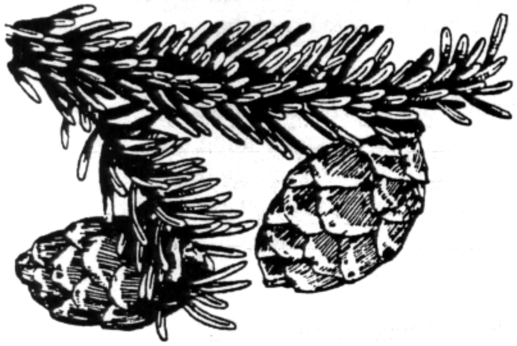
CANADIAN TREE IMPROVEMENT ASSOCIATION/
ASSOCIATION CANADIENNE POUR L'AMÉLIORATION DES ARBRES

Tree Seed Working Group



NEWS BULLETIN

21

No. 21

March 1994

A WORD FROM THE CHAIRMAN

This spring, one of our Group's founding members officially retires after over 34 years of service in the forestry scientific community. Let's take a moment to talk about our colleague and some of his many career achievements.

Ben Shih Pin Wang was born in Huangxian, northern China. He came to Canada in 1957, a couple of years after receiving a B.Sc.F at the National Chung-Hsing University of Taiwan. He attended UBC, obtaining a Master's degree in Forestry (Forest Tree Seed) in 1960. He then worked for 6 years in silvicultural research for the Federal Government Forestry Service. He joined PNFI in 1966 where he developed his skills and became a world authority on seed research.

It is very difficult to summarize Ben's achievements. He has been a busy and prolific scientist. During his career he:

1. Established the Forest Tree Seed Research Unit and the National Tree Seed Bank at PNFI;
2. Conducted research in silviculture, and seed science and technology and authored or co-authored over 80 scientific, technical papers, and reviews;
3. With a colleague and forestry industry, he designed and developed the unique "Petawawa germination box" - now used worldwide;
4. Developed laboratory seed germination and vigour evaluation criteria that are presently used in many seed centres, universities, and forest industries;
5. Made the first thorough proposal for government forest tree seed registration and certification in Canada;
6. Provided and continues to provide advisory and consulting service to CIDA's ASEAN-Canada Forest Tree Seed Centre Project as Technical Advisor, Monitor, Scientific Coordinator, and Seed Technology Advisor;
7. Participated with CIDA since 1987 in the establishment of a Tree Seed Research Centre Network for 10 countries in southern Africa; and
8. Founded the Tree Seed Working Group within the Canadian Tree Improvement Association and made significant contributions towards its development into a networking group of all tree seed workers in Canada and participants from other countries.

Though he retires this spring, Ben expects to spend six months as a visiting research fellow at the Forest Research Institute of Taiwan and continue to work for CIDA. These projects will continue to take him around the world to places such as Brunei, Singapore, Malaysia, and the Philippines.

Ben is a highly respected, international leader in many aspects of tree seed research. He has offered a remarkable effort in sharing his knowledge and encouraging the development of tree seed research in Canada and throughout the world. His contributions to world forestry were recognized in 1991 when the Canadian Institute of Forestry awarded him their International Forestry Achievement Award.

Ben, we all wish you the best for your retirement. Thanks for your lifelong dedication to seed research. Your foresight has lead to major seed research developments in Canada and abroad, and this will be deeply appreciated by all for years to come.

Avec amitié,

Guy E. Caron, Group Chairperson

Note These Addresses

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Queries, comments, and contributions of the "NEWSBULLETIN" are welcomed by the chairperson, coordinators, or the editor.

Editors Notes

If seed research/technology is to progress there must be a good information flow within our research environment. Such information flow is generally satisfactory because it only requires dealing with our peers. However, much of the value in good research results lies in their practical application to solve real problems. Unfortunately as research/testing endeavors have become more complicated and more specialized, the communication process has not kept pace. There is abundant technical information neatly placed in unpublished storage and also large volumes of research results that sit published but unused on library shelves.

Publication is an important step in the scientific process but the communication of research should not stop there. The transfer of results to users in the field, to both research and operations managers, to policy makers and if necessary to the general public should be recognized as a meaningful responsibility of the researcher/technologist.

The transfer of knowledge isn't really a difficult task. All that is required for good communication is to rewrite the material in an appropriate language (i.e. non-technical language for the policy makers), then packaging the information in an appropriate format and distributing it to the selected audience.

The diffusion of information can be assisted by adopting a procedure that forces information generators (i.e. researchers or technologists) to decide what information should be transferred, who is to pass on the information, who is to receive it, how the transfer is to be made (media), and what sort of response to the transferred information might be expected. Consider using the following outline to guide the preparation of your next technology transfer effort.

<u>Title</u> (Brief working label for the transfer task)

<u>Message</u> (Exactly what information is to be transferred?)

<u>Audience</u> (Precisely; Who do you wish to reach? Focus only on 1 or 2 specific groups)

<u>Objective</u> (What outcome do you expect from your intended audience?)

<u>Return Messages</u> (What kind of knowledge might be gained in turn from the intended audience?)

<u>Team</u> (Who needs to be involved, and what will be the role of each person?)

<u>Media</u> (Bear in mind cost and available technical capabilities)

<u>Budget</u> (Include funds by source and time estimates by team member)

<u>Evaluation</u> - immediate impact (How do you measure immediate impact?) - longer term impact (How long a term do you want to consider?)

If you have information that could be used by other seed workers, please do your part to ensure its distribution. Also, don't forget that this Newsbulletin can be used to help spread the word.

Hugh O. Schooley (The above is pep-talk #11)

Forestry Canada Forêts Canada

Your file Votre référence

Our file Notre référence

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11 March 1994

Members of CTIA - TSWG

Dear 'Tree Seed' Colleague:

Since 1983, the seed research unit at Petawawa National Forestry Institute, (PNFI) has been supporting the Tree Seed Working Group of the Canadian Tree Improvement Association, in developing and maintaining a research/technology network among seed workers. The Working Group includes most of the people in Canada having tree seed interests as well as a few individuals in the USA, Africa, China, Finland, Sweden, India, and other countries. They are concerned with seed physiology, development, germination, production, pest control, or tree improvement research, with seed procurement, processing, storage, or testing technology, with seed orchard management, with seed certification and sales, or with seed utilization.

The Working Group's networking activities currently involve arranging for tree seed to be a subject for discussion at workshops and professional meetings, twice yearly publishing a Newsbulletin (English), maintaining a directory of seed workers, and as individuals, voicing support for tree seed work and distributing research/technology information in all possible ways both within and outside the Group.

The seed research unit at PNFI recognizes that the distribution of tree seed research/technology information can be further enhanced by the establishment of an email discussion group on the INTERNET and would willingly accept the responsibility of managing such a facility.

I am now pleased to announce that an international electronic mailing list discussion group for tree seed has been set up.

This discussion group is a forum for rapid exchange of research/technology information, ideas, and opinions related to topic tree seed and also welcomes announcements of meetings, calls for papers, help/employment wanted messages, and book reviews. Messages between members of the group are sent by electronic mail. All members are sent electronic copies of each piece of correspondence, keeping everyone informed of the ongoing electronic 'discussion'.

There are two parts to the service: the discussion group, and an automated list server. The discussion group operates in a very simple manner. All mail received at the address 'TREESEED@PNFI.FORESTRY.CA' will be copied and sent automatically to all subscribers on the list. Subscriptions are managed automatically by the list server.

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To add your name to the subscription list send a message to 'LISTSERV@PNFI.FORESTRY.CA' with single line message of the form: SUBSCRIBE TREESEED FirstName LastName. A message confirming that your name has been added to the list will be sent to you.

Membership in this group is open to everyone expressing an interest in tree seed. Please feel free to pass on this information sheet to any colleague that you think would be interested.

You have read or heard of how rapidly interest in electronic networking is developing. I urge you, if at all possible, to subscribe to the discussion group, read the information provided by the group, and share your information with everyone. Be forewarned, by the turn of the century 'NETWORK LITERACY' like computer literacy in the past decade, will become an essential tool in our work.

The Canadian Tree Improvement Association - Tree Seed Working Group produces a Newsbulletin twice yearly. Many of the articles submitted to the newsbulletin will be copied to the discussion group mailing list, and vice-versa. The newsbulletin provides a service to those without electronic mail access, but is only available in English. Requests for subscriptions to the newbulletin may be addressed to me at PNFI.

Sincerely,

Hugh

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UPDATE ON PROGRESS MADE BY THE IPMISO/CSIWP

The Integrated Pest Management in Seed Orchards (IPMISO) network was established in 1991 (see the March 1993 edition of the TSWG NewsBulletin). Its goal is to develop ecologically acceptable and practical pest management strategies for key diseases and insects in Canadian seed orchards. To this end, and with the support of Green Plan funds, scientists are conducting studies in three strategic areas:

1. **Population monitoring and damage prediction.** Key products are tools or methods to assist orchard managers in forecasting pest damage and making decisions regarding the use of control methods. They include: 1) effective and commercially viable pheromone dispensers for monitoring cone beetles in pine orchards; 2) sequential sampling plants for predicting percent seed losses due to cone maggots in spruce and tamarack orchards; 3) a hazard rating system for Armillaria in seed orchards; and 4) pheromone trap monitoring of the fir coneworm, *Dioryctria abietivorella* in British Columbia Douglas-fir orchards.
2. **Control tactics.** Key products are behavioral and cultural alternatives to chemical controls in seed orchards, and include: 1) the operational evaluation of a mass trapping program for suppression of cone beetle damage in pine seed orchards; and 2) guidelines for control of Armillaria in seed orchards.
3. **Basic biology and ecology.** Key products here are scientific knowledge necessary for the development and effective application of monitoring, damage prediction and alternative control strategies. They include: 1) life tables for cone maggots in spruce and identification of natural mortality factors; 2) identification and synthesis of alarm, sex and aggregation pheromones of the western conifer seed bug and their evaluation in laboratory and field bioassays; 3) effects of moisture stress, soil nutrients, and site conditions on Armillaria infection: and 4) elucidation of the life cycle of the coneworm on Douglas-fir.

Some highlight of results so far:

Researchers at CFS-FPMI and the US Forest Service began a pilot study in 1993 to determine if pheromone traps baited with pityol could remove sufficient numbers of male cone beetles, *Conopthorus* sp., to reduce beetle mating success, and lower beetle populations and damage within an orchard. Thousands of beetles were caught. Once the data are fully analyzed, requirements for the operational testing of a trapping out program will be determined. Other field tests clearly showed that significantly more white pine cone beetle males were caught in traps baited with a combination of pityol and alpha pinene than in traps baited with pityol only. These data are necessary for the development of an effective lure for both monitoring and mass trapping. Further evaluation of pheromone dispensers, the effect of trap colour on trap catch, and testing of the trapping out technique are planned for 1994-95.

