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PROCEEDINGS

OF THE

TWENTIETH MEETING

OF THE

CANADIAN TREE IMPROVEMENT ASSOCIATION

PART 1:

MINUTES AND MEMBERS' REPORTS

HELD IN
QUEBEC CITY, QUEBEC
AUGUST 19-22, 1985

EDITORS:
C.W. YEATMAN & T.J.B. BOYLE

Part 1. Minutes and Members' Reports

Distributed to Association members and to others on request to the Editor, C.T.I.A./A.C.A.A., Chalk River, Ontario. Canada, K0J 1J0

Part 2. New Ways in Forest Genetics

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Petawawa National Forestry Institute
Chalk River, Ontario K0J 1J0

Produced by
Canadian Forestry Service,
for the
Canadian Tree Improvement Association,
Ottawa, 1986

COMPTES RENDUS

DE LA

VINGTIÈME CONFÉRENCE

DE

L'ASSOCIATION CANADIENNE POUR L'AMÉLIORATION DES ARBRES

PARTIE I

PROCÈS-VERBAUX ET RAPPORTS DES MEMBRES

TENUE À
QUÉBEC (QUÉBEC)
DU 19 AU 22 AOÛT 1985

RÉDACTEURS
C.W. YEATMAN & T.J.B. BOYLE

Partie I. Procès-verbaux et rapports des membres

Distribué aux membres de l'association et aux autres sur demande au rédacteur, A.C.A.A./C.T.I.A., Chalk River (Ontario) Canada, K0J 1J0.

Partie II. Voies nouvelles en génétique forestière

Distribué à l'échelle mondiale aux personnes et aux organisations activement engagées ou intéressées à la génétique forestière et à l'amélioration des arbres.

Des exemplaires de cette publication peuvent être obtenus à l'adresse suivante:

Rédacteur A.C.A.A./C.T.I.A.
Service canadien des forêts
Institut forestier national de Petawawa
Chalk River (Ontario) K0J 1J0

Publié par
le Service canadien des forêts
pour
l'Association canadienne pour
l'amélioration des arbres,
Ottawa, 1986

PROCEEDINGS OF THE TWENTIETH MEETING OF THE CANADIAN TREE IMPROVEMENT ASSOCIATION

With the compliments of the Association

Enquiries may be addressed to the authors or to Mr. J.F. Coles, Executive Secretary, C.T.I.A./A.C.A.A., c/o Ontario Tree Improvement Council, Johnston Hall, University of Guelph, Guelph, Ont. N1G 2W1.

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The Twenty-first Meeting of the Association will be held in Truro, Nova Scotia, August 17-21, 1987. Speakers will be invited to address the topic of "Progressing together on Co-operative Tree Improvement Programs in Canada". Canadian and foreign visitors are welcome. Further information will be distributed in the winter 1986 to all members and to others on request. Enquiries concerning the 21st Meeting should be addressed to: Mr. Howard Frame, Tree Breeding Centre, Dept. of Lands and Forests, Debert, N.S. B0M 1G0.

To: *T.J.B. Boyle, Editor, C.T.I.A./A.C.A.A.*
Canadian Forestry Service
Petawawa National Forestry Institute
Chalk River, Ontario K0J 1J0
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COMPTES RENDUS DE LA VINGTIÈME CONFÉRENCE DE L'ASSOCIATION CANADIENNE POUR L'AMÉLIORATION DES ARBRES

Don gracieux de l'association

Les demandes de renseignements peuvent etre adressées aux auteurs ou à J.F. Coles, Secrétaire général, A.C.A.A./C.T.I.A., c/o Ontario Tree Improvement Council, Johnston Hall, University of Guelph, Guelph, Ont. N1G 2W1.

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La vingt et unième conférence de l'association aura lieu à Truro, en Nouvelle-Écosse, du 17 au 21 août 1987. Des orateurs seront invités à adresser le sujet de "Nos efforts vis-à-vis les programmes coopératifs de l'amélioration des arbres au Canada". Les intéressés au Canada et à l'étranger sont les bienvenus. Des renseignements supplémentaires seront distribués au cours de l'hiver de 1986 à tous les membres et à tous ceux qui en feront la demande. Si vous avez des questions à poser concernant la 21e conférence veuillez les adresser à: M. Howard Frame, Tree Breeding Centre, Dept. of Lands and Forests, Debert, N.S. B0M 1G0.

À: *T.J.B. Boyle, rédacteur, A.C.A.A./C.T.I.A.*
Service canadien des forêts
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Chalk River (Ontario) K0J 1J0

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M.
Mme . . . . . .

Adresse: . . . . . .
. . . . . .
. . . . . *Code postal* . . . . . .

s.v.p. cocher une seule case:

Correction

Nouveau destinataire

Rayer le destinataire de la liste d'envoi de l'A.C.A.A.

Signé . . . . . .

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August 1985

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Hugh George MacGillivray

George MacGillivray died in Fredericton, N.B. on August 31, 1984. George was born in Sydney, Nova Scotia in 1920 where he received his primary and secondary education. He enlisted in the Canadian Armed Forces (Royal Canadian Artillery) in 1939 the day after Germany invaded Poland and eight days before Canada officially entered World War II. He subsequently served with distinction in the West Nova Scotia Regiment. He was seriously wounded in 1944 crossing the Lamone River in Italy.

George entered the University of New Brunswick in 1946 and was awarded a BSc Forestry degree in 1949. He obtained his Masters of Forestry degree from the University of Michigan in 1950. In June 1950 he joined the Canadian Forestry Service, Maritime District, where he was employed until his retirement in December 1976.

Essentially all of George's professional career was devoted to research and development in forest genetics and tree improvement. He pioneered research in this field in the Maritimes where he succeeded in laying the foundation for a valuable research program despite difficult obstacles. George established numerous species and provenance trials throughout the Maritimes Region in close cooperation with Mark Holst at P.N.F.I. and many provincial and industrial representatives in the Region. He planted replicated trials of black, red, white, and Norway spruces, jack and red pines, balsam fir, Douglas fir, Japanese, European and native larches and yellow birch as well as numerous other species. His foresight in establishing these trials and in maintaining detailed records over a period of almost 25 years has left the Maritimes a legacy of valuable materials and information as a basis for current tree improvement activities.

George was an active member of the C.T.I.A. throughout his professional career and upon his retirement was elected as an honorary member. He maintained a strong and continuing interest and served in positions of responsibility in several organizations including the Royal New Brunswick Rifle Association (life member and past president), and the Fredericton Rifle Club (president). Throughout his life he maintained a keen interest in Scottish affairs and at the time of his death he was Honorary President of the Fredericton Society of Saint Andrew.

George will long be remembered by numerous friends and colleagues for his ability to overcome severe physical handicaps and to contribute to his fellow man with his knowledge, skills, generosity and friendship. He is survived by his life companion, friend and wife, Dr. Ellen MacGillivray.

HONORARY MEMBER

MEMBRE HONORAIRE

Dr. W.H. Cram

Dr. W.H. Cram

Dr. W.H. "Bill" Cram was born at Morden, Manitoba in 1913. He completed his highschool education to grade 12 at Morden in 1932 and graduated from the University of Manitoba in 1939 with a B.S.A., majoring in Plant Science and Horticulture. From 1934 to 1938 Bill was employed seasonally by the Experimental Farm at Morden, as a labourer and student assistant in the Pomology Section for propagation and breeding work. From 1939 to 1941, he was employed at the University of Manitoba as a summer supervisor of vegetable trials and also as a lecturer and laboratory instructor for Horticulture. From 1941 to 1942, Bill was employed with the Dominion Forest Nursery Station at Indian Head, Saskatchewan, as a tree planting supervisor. Bill joined the R.C.A.F. in 1942, where he served in Canada and Europe until 1945. Upon his return from war service, Bill returned to Indian Head, where he was employed at the Experimental Farm as a Horticulturist. During this time he also attended the University of Manitoba, from where he graduated in 1948 with his M.Sc. in Plant Breeding and Biometrics. In 1947 Bill again began work at the Forest Nursery Station in Indian Head as a Tree Breeder and conducted related propagation research. During this time, Bill also attended the University of Minnesota, where he obtained his Ph.D. in Plant Breeding and Genetics in 1950.

From 1947 to 1958, Bill was actively involved in a tree improvement program and had many papers published related to his work at the nursery. His extensive work with caragana and his promotion of this species earned him the title of "Caragana Bill".

In 1958 Bill was appointed Superintendent of the Canada Agriculture Nursery Station at Indian Head, and served in this capacity until his retirement in December of 1977. Although his duties as Superintendent reduced the time available for research, he continued to supervise an extensive and diverse program of applied research and equipment development which resulted in the nursery changing from a manual operation to one where herbicides and machines were of considerable importance.

After his retirement in 1977, Bill was rehired by the Prairie Farm Rehabilitation Administration (PFRA) Tree Nursery on a part time basis, to write up research projects which had been done during his tenure at the nursery.

Perhaps Bill's greatest contribution to prairie forestry and horticulture has been his great enthusiasm in promoting tree plantings, as well as his unending desire to improve the plant material available for prairie planting.

BUSINESS MEETING MINUTES

COMPTES RENDUS DE LA REÚNION D'AFFAIRES

BUSINESS MEETING - MINUTES

Dr. A. Corriveau chaired the 20th Business Meeting of the CTIA/ ACAA held in Pavillon De Koninck, Université Laval, Quebec City, on Tuesday, August 20, 1985.

227. MINUTES OF THE LAST MEETING

Motion: That the minutes of the 19th business meeting be approved as published.

Moved by D.P. Fowler, seconded by B. Cheliak. Carried.

228. CHAIRMAN'S REPORT

Dr. Corriveau commented on the busy term in office. Of particular interest was the Forest Research Advisory Committee of Canada meeting and their request for forest genetics research priorities from the CTIA. Recently the chairman has pursued incorporation of the CTIA and redesigning the letterhead. The CTIA received a Canada At Work grant to employ 3 students for 5 months to organize this meeting.

229. FINANCIAL STATEMENT

The financial statement prepared by Treasurer C.W. Yeatman was tabled for membership information and acceptance (see attachment #1). The statement shows a balance of $9,274.48 in the association's account as of August 16, 1985.

Motion: That the financial statement be accepted as presented.

Moved by G. Vallee, seconded by F. Yeh. Carried.

C.W. Yeatman stated that the CTIA should have their financial statement audited - particularly if the CTIA desires to become incorporated.

Motion: That the CTIA/ACAA have their financial statement audited and the cost be borne by the CTIA.

Moved by C.W. Yeatman, seconded by W. Baker. Carried.

230. EDITOR'S REPORT

C.W. Yeatmen reported that the Proceedings of the 10th meeting were produced and distributed rather tardily due to not receiving camera ready versions of papers.

The CTIA accepted the resignation of C.W. Yeatman as Editor.

Motion: To thank Kit Yeatman for the excellent services provided as Editor of the CTIA during the past several years.

Moved by G. Vallee. Carried.

231. MEMBERSHIP

a) Honorary Member

Dr. William H. Cram was proposed by C.W. Yeatman and seconded by W. Schroeder, A. Gordon and D. Fowler.

Dr. Cram has been a breeder of spruce and Caragand for many years and head of PFRA, Indian Head Nursery, Saskatchewan.

