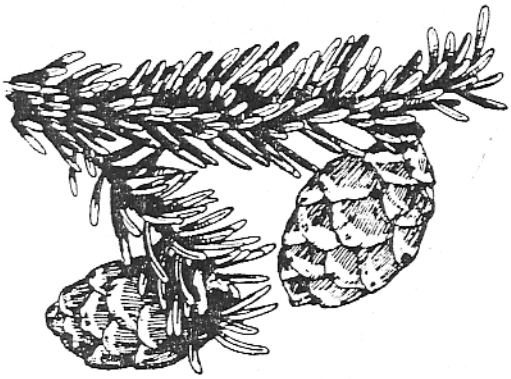
CANADIAN TREE IMPROVEMENT ASSOCIATION/
ASSOCIATION CANADIENNE POUR L'AMÉLIORATION DES ARBRES



Newsbulletin 14

Tree Seed Working Group

No. 14 November 1990

FROM THE CHAIRMAN

Following the Tree Seed Working Group's workshops at the last CTIA/ACAA meeting (Edmonton), there has been a lot of emphasis on gaining information on crown management for sustained, easy-to-reach, cone production. It seems appropriate that we should follow this up with a workshop on the topic at the next meeting. That meeting will be in Ottawa, 19-23 August 1991. Now is the time to consider what you may have to offer as a contribution.

I am currently in my second month of an 8-month stay in New Zealand. Before I left Canada, I asked Ron Smith to look after the organizational details for the workshop (Monday, 19 August). Ron, as many of you know from his questionnaire, had already been gathering available information on what has been learnt about crown management of our species (see the last 5 pages of the last Newsbulletin, #13). It was obvious that he was the right person to put the workshop together! Please give him support if he contacts you, or let him know about what you might be able to present (Forestry Canada - Maritimes Region, P.O. Box 4000, Fredericton, NB, E3B 5P7).

Here in New Zealand, crown management has been a routine feature of seed orchards of radiata pine operated on the "hedging" principle. That starts with pruning away of the leader of 2-year-old grafted ramets (500/ha) to allow four or more potentially cone-bearing branches to retain upward orientation. Now, however, "meadow" orchards are being developed, in which the need for purning will be minimal. The aim is to produce lots of cones on the leaders of closely grown ramets (5000/ha) in year 2, and to use these ramets for a future 2 to 4 years. Such a development is possible only for a species that normally produces (or that can be induced to produce) cones on the leader. It's an interesting concept that might be workable, or modifiable, for jack or lodgepole pine, but for our other species, the hedging ideas may be more serviceable. We have to remember, however, that pines have completely different developmental habits from spruces, Douglas-fir, hemlocks, or larches, and what suits one may not suit another. I look forward to an informative and stimulating workshop next August.

Graham Powell

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Queries, comment, and contributions to the "NEWSBULLETIN" are welcomed by the chairman or the editor.

EDITORS NOTES

Who reads the list of 'Recent Publications' provided as the last item in each of our News Bulletins??? What I should hear in answer to the question is a unanimous 'I do!!!' Unfortunately, however, most of us are so busy doing what needs to be done, that we won't take the time to keep up with current developments in subject areas important to our work.

What you see in this copy of the News Bulletin is a list of about 90 publications on a wide variety of seed-related topics. The entries vary all the way from a simple note on tree shaking in a seed orchard (McConnell et al.) to a sophisticated text on sexual reproduction (Sedgley and Griffin). A few of the publications have been forwarded to me by their authors - but most have been listed because they caught my eye as I passed over the tables of contents of various journals received by our library.

I don't claim to have read all the listed articles but those of particular interest are read and frequently copied and filed for future examination. Keeping up with what is being published is essential because it gives us the

opportunity to learn from the experiences of others. This learning can simplify, increase precision, and narrow the focus of our work so that the end results of our efforts are re valuable.

I take the time to assemble a list of recent publications for each issue of the News Bulletin because I want to help you all keep up to date with what's going on both inside and outside your normal work environments. However, my personalized view of what should appear on the lists isn't good enough for all of you. The lists would be much more comprehensive and of greater value if everyone in the Working Group periodically advised me of the publications they are reading.

Please be advised that I will welcome your participation in the preparation of the publication lists just as wholeheartedly as I welcome your contributions of articles for inclusion in News Bulletin. Remember, this is your News Bulletin and it won't survive without your contributions.

Hugh Schooley

NOTICE ABOUT NEWSBULLETIN MAILINGS

In order to save postage costs, some News Bulletins are now being mailed in bulk packages, though the copies still are addressed individually. Such bulk mailing is preferred when several or many recipients have the same mailing address. Please notify the Editor if this system causes any problems in your institution.

B.C. CONE AND SEED RESEARCH PRIORITIES

(from statement by B.C. Cone and Seed Committee to B.C. Forest Research Management Steering Committee, Sept. 1, 1990)

British Columbia's reforestation program entails the coordination of hundreds of agencies to annually plant 250 million trees of 12 species on approximately 216 000 ha spread across 10 major biological zones. Periodicity of natural seed crops necessitates collection and storage of large quantities of seeds to supply an uninterrupted flow of seedlings for reforestation. Although more than 90 per cent of recent seed collections have come from natural stands, the proportion of the seed requirements met from tree improvement programs is increasing steadily.

Despite the complexity of the landscape and the multiplicity of the agencies involved, genetic advances are being made in the quality of 10 species. Seed orchards are the principal means of delivering genetic gain for most of these species. To date, 85 orchards have been established or approved and these will deliver, when fully productive, seeds to provide 160 million seedlings for annual planting on the most productive lands. All steps in cone and seed initiation, development, protection, harvest and preing treatments of seeds must be optimized if seed orchard targets are to be met. Inefficiencies or losses in any of the steps from seed production to seed use will seriously diminish gains to be realized from genetic improvement programs.

