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SEED ORCHARDS AND STRATEGIES FOR TREE IMPROVEMENT

COLLOQUE SUR LES VERGERS À GRAINES ET LES STRATÉGIES D'AMÉLIORATION DES ARBRES

PROCEEDINGS OF THE EIGHTEENTH MEETING OF THE CANADIAN TREE IMPROVEMENT ASSOCIATION

PART 2

COMPTE RENDUS DE LA DIX-HUITIÈME RÉUNION DE L'ASSOCIATION CANADIENNE POUR L'AMÉLIORATION DES ARBRES

PARTIE 2

DUNCAN
BRITISH COLUMBIA
AUGUST 17-20, 1981

DUNCAN
COLOMBIE-BRITANNIQUE
DU 17 AU 20 AOÛT 1981

EDITORS
D.F.W. POLLARD
D.G. EDWARDS
C.W. YEATMAN

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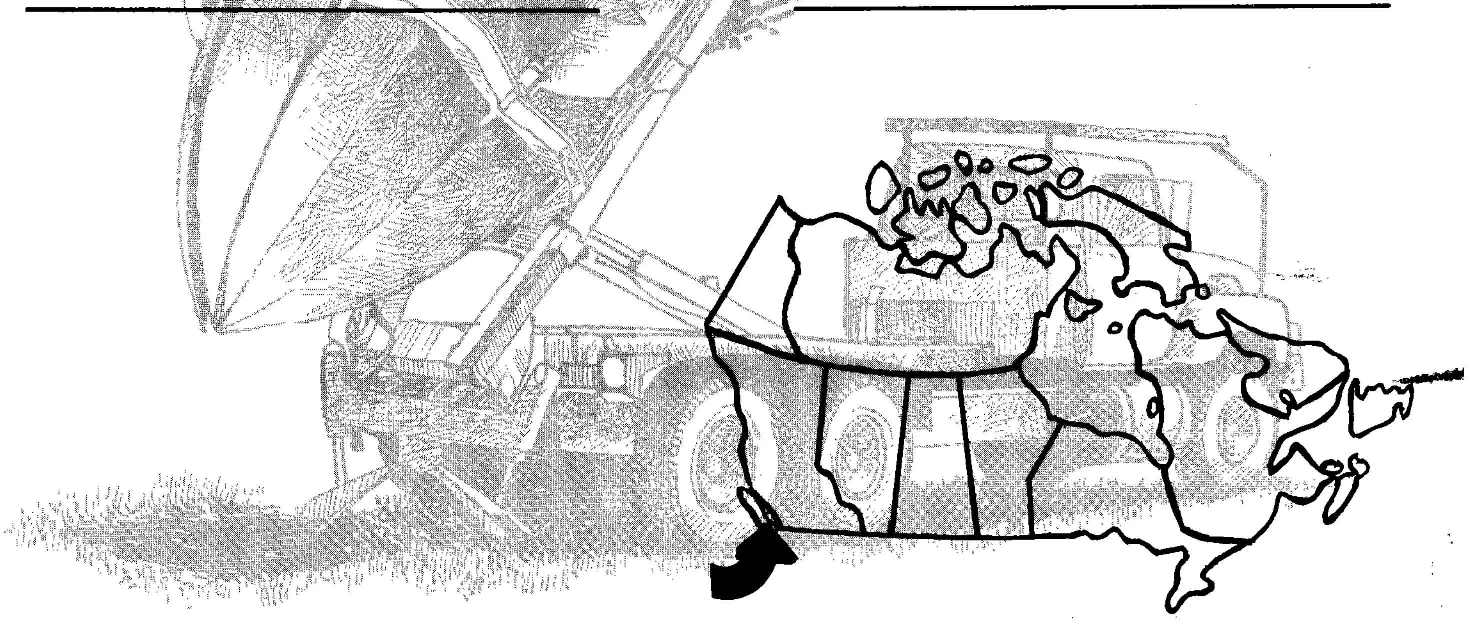

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ASSOCIATION

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SYMPOSIUM ON

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COMPTES RENDUS

DE LA DIX-HUITIÈME CONFÉRENCE

DE

L'ASSOCIATION CANADIENNE POUR

L'AMÉLIORATION DES ARBRES

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Ottawa, 1982

PROCEEDINGS OF THE EIGHTEENTH MEETING OF

THE CANADIAN TREE IMPROVEMENT ASSOCIATION

With the compliments of the Association

Enquiries may be addressed to the authors or to Mr. M.J. Coles, Executive Secretary, C.T.I.A./A.C.A.A., N.B. Executive Forest Research Committee Inc. 500 Beaverbrook Court, Fredericton, N.B. E3B 5X4.