Motion: That Dr. W.H. Cram be elected Honorary Member. Carried.

b) The following were nominated as new active members:

Dr. J.J. Balatinecz	Univ. of Toronto, Faculty of Forestry
Mr. L. Bennett	Ontario Paper Co., Timmins, Ontario
Mr. D. Brophy	Ontario Paper Co., Thorold, Ontario
Mr. J. Dojack	OMNR, N.C.R., Thunder Bay, Ontario
Dr. R. Gambles	Univ. of Toronto, Faculty of Forestry
Mr. K. Greenwood	OMNR, N.R., Timmins, Ontario
Dr. C.T. Keith	Forintek Canada Ltd., Eastern F.P. Lab.
Dr. R.M. Kellogg	Forintek Canada Ltd., Western F.P. Lab.
Mr. W. Moore	Great Lakes For. Prod. Ltd., Thunder Bay, Ontario
Mr. B. Nicks	E.B. Eddy Co., Espanola, Ontario
Dr. J. Poliquin	Université Laval, Faculty of Forestry
Mr. J. Russell	B.C. Ministry Forest, Dept. For. Resources
Dr. R. Savidge	Univ. New Brunswick, Dept. For. Resources
Mr. W. Schroeder	PFRA Tree Nursery, Indian Head, Sask.
Mr. R. Seabrook	Great Lakes For. Prod. Ltd., Thunder Bay, Ontario
Mr. V. Wearn	OMNR, N.R., Timmins, Ontario
Mr. P. Wearmouth	Proctor & Gamble Ltd., Grande Prairie, Alberta
Dr. D. Webb	Queens Univ., Biology Dept., Kingston, Ontario
Dr. A. Yanchuk	Alberta Forest Service, Edmonton

Motion: That the nominated new active members be duly elected.

Moved by J. Klein, seconded by D. Winston. Carried.

C.W. Yeatman stated that 33 new corresponding members were added to the list along with 12 Institutions. There were 11 deletions and 60 address changes.

232. BUSINESS ARISING FROM PREVIOUS MEETINGS

a) Education Committee (E.C.)

J. Begin stated that five of the six universities sent students to this meeting in response to offer of travel expenses by CTIA.

Since the last meeting, the E.C. had pursued scholarship funds from industry and received pledges for about $3000. Some concern was voiced that this had been done without the authority of the membership.

Motion: That the approximately $3000 received from industry for graduate student scholarship be invested immediately with a view to beginning a scholarship as soon as funds permit and that further solicitations to industry take place after this meeting and subsequent incorporation of the CTIA/ACAA.

Moved by J. Begin, seconded by F. Yeh. Carried.

Some discussion ensued on the difficulties involved in administering such a scholarship.

b) Forest Gene Resources

C.W. Yeatman attended a Plant Gene Resources meeting and presented a paper. Forest genetic resources are retained more readily than is the case with domesticated agricultural crop species. Gene resources will be maintained by the new planted forests and in wild stands designated and regenerated as genetic resource areas.

c) Forest Tree Seed Act

D. Pollard stated that with the CFS move from Environment Canada to Agriculture Canada there is no need to revise Canada Tree Seed Act to accommodate forestry concerns. Completion of the Forest T.S. Act has been delayed by the necessity to having the act in 2 languages and the constant legal review this requires. Once completed, approval will come by Order-In-Council. Pollard reported that no reports from the CTIA committee have been received and that the CTIA must take an active role in drafting the appendices to the Act.

The CFS has inspected and certified 3 orchards in B.C.

G. Vallee raised concerns about Plant Breeders Rights. Pollard suggested that because of extreme controversy and resistance the Plant Breeders Rights Act may not be passed.

d) Tree Seed Working Group

B. Wang reported that during the business portion of yesterday's meeting the Tree Seed W.G. had elected Y. Lamontange as chairman and H. Schooley as editor of newsletter.

233. NEW BUSINESS

a) Forest Research Advisory Committee of Canada

A. Corriveau reported that FRACC requested CTIA priorize forest genetics research.

Motion: That the CTIA/ACAA form a standing committee to advise and recommend research priorities on Forest Genetics in Canada to FRACC and that the 85/87 Chairman appoint a minimum of 3 active members to the committee for a 2 year term.

Moved by A. Corriveau, seconded by J. Klein. Carried.

b) Biotechnology Working Group

W. Cheliak reported that some months ago forest biotechnology scientists met in Saskatoon and formed the Canadian Association for Conifer Biotechnology and recommend that no further action be taken by the CTIA but that the CACB would gladly report progress to the CTIA.

c) Wood Quality Working Group

See attachment #2.

Motion: That a Wood Quality Working Group be established within the CTIA and that the Treasurer provide the Group with up to $500 for operating expenses if needed.

Moved by R. Kellogg, seconded by D. Fowler. Carried.

d) Incorporation of CTIA/ACAA

A. Corriveau reported it would be easier for CTIA/ACAA to attract corporate and government funding if the association was incorporated.

Motion: That an ad hoc committee be formed by the new executive to investigate the necessary procedures and proceed toward incorporation within a one year period.

Moved by W. Cheliak, seconded by A. Gordon. Carried.

e) Letterhead Revision

A. Corriveau presented a new design.

Motion: That the new design as proposed by A. Corriveau be adopted as presented.

Moved by C.W. Yeatman, seconded by W. Cheliak. Carried.

f) Cost of Publishing Proceedings

D. Winston expressed a CFS concern that the cost of publishing the proceedings (Parts 1 and 2) - borne by the CFS - was escalating beyond reason.

Motion: That the CTIA attempt to reduce the costs and paperwork involved in the production and distribution of the Proceedings and Members' Reports.

Moved by D. Winston, seconded by D. Fowler. Carried.

The new executive will appoint an ad hoc committee - chaired by the new editor - to address the motion.

g) Business Meeting Schedule

Motion: That all future business meetings be held during the late afternoon so that attendees can liesurely enjoy the culinary fantasies of the cities involved.

Moved by J. Coles, seconded by W. Cheliak. Carried.

234. FUTURE MEETINGS

a) Location of 1987 Meeting

The chairman called to attention the resolution passed by the 19th meeting (item 223b) which stated that the 21st meeting be held in Nova Scotia. T. Mullin of NS Dept. L & F confirmed that Nova Scotia would host the meeting and that the new executive would determine a theme.

b) Location of 1989 Meeting

An invitation was received from the Alberta Forest Service to host the 22nd meeting in Alberta.

Motion: That the CTIA/ACAA hold its 1989 meeting in Edmonton, Alberta.

Moved by J. Klein, seconded by D. Simpson. Carried.

c) Location of 1991 Meeting

An expression of interest was received from Petawawa National Forestry Institute.

235. ELECTION OF OFFICERS

The nominating committee chairman, D.P. Fowler, proposed the following slate of officers for election:

Chairman	T.J. Mullin
Vice-Chairman - Symposium	E.K. Morgenstern
Vice-Chairman - Arrangements	H. Frame
Executive Secretary	J.F. Coles
Treasurer	C.W. Yeatman
Editor	T.J.B. Boyle

Additional nominations were called from the floor but none were received.

Motion: That the slate of officers proposed be elected.

Moved by D.P. Fowler, seconded by G. Murray. Carried.

236. ADJOURNMENT

Motion: That members of the CTIA/ACAA thank the executive committee for a well-organized and thought-provoking meeting.

Moved by E.K. Morgenstern, seconded by G. Murray. Carried.

Motion: That the 20th business meeting of the CTIA/ACAA be adjourned.

Moved by N.K. Dhir, seconded by W.M. Cheliak. Carried.

Financial Statement, 1983-85 - Attachment #1

Canadian Tree Improvement Association/
Association Canadienne pour l'Amélioration des Arbres

August 20, 1985

Balance 17th August 1983	$5,125.58
Income (19th Meeting plus interest)	$8,403.01
Expenses	$4,254.11
Balance	$9,274.48

WOOD QUALITY WORKING GROUP - Attachment #2

Considering the interest in wood quality in Canadian tree improvement programs it would be desirable to create an organization through which communication can take place between tree improvement workers and wood scientists. The purpose of the organization would be to stimulate, support and coordinate wood quality activities in Canadian tree improvement programs. Specifically, the group would:

1. Serve as a source of technical information on wood quality required by tree improvement programs.

2. Standardize and coordinate methods of sampling and measuring wood quality characteristics in order to insure compatibility and comparability of measurements.

It is suggested that the logical form for this important national activity would be the Canadian Tree Improvement Association. It is hereby requested that a Wood Quality Working Group be established within the C.T.I.A. to carry out these proposed activities. The following individuals have agreed to serve as the initial executive body of the Wood Quality Working Group.

Chairman: Robert M. Kellogg, Forintek Canada Corp.
Vice-Chairman: Alvin Yanchuk, Alberta Forest Service
Secretary: Jean Poliquin, Laval University

R.M. Kellogg
20/8/85

POSTER SESSION ABSTRACTS

RÉSUMÉS DES AFFICHES PRÉSENTÉES À LA SÉANCE

POSTER SESSION - TITLES, AUTHORS & ABSTRACTS[1]

LE VERGER À GRAINES DE C.I.P. À HARRINGTON

M. Jacques Bégin
C.I.P. Inc. Montréal, Québec

En 1984, la compagnie C.I.P. Inc. inaugurait le premier verger à graines industriel au Québec. Le verger, d'une superficie de 50 ha, est établi sur une ancienne terre agricole dans le canton Harrington près de Lachute au Québec. La production du verger à maturité est estimée à 22 millions de semences annuellement. Elle comprendra de l'épinette noire et du pin gris ainsi qu'un volume appréciable de graines d'épinette de Norvège et d'épinette blanche.

L'emplacement du verger comprend également un arboretum pour chacune des essences principales soit l'épinette noire et le pin gris.

Des tests de famille pour chacune des essences indigènes sont établis dans la région où s'est effectuée la sélection des arbres-plus.

COLLECTION OF BRANCHES, CONES, AND FOLIAGE FROM TALL TREES IN NEW ENGLAND

Petr R. Brym and Robert T. Eckert
Department of Forest Resources
University of New Hampshire, Durham, N.H.

Forest tree needles, leaves, cones, or seeds are used for various purposes in forestry, including monitoring of pollution and pest damage, genetic population structure analysis, and tree propagation. The desired items can be easily obtained from tall trees in tree orchards with the help of specially equipped bucket trucks, but collections in natural stands in Northern New England are hampered by dense, multiple-species forests, and rocky topography. The following poster summarizes approximate costs, effectiveness, advantages, and limitations of eight methods that may be used to collect needles, leaves, or cones in mature forest stands under conditions encountered in New England. The cost estimates vary between regions and organizations, but the information should help in comparing approximate costs of the methods available to workers planning to collect foliage, cones, or branches from tall trees in unmanaged forest stands.

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[1]For more information, contact authors directly.

TEST DE RÉSISTANCE DU PIN GRIS À LA MALADIE DU CHANCRE SCLÉRODERRIEN

Bussières, G.*; Dessureault, M.*; Laflamme, G.**
*Université Laval
**Centre de recherches forestières des Laurentides

Nous testons la résistance de 38 provenances de Pinus banksiana Lamb. à la maladie du chancre sclèroderrien.

Le secteur expérimental se situe à environ 110 km au nord-ouest de Roberval, à la limite des régions forestières Laurentides-Onatchiway et Chibougamau-Natashquan. Les semis produits en récipients furent mis en terre au cours de l'été de 1983, dans un jeune peuplement de pin gris où la maladie était présente. Les plants sont établis dans un dispositif à bloc complet avec répétitions réparties au hazard.

Des branches infectées par Gremmeniella abietina (Lagerb.) Morelet ont été utilisées pour inoculer artificiellement les plants au printemps de 1984. le dénombrement des plants infectés permettra d'analyser et de vérifier l'existance de provenances résistantes à la maladie du chancre sclèroderrien.

PROGENY TEST OF PLUS-TREE SELECTION IN WHITE SPRUCE

Katherine Carter
Univ. of Maine, Orono, ME

Twenty-three superior trees of white spruce (Picea glauca (Moench) Voss) were selected in Maine and New Hampshire. Half-sib seedlots gathered from these mother trees in situ were grown in the nursery with "check" seedlots of nursery-run seedlings from the Maine and New Hampshire state nurseries. 3-0 seedlings were transplanted to a field site near moscow, Maine, in 1974. At age 14, the mean height of 21 out of the 23 selected families is greater than that of the check seedlots. Select families are on average 23% taller than the check trees.

SEED FLOTATION: FACT OR WISHFUL THINKING?