Table 1 ranks (on a priority scale of 1 to 8) the status of cone and seed research in this Province, and shows future needs of developing operational procedures and staff training. The potential impact and feasibility of the research is also indicated. This summary was obtained from a consensus of workers in "producing" roles (seed orchard managers, cone and seed collection planners) as well as those in "consuming" roles (silviculturists, nurserymen). The objective of the review is to focus attention on areas of concern in the provision of the raw materials required to complete the Provincial reforestation program. This summary is presented as an aid in planning work programs of the various agencies capable of investigating cone and seed problems.

Carol L. Leadem (chairperson)

Table 1

	Activity	Priority[1] R/D	Priority[1] O/T	Impact[2]	Feasibility[2]
1.	CONE INDUCTION AND SEED DEVELOPMENT				
	a. Cone Initiation				
	b. Forecasting and Monitoring	2	2	H	H
	c. Collectability and Maturation				
2.	CONE HARVESTING AND SEED HANDLING				
	a. Mechanized (Aerial) Harvesting	7	3	L-M	M-H
	b. Field Handling				
3.	CONE AND SEED POCESSING				
	a. Kilning				
	b. Extraction	6	4	H	M-H
	c. Dewinging				
	d. Sizing				
	e. Cleaning/Sorting				
4.	SEED TESTING AND PREPARATION				
	a. Pretreatment and Dormancy				
	b. Viability Sorting				
	c. Monitoring Seed Performance	1	1	H	M-H
	d. Vigour Testing				
	e. Quick Tests				
5.	SEED STORAGE				
6.	SEEDING				
	a. Pelletizing	5	6	M	M-H
	b. Precision Seeding (Sowing Factors)				
7.	CONE AND SEED AND OTHER INSECTS				
	a. Biology	3	5	H	M-H
	b. Prevention and Control				
8.	CONE AND SEED DISEASES				
	a. Biology	4	7	M	M-H
	b. Prevention and Control				

[1]Priority (rank 1-8): R = research, D = development, O = operational, T = training.
[2]Rating criteria: H = high, M = moderate, L = low.

A COMPUTERIZED, SOLID-STATE, CONTROLLED TEMPERATURE GRADIENT SYSTEM FOR DETERMINING OPTIMAL SEED GERMINATION TEMPERATURES

Temperature is a critical factor influencing conifer seed viability and germination success. A controlled temperature gradient system has been designed to enable forest researchers to determine quickly and accurately in the laboratory, the optimal temperature conditions for seed germination.

The thermogradient plate consists of 16 aluminum plates, each 12.5 cm square and arranged in a 4 x 4 matrix.

The temperature of each mini-plate is individually monitored, using a single diode temperature sensor, the voltage output from which is measured by an analog-to-digital conversion circuit connected to a microcomputer. The computer then determines whether heating or cooling is required according to user-entered control parameters.

Heating or cooling is achieved by passing DC current through thermo-electric heat pump module in one direction or the other. This technology employs semiconductor thermocouple materials which enable large temperature differentials (up to 70°C) to be generated across distances of a few millimetres. Convective exchange is reduced by insulating neoprene rubber beneath each plate and by transparent plastic covers installed over each plate. The plates have short time constants (ca. 1 minute), which helps provide direct and more precise temperature control than would be obtained with more conventional designs of controlled thermogradient plate.

A user-friendly control program enables the researchers to monitor current and historical plate temperatures and to set or change the target control temperatures as required. The program included the following features: (1) an optional randomized arrangement of plate temperatures, so that experimental bias can be virtually eliminated, (2) controlled changes in plate temperature as user-specified functions of time, including step changes and 24-h sinusoidal variation, and (3) automatic recording of plate temperature data on disk, so that subsequent analysis of the experiment can be achieved more easily.

Development funding was provided by the Canada-B.C. For. Res. Development Agreement, Project 2-69, and the apparatus is now available from Micromet Systems Inc., 740 Millgard St. Vancouver, B.C. V5Z 4A1. Ph. 604-736-4114.

David T. Price
Carole L. Leadem

ONTARIO BLACK SPRUCE GENECOLOGY STUDY

Genecology is a combination of genetics and ecology; it can be defined as the study of genetic variation within a species in relation to environmental variation.

The present study was initiated in the summer of 1990 by the Ontario Ministry of Natural Resources (OMNR) staff at the provincial, regional, and district levels. The intention of the study is to get a good description of, or "feel" for, the genecology of black spruce in the Northern Region.

The basic steps in the study are as follows.

(1) Collection of current black spruce cones from 6 to 20 areas scattered across each district. This amounts to a strategic geographic sampling of the Region.
(2) In each area, approximately 0.5 L of cones will be picked from each of 10 trees spaced at least 50 meters apart. The cones from the 10 trees will be mixed. The cones from any one tree will not represent a high proportion of the total cones picked at any area.
(3) The bulk cone lots will be individually identified and the collection areas mapped.
(4) The collection areas will be described using the Forest Ecosystem Classification (FEC) system. Areas will be selected so that a large number of the sites are not in the same FEC.
(5) The seeds will be extracted at the Ontario Tree Seed Plant in Angus.
(6) The seedlots will be sown and the seedlings grown under controlled conditions in a greenhouse.
(7) The identified seedlings will be planted in 2 or 3 places in Northern Ontario representing both mild and severe environments.
(8) During the next 3 to 5 years, the seedlings will be assessed on traits associated with adaptive variation. Some of these are: total height, duration of shoot elongation and date of bud set and bud break. The assessment of these traits will be correlated with climate data.

