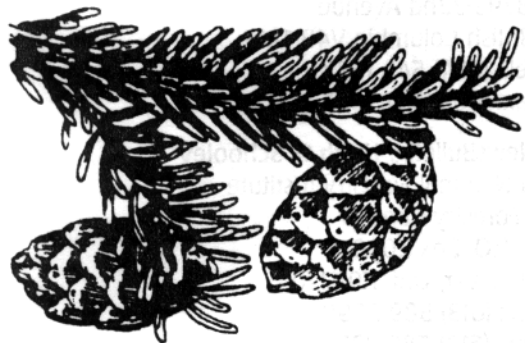


CANADIAN TREE IMPROVEMENT ASSOCIATION/  
ASSOCIATION CANADIENNE POUR L'AMÉLIORATION DES ARBRES

Tree Seed Working Group



# News Bulletin

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## A Word from the Chairman

The 25th meeting of the Canadian Tree Improvement Association/Association canadienne pour l'amélioration des arbres (CTIA/ACAA) will be held in Victoria, B.C., from August 28 to September 1, 1995. This meeting will be a joint venture with the Western Forest Genetics Association (WFGA) and its theme is "Evolution and Tree Breeding Advances in Quantitative and Molecular Genetics". Alvin Yanchuk, Michael Stoer, John Russell, and Pat McGuire have prepared a great program that should appeal to all! Plan to attend!

Three events will be held by the TSWG during this 25th CTIA/ACAA meeting:

- i) Our regular TSWG Workshop will be held on Monday morning, August 28. The theme for our 6th Workshop is: "Seed Orchard Management and Cultural Options for Quality Seed Production". Five speakers have already been lined up. For more information, please refer to Dave's report on page 3, in this NewsBulletin. Don't forget that our Workshop is on Monday! We'll see you then!
- ii) A visit to the BCMOF Tree Seed Center in Surrey is being organized by Dave. For early birds, a first visit will be held on Sunday, August 27. Another tour will be held after the CTIA meeting (September 1) for those that could not take part in the first tour. This tour to the BCMOF Tree Seed Center will be a great addition to our regular Workshop.
- iii) Our regular TSWG Business meeting will be held on Monday evening, August 28. We will need to address items related to our group, and certainly some to do with the recent budget cuts that could affect or is actually having an impact on TSWG – a new NewsBulletin Editor for one (see below)!

I would like to express my sincere thanks to Dave Kolotelo for planning and coordinating upcoming TSWG activities in Victoria. It would have been somewhat difficult for me from New Brunswick. At least, I know it is a lot easier with Dave's involvement! This collaborative approach will become even more important in the future in light of the many budget cuts that everyone is now experiencing. Team effort is the key to continued TSWG development! Thanks Dave!

Last but not least, I must regretfully announce that Hugh Schooley, had to resign as TSWG NewsBulletin Editor. As you all know, the legendary Petawawa National Forestry Institute will be forced to close completely by 1997. I personally still have difficulty in believing it. The 1995 Martin budget really did it! Many of our forestry colleagues will relocate, lose their jobs, or be asked to retire! Hugh has decided to retire.

Hugh has worked for Forestry Canada for many years. I have known him since my first participation in a CTIA meeting, namely the 18th meeting in Duncan, BC, in 1981. I have asked Willard Fogal and Ben Wang to prepare a short resumé of Hugh's achievements during his career. You will find their contribution on page 5. I had the opportunity to work with Hugh for a short time in 1984, and we co-authored two articles. I started to know him best when we teamed up in the TSWG Executive in 1991. In fact, I joined an already existing team!

Hugh has been the most permanent member of the TSWG Executive since its creation in 1983. During the 20th CTIA/ACAA meeting in Quebec city (1985), Hugh was named Editor of our NewsBulletin and served for 10 years. Hugh was instrumental in developing a sound periodical for tree seed managers and scientists throughout Canada and abroad. Such

dedication to the improvement of the NewsBulletin has certainly been the reason for our increased membership, passing from 106 in 1985 to over 250 in 1995. Rong Ho once said (NewsBulletin No. 8, 1987): "The NewsBulletin of TSWG ... is informative and interesting". This has been the case since then, thanks to Hugh's dedication and his continued and persisting encouragement to all in contributing regular items to the NewsBulletin.

In the first NewsBulletin (No. 4, November 1985) under Hugh's editorial leadership, we can notice articles such as: i) "First seed orchard seed collected in New Brunswick" submitted by Dale Simpson; ii) "New International rules for seed testing by the International Seed Testing Association" by Ben Wang; iii) "Seed orchard expansion boom in Quebec" by Hugh Schooley; iv) "First Cone and Seed Insect Working Party Workshop held in Quebec" by Hugh Schooley; v) "Quick tests for Tree Seed Viability" by Carol Leadem; etc. It is surprising to note so many changes across Canada since Hugh edited his first NewsBulletin in 1985. This is history in the making!

Thank you very much, Hugh, for your efforts and dedication to the Tree Seed Working Group. You and the past Chairmen have done much in promoting and developing the TSWG to what it is today! From all of us, all the best during your retirement.

Avec nos remerciements sincères et notre amitié.

Guy E. Caron

### Note These Addresses

Chairperson, TSWG, **Guy E. Caron**

École de sciences forestières

Université de Moncton

165 Boulevard Hébert

Edmundston, N.B. E3V 2S8

Tel.: (506) 737-5050 (Ext. 5243)

Fax: (506) 737-5373

Coordinator, CSIWP, **Peter de Groot**

Forest Pest Management Institute

Forestry Canada

P.O. Box 490

Sault Ste. Marie, Ont. P6A 5M7

Tel.: (705) 949-9461

Fax: (705) 759-5700

Coordinator, TSPTWP, **Dave Kolotelo**

Ministry of Forests

Tree Seed Centre

18793-32nd Avenue

Surrey, British Columbia V4P 1M5

Tel.: (604) 541-1683

Fax: (604) 541-1685

Editor of the NewsBulletin, **Hugh O. Schooley**

Petawawa National Forestry Institute

Forestry Canada

P.O. Box 2000

Chalk River, Ont. K0J 1J0

Tel.: (613) 589-3098

Fax: (613) 589-2275

Email: HSCHOOLEY@pnfi.forestry.ca

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

### Editor's Notes – Down-sizing the Canadian Forest Service

On February 28th, the Government of Canada announced a 'deficit reduction initiative' that will result in the elimination of 45,000 civil servant positions and substantially cut the financial support of many government programs by the end of 1997.

The Canadian Forest Service's share of these reductions has been dictated. Their financial resources will decrease to 95.6 million (or 43% of the current value) and personnel resources will be cut to 820 person years (or 66% of the current number).

To accomplish these reductions the CFS will close all eight Forest District Offices, the Newfoundland Forestry Centre and the Petawawa National Forestry Institute (PNFI) will close, and the Forest Pest Management Institute will be substantially reduced and amalgamated with the Great Lakes Forestry Centre. Activities at the five remaining regional centres and at headquarters will be substantially reduced. In addition, all support under the Forest Resources Development Agreements Program will be discontinued.

The 'regional' emphasis of the five retained laboratories will be changed so that each will have a National mandate. The new emphasis in forestry will be on developing scientific information and technologies that support sustainable forest development. Forest ecosystems information and more environmentally-benign forest protection technologies are among

the key tools available – and there will be a continued priority in securing a national consensus on forest policy issues and positioning Canada in international forestry issues.”

The seed services and research activities conducted by the CFS will be affected by the major cuts in government spending. In particular the announced closure of Petawawa National Forestry Institute, the home of the National Tree Bank and for many years a major centre for seed research, will necessitate a shift in these activities to other research centres. Since the importance of these activities as part of the support for ‘SUSTAINED DEVELOPMENT’ has been recognized the work should continue. However, those responsible for tree seed conservation and research within the CFS will undoubtedly need all the support that the seed community can give. Is the SEED COMMUNITY – our Community – prepared to offer this support?

This is the last issue of the NewsBulletin to which I will be contributing as your editor. (I have taken an early retirement package offered by the CFS) Because this move is so sudden, I have agreed, to voluntarily continue to serve as editor, with the full support of Petawawa National Forestry Institute, until a new editor is formally appointed at the Tree Seed Working Group’s Annual Meeting in August. All my current addresses will remain in effect until then.

It has been a real pleasure working with you all and I wish you all and the GROUP every success possible in the future.

Hugh Schooley

### Tree Seed Working Group Workshop

The Tree Seed Working Group (TSWG) will have a workshop in conjunction with the 25th meeting of its umbrella organization, the Canadian Tree Improvement Association (CTIA), in Victoria, BC on Monday, August 28, 1995 between 8:30 am and 12:00. The workshop will be held in the Human & Social Development Building of the University of Victoria, room A240. The workshop is titled ‘Seed Orchard Management and Cultural Options for Quality Seed Production’. The tentative set of speakers for the session is presented below.

James Barnett, Chief Silviculturist USDA Southern Forest Experiment Station – How seed orchard

culture effects seed quality - experience with the southern pines

Greg Adams, Tree Improvement Supervisor, J.D. Irving Ltd. – Clonal variation in cone and seed production in black spruce and white spruce seed orchards and management implications

Guy Caron, Professor University of Moncton – Spatial and temporal distribution of seed cones in orchard trees: a key towards developing proper forecasting tools

Chuck Masters, Leader of Applied Technology, Weyerhaeuser Corp. WA – Loss of MBC (methyl bromide chloropicran): minimizing the risk of disease through management of seed vigour, seed-borne pathogens and the family

Youssry El-Kassaby, Manager Saanich Forestry Centre, Pacific Forest Products Ltd. – Genetics of seed orchard seed: evaluation of current practices

If you are interested in presenting a paper please contact David Kolotelo at (604) 541-1683 or by EMAIL at [DKOLOTEL@mfor01.gov.bc.ca](mailto:DKOLOTEL@mfor01.gov.bc.ca). The business meeting for the TSWG will be held Monday evening in the MacLaurin Building D-wing. The room is available to us between 7 and 9 pm and an exact time can be decided at the workshop for the convenience of those wishing to attend.

At the last CTIA meeting there was an interest in visiting the BCMOF Tree Seed Centre in Surrey. I would be willing to tour a group on Sunday, August 27th (before CTIA meeting) or/and Friday, September 1 (following CTIA meeting). I especially hope that all participants in the TSPTWP, attending the CTIA, will be able to visit our Tree Seed Centre. Please contact myself to indicate whether you are interested in touring our facility and which date is most convenient.

### The Integrated Pest Management in Seed Orchards Network

The goal of the IPM in Seed Orchards Network is to develop ecologically acceptable and practical pest management strategies for key seed and cone insects and diseases in Canadian orchards. In addition to the funds we receive from the Integrated Forest Pest Management Initiative of Green Plan, we receive funding and in-kind support from Universities, NSERC, Forestry Development Agreements and private industry. Our research has focussed on developing: 1) practical methods of population monitoring and damage prediction; 2) behavioral and cultural alternatives to



chemical controls; and 3) basic ecological knowledge necessary for the development and effective application of monitoring, damage prediction, prevention, and alternative control strategies. Highlights of our progress in 1994 are summarized below.