A. Lee Eavy
Univ. of Maine, Orono, ME

Seed flotation, using various fluids, is a common and easy technique for separating sound tree seed from empty or supposedly non-viable seed. Many small-seeded conifers, especially the northern species, are routinely separated in 95% ethyl alcohol (ETOH). Results presented here show that the seeds which sink are highly viable and usually comprise the majority of sound seed. However, a significant quantity of floating seed is also sound and germinates. Therefore, we feel this method is unreliable for the assessment of seed set rates and subsequent selfing ability determinations. As much as 55% of "floated" and supposedly inviable seed have been successfully germinated, and X-ray

results support these findings. X-ray analysis also shows that the ETOH flotation method is very successful at removing Megastigmus-infected seed from floated samples.

SOMATIC EMBRYOGENESIS IN PICEA ABIES (Norway spruce)

Inger Hakman, Sara von Arnold and Tage Eriksson
Institute of Physiological Botany
University of Uppsala
Box 540
S-751 Uppsala, Sweden

Immature zygotic embryos of Picea abies (L.) Karst. were cultured on defined media supplemented with 2,4-D and a cytokinin. Roughly three types of tissue cultures were established within one month. One of these was a translucent and friable white callus containing numerous polarized and organized cellular structures (somatic embryos) intermingled with more unorganized cell clusters. The organized structures consisted of long vacuolated cells extending from aggregates of smaller meristematic cells. The morphology of these organized structures resembled very much the morphology of zygotic embryos, with the two parts representing the suspensor with an embryonal mass of cells. Upon subculture the somatic embryos developed further into plantlets. In the beginning, the somatic embryos terminated in the long suspensor-like cells. Subsequently, the somatic embryos developed further and became seedling-like, with cotyledons, a hypocotyl and a root. Up to 25 plantlets could under suitable conditions be derived from a single callus, which also contained numerous somatic embryos of smaller size. Plantlet formation was followed both in living and sectioned materials and showed close similarity to zygotic embryogeny.

EUCALYPTUS VEGETATIVE PROPAGATION IN ARACRUZ

Yara Kiemi Ikemori
Aracruz Florestal S. A.
29190 - Aracruz - ES - Brazil

Grafting, rooted cutting and in vitro culture techniques have been studied and utilized, as means of propagating both pure species of Eucalyptus and hybrids, for different purposes.

Grafting techniques are utilized to propagate pure species within the long term breeding program, aiming for gene preservation and seed production.

Rooted cuttings are mainly used in propagating highly productive hybrids for routine plantation establishment.

In vitro culture is an alternative propagation technique where the rooted cuttings have been unsuccessful.

EVOLUTIVE STRATEGY OF THE RECONSTRUCTION OF FORESTS IN HEAVY AIR-POLLUTED REGION OF THE ORE MOUNTAINS (CZECHOSLOVAKIA)

K. Kanak
Forest and Game Management Institute
Arboretum Sofronka
Plzen

Power stations near the Ore mountains utilize lignite with a high level of sulphur causing an increased concentration of SO_2 in the atmosphere and resulting in a catastrophic die-back of forests in the zone over 800 m elevation. The greatest damage occurs to spruce, which forms over 90% of the local forests. Of the autochtonous species, only Pinus mugo, Betula spp., Sorbus aucuparia and the highland ecotype of Scots pine (Pinus silvestris) remain. In 1982, on both the Czech and the German side of the mountains, resistent individuals and groups of trees of introduced pine species (Pinus strobus, P. cembra, P. peuce, P. flexilis, P. nigra, P. contorta), aged 45 to 60 years, were located which had survived the spruce. They were not damaged by emissions nor by the poisoned soil and were producing seed.

These conditions enabled a long-term strategy to be developed for the reconstruction of local forests using the results of the catastrophe selection:

1) From all fertile groups of pines, seed is being collected for local reforestation.
2) From the most resistent trees, ramets are collected for clonal seed orchards or multiclonal plantations,
3) In the Sofronka (Plzen) arboretum, individuals of various provenances of resistent species are grafted to establish provenance clonal seed orchards and multiclonal plantations.

FACTORS AFFECTING THE MICROPROPAGATION OF CHESTNUT SPECIES IN VITRO

Roy N. Keys and Franklin C. Jech
West Virginia Univ., Morgantown, W.Y.

Various factors affecting the in vitro production of shoots of juvenile American (Castanea dentata (Marsh.) Borkh.) and hybrid chestnuts were studied. The multiplication rate of juvenile American chestnut was significantly better in a 16-hour rather than a 24-hour photoperiod and on solid (6 g/l agar) rather than liquid medium. A BAP concentration of 1.5×10^{-6} M is recommended for the shoot multiplication stage. Doubling the calcium content and lowering the pH (4.0) of the modified Murashige and Skoog medium (SMM) used for shoot multiplication was not beneficial for multiplication. Hybrid shoots grew well on the SMM medium and on a medium consisting of Greshoff and Doy major salts and Murashige and Skoog minor salts organics. There was a significant clonal effect with the hybrid shoot cultures. Mature American chestnut shoots also grew on the SMM medium, but the multiplication rate is lower than that of juvenile tissue, even after several subcultures.

Rooting of juvenile American and hybrid shoots was accomplished using indole-3-butyric acid (IBA) and the phenylated form of IBA. In a preliminary test, mature American chestnut shoots rooted a very low rate (20%) and only on phenyl indole-3-butyrate.

Tip necrosis occurred in the majority of rooted shoots in all three shoot types. Tests to determine the cause of this tip necrosis indicate that the two-week dark period used for rooting was the prime cause of the tip necrosis. The inability to successfully transfer plantlets to soil was attributed to the weakened condition of any green tips after this dark treatment.

METHOD OF INCREASING SEED PRODUCTION IN CONIFERS BY THE APPLICATION OF BIOREGULATORS

Csaba Matyas
OMNR - U. of T., Toronto

A method of inducing generative primordia in vegetative buds of Scots pine (Pinus sylvestris L.) was developed at the Waldsieversdorf Tree Breeding Centre of the Institute of Forest Science, Eberswalde (East Germany). The method, involving repeated spraying with bioregulators, aims to retard vegetative growth, induce generative (male or female) primordia, decrease the abortion rate and condition the vigour of the trees. The application dates are determined on the basis of developmental phenophases of buds and shoots, respectively.

The response depends on the exact timing of the application. Clones react differently, with increases in flowering ranging from 20 to 150 per cent. Operational application in Hungary resulted in an average increase of 55% of female flowering as compared to the control.

The technology is applied on an operational basis in Scots pine grafted seed orchards in the GDR and Hungary, and may be acquired on a licence from the Institute of Forest Science, Eberswalde. Trials to extend the application to other hard pines are under way in Hungary.

BIOCHEMICAL CHANGES DURING GERMINATION OF TAMARACK (LARIX LARICINA) SEEDS

J.A. Pitel & W.M. Cheliak
Petawawa National Forestry Institute, Chalk River, Ont.

Activities of six enzymes from extracts of separated embryos and gametophytes of Tamarack (Larix laricina (Du Roi) K. Koch) seeds were assayed at various stages of imbibition and germination. On a per seed part basis, activities of 6-phosphogluconate dehydrogenase (6-PGD), glucose-6-phosphate dehydrogenase (G-6-PD), malate dehydrogenase (NAD^+-MDH), isocitrate dehydrogenase ($NADP^+$-IDH), soluble peroxidase (PER) and acid phosphatase (ACP) from both the embryo and gametophyte tissues generally increased slowly following cold stratification for one month and imbibition under germinating conditions for 5 days, but then

increased at a faster rate with emergence of the radicle and subsequent growth of the seedling. The rate of increase of enzyme activity was highest for PER. Soluble protein levels also increased with imbibition and germination, with about three times greater levels present in the gametophyte than in the embryo. Heat inactivation experiments showed that except for G-6-PD, activities were stable up to 40°C. Inactivation occurred at lower temperatures for G-6-PD, while higher temperatures were required for PER. Incubation of extracts for 7 days at 4°C indicated that loss of enzyme activity was greatest for G-6-PD (3.9% remaining) and least for PER and ACP (93.7% and 95.1% remaining, respectively).

AMÉLIORATION GÉNÉTIQUE DE L'AULNE: HYBRIDATION INTERSPÉCIFIQUE

Daniel Prat
École nationale du génie rural des eaux et des forêts
Nancy, France

Le genre Alnus comporte environ 30 espèces réparties surtout dans l'hémisphère nord. De nombreaux croisements interspécifiques sont possibles même entre espèces de sections ou de sous-genres différents. Les espèces intéressantes pour la France (A. glutinosa, A. cordata, A. rubra et A. incana) font l'objet de croisements interspécifiques contrôlés. Plus de 500 croisements ont été réalisés sur 20 arbres et plus de 150 lots de pollen différents. Les graines de chaque croisement sont récoltées et semées; le succès du croisement n'est appréciable que lors de la germination. Les autofécondations sont infructueuses. Il apparaît que certains croisements interspécifiques sont plus difficiles à réaliser que d'autres et que les effets individuels et/ou réciproques sont importants. Ceci peut être dû en partie au décalage phénologique entre les différentes espèces. La production du pollen doit être forcée à avancer ou à ralentir pour des durées variables selon le croisement considéré.

Le suivi des plants au cours de leurs trois premières années sur deux stations différentes (terrain hydromorphe, terrain sec à calcaire superficiel) montre un bon comportement des hybrides interspécifiques (A. cordata x A. inca sur les terrains sec et hydromorphe, et A. rubra x A. glutinosa et A. glutinosa x A. incana sur le terrain hydromorphe). Dans chaque station, certains plants hybrides ont une croissance plus forte que les plants des espèces pures associées.

Le taux de succès souvent faible des croisements (0,1 à 15,0 plants obtenus par strobile récolté) et la variabilité des descendances amènent à sélectionner les individus les plus performants et à les multiplier végétativement pour les diffuser sous forme de variétés clonales à l'issue de tests clonaux. Les études s'orientent également vers l'étude de la diversité génétique de diverses espèces d'aulne afin de guider la sélection des géniteurs.

POLLINATION AND SEED QUALITY IN YOUNG PLANTATIONS OF LARIX LARICINA

Kathleen J. Tosh
Univ. of New Brunswick, Fredericton, N.B.

Tamarack (Larix laricina (Du Roi) K. Koch) is one of four tree species included in the New Brunswick Tree Improvement Program. To meet the demands for reforestation, the procurement of good quality seeds on a regular basis is necessary and seed orchards are being established throughout New Brunswick for this purpose. This study was initiated in 1983 to identify factors that may be affecting seed set in young seed orchards. Three plantations of tamarack, established in 1978, on three sites at the Provincial Forest Nursery at Kingsclear NB, were used.

One of the main objectives was to relate pollen production to the success of seed production over a two-year period. Estimates of pollen production and dispersal patterns were made from pollen traps in 1983 and 1984. Pollen shedding occurred during the last part of April and early May in both years. The period of peak pollen shedding lasted 3 to 7 days and was closely associated with the weather conditions. The amount of pollen shed increased significantly in 1984 and was more frequently caught on the west side of pollen traps. Seed-cone receptivity and peak pollen shedding were synchronized.

Seed cones were collected at the end of August in 1983 and 1984, from each plantation. The seed cones were dissected, measured, and the seeds extracted. The mean number of full seeds increased significantly in 1984. The increase in seed quality was directly attributable to the increase in pollen availability. It can be estimated that the total full seed for the 90 trees assessed was 103,860 in 1983 and 492,660 in 1984.

UTILISATION DU PILODYN POUR ÉVALUER LA DENSITÉ DU BOIS DANS DES TESTS DE DESCENDANCE

Michel Villeneuve
Univ. of New Brunswick, Fredericton, N.B.

Le classement de familles de pins gris en fonction de la densité du bois a été fait à l'aide du Pilodyn. La corrélation entre la densité du bois juvénile et celle du bois mature était suffisante vers l'âge de 15 ans. L'échantillonnage de 2 ou 3 arbres par parcelle dans 5 ou 6 répétitions d'un seul test de descendance donnerait une estimation fiable de la densité moyenne d'une famille.