The information from the study is destined to be used to realign seed zone and breeding zone boundaries if necessary. In addition, to ensure that the allocation/transfer of seed and deployment of seedlings and stecklings is appropriate, so that the seed and planting stock are placed on sites where they are adapted to grow well.

R.D. Ford

AN ONTARIO TREE IMPROVEMENT COUNCIL UP-DATE

The industrial and Ministry of Natural Resources cooperators in the OTIC tree improvement programs completed the first phase of seed orhcard and family test establishment in 1989 and this past year have concentrated on the intensive management of these installations.

For the most part, survival and growth in the orchards and tests has been good. Deer browsing in the northwestern part of the Province has resulted in the loss of a jack pine family test and the construction of a two metre electric fence, with a moat, around a 14 hectare jack pine orchard. A black spruce test planted in the northeast on an organic site may be lost due to rather severe mortality.

Routine management practices in the orchards have included fertilization, volunteer removal, competition control, insect and disease control and the replanting of mortality from spares previously established at the sites. A number of operational trials have been established in our orhcards: fertilization to determine optimal nutrient levels for jack pine; mulching with poplar chips, straw and pulp mill sludge to reduce the threat of high soil temperatures and drought stress on black spruce; flower and cone monitoring to determine black spruce flower efficiency;

foreign pollen inflow; and jack pine crown management. In addition, a research project to study pollen contamination in our orchards has been initiated by Drs. Keven and Di-Giovanni of the University of Guelph. The study will determine both the pollen dispersal (source strength, dispersal, deposition) and biological (reproduction and gene flow through isoenzyme analyses) aspects. A model will be produced to suggest corrective management techniques for northern Ontario seed orchards.

Routine management practices were also carried out in the family tests where necessary. Volunteer removal, competition control, insect and disease control and identification measures were common. It is rather disappointing to see the increasing amount of damage caused to most jack pine tests by armillaria, white pine weevil, jack pine shoot borer and pitch nodule maker. These largely uncontrollable insults may result in modified assessment schedules and techniques.

Cooperation between industry and government continues to be strong and continuity of funding for the OTIC tree improvement programs is assured despite the hard times.

Jim Coles

NATIONAL TREE SEED CENTRE, PETAWAWA NATIONAL FORESTRY INSTITUTE

The Centre has recently completed, in cooperation with the Pine Ridge Forest Nursery of the Alberta Forest Service, an experiment dealing with the effect of cone scorching (220°C) on extraction efficiency and seed quality of lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.). Scorching for up to 1.5 minutes followed by kiln drying in a rotating drum kiln did not deleteriously effect germinability of the seeds. Furthermore, seeds from cones scorched for this period of time had the lowest rates of aging when subjected to accelerated aging at 40°C and 98% R.H. for periods from 3 to 21 days. It was also found that the rotating kiln drums, which allow seeds to drop out of the kiln environment upon release from cones, may be superior in preserving seed vigour to kilns in which any seeds released from the cones remain in the kiln for the kilning duration. Further studies on the latter finding are ongoing.

Another cooperative venture was recently begun with the Dept. of Silviculture, Swedish University of Agricultural Sciences in Umeå, Sweden. This experiment will use a variant of the incubation, dissiccation, separation (IDS) technique on seeds of balsam fir (*Abies balsamea* [L.] Mill.). Results with this powerful method for removing resin filled and filled-dead seeds from a seedlot have been promising with such species as Norway spruce, Douglas-fir, Scots pine, lodgepole pine, and jack pine. Species such as eastern white pine and white spruce give intermediate results, while use of the technique with the *Abies* species tested has been impossible because they are lighter than water even when fully imbibed. Dr. Urban Bergsten will use ID-Sedimentation in a sedimentation flume to classify portions of the seedlots into various germinability classes.

Bruce Downie and Ben Wang

STUDY OF HOST SPECIFICITY IN CONE INSECTS ATTACKING NATIVE AND INTRODUCED CONIFER SPECIES GROWING IN A LARGE ARBORETUM

(reprinted IUFRO, Cone and Seed Insect Newsletter)

A very interesting thesis dealing with this subject has been sustained in France by R. Ostermeyer. The thesis took place in the arboretum "Les Barres" (central France), where 190 exotic conifers have been introduced since last century. The author studied host specificity in two different ways. Firstly, insect fauna related to cones have been investigated and compared between the species belonging to the genus *Picea*. 25 spruce species coming from north America, eastern Asia, eastern and southern Europe have been studied. The author showed that the phylogenetical distance to the native species, *Picea abies*, is the main factor to explain the present colonization in a given spruce species. Various adaptative mechanisms allowing native insects to develop within exotic tree species are discussed from the differences observed in biology and survival.

Secondly, the author deals with the host range of the seed- chalcid genus *Megastigmus*. Seeds from all the conifers species (131) bearing cones in 1989 in the Arboretum have been sampled and X-rayed. 29 species belonging to the genus *Abies* (14/20 cone-bearing species), *Picea* (5/25), *Pinus* (1/29), *Larix* (3/7), *Pseudotsuga* (3/5), *Cedrus* (1/4), *Chamaecyparis* (2/5) showed seed insects. Conversely, Taxodiaceae, Cephalotaxaceae, Podocarpaceae, Taxaceae, most of Cupressaceae and *Tsuga* spp. did not present any insect. 7 species of *Megastigmus* have been identified. Among them, the first record in France of *Megastigmus atedius* on both *Pinus strobus* and *Picea orientalis*. Data also revealed the close relationships between tree phylogeny and infestation by native *Megastigmus* spp.

