Réimprimer De:
Comptes rendus de la dix-septième conférence de l'Association Canadienne pour l'amélioration des arbres: 1 re partie

FOREST GENETICS AND BREEDING AT THE LAURENTIAN FOREST RESEARCH CENTRE, 1977-1978

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Key words: genetics, tree breeding, provenance research, white spruce, black spruce, Norway spruce, eastern white pine.

The increasing demand for forest products and by-products results in growing pressure on the wood resources. World needs will have increased by 30 and 60 percent for the years 1985 and 2000 respectively.

In Québec the global productive potential of the forest has not yet been reached, however some regions in the southern portion of the province are already over exploited. The overall softwood potential of fiber production is depleting. Two million hectares of forest are inadequately regenerated after cutting and/or fire on public lands and more than eighty thousand hectares are added each year. At the actual rhythm of harvesting a shortage is expected before the turn of the century, in both public and private lands.

Québec needs to intensify its reforestation programme. The present objective is to plant 30 million seedlings annually starting in 1979 increasing to 70 million in 1984. Beginning in 1980, direct seeding is expected to be done on twelve thousand hectares of public lands each year. Management of seed production areas and establishment of seed orchards are urgent. Gene conservation and seed movement criteria are mandatory. Important gains are possible through breeding of selected trees. Additional knowledge of genetic population structures of our main forest species is necessary. More research is needed.

RESEARCH OF PROVENANCES OF CONIFEROUS SPECIES

The first experiments set up to search for the most suitable seed sources of indigenous and exotic trees species for reforestation in Québec were established in 1955 by the Canadian Forestry Service. From 1967 to 1977, some fifty additional tests were established in different forest sections of Québec. They included more than five hundred geographic souces and 350 individual trees (spruces, pines, larch, fir and Douglas). During the last two years trials of Polish, Russian and Finish provenances of Norway spruce were initiated concluding the expansion of our provenance research programme.

From 1976 to 1978, all observations collected in the trials since the beginning of the studies were punched on cards, verified, and mounted on a magnetic tape according to a Fortran subfile system. Some 325,000 card-like-records are now readily available for reference or analysis. Last summer, a student in programming was hired to work on programmes suitable for the statistical and genetic analysis of the data. Analyses have been performed on more than ninety percent of the bank content. New information is entered into the bank every year.

Our efforts to contribute to the formation of future forest engineers were continued during the last two years by providing directives, experimental material or data for undergraduate thesis of Laval University students. Research subjects were related to the production of accelerated growth seedlings in containers for genetic improvement purposes and to the study of geographically correlated genetic variations of black spruce. Early variation in growth and phenology of black spruce appeared to be clinal throughout its natural range. Nursery results indicate that the best growing sources are from the southeastern portion of the range.

GENETICS AND BREEDING OF WHITE SPRUCE

Initiated in 1976, the combined research and breeding programme of white spruce is partly based on results obtained from provenance trials conducted in the Great Lakes-St. Lawrence Forest Region. From those tests, seven populations superior for their growth performance and adaptability were identified. Fifty superior trees were selected within the original wild stands or on the provenance test sites for growth and form characteristics. When the selection was made in the provenance trials only one tree per provenance and site was selected in order to avoid possible loss of vigor in the succeeding generations due to inbreeding. Selected trees were grafted in the winters of 1977 and 1978 to constitute the basic material for a breeding arboretum and a seed orchard that will be established with the collaboration of the Ministère des Terres et Forêts of Québec. By using genotypes from populations separated by large geographical distances additional gains are expected due to the reconstitution of the heterogeneity lost within each small and homogeneous subpopulation.

To increase our knowledge of the genetic variation of white spruce and to constitute a second generation for further selection and breeding, in 1976, two hundred and fifty open pollinated families were sown and raised in Japanese paper pots. Seedlings were transplanted in the Valcartier Research Nursery to allow additional growth before field planting scheduled for the spring 1979. Observations of early development were taken each year. Partitioning of total variance for growth showed that populations and families are equally important sources of variation. Narrow sense heritability, on an individual seedling basis, was estimated to 0.22 and 0.19 at 4 months and 19 months respectively.

Seeds were exchanged with the Petawawa National Forestry Institute, Chalk River, and the wide range genecological study of white spruce was initiated last year. The study includes a total of 446 seedlots representing 100 provenances or populations and 420 mother trees.

The distribution of the seed sources between the provinces is as follows:

British Columbia	2	Québec	45
Alberta	2	New Brunswick	2
Saskatchewan	2	Nova Scotia	2
Manitoba	2	Newfoundland	2
Ontario	40	Prince Edward Island	1

In Québec, the early phase of the study is being conducted over two consecutive years because of the work load and of the restriction in staff and the physical facilities available. Seventy percent of the seedlots are sown each year under a plastic greenhouse in Spencer-Lemaire containers. Seedlings are grown in the greenhouse during six months and field planted the next spring in six different forest sections of Québec. In addition to providing information on the genetic structures of white spruce through its range the experimental stock will be used as basic material for population, family, and individual tree selection for producing improved white spruce varieties for Québec's reforestation needs.

GENETICS AND BREEDING OF WHITE PINE

At the beginning of the 20th century eastern white pine stands occupied over 95,000 km^2 of Québec territory. Because of intensive cuttings and lack of adequate natural regeneration, important populations are restricted to the valleys of the Ottawa River and its main tributaries. Whatever its economical importance white pine has not been planted as much as it should have been in the past because of the risk of blister rust infection and the difficulty in obtaining necessary seeds.

A recent re-evaluation of the situation of blister rust in Québec revealed that the natural range of eastern white pine could be divided into four susceptibility zones. In two of these zones, white pine can be grown with less than fifteen percent loss due to Cronartium ribicola (Lavallée, 1974). These zones cover the most favorable climatic and edaphic regions for fast growth. With site selection and minimum silvicultural practices to reduce weevil damages quality white pine can be grown in Québec.

It was urgent that genetic sampling of white pine populations be initiated before a too severe depletion of the gene pool occurred. Much progress has been done in the combined research and breeding programme of white pine initiated in 1976. In 1977 and 1978, more than one hundred populations were sampled and seeds were collected on 265 trees selected for apparent phenotypic resistance to blister rust, superior growth and form. During the fall of 1978, scions were collected on thirty plus-trees and grafted to establish one breeding clone park and clonal seed orchards.

White pine seeds were exchanged with Dr. L. Zsuffa of the Ontario Ministry of Natural Resources and Mr. C.M. Hunt of the U.S.D.A. Seeds of Eurasian white pines from the Working Party on Breeding White Pines collection were obtained from Dr. H.B. Kriebel of the Ohio Agricultural Research and Development Centre. This material will be tested

for rust resistance in Québec and could be used as a gene source for hybridization and transfer of resistant genes within the eastern white pine genome. Scions from blister rust resistant Pinus strobus x P. griffithii hybrid clones were obtained from Dr. L. Zsuffa and grafted on eastern white pine seedlings.

Genetic sampling, plus-tree selection and grafting will be continued this year. Testing will be started in 1980 according to the established programme.

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