OPTIMIZATION OF SHOOT FORMATION BY EMBRYONIC EXPLANTS OF *PINUS STROBUS* L. *IN VITRO*

D.T. Webb & B. Flinn
Dept. of Biology
Queen's Univ., Kingston, Ont.

Horizontally oriented *Pinus strobus* embryos produced shoots on SH medium containing cytokinin. Benzylaminopurine (BA) and 2-isoepentyladenine (2iP) induced caulogenesis, but BA was more potent. Shoots developed principally from swollen-yellow cotyledons. The duration of BA exposure did not significantly alter the final shoot number, but longer exposures led to more callus formation. A 2-4 week exposure was near-optimal for whole embryos. Contrary to prior results (Minocha, 1980) a cytokinin was required for caulogenesis, and neither auxins nor triiodobenzoic acid induced or markedly enhanced shoot formation. Seed preincubations at 5° or 27°C did not affect caulogenesis, but cotyledons from cultured embryos were more caulogenic than those isolated from seeds hydrated overnight. Upside-down embryo orientation increased the uniformity of the caulogenic response by whole embryos and reduced the BA-exposure time to 7 days. Cotyledons from UD embryos performed better than those from hydrated seeds. Timing experiments showed that a 50% response was achieved by cotyledons after 5 days exposure to BA. SH medium was superior to MS medium for shoot induction. The macronutrients accounted for this difference, and NH_4 was the controlling factor.

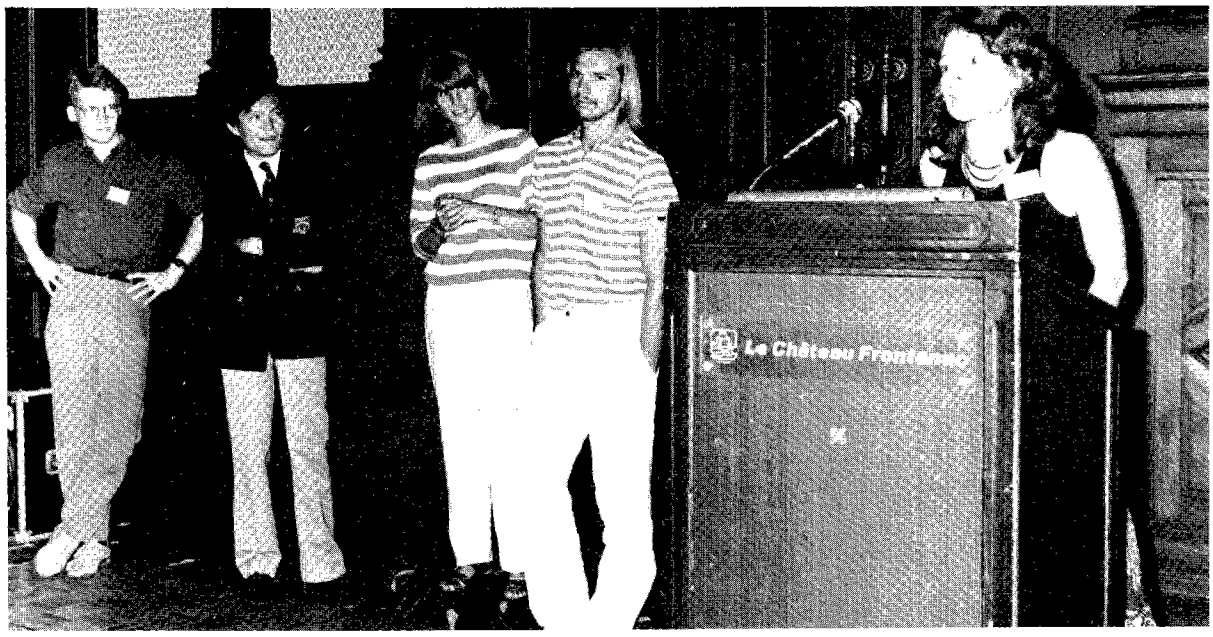
JACK PINE SEED ORCHARD RESEARCH

C.W. Yeatman, T.C. Nieman, and P. Copis
Petawawa National Forestry Institute, Chalk River, Ont.

A model breeding population of jack pine (*Pinus banksiana* Lamb.) was initiated in 1978 in cooperation with the Ontario Ministry of Natural Resources, Algonquin District. The population will provide fully pedigreed seed and trees for advanced-generation research and will quantify gains achieved by pursuing alternative procedures in selection, breeding and seed production within seedling and clonal orchards of jack pine.

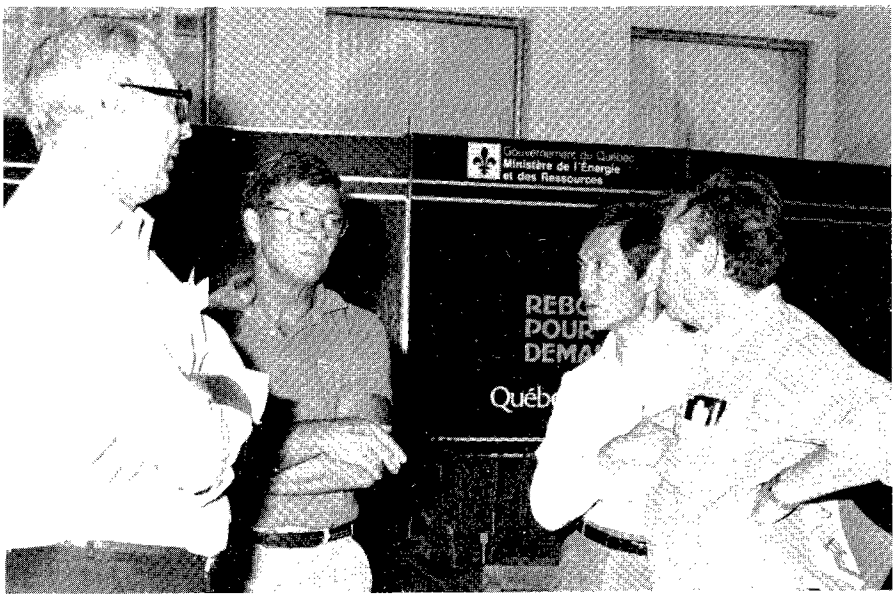
SYMPOSIUM, BANQUET AND FIELD TOURS - PHOTOS

SYMPOSIUM, BANQUET ET TOURS DES LIEUX - PHOTOS



Francis Yeh, président du comité d'éducation (deuxième à gauche), et les étudiants Adalsteinn Sigurgeirsson (Univ. de l'Alb.), Beth Beatson (Univ. de Toronto) et Dave Coletelo (Univ. du N.-B.) écoutent Catherine Beale (univ. de la C.-B.) qui remercie l'A.C.A.A. de l'occasion d'assister au symposium.

Francis Yeh, chairman of the education committee (second left), together with students Adalsteinn Sigurgeirsson (U of A), Beth Beatson (U of T) and Dave Coletelo (UNB) listen to Catherine Beale (UBC) thanking the CTIA for the opportunity to attend the symposium.



Bob Ackerman, Don Fowler, Francis Yeh, Stan Krugman - Des intellectuels peuvent-ils communiquer sans not dire?

- great minds apparently in speechless communication-thought control?

Les affiches donnent matière à discussion. Gordon Murray, Cathy Carter, Gilles Vallée, John Genys et d'autres participants resoulvent quelques problèmes.

Posters generated much discussion. Here, Gordon Murray, Cathy Carter, Gilles Vallée, John Genys and others come to grips with some problems.

Bob Bourchier et Dianne Roddy présentent leurs idées à un auditoire attentif, y compris Willard Fogal, Jerry Klein et Bob Ackerman.

Bob Bourchier and Dianne Roddy expand their views to attentive audiences, including Willard Fogal, Jerry Klein and Bob Ackerman.

TOUR 1: JEUDI LE 22 AOÛT 1985/THURSDAY, AUGUST 22, 1985

Visite des laboratoires de biotechnologie forestière et de technologie du bois de la Faculté de foresterie et de géodésie de l'Université Laval.

Visit to the forest biotechnology and wood technology laboratories of the Faculty of Forestry and Land Surveying of Laval University.

Visite de Laboratoires des biotechnologie forestière à la Faculté de foresterie et de géodésie de l'Université Laval; Dr. Lalonde explique les travaux en cours.

Visit to forest technology laboratories at the Faculty of Forestry and Land Surveying of Laval University; Dr. Lalonde explaining current research.

TOUR 2: VISITE DU POPULETUM DE VILLEROY ET DE L'ARBORETUM DE LOTBINIÈRE
JEUDI LE 22 AOÛT 1985

- Visite du populetum de Villeroy

  Test n° 2 Test de provenance-descendance de Populus deltoides de la vallée du Saint-Laurent (D 80-72-75).

  Test n° 8 Test de provenance avec Populus trichopcarpa (D 475-76).

- Visite de l'arboretum de Lotbinière

  Test n° 65 Essai de 125 clones de peuplier pour la production de biomasse sur de courtes rotations (2 à 4 ans) (D 568-88).

  Test n° 18 Essai de 13 provenances de Larix laricina comprenant respectivement 4, 2 et 1 provenances de Larix decidua, L. Leptolepis et L. sibirica (D 252-74).

  Test n° 17 Test de descendance comprenant respectivement 36, 7 et 3 demifratries de Larix decidua, L. laricina et L. leptolepis (D 251-74).

  Test n° 30 Test de provenance de Pseudotsuga menziesii (D 380-75).

  Test n° 42 Verger à graines de mélèzes comprenant des demi-fratries de mélèzes sélectionnés d'Europe, du Japon et laricin (D 457-76).

  Test n° 62 Test de provenance sur le pin de Murray (Pinus contorta var. latifolia) (D 570-80).

  Test n° 52 Test de 71 provenances de Larix laricina comprenant 8 provenances de 6 espèces exotiques de Larix (D 512-77).

  Test n° 21 Test de 180 clones de peuplier. Test clonal de deuxième génération (D 341-74).

  Test n° 87 Plantation de démonstration de 77 clones de peuplier en test clonal de troisièeme génération (D 689-84).

TOUR 2: VISIT TO THE VILLEROY POPULETUM AND THE LOTBINIÈRE ARBORETUM
THURSDAY, 22 AUGUST 1985

- Visit to the Villeroy Populetum

  Trial 2 — Progeny-provenance trial of Populus deltoides from St. Lawrence Valley (D 80-72-75).

  Trial 8 — Provenance trial of Populus trichocarpa (D 475-76).

- Visit to the Lotbinière Arboretum

  Trial 65 — Trial of 125 poplar clones for biomass production on short rotations (2 to 4 years) (D 568-80).

  Trial 18 — Trial of 13 provenances of Larix laricina including, respectively, 4, 2 and 1 provenances of Larix decidua, L. leptolepis and L. sibirica (D 252-74).

  Trial 17 — Progeny test including, respectively, 36, 7 and 3 half-sib families of Larix decidua, L. laricina and L. leptolepis (D 251-74).

  Trial 30 — Provenance trial of Pseudotsuga menziesii (D 380-75).

  Trial 42 — Larch seed orchard including half-sib families of selected European larch, Japanese larch and tamarack (D 457-76).

  Trial 62 — Provenance trial of lodgepole pine (Pinus contorta var. latifolia) (D 570-80).

  Trial 52 — Trial of 71 Larix laricina provenances including 8 provenance of 6 exotic Larix species (D 512-77).

  Trial 21 — Trial of 180 poplar clones: second generation of clonal trials (D 341-74).

  Trial 87 — Demonstration plantation of 77 poplar clones of the third generation of clonal trials (D 689-84).

Groupe du tour 2 devant un essai de 125 clones de peupliers évalués pour leur rendement en biomasse.

The group on tour number 2 in front of a test on 125 poplar clones under evaluation for their biomass yield.