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The Ninteenth Meeting of the Association will be held in Toronto, Ontario, August 22-26, 1983. Speakers will be invited to address the topic of Vegetative Propagation and its Impact on Genetic Improvement and our Future Forests. Canadian and foreign visitors are welcome. Further information will be distributed in the fall 1982 to all members and to others on request. Enquiries concerning the 19th Meeting should be addressed to: Miss R.M. Rauter, Chairman, C.T.I.A./A.C.A.A., Forest Resources Branch, Ontario Ministry of Natural Resources, Parliament Buildings, Toronto, Ontario M7A 1W3.

To: *Dr. C.W. Yeatman, Editor, C.T.I.A./A.C.A.A.*
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Les demandes de renseignements peuvent être adressées aux auteurs ou à M.J. Coles, Secrétaire exécutif, A.C.A.A./C.T.I.A., N.B. Executive Forest Research Committee Inc. 500 Beaverbrook Court, Fredéricton, N.B. E3B 5X4.

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La dix-neuvième conference de l'Association aura lieu à Toronto, Ontario, du 22 au 26 Août 1983. Des orateurs seront invités à s'adresser au sujet de la propagation végétative et son impact sur l'amélioration génétique et sur nos forêts futures. Tous sont bienvenues. Des informations supplémentaires seront distribuées durant l'automne de 1982 à tous les membres et à tous ceux qui en feront la demande. Ces demandes de renseignements concernant la dix-neuvième réunion devrons être adressées à: Miss R.M. Rauter, Chairman, C.T.I.A./A.C.A.A., Forest Resources Branch, Ontario Ministry of Natural Resources, Parliament Buildings, Toronto, Ontario M7A 1W3.

À: *Dr. C.W. Yeatman, rédacteur, A.C.A.A./C.T.I.A.*
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D.F.W. Pollard Vice Chairman (Symposium)
D.G.W. Edwards (Seed Technology Workshop)

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Au nom de l'Association canadienne pour l'amélioration des arbres, les rédacteurs désirent remercier les organismes qui ont permis aux conférenciers invités de participer au Colloque sur les vergers à graines et les stratégies d'amélioration des arbres:

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L'Association désire également remercier Mike Crown, vice-président (Dispositions locales) et Judy Boyd, du ministère des Forêts de la Colombie-Britannique, pour leur aide scientifique et technique, ainsi que pour l'accueil généreux offert aux participants. Le Service canadien des forêts a fourni une aide spécialisée pour la préparation du programme. Nous remercions plus particulièrement Frank Portlock, qui a supervisé la préparation du compte rendu, et Doug Taylor, tous deux du Centre de recherches forestières du Pacifique. Le Service canadien des forêts a payé la totalité des frais de publication du compte rendu.

D.F.W. Pollard, vice-président (Colloque)
D.G.W. Edwards (Atelier sur la technologie des graines)

CONTENTS

WELCOMING ADDRESS

T.M. Apsey

Deputy Minister of Forests

British Columbia Ministry of Forests

Ladies and Gentlemen, Good Morning

It is my pleasure and privilege to welcome you to this meeting on behalf of the Province of British Columbia and the Ministry of Forests.

Yours is a discipline that demands commitment. It demands commitment from yourselves and it also demands commitment from every other facet of forest management. From government. From industry.

A tree improvement program cannot be considered on its own. It must fit, like the vital piece of a jigsaw puzzle, into the overall pattern of increasingly intensive forest management practices. The achievements of such a program are measured in the number of seeds coming out of your seed orchards, the hectares of land reforested with superior stock and, years later, the increase in wood harvested - wood from trees that grew bigger and reached maturity faster than they would have in a natural forest. Before we reach these goals, there must be a broad-based commitment to, and long-term support for, tree improvement.