Studies of cone maggot population dynamics by researchers at CFS-Maritimes, FPMI, and the University of New Brunswick have brought us closer to an operational sequential sampling plan that will allow managers to accurately predict the category of percent seed loss in larch and spruce seed orchards, based on the number of egg-infested cones in spring. Once analyses are completed, data collected in 1992 and 1993 will provide quantitative estimates of survivorship from the egg stage to mature larvae, the frequency and spatial distribution of maggot eggs in black spruce and the impact of maggot on seed germination. With the cooperation of orchard managers, we plan to test a preliminary sequential sampling plan, based on results to date, in Maritime spruce seed orchards in 1994. Additional plans for 1994-95 include the development of life tables for the spruce cone maggot, *Strobilomyia neanthracina*, in white spruce, and evaluations of coloured sticky traps as tools for monitoring cone flies.

Behavioral bioassays and gas chromatographic analyses conducted by researchers at Simon Fraser University have revealed the presence of potential alarm pheromones emitted by *Leptoglossus occidentalis*, the western conifer seed bug. Plans for 1994-95 include identification and synthesis of the alarm pheromones and their evaluation in lab and field bioassays. If a synthetic alarm pheromone is available, it may be used to deter or interrupt seed bug feeding in seed orchards. Also planned for 1994-95 are the identification of antennally-active sex or aggregation pheromone candidates, and tests of their effects on seed bug behaviour.

Researchers at CFS-Ontario Region, CFS-Northern Region, and at Laval University have made considerable progress in the development of pest management guidelines (impact, hazard rating, control) for Armillaria, a key disease in many orchards. Seed orchards in Ontario and Quebec were surveyed to determine the range of Armillaria species present and also a number of site factors, such as soil type and soil moisture. Greenhouse experiments were conducted to determine the effect of soil nutrient levels and defoliation-induced stress on the development of Armillaria infection, and further tests are planned for 1994-95. This data will be used to develop a model to predict the risk of root rot in seed orchards and also to develop guidelines for its control.

Researchers with the B.C. Forest Service and Simon Fraser University have made significant initiatives towards elucidating the taxonomy, biology, and chemical ecology of the fir coneworm, *Dioryctria abietvorella*. This fir coneworm's biology is poorly understood it is a severe pest in Canadian seed orchards. Larval development was monitored at nine sites across southern B.C. in 1993. Although populations were low, pupation was observed to begin in late July and continued through September. There is currently no evidence to suggest a fall flight. Plans for 1994-95 include pinpointing the time of larval drop and adult flight and field testing of candidate pheromone compounds.

Jon Sweeney, IPMISO network Co-ordinator, Canadian Forest Service-Maritimes Region, P.O. Box 4000, Fredericton, N.B. E3B 5P7

TREE SEED: A TERRESTRIAL NON-FOOD CROP

The Southern (USA) Forest Tree Improvement Committee through its Seed Orchard Pest Management (sub) Committee, (established in 1989), has succeeded in having seed orchards reclassified from forestry to terrestrial non-food crops for the purpose of pesticide applications. This reclassification should significantly lower the cost of securing pesticide registration for seed orchard use and make it more attractive for chemical companies to consider registration of their products for this purpose.

(Reprinted from N.C. State Univ., Indust. Co-op. Tree Imp. Program. 36th Annual Rep. 1992).

LABORATORY REARING OF *DIORYCTRIA ABIETIVORELLA*

The fir coneworm, *Dioryctria abietivorella* (Grote), is a serious pest of seed orchards in the province of Quebec. Insects are mainly found on White spruce, Norway spruce and on White pine. The insect decreases the reproductive potential of these trees.

A research project was initiated during summer 1992, to evaluate the potential of various strains of *Bacillus thuringiensis* (Ber) var. *kurstaki* on each larval instar of the coneworm, using the standard method of LD_{50} determination. The first step of this study was to develop an aseptic rearing procedure to produce large numbers of insects without contamination. This goal has been achieved and a series of tests using *Btk* as an insecticide are being conducted.

Our laboratory colony is now approximately 4000 insects, from which we use 1000 insects each time we do bioassays. We have had very good success with the colony, but since we began this rearing (1992), we have not been able to go out to the field to get new stocks of insects.

The purpose of this note in the Newsbulletin is to request information from other researchers working on this insect. Does anyone else have a laboratory colony of the fir coneworm? We would like to make an insect exchange to refresh the genetic pool of our colony. We also want to inform researchers that the insects that we are rearing could be made available for other studies.

Please contact: **Richard Trudel**, Ministère des forêts, Service des laboratoires, 2700 Einstein, local D.1.205, Ste-Foy, Québec, G1P 3W8, ☎ (418) 644-2072, Fax: (418) 644-0031.

INSECT PEST MANAGEMENT: FIELD GUIDE

Copies of the English and French language versions of the field guide: Management of Insect Pests of Cones in Seed Orchards in Eastern Canada are still available -free-. Contact either:

1. Information Office, Canadian Forest Service, P.O. Box 490, Sault Ste. Marie, Ontario, P6A 5M7, or
2. Ministry of Natural Resources, Ontario Forest Research Institute, P.O. Box 969, Sault Ste. Marie, Ontario, P6A 5N5.

TRANSPORTATION OF TREE CONES IN BULK

Pine cones have traditionally been transported from the picking site to the seed extraction center in burlap bags. A new method of transportation, the Megabag, has recently been introduced by the Alberta Forest Service. This type of container, known as an intermediate bulk container (IBC), has been used for about 20 years in other applications such as the bulk transport of fertilizers, powders, grains and other solid materials; IBCs are also used for cone transport in the southern U.S.A. Intermediate bulk containers are made of woven polypropylene tapes with high tensile strength; the Megabags used by the Alberta Forest Service have a maximum capacity of 1000 kg. The Megabags are filled at a central field location and shipped to the seed-extraction center on open-decked semitrailers. From then on, all handling is done by forklift, allowing fast and easy loading and unloading. The megabags are also stackable when full. It is expected that these bags will reduce labour requirements in shipping and handling and reduce the risk of back injuries associated with manual handling of burlap bags. FERIC is carrying out a study that focusses on the cost and benefits of this system of transport, and also the constraints.

Ernst Stjernberg, Western Division, FERIC, Vancouver

(Reprinted from Silviculture Operations Newsletter 6(2): 24)

On-site Delimbing and Preparation of the Soil for Natural Regeneration of Jack Pine

This project tests the natural regeneration potential for jack pine when delimbing is performed directly on the cutover. Over the summer of 1993, a 36-ha experimental block was established on mesic clay soils to evaluate the effects of three harvesting methods on cone opening, seed germination and juvenile growth of jack pine.

The harvesting methods were designed to: (1) protect regeneration by minimizing soil disturbance; (2) to produce moderate soil disturbance; (3) and harvesting followed by site preparation to produce maximum soil disturbance. For each method, half the test block was clearcut with delimbing at the stump and the other half was clearcut, but leaving seed trees and with delimbing at roadside.

The study area will be followed over two years to determine: the recovery of understory species, the abundance of various microsites for germination, stocking, regeneration density before and after treatment, and the proportions of opened and closed cones, as well as their positions.

A second, smaller study block (6.48 ha) was also set up to address the same problem. Its goal was to examine jack pine natural regeneration on three soil types (clay, till, and sand). It will also attempt to address several specific questions on cone serotiny, seed production, seedbed quality, microsite environmental conditions (temperature, light and humidity), the importance of vegetative competition, and the regeneration of other species present in the Abitibi region's jack pine stands.

For further information, contact: **Martin Béland**, Université du Québec en Abitibi-Témiscamingue, Rouyn-Noranda, Que., ☎ (819) 762-0971, Fax: (819) 797-4727)

Reprinted from Silviculture Operations Newsletter 6(2): 7-8)

Pre-Seeded Shelter Cones; Preliminary Results

Scandinavian-made plastic shelter cones have long been considered as a lower-cost regeneration alternative to planting and for improving the success of direct seeding. The concept is sound, but the operational aspects of seeding with shelter cones are problematic. Inconsistent seed delivery coupled with an inability to effectively anchor the shelter to the soil surface prompted investigation into the development of a pre-seeded shelter cone accompanied by an improved tool for cone placement.

In 1991 the Forest Engineering Research Institute of Canada (FERIC), with Alberta plastics manufacturer Spencer-Lemaire, initiated development of a technique of attaching a predetermined number of seeds to a small flap or lid located at the shelter's apex. The seeds would be held in place by a water soluble adhesive and would be released during the first rainfall. Also a tool would be designed to both prepare the micro-site and insert the shelter. A spring loaded plunger housed in the shaft of the tool would bend the flap holding the seeds into the shelter while simultaneously releasing the shelter.

The Great Lakes Forestry Centre's involvement was to determine the biological effectiveness of the cone's design. In 1992 a field trial using jack pine seed was initiated to assess the pre-seeded cone in comparison to other shelter types and unsheltered seed spots. Fine-wire thermocouple sensors were used to measure differences in temperature between sheltered and non-sheltered seed spots at the soil surface and at 3.5 cm above the surface. Concern over the potential of the pre-seeded cone's flap to recoil to a closed or semi-closed position following insertion, and the effect that would have on inside shelter temperatures, prompted us to simulate various flap angles. (i.e. lid removed, at 45° and lid closed).

Figure 1 illustrates the mean hourly soil surface temperature variation during a sample day that represents the typical conditions that seeds would be exposed to during the very critical imbibition and germination phases. The data indicates that all seed shelters designs have the ability to moderate night time temperatures, bringing them closer to the optimum temperature range for jack pine germination. However, shelters with their lids closed and lids at a 45° angle both experienced significantly elevated soil surface temperatures which exceeded the upper cardinal temperature for germination for 4 to 5 hours. Air temperatures at the 3.5 cm height on that same day exceeded 50°C and within the shelters increased in relation to the temperature of the shelter wall. If the heat which radiates from the shelter's wall is allowed to build up within the shelter due to inadequate ventilation it will produce critically high mid-day temperatures. This resulted in a near 30% reduction in stocking. A subsequent modification to the shelter's seed holding flap was made to allow the lid to be locked into an open or vertical position once depressed by the shelter placement tool's plunger.