A. Stipanicic décrit un test de provenance du mélèze laricin effectué à l'arboretum Lotbinière.

A. Stipanicic giving an explanation of a tamarack provenance trial at Lotbinière arboretum.

TOUR 3: VISITE DES EXPÉRIENCES DE GÉNÉTIQUE FORESTIÈRE ET D'AMÉLIORATION DES ARBRES À LA STATION D'EXPÉRIMENTATION FORESTIÈRE DE VALCARTIER

Lunch à la Station de Valcartier - Bref historique.

Arrêt 1 Génétique et amélioration du pin blanc.

Arrêt 2 Transfert aux utilisateurs du matériel de qualité génétique supérieure.

Arrêt 3 Étude de la variabilité génétique des épinettes.

- Hybrides géographiques d'épinette blanche
- Essai de provenances d'épicea commun d'Europe de l'Est
- Essai de provenances d'épicea commun de Roumanie et de Tchécoslovaquie
- Banque clonale multiprovenances d'épinette noire
- Essai transdomanial de provenances d'épinette rouge
- Test comparatif du complexe épinette blanche X épinette de Sitka
- Test de descendances d'épinette blanche

TOUR 3: VISIT OF THE FOREST GENETICS AND TREE BREEDING EXPERIMENTS AT VALCARTIER FOREST EXPERIMENT STATION

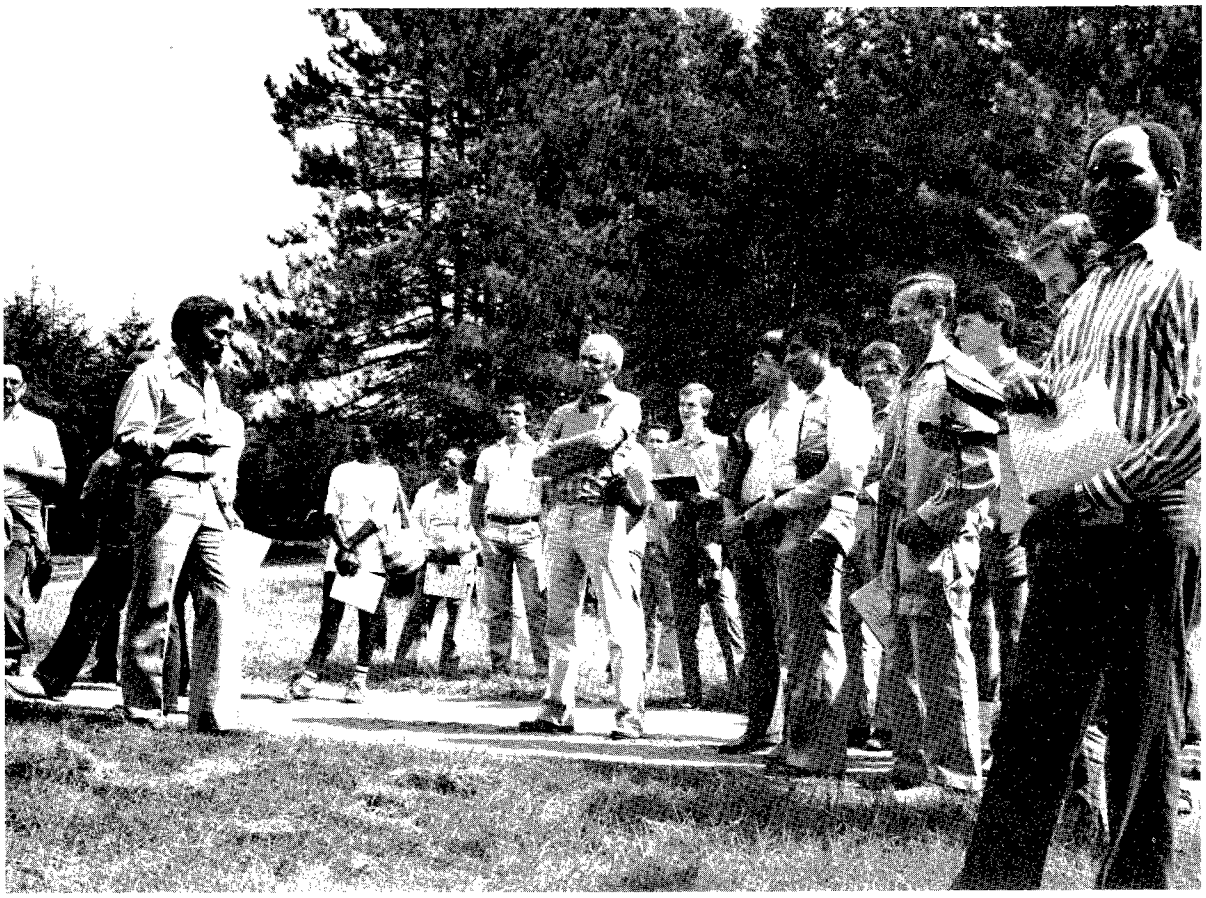
Lunch at Valcartier F.E.S. - Brief historic notes.

Stop 1 Gentics and improvement of Eastern white pine.

Stop 2 Transfer to users of material of superior genetic quality.

Stop 3 Study of the genetic variability of spruces.

- White spruce geographic hybrids
- Provenance trial of Norway spruce from Eastern Europe
- Provenance trial of Norway spruce from Romania and Czechoslovakia
- Black spruce multiprovenance clone bank
- Range-wide red spruce provenance trial
- Comparative test of white x Sitka spruce complex
- White spruce progeny test



Groupe du tour 3 écoutant attentivement les explications de Dr. A. Corriveau.

The group on tour number 3 listening to explanations from Dr. A. Corriveau.

NOTES FOR A SPEECH AT THE CLOSING BANQUET OF THE TWENTIETH MEETING OF THE CANADIAN TREE IMPROVEMENT ASSOCIATION, CHATEAU FRONTENAC, QUEBEC, AUGUST 21, 1985

Mr. Jean-Pierre Jolivet

Minister responsible for forests,
Ministère de l'énergie et des ressources,
Gouvernement du Québec

To begin with, I would like to thank Mr. Armand Corriveau, President of the Canadian Tree Improvement Association. I was very happy to accept his invitation to speak at your convention. Its theme, "New Avenues in Forest Genetics" ties in well with the government's objective of "Building a Forest for the Future".

Indeed, both these themes, and both these objectives, are part of the same vision of the future, and your convention here in Quebec City coincides with the beginning of a period of change in which all tree improvement specialists are called to play an important role.

Québec is a land of forests. The forest section of the ministère de l'Energie et des Ressources, for which I am responsible, manages the vast resources of the public forests and encourages the development of private resources and of the forest industry. As such, it is a major force in Québec's forest sector. Consequently, the new forestry policy which I made public last June 11 is a significant event for the entire forestry sector in Québec. I will therefore take a few minutes to outline the major thrusts of the new policy.

Based on its analysis of the forest sector's problems, the gouvernement du Québec has formulated an action program featuring five major elements:

- protection of the intended production use of the forest territory;
- changes in the way the public forests are managed;
- production from private forest property;
- joint action to adapt the structure of the processing industry to the characteristics of Québec's forests, and
- direction of research and development activities towards these.

To begin with, the forest generates several resources and supports various activities which contribute to the quality of life in Québec. Forest areas must be utilized in a rational way that is consistent with respective potentials and conforms to a master plan that will enable the entire community to draw maximum benefits from the forest.

The commitment requires that all the agents involved make whatever efforts are needed to recognize, protect and improve the various resources, while at the same time being conscious of the ecological diversity of Québec's forests.

From the economic standpoint, wood is without doubt the most important resource produced by the forestry world. The new policy specifies that from now, forest resources, public and private, will be managed and utilized on a sustained yield basis. This implies significant changes compared to the way public forests have been managed.

Another significant aspect of the orientation of the new forestry policy is the recognition that research is an essential tool for improving and managing the resource so that a bright future is ensured for Québec's forest sector. The government will make a significant effort to support an active and dynamic research program within both the public administration and other research organizations. In addition to these efforts, particular attention will be paid to disseminating research results, so that the scientific and technical information gained is used as fully as possible.

These few elements give you a very general idea of the major thrusts of the new forestry policy.

I would now like to deal in greater detail with an aspect which, I am sure, interests all of you: restoring cutover or damaged areas to production.

Under the new policy, it is now mandatory that forest operators provide for the regeneration of areas they have harvested, using artificial reforestation if necessary. In addition, the Ministry is committed to restoring normal yield levels to areas which are currently unproductive, as a result of past harvesting or damage. There again, reforestation will be necessary in a good number of areas. To put it briefly, there will be no harvesting without regeneration.

In this regard, the reforestation program is an essential component of the forestry policy. Beginning in 1988, the program calls for 300 million saplings to be planted each year. This is an ambitious project, with significant consequences both from an economic and a forestry standpoint, and will generate activities such as the production of seeds, production of saplings using different techniques, and ground preparation.

The government has decided to be responsible for the production of all the saplings needed for reforestation, both in public and private forests. Since reforestation is so important for the future of the forest sector, and in view of the costs involved, the government is thus ensured of obtaining saplings of the highest possible quality.

The program covering the establishment of seed orchards to provide seeds of the required quality will be stepped up considerably. Whereas 7 or 8 years ago, there were practically no orchards, there are now a little more than 300 hectares established and the objective is 1 900 hectares by the end of the decade.

In addition, since two-thirds of the saplings will be produced by private producers or forest companies, the program's success also depends on adequate transfer of knowledge and technology. The concrete involvement of industry and private property owners in the production of seedlings and particularly in establishing and maintaining plantations, the financial participation of the federal government and on-going consultation among the various agents involved in the forest sector, are all vital elements for the program's success.

Before I conclude, allow me to emphasize that the gouvernement du Québec is giving a high priority to research into improving the genetic qualities of seedlings. In cooperation with other research organizations, the forestry genetics section of the Service de la recherche of the ministère de l'Energie et des Ressources has undertaken research projects and experiments in the genetic improvement of forest trees. Some 650 plantation installations comparing species, provenances, progeny and clones as well as installations for the introduction of species, have been put into operation. A network of 21 experimental sectors for the improvement of forest trees is the key element in the operation of the comparative plantations. In addition, 31 special sectors have been created to meet particular needs.

The Service de la recherche is also undertaking research projects into advanced techniques such as propagation by cuttings and IN VITRO culture.

Finally, in a field as specialized as forestry genetics, attention must be paid to communication between researchers and diffusion of scientific and technical information gained. In addition to more research, the new forestry policy suggests that a cooperative organization be formed which would bring together all those interested by work being done in the genetic improvement of trees.

I trust that this 20th meeting has been fruitful for all of you and I hope that you will continue your work so that the quality of our forest resources will improve in the years to come.

Thank you for your invitation.

NOTES POUR UNE ALLOCUTION LORS DE LA 20E RENCONTRE BIENNALE DE L'ASSOCIATION CANADIENNE POUR L'AMÉLIORATION DES ARBRES, UNIVERSITÉ LAVAL (QUÉBEC), LE 20 AOÛT, 1985

M. Jean-Claude Mercier

Sous-ministre associé (Forêts),
Gouvernement du Canada

Mesdames et Messieurs,

Il me fait plaisir de prendre la parole aujourd'hui à l'occasion de la vigtième rencontre biennale de l'Association canadienne pour l'amélioration des arbres (ACAA).

I am very pleased to be representing the honourable Gerald Merithew, Minister of State, Forestry, and the Canadian Forestry Service. Since the federal election in 1984, the government has done many things to advance and enhance the forestry sector in Canada. For example, the CFS now enjoys a status within the government that it has not had in the past twenty years. And the CFS has actually undergone it's first expansion in the last fifteen years, resulting from new responsibilities in the negotiation and management of federal-provincial agreements. These agreements are now in place for all provinces except Newfoundland and that one is now being considered. Another new activity is that of job creation programs in forestry.