Peter de Groot (CFS - FPMI), collaborating with Gary DeBarr (US Forest Service) and others, is developing pheromone-based tools for the detection, monitoring, and suppression of cone beetles in pine orchards. Studies comparing pheromone dispensers, trap designs, and trap height suggest the optimal system is a Japanese beetle trap, baited with Phero Tech's bubblecap, suspended in the upper crown of trees. The optimal density of traps per orchard and the relationships between trap catch and beetle damage will be field tested in 1995. A promising control strategy under investigation is the suppression of *Conophthorus* sp. cone beetle populations, by the mass trapping of male beetles. Over 5000 beetles were caught in a pilot study carried out in 1993; the beetle population was significantly lower in 1994, when the trapping out technique was repeated. Replicated field trials will be conducted in 4-6 pine orchards in 1995 to determine the effectiveness of the trapping out technique as a population suppression tool.

Jon Sweeney (CFS-Maritimes), Jean Turgeon (CFS-FPMI), Dan Quiring (UNB) and graduate students Laura Fidgen, Martha McClure (UNB), and Eckehard Brockerhoff (U of T) are studying the population dynamics, host location process, and impact of cone maggots, *Strobilomyia* spp., affecting spruce and larch orchards. Partial life tables were constructed for the spruce cone maggots from data gathered in 1992-94 and they indicate that significant mortality occurs to mature larvae and puparia in the soil, chiefly due to invertebrate predators. Carabid beetles and ants made up more than 80% of the total potential predators caught in pitfall traps. Parasitism rates were quite low and the parasitoid guild appears similar to that exploiting *Strobilomyia anthracina*, the cone maggot that infests cones of Norway spruce in Europe. The survivor data will be analyzed in 1995 and will provide us with a better understanding of the natural mortality factors affecting cone maggots; this knowledge is vital for developing control strategies.

Considerable progress was made in the development of cone maggot sampling and damage prediction methods and we have started to transfer some of these to the orchard managers. Preliminary sequential sampling plans for predicting seed losses to spruce cone maggots were tested operationally in the

Maritimes with the assistance of orchard managers. Additional data on the relationship between egg density and seed loss was collected in Ontario to improve the sampling plan in black spruce orchards. Knowledge of the phenology and impact of larch cone maggots arising from M. McClure's graduate work was applied in three orchards in 1994 to determine the need for and timing of insecticide applications. Jean Turgeon's "Process" blue sticky trap caught extremely large numbers of larch cone flies in 1994 and shows promise as a tool for monitoring and possibly controlling most species of larch cone flies in North America and abroad.

Suzie Blatt, a Ph.D. student with John Borden at Simon Fraser University, has made excellent progress towards elucidating the pheromone chemistry and pheromone-mediated behaviour of the western conifer seed bug, *Leptoglossus occidentalis*, and assessing the potential for pheromone-based management techniques. A five component alarm pheromone was identified, synthesized, and shown to have significant repellent effects on seed bugs in laboratory bioassays and preliminary field trials. Also, field experiments detected a male-produced aggregation pheromone that is released in the fall when these bugs are seeking overwintering sites. Both the alarm pheromone and aggregation pheromone have potential for the development of management tools. In 1995 there will be additional field trials of the alarm pheromones as management tools, and work to identify and bioassay the antennally active host-flower volatiles, sex and aggregation pheromones.

Tony Hopkin (CFS-Ontario), Ken Mallett (CFS-Northern) and Michel Dessureault (Laval) are determining the factors that predispose conifers to *Armillaria* infection in order to develop a hazard rating system for use in orchard site selection. Greenhouse trials repeated in 1994 confirmed that the incidence of *Armillaria* infection increased with increased availability of soil moisture and nutrients, likely due to direct effects on inoculum viability. Data on the incidence of disease and various factors such as site age, soil texture and fertility, and site history gathered from over 30 black spruce seed orchards and plantations suggest that incidence of *Armillaria* is associated with soil deficiencies of calcium and magnesium, root deformities, sandy soils, and presence of forest debris. Experiments testing the relationship between defoliation-induced stress and *Armillaria* infection were repeated in 1994. The hazard rating system is being developed from these data and will be validated in 1995.



Robb Bennett and Bev McEntire of the B.C. Ministry of Forests, in collaboration with Gerhard Gries of the Chemical Ecology Group at SFU, Gary Grant (CFS-FPMI), and Jean Francois Landry of the Centre for Land & Biological Resources Research have greatly improved our knowledge of the pheromone chemistry of the fir coneworm, *Dioryctria abietivorella*, and its life cycle on Douglas-fir in B.C. Adults were caught in pheromone traps from late May through October, with the flight period beginning one month earlier in the interior than on the coast. A range of larval instars were found in cones throughout the summer and fall and late instar larvae overwinter in silken cocoons within the cones. Several hundred larvae were collected and were reared for pheromone analysis and morphological examination. Pheromone trapping and cone sampling will be repeated in 1995 to further elucidate this coneworm's life cycle. The ultimate goal is to provide orchard managers with a *Dioryctria* monitoring program.

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

## A Tribute to the Editor

Since 1985, the Tree Seed Working Group of the Canadian Tree Improvement Association has enjoyed the services of **Hugh Schooley** as editor of the NewsBulletin. Hugh has expressed the desire to pass on the mantle for editing to someone else, after this issue.

He placed his mark on the NewsBulletin over the years as it proved to be a wealth of knowledge for seed production managers and researchers. Subject matter ranged from high tech coverage of biotechnology applications and access to the electronic highway to management problems such as losses of seeds to squirrels and other agents and the development of methods for improving seed quality.

Hugh brought many years of experience in seed production research and management to his job as editor of the NewsBulletin. The direction of Hugh's scientific career was set in motion while he was a student in the University of New Brunswick Faculty of Forestry where he studied flies that attack conifer trees as an undergraduate thesis that was completed in 1962. This may be where he was introduced to insects as important factors causing major losses of seed. Apart from a small departure to study soil arthropods in red pine stands as part of his thesis at

Michigan State University, his career was devoted to seed production and forest regeneration problems.

His research career began in 1964 with the Canadian Forestry Service at Newfoundland. Here he established himself as an expert on the impact of the balsam woolly aphid on regeneration and wood production. With his colleagues he clearly documented the effects of spruce budworm and other insects on cone and seed production of conifer trees and impacts on forest regeneration. His reports appeared principally in the Forestry Chronicle, Woody Points – a Newsletter published by the Newfoundland Forestry Centre, CFS Information reports and numerous Internal Reports.

Upon transferring to the Petawawa National Forestry Institute in 1982 he initiated new studies on seed production with colleagues in the National Tree Seed Centre by undertaking a major review of the role of soil fertility in cone and seed production of conifer trees. This led to the development of major fertilizer trials in containerized- and soil-based seed trees along with trials on the use of gibberellins to enhance the yield of tree seed and on the use of crown pruning as a means of controlling the growth of seed orchard trees.

He has made a major contribution to forest tree seed research and management through his tireless effort and dedication to, editing, publishing, and distributing the Tree Seed Working Group NewsBulletin. The NewsBulletin is a powerful vehicle for networking and exchange of information with the national and worldwide community of people who work on forest tree seed. In addition to acting as the editor and soliciting articles for publication from across the country he contributed numerous articles himself. His reports are always written in a lucid and homespun style acceptable to forest manager and researcher alike.

On a more personal note, we know Hugh as a very gentle and kind person whom we have seldom seen in an angry state. We believe he lives by the adage "if you can't say something good about someone don't say anything". We see Hugh as a very independent-minded person yet very sociable and ready to lend a helping hand. This is seen in his willingness to review and comment on research papers, presentations, and proposals of colleagues and extends to his active involvement in local community activities related to forestry, horticulture and environmental concerns. We all owe Hugh a great deal for his valuable contributions. Thanks Hugh.

Willard Fogal and Ben Wang

## The Ontario Tree Seed Plant

Our story begins in the mid 1800s, when the village of Angus was becoming a thriving little community. The village was first known as the Village of the Pine River, as settlement began because of the saw mill on the Pine River. With the coming of the railway in 1855 the Village of the Pine River began its growth. It stood on the border of one of the finest pineries in southern Ontario and was a natural outlet for wheat and other produce for several miles to the south.

Jonas Tar Bush and W. Proudfoot entered into a partnership. Together they envisioned the future of the village. In 1857 a map was produced bearing the names of these two men. The plan laid out the lots and streets and the village was renamed to Angus after Angus Morrison the first MP of Simcoe.

Angus enjoyed much prosperity. The pine plains to the south and west of Angus were covered with a blanket of high quality white and red pine, producing mast spars, spar timber, and square timbers.

Angus was the centre of the timber industry for miles around. The number of sawmills operating in the area at one time was seventeen. It was not uncommon for ten to twelve trains of lumber and square timber to leave Angus in a week.

With such a thriving trade in timber and grain and so many people living in and around the village, many places of business developed. There were five hotels, four blacksmith shops, a wagon and carriage shop, two tailor shops, two photographers, a bake shop, two farm implement agencies, a saddle and harness store, two liquor stores, a tinsmith, cooperage shop, drug store, a flour and feed business, a school, three churches, and last but not least, a physician.

As the forest disappeared, the prosperity also went until the village of Angus reached a very low ebb and progressed into a period of civic awakening.

One of the factors which influenced the community was the activities of the Ontario's Forestry Branch. In 1920 Mr. A.H. Richardson, who was in charge of reforestation with the forestry branch, came to Angus and arranged for the use of a Base Borden building for the storage of cones. Increased quantities of white and red pine seed were now needed to supply the provincial Forest Stations. It was then decided to locate a seed extraction plant in Angus because of

the remaining available white and red pine, suitable railway facilities, roads and water supplies. So, in 1923, 8 acres was purchased and construction began of Ontario's first provincial seed extraction facility. Additional land was later purchased to comprise a site total of 28 acres.

The centre has seen numerous changes and additions to existing buildings since the early days but we are always cognizant that it is a priority to adjust and accommodate the ever increasing demands and needs of our clients.

A giant leap will occur April 1, 1995 as the Ontario Tree Seed Plant implements a fee for service schedule. Revenues generated by the centre will form some of the operating dollars. Processing applications have been modified to correspond with end user operations in mind, from basic direct seedling programs to high efficiency precision seeding. This fee schedule allows the client to make the call on how seed is processed as it relates to the intended end use. For those interested in the fee schedule, it is available upon request.

Annual extraction operation volumes have not varied too much over the last few years. Receipt volumes have maintained an average of about 10,000 to 11,000 hl., however within this total volume the species are variable according with crop periodicity and target demands. The complex has greater volume capabilities than what has been reported to date but has not had the opportunity to test the limit.

