RECENT ADVANCES IN FOREST TREE
IMPROVEMENT IN OTHER REGIONS

Progress Report for Shelterbelt Tree Improvement and Nursery Problems in Prairie Canada

by W. H. Cram 1/

Mr. Mark Hoist has previously given you a bird's-eye view of tree breeding work in Canada (Proc. 2nd. Conf. pp. 41-42. 1955), so we shall confine this report to our activities at Indian Head. The Indian Head Forest Nursery Station was established by the Canada Forestry Branch in 1903 for the express purpose of supplying shelterbelt material to prairie farmers. Since then the station has produced and distributed some 250 million broadleaf seedlings and since 1910 some 8 million conifer seedlings for shelterbelt plantings. From 1935 on, increasing attention has been given to field shelterbelts for farms, and afforestation on submarginal land. (A few copies of the Station's 1947-52 Progress Report are available for those desiring further details.)

Research in tree improvement was initiated at the Station in 1947. While the professional staff for this work has not increased., the technician staff has grown from 1 in 1949 to 6 in 1957. In addition, our facilities and equipment have been greatly improved, especially by the construction of a new headerhouse and greenhouse in 1957. Research work from 1947 to 1949 was of an exploratory nature, which resulted in the formulation of improvement projects for caragana, pine, spruce, and poplar. Investigations were also initiated to resolve problems in seed viability, storage,

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1/ Plant Breeder, Forest Nursery Station, Canada Department of Agriculture, Indian Head, Saskatchewan.

vegetative propagation, and disease and insect control. Solutions to these problems are essential prerequisites to our tree improvement work.

Caragana Projects

The Siberian peashrub has proven an important and versatile tree species for shelterbelt purposes in the Canadian prairies. Favorable results in the control of wind erosion by the use of this species created a demand for increased height growth. This was one objective of the improvement program initiated in 1949

The species was found to be naturally cross-pollinated, with Hymenoptera insects being the principal pollinating agents. Cheesecloth proved superior to paper or plastic bags for isolation of the bloom. Self- compatibility of 218 open-pollination plants, which were selected on the basis of vigor, seed set, etc., ranged from 0 to 100 percent. To date, we have identified 13 self-incompatible (or sterile) vigorous selections. Cross-compatibility results for self-fertile and self-sterile selections appear to be conditioned by the action of several compatibility (S) factors. Regrettably, all self-steriles apparently have the same genotype and hence are cross-incompatible. To overcome this problem we have collected accession material from all possible sources, which should ensure genetic diversity of the growth and compatibility factors.

Inbred and hybrid progenies, which resulted from self- and cross-determinations since 1 948, have been planted in performance tests. Results to date suggest that the vigor potential of progenies may be estimated with reasonable accuracy from the height of 4-year-old seedlings. The fact that some highly self-fertile selections carry good growth factors has been substantiated by the superior vigor of their inbred (S_1) progenies. Tests are in progress to evaluate the combining ability of these vigorous self-fertile selections with existing self-sterile selections.

Softwood cuttings were superior to hardwood cuttings, budding, or grafting as a means of propagating selections. Maximum rooting of softwood cuttings was obtained if collected before moisture content of the wood fell below 71 percent. Malathion treatments gave good control of aphids within isolation bags. Satisfactory means of controlling the seed chalcid have not been determined.

Spruce Improvement Projects

Spruce improvement work was delayed awaiting solutions of problems relating to seed viability, disease, procedures, and personnel. Indices for cone maturity, seed stratification treatments, and controls for damping-off diseases have now been resolved. Through the courtesy of Dr. T. O. Perry of the University of Florida, we have adopted sausage casings for the isolation of spruce bloom. Paper, cotton, and polyethylene materials proved unsatisfactory.

The prime objective of the spruce breeding project is the production of "True-blue" seedlings of Colorado spruce, which appear to be immune to the pine needle scale (Phenacaspis pinifoliae). Selections have been rated from 0 to 5 on the basis of the intensity and distribution of the blue coloration of their needles. Depending on the seedtree, from 12 to 97 percent of the open-pollination seedlings were found to display some degree of blue needle coloration.

Controlled pollinations were started in 1955 to determine the self- and cross-compatibility of selections. The results were seriously distorted by insects in both 1955 and 1956. Male flowers were attacked by larvae of the owlet moth (Epizeuxis sp.) in late May, female flowers were destroyed by larvae of the spruce budworm (Choristoneura fumiferana) in early June, while mature cones were damaged or destroyed by larvae of the spruce coneworm (Dioryctria abietella) and of the spruce seedworm (Laspeyresia youngana). Nevertheless, our results suggest that self- and cross-incompatibilities exist within Colorado spruce.

Control measures for flower and cone insects are under investigation with Mr. L. O. T. Peterson, entomologist. Current tests involve dusts and sprays of DDT, Malathion, Lindane, and Dieldrin.

Grafting methods for Colorado spruce were investigated in 1956. Grafts were made in April on 3-year-old seedlings which were potted a year earlier. The average catch for cleft, side, and bottle grafts was 45, 27, and 9 percent, respectively.

The improvement of while spruce is a major project of Mr. M. Holst at the Petawawa Forest Experiment Station. For this reason we have utilized white spruce only for exploratory studies and tests, such as controlled pollinations, insect control, seed viability, etc.

Pine Studies

Open-pollination progenies from 88 selections of 7 Scotch pine races were field planted in 1952 and 1953. Records for needle-burn and vigor in 1956 revealed that outstanding seedlings were produced by seedtrees of each race. Eighty-five seedlings were selected for grafting and retest. A slight relationship ($r = .55$) was found to exist between the height of the seedlings at 4 and 8 years.

Poplar Improvement

On the basis of performance and rooting, 17 poplar clones were selected from 80 hybrids and 40 species in test station plantings. A test for these 17 clones was planted in 1951, and records were taken in 1956 on survival, disease, and vigor. One clone, FNS 44-52 (a selection of eastern cottonwood), proved outstanding for survival (94 percent), vigor (25 feet), and absence of cankers.

Seed Viability

Problems pertaining to tree seed maturity, storage, dormancy, etc., are being investigated as prerequisites to our breeding program.

Indices for determining the stage of maturity for harvesting spruce cones and peashrub pods have been evolved. Size, yield, and germination of spruce seed were found to increase with maturity of the seed. Viability of mature peashrub seed was double that of immature seed after common storage for 5 years. Dormancy of spruce seed appeared to increase or decrease with maturity depending on the seedtree and seedyear. Dormancy of peashrub seed seemed to decrease with maturation on the tree and decreased further under storage

Hybrid Seed Production

Hybrid progenies, which have been produced to date by hand pollinations, are now in performance tests to identify the superior combinations. It is proposed to mass-produce seed for such superior hybrids in the future by means of natural crossing blocks, The two parental selections of each superior hybrid will be propagated vegetatively and planted as alternate rows in such blocks in an isolated location. It will be essential that one (and preferably both) of the parents be self-incompatible if only one of the parental selections is self-incompatible the hybrid seed will only be produced on clonal material of this selection in a natural c rossing block.

Other Studies

Studies are in progress to resolve the photoperiodic requirements of tree seedlings for progeny tests. Results to date suggest a 16-hour photoperiod is required for peashrub and a 20-hour period for spruce.

Cooperative studies, with Dr. O. Vaartaja, pathologist, have indicated that soil drenches are effective for controlling damping-off diseases. Pre- and post-sowing applications (soil drenches) of Tersan or Captan at 0.6 and 0.2 gram per square foot are recommended.