Sometimes advancements are considered 'proprietary' or of a competitive advantage, so not all advancements get widely distributed. It is also a very specialized field and the audience for processing information is limited.

Early trials 'sacrificed' seedlots for knowledge gain, but today that is impractical. Gains in productivity and efficiency are mainly attained through quality assurance monitoring employed at each facility. This allows for improvements to be made based on a wide genetic base and preferably on the results of several processing years. Early trials were often based on a single or few seedlots. Some studies can be performed under "lab-type" conditions, but one must appreciate that the results of someone extracting every individual seed by hand may not be exactly duplicated under operational processing.

There are also different expectations in terms of proportion of viable seed, purity, and moisture content for different jurisdictions. In general, containerized growing systems are more demanding of seedlot quality. Cone and seed processing steps need to be performed correctly as you generally only get one chance to perform an activity. Efficiency certainly influences this, but overhandling of materials through repeated or improper processes and its impact on seed quality should always be a concern.

At our facility, we have standard workplans for species, but it is expected that the type, extent, duration, and order of treatment can and will vary between seedlots. This is why CSP is often referred to as both Art and Science. The art aspect is involved in the balancing of seedlot quality, quantity, integrity, and diversity without introducing longer term seed problems. There are no recipes and although seedlots of a specific species have much in common there are many items beyond the direct control of the processor such as reproductive success, pest problems, collection timing, type and duration of post-collection handling, shipment method, crop-to-crop differences, and variability in the due diligence applied to all of these activities. This introduced variability results in a need to base processes on the characteristics of the individual seedlot and sometimes on specific fractions of a seedlot (i.e., at final cleaning). Each seedlot is unique and through processing, evaluation of seed retained and discarded and final germination tests, a great deal of knowledge is uncovered about the seedlot.

The lack of current published studies should not underscore the importance of cone and seed processing to the quality of the seedlots we use to regenerate our forests. These activities can have a huge impact on the quality and diversity of seed we are using. Seed upgrading can be a solution to increase seed quality in some seedlots. This improvement can be due to seedlots being old and needing more current processing techniques or to gains obtained by using physiological characteristics to remove ‘inferior’ seeds. The gains are not possible with all seedlots and the unique characteristics of each seedlot need to be carefully considered.

For our next News Bulletin the theme will be “Information Management” and compared to this edition’s theme it is something everyone should be able to comment upon. It is relevant to orchards, breeding programs, cone and seed processing, seed storage, testing, seed preparation, and the nursery. Everyone has to manage information and I’m sure we can all gain something by sharing information regarding how we do this, what is possible today technically, and also expressing opinions of what information is most relevant. I would greatly appreciate contributions. The next News Bulletin will come out in June, if Dale or I could receive articles by mid-May that would be greatly appreciated.

I’d also like to pass on some sad news concerning a friend and colleague. Clare Hewson passed away on October 9th, 2005 after a long fight with cancer. Many will remember Clare for his strong opinions and desire to move our tree improvement program forward. He played a big part in the interior spruce tree improvement program going back to parent tree selection and continued in tree improvement eventually being the technical advisor for the interior orchard program. In addition to Clare’s passion for his work and gold-panning I’ll remember a caring and unique individual. I’ve taken the liberty of including a poem from his memorial “The Old Prospector” to celebrate Clare. Our condolences are passed on to his family and friends.

“The Old Prospector”
A Tribute to Clare Hewson

They headed out the canyon,
Late autumn in the snow,
The old prospector and his mule,
Loaded down, movin’ slow.
He’d button high his collar,
Had his hat stuck on like glue
And they headed straight for Elko
‘cause well, they wanted to!
He chewed a twist of something
That’d most likely curl your hair,
His long beard matched his steel-gray
Eyes, with their penitratin’ stare
He moved with calm demeanor,
Seemed fearless thru and thru,
And they headed straight for Elko
‘cause they wanted to!
His mule was short and wiry
With a face long and sad,
He had away of movin’
Kinda like his owner had.
They seemed to fit together
And their partnership was true,
And they headed straight for Elko
‘cause, well they wanted to!
When they hoofed it into Elko
A bunch of cowboys gathered around,
See they just come off the trail
And was shootin’ up the town.
When they spied the old prospector,
They decided what they’d do,
And they circled up around him,

‘cause they wanted to!
One asked the old prospector
If he’d ever learned to dance,
“Naw” he said real cautious,
“I ain’t never had the chance.”
The cowboy drew his sx-gun,
said “You’ll dance before I’m thru!”
So he danced that night in Elko,
just as if he wanted to!
Yeah, he danced and dodged the bullets
Just like a jumpin’ jack,
‘til he counted six, then he stopped,
And took somethin’ from his pack.
In his hand he held a shotgun,
His voice was calm and cool,
He said “Sonny, tell me somethin’,
Have you ever kissed a mule?”
The young man’s face contorted
As he pondered his disgrace,
He stared with consternation
At the shotgun in his face.
He swallowed hard before he spoke,
It was plain he’d thought it thru,
“No I ain’t never kissed a mule,
But I’ve always wanted to!”

Dave Kolotelo
Chairperson

EDITOR’S NOTES

The theme of this New Bulletin follows nicely on the theme of the previous one. Cone and seed processing is where you can make or break what Mother Nature (and seed orchard managers) has/have provided/produced. By and large, processing methods are quite standard for conifer species but there are always aberrations that are unique to each cone and seed processing facility. This is also where the art comes into play with the science. Processing of hardwood seed and fruit also has its unique challenges.

The coming summer of 2006 will see several meetings dealing with seed and genetics taking place in Canada, specifically in the east (see Upcoming Meetings for additional details). I hope many of you will be afforded the opportunity to attend these and enjoy some eastern hospitality.

At this time I want to wish you all a Merry Christmas and all the best for a healthy, prosperous New Year.

Dale Simpson
Editor

TREE SEED WORKING GROUP

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

Ab*ies* spp. PROCESSING

The B.C. Ministry of Forests and Range Tree Seed Centre (TSC) processes three *Abies* species: *grandis, lasciocarpa,* and *amabilis*. The following is a high level overview of our cone and seed processing practices for those interested in these species.

We encourage clients to make use of our cone and seed evaluation services before and during cone collection and in some cases during interim storage. These evaluations are a good way to confirm general quality and condition of cones and seed, seed development, fungal activity, insect species and infestation levels and predict expected yields. These evaluations also give us a better understanding of each year’s unique crop development, pests, and collection timing characteristics.

Abies cones are received at the TSC after a 4 week or more period of field storage. This pre-shipment storage period is strongly recommended to allow sufficient time for cones to dry prior to shipping. We recommend that clients use pallets to separate sack layers, fill sacks no more than half full (20 L) and use refrigerated trailers for the haul duration. Cones are sacked in either burlap or nylon mesh (onion sack) bags. Depending on collection and field storage conditions, cone moisture content on receipt can be high, ranging from 20 to 55%; cone condition varies from intact to fully disintegrated.