In 1993 a second seed spot field trial using the modified shelter was conducted near Chapleau, Ontario. Four white spruce seeds were pre-attached to the shelter's hinged lid using a 12.5:1 ratio (water:Airvol 603) solution. The shelters were installed by hand. The control consisted of hand sowing four seeds onto an unsheltered seed spot. All seed spots were hand scalped, removing from 3 to 7 cm of duff to expose mineral soil. Conditions were very favourable for seed germination and seedling establishment. There were no more than five consecutive days without precipitation during the growing season which resulted in minimal moisture stress and subsequently higher than normal overall rates of germination. However, even under these favourable conditions, the shelters outperformed the unsheltered control in stocking by 31 percent and increased germination density by over 40 percent. In fact, germination results within seed shelters rivalled those achieved in laboratory germination tests conducted under controlled conditions. Results from both the 1992 and 1993 seed spot trials are presented in Figure 2.

Spencer-Lemaire is refining the shelter lid locking mechanism to ensure that it is securely held once depressed. They are also continuing to develop an automated process for attaching seeds to the shelter lids. FERIC is continuing to modify the shelter placement tool as this system evolves.

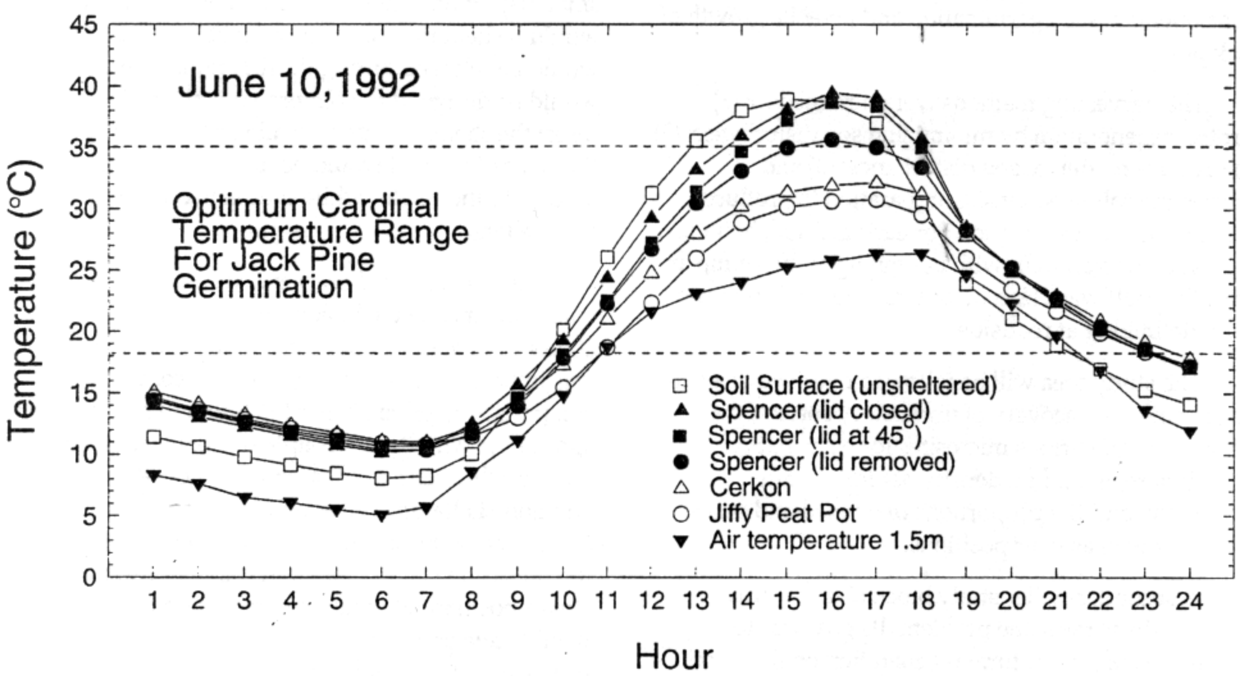

Figure 1. Relationship between seed shelter design and mean hourly soil surface temperature on a typical clear, spring day. Dotted horizontal lines represent the upper and lower cardinal temperatures for jack pine germination.

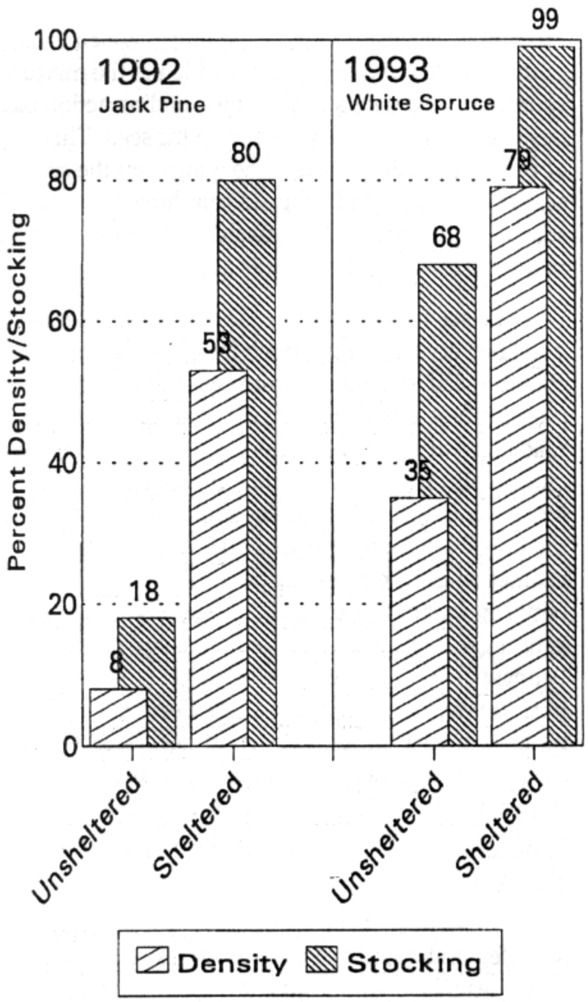

Figure 2. Percent stocking (at least one seedling per seed spot) and percent density or germination ratio (number of seedlings per 100 seeds sown) for unsheltered seed spots and pre-seeded cone shelters.

Mike Adams (CFS, Sault Ste. Marie)

TECHNOPHOBIA: FEAR OF E-MAIL AND INTERNET CONNECTIONS

Technophobia: boy have I got it bad! I can look at my computer terminal — no problem — but touching the keyboard sends shivers of dire consequences up and down my spine. I'm not really out-of-touch with today's way of doing almost everything on a computer: its just that until a couple of years ago the organization I work for was big enough to do all the computer work I needed — as a service. I never had to learn to do it myself. However, things have changed!!!

Despite my phobia I have recently been communicating with my peers and with TSWG members through E-MAIL. My one-finger-key-punching isn't easy but the messages come and go and the work gets done: probably more efficiently. I have also spent considerable time during the past month wandering through the BULLETIN BOARDS of the INTERNET. I now subscribe to several that are of interest to me as a forester; ie. BIONET.AGROFORESTRY, and BIONET.PLANTS, and I belong to LIST SERVER: <forest@nic.funet.fi> an IUFRO interest connection.

There was and will be a lot of interesting information on the INTERNET, but not too much about tree seed. (This could change if our Group got active.) Some pieces of information are worth following up on. For example, I learned from JANET: <ajt@uk.ac.sari.rri>, through BIONET.PLANTS that 'PineBib, a conifer bibliography' is available at gopher node:

University of California - Irvine →
Departmental Information Sources →
Ecology and Evolutionary Biology →
UCI EcoEvo Departmental Resources →
PineBib: A Conifer Bibliography →

'PineBib' is a bibliography database containing references on conifer reproductive biology, breeding systems, and genetics. PineBib focuses on, but is not restricted to, the Pinaceae.

This is information I will probably utilize and may contribute to. Also, now I know the names and addresses of two more people interested in tree reproduction:- Dr. A.J. Travis who posted the message on BIONET.PLANTS and Robin Bush who originated the message and posted it on BIONET.ANNOUNCE.

If your not already using E-MAIL and visiting the INTERNET I suggest you read 'Foresters And The Email Revolution: A Glorious Opportunity' by Steven Rose (Jan/Feb 1994, Forest Chronical, Vol.70 (1):55-57) — then get with it!!!

Hugh Schooley

ATLANTIC FOREST SEED CENTRE — FREDERICTON, N.B.

The Atlantic Forest Seed Centre (AFSC) was established under the auspices of a federal/provincial forestry agreement in 1978 to meet the seed extraction needs of the Atlantic Region. The facilities include areas for cone receiving, cone and seed pressing, seed storage, a seed laboratory, and office space. The AFSC provides seed extraction and seed storage service to the four Atlantic provinces, many forest companies as well as approximately 20 private growers and also offers seed for sale.

On average the AFSC processes between 200-400 hectolitres (hl) of cones per year. This fluctuates greatly depending on the cone year. Virtually, all of the cones processed originate from clonal and seedling seed orchards. Currently we have 4500 kg of seed in storage which represents 265 seedlots and 10 major tree species.

The Centre is also responsible for cone collection from New Brunswick's Department of Natural Resources and Energy seed orchards. These seed orchards were established under the Department's Tree Improvement program, where selected trees provide genetically superior seed for reforestation. In addition, the Centre supplies seed and provides an advisory service on seed use for the Department's forest nurseries.

Cones collected by the various clients are shipped to the Centre for seed extraction and seed cleaning. When they arrive at the Seed Centre each batch is carefully labelled to avoid becoming mixed with cones belonging to another organization then placed in specially designed sheds, to promote ripening and evaporation of some of the moisture. After several weeks of drying cones are moved into the Seed Centre building on each production day.

The Centre has five heated kilns, each containing a large wire mesh drum. The cones are put into the drums, which revolve. The heat opens the cones while the rotating action of the drum causes the seed to fall out and drop into hoopers below. The time involved in this process varies from species to species, although most require approximately 20 hours in the kilns to release the seed. Once the seed has been released from the cones, the bits of cone, seed wings and other chaff must be removed to ensure that only the best quality seed is shipped from the AFSC.

A variety of specially designed machines and systems are used for the cleaning process. The first step is the removal of dust and larger pieces of waste material using a "clipper" cleaning machine. The seed and chaff is loaded into the hopper at the top of the machine, and as it drops through a series of vibrating screens, the large waste particles are removed first, followed by the dust. This leaves a mixture of seed and waste material of approximately the same size as the seed. The seed is loosened from the seed wing in the next stage, which involves placing the seed/waste mixture in a canister called a dewinger, which is lined with a series of ridges. Water is added to the mixture to soften the seed wings so that the tumbling action of the dewinger detaches the wings from the seed. This takes approximately 20 minutes. The wings and the seed are separated in a second "clipper" machine. Usually, the seeds are put through this machine twice to remove as many wings and hollow seeds as possible.