Some copies (in french) of this thesis are still available. (R. Ostermeyer, Zoologie forestière, INFRA-CRF, Ardon 45160 Olivet, FRANCE).

SEED LOSSES IN NEWFOUNDLAND RED PINE FROM FIR CONEWORM PREDATION

Red pine (*Pinus resinosa* Ait.) is a rare species on the island of Newfoundland where it exists at the northeastern extreme of its geographical range. The species occupies only 20 stands distributed in 2 main population centres (Sandy Lake and Terra Nova National Park) in central Newfoundland. Concern over declining numbers of red pine was first expressed in an item written for this Newsbulletin by Woodrow Burry in 1986. Since that time red pine populations have been further eroded

through fuelwood harvesting and human settlements. Ingrowth of black spruce through its vulnerability to wildfire threatens many of the remaining natural stands with extinction.

Natural regeneration of red pine has been very sparse, particularly in stands associated with the stands near Terra Nova National Park. A survey of cone and seed production and quality was conducted during the fall of 1989 and 1990 to evaluate fecundity in natural populations of red pine and to determine if the species was producing adequate quantities of seed. In the course of this evaluation, observations on cone predation by the fir coneworm. *Dioryctria abietivorella* (Groté) (Lepidoptera: Pyralidae), were made by assessing damage on 10 branches for each of 8 trees in 12 of the 20 extant natural stands on the Island.

There was a much higher incidence of cone predation in stands located near Terra Nova National Park than near Sandy Lake. Cone predation in the Terra Nova Park area has been so heavy over the past 2 years that virtually the entire seed crop was lost in many stands.

A bumper cone crop occurred on all conifer species throughout the Island and throughout most of eastern Canada in 1988. Subsequent crops have been small on all species except red pine. In contrast red pine has produced good cone crops each year since 1988 and another good crop is apparent for 1991. It appears that the increase of fir coneworm damage to red pine has been caused by an absence of cones of other tree species normally damaged by the pest. Oddly, the Sandy Lake stands suffered relatively little predation, possibly as a result of lower initial population numbers of the coneworm.

The fir coneworm is known to occasionally cause losses in Ontario red pine stands, but it is unusual to observe such a large destruction of a species reproductive effort by insects like the coneworm. Given the tenuous ecological position of red pine in Newfoundland, the fir coneworm may have profound consequences for the regeneration of red pine. A continuation of the coneworm infestation may significantly increase red pine's vulnerability to local extinction, particularly in eastern Newfoundland. The degree of the observed losses in red pine seed production provides evidence for the potential ecological effects of cone insect predation on rare and small conifer populations.

Alexander Mosseler and Rick West

CONE AND SEED PEST SURVEYS IN 1989 IN ONTARIO

(From Forestry Canada, Spring 1990 Survey Bulletin, Ontario Region)

A long-term program to gather baseline data on various agents that affect cone and seed production of major conifer species focussed on black spruce and white pine in 1989 (jack pine and red pine were examined in 1988, see News Bulletin #12, November 1989; white spruce was examined in 1987, see News Bulletin #10 November 1988).

For the black spruce survey, each ranger collected 100 cones from an upland site, preferably a seed-production area, and 100 cones from a lowland site. These cones were mature and fully developed but still green and not yet hardened off. For white pine 100 mature second-year cones were collected by each ranger, preferably from a seed orchard or seed-production area. The cones were dissected and analyzed at the Sault Ste. Marie laboratory.

Black Spruce

In the black spruce survey, 443 (34%) of the 1300 cones were damaged by various agents. The proportion of damaged cones at various locations ranged from 8% to 87%. Seed loss within damaged cones averaged 3.3% and ranged from 0.5% to 72%. The principal agents causing the damage and seed loss were as follows: the spruce cone axis midge (*Dasineura rachiphage* Tripp), the spruce cone maggot (*Lasiomma anthracinum* [Czerny]), the spruce micro moth (*Endopiza piceana* [Free.]), the spruce cone rust (*Chrysomyxa pirolata* [Körn] Winter), unknown lepidoptera, unknown agents, and the spruce seed moth (*Cydia strobilella* [L.]).

White Pine

A total of 600 white pine cones was dissected. Forty-one per cent of these were damaged, with an average seed loss within damaged cones of 37%. The proportion of damaged cones ranged from 19% to 76% in the different locations. The principal agents causing the damage were the white pine cone borer (*Fucosmo toculloonana* Heinr.), the white pine cone beetle (*Conophthorus coniperda* [Schw.]), a cone midge (*Resseliella* sp.), unknown lepidoptera, unknown agents and the fir coneworm (*Dioryctria abietivorella* [Grt.]).

BUMPER CROP OF SPRUCE SEED IN NORWAY - 1989

The flowering of Norway spruce in the spring of 1989 was plentiful both in the field as well in seed orchards. The weather was warm and there was no rain while the trees were in flower and consequently pollination was excellent. The cone crop collected in the autumn of 1989 was probably the biggest for this century.

Norway spruce seed orchards flowered properly for the first time. There are 29 of these orchards in the country and they cover a total of 300 hectares. All in all, 2000 kilos of seed was collected from them.