Upon receipt at the TSC, representative cone samples are drawn for moisture testing and cone/seed evaluations. The information provided by these evaluations serves to help guide and inform our processing treatment selections and schedules. Any findings that could significantly impact potential germination capacity and/or yield are reported back to the client. On receipt, *Abies* cones are removed from sacks, spread on screen-lined, plastic trays and moved to a pre-conditioning area. Cones will remain in this cool wind tunnel environment, at temperatures ranging from 12 to 15°C for 1 – 3 months. During this period, cones and seed are routinely inspected, remixed, trays rotated to assist drying if necessary, and samples drawn for moisture content monitoring. When cones are fully disintegrated and seed moisture levels have dropped to 15%, the seedlot is ready to be scheduled for processing.

TSC processing begins with seed extraction, where large, coarse cone debris (scales and axes) and fines are removed by a circular action screening machine. Initial cleaning follows where most but not all of the moderate debris and fines are removed. Seed is dewinged by dry rotary methods. Final cleaning involves specific gravity table separation methods. An additional screen cleaning treatment (secondary cleaning) may occur depending on types and volumes of debris present in a given seedlot.

Quality assurance measures are in place through all phases of processing. At the TSC we monitor and record seedlot identity, input and output weights and volumes, carefully scrutinize and note resin vesicle condition and evaluate seed fill, development, and insect damage/activity at all processing steps.

Abies seed processing combines a number of processing challenges: 1) resin vesicles (and the risk of over handling and loss of seedlot diversity), 2) high proportions of empty seed (and the seed coat differences within), and 3) large volumes of debris and pitch, fungal, dead and insect filled seed volumes (and the risk of under handling).

In our particular processing environment, to minimize the risk of seed damage and to achieve *Abies* processing success we employ the following guidelines:

1) To minimize the risk of potential resin vesicle damage, foam inserts are placed in all collection tubs. Foam inserts have been designed for the dewinging drum and all possible equipment impact areas are padded with foam.
2) Portions to be run are gently blended with talc prior to equipment processing.
3) Process duration and number of steps are kept to a minimum.
4) Seed is kept as cool as possible during processing:
   - removal of limited volumes of product at any one time
   - returned to cooler storage during break times
   - minimum of 24 hours between processing activities.
5) Screen selection: types, order of placement in equipment, perforation size, shape and orientation on screen (a sloped insert is utilized to minimize the volume of product on roller belt fed regulating gates).
6) Seed development and fill are monitored during and between every phase.
7) To optimize dewinging performance, seed moisture testing is completed prior to dewinging and dry back performed if necessary.
8) Dewinging batch size is not only related to volume but filled seed averages as well.
9) Use of gravity table rather than pneumatic specific gravity separation equipment (cloth deck).
10) Finding the right balance of seed quality and quantity in the final product.
11) Final product gently talced and blended by hand, not mechanically.

The table below summarizes average germinations and yields/hL for processed *Abies* species over five crop years.

Please contact me if you would like more detailed information about our processing equipment, practices, and standards.

Species	Germination (%)	Yield per Hectolitre (kg/hL)
Abies amabilis – Amabilis fir	75	2.289
Abies grandis – grand fir	76	1.989
Abies lasiocarpa – sub-alpine fir	65	1.411

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J.D. IRVING, LIMITED PARKINDALE SEED ORCHARD

The Irving Company has been planting trees since 1957. In the first 20 years most of the seedlings were produced in outdoor seedbeds (bare-root). By the late 1970's seedling production changed more and more to container seedlings, grown in greenhouses. Last year we produced 23 million seedlings, 2 million rooted cuttings, and 750,000 tissue culture trees, all grown in "Multipots".

In the late 1970's we also started our tree improvement program, producing the best possible trees for our reforestation program. With this came the establishment of seed orchards and the production of genetically improved seed. As seed quality improved and seed became more valuable, the need for cleaning it properly became more important as well. In 1988 we purchased the best extracting and cleaning equipment available on the market, at that time! (BCC – Bjorkemar Construction & Consulting, AB).

The equipment was set up at our clonal seed orchard located at Parkindale, 50 km south-west of Moncton, New Brunswick. The seed extraction equipment consists of one propane fired kiln (capacity of 10 hL per load), one combination tumbler and dewinger, one combination scalper and sizer, a liquid separator, and two gravity separators. The Swedish company custom built the tumbler/dewinger and the scalper/sizer for us, as space was limited in the plant. We have had great success with the BCC equipment and only a few minor changes were made.

Since 1988 we have extracted and cleaned seed from more than 4000 hL of cones. Most of the cones came from our orchards, with some custom cleaning for other organizations as well. Our main species are: white, black, red and Norway spruce, and jack and white pine. We also work with red and Austrian pine; Eastern, European and Japanese larch; eastern white cedar; eastern hemlock; balsam fir; and white and yellow birch. All the seed for our nurseries comes from orchards, except red spruce and white pine. Both of these species were just recently established at Parkindale.

Cone production was poor in 2005 at the orchard. Only 10 hL of white pine and 11 hL of second generation jack pine were collected and cleaned. All our seed is tested for purity and germination and stored at the Sussex Tree Nursery.

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CONE AND SEED PROCESSING AT ALBERTA TREE IMPROVEMENT & SEED CENTRE

The Alberta Tree Improvement and Seed Centre (ATISC) extracts and cleans small research seedlots less than one hL in volume, including mostly single-tree collections, as part of the seed germplasm conservation program in support of the provincial tree improvement program. Species handled are white spruce, black spruce, Douglas-fir, balsam fir, subalpine fir, Siberian larch, tamarack, western larch, subalpine larch, white bark pine, limber pine, lodgepole pine, jack pine, balsam poplar, cottonwood, and aspen. The average seedlot size is approximately 20 g. Because research seedlots are much smaller than operational lots, the seed processing equipment used, such as the kiln, tumbler and aspirator, are designed for handling small lots.

All collections, upon receipt, are assigned an accession ID number and measured for volume. With the exception of some pines, cones of most conifer species are spread thinly in screened-bottom trays or pallets, labelled, and placed into a temperature-controlled environmental room for curing. Temperatures are set between 13 to 16°C. Cones are stirred daily to promote uniform drying. After 5 to 6 weeks cones are moved into an empty greenhouse for any additional curing if needed and where they are held until extraction. Temperature in the greenhouse is set at 18°C. Lodgepole pine and jack pine cones, if received dry, are stored in their collection sacks in a production room until extraction. Poplar and aspen collections are spread thinly in screened-bottom trays. Each tray is covered with an upside down screened tray to prevent fluff dispersal and seedlot contamination. The trays are held at room temperature in the production room.

The ATISC has a walk-in kiln with stationary shelving units which hold screened-bottom trays. Each tray holds about 3 to 5 L of cones. The kiln is equipped with fans to promote air circulation and an exhaust system to remove humid air. Most cones open readily during the curing process in the temperature-controlled room or in the greenhouse but, where necessary, cones may be kilned at 40°C for four to eight hours to facilitate further cone scale flexing. Cones of serotinous species, such as lodgepole pine and jack pine, are placed in small aluminum cages, dipped into 80°C water for about 1 minute, drained, spread to one cone thickness in the screened-bottom trays, and placed in the kiln. The kiln temperature is raised and held at 60°C for 8 hours. Black spruce cones are soaked in tepid water for 4 hours, drained, air dried for 17 hours, and then kilned for 8 hours at 60°C. This soak-drain-kiln operation may be repeated up to three times before all the seed is released.

Once opened, cones are tumbled in a small portable screened drum extractor. The winged seed falls through the screen and is collected into a bin beneath the tumbler.