Oak, ash, maple, walnut and butternut seed which account for approximately 1,500 hl., bypass Angus and are shipped directly to the appropriate nursery for bareroot production.

Five major coniferous species contribute in the framework of Ontario's regeneration programs; white, red and jack pine and white and black spruce. A role is also played by other coniferous and hardwood species. In total there are 49 different species in our storage facility, 20 of which are coniferous and 29 being hardwood species. This accounts for a total weight of 30,202.683 kg., equating to 8.2 billion viable seed with a street value of \$6.5 million, 1993/94 numbers. The major portion of the seed is stored in sealed containers at a moisture content of 4 to 8% in temperatures of -7°C to -16°C. A small amount of hardwood seed is in storage at above freezing temperatures of 2°C to 5°C, at a moisture content of 7.5% to 30% i.e., black alder and red oak.

Annually the Ontario Tree Seed Plant ships 1.1 to 1.4 billion viable seeds. The seed used for direct seeding programs accounts for 50% to 70% of all seed shipped.

As we integrate new processing equipment, techniques and concepts research and development are an ongoing occurrence at the Ontario Tree Seed Plant. Apart from our Prevac System discussed in the last newsletter, efforts have been directed in the area of extraction and processing efficiencies. Hot water dipping for jack pine is being tested to evaluate an optimum extraction timeframe and kiln volumes in relationship to yield.

A report will be available later this year for anyone interested. Other interesting activities include a butternut seed storage trial, and a complete seed transfer study of the cleaning area for jack pine.

I know I have taken more of an historical approach to this article, but I think we have to step back at times and look at the how's and the why's of where we have come from in order to evaluate our future directions.

It was once said "That the world is round and the place which may seem like the end may also be the beginning."

Our door at the Ontario Tree Seed Plant is always open. Please feel free to write, call, or even better, visit us.

K.R. Creasey, Technical Coordinator,  
Ontario Tree Seed Plant, P.O. Box 70, King St.,  
Angus, Ontario L0M 1B0  
Tel.: 705-424-5311; Fax: 705-424-9282

## Dormancy in Recalcitrant Tree Seeds

In Dr. Frank Bonner's paper entitled "Storage of seed: potential and limitations for germplasm conservation" (1990, For. Ecol. & Manag. 35: 35-43), he classified tree seed storage behaviour into four groups: true orthodox, sub-orthodox, temperate recalcitrant, and tropical recalcitrant. This classification appears to be more applicable to tree seeds than Professor Roberts' classification of orthodox and recalcitrant (1978, Seed Sci. & Tech. 63: 53-63), although new findings of an intermediate group by Ellis et al. (1990, J. Exp. Bot. 41:1167-1174; 1991a, Seed Sci. Res. 1: 69-72; b, J. Exp. Bot. 42: 652-657; c, Seed Sci. Res. 1: 99-104) suggest that there may be other groups of seed storage characteristics which do not fit with any of the currently known groups.

Among the tree species listed under both the temperate recalcitrant and the tropical recalcitrant groups in Dr. Bonner's paper, only red oak (*Quercus rubra*) and cherrybark oak (*Quercus falcata* var. *pagodaefolia*) acorns are known to be shallow and deep dormant and requiring 30-45 day and 60-120 day cold stratification, respectively. During my visiting study at the Seed Physiology and Biochemistry Laboratory of the Taiwan Forestry Research Institute last year, I was surprised to find that seeds of many recalcitrant tree species in that sub-tropical region exhibited various degrees of dormancy and required two to six-month cold stratification for maximum germination. Those seeds that can be classified as having temperate recalcitrant seed storage behaviour (e.g., *Castanopsis hystrix*, *Elaeocarpus sylvestris*, *Taxus celebica*) are sensitive to desiccation, some require post-harvest ripening and maintenance of a relatively high moisture content at maturity, they are sensitive to subfreezing temperature storage, and require wet storage or to be moist stratified at 4°C to attain a storage life of 1-3 years. Those seeds which can be classified as tropical recalcitrant (e.g., *Cinnamomum zeylanicum*, *Machilus kusanoi*, *Neolitsea variabilima*) are sensitive to desiccation and will lose viability immediately upon dehydration. They require maintenance of a high moisture content similar to that at seed maturity, and with wet storage or moist cold stratification at 4°C can be stored for 1-12 months. It is most interesting that some recalcitrant seeds in the sub-tropical region of Taiwan are very close to the tropical recalcitrant seed in their storage behaviour but have strong dormancy and require 6 months of moist cold stratification for maximum germination. Such dormancy may have evolved for survival at high elevations where winter temperature can be as low as 4-5°C.

B.S.P. Wang

## 125 Years of Seed Testing

In 1869 Friedrich Nobbe founded the first agricultural seed testing station and developed the intellectual background and scientific basis for seed certification serving to protect the consumer and the interest of public economics. The 125th anniversary of this is a good opportunity to remember the name of Nobbe and his achievements.

In the 19th century, with industrialization, urbanization and the introduction of hygiene, the population in Europe grew rapidly, demanding a concomitant increase in food supply. Several terrible famines in the tens and forties had killed millions of people and forced other millions to emigrate. Seed played



key role as the prime commodity in plant production. At that time, seed supply, in particular the seed of fodder plants, became increasingly a matter of national and international trade. With trade inevitably fraud, swindling and cheating was an unpleasant everyday experience.

Penal laws were passed to try and control this situation. For example in 1816 the City and Republic of Bern, Switzerland, decreed that inspectors had to test trueness and purity of trefoil seed. In case of objections, a control sample was taken and tested by experts. If fraud was proven, a first-time offender was fined 10 Francs per 50 kg, and a second-time offender 50 Francs, then quite a fortune. In addition, the offender was reported to the State-Economy Commission, and his name, business data and offense were published in the official news. The most colourful picture of seed processing and trade usages, however, is presented by the minutes of the debates preceding the disposing of the Adulteration of Seeds Bill in the British Parliament. All practised abuses and details of "doctoring" seeds were publicly brought to light. This bill, became effective in 1869.

In the same year Prof. Dr. Friedrich Nobbe, Head of the Physiological Experimental Station at Tharandt, near Dresden, Saxony, published his famous Statute Concerning the Control of Agricultural Seed. The Statute is composed of 6 paragraphs. In brief, their contents are: 1) the subject is protection from adulterated or low quality seed; 2) members of the Agricultural Club, holder of the station, get free seed testing; 3) samples must be sealed, and represent the average character of the lot, species specific minimum masses of submitted-sample sizes are prescribed; 4) the test results are published officially; 5) the fees for testing cereal seeds and larger seeds was the equivalent of \$60 US in today's money and were greater for small seeds and for seed mixtures.

The statute pointed out that only official seed testing offers the possibility of self-protection. A test before buying the seed and a control test after the purchase protect from fraud. Based on seed testing results, contracts of guarantee and liability of the dealer in case of failure are recommended as additional instruments for consumer protection. However, action for failure is absolutely not possible on the basis of deficiencies in field performance, but only on the basis of laboratory tests, because compared to the unpredictable field emergence conditions only the testing under controlled and standardized laboratory conditions can guarantee a true comparative estimation of seed quality.

Nobbe completely changed the attitude of his times towards seed business and conceived of a then revolutionary new approach. A closer look at the Seeds Bill and Nobbe's Statute, both published at practically the same time, reveals two completely contradicting philosophies concerning the means of controlling seed business. Until Nobbe, solely penal legislation was considered as the appropriate tool to handle fraud, entirely disregarding whether caused intentionally (*dolus*) or simply by ignorance (*culpa*). On the contrary, Nobbe was convinced that criminal procedures never could be successful in making seed business safe from fraud.

A short biography of F. Nobbe is published by H. Jähnel and H. Ludwig in: Proceedings of the International Seed Testing Association 26, 127-139, 1961, and a more extensive biography including a complete publication list and the history of the Seed Control Station at Tharandt by H. Vater in: Tharandt forstliches Jahrbuch 75, 140-188, 1924.

(Extracted from an article of the same title, by A.M. Steiner in ISTA News Bulletin #107, Dec./94 p. 24-25)

### Why Posters are Better Than Talks

**S**ad but true, conference goers risk being trapped in boring talks every time they walk into a session. The problem is that you have no way of knowing how good or bad each talk will be. The abstracts are not much help even if you do read them, so what are you going to do?

The answer is to make more of the poster sessions. The current status quo in science relegates posters to second class status despite platitudes to the contrary. Hot shot professors, it seems, do not give many posters. The reasons for this are many. For example, posters take hours of careful work while you can knock together an average talk between dessert and coffee on the plane.

Talks get more attention because conference goers have been taught from an early age that they should sit in darkened rooms for days on end if they are to be truly professional. Think about what is important in conferencing. At a conference it is most important to get to know all the other people who are just as unfortunate as you are, to gain useful information and to have a good time. Going to talks simply does not serve these objectives. With the poster session there is no information lottery, you can pick and choose. If it's boring, forget it and move on. If it is obscure and unclear, forget it and move on. You don't have to sit quietly for 15 minutes in the

dark in front of a bad poster. Secondly, you can't look at posters without meeting people. Though some try to pretend the poster owner is inanimate, most people at least exchange pleasantries when they stop in front of a particularly arresting visual extravaganza. If the poster owner is genial and engaging, this is your chance to network with a fellow punter.

Then there is the question of fun. Poster sessions can be fun, it is up to the organizers to make them that way. A proper poster session will be well lubricated with a free bar – one less invited speaker will cover the cost.

Organizers can also arrange to serve lunch at the poster session to further encourage attendance. It is even possible to run a competition to find the posters with the highest impact factors. Punters would have to submit a list of the 5 or 10 most interesting or talked about posters in exchange for refreshments. With appropriate prizes and helpful statisticians the competition could hot up.

If posters are to become the preeminent mode of communication what should we be doing to help them along? There needs to be more time devoted to poster gazing and the poster reading public should be more prepared to interact. To encourage the readers, the poster makers have to perk up their own performance. Most poster makers would benefit from a quick look at magazine advertising. What advertisers understand is the need to capture the attention of your audience. Surely if the science is original the poster should look original too? Similarly, if the science is creative the presentation should be creative to match? "9 font laser print on white bond" hastily glued to some coloured card is just not going to pull crowds.

Some minimalism in the poster content wouldn't hurt either. Minimalist posters are easier to make and information transfer is just as efficient because the poster maker is available to answer questions. Posters should be designed to stimulate questions and to tease readers into delving into the subject further. Only the best bits of the good data need be present. The poster is an eye catcher not a paper. The poster is really meant to serve as a set of visuals for your short entertaining spiel that explains your work to passers by. It is meant to stimulate discussion because the best exchange of information occurs with a two way conversation not a monologue such as you get in the concurrent sessions. A poster without dialogue is a waste of time.

Still not convinced? The last and most wondrous advantage of posters is that you are free once you hit the conference centre. Apart from a few hours tending your masterpiece you are able to relax and enjoy the conference. There are no slides to lose, no butterflies, no going to bed early and no last minute practices. If you are lucky you will meet some interesting fellow punters over a beer at the poster sessions who will then keep you up all night with memorable conversation.