The seed to be used in today's precision seeders must be very clean. Fine pitch (or resin) dust may still coat the seed. In addition, pitch granules and cone pieces can be difficult to remove with the "clipper" machines. In a liquid separator, the good seed floats and is collected, while the cone pieces become water logged and the pitch granules sink to the bottom. From the liquid separator, the seed goes into the drying cabinet where the moisture content is reduced to between four and eight percent. The drying cabinet that is used, was designed and manufactured in New Brunswick and we have been very pleased with its performance. The final step of the cleaning process passes the seed through a vacuum separator. Generally, the good seed is heavier and will pass through the vacuum separator while the unwanted material is suspended in the airflow and deposited into separate chambers.

Every batch of seed processed by the Centre is sampled and a series of quality tests is conducted. These tests follow international seed testing standards and include determination of percent germination, moisture content, seed purity and seed weight. Forest seed can be stored for many years providing that the seed moisture content and storage temperatures are kept at acceptable levels. Quality tests are periodically repeated on all seed stored at the AFSC.

Kathy Tosh

MIGHT GENETIC PERFORMANCE CHANGE IN A HIGH CO_2 WORLD?

Atmospheric CO_2 concentrations are predicted to double in the next century. Numerous studies with both herbs and trees generally indicate some degree of growth enhancement due to elevated CO_2. In addition, elevated CO_2 often results in the modification of physiological and morphological process components of growth. Such effects include: decreased photosynthetic capacity, increased water use efficiency, alterations in biomass partitioning and shifts in shoot growth phenology.

Genetic variation in growth and survival among and within populations of trees is manifested via genetic variation in process components including those listed above. By it's influence on process components, might elevated CO_2 alter genetic rankings in growth and survival? A series of experiments at the Petawawa National Forestry Institute are designed to study this question using different levels of black spruce genetic structure including: wide-range provenance material, narrow range provenance material, families and clones within stands, as well as families displaying a range of field performance from an operational tree breeding program. Here are some early results from these experiments.

One study has examined the responses of six provenances ranging from the Yukon to southern Ontario. They were grown for one season in greenhouse chambers providing ambient (370 ppm) or elevated (700 ppm) CO_2. Growth and eco-physiological traits including net photosynthesis and respiration were measured. Across all seed sources, seedlings grown under high CO_2 had final dry weights of 16.02 g compared to 10.37 g for trees grown under low CO_2. There was large variation (range - 6.94 - 19.56 g) in growth among seed sources which correlated well with growth in a 20-year-old local provenance test. There was no interaction between seed source and CO_2 concentration. Seed sources displayed large differences in gas exchange traits which were again consistent under both CO_2 regimes. It appears that the profound differences in physiology, phenology and growth among these diverse sources of black spruce are expressed similarly under both low and high atmospheric CO_2 concentrations.

In another study, eight seed sources from northern Ontario were grown from seed for two simulated growth seasons (May 15 - October 15) under combinations of ambient (350 ppm) and elevated (700 ppm) CO_2 and well-watered and drought conditions. Four seed sources originated from a "northern" region (mean lat. = 49°37') and four seed sources were from a "southern" region (mean lat. = 47°31'). Within each latitudinal region, two seed sources were from wet sites and two seed sources were from dry sites. Again, growth and physiological traits have been measured although only height growth results have been analyzed. Under ambient CO_2, southern sources outgrew northern sources and dry site sources outgrew wet site sources. The superiority of dry site sources over wet site sources was greater under drought than well watered conditions suggesting the possibility of an ecotypic response. Under elevated CO_2 conditions, there were no growth differences attributable to latitude, site type or ecological site type x irrigation regime interaction. These results suggest that where the physiological differences are more subtle, it is possible that deployment of seed sources based on testing strictly under current CO_2 concentrations might result in decreased potential productivity or even mal-adaptation of future forests.

Kurt H. Johnsen, Petawawa National Forestry Institute, Chalk River, Ontario, K0J 1J0

Variation in Germination Parameters Across Jack Pine Families Originating from a J.D. Irving Limited Seed Orchard

Introduction and Methods

All jack pine seed grown by J.D. Irving Limited since the late 1980s has originated from seed orchards. Overseeding (1.2-1.3 seeds per cavity) or multiple seeding, depending on germination rate, is a common practise in container production nurseries to ensure that containers are fully occupied with seedlings. The extra germinants can be used to fill in where misses occur. It was noted in 1992 at the Juniper Tree Nursery that quite a few new germinants appeared after the thinning and transplanting operation was completed. This necessitated additional thinning to remove the extra germinants. To determine if genetics was a factor in this problem, a sample of cones was harvested separately from seventy-seven clones at the Parkindale Seed Orchard. The seeds were extracted and cleaned separately and stored at -10°C until germination testing was started. Germination testing was conducted both in the greenhouse and in a Conviron germination cabinet at the Sussex Tree Nursery. In the greenhouse, 100 seeds from each family were sown in Multi-pot #67 containers in a mixture of 3:1 peat and vermiculite with a covering of grit. The minimum night temperature was set at 22°C and the photoperiod was maintained at 18 hours with irrigation as required. For the germination cabinet test, 100 seeds from each family were sown on damp filter paper in germination boxes. The cabinet was set at a constant temperature of 23°C with constant fluorescent lighting. Germination of seed in the greenhouse and cabinet was recorded daily.

Results

In the greenhouse only one family had very poor germination (not included in the figures) while the remaining 76 families all achieved 100% germination. Figure 1 shows the variation in the time for germination to begin with all families exhibiting some germination 3 to 7 days from sowing. There was much greater variation across families for the length of germination period (Fig. 2) where there was a 9 day spread in the amount of time required for families to complete germination. The overall time requirement from sowing through the completion of germination varied from 7 to 16 days; (Fig. 3) 18% of the families were classed as fast germinators (7 to 9 days) and 17% were slow (14 to 16 days). The germination cabinet test showed the same trends, however, the time scale was compressed (Fig. 4). The time required from sowing until germination was completed varied across families from 4 to 10 days. It was interesting also to observe in the germination cabinet that only 70 of the 77 families achieved 100% germination. Germination results achieved in the cabinet are most often higher than in the greenhouse.

Conclusions

This trial has demonstrated that variation among jack pine families in the duration of the germination period is likely to be a factor in the presence of late germinants in container seedling crops from bulked orchard seed. There was almost no variation among families for overall percent germination but the time to achieve maximum germination varied from 7 to 16 days from sowing. Germination began in a fairly narrow window of 3 days across 76 families. These results indicate that thinning should not be conducted until at least 16 days after sowing and possibly longer depending on greenhouse conditions.

Nursery sowing practises can have an impact on the genetic diversity of seedling crops from bulked orchard collections (El-Kassaby 1992). Variation in germination rates across families will result in unequal representation of families in the seedling crop. This does not appear to be a problem for jack pine seed from this orchard since almost all of the families achieved 100% germination. Standard greenhouse protocols are unlikely to produce 100% germination rates but results should be quite high. El-Kassaby (1992) points out that faster germinating families will be faivoured at the time of thinning if multiple seeding is practised. If overseeding or at the most, double seeding is practised, there should be limited impact on the genetic diversity of seedling crops from this orchards as a result of nursery practises. As orchards are rogued and the

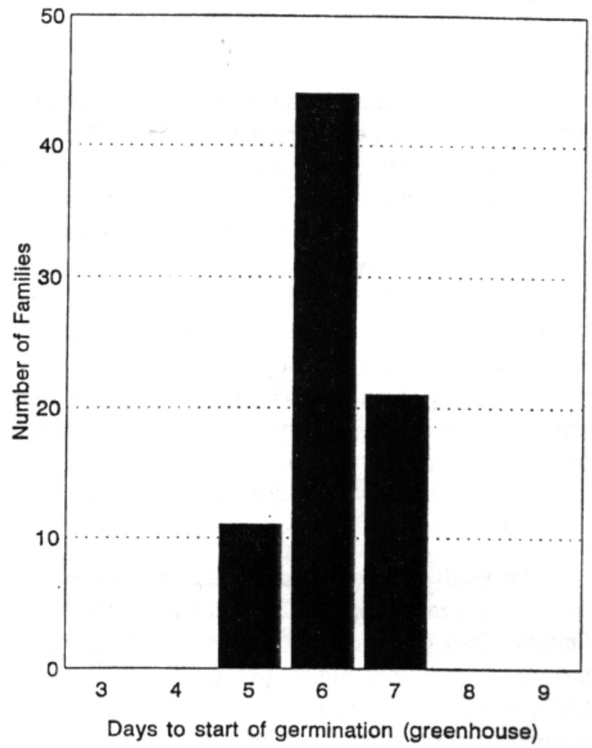

Figure 1. Number of days until germination began across 76 jack pine families in greenhouse conditions.

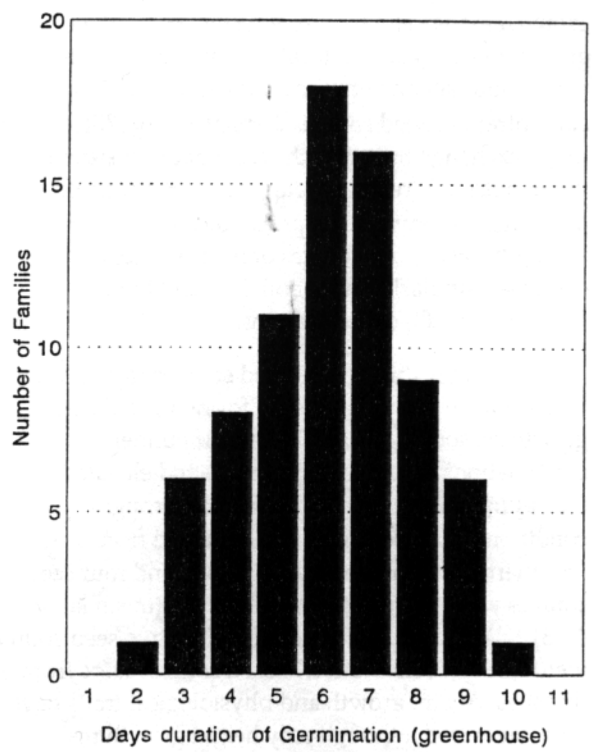

Figure 2. Duration of germination across 76 jack pine families in greenhouse conditions.