Dewinging is done by misting the seed with water in a small stainless steel bowl and gently stirring intermittently with a rubber spatula. After about 30 minutes, when the majority of the wings appear to be separated, the seed and wings are spread on screened-bottom trays for drying. Once dry, in 2 to 3 hours, wings and empty seeds are removed in a Dakota blower. Top fractions from the blower are examined under the microscope for full seed. Scales and bracts are removed using a variety of soil sieves.

Fluff from *Populus* species is removed from the capsules by hand and placed between the first two sieves in a series of four soil sieves with the mesh opening decreasing in size from the top down. Mesh size is determined by the species being processed. Compressed air is directed through the sieves for about 30 seconds separating the seed from the fluff which allows it to fall through to the smaller mesh sized screens below.

Finally, seedlots are hand cleaned to remove resin, insects, cone particles, wings, etc. Where amounts allow, moisture content tests are conducted. Seed having a moisture content over 8% is spread thinly on netting inside plastic trays and is placed inside a drier/germinator at 29% RH and 20°C. Drying time is adjusted to the initial moisture content. Once the drying is completed and again where amounts allow, another moisture content test is done.

After seedlots have been processed they are tested and placed into -18°C storage. About 150 to 200 seedlots are added to the inventory each year. The ATISC presently has 5,669 seedlots in inventory.

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OVERVIEW OF THE ATLANTIC FOREST SEED CENTRE

The Atlantic Forest Seed Centre (AFSC) was established in 1978 by the NB Department of Natural Resources (DNR). The facility is located just outside Fredericton at the Kingsclear Forest Nursery and overlooks the beautiful St. John River valley. Without a doubt we have the best view of all the seed centres in Canada!

Besides the best view, the AFSC provides two important services: it provides the provincial nursery with high quality seed for use in the reforestation program and it offers extraction services. This includes seed extraction, cleaning, and storage to clients across Atlantic Canada and Maine. The majority of seed extracted for both DNR and the forest industry originates from first and second generation seed orchards. The AFSC also extracts substantial amounts of balsam fir seed for the NB Christmas tree growers.

The facility is typical of many seed centres with the process beginning when the cones arrive in burlap bags in the fall. The bags are hung in curing sheds until they are moved indoors for extraction, which generally begins in November or early December. The Centre has five heated kilns, each containing a large wire mesh drum that rotates. As the cones open, the seeds are released and are gathered in hoppers below.

The AFSC has various seed cleaning equipment, including a clipper machine, seed de-wingers, a drying cabinet, and a BCC liquid separator and vacuum separator. Once extraction is complete, the seeds are quality tested for germination, moisture contact, and purity. A large walk-in freezer set at -8°C is located under the office where the AFSC stores over 3500 kg of seed.

Of course cone production is cyclical and therefore annual extraction follows the ups and downs of cone production. Below is a chart illustrating the annual extraction at the AFSC over the past 12 years (Fig 1).

As is illustrated in the chart, 2005 was a very busy year with over 164 000 L of cones extracted with a yield of almost 2000 kg of seed. Of this amount, 55% was spruce, 27% balsam fir, 11% pine, 6% larch species, and 1% hemlock/cedar. Our only full time staff at the seed centre, Peter Goodine (with help from our tree improvement staff), was busy from October until the end of June.

In addition to the day-to-day activities, we also provide tours for educational institutions, conferences, and just about anyone that drops by. So if anyone is ever in the vicinity, please feel free to stop for a tour of the AFSC. We would be happy to show you around.

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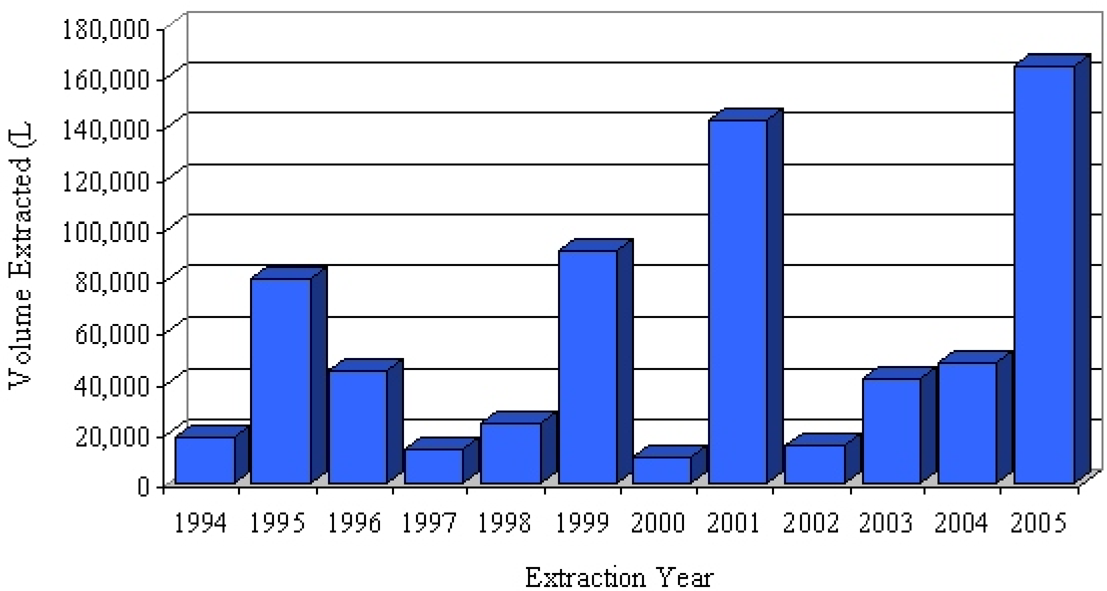

Figure 1. Annual volume of cones extracted at Atlantic Forest Seed Centre.

CONE AND SEED PROCESSING IN MANITOBA

Pineland Forest Nursery is the site of the only forest seed processing facility in Manitoba. Pineland is located in Hadashville, Manitoba which is 100 km east of Winnipeg. The facility processes between 3000 and 4000 hL of cones per year for the Province of Manitoba, Tembec (Pine Falls), Louisiana Pacific (Swan River), Tolko Industries (The Pas), and various clients in Northwestern Ontario. The majority of seed processing is black spruce, white spruce, and jack pine, but also includes smaller volumes of red pine, white pine, Scots pine, eastern white cedar, and tamarack.

Originally built in 1964, the facility most recently underwent an upgrade in 1997 with the addition of a large scale dewinger and screen/sizer purchased from BCC. The addition of the BCC equipment allowed for a large increase in processing capacity. This equipment, along with our small scale equipment gives the flexibility that allows us to process cone lots of any size from under one hL to lots of several hundred hL. Pineland also has very small extracting and cleaning equipment which allows for the processing of very small single-batch cone lots such as those required by tree improvement programs for family tests.