I am told that it has been ten years since this association last met in British Columbia. There have been some important changes since that 1971 meeting in Prince George:

- A major commitment to intensive forest management has been made by both the Ministry and the forest industry.
- Our new Ministry of Forests Act, proclaimed at the beginning of 1979, paved the way for a revolving system of resource analyses and five-year plans.
- And in the field of tree improvement we have built on the foundations established by Dr. Alan Orr-Ewing in his pioneering work in coastal Douglas fir. Commitments now have been made to work in other important coastal species and the program has expanded to embrace the enormous potential of the Interior forests.

During this week you will see evidence of these changes for yourselves. But before you begin, I believe it will be a valuable exercise to examine the role of tree improvement within the context of the overall management process.

Ask a tree breeder how his program is going and you will get back an enthusiastic response about the great potential for enhancing the forestry practices of the future. He works with the program day by day. He has no problem living with the inherent long-term nature of such a project. However, the silviculturists, the forest managers and the wood processors must also be looking to the years ahead. They, too, must be planning how best to take advantage of these long-term possibilities.

The fall-down effect — the realization that even if second-growth forests are managed intensively they will not produce the same volumes of wood that were available from the old-growth forests -- hangs over all of us. Our job is to deal with this shortfall. That will require all the tools and techniques the silviculturist has at his disposal -- choice of tree species, quick establishment, spacing control, possibly fertilization of forest lands. And underlying all this, as the true foundation, the genetic quality of the seeds we use.

The effects of using genetically-improved seed may take a long time to unfold but they are cumulative and their influence will be felt over the whole growth cycle and the eventual treatment of the crop. The actual cost of the seed is such a tiny fraction of the total crop value that additional investments to increase seed quality can be justified as money well spent, most particularly with those species that have a potentially high impact on wood supply.

Once there is a commitment to artificial regeneration and to planting programs, breeders can take steps to direct the crop towards the greatest return. Tree improvement practices will lead to assured seed supply and will influence the quality and quantity of wood produced in a given period of time. In this province, the move to more intensive forestry has been accompanied by the development of a co-operative approach. The work load for the total program is very large, even if you consider only the seed production function. By sharing that work with the forest industry, we are able to advance faster and more efficiently.

The province owns 94 per cent of the forest resource and the Ministy of Forests therefore holds the primary responsibility for managing the resource and ensuring the greatest benefit to the people of British Columbia. Some have referred to this arrangement as the "Big Brother Effect". I prefer to think of it as a true "Partnership". In any case, we have begun to share our responsibility with industry and the potential advantages of this partnership have already become evident.

You have heard about British Columbia's formation of a Coastal Tree Improvement Council. This body, made up of senior personnel from the Ministry and from major forest licencees, advises the Chief Forester on policy matters and actively works to strengthen the co-operative features of the program. Since then we have opened a program in the Interior and one of the first steps was to establish another organization: The Interior Tree Improvement Council.

The needs of this new program are already very large. For a start, the Ministry established an Interior target of 80 million improved seedlings for 1995. For the province as a whole, the annual production target is 150 million improved seedlings by the year 2000.

These goals can be met only through a strong joint commitment by the minsitry and industry of both the tree breeding and seed production phases of the program. As recent evidence of this commitment, a new facility has been built at Vernon, to be officially opened in the near future. The Vernon Research Station and Seed Orchards will support the work of breeders and orchardists as well as physiologists and silviculture specialists who will provide much of the necessary knowledge and support. I hope by the time the CTIA comes back to British Columbia for another meeting, it will be able to meet at the Vernon centre. By then, too, the scale and scope of the Interior tree improvement programs will be closer to being on par with those on the coast. Indeed we expect the scale of the Interior programs will likely overtake the coastal commitments, despite the product value and high Mean Annual Increment of the coastal forests.

At present the emphasis of the Interior program is still on the interior spruces and lodgepole pine but some attention is being directed to the tree improvement potential in interior Douglas fir and western larch.