(Extracted from an article of the same title, by Ropurt Murcock in CSPP/SCPV Bulletin, March 1994)

### Interest in Seed Orchards is Declining in Sweden

In Sweden the interest in seed orchards has dropped for the following reasons. The price for timber and demand for plants decreased during the 90s because of the world recession. Current forest growth projections suggest that annual growth is much higher than annual cut, and this raises doubts about the need of improved seeds. The focus on forestry has changed from production towards environmental issues. To abstain from actions to increase production is now regarded as good environmental practice and gives immediate savings, which is an attractive combination. When foresters encounter problems that they cannot explain, they tend to blame the provenance. The improved production of genetically improved stocks is, although economically highly significant, difficult to see with the naked eye in field trials. The predicted gains of the initial selections have become lower and the problems better known and more evident as more knowledge about seed orchards has accumulated. A system with governmental subsidies for establishment of seed orchards has been discontinued. Plant and seed production are now regarded as commercial activities and not as a governmental responsibility. Seed and plant supply for long rotation forestry are not the best targets for strict application of the principles of market economy. Seed production forests fit much better into a market-economy than conventional orchards. The land investment is cheaper and seed production forests also produce wood. In such stands there are seed costs only when the cones are collected or if cultural treatments are applied to improve: the rate of stand development (fertilizer application), the quality of seeds (culling), or the amount of seed produced (thinning).

(Extracted from an article by D. Lindgren and B. Karlsson, 'Cheaper Improved Norway Spruce Seed for Sweden' p. 224-30 in Proc. IUFRO Symposium Norway Spruce Provenances and Breeding, Latvia, 1993.)

## Lebanon's National Symbol Threatened

The cedar of Lebanon (*Cedrus libani*), valued for millennia for the quality of its wood and immortalized on the national flag, has reached dangerously small numbers in fragmented sites. The Phoenicians built their ships from cedar wood and began the heavy exploitation of the species for timber. The ancient Egyptians made sarcophagi from the wood and used the resin for embalming the dead. More recently, the timber was used for railways and furniture because of its hardness and resistance to fungal and insect attack.

Measures to protect cedar forests date back to the time of the Pharaohs who maintained them as private hunting grounds. Turkish governors of Lebanon restricted access to the forests in the 17th century to prevent overexploitation. Queen Victoria of England paid for a wall to be built around reserves. There are numerous references to the tree in the Bible and, to this day, it is protected by the Maronite church; anyone causing damage to the cedar is punished by excommunication. Currently, barbed wire and land mines provide sadly modern means of excluding access to some areas.

Despite these measures, the cedar is losing the battle for survival. Natural regeneration is threatened by grazing of seedlings, sand extraction, and damage by visitors. As sites are depleted, soil erosion follows and hopes for recovery are slight. Scientists in Lebanon and France are collaborating on research to gain a better understanding of the cedar of Lebanon's genepool and its seed physiology. But a lack of funds has made the scientists pessimistic. It is clear that without a concerted effort, the cedar of Lebanon will remain a national symbol in memory only.

(Reprinted from *GeneFlow* 1994, pp. 18)

## ASEAN Tree Seed Centre News

The 15th Project Steering Committee Meeting of the ASEAN Forest Tree Seed Centre Project was successfully held at the Sir James Lodge of the Forest Hills Golf Club near Muak Lek, Saraburi, Thailand, January 30 - February 1, 1995. Among the many topics discussed and agreed was the extension of the Project term from March 31, 1996 to to March 31, 1997 in order for all allocated funds to be spent. However, the funds available for the additional year extension will not be sufficient for carrying out a full range of planned activities. The Steering Committee members also approved a proposed training course

on "Procurement, handling and storage of forest tree seeds" to be held in Thailand in mid-November 1995. The training course will be co-sponsored by two other international donor agencies, DANIDA and GTZ.

Ben Wang

## Detrimental Effect of Storing White Spruce Seeds Over Saturated Calcium Chloride Dehydrate. $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ - Mol. Wt. - 147.02

In a long-term storage study of white spruce from an Alberta source, seeds were dehydrated over saturated Calcium Chloride for 30 days to attain a moisture content of 5% (fresh weight basis). This treatment caused a detrimental effect on germination as compared to controls. There was a 20% reduction in germination of the dehydrated seeds. It appears that the seeds may be affected by chlorine. In an earlier study, a different salt solution (potassium acetate) was used to attain the same moisture content but had no ill-effect on germination of white spruce. It is also interesting to note that seeds of two other species, lodgepole pine and black spruce, were also dehydrated under the same conditions but were not affected by the calcium chloride. Further work is being carried out to confirm these results.

Garry Scheer, Tannis Beardmore, and Ben Wang

## New Reference Books

Kigel, Jaime; Galili, Gad. 1994. *Seed Development and Germination*. 872 pp. US \$195.

This timely reference integrates the latest advances in the diverse and rapidly expanding field of seed science offering a broad, multidisciplinary approach that covers both theoretical and applied knowledge. It examines

- regulation of synthesis and the accumulation of seed storage compounds as well as their utilization during germination
- mechanisms of desiccation tolerance and maintenance of seed viability
- genetic, hormonal, and environmental issues in seed dormancy
- water relations in germination and osmotic priming
- the germination of weeds and parasitic plants plus seed-bank germination modelling
- the genetic engineering of seeds to improve nutritional quality



- the biotechnology of artificial seed production
- and more!

Generously illustrated and containing some 4000 bibliographic citations, *Seed Development and Germination* is an outstanding resource for plant physiologists, molecular biologists, biochemists, biotechnologists, and geneticists; horticulturists; agronomists; botanists; and upper level undergraduate and graduate students in these disciplines.

Contact: Promotional Dept., Marcel Dekker Inc.,  
270 Madison Ave., New York, NY 10016.

### **Understanding Seed Vigor: 1994 - Text of Explanations**

Prepared by the International Seed Testing Association -  
Vigor Test Committee

Very effectively introduces, defines, and discusses seed vigor, outlining the need for more quality information, the implications of vigor testing for sowing, storage and transport and the use of such tests. There is also a handbook 'Vigor Test Methods'.

Available from ISTA, P.O. Box 412,  
8046 Zurich, CH-Switzerland

### **Seeds - Physiology of Development and Germination**

2nd Edition

By: J. Derek Bewley and Michael Black

The second edition of *Seeds*, like its predecessor, offers advanced undergraduate and graduate students a contemporary, state-of-the-art review of all essential aspects of seed physiology and biochemistry. Fully revised and expanded, it is the only up-to-date textbook to cover structure, development, dormancy, germination, ecophysiology, mobilization of reserves, and seed industrial uses. This new edition incorporates the latest discoveries in the key area of seed development, including an entirely new chapter on seed maturation not found in any other source.

This extraordinary text takes you – in chronological sequence – through the most important events in seed development, maturation, and germination, and post-germination stages of seedling establishment. It carefully explains difficult biochemical concepts and pathways as they are encountered and is concluded with a timely discussion of seed physiology and biochemistry in relation to current problems in agriculture and industry.

For ordering and further information, please contact: Sue Kwiatkowski, Textbook Marketing Manager,

Plenum Publishing Corporation, 233 Spring Street,  
New York, NY 10013-1578, USA.

### **New Members**

**Paul Chapman**  
Canadian Forest Service  
200-180 Main St.  
Winnipeg, Manitoba R3C 1A6

**Joanne Hallam**  
N.E. Sci. & Technol.  
Ministry Natural Resources  
60 Wilson Rd.  
Timmins, Ontario P4N 2S7

**Helen Markussen**  
Canadian Forest Service  
Petawawa National Forestry Inst.  
P.O. Box 2000  
Chalk River, Ontario K0J 1J0

**Charles I. Umechuruba**  
Head, Department of Botany  
University of Port Harcourt  
P.M.B. 5323  
Port Harcourt, Nigeria

**Library**  
Danida Forest Seed Centre  
Krogerupvej 3  
DK-3050 Humlebaek  
Denmark

### **Address Changes**

**Robb G. Bennett**  
Ministry of Forests  
7380 Puckle Rd.  
Saanichton, British Columbia V8M 1W4

**Bruce Downie**  
MannLab  
Dept. Vegetable Crops  
University of California  
Davis, CA 9561-8613, USA

**E. Kris Morgenstern**  
R.R. #7  
Pembroke, Ontario K8A 6W8

**Hugh O. Schooley**  
552 Melton Street  
Pembroke, Ontario K8A 2S1

### **Upcoming Meetings**

**ISTA Congress**  
6-16 June 1995

Copenhagen will host the 24th International Seed Testing Association (ISTA) Congress Symposium. This

Association is primarily interested in agricultural seed but does recognize input from forest seed workers and supports a 'Tree and Shrub Seed Working Group'. Two subjects are on the symposium agenda.

1. Production Factors Affecting Seed Quality

- Sowing to harvest
- Harvest to buyer

2. Evaluating Seed Quality

- Seed lot description
- Seed lot hygiene
- Seed lot viability and performance potential
- Seed lot testing, automation and innovation

Note: Symposia on Seed Pathology (June 6) and Seed Vigor (June 7) will also be held in conjunction with the Congress.

Contact: ISTA Secretariat, P.O. Box 412, 8046 Zurich, Switzerland – Tel.: +411 3713133; Fax: +411 3713427.

**International Symposium: Recent Advances in Tropical Tree Seed Technology and Planting Stock Production**

12-14 June 1995

Haad-Yai, Thailand

A recent dramatic increase in forest renewal programs in Southeast Asia has greatly increased the need to develop seed technology and planting stock production procedures. This symposium will

- provide a forum for reviewing recent advances on seed technology and planting stock production
- make forest managers and other interested specialists aware of significant advances, and
- discuss present constraints and identify priority research areas.

*Topics*

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

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

**23rd Southern (USA) Forest Tree Improvement Conference**

19-22 June 1995

Ashville, North Carolina

This conference will include sessions on the following topics

- Seed orchard management
- Breeding, testing, and selection
- Vegetative propagation
- Molecular genetics
- Genetic diversity
- Tree improvement and forest productivity

Contact: Robert J. Weir, Director, North Carolina State University - Industry Coop., Tree Improvement Program, 1019 Biltmore Hall, Box 8002, Raleigh, N.C. 27695-8002, USA – Tel.: (919) 515-3168.

**7th International Conifer Biotechnology Working Group**

26-29 June 1995

Gold Coast, Australia

Conference Focus – Forests for the year 2000 and beyond.

- Mass Propagation
  - micropropagation
  - somatic embryogenesis
  - robotics
- Molecular Biology of Development
  - juvenility
  - wood structure
  - sterility
- Genome Characterization
  - linkage mapping
  - marker aided selection
- Secondary Metabolism

Select key speakers will address the conference themes, providing an informal and supportive forum to discuss critical issues and recent developments. Individual oral and poster presentations are encouraged. Students most welcome.