The last decade in Manitoba has seen a shift from the exclusive use of general collection seed to seed from improved sources. Jack pine testing and breeding programs were begun in Manitoba in the early 1970's by the Canadian Forest Service and were turned over to provincial management in 1991. These programs have developed to the point where the majority of jack pine seedlings grown for forestry purposes in the Southeast, Interlake, and Northwest regions of the province are derived from seed orchards established under the program. The current tree improvement programs for black and white spruce were initiated by the Manitoba Forestry Branch in the late 1980's with the co-operation of forest companies. A Tree Improvement Trust Account was created in 2000 to allow for joint funding of some of these programs with the major forest industry partners in Manitoba (Louisiana Pacific, Tolko Industries, and Tembec). Several of the spruce orchards have now started producing seed on an operational level and a transition to improved spruce seed sources has been taking place over the last several years in most of the major operating areas throughout the province.

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SEED PROCESSING AT THE CENTRE DE SEMENCES FORESTIÈRES OF BERTHIER

Seed processing began in Québec in 1908, with the creation of the Pépinière forestière of Berthier, the first government-owned nursery in Québec. The present Centre de semences forestières of Berthier (CSFB, Tree Seed Centre) was inaugurated in 1987. It comprises a forest seed processing plant with a capacity of 15 000 hL of cones, one large shed where cones are dried, and three cold storage rooms. A unique feature of the plant is that empty cones are crushed and used for the heating of the Seed Center and the nursery.

In 1987, Québec's objective was to produce 300 million softwood seedlings per year. Now, we annually reforest around 130 million softwood seedlings and 1.5 million hardwood seedlings. The annual harvests are between 1000 and 3000 hL of conifer cones and around 345 hL of hardwood seeds. See Table 1 for a summary of 2004 seed extraction. Most of the hardwood seeds are harvested in southern Québec and the harvesting season depends on when the fruit reaches maturity. All the seedlots are sent to the Seed Centre where they undergo processing and testing. Each year, between March and May, about 440 million seeds are shipped to Québec's nurseries (both public and private).

The major steps of processing softwood seeds are:
1) Extracting the seed with 8 tumblers of 10 hL capacity each.
2) Cleaning the seeds with Swedish Hilleshög equipment (dewinger, liquid seperator, seed dryer, seed sizer, and gravity separator).
3) Analyzing the quality of the seeds in the laboratory (X-rays, water content, purity, number of seeds per kg, germination rate and vigor) .
4) Storing the seeds in 20 L plastic containers (about 15 kg of seeds) in cold rooms set at -3˚C.

For hardwood seeds, processing methods vary with the species. Space does not permit providing details for each species, but we can send a description on request.

Improvement of the Extraction Process

During the summer of 2002, we visited the J.D. Irving Tree Seed Centre in Parkindale, New Brunswick. We noticed that, for the species we have in common, their germination capacities were always higher than ours. In autumn 2002, they extracted part of one of our white spruce seedlots. The germination capacity was 95% while the germination of the same seed lot extracted at our Seed Centre was 87%. As a result, we began to check our extraction process step-by-step. Before and after each stage of extraction, we took a small quantity of seeds. After that, we continued to process these seeds manually. So, if the germination rate was reduced, we were able to identify where the seeds were damaged. By this way, we improved our seed extraction methods. For example,

Table 1. Cone collection and seed yield in Québec for 2004

Major species collected	Cone or seed volume (hL)	Improved sources (%)	Mean yield (1000 viable seeds/hL)	Mean germination (%)
Softwood species				
Picea mariana Black spruce	119	100	283*	96
Pinus banksiana Jack pine	355	100	161	92
Picea glauca White spruce	430	100	471	93
Pinus strobus Eastern white pine	274	99	37	95
Picea abies Norway spruce	12	97	100	97
Hardwood species				
Quercus rubra Red oak	76	0	10	86
Fraxinus americana White ash	25	0	69	56

* This yield is abnormally low. The hypotheses are: poor pollination or late harvest as cones had already opened. The average yield is around 500 000 viable seeds/hL.

average germination increased from 85 to 93% for white spruce, from 93 to 97% for black spruce, and from 90 to 93% for jack pine.

Our main changes in the extraction process were.

1) As seeds are extracted from the cones and fall down to the bottom of tumbler, they are periodically removed to reduce the time they are exposed to heat in the tumbler.
2) Depending on the species, dewinging time was drastically reduced by increasing the quantity of water applied and the rotation speed of the dewinger. For example, it takes now 20 to 25 minutes to dewing a batch of 50 L of black spruce seeds instead of more than 60 minutes for 25 L of seeds.
3) We removed the two vacuum systems to transfer the seeds from the dryer to the seed sizer and to bring seeds from the seed sizer to the gravity separator because some seeds are damaged during the transfer.

We also started processing control lots. For each lot that is extracted, we collect a sample of 2 to 5 L of cones. This control is extracted manually and gently. The germination capacity of this control lot becomes the target and is compared to that of the operationally extracted seedlot. If the control is higher than the seedlot, we check our process to find what could have been wrong.

Recently, the CSFB laboratory acquired a new X-ray unit (Konica SRX-101A). This apparatus produces high quality radiographs. The evaluation of the seedlot is more accurate because the resolution and the definition are enhanced. High quality radiographs will help us to sort the sound seed and discard the empty seed for species where the elimination of such seeds is difficult like hybrid larch and black cherry.

For more information, see the Québec ministry web site:
http://www.mrnfp.gouv.qc.ca/english/forest/quebec/quebec-system-management-plants.jsp (in English)
http://www.mrnfp.gouv.qc.ca/forets/entreprises/entreprises-semences.jsp (in French, more exhaustive)

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A PROFILE ABOUT: NOTHING VENTURED – NOTHING GAINED

The title chosen for the article stimulates thoughts around visions, ideas, concepts, and principles and can serve in demonstrating different horizons that are obtainable by adding some new twists to old science. Some that do become realities and others remain in the mind of the imagineer. This is where our IDS Lab has its roots. Something that has been steeped by vision in a way that serves and benefits many. Numerous imagineers can be credited with the kinds of seed enhancement processes we offer and make available each operating season to forest companies, nurseries, and Government departments across the country. Clients come and go but there is a consistent core group that includes enhancement protocols which are intricately part of their greenhouse and nursery programs.

Lets go back to the thought surrounding vision, a vision that started with two men Frank Barnard and Tom Hilman at a small seed company located in the south central interior of British Columbia - Western Tree Seeds. Western Tree Seeds in itself was a project of vision that began in 1963. IDS applications initiated here in the late 80's serve as a benchmark that was built upon. Liaison with top seed physiologists in Canada and Europe provided the solid science that projected the IDS to an operational level which eventually found its way to serving the nursery industry. None the less, the vision that IDS would be made available in Canada did become a reality.

In terms of today, our lab is entering its 10th year of operation and it has seen steady growth during that time. We annually process 350 to 400 kg of seed each operating season. It's a sharing place and a place where folks can come for help with a wide range of seed concerns and other concerns that aren't even remotely related to seed. Scientific principles/protocols provide a strong backbone for the enhancement processes, even though in some ways, applications and avenues of implementing the science can take an "off the wall" approach. It's paramount to "think out of the box" when hurtles present themselves.

Seed is a resource that has been created and designed. Understanding how it functions can go a long way in ending up with good results necessary to transform this small bit of biology into a towering tree. This response is clever as it ensures metabolic activity is sequentially addressed as the germination process kicks into gear. The ability of living organisms to reorganize, reproduce, and regenerate has astonished all of us since ancient times.

Water separation techniques that are applied to processed seed, remove physically damaged seed, heavy debris, light debris, and dead/empty/partially filled seed which make notable improvements to the vigour and germination capacity of the seed within the seedlot. This enhancement process benefits seed conservation and seeding efficiency.