La plupart d'entre vous savez que le Service canadien des forêts est le symbole de la recherche forestière au Canada: un organisme réputé pour sa stabilité, son intégrité de même que la qualité de ses programmes de recherche. Au cours des dernières années, plusieurs facteurs ont réduit la capacité du Service canadien des forêts à régler efficacement les problèmes rattachés à la recherche forestière de même que ceux touchant le transfert des connaissances techniques. Il s'avère plus important que jamais que la recherche scientifique soit entreprise avec l'objectif de bénéficier tant au secteur public que privé. À cet effet, nous faison en sorte que toutes les ententes fédérales-provinciales appuient les efforts de recherche et que la diffusion des résultats de ces recherches contribue à l'aménagement forestier.

L'objectif primordial de ces programmes de recherche découle de l'importance que revêt la ressource forestière pour le Canada, aussi bien du point de vue social qu'économique. Si nous voulons assurer un avenir prospère à l'industrie forestière, il nous incombe dès aujourd'hui de régénérer et d'administrer adéquatement la totalité de nos terres

forestières disponibles. D'autre part, nous devons reconnaître qu'il est notre responsabilité de voir à la protection, à la promotion et à la sauvegarde de notre richesse forestière pour bon nombre d'autres motifs.

C'est en tenant compte des diverses parties intéressées que les gestionnaires de la ressources forestière reconnaissent l'importance d'accroître le rendement de nos forêts de façon à suffire aux besoins d'approvisionnements compte tenu des terres consacrées à cette fin.

Canadian foresters are looking to tree breeding, genetics and tree improvement as a major means of accomplishing this goal. Traditionally, tree breeding has been a relatively slow process, particularly when dealing with our northern boreal conifers. Nevertheless, research by CFS scientists and by colleagues with other agencies, in effect, you, the members of the CTIA, is starting to show dividends. For example, all provinces now have identified seed zones and regulations for seed transfer as a result of provenance trials conducted by tree breeders. While this may sound quite elementary now, it is only a few years ago that seed zones became normal operating procedure.

Also, some other very important findings have derived from these long-term provenance trials. I am thinking especially of the identification of the Upper Ottawa Valley seed sources providing superior seed for growing white spruce in eastern Canada; the identification of the Baskatong source of jack pine which is resistant to scleroderris canker; and the identification of lodgepole pine as being particularly susceptible to sweet fern blister rust when moved to jack pine sites in eastern Canada. As a result of this latter finding, the transport and planting of lodgepole pine seed and seedlings into eastern Canada will be restricted under the tree seed regulations of the seeds act, which is expected to be enacted by the end of this year.

Comme je l'ai mentionné plus tôt, je crois qu'il est essentiel que les résultats en recherche forestière puissent être mis en application. Il me fait plaisir de constater que les spécialistes en amélioration des arbres font figure de pionniers dans ce domaine. Par l'entremise des rencontres de l'Association canadienne pour l,amélioration des arbres et par leurs études, les activités de recherche en amélioration génétique des arbres et leurs résultats sont mis à la disposition des techniciens forestiers, des spécialistes en amélioration des arbres ainsi que des gestionnaires forestiers.

D'autre part, la communauté scientifique a participé à la formation de coopératives fédérales-provinciales et industrielles chargées de l'amélioration des arbres, dont le rôle est de mettre sur pied des vergers à graines et des stratégies de gestion de récoltes de graines pour ses membres en utilisant les connaissances scientifiques les plus avancées. De telles coopératives sont maintenant en voie de réalisation en Colombie-Britannique, au Nouveau-Brunswick, en Nouvelle-Écosse et plus récemment en Ontario.

Il me fait plaisir de souligner que les programmes pour l'amélioration des arbres ont reçu une attention particulière dans le cadre de la signature des ententes fédérales-provinciales avec le Manitoba et le Québec. À titre d'exemple, je tiens à souligner le travail de M. Klein, un chercheur du Service canadien des forêts au Manitoba, qui est responsable de l'établissement des vergers à graine qui utilisent du pine gris supérieur pour la reproduction. On prévoit que ce travail d'amélioration des arbres produira un taux de croissance jusqu'à 20 % supérieur à la normale.

Il en est de même pour le Québec où la nécessité d'utiliser du matériel de qualité supérieure pour l'aménagement forestier a été stipulée dans l'entente auxiliaire Canada-Québec sur le développement forestier. Par ailleurs, le ministère de l'Énergie et des Ressources du Québec a réitéré l'importance de ce genre de recherches dans la publication de sa politique forestière rendue publique récemment.

Le gouvernement du Québec se propose entre autres d'établir un organisme dont le but serait de faire avancer la recherche et le développement en matière d'amélioration des arbres. Le Québec considère que l'amélioration des arbres est essentielle si les objectifs de l'aménagement forestier doivent être réalisés tant sur les terres publiques que privées. Le gouvernement fédéral, de même que l'industrie forestière et les universités, seront invités à participer à ce projet.

During the past 10 years, CFS scientists and tree breeders in general have been attempting to develop methods of growing seedlings and trees faster for testing purposes as a means of screening genetic crosses, breeding for resistance and other factors. This work has resulted in the development of many new techniques such as the application of gibberellins and other methods to stimulate cone production, the rooting of coniferous cuttings, the growth of seedlings from embryonic tissue and the development of isozyme analysis as a means of identifying genetic integrity. Research into these genetic methods has provided very powerful tools to promote seed and seedling production.

Also, these developments have heralded the age of biotechnology, the buzzword of the 1980s. Ironically, the CFS initiated this type of research in the 1960s and it was considered too basic and too radical to be continued.

Canadian tree breeders and forest scientists have been at the vanguard of biotechnology for several years. And I believe that the CFS has a vital role to play in its future. Already the CFS has programs launched in micropropagation, genome analysis and quantitative genetics at the Petawawa National Forestry Institute, embryonic tissue culture at the Maritimes Forest Research Centre and vegetation propagation at the Laurentian Forest Research Centre.

In addition, CFS scientists have established close links with the National Research Council of Canada and several Canadian universities to enable sharing of facilities, training in methodology and joint research studies. And, this summer, the first steps have been taken for

CFS scientists to work with ten other nations in biotechnology for the breeding of fast-growing hardwood species under the auspices of the International Energy Agency. As the lead CFS establishment in this field, the Petawawa National Forestry Institute has expanded its scientific expertise and has expanded its provenance research and nitrogen fixation studies to complement the new thrusts in biotechnology that are commencing.

Ces réalisations ne sont que quelques-unes des recherches effectuées dans le domaine. Ainsi, les chercheurs du Centre de recherches forestières du Pacifique étudient dans quelle mesure la biotechnologie peut être utilisée pour résoudre le problème de la rouille vésiculeuse du pin blanc. Par ailleurs, tandis que plusieurs chercheurs etudient les moyens d'améliorer nos forêts par le biais de la technologie et de l'amélioration des arbres, d'autres voient à ce que ces recerches garantissent l'intégrité et la qualité de nos forêts. Je tiens à mentionner qu'en sa qualité de participant au programme de l'OCDE (Organisation de coopération et de développement économique) du commerce international des graines et des plantes, le Service canadien des forêts a enregistré au nom du Canada trois vergers à graines de la Colombie-Britannique.

En terminant, je tiens à vous réitérer mon appréciation pour votre aimable invitation à vous adresser la parole. Le Service canadien des forêts est optimiste quant à l'avenir de la ressource forestière canadienne et je compte sur la participation de nos chercheurs et de leurs collègues de l'Association canadienne pour l'amélioration des arbres (ACAA) en vue d'augmenter le rendement et la qualité de la matière ligneuse.

Ces efforts de recherche constituent une étape importante dans la revalorisation de notre richesse forestière.

Merci.

TREE IMPROVEMENT IN NEWFOUNDLAND AND LABRADOR
A PROGRESS REPORT

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Keywords: Plus-tree selection, progeny tests, exotics, arboretum, seed orchards, seed-production areas, provenance trials.

In 1983, this member's report was titled "Tree Improvement in Newfoundland and Labrador -- A Future Outlook" (Harrison 1984). In that report, it was pointed out that the Provincial Government first became involved in tree improvement in 1979, when the Newfoundland and Labrador Tree Improvement Working Group was formed. A further commitment was made in 1982 when the Province hired a full-time forest geneticist. A number of approaches, which the Province planned to follow over the next several years, were discussed. This paper reports the progress made in the various areas of the improvement over the past two years.

SEED PRODUCTION AREAS

A white spruce (Picea glauca (Moench) Voss) seed production area (s.p.a.) at Grand Lake, in the vicinity of Corner Brook, has been thinned and rogued, and cultural treatments are ongoing. The stand is about 30 years old, and some seed was collected in 1984. This s.p.a. should be in full production by 1990, and should supply the needs of western Newfoundland until genetically improved seed is available from clonal orchards. A similar stand at Frenchman's Pond, southwest of Grand Falls, has been treated to serve as the white spruce s.p.a. for central Newfoundland. Maintenance and cultural work is proceeding on the black spruce (P. mariana (Mill.) B.S.P.) s.p.a. at Carmanville, and larch (Larix laricina (Du Roi) K. Koch) stands near Millertown and Taylor Brook have been tentatively selected as s.p.a.'s.

PLUS-TREE SELECTION

In 1984, a concerted effort was made to locate white spruce plus trees. Seventy were located, counting about 30 that had previously been selected. Ten black spruce and ten larch plus trees have also been

selected. The goal is to have at least 100 of each of these three species. We hope to attain that figure with white spruce and increase the numbers of the other two species significantly in 1985. The bulk of our plus trees are in the central region, but we have also carried out selections in Labrador, the northern peninsula, western and eastern Newfoundland. So far, response to the public participation program has been minimal, but new approaches are being considered.

PROGENY TESTS

After the CTIA meeting in 1983, the author visited various plantations and installations in Québec, and obtained, from Roger Beaudoin of the Ministère de l'énergie et des ressources du Québec, seed from 59 of Québec's black spruce plus trees. These were germinated in the winter of 1983-84, and, after two seasons of greenhouse growth, are to be planted out in progeny tests this summer. The tests will be replicated in the St. George's and Springdale areas, and at a site east of Grand Falls. Each replication will consist of 10 blocks, with each family, plus a Newfoundland source, being represented in each block by a four-tree linear plot. The reason for this design is to facilitate later use of the tests as seedling seed orchards, if these families prove also to be superior in Newfoundland. This approach was adopted because of the impoverished gene pool of Newfoundland spruce and the scarcity of black spruce stands in the 20 to 60 year-old age range, which is the best range for selecting black spruce plus trees.

Seed from our own white spruce plus trees, with a handful of exceptions, were collected in the autumn of 1984. These were germinated in the winter of 1984-85, and, like the Québec black spruce families, will be planted according to the same design, for the same reason. Seed will be collected annually from as many plus trees as possible, and additional progeny tests will be established when seed from sufficient numbers of plus trees of each species is available.

Progeny of selected Ottawa Valley, Ontario, trees will be tested along with that of the Newfoundland white spruce plus trees. Again, the reason is to see if the introduction of genetic material from superior trees outside the province will contribute to our overall genetic improvement programme in that species.

PROVENANCE TRIALS

An all-range provenance trial of Populus trichocarpa Torr. & Gray, located at Villeroy Populetum, Québec, has been replicated at Johnson's Lookout, near Springdale. Cuttings from all trees at Villeroy were obtained from Gilles Vallée in May, 1984, and planted the same month. A 10% sample count in late October, 1984, indicated that 88% had taken root, but 4% subsequently died. Another 13% had sustained frost damage to the growing shoots, leaving 61% apparently healthy with frost damage, if any, limited to the leaves. A full count will be made in the summer of

1985. A new all-range white spruce provenance trial, including more Newfoundland sources than the one established 26 years ago, is in the planning stage.