If you wish to obtain more information about the International Conifer Biotechnology Working Group meeting, please contact: Professor R.D. Teasdale, ICBWG Secretary, Forbio Pty Ltd., BSES Laboratories, 50 Meiers Rd., Indooroopilly, Queensland 4086, Australia – Fax: +61 7 870 5777.

**IUFRO Working Party S2.02-07  
Larch Provenances and Breeding  
31 July - 4 August 1995**

The Swedish University of Agricultural Science in Umea following the IUFRO World Congress. The main subject of the meeting will be 'Larch genetics and breeding: research findings and ecological-silvicultural demands'. There will be a 3-3 1/2 day study tour.

Contact: Owe Martinsson, Swedish Univ. Agric. Sci., Faculty of Forestry, Dept. Silviculture, S-90183, Umea, Sweden – Tel.: 090-165800; Fax: 090-167669.

**IUFRO World Congress  
6-12 August 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.

**25th Canadian Tree Improvement Association and  
Western Forest Genetic Association Joint Meetings –  
Evolution and Tree Breeding: Advances in  
Quantitative and Molecular Genetics  
for Population Improvement  
29 August - 1 September 1995**

This meeting will be held in Victoria, B.C. and will be preceded by a Tree Seed Working Group Meeting and seed orchard tour August 28.

The meeting is divided into six sessions dealing with the following topics:

- Experience from theoretical and empirical work in quantitative genetics
- Applied considerations for breeding population structure and selection criteria: 3 case studies
- The use of molecular markers in quantitative genetics and breeding
- General tree improvement topics
- Genetics and breeding for growth, wood quality and pest resistance
- Synthesis, conclusion and outstanding problems in advanced generation breeding.

For more information contact, Conference Management, Univ. Victoria, Box 3030, MS 8451, Victoria, B.C., Canada V8W 3N6 – Tel.: (604) 721-8470; Fax: (604) 721-8774; Email pmcquire@postoffice.uvic.ca.

**Canadian Tree Improvement Association  
Tree Seed Working Group Workshop**

The Tree Seed Working Group (TSWG) will have a workshop in conjunction with the 25th meeting of its umbrella organization, the Canadian Tree Improvement Association (CTIA), in Victoria, B.C. on Monday, August 28, 1995 between 8:30 a.m. and 12:00. The workshop is titled "Seed Orchard Management and Cultural Options for Quality Seed Production". The tentative set of speakers for the session is presented below.

James Barnett, Chief Silviculturist, USDA Southern Forest Experiment Station – How Seed Orchard Culture Effects Seed Quality - Experience with the Southern Pines

Youssry El-Kassaby, Manager Saanich Forestry Centre, Pacific Forest Products Ltd. – Genetics of Seed Orchard Seed: Evaluation of Current Practices

Greg Adams, Tree Improvement Geneticist, J.D. Irving Ltd. – Management of Seed Production in Seed Orchards: Reproductive Balance

Chuck Masters, Leader of Applied Technology, Weyerhaeuser Corp. WA – Loss of MBC (methyl bromide chloropicran): minimizing the risk of disease through management of seed vigour, seed-borne pathogens and the family

There is an opening for one and possibly two speakers with topics directly related to the workshop. Posters on any seed related topic can be presented. If you are interested in presenting a paper or a poster please contact David Kolotelo at (604) 541-1683 or by EMAIL at DKOLOTEL@mfor01.gov.bc.ca.

**Innovation of Tropical Tree Seed Technology  
7-16 September 1995  
Arusha, Tanzania**

*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 – Tel.: +255 56 3192; Fax: +255 56 3275; Telex: 55392 NTSP TZ.

#### **Fifth International Workshop on Seeds Basic and Applied Aspects of (Agricultural) Seed Biology**

11-15 September 1995

The fifth meeting in the series of International Workshops will be held at the University of Reading, UK. Contact: Richard Ellis, Department of Agriculture, University of Reading, Earley Gate, P.O. Box 236, Reading RG6 2AT, UK.

#### **IUFRO Working Party: S2.07-01 – Cone and Seed Insects Meeting** 2-9 September 1996

Dr. Andrea Battisti of Italy has offered to organize the next WP meeting. He proposes to hold the next meeting during the week of 2-9 September 1996, at the Alpine Ecology Centre of Monte Bondone, located in the Central Alps, not far from the town of Trento, about 200 km north west of Padova. This Centre can be easily reached from Florence (4 hour train ride). According to Dr. Battisti, there is a possibility to accommodate 50 people at the Centre, and to visit forest research and recreation sites (Dolomites, glaciers, Garda Lake) during a day trip. This meeting would take place the week following the International

Congress of Entomology which will be held in Florence (25-31 August 1996). Further details will be provided as they become available.

#### **Cone and Seed Entomology Workshop** 15 October 1995

#### **Meeting of the Entomological Societies of Canada and British Columbia, Victoria, British Columbia** 14-18 October 1995

A Cone and Seed Entomology Workshop will be held on 15 October 1995 at the Joint Meeting of the Entomological Societies of Canada and British Columbia in Victoria, British Columbia. This workshop will be half day in length and have as its theme "Cone and Seed Insect Biology and the Future of Seed Orchard Insect Management." Workshop format will be two hours of short, information presentations on current or promising areas of research followed by a two hour round table discussion.

Contact: Robb Bennett, Seed Pest Management Officer, Silviculture Practices Branch, Ministry of Forests, 7380 Puckle Road, Saanichton, British Columbia, V8M 1W4 – Tel.: (604) 652-5600; Fax (604) 652-4204; Email: [rgbennet@mfor01.for.gov.bc.ca](mailto:rgbennet@mfor01.for.gov.bc.ca).

#### **Recent Publications**

Requests of reprints of the following publications should be sent to respective authors.

- Bak, J. 1994. Cone entomofauna of fir *Abies alba* Mill. in the St. Cross Mts. National Park in Poland during 1987-1992. *J. Appl. Entomol.* 118: 158-164.
- Berry, R.J.; Crawford, T.J.; Hewitt, G.M., eds. 1994. *Genes in Ecology*. Proc. 33rd Symposium of the British Ecological Society, University of East Anglia, 1992. Blackwell Scientific Publ. London. 534 pp.
- Caron, G.-É. 1994. Seasonal variation in pollen catch in a black spruce orchard. *Grana* 33: 313-320.
- Caron, G.-É. 1994. Pollen contamination evaluation on a proposed Eastern larch seed orchard site. *North. J. Appl. For.* 11(4): 124-130.
- Colas, F.; Mercier, S. 1994. Conservation à court terme et évaluation du taux de germination du pollen de bouleau gris et de bouleau à papier. Ministère des Ressources naturelles. Direction de la recherche forestière. Service de l'amélioration des arbres. Rapport interne n° 378. 35 p.
- Colas, F.; Mercier, S. 1994. Établissement d'une gamme de viabilité du pollen de pin gris. Ministère des Ressources du Québec. *For. Res. Note No.* 58. 7 pp.

- Colas, F.; Mercier, S. 1994. Établissement d'une gamme de viabilité du pollen de pin gris. Ministère des Ressources naturelles. Direction de la recherche forestière. Service de l'amélioration des arbres. Note de recherche n° 58. 7 p.
- de Groot, P.; Turgeon, J.J.; Miller, G.E. 1994. Status of cone and seed insect pest management in Canadian seed orchards. *For. Chron.* 70(6).
- Dyck, J.R. 1994. Converting aspen stands to white spruce-aspen mixedwoods by planting and seeding, Manitoba. Canada-Manitoba Partnership Agreement in Forestry Publication. 28 pp.
- Edwards, D.G.W.; Wang, B.S.P.; Boross, P.A. 1994. Guide des essais de semences forestières en laboratoire. Can. Forestry Service, Information Rep. PI-X-110F. 57 pp.
- Ericsson, T. 1994. Lodgepole pine (*Pinus contorta* var. *latifolia*) breeding in Sweden: Results and prospects based on early evaluations. Dissertation Swedish Univ. of Agric. Sci., Faculty of For., Dept. For. Genetics and Plant Physiology. Umea, Sweden.
- Foster, G.S.; Diner, A.M., eds. 1994. Application of vegetative propagation in forestry. Proc. S. Reg. Info. Exchange Group Biennial Symposium on Forest Genetics, Huntsville, Alabama-1992. USDA For. Serv., Gen. Tech. Rep. SO-108. 152 pp.
- Hopkin, A.A.; Howse, G.M. 1994. Pest damage to Ontario seed orchards: Results of FIDS seed orchard surveys 1990-1992. Forest Insect and Disease Survey Unit, Canadian Forest Service-Ontario. Inf. Rep. O-X-440. 15 pp.
- Loeschcke, V.; Tomiuk, J.; Jain, S.K., eds. 1994. Conservation Genetics. Birkhäuser Verlag, Boston. 440 pp.
- Lowe, W.J.; Barber, L.R.; Cameron, R.S.; DeBarr, G.L.; Hodge, G.R.; Jett, J.B.; McConnell, J.L.; Mangini, A.; Nord, J.C.; Taylor, J.W. 1994. A southwide test of Bifenthrin (Capture\_R) for cone and seed insect controlling seed orchards. *Southern J. Appl. For.* 18: 72-75.
- McDonald, P.M.; Abbott, C.S. 1994. Seedfall regeneration and seedling development in group-selection openings. USDA For. Serv. Res. Paper PSW-RP-220. 13 pp.
- Mercier, S.; Langlois, C.-G. 1993. Relationships between *Epilobium angustifolium* phenology and *Picea glauca* seed maturation. *For. Ecol. & Manage.* 59: 115-125.
- Mercier, S. 1994. La maturation des graines de l'épinette blanche en milieu nordique. Ministère des Ressources naturelles. Direction de la recherche forestière. Service de l'amélioration des arbres. Note de recherche n° 59. 11 p.
- Mercier, S.; Cuierrier, A.; Caron, F., eds. 1992. Comptes rendus du colloque sur les semences forestières. Ministère des Forêts. Direction de la recherche. Les 12 et 13 février 1992, Sainte-Foy, Québec. 207 p.
- Meyerowitz, E.M. 1994. The genetics of flower development. *Scientific American*. Vol. 27 (5): 56-65.
- Patry, S.; Mercier, S. 1994. Les parcs de croisements sous abri: revue de littérature. Ministère des Ressources naturelles. Direction de la recherche forestière. Service de l'amélioration des arbres. Rapport interne n° 380. 38 p.
- Powell, G.L.; White, T.L. 1994. Cone and seed yields from slash pine seed orchards. *Southern J. Appl. For.* 18: 122-127.
- Rappaport, N.G.; Wood, D.L. 1994. *Pityophthorus orarius* Bright (Coleoptera: Scolytidae) in a northern California Douglas-fir seed orchard: effect of clone, tree vigour, and cone crop on rate of attack. *Can. Entomol.* 126: 1111-1118.
- Schowalter, T.D. 1994. Cone and seed insect phenology in a Douglas-fir seed orchard during three years in western Oregon. *J. Econ. Entomol.* 87: 758-765.
- Sheedy, G. 1994. Fertilisation d'un peuplement semencier d'épinette noire: Résultats de six ans. Ministère des Ressources du Québec. For. Res. Note No. 57. 15 pp.
- Veilleux, L.; Mercier, S. 1994. Maturation des graines de l'épinette blanche à partir du suivi systématique de 16 acides aminés libres. Ministère des Ressources naturelles. Direction de la recherche forestière. Service de l'amélioration des arbres. Note de recherche n° 61. 11 p.
- Waldron, R.M.; Kolabinski, V.S. 1994. Uniform shelterwood cutting and scarifying in white spruce-trembling aspen stands to induce natural white spruce regeneration, Manitoba and Saskatchewan. Canada-Manitoba Partnership Agreement in Forestry Publication. 53 pp.
- Wang, B.S.P.; Charest, P.J.; Downie, B. 1994. Conservation *ex situ* de pollen et de graines, et de cultures *in vitro* de plantes ligneuses pérennes. Étude FAO Forêts 113. 97 pp.