At the same time that we've been developing new initiatives in the Interior, we have moved to meet the increased propagation requirements for coastal programs through the expansion of research facilities at Cowichan Lake. The research station you will visit tomorrow is no longer just the home of the established program for coastal Douglas fir. The staff there is already involved in work on western hemlock and yellow cedar and in propagating Sitka spruce, amabilis fir, red cedar and other species. As part of the first stage of this expansion, 33,000 grafts were made there this spring. The staff and facilities are being built up. Clone banks are being established for all commerical coastal species to maintain the gene pool against losses through field exploitation. Similar developments are planned for the Interior at Vernon and Skimikin.

The work as you can see, goes on. We are making progress. But the main point I make today is this: tree improvement cannot supply fast answers: it needs a serious, long-term commitment. In British Columbia there is that commitment. Within our co-operative relationship with industry, the Ministry of Forests' Silviculture Branch spent $3 million in the last fiscal year on seed orchard establishment, maintenance, service projects and the selection of "plus" trees. In the current fiscal year the amount is increased to $3.5 million. These funds are in addition to the support given to the tree improvement section of the Ministry's research branch, where expenditures on breeding, provenance and research run at about the same dollar figure. Money, of course, it not the only commitment to be made, but you all know that having a firm, consistent fianancial base is an important part of laying the foundations for a stable, well-planned program on a useful scale.

The British Columbia Ministry of Forests is relying on tree improvement to play a vital role in helping to meet future wood supply goals. You people meeting here today provide welcome reassurance that we are not alone, that commitments are being made to tree improvement in other provinces, other nations. I hope the experiences shared at this convention will help all participants expand their knowledge and speed up the essential work they are doing in this field.

The prime objective of the Canadian Tree Improvement Association, as stated in your constitution, is "to promote the use of scientifically and technically sound genetic practices in Canadian forestry." To which I say: "Go to it".

KEYNOTE ADDRESS

Roy Faulkner
Principal Geneticist
British Forestry Commission
Northern Research Station
Roslin, Lothian, Scotland

KEYNOTE ADDRESS

TREE IMPROVEMENT RESEARCH AND DEVELOPMENT - SOME THOUGHTS FOR THE 1980'S

Roy Faulkner

Principal Geneticist

British Forestry Commission

Northern Research Station

Roslin, Lothian, Scotland

INTRODUCTION

I am indeed honoured to have been invited to speak to the Canadian Tree Improvement Association and I look forward during the meeting to seeing and discussing mutual problems with you all - and, at the same time, to learn some of your recipes for success. You should not assume, however, that my crystal ball is any bigger or better than your own - in many respects it is undoubtedly inferior.

Before warming to my main theme, which mainly relates to north-temperate conifers, it will be helpful, perhaps, if I outline briefly the responsibilities and current work of my team engaged on tree breeding which started in Britain in 1949 and where we have an expanding forest estate - the current area of which is some 1 3/4 million hectares. The annual programme of new planting is in the order of 24,000 ha with a further 8,500 ha of re-stocking.

My association with this tree improvement programme goes back 23 years during which period I have seen many changes in forest policy, attitudes, thinking, methodology technologies, and, like most others, have passed through the hoops of economic appraisals and financial constraints. All these have affected our breeding strategies which have the ultimate goal of maximising improved saw-timber production per unit-of-time. It is of some interest, perhaps, to note that our manpower resource (which currently consists of five graduates, eight technicians and support labour of eleven men), has remained almost static since 1963. Total funding, which is currently 450,000 C$ per year, has been kept broadly in line with inflation during the past decade. Nevertheless output per staff member has increased greatly due to ever-increasing experience; flexibility of management and job specification; a strong team spirit; integration and relationships with both forest manager and with our research colleagues in Silviculture and Physiology; by having only three well-located field stations; by having almost complete delegation of authority and control under one head; and by having responsibility for breeding research and development for both the private-and state-owned forestry sectors.

The research essentially applied but we have some involvement in basic- applied projects. In round terms our annual capacity is: the survey of up to 1000 ha of plantations for registration as new seed collection areas and the resurvey of up to 500 ha of existing registered stands; making 10-12,000 grafts; designing and supervising the planting of 12 ha of new clonal or seedling orchards; making 7,500 isolations and artificially pollinating 20,000 flowers; raising 500 families (80,000 plants) and planting these in progeny tests on up to eight sites and up to 700 miles apart; and assessing an equivalent number of plants for height and stem form and a proportion for girth. Currently we have 38 ha of orchards of which 25 ha are 1.5 generation, 375 ha of progeny tests and 8,500 selected trees most of which are now under test.