Water processes are more directly advantageous for enhancing seedlot quality. Seed shape dynamics are minimized and water separations are solely the effect of density differentials. Air and water separation techniques are not comparable. Each approach has a very important place along the way in optimizing the reproductive capability of the seed.

Our upgrading techniques are focused on utilizing the combined effects of :

1) PREVAC (pressure vacuum)
2) IDS (Incubation, Drying, Separation)
3) Seed Moisture Management

Specific biological principles and attention to detail for each of these segments is integral and the cornerstone in achieving successful results. Tracking moisture content initially and throughout the processes is important and also very interesting to follow. All steps throughout the upgrading process are pieces of a puzzle and at the days end can provide an interpretive picture of what actually occurred in relating how the upgrading techniques played out.

Fact demonstrates that most of the species and the corresponding seedlots treated through these upgrading procedures and protocols have very positive results and enable nurseries to utilize single sow applications. A small number of the many seedlots treated annually respond negatively to the processes for undetermined reasons.

It is very interesting to observe the varying characteristics and to try to hypothesize the question of "WHY". Many thoughts can come to mind depending on individual seedlot information and circumstances. Questions like:

1) Degrees of dormancy vs. incubation period - enough or not enough.
2) Accuracy of initial germination information provided.
3) Pathogenic problems and corrective measures taken.
4) Adequate moisture levels - too much or not enough.

5) Inhibitory effects attributed to decreased water permeability (Baron 1978, Downie 1999).
6) Decreased oxygen permeability (Koslowski and Gentile 1959, Downie 1999).
7) Restriction of expansion of the megagametophyte and embryo (Asakawa 1956), (Downie 1999).

As difficult as it may be, the best any one of us can do when utilizing upgrade techniques is to "Read The Seed". Read the seed to the best of your ability to gain an intimate understanding of what's happening biologically. Some species tend to be very open to interpretation while others are very discrete and subtle. Reading the seed and understanding what is in front of you is your key to unlocking a multitude of design secrets. "Follow and Observe Nature and you'll find the Common Elements". Treat the upgrading task as a challenge and have fun with it.

This article is structured to demonstrate the importance of vision and imagination. Don't **ever** be afraid to dream and venture out. We've presented some practical and operational approaches with the intent of sharing some handy tricks and tips that you may find useful. Equipment used in our operation has evolved through a combination of vision/imagination and necessity, the mother of all invention.

Some new direction is on the horizon for us here as Wendy and I are about to become first time Grandparents in early December 2005. Also, in January 2006, Mike Long of Haveman Brothers Forestry Services from Kakabeka Falls, Ontario will join us with some innovative research project work as well as assisting with the day to day IDS applications.

If there is something causing you concern, please don't hesitate to contact us.

Merry Christmas to all and enjoy the ***Peace of the Season*** ☺☺☺☺ !!

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SEED PROCESSING AT THE NATIONAL TREE SEED CENTRE

The National Tree Seed Centre (NTSC) collects, obtains, stores, and provides seed from Canadian tree and shrub species of known origin for use in research. More recently the NTSC mandate has been expanded to include collections of seed from species and populations that are unique or that may be considered at risk and storing them for gene conservation purposes. All seed collected is from natural populations. The quantities of seed collected are small compared to those made for reforestation. The ultimate goal of the NTSC is to acquire seed from across the range of Canadian tree and shrub species.

Most of the collections are from individual trees rather than bulk collections made up of many trees. Data from seed collected from individual trees collected at the same time from the same site and processed and stored under identical conditions indicate that seed from these trees sometimes stores quite differently. This suggests that there is a difference in the quality of the seed from individual trees. A bulk collection made from such a population could result in a mediocre seed lot after a number of years in storage as a result of seed from the various trees decreasing in quality at different rates. By making collections from individual trees it is possible to monitor the quality over time and discard seed lots that are no longer good.

Conifer seeds are usually collected between late summer and late fall. Crops are assessed to make sure the seed is ripe. Care of the cones begins in the field. Rough handling and overheating of green cones could cause serious damage to the seed. When the cones are brought in from the field they are laid on screen trays or left in burlap bags and laid on racks and placed in a well ventilated area. This allows the cones to dry and open. The cones are checked periodically and stirred or the bags turned to promote uniform drying of the cones. They remain in the drying area until early winter when they are brought inside for processing.

All opened cones are placed in a small rotating screen drum (squirrel cage) and tumbled for several minutes to dislodge the seed from the cones. No heat is applied during this process. The winged seed as well as any debris (powdered pitch, dry pitch, scales, etc.) are placed in a labelled paper bag. Cones that fail to open are soaked in warm water for 2 – 3 hours and placed in a forced air oven at 30°C for 24 hours or until they have opened. They are then tumbled a second time. The winged seed are then sieved to remove the small and large debris and then rubbed in cloth bags to de-wing the seed. Water is added to spruce seed to facilitate removal of the wing. The wetted seed and wings are then laid out to dry on screen trays for 24 hours. Pine species are usually dry rubbed. Larch, fir, and hemlock seed are also dry rubbed but the rubbing must not be too aggressive because of the risk of rupturing resin vesicles that are on the outside of the seed coat. Once rubbing is complete, the wings and debris are sieved and then cleaned using an air aspirator. Seed of cedar species are not de-winged.

Cleaning and processing of hardwood and shrub seed presents some unique challenges. Seed of *Betula* and *Alnus* spp. have small wings that take up a lot of space in storage. Seed set is also sometimes poor with germination of uncleaned seed falling below 10%. After collection, seed is placed in a drying area until it is ready for processing. Catkins of white and grey birch are crushed and sieved or blown to separate the bracts from the winged seed. Seed from yellow birch and *Alnus* are tumbled to dislodge the seed and then sieved or blown. The seed is then placed in cloth bags and rubbed lightly to de-wing the seed. This may have to be repeated 2 – 3 times until the wings are completely broken off. A fine sieve is used between each rubbing because the wings become a fine powder. Once rubbing is complete the seed are blown lightly and sieved to remove any bracts that might still be present. Alcohol separation will remove most remaining empty seed as these will float while the filled seed sink and are recovered. The seed must then be rinsed in running tap water for 15 seconds and laid to dry. This process greatly increases the quality of the seedlot and dramatically reduces storage volume.

Populus and *Salix* catkins are collected when they have started to shed or are just about to start and are brought directly into the lab for drying. They are laid on large screen trays and covered with another screen tray to prevent cross-contamination. The trays are placed in a room with a dehumidifier. This is essential as relative humidity is usually high in late May – early June when the catkins are collected. The catkins are allowed to dry for 1–2 days. The partially opened catkins are then placed in a squirrel cage tumbler covered with fine screen that will allow the seed to pass through. The catkins are then tumbled while warm air (hair dryer) supplemented with a strong air flow (reverse air flow on a vacuum) is blown on them. The combination of warm air and the rotation of the drum opens the catkins and the dried seed fall through the screen and are collected in the drawer below. Seed are then processed and stored as quickly as possible as they quickly lose their viability if not frozen.