The planting of Norway spruce is expected to expand during the coming years and the annual seed requirement of the nurseries is expected to be in the region of 1600 kilos. The seed from seed orchards will not be sufficient, because years favorable for flowering do not occur frequently enough. New seed orchards are being planned, but it takes twenty years from the moment of establishing an orchard until it reaches a productive age. Since seed

orchard seed is not available in sufficient amounts, we must turn to the alternatives of using seed from tested seed collection stands and of using vegetatively propagated seedlings. At FFTB, we have already commenced with the testing of trees in selected stands of spruce and the development of vegetative mass propagation methods.

Marja-Leena Napola
Haapastensyrja Breeding Centre,
SF-12600 Layliainen, Finland (from Metsanjalostussaatio 1990)

1990 SEED UTILIZATION IN B.C.

The seed required to produce 2.5 million seedlings was sown in 1990. Production goal for the various species were as follows:

SPECIES	% OF TOTAL
Lodgepole pine	38.48
White spruce and hybrids[1]	29.16
Englemann spruce	13.29
Douglas-fir	6.61
Western red cedar	3.96
Hemlock[2]	2.83
True firs[3]	1.92
Sitka spruce and hybrids[4]	2.22
Western larch	0.89
Yellow cedar	0.37
Other pines[5]	0.23
Birch	0.01

[1] White spruce X spruce (unknown)
[2] Western, mountain
[3] Amabilis, alpine, grand, noble
[4] Sitka spruce X white spruce
[5] Western white, ponderosa, jack, scotch

The nursery industry has identified improving seed quality and purity as "high-pay-off" opportunities. The poor germinability of seed lots as a result of deep dormancy or poor vigor and the occurrence of debris with the seed necessitates multiple seeding in container operations. Multiple seeding results in increased operational costs because thinning to one seedling per cavity is necessary. It is argued that true seed costs should not be based on only the cost of seed but should also include seed related expenses such as thinning and the occurrence of blank cavities. Including these factors true seed costs can be as high as 20% of the cost of producing a seedling.

CONE COLLECTION IN A QUÉBEC WHITE SPRUCE SEED ORCHARD

A white spruce clonal seed orchard located at Caplan, in the Gaspé Peninsula, produced its first cones in 1988. It was planted in 1985 with two-year-old grafts and is composed of 175 clones, each represented by approximately 13 ramets.

Only 2.4% of the six-year-old grafts produced cones. We attributed this low production mainly to the size of the grafts. The number of cones per producing tree varied from 1 to 23, with a mean of 5.

The cones yielded a mean of 18 seeds. Since very little pollen was produced by the orchard trees, seeds originated from pollination by foreign sources. Germinative power evaluated by X-rays showed that 98.5% of these seeds were full, while 63.8% actually germinated in the seed trays. This germination rate is comparable to local natural sources in the same year (68 to 77%) and to the provincial mean for the species over 24 years (67% between 1960 and 1984).

The production will undoubtedly increase as the orchard grows older and trees get larger in size and this development will be documented. Similarily, the other 66 orchards established in the province will gradually enter into juvenile production phase. Orchard managers intend to collect cones every year, even if quantities are small: by coupling collections with regular orchard operations they hope to control the insects and diseases attacking cones and avoid severe infestations.

André Rainville

ARITIFICIAL SEEDS—SOON TO BE AVAILABLE FOR SPRUCES?

There have been exciting developments in the last few years in Canada in biotechnical approaches to the vegetative propagation of spruce species.

The tissue culture process called somatic embryogenesis enables us to proliferate multiple pro-embryos from a single mature or immature embryo excised from a seed. These pro-embryos, which grow in a special embryogenic callus tissue, are all identical. They can develop into mature embryos and plantlets (called emblings) after proper maturation and germination steps. Theoretically, about one million genetically identical embryos (or propagules) can be produced from one kilogram of embryogenic callus. The technology was developed in research groups at the Petawawa National Forestry Institute (PNFI), the British Columbia Research Corporation (BC Research) and the Plant Biotechnology Institute (PBI) among others, and has been applied, to black spruce, white spruce, engelmann spruce, sitka spruce, and larch and its hybrids.

The potential advantages of using somatic embryogenesis in tree improvement programs are immense. The time taken to introduce genetically improved varieties of tree can be reduced by over 20 years because the need for a seed orchard is by-passed. Embryogenic calli can be stored safely for long periods in liquid nitrogen through cryopreservation, which allows their regrowth and use when required. This permits long term germplasm conservation and its use in clonal forestry. Cryopreservation methods for spruce and larch embryogenic calli have been developed at PBI and at PNFI.

At present, the somatic embryogenesis method is efficient at the research level for the regeneration of thousands of emblings. Small scale field tests have been initiated at PNFI and at BC Research. However, the process invovles the manipulation of the emblings one by one through their conditioning between the tissue culture step and the greenhouse. This is labour intensive and costly. For commerical application, further development is needed to deliver propagules directly from tissue culture to the greenhouse, which would permit the processing of millions of emblings at any given time.

Obviously it would be desirable to find a way of transferring somatic embryos directly to soil for germination in the greenhouse. Several ways have been suggested. For instance, it may be possible to float the embryos in a gel, which could be squeezed out like toothpaste. This could be applied mechanically directly to the soil for germination. Another possibility, which would be more closely aligned to conventional methods, would be to develop an artificial seed.

An artificial seed would need to function in a way similar to a natural seed. That is, it must be able to be stored without loss of viability for a reasonable period, and it must be capable of germinating normally when planted. In order to convert somatic embryos into artificial seeds two steps are necessary. Firstly, the embryos must be dehydrated to a moisture content as low as that in the natural seed. Secondly, the dehydrated embryos need to be encapsulated in a protective coating capable of permitting germination when planted. The coating should also contain the nutrients and pesticides desired at this stage.