## MEMBERS OF THE CTIA TREE SEED WORKING GROUP

- Aboud, S.W., University of Guelph Arboretum, Guelph, ON, N1G 2W1
- Adams, B., Northern Alberta Inst. of Technology, 11762-106 St., Edmonton, AB, T5G 2R1
- Adams, G., J.D. Irving Ltd., Sussex Tree Nursery, R.R. #4, Sussex, NB, E0E 1P0
- Adams, M.J., Canadian Forest Service, Ontario Region, P.O. Box 490, Sault Ste. Marie, ON, P6A 5M7
- Alexander, M., Canadian Forest Products Ltd., Sechelt Seed Orchard, R.R. #1, Sechelt, BC, V0N 3A0
- Allen, J.R., STORA FOREST Industries, P.O. Box 590, Port Hawkesbury, NS, B0E 2V0
- Ambrose, J.D., University of Guelph Arboretum, Guelph, ON, N1G 2W1
- Amirault, P., Canadian Forest Service, Northwest Region, 5320-122 Street, Edmonton, AB, T6H 3S5
- Asakawa, S., Fac. of Agriculture, Tamagawa University, Machida, Tokyo 194, Japan
- Attack, C., Ontario Tree Improvement Council, c/o Ministry Natural Resources, 896 Riverside Dr., Timmins, ON, P4N 3W2
- Atkinson, G.T., Canadian Forest Service, Ontario Region, P.O. Box 490, Sault Ste. Marie, ON, P6A 5M7
- Baillargeon, G., Centre for Land Biological Resources Res., K.W. Neatby Bldg., Central Experimental Farm, Ottawa, ON, K1A 0C6
- Baker, B., Takca Forest Products, P.O. Box 6000, Prince George, BC, V2N 2K3
- Baker, B.D., Ministry of Natural Resources, P.O. Box 5000, Thunder Bay, ON, P7C 5G6
- Banerjee, M., Scientific Consulting, 309-7297 Moffat Rd., Richmond, BC, V6Y 3E4
- Barauska, A., Ministry of Natural Resources, P.O. Box 5160, Kenora, ON, P9N 3X9
- Barber, B.T., Ministry of Forests, 3rd Fl., 31 Bastion Sq., Victoria, BC, V8R 3G3
- Barnett, J.P., USDA Forest Service, Southern Forest Exp. Station, P.O. Box 5500, Pineville, Louisiana 71361, U.S.A.
- Beardmore, T., Petawawa National Forestry Institute, P.O. Box 2000, Chalk River, ON, K0J 1J0
- Beaudoin, R., Ministère des Forêts, 2700, rue Einstein, Sainte-Foy, QC, G1P 3W8
- Béland, M., Université du Québec, en Abitibi-Temiscamingue, P.O. Box 700, Rouyn-Noranda, QC, J9X 5E4
- Bennett, R.G., Ministry of Forests, 7380 Puckle Rd., Saanichton, BC, V8M 1W4
- Bettle, R.D., Dept. Natural Resources & Energy, P.O. Box 6000, Fredericton, NB, E3B 5H1
- Blake, P., Canadian Forest Products Ltd., Bag 100, Grande Prairie, AB, T8V 3A3
- Bonner, F., Southern Forest Exper. Station, P.O. Box 906, Starkville, Mississippi 39759, U.S.A.
- Bowden-Green, R.C., Ministry of Forests, Seed Centre, 18793-32nd Avenue, Surrey, BC, V3S 4W8
- Bower, R.C., MacMillan Bloedel Ltd., 65 Front Street, Nanaimo, BC, V9R 5H9
- Boyd, L., Dept. of Forestry and Agriculture, P.O. Box 616, Grand Falls, NF, A2A 2K2
- Brooks, G., Banco de Semillas, Apartado 10094, San José 1000, Costa Rica, Central America
- Brown, P., Canadian Forest Products Ltd., Sechelt Seed Orchard, R.R. #1, Sechelt, BC, V0N 3A0
- Brown, W., Bowater Newfoundland Ltd., Cornerbrook, NF, A2H 6J4
- Brulotte, F., Reboisement Forestrie Inc., R.R. #1, 157 Chemin Simard Martinville, Cte de Compton, QC, J0B 2A0
- Burnside, N., Ministry of Natural Resources, Thessalon Tree Nursery, Thessalon, ON, P0R 1L0
- Burry, W., Apt. 304, B&B Apts., 131 Bennett Dr., Gander, NF, A1V 1X3
- Butler, M., Dept. of Energy & Forestry, P.O. Box 2000, Charlottetown, PEI, C1A 7N8
- Cameron, R., Dept. Natural Resources, Pineland Provincial Nursery, P.O. Box 45, Hadashville, MB, R0E 0X0
- Campagna, J.-P., Ministère des Forêts, C.P. 540, 1690, Grande Côte, Berthier, QC, J0K 1A0
- Caron, G.E., Ecole de sciences forestieres, Univ. du Moncton (CUSLM), Edmundston, NB, E3V 2S8
- Carr, C., Dept. Natural Resources and Energy, Kingsclear Forest Nursery, R.R. #6, Fredericton, NB, E3B 4X7
- Carson, D.W., Ministry of Forests, 7060 Forestry Rd., P.O. Box 335, Mesachie Lake, BC, V0R 2N0
- Carson, M., La Compagnie James MacLaren Ltee., R.R. #2, Mont-Laurier, QC, J9L 3G4
- Casement, E.B., Alberta Tree Nursery & Hort. Centre, R.R. #6, Edmonton, AB, T5B 4K3
- Chapman, P., Canadian Forest Service, 200-180 Main Street, Winnipeg, MB, R3C 1A6
- Charrette, P., Ontario Tree Improvement Council, c/o School of Forestry, Lakehead University, Thunder Bay, ON, P7B 5E1
- Colangeli, A., Dept. of Biology, University of Victoria, P.O. Box 1700, Victoria, BC, V8W 2Y2



Coles, J.F., ASEAN/Tree Seed Centre, Muak Lek, Saraburi, 18180, Thailand

Connett, M.B., Forest Biotechnology Centre, Te Teko, BOP, New Zealand

Copis, P., Canadian Forest Service, Petawawa National Forestry Institute, P.O. Box 2000, Chalk River, ON, K0J 1J0

Crawford, K., Ministry of Natural Resources, Thessalon Tree Nursery, P.O. Box 310, Thessalon, ON, P0R 1L0

Creasey, K.R., Ontario Tree Seed Plant, P.O. Box 70, Angus, ON, L0M 1B0

Crook, G., Canadian Pacific Forest Products, Harrington Nature Centre, R.R. #2, Calumet, QC, J0V 1B0

Crown, M., 38211 Schooner Way, R.R. #1, Pender Island, BC, V0N 2M0

D'Amico, D., Blue Ridge Lumber Ltd., P.O. Box 1079, Whitecourt, AB, T0E 2L0

Daoust, G., Canadian Forest Service, Quebec Region, C.P. 3800, Saint Foy, QC, G1V 4C7

Darago, H., Forestry Service, Pine Ridge Forest Nursery, Box 750, Smoky Lake, AB, T0A 3C0

De Groot, P., Canadian Forest Service, Forest Pest Management Institute, P.O. Box 490, Sault Ste. Marie, ON, P6A 5M7

DeBarr, G.L., USDA-Forest Service, Forest Sciences Laboratory, 320 Green St., Athens, Georgia 30602, U.S.A.

Desmond, D.F., UNV Forestry Extension Specialist, P.O. Box 162, Thimphu, Bhutan, Asia

Desrosiers, D., Min. Natural Resources, 6/70 Community Forest Pilot Project, 100 Government Rd., Kapuskasing, ON, P5N 3H8

Desrosiers, L., Service de la production de plants, Ministère des Forêts, 5700, 4 Avenue Ouest, Charlesbourg, QC, G1H 6R1

Dhir, N.K., Forest Service, Reforestation Branch, 9th Floor, Bramalea Bldg., 9920-108th Street, Edmonton, AB, T5K 2M4,

Di Giovanni, F., CCADIB, Environment Canada, C.A.R.E., R.R. #1, Egbert, ON, L0L 1N0

Dickett, S., Ministry Natural Resources, Forest Nursery, R.R. #1, Thunder Bay, ON, P7C 4T9

Dinkel, G., USDA, Forest Service, Ottawa & National Forest, P.O. Box 336, Watersmeet, MI 49969, U.S.A.