Seed of *Acer*, are also dry rubbed to remove the wing and then sieved and blown in an air aspirator. De-winging of *Acer* seed serves two purposes. First it reduces the storage volume and secondly half of the seed of some *Acer* species (e.g., *Acer saccharum*) are empty and impossible to remove unless the wing is removed.

The fleshy exterior of the fruit from many shrub species (*Prunus*, *Cornus*, *Viburnum*, *Sorbus*, *Crataegus*) is removed by placing them in a blender (dulled blades), or milk shake mixer and macerating the fleshy fruit. The blender is used for the harder seed (*Crataegus*, *Prunus*) while a milk shake mixer is used for seed with a less durable seed coat. Once macerated, the seed are rinsed in flowing water. The pulp and empty seed float and are easily removed. The seed are then laid to dry and blown to remove any seed that may have been broken in the process.

Once the mechanical processing is complete, the seed are cleaned manually to remove any remaining debris, broken or insect damaged seed. Moisture content is determined for all seed lots. Two samples of approximately 2 g each are placed in small containers and dried for 16 hours at 103°C. After drying the seed are placed in a desiccator and allowed to cool. They are then weighed and the moisture content calculated. Moisture contents between 5 – 8% are targeted. Seed with moisture contents greater than 8% are dried further until the target moisture content is achieved. During winter, the lab is maintained at 22°C and 20 % relative humidity. Under these conditions, seed from most species will dry to about 6% moisture content. Once moisture content is within the accepted range, 1000-seed weight is determined by weighing 8 replicates of 100 seed each and the 1000-seed weight calculated.

The seed is finally tested for germination. Because of the small quantities of seed, 4 replicates of 50 seed each are used. Seed are stored in hermetically sealed glass jars and placed in a walk-in freezer at -20°C. Smaller seed lots are placed in plastic vials and then put into glass jars. This allows for several seed lots in the same jar which maximizes storage space.

Data in the NTSC database show that seed from most conifer and hardwood species can be successfully stored for several decades with very little loss in germination and vigour. This is very important since seed used for research and gene conservation may not be used for many years. NTSC staff make between 100 and 500 collections each year (depending on seed crop). The NTSC has over 12 000 seed lots in storage.

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RESIN VESICLES IN CONIFER SEEDS

The term resin vesicles (or resin cavities) is commonly understood in conifer seed technology, but it is amazing how little is known about these structures. This is surprising considering the influence these structures can have on successful germination. This article attempts to summarize the known literature of resin vesicles in conifers. I would appreciate knowing of any additional documentation.

Resin vesicles are found within seeds of the following genera in the Pinaceae: *Abies*, *Cedrus*, *Keteleeria*, *Nothotsuga*, *Pseudolarix* and *Tsuga* (Frankis 1988) and within the genera *Libocedrus* (Schopmeyer 1974) and *Thuja* in the Cupressaceae. Within the Pinaceae, those genera bearing resin vesicles diverged from those not bearing resin vesicles quite early in evolutionary history (Wang et al. 2000). Singh (1978) discusses the "differentiation of mucilage canals (cycads) or resin ducts (in conifers)" in the section on development of the seed coat providing a hint to the origin of these structures. The occurrence of resin vesicles in *Thuja* is not well documented!

The resin vesicles in *Abies* spp. appear to differentiate at the young archegonial stages in *Abies grandis* (Singh and Owens 1982); during the last stages of female gametophyte development in *Abies amabilis* (Owens and Molder 1977); and soon after fertilization in *Abies lasiocarpa* (Singh and Owens 1981). The vesicles consist of an oblong cavity surrounded by a layer of epithelial cells described as richly protoplasmic. The enlargement of the resin cavities causes depressions on the surface of the female gametophyte (Singh and Owens 1982; personal observation). This depression causes a displacement of nutritive tissue and although the role of resin vesicles is not understood – this tradeoff in potential energy indicates it must have an important role in the success of the species that possess them.

The resin arising from other parts of the tree has been studied more fully than resin from seeds. This trend will probably continue as more information is gained on the role of terpenoids from resin and how to induce traumatic resin defenses against herbivores and pathogens (i.e. Faldt et al. 2003). Hopefully this will also increase our knowledge on resin vesicles and their role in conifer seed. For those really looking for more on resin a new book entitled "Plant Resins: Chemistry, Ecology and Ethnobotany" by Jean H. Langenheim was published in 2003. Reference to a review of this book by Gershenzon (2003) is included for those wishing to explore the subject further.

Resin is considered "a lipid-soluble mixture of volatile and non-volatile terpenes and/or secondary compounds that are secreted in specialized structures" (Langenheim 2003). The amount of resin in *Abies alba* has been documented as up to about 20% of the fresh mass of seeds with monoterpenes accounting for 90% of the total volume of volatile terpenes. The monoterpenes have been studied and the main components and their [ranges] are: limonene [60 – 90%]; á-pinene [5 – 30%]; Ä-3-carene [3 – 4%], and â-pinene [1 – 2%] (Èermák 1987). During storage for 24 months at 1 – 3° C the monoterpene composition changed with á-pinene decreasing and Ä-3-carene decreasing (Èermák and Penka 1978).

The most detailed studies were done by Èermák (1987) who looked at variability in monoterpenes between and within trees and in relation to the position of the resin vesicles on the seed surface. Differences between trees were significant, but cones from the same tree differed only slightly. There was actually greater variability between different resin vesicles on the same seed compared to different cones (if the same resin vesicles are compared). These results indicate the importance of clearly defining the location of resin vesicles in further studies. Èermák (1987) determined the resin vesicles closest (abaxial) and furthest (adaxial) from the ovuliferous scale had quite different proportions of á-pinene, â-pinene and limonene forming a gradient around the seed. No differences between resin vesicles were noted for Ä-3-carene.

The reduced germination from seedlots with damaged resin vesicles is well-known and has been duplicated through puncturing resin vesicles or dipping the seed in the resin (Gunia and Simak 1968, Kitzmiller et al. 1973, Kitzmiller et al. 1975). The resin has also been shown to be inhibitory to germination of pine and spruce (Rohmeder 1951). It is especially interesting that if resin vesicles were damaged following stratification (vs. before) that the decrease in germination was not as great (Gunia and Simak 1968, Kitzmiller et al. 1973) and that damaged seed performed better than undamaged seed without prechilling (Kitzmiller et al. 1975). Interesting findings on a few seedlots and surprising that no follow-up studies have been done in this area.

A question that many BC nurseries are asking is whether there is a good seed sanitation method for *Abies* spp. Some early work with hydrogen peroxide indicated that the proportion of fungi on the seed coat could be reduced with hydrogen peroxide, but in general (one exception) a decline in germination was found (Edwards and Sutherland 1979). A trial was conducted involving seedlots [# in brackets] of *Abies amabilis* [6], *A. lasiocarpa* [2], and *Abies grandis* [2] that were exposed to 3% hydrogen peroxide for 0.5, 2, and 4 hours after soaking and to a 2-hour treatment performed prior to soaking. Data were collected on resin vesicle damage, germination capacity, and incidence of *Fusarium* sp. and *Calosypha fulgens*. The results overwhelmingly showed the individual seedlot accounted for the greatest proportion of variation in germination capacity (83%), resin vesicle damage (78%), *Fusarium* contamination (85%), and *Caloscypha fulgens* infection 86%. In Amabilis fir a significant increase in resin vesicle damage was found by extending the sanitation treatment from 0.5 to 4 hours with a decrease in germination from 72 to 66% (not statistically significant) (Kolotelo 2001). Growers are currently cautioned against the use of hydrogen peroxide on resin vesicle species due to the uncertainty of the practice. Some growers have succesfully used hydrogen peroxide to sanitize *Abies* spp., but others have had very poor results from the practice. The use of running water soaks to reduce pathogen loads is considered the best alternative at this time. This can help with *Fusarium* which is borne on the seed coat, but it would have no impact on *Caloscypha fulgens* which infects and kills the seed. There is still lots of work that needs to be done on this issue, but work on *Abies* spp. in general does not rate very high in many jurisdictions today.