THE PROVINCIAL ARBORETUM

An arboretum, about 5 ha in extent, is now being established adjacent to the Provincial Tree Nursery at Wooddale. It will consist of two divisions - viz. the exotic division and the genetic division. In the exotic division a small number of individuals of as many species as possible will be planted. Despite the name "exotic division", native species will be present alongside exotic species of the same genus for comparison purposes. Generally speaking, the species will be grouped taxonomically, but exceptions will be made in the case of, for example, those that require special treatment, such as liming. A limited number of warm-climate species, such as Pinus elliottii Engelm. and Acacia melanoxylon Mill., will be located in a display greenhouse, which will be part of the arboretum.

The genetic division will be a repository of all genotypes which we wish to preserve for whatever reason. For example, a ramet of each plus tree will be stored there in case we lose both the original and all ramets in clonal orchards to fire, or another catastrophe. A special section of the genetic division will be the freak gardens, in which genetic aberrants encountered in the nursery or in the field will be planted.

The arboretum will serve several purposes, among which will be educational and scientific aspects. The arboretum will be open to schools, conservation groups, scientists, and individuals who wish to learn more about the trees of the world and tree breeding. A by-product of this will be better public relations. Another benefit will be convenience, in that it will enable our own scientists and those of Canadian Forestry Service to experiment with and to compare material, without travelling to distant parts of the province or even outside the province. Also, only a limited number of exotic species can be tested in formal species trials. Occasionally, a species could surprise us with its performance under Newfoundland conditions. The exotic division will give scores of species a chance to indicate potential, after which larger trials may be established. For example, the great potential of Pinus radiata D. Don for South Africa was discovered by just such a planting of a few specimens near Cape Town, in 1877 (Immelman et al, 1973).

Seed lots of 66 species of exotics were obtained from Petawawa National Forestry Institute, earlier this year. More than one variety of some species were included. These, along with a few other species, seed of which was already available, are now being raised in the greenhouse at Wooddale for planting in the arboretum. Approximately 85 exotic species will be planted in the initial establishment of the arboretum.

EXOTIC SPECIES TRIALS

Besides the Populus trichocarpa provenance trial, a poplar trial was established near Flat Rock, north of St. John's, involving 97 clones of various species and cultivars. Cuttings (5 per clone) were obtained from Lotbinière Arboretum in Québec. Based upon a winter observation in January, 1985, an 80% take was estimated. A full enumeration will be undertaken in the summer or early autumn of 1985.

Several new trials of Japanese larch (Larix leptolepis (Sieb. and Zucc.) Endl.) have been established in various parts of the province. This species has shown promise in several trials in the past. One of the new trials is a 1 km^2 plantation designed to determine how the species will perform in a pure-stand forest situation, as opposed to small blocks.

Jack pine (Pinus banksiana Lamb.) and lodgepole pine (P. contorta Dougl.) from selected provenances are being grown in the provincial nursery at Goose Bay for trials in Labrador. Siberian larch (Larix sibirica Ledeb.) will also be tried in Labrador, as well as on the island. However, past trials on the island have not been particularly promising. Other exotic species now undergoing initial trials are red alder (Alnus rubra Bong.) and several species of Nothofagus. Species scheduled for initial tests in the next year or two are Carsican pine (Pinus nigra ssp. maritima (Ait.) Melville), giant sequoia (Sequoiadendron giganteum (Lindl.) Buchkolz), sweetgum, (Liquidambar styraciflua L.), and western hemlock (Tsuga heterophylla (Raf.) Sarg.). About 35 other exotic species have been planted here in the past, not counting ornamentals.

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TREE BREEDING AT THE NEWFOUNDLAND FORESTRY CENTRE 1983-1985

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Keywords: Hybridization, inbreeding, selection, specific gravity, Picea mariana, P. glauca, Larix

Reforestation programs in Newfoundland concentrate on the use of black spruce and white spruce because of a superiority in fibre production and proven adaptability to local conditions. Tree improvement has little effect on reforestation costs but can result in permanently increased productivity. Various exotic species are also being tested for growth and development under Newfoundland conditions.

BLACK SPRUCE (P. mariana)

1. A study of the effects of inbreeding in black spruce was continued with the outplanting of the families obtained in controlled pollinations. Early results in the greenhouse had shown there to be a reduction in seed set and in the growth of selfed compared to outcrossed seedlings (Hall 1984c). The continued development of the various families is being monitored in a replicated field trial.

2. The relationship between growth rate and specific gravity was examined in several natural stands of native conifers. Current plus-tree selection methods are based on rapid growth rates and it is assumed that wood specific gravity is unrelated to growth rate. Results of the study showed a weak relationship between the two and selection based solely on growth rate resulted in a slight reduction in specific gravity. To optimize gains through selection, rapidly growing trees of high specific gravity must be selected and a method for this was suggested (Hall 1984a).

3. The "Pilodyn Tester" was tested on black spruce, white spruce, larch, balsam fir and jack pine to determine its value in selection of trees of higher wood specific gravity. Preliminary results indicate a significant relationship between the inferred specific gravity (Pilodyn) and the measured specific gravity (displacement method).

4. Collection of cones have continued in the demonstration seed production areas established by th NFC. Seed yields are measured annually on selected trees. The proportion of trees flowering, number of cones per tree and number of filled seed per cone are all determined.

5. Two sets of provenance trials have been established in Newfoundland, an all-range trial and a regional trial. In 1984 and 1985 both sets were remeasured at 15 years from seed. Data on height and diameter are currently being analyzed.

WHITE SPRUCE (P. glauca)

1. A provenance trial of 31 sources from the Great Lakes-St. Lawrence Forest Region was remeasured for height and diameter 25 years from seed. The superiority of several Quebec and Ontario provenances was confirmed and a close relationship was found between height at 20 and 25 years ($r = 0.940$). Site conditions are variable within the plantation and this partially confounded the results. Collections of open-pollinated cones were made from the fastest growing provenances in 1984 and 1985.

2. A series of controlled pollinations (both inter- and intra-provenance) have been made on the faster-growing provenances to provide material for selection and to test these various family combinations. In May 1985 seedlings from these crosses were outplanted in western Newfoundland. A replicated field trial of 60 families was also established.

LARCH (larix spp.)

1. Studies of microsporogenesis in native and exotic larches in Newfoundland were completed and a paper was presented at a meeting of the IUFRO Seed Problem group (2.04.00) in Vienna in June 1985 (Hall 1985c). It was concluded that damage induced by low temperatures was not a significant biological impediment to the development of viable seed.

2. Seed quality and quantity were examined in two clones of European larch (L. decidua). Variation was large between and within clones, after inter- and intra-specific hybridization and between the two years sampled (Hall 1985a).

TESTS OF EXOTIC SPECIES

Various species of exotics have been tested in Newfoundland in unreplicated trials, species trials and provenance trials. Most trees are now 20 years old from seed and have been remeasured during 1984 and 1985. To date only Japanese larch (L. kaempferi), European larch, (L. decidua) and Dunkeld larch (L. eurolepis) have been shown to grow faster than native species and still be adaptable to local conditions. A large scale trial of Sitka spruce (12 provenances, 9 plantations) has shown that on average black spruce and white spruce have superior growth rates to Sitka spruce. However some individual trees of Sitka spruce have shown superior growth to black and white spruce.

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COOPERATIVE TREE IMPROVEMENT IN NOVA SCOTIA 1983-85

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Keywords: government-industry cooperation, selection, seed orchards, breeding strategies, genotype-environment interaction.

Tree improvement in Nova Scotia is carried out by a government/industry cooperative known as the Tree Improvement Working Group (TIWG). Established in 1977, the TIWG has representatives from the Provincial and Federal Governments, and the three major pulp companies: Bowater Mersey Paper Co. Ltd., Scott Paper International Inc., and Stora Forest Industries (formerly known as Nova Scotia Forest Industries). The Province and the industry cooperators share the workload of selection and testing, and each maintain major seed orchard installations. The TIWG Management Committee meets twice yearly to review progress and set targets, while day-to-day program direction is handled by the Department of Lands and Forests.

Species of primary interest are black spruce (Picea mariana (Mill.) B.S.P.), red spruce (Picea rubens Sarg.), and white spruce (Picea glauca (Moench) Voss). Some effort is also directed at species planted in smaller numbers: Norway spruce (Picea abies (L.) Karst.), white pine (Pinus strobus L.) and larches (Larix Mill.).

Activities of the TIWG have been reported to the CTIA in earlier members' reports. The present report covers a 2-year period ending in the summer of 1985, and highlights major accomplishments.

Selection

Original selection targets called for 500 plus-trees for species where clonal seed orchards were to be used, and 1500 where seedling seed orchards were planned. For red spruce the TIWG has actually exceeded the 500-tree target. White spruce selection is just short of the 500-tree mark. In both cases field selection has all but curtailed, as additional trees will soon become difficult to phase into the breeding plan.

Black spruce selection remains well below the original 1500-tree target. Poor seed crops and the limited area of black spruce stands in the Province have created problems in building up numbers. Seedling orchards

which have been established to date have included plus-tree selections from other areas, primarily southern New Brunswick, to flesh out the number of families.

Expansion of Orchards

At this point, all cooperators in the TIWG have started major seed orchard installations, and all but one are handling two or more species. A summary of orchards established to date is given below:

Species	Location	Type[a]	Approximate area (ha)[b]	Managing Agency
Black Spruce	East Mines	S	5.2	Scott
	Aldershot	S	4.4	Stora
High-elevation black spruce	Strathlorne	S	2.8	Stora
White spruce	Debert	C	1.4	L & F
	East Mines	C	3.3	Scott
	Waterville	C	0.9	Stora
Ottawa Valley white spruce	MacQuarrie Lk. Rd.	S	3.6	Stora
Red spruce	Melvern Square	C	4.2	Bowater
	Waterville	C	2.7	Stora
	Lawrencetown	C	1.6	L & F
White pine	Debert	C	1.6	L & F
Norway spruce	Debert	C	1.8	L & F
		Total	33.6	

[a]Type: C = clonal (grafted), S = seedling
[b]Area: exclusive of roadways and unplanted locations

The next few years will be a period of rapid orchard expansion, as most of these sites are preparing to receive large shipments of orchard stock from the Tree Breeding Centre. Orchard design, layout and record keeping is handled by computer.

Seed Production

Nova Scotia, like most parts of eastern Canada had a reasonably good seed year in 1984. The TIWG's first orchard in Lawrencetown, established in 1977, flowered heavily and produced over 2.5 kg of red spruce seed. Although some of the seed has been set aside for testing, most has been put into the production stream, and represents the first major contribution of improved seed to the Nova Scotia reforestation program.

Breeding Strategy

The TIWG program is about to enter a period of evaluation and breeding of selected parents. Approaches to breeding have been discussed for some time, but detailed strategies for each species have only recently been compiled. Don Fowler at the Maritimes Forest Research Centre has prepared a set of strategies which is currently under review, and is expected to form the basis for planning of mating and testing operations which will begin in earnest over the next few years.

Genotype-environment Interactions

The impact GxE interactions on breeding strategy continues to be of interest. An MScF thesis on genotype-nitrogen interactions in black spruce was accepted in 1984 (Mullin, 1984). This work will soon be published in the literature (Mullin, 1985).

Clonal material from the original greenhouse experiment has been propagated by rooted cuttings and established in a series of field tests. A total of 240 clones from 40 full-sib families are represented on each of 4 test sites.

Stand Out-crossing Project on Cape Breton Highlands

Seed from the Highlands of Cape Breton has been in very short supply, as budworm feeding in addition to the harsh environment have all but eliminated flower production. Reforestation stock for this area is required in large numbers (6 million trees annually) and is currently produced as rooted cuttings.

Provenance test results have suggested that the level of inbreeding may be high in the long, narrow stands of black spruce found on the Highlands (Fowler and Park, 1982). Since nursery production is already geared for rooted cutting propagation, it was felt that controlled mating could be used to produce sufficient seed, and would permit a reduction in inbreeding by mating parents from widely spaced stands. A pilot project was initiated in 1984 using pollen from 3 stands to produce outcrossed seed by controlled pollination. The project will likely be expanded in 1985.