Dojack, J., Forestry Branch, 300-530 Kenaston Blvd., Winnipeg, MB, R3N 1Z4

Downie, B., 494 Kortright Rd., Guelph, ON, N1G 2W1

Eastham, A.M., Canadian Forest Service, R.R. #8, Site 25, COM.10, Prince George, BC, V2N 4M6

Edwards, D.G., Canadian Forest Service, Pacific and Yukon Region, 506 West Burnside Road, Victoria, BC, V8Z 1M5

El-Kassaby, Y.A., Can. Pacific Forest Prod., Forestry Centre, R.R. #1, 8067 East Saanich Road, Saanichton, BC, V0S 1M0

Elders, T., Ministry of Natural Resources, 190 Cherry Street, Chapleau, ON, P0M 1K0

Falk, G., Manitoba Natural Resources, Box 27, Grp. 8, R.R. #2, Dugald, MB, R0E 0K0

Farmer, R.E., Faculty of Forestry, Lakehead University, 955 Oliver Rd., Thunder Bay, ON, P7B 5E1

Farmer, T.J., 49 Albert St. S., Lindsay, ON, K9V 3G9

Farrar, J.L., 255 Bamburgh Circle, Unit 316, Scarborough, ON, M1W 3T6

Faulkner, H., Sir Sandford Fleming College, P.O. Box 8000, Lindsay, ON, K9V 5E6

Flight, D., Forestry Branch, Pineland Forest Tree Nursery, P.O. Box 45, Hadashville, MB, R0E 0X0

Fogal, W.H., Canadian Forest Service, Petawawa National Forestry Institute, P.O. Box 2000, Chalk River, ON, K0J 1J0

Ford, R., Ministry of Natural Resources, P.O. Box 129, Swastika, ON, P0K 1T0

Frame, H.M., Dept. Natural Resources, Tree Breeding Centre, P.O. Box 190, Debert, NS, B0M 1G0

Fraser, R.G., Saanich Forestry Centre, Can. Pacific Forest Prod. Ltd., R.R.#1, 8067 East Saanich Rd., Saanichton, BC, V0S 1M0

Fry, M., Sir Sandford Fleming College, School of Natural Resources, P.O. Box 8000, Lindsay, ON, K9V 5E6

Fullarton, M., Dept. Natural Resources & Energy, Kingsclear Forest Nursery, R.R. #6, Fredericton, NB, E3B 4X7

Georgeson, E., Dept. of Natural Resources, P.O. Box 68, Truro, NS, B2N 5B8

Gillespie, M., J.D. Irving Ltd., Sussex Tree Nursery, R.R. #4, Sussex, NB, E0E 1P0

Gonzalez, J.S., Forintek Canada Corp., 6620 N.W. Marine Drive, Vancouver, BC, V6T 1X2

Graham, C., Ministry Natural Resources, Forest Policy Branch, Suite 400, 70 Foster Dr., Sault Ste. Marie, ON, P6A 6V5

Grant, G.G., Canadian Forest Service, Forest Pest Management Institute, P.O. Box 490, Sault Ste. Marie, ON, P6A 5M7

Groot, A., Canadian Forest Service, Ontario Region, P.O. Box 490, Sault Ste. Marie, ON, P6A 5M7

Haavisto, V.F., Canadian Forest Service, Ontario Region, P.O. Box 490, Sault Ste. Marie, ON, P6A 5M7

Hagman, M., Finnish Forest Research Institute, Dept. Forest Genetics, P.O. Box 18, SF01301, Vantaa, Finland

Hall, P.J., Canadian Forest Service, 19th Floor, Place Vincent Massey Bldg., Ottawa, ON, K1A 1G5

Hallarn, J., N.E. Sci. & Techno., Ministry Natural Resources, 60 Wilson Rd., Timmins, ON, P4N 2S7

Hallet, R.D., Canadian Forest Service, Maritimes Region, P.O. Box 4000, Fredericton, NB, E3B 5P7

Hamilton, J.R., Forest Service, Pine Ridge Forest Nursery, P.O. Box 750, Smoky Lake, AB, T0A 3C0

Han-dong, G., Southern Tree Seed Inspection Centre, Nanjing Forestry University, Long Pan Rd., Nanjing 210037, China

Hansen, Christine, Forest Service, Pine Ridge Nursery, P.O. Box 750, Smoky Lake, AB, T0A 3C0

Hartling, L., Dept. Natural Resources & Energy, Timber Management Branch, P.O. Box 6000, Fredericton, NB, E3B 5H1

Hellum, A.K., Dept. of Forest Science, Faculty of Agriculture & Forestry, University of Alberta, Edmonton, AB, T6G 2H1

Hessey, B., NCR Container Stock, P.O. Box 5000, 435 James St., Thunder Bay, ON, P7C 5G6

Hewson, C.A., Ministry of Forests, Kalamalka Research Station, 3401 Reservoir Rd., Vernon, BC, V1B 2C7

Ho, R.H., Ministry of Natural Resources, Forest Research Inst., P.O. Box 969, Sault Ste. Marie, ON, P6A 5N5

Hopkins, T., Canadian Forest Service, Ontario Region, P.O. Box 490, Sault Ste. Marie, ON, P6A 5M7

Howe, J., Superintendent, PFRA Tree Nursery, Indian Head, SK, S0G 2K0

Jensen, H.P., Ministry of Forests, Cowichan Lake Research Station, P.O. Box 335, Mesachie Lake, BC, V0R 2N0

Johnson, F., Ministry Natural Resources, P.O. Box 640, Geraldton, ON, P0T 1M0

Jones, H., Chairperson, E. Chap., Ont. Nut Growers Assoc., 94 Cameron Ave., Ottawa, ON, K1S 0X1

Joyce, D., Forest Research Institute, Ministry of Natural Resources, P.O. Box 1000, Sault Ste Marie, ON, P6A 5N5

Joyce, S., Western Forest Products Ltd., 1020 Beckwith Ave., Victoria, BC, V8X 3S4

Kalaghe, A.G., Project Manager, National Tree Seed Project, Danida/Tanzania, P.O. Box 4012, Morogoro, Tanzania

Kamra, K., Dept. of For. Genetics & Plant Phys., Swedish Univ. of Agric. Sciences, S-90183, Umea, Sweden

Kang, M.P.C., Arboretum of the Chinese Academy of Forestry, Wan Shou Sahn, Beijing, People's Republic of China

Karlsson, I., Cowichan Lake Research Station, P.O. Box 335, Mesachie Lake, BC, V0R 2N0

Kelley, B., Canadian Forest Service, Petawawa National Forestry Institute, P.O. Box 2000, Chalk River, ON, K0J 1J0

Klages, W., Canadian Pacific Forest Products Ltd., 2001 Neebing Ave., Thunder Bay, ON, P7C 4W3

Klein, R.G., Ministry of Natural Resources, P.O. Box 5000, Thunder Bay, ON, P7C 5G6

Kock, H., University of Guelph Arboretum, Guelph, ON, N1G 2W1

Kolotelo, D., Ministry of Forests, 18793-32nd Avenue, Surrey, BC, V4P 1M5

Kossuth, S.V., USDA Forest Service, University of Florida, 1143 HS/PP Bldg., Gainesville, Florida 32607, U.S.A.

Kunze, H.A.H., J.D. Irving Ltd., Sussex Tree Nursery, R.R. #4, Sussex, NB, E0E 1P0

Labrecque, L., Ministère des Forêts, 60, avenue Bernatchez, Rouyn, QC, J9X 4Z4

Lacasse, J.-M., Fédération Des Production De Bois, 555 Boul. Roland-Therrien, Longueuil, QC, J4H 3Y9

Lacroix, R., Min. des Forêts, C.P. 190, 143 route de Duchesnay, Sainte-Catherine, QC, G0A 3M0

Ladipo, D.O., Forestry Research Inst. of Nigeria, P.M.B. 5054, Ibadan, Nigeria, Africa

Lamontagne, Y., Min. des Forêts, Service de l'amélioration des arbres, 2700, rue Einstein, Sainte-Foy, QC, G1P 3W8

Lapage, R., Forestry Branch, Pineland Forest Nursery, P.O. Box 45, Hadashville, MB, R0E 0X0

Lavergne, E., Ministère des Forêts, C.P. 540, 1690 Grande Côte, Bertier, QC, J0K 1A0

Leadem, C.L., Ministry of Forests, Research Branch, 1320 Glyn Rd., Victoria, BC, V8Z 3A6

Lin, T.-P., Taiwan Forestry Research Institute, Division of Silviculture, 53 Nan-Hai Road, Taipei, Taiwan (ROC) 10728

Lippitt, L., Davis Nursery, Box 1590, Davis, California 95617, U.S.A.

Lohr, C., Ministry of Forests, 7380 Puckle Rd., Saanichton, BC, V0S 1M0

Lucas, J.S., Ministry of Natural Resources, Kemptville Nursery, R.R. #4, Kemptville, ON, K0G 1J0

MacDonald, J., Canadian Forest Service, Newfoundland and Labrador Region, P.O. Box 6028, St. John's, NF, A1C 5X8

MacKinnon, W., Dept. Energy & Forestry, P.O. Box 2000, Charlottetown, PEI, C1A 7N8

Mah, S., Silviculture Branch, Ministry of Forests, 3rd Floor, 31 Bastion Sq., Victoria, BC, V8W 3E7

Major, J.E., Canadian Forest Service, Petawawa National Forestry Institute, P.O. Box 2000, Chalk River, ON, K0J 1J0

Malek, L., Dept. Biology, Lakehead University, Thunder Bay, ON, P7B 5E1

Manager, USDA Forest Service, Oconto River Seed Orchard, 15085 Hwy. 32, Lakewood, Wisconsin 54138, U.S.A.

Mansfield, C.F., Ministry of Natural Resources, Midhurst Nursery & Seed Unit, Midhurst, ON, L0L 1X0

Markussen, H., Canadian Forest Service, Petawawa National Forestry Institute, P.O. Box 2000, Chalk River, ON, K0J 1J0

Marshall, J., 95 Park Drive, Toronto, ON, M6S 2Y8

Masse, L., Ministère des Forêts, 5700, 4th Ave. West, Secteur F-316, Charlesbourg, QC, G1H 6R1

McDougald, S., Weyerhaeuser Canada Ltd., Saskatchewan Timberlands, P.O. Box 1720, Prince Albert, SK, S6V 5T3

McIntyre, J.M., Ministry of Natural Resources, P.O. Box 90, Wabigoon, ON, P0V 2W0

Medves, D., MacMillan Bloedel Ltd., 65 Front Street, Nanaimo, BC, V9R 5H9

Meier, D., USDA Forest Service, 68 South Stevens St., Rhinelander, Wisconsin 54501, U.S.A.

Mercier, S., Ministère des Forêts, Service de l'amélioration des arbres, 2700, rue Einstein, Sainte-Foy, QC, G1P 3W8

Messer, D., Dept. Natural Resources and Energy, Kingsclear Forest Nursery, R.R. #6, Fredericton, NB, E3B 4X7

Mittal, R., Research Scientist, Vivekananda Parvatiya Krishi, Anusandhan Shala, I.C.A.R., ALMORA-263601, U.P., India

Moisan, J., Fédération des producteurs de bois du Québec, 555, boul. Roland-Therrien, Longueuil, QC, J4H 3Y9

Morgenstern, E.K., R.R. #7, Pembroke, ON, K8A 6W8

Morin, J.R., Ministry of Natural Resources, P.O. Box 3070, North Bay, ON, P1B 8K7

Morrow, W.G., Ministry of Forests, North Island Seed Orchards, P.O. Box 40, Crosley Road, R.R. #1, Bowser, BC, V0R 1G0

Mosseler, A., Canadian Forest Service, Petawawa National Forestry Institute, P.O. Box 2000, Chalk River, ON, K0J 1J0

Mullin, T., P.O. Box 1321, Truro, NS, B2N 5N2

Myers, M., Dept. Energy and Forestry, P.O. Box 2000, Charlottetown, PEI, C1A 7N8

Myland, T., Ministry of Natural Resources, Dryden Nursery, Box 90, Wabigoon, ON, P0V 2W0

Nanka, A., Canadian Forest Service, 104-180 Main Street, Winnipeg, MB, R3C 1A6

Ndungu, J., International Centre for Research in Agroforestry, P.O. Box 30677, Nairobi, Kenya, Africa