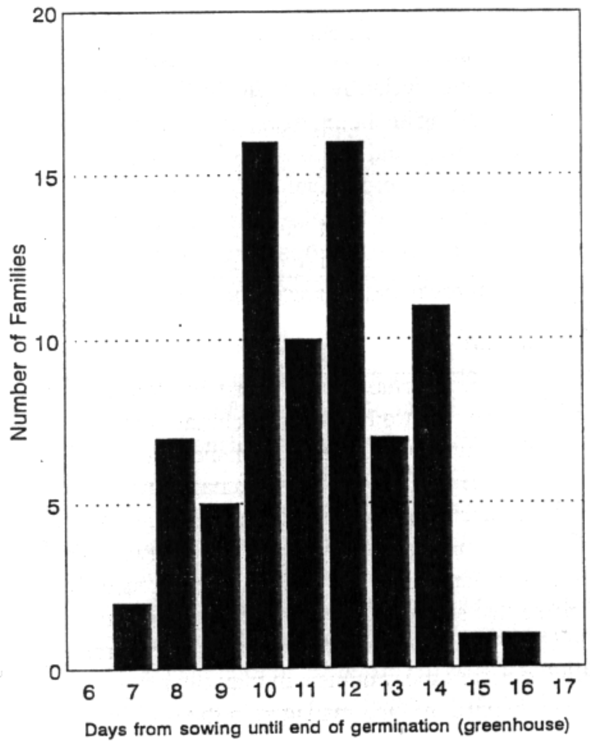

Figure 3. Total time from sowing through germination across 76 jack pine families in greenhouse conditions.

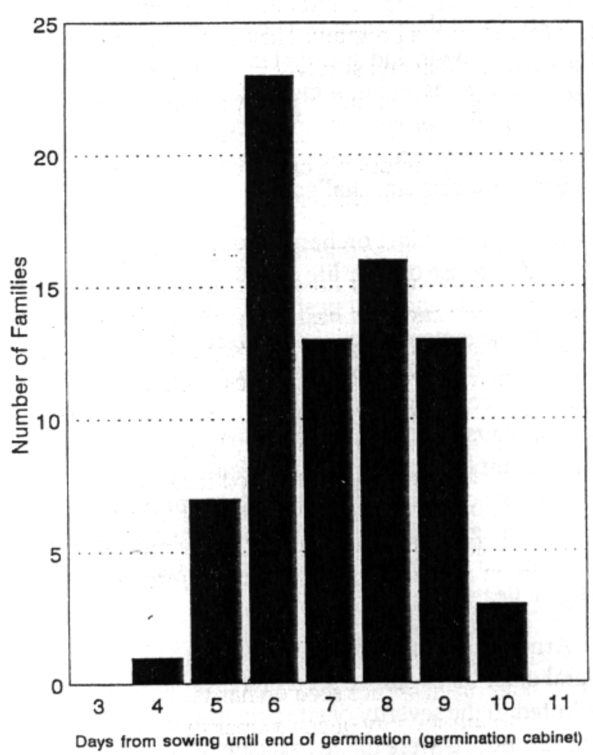

Figure 4. Total time from sowing through germination across 76 jack pine families in the germination cabinet.

number of clones is reduced this aspect should be re-evaluated.

Reference

El-Kassaby, Y.A. 1992. Domestication and genetic diversity - should we be concerned? For. Chron. 68(6): 687-699.

Greg Adams and Hartmut Kunze

Organic and Inorganic Mulches Trials on Black Spruce Orchards: First Year Results

In 1986 the first black spruce seedling seed orchards were established at the Edward Bonner Tree Improvement Center near Kapuskasing Ontario, as part of the tree improvement program in Ontario. These orchards were established on old agriculture fields and the annual and perennial grass cover has never been adequately controlled. Over the years there has been high mortality and in some sections slow establishment of the trees. Application of Vision (herbicide) has been an annual practice but this has proved to be only partially effective. Certain perennials are still strong competitors for light, water, and nutrients. These are high-value trees taken from plus tree seeds of which the supply is limited. Every effort must be taken to ensure their survival.

As part of a refill planting in 1992, a trial was established to determine the effect of various mulches on survival and growth of newly planted black spruce seedlings, and on soil moisture and temperature, and to compare material and application costs. The sites chosen were a sandy hilltop, a loamy mid-slope and a lower-slope clay. Nine treatments were applied; no-mulch, herbicide, 60 and 90 cm square Brush Blanket - a green polyethylene, 60 and 90 cm square Mirafi woven black polypropylene, 45 cm square non-woven polyester felt Terra-mats both black and white, and 20 litres of raw poplar chips. A randomized complete block design was used with 30 replications per site. Soil temperature and moisture, and tree survival, height, current increment and diameter were measured.

In most cases the soils under the chips were significantly ($p<.05$) cooler and moister and the no-mulch and herbicide treatments were significantly warmer and drier than the other treatments at all sites. After one year total height growth was not effected by mulch treatments. On the clay site there was significant

($p<.05$) differences in current height increment between treatments. Diameter growth was significantly lower ($p<.06$) for the no-mulch and herbicide treatments on the clay and loamy sites. The 90 cm mulch treatments were most effective in protecting the trees from weed competition. Weed competition most strongly affected trees in the no-mulch and herbicide treatments. The Terra-mat was the highest cost item although it was the smallest size. The 60 cm Brush Blanket and Mirafi fabrics had the lowest purchase costs. The cost of chips is variable depending on purchase price and transport. Equipment needs are higher for application of the chips. Smaller mulches were easier to apply than larger mulches.

Preliminary recommendations are to use the 90 cm Brush Blanket in areas of heavy weeds and the 60 cm Brush Blanket or Terra-mat (if lower cost) for areas with less weed competition.

This project has been funded through the Vegetation Management Alternatives Program of the Ontario Ministry of Natural Resources. For more information contact **Terry Schwan**, OMNR, Kapuskasing, Ontario P5N 2Y3, ☎ (705) 337-9345.

Tree Improvement in Ontario

How We're Organized

The tree improvement program has undergone some reorganization. In 1991, the Ministry of Natural Resources and the forest industry agreed to a new framework under which to deliver this program. The result was the replacement of the Ontario Tree Improvement Council (OTIC) with a new organization, the Ontario Tree Improvement Board (OTIB). OTIB covers the province under one umbrella and includes the North Shore Tree Improvement Council and OTIC members, as well as a number of new faces.

OTIB was legally incorporated in April of 1993. Its mandate includes the management of seed banks and seed source control, intensive tree improvement (seed orchards), and gene conservation (an issue of particular importance in southern Ontario). Bringing together such a wide range of interests will no doubt be a challenge.

To administer the tree improvement program, the province has been split into 6 zones, each of which is staffed by a program coordinator. In essence, there are 6 independent cooperative programs. Each zone has a Steering Committee with a senior management representative from each of the organizations involved. These set the local program goals and priorities. Each of the members also is represented on an Operations or Technical Committee, which generally coordinates how things get done efficiently and effectively. Memoranda of Understanding are being developed by each group outlining the roles and responsibilities of the participants. At the provincial level is a structure which is mandated to ensure that the zonal programs are based on good science and operating efficiently, and to provide analytical and technical support.

The Program

Tree improvement has a long history in Ontario which dates back to the late 1950s, when clonal orchards of black and white spruce were established in Longlac. There are currently over 60 seed orchards across the province. Black spruce and jack pine, as the province's most commonly planted tree species, represent the vast majority of our effort - 48 seedling seed orchards in total for these two species alone. In addition there are 20 white spruce and white pine clonal seed orchards scattered across the province. In total over 500 hectares of seed orchard is being managed in the province.

A large program such as this obviously has to be established in stages. As a result, we have orchards which are still being planted, and orchards which are currently producing seed. Our issues and problems vary across the province and depend to some extent on the maturity of the program. They cover the spectrum from early growth and survival in younger programs to quantifying gains and moving forward to the next generation of improvement in older ones. Providing the required support across the province with limited resources is a constant challenge.

Because our older orchards are just entering the productive phase of their life cycles, an awareness of the severity of cone and seed pest losses is now developing. A pest management specialist has recently been hired by the Ministry of Natural Resources. Jack pine seems relatively free of major insect pests - the red squirrel probably causes the highest losses. We are seeing the normal complement of cone and seed insects in our black spruce orchards as well - eastern spruce budworm and cone maggot have been noted. White pine weevil is also common in our jack pine and black spruce orchards and genetic tests.

Armillaria root rot continues to cause mortality in several older black spruce seed orchards. This has been attributed to the severity of site preparation in these orchards. Efforts were made to locate black spruce orchards on droughty soils to stimulate cone production. The combination of extremely sandy and nutrient-poor soils, along with the removal of much of the organic matter during land clearing operations, left the planted trees in severely stressed condition despite substantial efforts to irrigate and fertilize. This created vulnerability to the disease, which is with us still today.

Ontario's seed orchards have been planted on a wide variety of sites ranging from full tree logged cutovers to stumped and levelled fields. This complicates implementing pest control measures. Any solutions developed have to be sensitive to factors such as site accessibility to equipment and limited staff availability. These are challenges which, over time, we hope to deal with proactively.

For further information, contact: **Peter Nitschke**, Operations Coordinator, Ontario Tree Improvement Board, 70 Foster Drive, Suite 400, Sault Ste. Marie, Ontario P6A 6V5.

Measuring Moisture Content in Tree Seeds

The objective of this note is to determine if anyone has experience with non-destructive meters for determining the moisture content [mc] in stratified seed or North temperate coniferous species. Accurate measurement of mc in tree seeds is a critical test to determine the following: if seed is dry enough for long-term storage; if seed is wet enough for dormancy to be broken during stratification; and whether the seed is so wet in stratification that fungal growth is encouraged.

Most facilities use the oven-dry method for determining moisture content based on the change in weight [weight of water] after drying the seed compared to the original fresh weight of the seed. The conditions recommended by ISTA for drying are 103°C for 17 hours. This test is destructive and will require at least 17 hours (usually overnight) for an assessment to be made. This method is preferred where very accurate mc determination is required, however, in addition to its destructive nature, it is labour intensive and not well suited to monitoring (e.g. quality assurance during seed preparation) where rapid, non-destructive, reasonably accurate estimates are required.

Many facilities use agricultural grain meters to provide a quick test of the level of moisture present in seed. A variety of meters are available which assess the moisture content based on the dielectric constant of the seed, referred to as a "Capacitance" type meter. The dielectric constant will vary with seed moisture content and corrections are required for differences in temperature between the seed and the grain meter; this temperature compensation may be automatic, determined by an additional measurement or read directly from tables. The test is quick (0.5 to 3 minutes) and non-destructive, but requires 30 to 200 grams of seed and is not considered reliable above 20% mc.