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TREE IMPROVEMENT AT NB DEPARTMENT NATURAL RESOURCES

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Keywords: Stand test, plus tree selection, seed orchards, family tests.

The New Brunswick Department of Natural Resources' tree improvement program has continued, concentrating on its four main reforestation species: black spruce, jack pine, white spruce and tamarack. More recently, Norway spruce is being considered for reforestation and tree improvement work has commenced on this species. Active participation has continued within the New Brunswick Tree Improvement Council.

A summary of the Department of Natural Resources' tree improvement effort follows.

STAND TESTING

A number of black spruce (Picea mariana (Mill.) B.S.P.) and jack pine (Pinus banksiana Lamb) stands have been reserved and tested throughout New Brunswick. Most of these stands are mature and as cone crops develop the better stands or sections of them are cut. To date, 247 kilograms of black spruce seed and 116 kilograms of jack pine seed have come from tested reserve stands.

PLUS TREE SELECTION AND BREEDING

To date, 656 black spruce and 531 jack pine have been selected for use in seedling orchards. A total of 66 white spruce (Picea glauca (Moench)Voss) and 75 tamarack (Larix laricina (Du Roi) K. Koch) have been selected for use in clonal orchards.

ORCHARD ESTABLISHMENT AND FAMILY TEST

To date, 24 hectares of black spruce, 24 hectares of jack pine, 8 hectares of Ottawa Valley white spruce and 3 hectares of tamarack seedling orchard have been outplanted. Five-year measurements of the 1979 black spruce and jack pine family tests were taken. The corresponding 1979 jack pine seedling orchard is beginning crown closure and an initial culling of the poorer families and individuals will take place in 1985.

Grafting of white spruce and tamarack for clonal orchards and breeding orchards has continued. About 4100 white spruce and 4900 tamarack grafts have been done. In 1984, 3 hectares of tamarack clonal orchards were established. Outplanting of 3 hectares each of tamarack and white spruce clonal orchard is planned for 1985.

TREE BREEDING AT THE MARITIMES FOREST RESEARCH CENTRE 1983 AND 1984

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Keywords: Population studies, provenance tests, species hybridization, applied tree improvement, tissue and organ culture, Picea, Larix.

An opportunity exists to substantially increase forest growth by developing and utilizing genetically superior seeds and seedlings in the expanding reforestation programs of the Maritimes Region. The objectives of the tree breeding work at the Maritimes Forest Research Centre (MFRC) are to determine the amount of genetic improvement attainable within promising tree genera and to provide resource managers of the Region with the information and breeding materials required to obtain realistic levels of genetic improvement.

R.F. Smith returned from educational leave in the summer of 1983, and is currently working in the area of seed orchard research and development. J.F. Coles accepted employment with the Ontario Tree Improvement Council and J.D. Simpson became a permanent member of our tree improvement group in 1984-1985. Mr. Simpson's primary job is to provide technical assistance and advice to the New Brunswick Tree Improvement Council.

HYBRIDIZATION IN PICEA AND LARIX

In 1983, work on species crossability and testing of Picea and Larix was continued. Emphasis in the pollination work was placed on producing hybrids of selected Japanese (Larix leptolepis (Sieb. et Zucc.) Gord.) and European larches (L. decidua Mill.). To this end, 56 different tree x pollen combinations were attempted. White (Picea glauca (Moench) Voss) and black spruce (P. mariana (Mill.) B.S.P.) were again crossed with pollens of Sitka spruce (P. sitchensis (Bong.) Carr.) from selected British Columbia trees (60 tree x pollen combinations). In 1984 over 100 tree x pollen combinations were attempted in Picea. In Larix, 3 sets of 4-tree diallel crosses were attempted with European larch and each of the 12 trees was crossed with 4 selected Japanese larches. Seed yield from most of the Larix crosses was unexpectedly low, possibly due to poor pollen viability.

SPECIES AND PROVENANCE TRIALS

This study was initiated in 1954 and includes a total of 200 replicated experiments and observation plots. Both range-wide and limited range provenance experiments are established over a variety of environmental conditions in the Maritimes. These experiments are maintained, and scheduled measurement, analysis, and interpretation of data are carried out. In 1983-84, four experiments were established or remeasured: tamarack (Larix laricina (Du Roi) K. Koch), black spruce, red spruce (Picea rubens Sarg.), and yellow birch (Betula alleghaniensis Britton).

Tamarack A cooperative range-wide provenance test of tamarack was planted at 10 locations in the Maritimes Region: four in each of New Brunswick and Nova Scotia and two in Prince Edward Island. At each location, 65 provenances covering the entire species range were planted in 8 replicates of 4 tree plots. The seedlings were measured prior to field planting.

Black spruce A cooperative range-wide provenance test of black spruce growing in 10 locations in the Maritimes was remeasured. Ten-year (from planting) height and other observations were recorded and are currently being analysed. At each test location, trees from up to 99 provenances are represented in 6 replications with 8-tree plots.

Red spruce Red spruce provenance data from 10 locations in the Region are being analysed. This test includes a total of 30 provenances from the Maritimes and adjacent Maine and 2 provenances from West Virginia. Preliminary analysis indicates considerable variation among provenances and a correlation between growth and degree of hybridization with black spruce.

Yellow birch A cooperative range-wide provenance test of yellow birch, established in 1963, was remeasured. A total of 45 provenances are represented in 10 replicates of 4-tree plots in only one location in the Region. Data accumulated over the past 20 years are being analysed.

POPULATION STUDIES

The purpose of this study is to elucidate the genetic structure of populations of tree species used for reforestation in the Maritimes and includes work on population structure, inbreeding, progeny testing, and quantitative genetics.

White spruce A white spruce inbreeding study involving five experiments was published in two parts. The first (Fowler and Park 1983) was concerned with the effects of self-pollination on seed set and performance. The results based on 20 trees from three populations up to age 17 years were reported. The most drastic effect of selfing was the increased frequency of empty seeds which averaged over 90%, and was 5 to 22 times higher than from comparable cross pollinations. The average number of embryonic lethal equivalents, although highly variable for individual

trees, averaged 8.0, 9.1, and 12.9 for the three populations. Self-pollination also resulted in slightly lower germination and reduced survival. Seedlings from self-pollination averaged 44.5 and 63.7% less height and diameter growth, respectively than seedlings from unrelated matings at age 17 years.

The second paper (Park, Fowler, and Coles 1984) involved natural inbreeding and relatedness among neighboring trees. Based on percent full seed data from various controlled pollinations, the estimated coefficients of relationship were 0.29 and 0.28 for neighbor and wind pollinations, respectively. Neighboring white spruce trees appear to be related at about the half-sib level. Wind pollination approximates a level of inbreeding expected from trees related at a level well above that of half sibs and differential selection at the pre-embryo to early seedling stage results in progenies again related at the half-sib level. It is suggested that an inbreeding equilibrium exists in natural stands of white spruce and that this equilibrium approximates that expected from half-sib matings. The inbreeding equilibrium is controlled, at least in part, by the frequency of lethal genes in the population.

Black spruce The results of a black spruce inbreeding experiment concerning self-fertility, genetic load, and performance were published (Park and Fowler 1983). Self-pollination resulted in a significant reduction in full seed set and early height growth. The number of embryonic lethals was estimated to be between 5 and 7 for trees in this population. The total number of lethal equivalents acting from time of pollination through age 6 years, ranged from 6 to 8. It was estimated that there are, on average, 1.8 archegonia per ovule in black spruce and polyembryony appears to have an important role in maintaining heterozygosity. Significant differences among female parents with respect to seed weight, percent germination, and 2- and 6-year heights indicated substantial variation due to additive genetic and maternal effects. Relative self-fertility, although generally high, varied widely among parent trees.

A series of black spruce progeny tests at three locations was measured after 5 growing seasons. This experiment includes 130 families from plantations and natural populations. The purpose of the experiment is to provide quantitative estimates of genetic parameters for use in predicting genetic advances and to explore the possibility of converting parental populations into seed collection plantations to provide a moderate level of genetic gain until the time seed orchards are in full production.

Tamarack An open-pollinated progeny test of tamarack from three different populations and planted in four locations was measured at age 5 years from planting. This experiment is designed to provide estimates of additive genetic variance and heritability needed to predict genetic gains through a tree breeding program. The data are currently being analysed.

CONE AND SEED RESEARCH/SEED ORCHARD MANAGEMENT

Over 100 ha of seed orchard have been established in the three Maritime provinces. Numerous problems have arisen associated with both the establishment and management of these orchards. Short-term research projects have been conducted to attempt to solve some of these problems.

Black spruce cone production was successfully enhanced by applying ammonium nitrate at rates of 200 to 300 kg elemental nitrogen per hectare. Six-year results from spacing trials in black spruce plantations have shown that seedling seed orchards planted at 1 x 2 m spacing will have to be rogued to 2 x 4 m by age 15 years otherwise both seed and pollen cone production will be detrimentally affected.

An experimental clonal seed orchard was established at the Acadia Forest Experimental Station to allow Canadian Forestry Service staff to conduct cone induction trials in white, black, and Norway spruce (Picea abies (L.) Karst), jack pine (Pinus banksiana Lamb.) and tamarack.

In 1984, there was a bumper white spruce cone crop. Coinciding with this large cone crop was a high incidence of the spruce needle rust (Pucciniastrum americanum) infecting the cones. This was attributed to the wet weather in the spring and early summer. Several cone collections were made and preliminary results indicated that this rust can seriously reduce or totally destroy seed in heavily infected cones, and therefore could pose a serious problem in white spruce seed orchards.

COOPERATIVE TREE IMPROVEMENT

Technical assistance continues to be provided by the MFRC to the expanding operational tree improvement programs in New Brunswick, Nova Scotia, and Prince Edward Island.

The New Brunswick Tree Improvement Council, composed of 13 cooperators, continues to focus its efforts on black spruce, white spruce, jack pine and tamarack. During the past two years, an additional 350 black spruce plus trees were selected (total 900) and 11 ha of new seedling seed orchard planted (total 65 ha). Jack pine selection progressed steadily with 290 new selections (total 800) and 15 ha of new seedling seed orchards established (total 45 ha). Due to the stage of development of the program, emphasis is now starting to shift to clonal seed orchard establishment. One agency has begun planting clonal orchards of black spruce and jack pine. White spruce and tamarack are receiving more widespread attention with 2 and 12 ha of orchard, planted, respectively. Ninety white spruce and 40 tamarack were selected increasing totals to 260 and 170, respectively. All plus tree selection activities and family test establishment are scheduled to be completed by 1987 at which time emphasis will shift to controlled pollinations and progeny testing.

Family tests and stand tests continue to be measured regularly. The first series of 10-year measurements is scheduled for 1985. Final analysis of five year measurements from all stand tests has identified the best reserve stands of black spruce and jack pine to collect cones from until seed orchards come into full production. Analysis of five-year data from two series of black spruce family tests demonstrated the top ranking families were at least 15% taller than the test averages and the check lots. An EPSON HX-20 portable computer was purchased and developed as a portable electronic data collector.

The first seed was collected from seed orchards in 1984! One agency collected 4.5 kg from a 6-year-old, 5 ha jack pine seedling orchard, another collected 280 g from a 7-year-old Japanese larch clonal orchard.

TISSUE AND ORGAN CULTURE

The present conifer tissue culture program deals primarily with one species, Larix decidua. This species is more responsive in vitro than any of the other conifer species worked with over the years. The major concern is in vitro propagation of mature trees. Techniques to produce adventitious plantlets, either directly from the explant or from subculture callus have been developed. Immature female cones collected in early May, or buds collected in late summer from 30-year-old trees have been used as explants. The plantlets survived transfer to soil for a few months. However, their stems did not elongate, i.e., they remained as rooted short shoots.

Somatic embryogenesis has been induced in subcultured callus from immature megagametophytes. A large number of plantlets were obtained and survived for several months after transfer to soil. These plantlets remained small. This experiment has yet to be reproduced.

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