Neily, P., Dept. Lands and Forests, P.O. Box 68, Truro, NS, B2N 5B1

Nicks, B.D., E.B. Eddy Forest Products Ltd., 1 Station Road, Espanola, ON, P0P 1C0

Nielsen, C., Ministry of Natural Resources, P.O. Box 605, Brockville, ON, K6V 5Y8

Nielsen, D., Shand Greenhouse, Box 280, Estevan, SK, S4A 2A3

Niembro-Rocas, M. en C. Anibal, Scientific Director, Tropical Forest Research Centre, Universidad Auto'noma de Campeche, Av. Agustín Melgar s/n, Apartado Postal 204, Campeche, Champ, Mexico C.P. 24030

Nitschke, P., Ontario Tree Improvement Council, Suite 400, 70 Foster Dr., Sault Ste. Marie, ON, P6A 6V5

Noland, T.L., Ministry of Natural Resources, Ontario Forest Research Institute, P.O. Box 969, Sault Ste. Marie, ON, P6A 5N5

Nursery Staff, Ministry of Natural Resources, Orono Nursery, P.O. Box 119, Orono, ON, L0B 1M0

O'Reilly, C., Science & Engineering Dept., Tralee Regional College, Tralee, Co. Kerry, Ireland

Oja, B., Kirkwood Nursery, P.O. Box 310, Thessalon, ON, P0R 1L0

Ouedraogo, L.G., Centre National Des Semences Forestiers, 01 BP 2682, Ouagadougou 01, Burkina Faso, Africa

Owens, J.N., Graduate Centre for Forest Biology, University of Victoria, P.O. Box 1700, Victoria, BC, V8W 2Y2

Palamarek, D., Forestry Service, Pine Ridge Forest Nursery, Box 750, Smoky Lake, AB, T0A 3C0

Palmer, L., Ontario Tree Improvement Council, School of Forestry, Lakehead University, Thunder Bay, ON, P7B 5E1

Pandila, M.M., Dept. of Parks & Renew. Resources, P.O. Box 3003, Prince Albert, SK, S6V 6G1

Park, T., Ministry of Natural Resources, P.O. Box 5003, Red Lake, ON, P0V 2M0

Park, Y.S., Canadian Forest Service, Maritimes Region, P.O. Box 4000, Fredericton, NB, E3B 5P7

Phillion, B., Ministry of Natural Resources, Forest Nursery, P.O. Box 2960, Thunder Bay, ON, P7B 5G5

Pieper, G., Crown Forest Industries, R.R. #3, Armstrong, BC, V0E 1B0

Piotto, B., Centro Di Sperimentazione, Agricola E Forestale, via Casalotti, 300, 00166 Roma, Italy

Poliquin, J., Université Laval, Faculté de Foresterie et de Géodésie, Cité Universitaire, QC, G1K 7P4

Powell, G.R., Faculty of Forestry, University of New Brunswick, Bag Service #44555, Fredericton, NB, E3B 6C2

Prévost, Y., School of Forestry, Lakehead University, Thunder Bay, ON, P7B 5E1

Quiring, D., Dept. Forest Resources, University of New Brunswick, Bag #44555, Fredericton, NB, E3B 6C2



Rainville, A., Ministère des Forêts, Service de l'amélioration des arbres, 2700 rue Einstein, Sainte-Foy, QC, G1P 3W8

Ranasen, P.K., Department of Silviculture, University of Helsinki, Unioninkatu 40 B, 00170 Helsinki 17, Finland

Robert, D., Min. des Forêts, 200 B Chemin Ste Foy, (4e Etage), Quebec City, QC, G1R 4X7

Roddy, D., Weyerhaeuser Canada, P.O. Box 1720, Prince Albert, SK, S6V 5T3

Roques, A., INRA-CRF, Zoologie Forestière, 45160 Olivet, FRANCE

Rose, B., Ministry Natural Resources, P.O. Box 3070, North Bay, ON, P1B 8K7

Rukuni, D., Regional Tree Seed Centre, Forestry Commission, P.O. Box HG 595, Highlands, Harare, Zimbabwe

Sauvageau, F., Federation Des Producteurs De Bois du Québec, Nursery & Reforestation Service, 555 boul. Rolland Therrien, Longueuil, QC, J4H 3Y9

Schiff, J.M., Forest Service, 9th Floor Bramalea Bldg., 9920-108 Street, Edmonton, AB, T5K 2M4

Schneckenburger, F., Ministry of Natural Resources, Forest Resources Group, P.O. Box 1000, Sault Ste. Marie, ON, P6A 5N5

Schooley, H.O., 552 Melton Street, Pembroke, ON, K8A 2S1

Schroeder, B.R., PFRA Shelterbelt Centre, Indian Head, SK, S0G 2K0

Schwan, T., Ministry Natural Resources, P.O. Box 220, Kapuskasing, ON, P5N 2Y3

Secord, J., Gogama Nursery, Gogama, ON, P0M 1W0

Seed Laboratory, Forest Res. Institute, Chinese Academy of Forestry, Wan Shou Shan, Beijing, People's Republic of China

Setiawati, Y., Seed Sci. & Tech. Dept., Agricultural University, Kampus 1 PB Baranangsiang, Jl. Raya Pajajaran, Bogor, Indonesia

Sharma, K.K., F.R.A. & Colleges, Silviculture Branch, P.O. New Forest, Dehra Dun, PIN-248006, India

Simpson, D., Canadian Forest Service, Maritimes Region, P.O. Box 4000, Fredericton, NB, E3B 5P7

Slaby, R., British Columbia Forest Service, Cowichan Lake Research Station, 7060 Forestry Rd., Mesachie Lake, BC, V0R 2N0

Smith, E., SADC Tree Seed Centre Network, Private Bag BW 6238, Borrowdale, Harare, Zimbabwe

Smith, R.F., Canadian Forest Service, Maritimes Region, P.O. Box 4000, Fredericton, NB, E3B 5P7

Some, L.M., Centre National De Semences Forestiers, 01 BP 2682, Ouagadongon 01, Burkina Faso, Africa

Sorensen, F.C., Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis, Oregon 97331, U.S.A.

Splinter, M., University of Alberta, Faculty of Extension, 4-30B University Extension Centre, Edmonton, AB, T6G 2T4

Stinson, E., Atlantic Forest Seed Centre, R.R. #6, Fredericton, NB, E3B 4X7

Stjernberg, E., FERIC, 2601 East Mall, Vancouver, BC, V6T 1Z4

Stoehr, M., Research Branch, Ministry of Forests, 1320 Glyn Rd., Victoria, BC, V8W 3E7

Summers, D., Ministry of Forests, Nursery Extension Services, 14275 - 96th Avenue, Surrey, BC, V8V 7Z2

Swaile, B.D., Ontario Tree Seed Plant, P.O. Box 70, Angus, ON, L0M 1B0

Sweeney, J., Canadian Forest Service, Maritimes Region, P.O. Box 4000, Fredericton, NB, E3B 5P7

Sweet, G.B., School of Forestry, University of Canterbury, Christchurch 1, New Zealand

Sziklai, O., Faculty of Forest Science, University of British Columbia, 270-2357 Main Mall, Vancouver, BC, V6T 1W5

Talbot, N., Ministère des Forêts, 742, 11e Avenue Ouest, Amos, QC, J9T 3A7

Thompson, B.H., J.D. Irving Ltd., Sussex Tree Nursery, R.R. #4, Sussex, NB, E0E 1P0

Tosh, K.J., Dept. of Natural Resources & Energy, Kingsclear Forest Nursery, R.R. #6, Fredericton, NB, E3B 4X7

Trotter, D., Ministry of Forests, Nursery Extension Services, 14275-96th Avenue, Surrey, BC, V3S 7Z2

Trudel, R., Ministère des Forêts, 2700, rue Einstein, Sainte-Foy, QC, G1P 3W8

Turgeon, J., Canadian Forest Service, Forest Pest Management Institute, P.O. Box 490, Sault Ste. Marie, ON, P6A 5M7

Umehuruba, C.I., Head, Dept. of Botany, University of Port Harcourt, P.M.B. 5323, Port Harcourt, Nigeria

Van Damme, L., Ontario Advanced Forestry Program, Lakehead University, 955 Oliver Road, Thunder Bay, ON, P7B 5E1

Vozzo, J.A., U.S.D.A. Forest Service, P.O. Box 906, Starkville, MS 39759, U.S.A.

Vrijmoed, P., Reid, Collins Nurseries Ltd., P.O. Box 430, Aldergrove, BC, V0X 1A0

Walsh, C., Kalamalka Forestry Centre, 3401 Reservoir Road, Vernon, BC, V1B 2C7

Walsh, C.M., Ministry of Natural Resources, Kapuskasing, ON, P5N 2Y3

Wang, B.S.P., Canadian Forest Service, Petawawa National Forestry Institute, P.O. Box 2000, Chalk River, ON, K0J 1J0

Wanner, K., Ontario Forest Research Institute, P.O. Box 969, Sault Ste. Marie, ON, P6A 5N5

Wasser, R.G., J.D. Irving Ltd., Sussex Tree Nursery, R.R. #4, Sussex, NB, E0E 1P0

Wasurwanich, P., c/o Silviculture Division, Royal Forest Department, Bangkok 10900, Thailand

Watson, S., Ministry Natural Resources, 70 Foster Dr., Suite 400, Sault Ste. Marie, ON, P6A 6V5

Webber, J.E., Ministry of Forests, Research Branch, 1320 Glyn Rd., Victoria, BC, V8W 3E7

West, R.J., Canadian Forest Service, Newfoundland and Labrador Region, P.O. Box 6028, St. John's, NF, A1C 5X8

White, B.F., Dept. of Lands & Forests, P.O. Box 68, Truro, NS, B2N 5B8

White, B.G., Ministry of Natural Resources, P.O. Box 5160, Kenora, ON, P9N 3X9

Woods, J.H., Ministry of Forests, Cowichan Lake Research Station, P.O. Box 335, Mesachie-Lake, BC, V0R 2N0

Worrall, J., Faculty of Forestry, University of British Columbia, 2075 Wesbrook Place, Vancouver, BC, V6T 1W5

Yakimchuk, K.A., Forest Service, Pine Ridge Forest Nursery, P.O. Box 750, Smoky Lake, AB, T0A 3C0

Yang, J.-C., Director General, Taiwan Forestry Research Institute, 53 Nan-Hai Road, Taipei, Taiwan (R.O.C.) 10728

Yates, H.O., III, USDA-Forest Service, Carlton Street, Athens, Georgia 30602, U.S.A.

Yeates, L., Forestry Centre, Maritimes Region, P.O. Box 4000, Fredericton, NB, E3B 5P7

Ying, C.C., Ministry of Forests, Research Branch, 1450 Government Street, Victoria, BC, V8N 4V1

Young, J.H., Ministry of Natural Resources, P.O. Box 309, Sioux Lookout, ON, P8T 1A6

Yousheng, C., Southern Tree Seed Inspect. Centre, Min. of Forestry, P.R.C., Nanjing Forestry University, Nanjing 210037, China