Several theories have been proposed for the role of resin vesicles. Based on the fact that damaged seed without a prechill germinates better than undamaged seed without a prechill, it was hypothesized that seedcoat dormancy is an important factor and that resin vesicle damage was possibly a form of scarification (Kitzmiller et al. 1975). There may be a relationship, but undamaged and stratified seed obtained the highest germination in all studies referred to here. It was also suggested that the resin vesicles were involved in dormancy and prevented germination in the same year as seed dispersal (Rohmeder 1951) and that the resin provides a layer of protection preventing excessive drying of the embryo and megagametophyte (Gunia and Simak 1968). Still lots of mystery regarding resin vesicles and their roles in conifer seeds. Hopefully this has brought some of the literature to people's attention and maybe someone would be interested into looking at some of these unanswered or unasked questions. I have connections for seed if anyone is interested. ☺

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NEWFOUNDLAND'S FIRST MAJOR WHITE SPRUCE ORCHARD CONE COLLECTION

Over a decade was spent combing the wilds of Newfoundland in search of white spruce plus trees. In 1994, many copies of each of the chosen candidate trees were established in a clonal orchard. In 2005, this orchard produced a bumper cone crop. With an effective frost and insect control program, virtually 100% of the cones were harvested. The yield was 19 000 L from 1 900 trees. The seed collection and seed extraction (yet to start) will be by clone. Over the next few years progeny test data will allow blending of seed to create better than average orchard seedlots yielding additional genetic gains.

Unproportional seed production has been described in the literature by a 20:80 rule where 20% of the clones produce 80% of the seed. Is it the experience that this rule is followed in clonal white spruce orchards? In this harvest, 20% of the clones contributed only 27% of the cones! Over 60% of all clones were required to make up 80% of the cones. At this point there is no reason to expect seed yield to skew these ratios significantly. This bodes well for the genetic diversity of this orchard lot.

Being new to the seed production business, there is a thirst for the understanding of the genetic differences among clones. Thus several experiments were initiated. One surprise was that one clone shed its seed at 1100 growing degree days (GDD) while another held on until 1400 GDD.

Having had modest amounts of 1st generation white spruce seed available for seedling production over the past few years has hinted of great expectations of future volume gains. In comparison to most wild seed collections, the orchard lots have germinated better and the seedlings grew larger with more crop uniformity. The observed difference in specific crosses sown in the greenhouses has been phenomenal and again holds promise for the future.

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SILVA ENTERPRISES LTD.

Silva Enterprises Ltd. was started in 1965 by Finnish immigrant and BC Forester Rolf Hellenius, at the request of Swedish and Finnish Foresters that required good quality seed and pollen from British Columbia and the Yukon. The company has remained a family business, currently managed by Peter Hellenius. We now provide indigenous and imported forest tree seed for Canadian companies and export OECD certified forest tree seed to companies in Scandinavia, Europe, and the United States. As well we handle custom seed extraction, cleaning, lab services, and cone/seed consultations and evaluations for domestic companies. Telephone and/or fax consultations are provided at no charge or obligation to use our services.

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NATIONAL TREE SEED CENTRE

The fruit and seed crop was not good on most species in the Maritimes in 2005. Seed from red maple (*Acer rubrum*) and fruit from pin cherry (*Prunus pensylvanica*) was collected. Seed and fruit from these species was also collected for the Seed Centre by the Newfoundland Department of Natural Resources. We are grateful for these donations. Choke cherry (*Prunus virginiana* var. *virginiana*) fruit was also collected at Chicoutimi, Québec. These *Prunus* collections are being made as part of range-wide collections for an agroforestry project being conducted by Bill Schroeder at Agriculture and Agri-Food Canada's Indian Head Nursery in Saskatchewan. One surprise this year was a seed crop on black ash (*Fraxinus nigra*) because there was quite good production in 2004 on some sites. Therefore, single-tree collections were made at three locations in northern New Brunswick, one location in the Gaspé region of Québec, and a partial collection along the Saguenay River in Québec. These collections will supplement those made in 2004 as part of a project to conserve ash germplasm before it is destroyed by the Emerald Ash Borer and to allow for the evaluation of genetic variation within black ash.

When the Seed Centre was located at the former Petawawa National Forestry Institute it stored seed for researchers of the tree breeding program. A significant portion of these seedlots are left over after the establishment of range-wide provenance trials. As time and personnel resources permit, seed is germination tested. Testing has been completed for white spruce (*Picea glauca*) and black spruce (*P. mariana*). This past summer, work focussed on jack pine (*Pinus banksiana*) with the testing of over 800 seedlots. These had been last tested in 1986. Seed remained from 57 seedlots representing provenances tested in the range-wide provenance trials established in the mid 1960s. Much of this seed had been collected in the 1950s. Germination ranged between 0.1 and 96% and averaged 61% for these older seedlots. The majority of the remaining seed (689 seedlots) had been collected in the 1960s, 1970s and 1980s. Germination averaged 89%. Over 300 seed lots were collected in 1977 and 1978 and germination of this 27- and 28-year-old seed averaged 94%. The decline in germination from when the last test was done (20 years ago) was very small. These results clearly demonstrate the long-term storage potential of jack pine seed particularly when one considers that these older seed had not always been stored at optimal conditions.

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DEVELOPMENT OF BIOLOGICAL CONTROL METHODS AGAINST SEED ORCHARD INSECT PESTS

Seed orchards are favorable sites for the establishment and development of insect pest populations. These pests can attack cones and seeds which leads to a significant reduction of harvested seeds used for the production of genetically improved seedlings. Since 1999, concerted efforts from many researchers allowed the development of biological control methods against some of the most important pests. More particularly, the Entomopathogen Research Laboratory of Dr. Claude Guertin directed its research activity on the development of biological control tools against cone and seed insects in order to limit damage caused by these pests.

Fir Coneworm and Spruce Cone Maggot: Control Methods Oriented on the Use of Entomopathogens

The fir coneworm (*Dioryctria abietivorella*) is an insect that causes important damage in white spruce seed orchards of many Canadian provinces. In collaboration with Fabienne Colas (Ministères des resources naturelles et de la faune du Québec), we developed an application protocol for the use of *Bacillus thuringiensis* var. *kurstaki* (*Btk*) to control fir coneworm populations in seed orchards. The objectives of this project were: 1) to evaluate the effect of multiple applications of *Btk* on *D. abietivorella* mortality, and 2) to determine the appropriate application rate in order to obtain satisfying levels of cone protection. This study allowed us to demonstrate that 3 *Btk* applications on a weekly basis, once *D. abietivorella* larvae are found in cones, can lead to a significant reduction in cone damage. The study showed that trees that were treated 3 times with *Btk* had 21% of their cones damaged compared to 46% in the control plot. A rate of 1 L/ha was used to obtain these results.