In descending order of importance our species interests are: Sitka spruce, lodgepole pine, Scots pine, and Corsican pine (Pinus nigra var maritima). The hybrid between European and Japanese larches is also of importance and there is a growing interest in the hybrid between Sitka spruce and white spruce as a frost-hardy hybrid capable of growing well on very difficult sites in northern Scotland. Breeding effort and priorities are related broadly on a pro rata basis according to the importance of each species or hybrid. In addition to the main breeding programme we have established a number of research projects which aim to provide basic information to assist us in improving our strategies and techniques. Of these the more important ones have been: a plot-size and shape experiment; a population heritability study of 150 interbreeding trees representing all size classes; a complete diallel crossing-pattern of seven Sitka spruce trees; population studies of lodgepole pine and our own remnant native Scots pine stands using biochemical techniques; the development of standardised techniques for the assessment of experiments, mechanical data-handling and computation and interpretation of genotype x environment interactions, and a data bank.

On the international scene, and under the aegis of IUFRO, we have arranged and made a series of provenance seed collections of Sitka spruce, lodgepole pine, grand fir, noble fir and A. lowiana and have produced a handbook on seed orchards. In the early 1960's we were involved in launching the OECD scheme for the certification of forest reproductive material moving in international trade.

This sums up my experiences; it is against these that I present some thoughts on how I expect research and development in tree breeding to move during the next decade and which have relevance to some Canadian situations highlighted during the Petawawa Workshop of 1978.

The "crie de coeur" for more funds, staff and facilities is all too familiar; there are no glib answers for these matters which can only be realistically, if not always satisfactorily, settled by senior administrators and managers impartially discussing and firmly deciding how big the total research and development cake is to be over the next one or two decades, and how it should be divided. Johnston (1976) sets out some sound advice on the organization and management of forest research programmes and in particular he highlights the importance of retaining flexibility in staffing and producing long-, mid- and short-term plans which are regularly updated.

Now let us consider some of the activities connected with a tree improvement programme, including some which currently are not so important but which we should bear in mind for the future.

SEED SOURCES

Seed Stands

Seed stand registration and seed certification schemes were organized and operated on a voluntary basis in Britain during the period 1956-73; there were three phenotypically-based categories. Despite several propaganda campaigns the schemes were not a success and although the 300 members paid lip-service to the objects of the schemes they never gathered any impetus. The reasons for failure varied but primarily were because: there was no established tradition of collecting conifer seed (other than from Scots pine): we were highly dependent on imports which were easy to arrange through merchants in north-west America, Europe and Japan; seed crops on seed stands of all but the pioneer species were unpredictable and infrequent, financial statistics and methods of assessing cone crops were unreliable; the physical difficulties of collecting seed by climbing; the stringent safety rules and practical difficulties of training and retaining seed collection teams as a unit from one year to the next - and - perhaps our misfortune to have imported the American grey squirrel into Britain instead of Tamiasciurus douglassii!!

In the mid-1960's it was becoming increasingly difficult to obtain lodgepole pine seed from certain Canadian and American sources which had been proven to have merit in origin experiments established in the 1930's. Furthermore, collections from some places were impossible to arrange, or, excessively expensive - for example - seed from certain Alaskan sources was quoted at 370 C$ per pound (820 C$/kg). For this reason over 100 ha of seedling seed plantations were established on sites well isolated from contaminant pollen and based either on a single proven superior origin, or, six unproven origins from a given seed region or zone. Where six origins were used they were planted concurrently with (or a year or two later than) origin experiments based on the same seed lots but established on forest sites. On the seedling seed plantation site each origin is represented by pure lines in each of many randomised blocks across the site. Inferior origins - determined on the basis of data obtained from the forest experiments - are removed and the plantation of resultant 'hedges' is then managed for seed production. The final plantation may consist of a single origin or 2 or 3 origins if there are no significant differences between them in the forest experiments.

This method is well suited to precocious flowering species, such as lodgepole pine and jack pine, and it quickly provides a reliable "home" seed source of proven desirable origin. It is inexpensive and easy to organize and each plantation provides an excellent base