CFS FOREST GENETICS RESEARCH AND TREE IMPROVEMENT IN QUEBEC: 1981-83

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During the period under review, the CFS conducted in collaboration with the Quebec Ministry of Energy and Resources, research and work on genetics, improvement, and vegetative propagation of white spruce, white pine, and Norway spruce. Natural as well as artificial populations were genetically sampled, genetic tests were conducted in a controlled environment and in a nursery. They were analyzed then replicated in different ecological regions. The selection of superior genotypes was pursued, while breeding arboreta and propagation gardens were established. In addition, research contracts on the genetic variability of wood quality of white spruce and on the in vitro production and selection of frost hardy stocks were made with faculty members at Laval University.

WHITE SPRUCE

Research and work on the genetics and improvement of white spruce were initiated in 1976 by genetic sampling and testing of 50 populations of Quebec origin. The early test, conducted in a plastic greenhouse, included 250 half-sib families. Estimation of the genetic variability and inheritance of growth characteristics were obtained from first and third year observations in the greenhouse and nursery. In the spring of 1979, the experimental material was replicated in three forest environments representative of the Lac St. Jean, Eastern Township, and Lower St. Maurice reforestation areas.

The research in the genetics of white spruce was later enlarged through the exchange of seeds with Canadian collaborators, mainly Dr. Ying of the Petawawa National Forestry Institute. The wide range progeny/population study that included 450 seedlots was conducted in two phases. Phase 1 was started in rootrainers in February 1979 and included 308 half-sib families from 90 different populations. Measurements were taken in the greenhouse and the container grown seedlings were transplanted the following spring in three sites located in the Gaspé Peninsula, Lower St. Lawrence Valley, and the Laurentides regions.

Phase 2 of the study was initiated in March 1980 and included 356 half-sib families from 90 populations. Fifty percent of these populations were also part of phase 1 and served as link between both phases. After measurements of early growth and phenology, the seedlings were taken out to overwinter and were transplanted in the nursery for additional observations and development. Flushing, weekly growth measurements, and dormancy observations were taken during the 1982 growing season. They are the subject of a forestry student's thesis. In June 1983, the experimental material was transplanted, according to complete randomized block designs, in five additional environments, completing the sampling of Quebec areas of high interest for white spruce reforestation.

Meanwhile, a study of the inter and intra-population variability of the moisture content and unextracted wood specific gravity was conducted from a 20 year old white spruce population trial. Statistically significant differences were found between sources for both characteristics and a positive correlation was found between provenance mean wood specific gravity and diameter growth rate. This study was conducted within the frame of a Laval University student's thesis.

In addition, a breeding orchard including superior clones selected in wild stands, provenance trials, and progeny tests was set up at Cap-Tourmente. Multiplication hedges of 200 clones of outstanding Peterborough and Cushing provenances were established at Valcartier Forest Experiment Station. Some 150 additional clones from superior sources were also established for the same purpose. In Beauce, a seedling and a clonal seed orchard were set up in collaboration with the Quebec Department of Energy and Resources.

Finally, a research contract was undertaken by Laval University researchers for the study of inter and intra-population variability of the intrinsic lumber related to white spruce wood characteristics.

WHITE PINE

White pine genetics research and improvement work, conducted taking into consideration the climatic and edaphic conditions of southern Quebec, were initiated in 1976. The study was undertaken following the results of a survey of blister rust incidence demonstrating the possibility of producing white pine in low rust incidence zones with less than 5 and 15% losses by the fungus. Since then, 250 natural populations were genetically sampled, sixty plus-trees were selected for fast growth, good stem and crown form, and absence of rust galls or damage caused by white pine weevil, and propagated by grafting to establish breeding and clonal seed orchards. A first orchard site was prepared and rootstocks were established by the Quebec's Service of Nurseries and Reforestations. Field grafting is scheduled for next spring.

White pine genetic material was exchanged with Canadian and American collaborators. Our seed bank has almost 800 lots. In the

spring of 1982, phase 1 of the genetic study of the species was started in a plastic greenhouse. The early test counted 250 half-sib families from 165 different populations. Germinative capacity, hypocolyl length, and total height at 8 and 17 weeks were measured. These observations were the subject of a B.Sc. thesis. No particular trend in the growth of white pine populations was found. However, family and population differences were statistically significant. Few south-western Quebec and south-eastern Ontario populations grew as well as sources from the southern Appalachian region. Seedlings were transplanted in the nursery where additional observations relative to growth and phenology will be taken before field testing.

Also in 1982, 175 families form 37 populations of four haploxylon pine species; Pinus griffithii, P. koraiensis, P. sibirica, and P. peuce were produced in the greenhouse. Germination percentage was good in most of the lots. Even after a 90 days stratification, seeds of Korean white pine were still germinating one year after sowing. All the lots overwintered successfully. Cold resistant stocks will be used as sources of blister rust resistant genes.

NORWAY SPRUCE

Based on results of trials of more than one hundred provenances conducted within the Great-Lakes - St. Lawrence forest region, the Norway spruce improvement program was initiated in 1981. Fifteen high yield and frost hardy provenances were identified, and nearly one hundred superior phenotypes were selected based on their growth, form, and apparent tolerance to white pine weevil. In 1982, commercial plantations older than 15 years, were surveyed. They were evaluated as potential gene sources for the improvement program. Twenty-five additional plus-trees were selected in the outstanding plantations. Fifty clones were multiplied by grafting to set up breeding orchards for the controlled crosses and multiplication gardens which will produce scions and cuttings required to establish the projected 90 ha clonal orchards.

CLONING

Our cloning work has two objectives: first, the achievement of rapid genetic gains through the multiplication of outstanding genotypes; and second, the improvement of the cloning techniques adapted to forest trees.

Through testing of different substrates and environmental conditions, rooting success of mini-cuttings was increased. We hope by such a practice to compensate for the insufficiency of seeds produced by specific crosses and accelerate genetic tests. Six to eight week old Norway spruce seedlings were rooted with 92% success, while one year old superior white spruce seedlings were rooted with 90% success. Hedging

increased the rootability of 20 year old white spruces; 28% of the cuttings taken from the ortets rooted while 45% rooting success was obtained from hedges made from the same ortets.

A research contract was undertaken by to Dr. M. Lalonde of Laval University to produce by tissue culture and to select frost resistant Alnus and Larix genotypes.

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