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# Application of Nursery Testing in Long-Term White Spruce Improvement Programs



**Yuhui Weng, Kathy Tosh, Yill Sung Park, and Michele S. Fullarton**

ABSTRACT

Polycross-pollinated white spruce (*Picea glauca* [Moench] Voss) families were evaluated in field and retrospective nursery tests in 1989, 1991, and 1992, respectively. Height growth was measured at age 10 for the field tests and at ages 1 to 6 for the retrospective nursery tests. Except for a few cases, the family mean correlations between nursery and field heights were significant for the 1989 and 1992 series, and their corresponding genetic correlations ranged from low to medium (from 0.37 to 0.74). Because of heavy noncrop competition, height growth in the 1991 nursery series showed consistently lower heritabilities and correlations with field performance compared with those of the other two series. Early nursery selection by theoretical prediction was generally efficient for the 1989 and 1992 series. Rank classification analysis indicated that application of early nursery selection should be used with caution for identifying elite families but could be used to cull inferior families or clones, apply multiple-stage selection, or perform positive assortative mating.

**Keywords:** early selection, family mean correlation, genetic correlation, selection efficiency, *Picea glauca*, rank classification analysis

White spruce *(Picea glauca* [Moench] Voss) is commercially important as a reforestation species throughout eastern Canada because of its value as pulpwood and construction lumber, and thus, tree improvement and breeding programs have become increasingly important. The potential for improvement for this species is great, because large variability in growth, both among and within populations, has been reported from provenance and progeny trials (Merrill and Mohn 1985, Nienstaedt 1985, Nienstaedt and Riemenschneider 1985, Magnussen 1993).

Genetic improvement of white spruce in New Brunswick was started in the late 1970s (Simpson and Tosh 1997) and generally follows the selection, breeding, and testing scheme outlined by Fowler (1986). Half-sib progeny tests from selected plus trees were established to provide information for seed orchard roguing and next-generation selection. If reliable selection could be made at a young age, the extra gain per unit of time from breeding and testing would be significant. To evaluate family performance at a young age, concurrent testing in a nursery environment was established. Height growth of trees in a nursery has often been found to be a good predictor of field height performance (Magnussen and Yeatman 1986, Mullin et al. 1995, Woods et al. 1995, Bridgwater and McKeand 1997, Adams et al. 2001), although negative examples have also been reported (Bastien and Romat-Amat 1990, Hogberg and Karlsson 1998). The objective of this study was to evaluate the potential of incorporating nursery testing, on the basis of height growth, by rank classification analysis, into long-term white spruce improvement programs. Three series of tests were established in 1989, 1991, and 1992, using field-grown progeny and concurrent nursery tests.

## Materials and Methods

### Field Trials

Three white spruce progeny test series were established by the New Brunswick Tree Improvement Council (NBTIC) in 1989, 1991, and 1992. Seed for these progeny tests were generated by polycrosses on ramets of selected plus trees using a pollen mix of 25 unrelated trees growing in Kingsclear Provincial Nursery and Acadian Forest Station, New Brunswick. The selected plus trees and pollen providers are within the same breeding zone. Seedlings for the field tests were grown in the Kingsclear tree improvement greenhouse in multipots for 1 year, and outplanted at 2 X 2 m spacing. A randomized complete design with 15 blocks of two-tree row plots was used at each test site. Fourteen sites were used for this study, five of which were used for the 1989 test series, four for the 1991 series, and five for the 1992 series. All test sites were well prepared by scarification before planting. These series comprised 127 families: 60 in 1989, 33 in 1991, and 34 in 1992. The sites within each series included a common set of families. The detailed information for these tests was reported elsewhere (NBTIC 1989, 1991, 1992). The last measurement for tree height (HT) was done at age 10.

### Nursery Tests

Nursery tests for 51 of the 60 families included in the 1989 series progeny tests, 31 of the 33 families in the 1991 series, and 32 of the 34 families in the 1992 series were established at the Kingsclear Nursery, 10 km west of Fredericton, New Brunswick, in 1989, 1991, and 1992, respectively. The seedlings were grown in the same greenhouse and similar conditions as those for the field tests, and planted in nursery beds at 50 X 50 cm spacing. A randomized complete block design with 15 replications of one-tree plots was

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*Y.H. Weng (Yuhui.Weng@gnb.ca), New Brunswick Department of Natural Resources, Kingsclear Forest Nursery, 3732 Route 2, Island View, New Brunswick E3E 1G3, Canada. K.J. Tosh and M. S. Fullarton, New Brunswick Department of Natural Resources, Kingsclear Forest Nursery, Island View, New Brunswick E3E 1G3, Canada. Y.S. Park, Natural Resources Canada, Canadian Forest Service, Atlantic Forestry Centre, P.O. Box 4000, Fredericton, New Brunswick E3B 5P7, Canada.* *We thank Dale Simpson and Greg Adams for valuable comments on an earlier version of the manuscript. We appreciate the dedicated NBTIC member agencies of J.D. Irving, Ltd.; UPM-Kymmene Miramichi, Inc.; Bowater Pulp & Paper Company; Bowater Maritimes, Inc.; Canadian Forest Service; New Brunswick Department of Natural Resources; Nexfor Fraser Papers, Inc.; St. Anne Nackawic Pulp Company, Ltd.; and Weyerhaeuser Company Ltd., which contributed so much to the success of this program.*