At PNFI we have been interested in the development of artificial seeds from somatic embryos of black spruce. Dr. Brian McKersie's group at the University of Guelph have kindly carried out desiccation of our black spruce somatic embryos. The resutls are encouraging. As with alfalfa, it is possible to desiccate black spruce somatic embryos and regrow them afterwards. The next step will be to investigate encapsulation systems.

A joint project involving PNFI, PBI, and BC Research was initiated a year ago to address some of the problems associated with somatic embryogenesis technology. Questions such as genetic variation induced by the tissue culture process are being explored, in addition to the optimization and upscaling for industry. Preliminary results indicate that there is no genetic variation induced by somatic embryogenesis at the isozyme level.

With the current effort of several groups in Canada, it is realistic to envision the application of somatic embryogenesis in spruce species for tree improvement programs. The main problem remaining is the large scale delivery of emblings for operational purposes. That is where research in this area is focussing now.

IN VITRO FLOWERING ALLOWS FIRST BREEDING OF BAMBOO

(Source: Agricell Report 14(6):1, June 1990)

Although bamboo is one of humanity's most important structural raw materials, its long germination time and "gregarious" flowering characteristic have made it virtually impossible to improve the plant by selective breeding techniques. Almost all tropical Asian bamboo plants flower only once, after 12-120 years of exclusively vegetative growth. An entire local bamboo population behaves as if it were a single plant: flowering, setting seed and dying together. The process is poorly understood and unpredictable.

Now, in a discovery described as "extraordinary" by the journal Nature, R.S. Nadgauda and colleagues at India's National Chemical Laboratory have developed a system that consistently induces flowering in tissue cultures of 3 bamboo species: *Bamnbusa arundinacea*, *Dendrocalamus brandisii* and *D. strictus* after 3 subcultures instead of the approximately 30 years normally required for flowering (Nature 344:335, 1990).

Nadgauda's group cultured seedling segments, containing coleoptile regions with growing points, on MS medium containing 2% sucrose, at 28°C under light on a rotary shaker. Shoots that developed were excised and subcultured on MS medium containing 2% sucrose, 0.5 ppm BAP and 5% coconut milk. Three consecutive subcultures on this medium resulted in development of panicles of spikelets with normal stamens and pistils in 70% of *B. arundinacea* and 40% of *D. brandisii* cultures. Inflorescence could be subcultured on the same medium, each producing several additional flowers. Normal seeds were obtained from the cultures of both species.

In addition to (1) allowing breeding of improved bamboo plants, (2) providing a means of producing intergeneric hybrids, and (3) providing a perennial source of bamboo seed, *in vitro* flowering provides a system for studying the physiological and molecular control of bamboo flowering.

INFORMATION WANTED

Rick West has forwarded this request for information

Dear Dr. West:

I have read your name in vol. 12(1) IUFRO newsletter in connection with spruce cone insects and thought about the possibility of asking you a question concerning cone insects of *Pinus albicaulis*, though I know it grows in the western part of N. America. It is interesting for me for this species is a vicariant of our *Pinus pumila* in NE Asia. I will be very grateful to you for any data or names and addresses of scientists who know anything about it. Of course, any information about entofauna of *P. albicaulis* will be also valuable.

Thanking you in advance.

Yours sincerely,

Dr. P.A. Khomentovsky, Kamtchatka Department of the Environment, USSR Academy of Sciences, Prospect Pybakov, 19-A, Petropavlovsk-Kamtchatsky, 683024, USSR

MEXICAN TREE BREEDING CENTRE APPEALS FOR HELP!

On March 11, 1990, the main building of Centro de Genetica Forestal, A.C. was destroyed by fire. The building, that housed offices, laboratories, the library, and computer facilities, was a total loss. The laboratory and all equipment, the herbarium, all office equipment, all files — scientific, as well as, business — and the library of journals, textbooks and reprints were completely ruined.

Centre de Genetica Forestal A.C. was organized in the fall of 1985 as a joint effort of the Universities of Veracruz and of Chapingo. Since then, the Center has developed cooperative tree improvement programs in eight key wood producing states and the Federal District of Mexico.

These programs include the development of seed zoning, establishment of seed production areas, the selection of superior trees and planting of seed orchards, and progeny testing. Research includes provenance tests, biosystematic studies, electrophoretic research, progeny tests, and studies of phenology and of wood characteristics. Under the aggressive leadership of Dr. Teobaldo Equiluz Piedra, the Center has made advances towards the development of improved pine seed for Mexico's forests.

This is an appeal for help with the restoration of the library. We need back issues of the following journals: Forest Science, Canadian Journal of Forest Research, Silvae Genetica, Canadian Journal of Botany, Plant Physiology, Ecology, and Journal of Forestry. For these journals, we had built up complete sets, or sets going back 20 to 30 years. We need recent, as well as, older textbooks in the fields of genetics, tree genetics, and tree improvement, tree physiology, plant propagation, silviculture - particularly of pine, statistics; proceedings of the tree breeding associations in the United States and Canada; manuals relating to pollination, seed handling, silviculture, analytic procedures, etc. Thousands of reprints were destroyed. We ask colleagues to send us sets of their reprints — new and old — in all fields related to genetic variation, tree genetics, and tree improvement, tree physiology, etc.