A gap in mc measurement lies in the non-destructive measurement of moisture in a 'reasonable' sample of stratified seed. This type of technology will allow one to quickly ensure that the moisture content for stratification is acceptable and would greatly increase the efficiency and size of quality assurance programs. A mc range of 5% to 45% would allow standardization of all quick moisture testing to one piece of equipment.

I have started investigating various manufacturers of moisture determination equipment and have not been able to locate a suitable piece of equipment. For quick destructive tests a variety of meters using infra-red or microwave technology are available. Most of these are more accurate than grain meters, but are costly and require more time (5-15 minutes); these meters have been very popular for quality assurance in the food industry. References have also been found in agriculture to Nuclear Magnetic Resonance (NMR) measurement, but cost would probably exclude this from use in most facilities.

If anyone currently is using a moisture meter which is non-destructive and covers a wide range of moisture contents or has additional information on advances in moisture measurement technology I would greatly appreciate your help in our search.

David Kolotelo

Report of Meetings

Black Spruce Seeding Workshop

On January 25th,1994, Northeast Science & Technology (NEST) held a Black Spruce Seeding workshop. NEST is a client driven, science and technology organization of the Ontario Ministry of Natural Resources (MNR). Its mission is to deliver practical and innovative solutions to clients, in support of sustainable resource management. NEST workshops are an effective tool used to transfer knowledge to the field.

Black spruce is the most important commercial tree species in northeastern Ontario. Seeding is an effective low-cost option for establishing black spruce regeneration on certain sites. This workshop arose from an expressed need from clients to know more about this regeneration method. It was designed to provide participants with the tools and knowledge required to plan and implement a black spruce seeding program. Expertise was brought in by research scientists, those involved in technology development, and field personnel who have experience with seeding programs.

David Archibald (Fire Science Specialist, NEST, Timmins) kicked off the workshop with a briefing on the silvics and ecology of black spruce. Notions of seed production, seed viability, timing and necessary conditions for germination and establishment of black spruce, were reviewed.

Arthur Groot (Research Officer, Canadian Forestry Service CFS, Sault Ste. Marie) then presented his talk on "Broadcast Seeding on Lowlands". His presentation was based on the results of CFS experiments on direct seeding black spruce on peatlands. His colleague, Rob Fleming (Research Officer, CFS, Sault Ste. Marie), talked about broadcast seeding of black spruce on upland sites. Each component of a successful seeding operation was addressed: site type, seedbed receptivity, site preparation, seed application, seeding prescriptions, 'naturals', and subsequent growth competition.

An operational view of broadcast seeding was presented by Jeff Leach (Forestry and Engineer Technician, Spruce Falls Inc.), who is responsible for the regeneration efforts of Spruce Falls Power and Paper Co. in Kapuskasing, Ontario. Operational seeding programs are carried out every year by the company and Jeff guided us through his experience. Spruce Falls constantly tries to augment the stocking levels of their seeded sites by looking for new seeding methods. Jeff outlined some of the innovative methods that have been tested at Spruce Falls Inc.

Shelter cone seeding was the next topic. Brian Polhill (Stand Establishment Specialist, Northwest Science & Technology, MNR, Thunder Bay) presented the northwestern experience with shelter seeding. Shelter seeding is a method of spot seeding were a plastic open-ended cone is placed over the seeded spot to improve environmental conditions for germination and survival. The trial work in the Northwest Region was centred on the Cerkon cones, which seems to exhibit good properties for black spruce.

QUNO Corporation, based out of South Porcupine near Timmins, has also put in spot seeding trials. They evaluated germination and survival results from gluing Black Spruce seeds to unexpanded Jiffy Pellets with subsequent outplanting. Results look positive and they are presently heading for an operational trial. John Russell (Forestry Supervisor, QUNO Corporation), presented the results.

To provide participants with tools enabling them to narrow down seeding to appropriate sites, Rob Arnup (Consultant, Ecological Services for Planning Inc., Timmins) identified the linkage between NOREFEC (Northeast Region Forest Ecosystem Classification) and seeding potential.

To wrap up the day, Arthur Groot gave a second presentation where he demonstrated a computerized seeding model. This software, PCSEED, will be part of a direct seeding manual now being prepared by the CFS in Sault Ste. Marie.

Throughout the duration of the workshop, Mike Adams (Research Technician, Canadian Forestry Services, Sault Ste. Marie), presented a poster session on seed treatments for potential application in black spruce direct seeding. Seed treatments which promote early seedling establishment, control the timing of germination, influence microsite or enable precision sowing may have great impacts on the success of direct seeding. Mike was available for questions and discussion throughout the day.

All the presentations were evaluated as very well received and appreciated. The importance of site selection, timing, seed viability, and germinating conditions was clearly established. Research into new and improved ways to regenerate our forests, find their value when they are applied and successful in the field. However, effective linkages between research and the field are the catalyst which enable this system to work. This workshop, and others like it, have found success in this role.

Celine Boisvenue, Stand Establishment Project Forester, Northeast Science and Technology

IUFRO Working Party P2.02-00 Productivity of Plantation Forestry with Fast-growing Trees

The proceedings have just been published for "Mass Production of Genetically Improved Fast-growing Species" meeting in Bordeaux, France, September 14-18, 1992.

The meeting was organized by AFOCEL under the auspices of IUFRO Working Party P2.02-00 (Productivity of Plantation Forestry with Fast-growing

Trees). Nearly 200 people attended; roughly 2/3 from research organizations and the rest from industrial companies concerned with intensive afforestation.

The meeting itself was organized around four major themes, with 130 papers presented. Round-table sessions allowed more detailed discussion of issues in relation to the major groupings of fast-growing genera: eucalypts, pines, other hardwoods, and other conifers.

I Biological Constraints

The rapid increase of vegetatively propagated clonal plantations around the world has been made possible by good rejuvenating ability. It seems that a complex combination of internal and external factors affects the juvenile/mature phase transition. Recent experiments give some useful guidance. For example, the number of nodes seems more important that the age in defining the juvenile stage. Several criteria such as rooting, flowering and morphology can be considered as physiological markers of phase change. Light, auxins, phenols and other basic factors are related to the evolution of maturation and/or re-juvenation. Greater understanding of this physiology is the key to the future; and contact between breeders and researchers is to be encouraged.

II Genetics and Breeding

a) Clonal varieties: The general adoption of cloning has important implications for breeding strategies. The need to maintain a broad genetic base is particularly important as genotypes which do not root easily are easily lost. In order to move beyond the initially selected clonal populations, it is necessary to generate large varietal diversity. Controlled crosses and progeny testing are needed, but this requires a lot of work and it may be difficult to get better clones than the best that are already in use.

Improved rooting is commonly sought through inter-specific hybridization, using one parent with good rooting ability. The direction of the cross has several important practical consequences (compatibility, seed/flower ratios, development period in relation to sowing times, etc.)

Clones derived from inter-specific hybrids are more and more used in plantations on marginal sites. They allow a better combination of favourable characters for growth, adaptability and wood quality. Understanding of genótype x environment interactions is important in deciding whether to opt for selection of plastic clones or those with high site-specific productivity.

b) The sexual path: Production costs of cuttings are still more expensive than seed.

Eucalyptus flowering induction techniques (using paclobutrazol) have given very promising results. They allow more intensive management of seed orchards.

Breeding strategy for inter-specific hybrids is a long term, complex operation. Research on simplification is urgently required.

Good uniform full-sib families can be selected more rapidly than clones (because fewer cycles of testing may be required). There is an opportunity to develop bulk seed varieties.

III Seed Production

Seed production from orchards remains a primary source of planting stock. Quality depends on genetic origin of the material and on adequate isolation.

Some programmes already produce large quantities of hybrid seeds - experience with pines shows that this does not necessarily lead to undesirable variation. An effort must be made to develop low cost techniques for mass production of select seeds.

IV Cuttings Production

Cuttings production is becoming the most important source of improved planting stock, and is the focus of heavy investment. The results in various countries have often been spectacular.

The most important points to consider are:

- stock plant management
- physiological condition of the cuttings
- rooting environment
- exogenous treatment of the cuttings

In spite of big differences between species, there are clear trends towards more intensive stock plant management. Cuttings are becoming smaller and mini apical cuttings are performing well.

Some basic physiological and biochemical problems remain. Effects of light, water and nutrition are important and we need to know more of the physiology of rooting ability.

If you wish to obtain a copy of the Proceedings, write to: AFOCEL, Service de Publications, Domain de l'Etancon, 77370 Nangis, France, Fax: 331 6408 4993. Price: FF 220 outside of France.

(Source: J-N Marien, IUFRO News 22(4): 6 PL P2.02-00.)

Visit to ASEAN-Canada Forest Tree Seed Centre, Muak-Lek, Saraburi

The ASEAN-Canada Forest Tree Seed Centre (ACFTSC) is located in Muak-Lek, Saraburi, about 70 km northeast of Bangkok. The ACFTSC is jointly funded by CIDA and in-kind contributions from ASEAN-member countries (Thailand, Malaysia, Philippines, Brunei-Darussalem, Indonesia, and Singapore). The executing agency is the Forestry Canada Petawawa National Forestry Institute, which is contributing $9.5 M over 6 years. Thailand is the host country and the Royal Forest Department, Silvicultural Research Subdivision, supports and operates the project headquarters at Muak-Lek. Officially launched in 1981, the Project objectives are related to improving forest management within the ASEAN region by supplying higher quality seed and planting stock.

The centre provides on-the-job training, post-graduate scholarships (M.Sc., Ph.D.), and arranges for practical attachments in other countries. The centre sponsored and organized the IUFRO symposium "Genetic conservation and production of tropical forest tree seed", and another symposium "Recent advances in tropical seed technology and nursery stock production", is to be held in Sarawak, Malaysia in 1995. They have also developed four technical working groups in which representatives from each ASEAN country meet once a year to review proposals and review activities. The groups are (a) Seed ontogeny and seed production, (b) Seed technology and materials exchange, (c) Seed origin and genetic resources, and (d) Nursery technology and stock production.

The Centre is also responsible for editing and publishing a variety of technical reports, review papers, and workshop proceedings and has a library that serves all ASEAN countries. The library has substantial holdings in tropical forestry literature and journals, and new literature search capabilities are being developed.