The spruce cone maggot (*Strobilomyia neantracina*) is the most important cone and seed pest of spruce seed orchards. Its main host is white spruce, but this insect can also attack cones of other North American spruce species, in particular black spruce. Research studies were conducted over the last years investigating the insectidal potential of *Beauveria bassiana* for the control of this pest. During preliminary studies, the screening of different isolates allowed us to identify a very effective one with very good mortality rates. With a dose of 1.0 x 10^7 conidia/ml, it was possible to achieve 98% larval mortality after an experimental period of only 6 days. Even if larvae were undergoing metamorphosis into pupae after a *B. bassiana* treatment, histological observations revealed they were moribund and that they would not reach the adult stage. Other projects are in progress in order to determine the efficacy of soil application of *B. bassiana* on pupa and adult mortality after winter diapause.

White Pine Cone Beetle and Spruce Seed Moth: Control Methods Oriented on the Use of Sex Pheromone

The white pine cone beetle (*Conophthorus coniperda*) is a threat to cone crops in white pine seed orchards in Québec and in many other provinces in Canada. The use of a sex pheromone in a mating disruption device was tested in order to verify the effect of this control method on cone protection. Dr. Peter de Groot contributed, over the last ten years, to the identification and the development of the synthetic pheromone of *C. coniperda*, the (+)-trans-pityol, (2R,S)-(+)-2-(1-hydroxy-1-methylethyl)-5-methyltetrahydrofuran (hereafter called pityol). In collaboration with Dr. de Groot, we conducted an experiment in order to evaluate the potential of mating disruption in a white pine seed orchard at St-Amable, QC, where control and treated plots were established. At the end of the first year of the study, 80% of cones were intact in the pheromone-treated plot compared to 14% in the control plot located 100 m west. After two years, an average reduction of 63% of cone damage was obtained in the pheromone-treated plot compared to the control plot. A minimum density of 10 pytiol bubble caps per hectare is required in order to reach a significant level of cone protection (Trudel et al. 2004).

The spruce seed moth (*Cydia strobilella*) is also another important seed orchard pest. This insect is mainly found on white spruce, but it can also attack other spruce species, such as black spruce. During a previous experiment, Dr. Gary Grant and his collaborators were able to identify and develop the synthetic sex pheromone of *C. strobilella* (*E*8-12 :Ac). The efficacy of the synthetic pheromone was tested in the laboratory using electroantenographic tests and also in the field with monitoring sticky traps, during the mating period. With the collaboration of Dr. Grant, we documented the potential of mating disruption for the control of *C. strobiella* in a white spruce seed orchard at Wendover, QC. Sixty septa per hectare were hung in the treated plot, and then 4 monitoring traps baited with *E*8-12 :Ac (3µg/septa) were placed in the pheromone-treated plot and 4 others in the control plot. Two weeks later, an average of 27 *C. strobilella* males per trap were counted in the treated zone compared to an average of 453 males per trap in the control plot. In addition, 51% of the cones were damaged in the control plot compared to 22% in the pheromone-treated plot. After a two year experiment, an average reduction of 62.1% of cone damage was obtained in the pheromone-treated plot compared to the control plot (Trudel et al. 2006, in review).

Financial support for these research studies came from la Direction de la production des

semences et des plants du Ministère des ressources naturelles et de la faune du Québec, Fond québécois de la recherche sur la nature et les technologies (FQRNT), and INRS – Institut Armand-Frappier. For more information on these research projects, please contact Richard Trudel.

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WEB SITE UPDATES

A recent e-mail from Frank Bonner confirms that work is progressing well on the printed version of "Seeds of Woody Plants of the United States." Frank expects to be finished with the second review of the galleys in January and the book will go to press shortly thereafter. Five chapters and all the genera can be viewed by going to the National Seed Laboratory's web site http://www.nsl.fs.fed.us/ , following the link to the Seed Technology Centre - Publications page, and clicking on Woody Plant Seed Manual.

The BC Tree Seed Centre has a new web site as a result of a recent renaming of the Ministry to Ministry of Forests and Range. The Seed Centre's home page can now be found by going to http://www.for.gov.bc.ca/hti/treeseedcentre/index.htm.

IUFRO TREE SEED SYMPOSIUM

The Tree Seed Physiology and Technology Working Group 2.09.00 of the International Union of Forestry Research Organizations will hold its next symposium July 18 – 21, 2006 in Fredericton, New Brunswick, Canada. The Seed Physiology and Technology Working Group is an open group and welcomes all interested people to attend.

The theme of the symposium is "Recent Advances in Seed Physiology and Technology" and the goal is to discuss forest tree seed problems and their solutions, and for the exchange of information on all aspects of forest tree seed physiology and biotechnology.

This meeting will be held just prior to the Tree Seed Working Group Workshop (July 24, 2006) and the Canadian Tree Improvement Association (CTIA) meeting (July 24-29) in Charlottetown, Prince Edward Island. Transportation will be provided for those wishing to attend these meetings.

For further information e-mail: cfs-IUFRO@nrcan.gc.ca

NEW CONE AND SEED INSECT AND DISEASE RESEARCH PROGRAM IN BC MINISTRY OF FORESTS

A new research program dedicated to cone and seed pest management issues has been created within the Research Branch of the British Columbia Ministry of Forests and Range (MoF). Located at the Kalamalka Forestry Centre in Vernon, this program takes over from where the Canadian Forest Service left off nearly two decades ago. Operation of the program is funded by the provincial Forest Investment Account with the guidance of research plan priorities identified by the Forest Genetics Council of BC (FGC). Dr. Ward Strong, previously the MoF's Cone and Seed Pest Management Biologist, will assume leadership of the program in January 2006. He will work closely with the FGC's Pest Management Technical Advisory Committee (PM TAC) and a wide range of research partners to ensure that the research plan evolves and important cone and seed pest management research issues are addressed. For further information about cone and seed pest management research in British Columbia, contact Ward at Ward.Strong@gov.bc.ca or the Chair of the PM TAC, Dr. Robb Bennett.

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UPCOMING MEETINGS

ISTA Annual Meeting
June 26–29, 2006 Zurich, Switzerland
www.seedtest.org

IUFRO Seed Physiology and Technology
July 19–22, 2006 Fredericton, NB
cfs-IUFRO@nrcan.gc.ca

30th Canadian Tree Improvement Association
July 24–29, 2006 Charlottetown, PEI
http://www.gov.ns.ca/natr/forestry/ctia/

Seed Ecology II
September 9–13, 2007 Perth, Western Australia
www.seedecology2007.com.au

Carrefour de la recherche forestière
September 19–20, 2007 Québec City, QC
http://www.mrn.gouv.qc.ca/carrefour/

IUFRO Larix Symposium
September 16–21, 2007 Québec City, QC
http://www.mrn.gouv.qc.ca/carrefour/larix.asp

Canadian Poplar Council
September 16–21, 2007 Québec City, QC
http://www.mrn.gouv.qc.ca/carrefour/populus.asp

28th ISTA Congress
May 5-11, 2007 Iguassu Falls, Brazil
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