

Cooperative Advanced-Generation Breeding and Testing of Coastal Douglas-fir and Western Hemlock – Strategy and Implementation

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The IFA-PNW “Progressive Tree Improvement System” was launched in 1966. The emphasis here was on forming local cooperatives to share costs, and on progeny testing large numbers of trees using wind-pollinated seed in small testing zones. This phase ran from 1967 till 1993, during which over 28,000 first-generation Douglas-fir and western hemlock parents were tested in 115 breeding units, with over 3 million progeny test trees planted.

A second-generation breeding and testing strategy for coastal Douglas-fir was developed between 1996 and 1997. First-generation testing programs were merged into larger *testing zones* to share genetic material. Breeding population size for the merged programs was at least 200 selections, but most were >300. Within a breeding population, *breeding groups* of 20-30 selections were constructed, each breeding group was from a single first-generation program. This resulted in sublines to manage inbreeding, and multiple populations to maintain locally adapted gene complexes. The top 10-20 percent of selections within a breeding population were assigned to an *elite population*. The breeding population for each new testing zone is comprised of families/selections from the "local" breeding groups that come from the testing zone, and only the most elite selections from breeding groups originating further away from the testing zone. Each selection is used in at least two crosses, with elite selections being used in 3 or 4 crosses; simulations had shown that the overall gain in an orchard or breeding population, based on two crosses per parent, was over 85% that obtained with six crosses per parent. Some of the elite crosses are made across first-generation zones. Three types of tests are used: family-ranking/selection tests; long-term stability tests; and adaptability-screening tests.

Breeding and testing is underway for seven different programs, which would lead to nine testing zones, over 2,600 crosses, and about 300,000 test trees planted. The rule of thumb in choosing selections crossed to form advanced-generation populations has been a 1 in 10 among-family selection intensity. Most selections were based on age-15 height; information on DBH, stem form and wood specific gravity were also considered.

Between five and six tests are established per testing zone, with 20 trees per cross per site in single-tree plots. Trials established to date have contained from 143 to 283 full-sib crosses, planted as containerized seedlings and fenced for protection against browse. Tests will probably be measured twice, around seven and 12 years from seed, or when the trees are 15 and 30 feet (4.5 and 9 meters) tall respectively.

A single advanced-generation testing zone has been developed for western hemlock, from the mid-point on the Oregon coast to northern Vancouver Island. The main population has 150 parents (chosen from over 1,500 parents) crossed in six-parent disconnected diallels, forming 342 crosses. The elite population based on 30 parents has 166 crosses. Over 130,000 test trees were planted between 1997 and 2001. Age-5 heights for all these trees are to be collected by the end of 2004.