Reprints and individual textbooks should be sent directly to Centro de Genetica Forestal, A.C., Apartado Postal 104, Chapingo, Mex. C.P. 56230, MEXICO. If you can contribute volumes of journals, please write and indicate what journals and volumes you have available. Letters should be addressed to: Dr. Hans Nienstaedt, c/o U.S. Forest Service, Forestry Sciences Laboratory, P.O. Box 898, Rhinelander, WI 54501. To avoid duplications, Dr. Nienstaedt will coordinate the collection of the journals. He will write you with further shipping instructions. To a large extent, we built the library we had with the generosity of our friends and colleagues. We hope we can depend on your help once more.

TRAINING AIDS

The B.C. Forest Service has developed slide/tape shows on the following topics,

1. Cone crop forecasting
2. Cone crop surveys
3. Seed evaluation
4. Cone collection—preorganization
5. Cone collection—methods
6. Cone handling and storing

REPORTS OF MEETINGS

Conference Tour to Western Forest Genetics Association/IUFRO Meeting in Olympia, Wash. (Host Weyerheuser)

The meeting (Aug. 20-24, 1990) brought together tree breeders and geneticists from 17 countries to discuss and present new results on Douglas-fir, Sitka spruce, and lodgepole pine.

The importance of seed source was reiterated and the problems related to specification and repeatability became evident. The success with domestication of North American conifers became obvious to everyone. Seed from existing plantations of exotics in Europe is now superior to seed collected from natural stands in British Columbia and Washington.

Although almost everybody believed in the potential of increasing the per unit area yield by conventional breeding it soon became evident that there were few true yield studies with genetically improved stock. Comparative yield studies are clearly needed to ensure continued funding of conventional breeding efforts.

Gene Namkoong's presentation "Forest Genetics: 2050 - the quick and the dead" was a dire warning against losing the ecological and population perspective in tree breeding. It is the nature of science to specialize and break down a complex system into simpler subcomponents in the belief that the complexities of the whole can be summarized by knowledge about simpler structures. This may work in physics or chemistry but it is likely to fail in the biological sciences.

Gene conservation and a popular uprising against plantation forestry in Europe were also 'hot' topics over a beer and a delicious salmon steak in the evenings.

Friendships were renewed with a lot of colleagues and new friends were easy to find in the relaxed and positive atmosphere so typical of tree improvement conferences.

Steen Magnussen

ISTA/USSR International Seed Symposium and Regional Seed Workshop, Novosibirsk, July 18-26, 1990

This symposium and workshop was jointly sponsored by the International Seed Testing Association and the USSR Government Seed Inspection Branch, and held in the House of Scientists, Siberian Branch of the V.I. Lenin All -Union Academy of Sciences, Novosibirsk, Siberia. While the symposium was attended by about 125 participants from 25 countries, about 80 attendees took part in the 2-day workshop sessions.

There were four sessions in the seed sympsoium: seed dormancy and seed storage, seed germination, seed vigour, and posters. The workshop sessions covered dormancy in cereals, yellow cotyledons in *Brassica*, mechanical damage in soybeans and peas, split coleoptile in maize, germination behavior of tree seeds, and seed vigour. All papers and workshop presentations will be published in the symposium and workshop proceedings.

Ben Wang

ASEAN-Canada Forest Tree Seed Centre, Muak lek, Saraburi, Thailand

At the Second Joint Meeting of the Working Groups of the Seed Technology and Materials Exchange and the Seed Origin and Genetic Resources held at Khon kaen, Thailand on October 15-19, 1990, one of the most significant achievements was the recommendation of the adoption of an uniform ASEAN Tree Seed Register Form to be used for all seed collections in ASEAN countries. The ASEAN Seed Register will be recommended for adoption and utilization in the ASEAN countries at the next Project Steering Committee meeting to be held in April 1991.

The Centre just published its third and last issue of the 'Embryon' (Volume 3, Number 1) in July 1990. The Embryon has been used for disseminating results of research and development undertaken at the Centre. Based on a recommendation from the Project Steering Committee, future results of research and development will be published as a series of technical notes or as contributions in journals or proceedings of meetings. In this issue there are eight papers covering topics such as determination of seed quality of *Acacia auriculiformis* and *Pterocarpus macrocarpus*, seed pretreatments to enhance germination *Peltophorum dasyrachis* and leguminous species, development of pollen and ovule in *Pterocarpus macrocarpus*, stump planting of *Azadirachta indica*, rooting variation in *Eucalyptus camaldulensis*, and symbiosis between insects and the seeds of *Sesbania grandiflora*.

Ben Wang

Pollen Management Workshop; Macon, Georgia

In July 1990 I attended a 2-day pollen management workshop organized by the Southern Research Information Exchange Group (SRIEG). Fourteen papers were presented by regional, national, and international researchers on pollen biology and pollen management for tree breeding and seed orchard production.

It has been almost 10 years since the very informative "Pollen Management Handbook" was published (1981 ed. E. Carlyle Franklin, USDA Handbook no. 587) and the intent of the meeting was to provide updated information in pollen research and technology and to discuss future concerns and direction for study. Papers submitted by the speakers are to be published in a Southern Forest Experiment Station Technical Bulletin in early 1991. Topics presented included: pollination biology, phenology, production, collection, testing and storage; orchard management, insect and diseases of catkins, and pollen and the application of biotechnology.

The workshop was educational and enlightening in terms of my understanding of pollination biology. Listening to professors, researchers, and practising foresters discuss their accomplishments and their concerns on a wide range of topics specific to pollen focused my understanding a little more to the 'why for' rather than simply the 'how to'.

Peter Copis

UPCOMING MEETINGS

Seed Dormancy and Barriers to Germination

Plans for IUFRO, Project Group P2.04.00, Seed Problems symposium are nearly complete. The meeting will be held April 22-25, 1991 in Victoria, British Columbia at the Grand Pacific Hotel and Forestry Canada's Pacific Forestry Centre.