The Seed Technology and Materials Exchange Section of the Centre is responsible for the collection, processing and storage of forest tree seeds in Thailand, and for the storage and exchange of reproductive material throughout the ASEAN region. The section processes seeds of about 85 different species, of which 30-40 might be considered major species. Luckily, not all species produce seed crops every year.

Seeds are collected by ACFTSC staff, primarily from natural stands. A significant aid to collection is the recently published ACFTSC brochure "Seed collection period for selection tree species in Thailand" which summarizes all available information on seed production periods of 76 species normally collected in Thailand. Crops are regularly monitored during development, and seeds are collected just prior to natural seedfall. Primary maturity indicators are colour and moisture content.

Orthodox seeds (e.g., *Acacia*, *Pinus*) can be stored for long periods at low temperatures (2-4°C), but this is considered too expensive, so seeds may be stored for short periods at ambient temperatures. A great many tropical tree seeds belong to the recalcitrant category [e.g., dipterocarps, neem (*Azadirachta indica*)]; these seeds must be kept at relatively high moisture content (20-30%), can only be stored for short periods (several weeks to several months), so are best to sow immediately.

The seed registry program is based on dBase III+ and details seed source and collection information. The seed bank is relatively new, and currently contains about 200 seed lots representing about 60 species (about 200 spp. are possible). Seeds are tested annually for moisture content and germination, and efforts are made to replenish depleted seed stores with the same seed source. Seeds are used for seedling production within Thailand and for exchanges with other ASEAN tree seed centres, primarily for research purposes.

Testing is conducted in walk-in growth rooms with open shelving kept at ambient conditions (30-35°C); it is only necessary to provide ventilation and lighting. The test media may be vermiculite, sand, paper, or coconut husk. Seed coat dormancy is the most frequent type of dormancy in tropical seeds; soaking in hot or warm water, abrasion, and sulfuric acid are the most common dormancy-breaking treatments.

Seed Origin and Genetic Resources Section of the Centre has focussed on (a) the establishment of Forest Genetic Resource Areas, and (b) scientific exchange of seeds of *Pterocarpus macrocarpus* with several ASEAN countries to examine provenance effects within the region.

On-going research projects involve the study of genetic variation, flowering, and germination of several important ASEAN dipterocarps.

The Seed Ontogeny and Seed Production Section of the Centre has recognized that species diversity in natural stands is high, but there may only be a few individuals/hectare of the same species. In mature angiosperm trees capable of producing flowers, the timing of anthesis in different clones may result in insufficient pollination. Differences in flowering between provenances, clones and individual trees also present problems in establishing tree improvement programs, seed production areas, and seed orchards.

In tropical pines, knowledge about flower initiation and differentiation and control factors is also limited, but a major constraint appears to be pollination failure. In temperate regions, conifer pollination occurs over a relatively short period of 1-2 weeks, resulting in a pollen "cloud". In tropical areas, pollination occurs over several months, and could be better characterized as a pollen "drizzle".

Lack of basic knowledge of the flowering biology of tropical forest trees has led to an emphasis on studying flowering and seed ontogeny of native species. In Thailand, the focus has been on the most important forest species i.e., *Tectona grandis* (teak), *Pinus kesiya*, *Pinus merkusii*, and *Dipterocarpus* species.

A major study on the flowering biology and seed production of *Dipterocarpus macrocarpus* is currently underway. It is a major species of the dry tropical forest, and is used for furniture and house building. To conduct the study, metal scaffolds were erected next to three trees growing on the grounds of the tree seed centre to enable daily collection of data and plant materials. Flowering begins in May and seeds are mature by November or December. The fruit is a samara which may contain 1 to 3 seeds (usually 2). The timing of critical flowering events has been established and it has been found that insects play a major role in the biology of this species, both as pollinators (primarily large and small bees) and as predators (ants) of the developing fruits. The use of pesticides, therefore, and the timing of their applications, may be a critical factor in the seed production success of this and other tropical forest trees.

Dipterocarps constitute a major portion of the forest trees planted in the ASEAN region, but most dipterocarp seeds are recalcitrant and do not store well, if at all. *Hopea odorata*, for example, is an important species used in boat building, construction, and furniture making, but the seeds can only be stored for 1-2 weeks at 15-20°C. Seed crops are infrequent, and when they do occur, seeds are fed upon by insects and birds, or else are attacked by fungal pathogens. Germination of seeds of *Acacia* and other leguminous species (also important forest species) is often depressed by seed coat dormancy requiring sulfuric acid, abrasion, or hot water treatment.

The difficulties with propagating seedlings from seeds has resulted in greater attention being given to vegetative propagation methods by the Centre's Nursery and Stock Production Section. Rooting of juvenile material is achieved by putting cuttings in plastic bag containers filled with a medium composed of coconut husk and sand. Cuttings are then placed in polyethylene tent enclosures to maintain high humidity. Ambient temperature is 32°C but cuttings can withstand up to 40°C without problems. Dipterocarps are very shade tolerant as young seedlings, with a very low light compensation point, and a light saturation point between 30-50% full sunlight. In the wet season, shade cloth providing 50% full sunlight is necessary, but in the dry season 30% full sunlight is required.

An interesting aspect of the research nursery facility is the innovative use made of local materials and environmental conditions. For example, natural sunlight is used to sterilize germination media for several days prior to use. Coconut husk is used as a growing medium much as peat is used in Canada. Coconut husk is a common industrial by-product which can be obtained locally at no cost. It has good texture and a high water holding capacity. Sand can be used to increase aeration and lower the water capacity, if necessary. Coconut husk contains essentially little or no nutrients, but these can be added in whatever proportions are required. Coconut husk is also used throughout the nursery as a mulch, and a packing material for the interim storage of cuttings.

Compost is also prepared at the nursery as an amendment to growing media. The compost is made from cut grass, cassava, rice husks and stems, and any other available organic materials. The process is aided by the addition to compost-initiating organisms (obtained from Bangkok University) and a source of additional nitrogen such as urea. Compost materials are built up in 30 cm layers, and given adequate aeration and moisture. The compost temperature is monitored to determine when to turn (usually about once/week). Under the usual nursery conditions, the process takes about 5 weeks to complete.

A Royal Forestry Department (RFD) seedling nursery is situated adjacent to the ACFTSC and produces about 1.3 M seedlings annually to fill requests for forestry, recreational areas, local governments (village, municipal, and provincial), and farmers. The trees are used for reforestation, fruit production, road and farm boundary plantings (primarily Eucalyptus, neem), and ornamental use. All requests for seedlings must be approved by the RFD Silviculture Division.

Average cost per seedling varies form 0.8 to 1.4 Bhat ($0.04-0.07 Canadian). The demand for timber trees exceeds current production capabilities.

B.C. Extension Topics

Are you a subscriber to the British Columbia Forestry Service's publication "Seed and Seedling Extension Topic". If not, you're missing out on an excellent source of information. This newsletter is now sent out to over 400 addresses in North America, Asia, and Europe. The most recent issue, Dec. 1993, has articles on seed orchard seed versus natural stand seed with a paper comparing seedlots germinated and grown under various conditions. Additionally there are articles on western white pine stratification trials, quick cone maturity determination, seeding peat plugs, the BC Tree Seed Dealers Association, the 1993 seed orchard cone harvest (a bumper year), and insects as food — as well as a variety of shorter notes on diverse topics.

If you want to be up-to-date on BC activities, get yourself placed on the mailing list. (It's free). Contact **Eric van Steenis**, Seed & Seedling Extension Topics, B.C. Ministry of Forests, Silviculture Branch, Nursery Extension Service, 14275-96th Ave., Surrey, B.C., Canada, V3V 7Z2.

New Periodicals

Forest Genetics

A new international journal called 'Forest Genetics' is aimed at the recent advances in forest genetics in a broad sense including molecular genetics, cytogenetics, population, evolution and ecological genetics as well as gene conservation and breeding of forest tree species. The international Editorial Board includes prominent specialists in forest genetics from all parts of the world. Papers (up to 20 double spaced pages), short notes (up to 6 pages) announcements for conferences and meetings and book reviews are welcome. Manuscripts should be sent to and further information on the journal is available from the Editor-in-Chief: **Prof. Dr. Ladislav Paule**, Lesnicka fakulta TU, SK-96053 Zvolen, Slovakia, Fax: +42-855-22654, E-mail: paule@vsld.tuzvo.sk.

The first volume (1994) will contain four issues: the first issue is planned for March 1994, the second for June. Subscription rate for the first volume is 90 US$ plus mailing expenses.

(Further information: Arbora Publishers, s.r.o., P.O. Box 22, SK-96006 Zvolen 6, Slovakia.)

Canadian Silviculture Magazine

The premier issue of "Canadian Silviculture Magazine" hit the streets in the summer of 1993. This is a joint publication of the Western Silviculture Contractors Association, the Canadian Silviculture Association, and other provincial associations. Featured in the first issue are articles on BC's and Ontario's silviculture strategies and their implications. This publication incorporates the old WSCA Newsletter and is available only by subscription from: Canadian Silviculture Magazine, #310-1070 W. Broadway, Vancouver, BC V6H 1E7, ☎ 604-736-8660, Fax: 604-738-4080.

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Upcoming Meetings

Sixth Workshop of the IUFRO Working Party S2.04-06 Molecular Genetics of Forest Trees

May 21-24, 1994

Scarborough, Maine, USA. For information contact: **Prof. Michael S. Greenwood**, Dept. of Forest Biology, The University of Maine, Orono (☎ +1-207-581-2838 / Fax: +1-207-581-2858).

5th International Symposium Genetics and Molecular Biology of Plant Nutrition

July 17-24, 1994

The symposium will offer summary papers, reports, and posters dealing with genetic and molecular biological aspects of the following and related topics: nutrient acquisition, plant nutrient requirements and responses, functional aspects and efficiency of nutrient use, mineral composition, and tolerance of toxic ions and salts. Papers dealing with all species of crops will be welcome, as well as papers on wild species. Please refer inquiries to: **D.W. Rains**, Department of Agronomy & Range Science, University of California, Davis, CA 95616 (☎ 916-752-1711 / Fax: 916-752-4361).

4th International Congress of Plant Molecular Biology

June 19-24, 1994

Amsterdam, The Netherlands Symposium topics will include flowering and sexual reproduction. For information contact: Congress Secretariat, c/o RAI Organisatie Bureau Amsterdam bv, Europaplein 12, 1078GZ Amsterdam, The Netherlands (☎ 31(20)5491212 / Fax: 31(20)6464469.

