Utilization and management of red alder genetic resources in British Columbia

by

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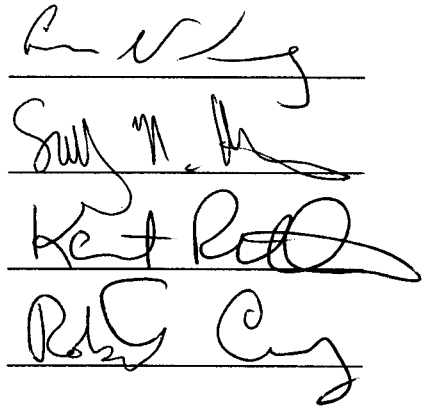

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Abstract

In this thesis genecology, phylogeography, and quantitative genetics of red alder were investigated. Further, literature with respect to red alder product values, market demand, forest resources, and red alder biology were reviewed. Implications of these aspects for genetic resources management were evaluated and a breeding strategy for red alder in British Columbia was developed.

Genetic differentiation among provenances in British Columbia was investigated based on six polymorphic allozyme loci and measurements of six quantitative traits. Multivariate analysis revealed complex associations of quantitative traits with the latitude, distance to the coast, and elevation of the seed source. Nei's genetic distance revealed a strong differentiation among island and mainland provenances at one allozyme locus. This differentiation can be interpreted as a result of migration from two different refugia since the last glaciation.

Adaptation of red alder provenances was investigated based on trials in multiple planting environments. Significant genotype × environment interactions were found at the population and family level. Provenances close to each planting site showed superior performance in growth and survival, suggesting adaptation of red alder to local environments. Seed transfer guidelines and seed procurement zones were developed under the assumption of local optimality using improved methodology based on risk associated with seed transfer.

In order to assess the potential benefits from selection and evaluate different options for tree improvement, genetic parameters for growth and adaptive traits were estimated from progeny tests.

Estimated heritabilities for growth and adaptive traits were moderate with values between 0.30 and 0.50. Genetic gain in growth traits from individual selection would range from 25 to 35%. Small improvements (approximately 5%) would indirectly be achieved in the form score due to positive genetic correlations. Removal of spatially autocorrelated error variation in field experiments increased heritabilities and gains from selection.

A multiple population breeding strategy for uncertain climatic conditions in British Columbia was derived as a synthesis, using information on genecology, risk associated with seed transfer, and genetic parameters. Six breeding populations of red alder, some with novel trait combinations, were found to be necessary to cope with possible effects of climatic warming in British Columbia.

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