Contact Dr. D.G. Edwards, Forestry Canada, Pacific Forestry Centre, 506 W. Burnside Rd., Victoria, B.C., Canada V8Z 1M5.

Seed Quality

The IUFRO, Project Group P2.04.00, Seed Problems is organizing a second symposium in Nanjing, China for Oct. 13-17, 1991. This meeting will be preceded by a Workshop on Seed Radiography, Oct. 9-12 and a post-meeting tour is planned for Oct. 18-22. The meeting will be held on the campus of Nanjing Forestry University where the Southern Tree Seed Inspection Centre is located. The deadline for submission of papers is May 1, 1991. Contact: Mr. Gao Handong, Secretariat, Southern Tree Seed Inspection Centre, Nanjing Forestry University, Nanjing, 210037, China.

Sowing the Seeds - Conference on Direct Seeding and Natural Regeneration, 22 to 25 May 1991, Adelaide, Australia.

Direct seeding and the encouragement of natural regeneration of vegetation are useful, low-cost technologies in the battle against land degradation. Greening Australia is organizing a conference on these topics, with sponsorship from the Australian Government. Participants will be land-care professionals, farmers,

mining-industry technologists and others interested in vegetation, including agroforesters.

The aim of the conference is to bring together current research knowledge and practical know-how and also to identify new areas for research and development. The conference will include a field day for inspection of large projects in South Australia, plus demonstrations of the latest direct seeding techniques and equipment. For more information and registration forms, contact: The Secretariat, Greening Australia Sowing the Seeds Conference, P.O. Box 232, Kensington Park 5068, South Australia.

Canadian Tree Improvement Association 1991 Meeting

Over the last decade our biennial meetings have focussed our attention on tree improvement, breeding, progeny testing, orchards, clonal forestry, and biotechnology. These meetings have intentionally often been quite technical with emphasis on "how to". Now that our breeding programmes are mostly well underway it may be worthwhile to think about the genetic variation that we have excluded from our breeding populations and the broader consequences of our activities on diversity and genetics. With this in mind the topic of our next CTIA meeting is going to be: **Mainting Biodiversity - Should you be concerned?** The meeting will take place in Ottawa (August 19-23, 1991). We are now in the process of putting together an exciting programme for you. At the present time we have confirmation from several distinctive speakers (G. Namkoong [U.S. For. Serv.], C. Millar [U.S. For. Serv.], and T. Williams [FAO]) who promise to make this meeting very stimulating for everyone involved with managing natural resources.

Please inform your colleagues about our meeting. More information will soon appear in pertinent Forestry Journals. Registration forms will be mailed to our active members. Corresponding members and other interested persons can obtain registration forms by sending a request to: Steen Magnussen, Editor CTIA, Forestry Canada, Petawawa National Forestry Institute, Chalk River, Ontario, K0J 1J0, Fax. 613-589-2275.

Cone and Seed Insects

An IUFRO Working Party, S2-07-01, Cone and Seed Insects, Conference being planned for 1991 in Hasbin, China has been postponed (due to a poor attendance forecast). It is now being suggested that the meeting be held in 1992 in conjunction with the 19th International Congress of Entomology to be held in Beijing, China June 28-July 4. Note this is a suggestion and not definitely arranged. Organizers will welcome suggestions to make the meeting a success and also indications of papers that may be offered. Contact: Gary L. DeBarr, Southeastern Forest Experiment Station, Carlton St., Athens, Georgia USA 30602.

Centennial Meeting of IUFRO, 1992

This meeting will be held in Berlin, September 1992. The proposed presentation by Entomology and Pathology consists of three different sessions, concerning temperate countries: Development of Forest Protection in Europe; Development of Forest Protection in North America; Protection Strategies and Tactics for the Future. A Pilgrimage to Eberswalde, the birthplace of IUFRO, is also planned.

21st Southern Forest Tree Improvement Conference June 17-20, 1991

Organized by the University of Tennessee and Tennessee Division of Forestry at the Hyatt Regency, Knoxville, Tennessee, contributed papers and posters are being solicited by the Program Committee for the 21st Southern Forest Tree Improvement Conference. Session topics include the following:

Tree Improvement Strategies and Environmental Change
Seed Orchard Management
Growth and Yield of Improved Plantations
Breeding and Propagation
Genetic Testing and Selection

Papers on basic and applied rsearch areas will be integrated in the above sessions. Authors submitting papers on basic research topics should select the session most pertinent to the eventual use of their results. Submitted papers should not exceed 10 typed pages. Contributed presentations will be restricted to 20 minutes including 5 minutes for discussion. Title and a one-page abstract should be submitted by January 25, 1991 to:

Dr. Scott E. Schlarbaum
The University of Tennessee
Department of Forestry, Wildlife & Fisheries
Knoxville, TN 37901-1071

Please specify if the submitted abstract is for a paper or a poster. Abstracts from accepted contributed papers and posters will be published as received in the Conference Program.

Early Selection of Forest Tree Species Combining Morphophysiological Traits and Molecular Markers Workshop (Oak Ridge, Tennessee - June 13-14, 1991)

This workshop is designed to bring tree breeders and molecular geneticists together to determine where marker-aided selection fits in tree improvement programs.

If interested in attending, contact by December 1, 1990:

Dr. Jerry Tuskan
Oak Ridge National Laboratory
P.O. Box 2008 MS 6352
Oak Ridge, TN 37831-6352

We thank Petawawa National Forestry Institute for their assistance in the preparation of this Newsletter.

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