1st International Symposium on Plant Dormancy

August 4-6, 1994

This interdisciplinary symposium is patterned after the NATO Advanced Research Workshop series. It will include keynote and invited speakers, contributed paper and poster sessions, extensive discussion periods, and topical workshops. It is strategically scheduled to bridge the gap between the ASPP meeting in Portland and that of the American Society for Horticultural Science in Corvallis. Session topics include: Approaches to Dormancy Research; Physiology, Biochemistry and Gene Expression Related to (1) Temperature, (2) Hydrational Status, and (3) Photoperiodism; and Agricultural and Biotechnological Manipulation. Workshop topics include: Seed Dormancy; Bud Dormancy; Physiological, Biochemical, and Molecular Aspects of Plant Dormancy; and Control in Agricultural Cropping Systems (including breeding). Attendance will be limited by application to a maximum of about 75 participants, with a proportion of applications available to advanced graduate students and postdoctoral researchers. For additional information and/or future announcements, contact: **Dr. Gregory A. Lang**, 137 Julian C. Miller Hall, Louisiana State University, Baton Rouge, LA 70803-2120 (☎ 504-388-1043 / Fax: 504-388-1068).

Making the Grade: IUFRO Symposium on Planting Stock Performance and Quality Assessment

September 11-15, 1994

Sault Ste. Marie, Ontario, Canada. The goal of this meeting is to bring together world leaders in plant quality assessment to synthesize the current state of knowledge and to point to directions for the future of this important field of study. The meeting will be of interest to anyone involved in the development and application of procedures for the assessment of plant quality, particularly as it relates to reforestation success. There will be invited papers on: Using Plant Quality Assessment to Produce the Designer Tree, (Dr. Michael Menzies, New Zealand Forest Research Institute);

Predicting Field Performance Using Plant Quality Assessment, (Prof. Anders Mattsson, Swedish University of Agricultural Sciences); Effects of Rough Handling on Plant Quality and Performance, (Dr. Helen McKay, Forestry Commission, Great Britain); Does Root Growth Potential Predict Field Performance? A Debate, (Mr. David G. Simpson, British Columbia Ministry of Forests - speaking for the proposition, Dr. Gary Ritchie, Weyerhaeuser Company - speaking against the proposition); Looking for the "Silver Bullet" [Can One Test Do it All?], (Dr. Pasi Puttonen, British Columbia Ministry of Forests); and Plant Quality Assessment: An Industrial Perspective, (Mr. Glen Dunsworth, MacMillan Bloedel).

The symposium will involve presentations, field tours, and poster sessions relating to seedling quality issues. Voluntary papers now being accepted. Selected papers to be published in a special issue of New Forests. Contact: Erika Menes, Ontario Forest Research Institute, P.O. Box 969, 1235 Queen Street E., Sault Ste. Marie, Ontario P6A 5N5 Canada.

International Symposium on Scots Pine Provenances and Breeding and Selection (Working Party S2.02-18)

September 13-17, 1994

For information contact: **Dr. J. Danusevicious**, Lithuanian Forest Research Institute, Department of Forest Genetics and Reforestation, 4312 Kaunas-Girionys, Lithuania (☎ +7-127-547241; 744460 / Fax: +7-127-54447446).

Recent Advances in Tropical Tree Seed Technology and Planting Stock Production

June 12-14, 1995

BP Grand Tower Hotel, Haad-Yai, Thailand

The objectives:
- to provide a forum for reviewing recent advances on seed technology and planting stock production
- to make forest managers and other interested specialists aware of significnat advances
- to discuss present constraints and identify priority research areas

Program highlights:
- High-quality seeds for high-quality planting stock
- Seed quality: collection, handling, processing, storage, testing, and certification
- High-quality seedlings: physiology, morphology, and standarization
- Alternative planting stock production techniques
- Application of soil microorganisms in planting stock production

Organized by ASEAN-Canada Forest Tree Seed Centre Project

Please address all correspondence to: Symposium Secretariat, ASEAN-Canada Forest Tree Seed Centre, Muak-Lek, Saraburi 18180, Thailand, ☎ 66-36-341-305, Fax: 66-36-341-859.

IUFRO World Congress

August 6-12, 1995

Finland will host the 20th IUFRO World Congress. This important event will focus on forestry science with all its linkages to the environment, development and the economy. The Congress will take place in modern facilities within the city of Tampere, beautifully located in the Finnish landscape. Post-congress excursions will be arranged in Finland as well as in other Nordic Countries and the Soviet Union.

Innovation of Tropical Tree Seed Technology

September 4-11, 1995

Aim

Exchange of knowledge on improved seed handling techniques with emphasis on appropriate operational and economical techniques.

Topics

Innovation and transfer of knowledge within

Seed Collection: crop assessment; timing; methods; equipment; transport

Seed Processing: extraction; cleaning; drying; grading; seed invigoration

Seed Storage: conditions; equipment; facilities; temporary storage; seed longevity

Seed Testing: dormancy; germination environment; equipment; sampling; recording; international standards

Itinerary

A workshop will be held at NTSP, Morogoro, Tanzania, 4-6 September.

The symposium will be held at Arusha International Conference Centre, Morogoro, 8-11 September.

A post-symposium excursion will be held 12-15 September.

Sponsors
Danish International Development Assistant (Danida); Canadian International Development Agency (CIDA) via Southern African Development Community (SADC) Tree Seed Centre Network; Australian Centre for International Agricultural Research (ACIAR).

Contact: National Tree Seed Programme, P.O. Box 4012, Morogoro, Tanzania, ☎ +255 56 3192, Fax: +255 56 3275, Telex: 55392 NTSP TZ.

BScF Theses at the Université de Moncton

The École de sciences forestières of the Université de Moncton has offered since 1985 a five-year bachelor program leading to a B.Sc.F. degree. In 1990, the first group of four graduates completed successfully the program. In 1991 and 1992, four and seven more obtained their B.Sc.F. degree. (See Newsbulletin Issue #19)

Three undergraduate theses related to tree improvement or seed research were produced in 1993 at the École de sciences forestières of the Université de Moncton. For each of these, a short summary of some findings are provided:

1. Plourde, R. 1993. Variation inter-familiale du volume par arbre, de la densité du bois et de la masse anhydre par arbre chez *Picea mariana* (Mill.) B.S.P. 40 pp.

Specific gravity from half-sib black spruce families was significantly and negatively correlated with diameter growth. However, some families had both high specific gravity and high diameter growth. The use of specific gravity as a selection criterium during roguing phase of an orchard is being discussed.

2. Thériault, P.E. 1993. Quantité et qualité des semences chez les proliférations d'épinette noire (*Picea mariana* [Mill.] B.S.P.) en verger. 53 pp.

According to information available in the literature, spruce seed-cone proliferations (a structure intermediate between a seed cone and a vegetative shoot) do not yield viable seed. This study indicates that most types of proliferations in young black spruce yield full-sized seed that germinate. Seed yield is generally lower with proliferations having less of a seed-cone appearance. Only proliferations with little seed-cone attributes yield no viable seed.

3. Ritchie, R.A. 1993. Évaluation de la contamination pollinique dans le verger à graines d'épinette noire (*Picea mariana* du Deuxième-Sault), Nouveau-Brunswick. 40 pp.

Pollen contamination was evaluated in 1992 for a 2.8 ha black spruce orchard. Seed-cone receptivity lasted for 12 days (May 27 - June 7). Average seed-cone and pollen-cone production was 649 and 422, respectively. Pollen contamination was estimated at about 30%. Most contaminant pollen were imported into the site by northern winds.

Guy E. Caron

Recent Publications

Aho, Marja-Leena; Pertti, Pulkkinen. 1993. Evaluation of the frost hardiness of Scots pine seed orchard crops using early freezing tests. Found. For. Tree Breed. Finland, Rep. No. 7. 12 pp.

Caron, G.E.; Wang, B.S.P.; Schooley, H.O. 1993. Variation in *Picea glauca* seed germination associated with the year of cone collection. Can. J. For. Res. 23: 1306-1313.

Copis, P. 1993. A system of pedigree record-keeping. Can. Forest Serv. PNFI Technical Rep. 15. 12 pp.

Dominy, S.W.J. 1993. The Bartt MK IV seeder - follow-up evaluation. FERIC Silvic. Field Note No. 51. 2 pp.

Downie, B.; Wang, B.S.P. 1992. Upgrading germinability and vigour of jack pine and white spruce by the IDS technique. Can. J. For. Res. 22: 1124-1131.

Downie, B.; Bergsten, U.; Wang, B.S.P.; Bewley, J.D. 1993. Conifer seed germination is faster after membrane tube invigoration than after prechilling or osmotic priming. Seed Sci. Res. 3: 259-270.

Edwards, D.G.W. (compiler/editor). 1993. Dormancy and barriers to germination. Proc. Symp. IUFRO Project Group P2.04.00; Seed Problems. Victoria, British Columbia, Canada. Apr. 23-26, 1991. pp. 153.

Mittal, R.K.; Wang, B.S.P. 1993. Effects of seed-borne fungi in reforesation. Seed Res. Special Vol. #1: 613-623.

Mittal, R.K.; Wang, B.S.P. 1993. Effects of some seed-borne fungi on *Picea glauca* and *Pinus strobus* seeds. Eur. J. For. Path. 23: 138-146.

Mosseler, A.; Johnsen, K.H.; Tricco, P. 1993. Growth performance in seedlings derived from premature cone collections from natural populations of black and white spruce. Seed. Sci. & Technol. 21: 537-544.

Schwan, T. 1993. The effects of organic and inorganic mulches on black spruce seedlings in seed orchards. N.E. Sci. & Tech. Ontario. Tech. Rep. TR-013. 24 pp.

Templeton, C.W.G.; Odlum, K.D.; Colombo, S.J. 1991. How to dissect spruce buds. Ont. Min. Nat. Res., Can. Ont. For. Res. Dev. Agreement Proj. No. 33501, pamphlet.

Templeton, C.W.G.; Odlum K.D.; Colombo, S.J. 1993. How to identify bud initiation and count needle primordia in first-year spruce seedlings. For. Chron. 69(4): 431-437.

Wang, B.S.P.; Charest, P.J.; Downie, B. 1993. *Exsitu* storage of seeds, pollen and *in vitro* cultures of perennial woody plant species. FAO of UN, Forestry Pap. 113. 83 pp.

Yue-Luan, Hor; Pukittayacamme, Prapan; Komar, Tajudin Edy; Cornejo, Apolinaria. 1993. Seed testing for selected tropical trees in ASEAN region. ASEAN-Canada For. Tree Seed Centre, Rev. Pap. No. 2. 83 pp.

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