

## Improving Root Development: Genetic Selection, Cultural Practices or Both?

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White spruce (*Picea glauca* (Moench) Voss) is a highly variable species with a great potential for genetic improvement. Being one of the most commonly reforested species in Quebec, a local breeding program was set up during the 1960s. Selective criteria exploit the variability of above-ground growth and wood characteristics. To date, no detailed studies have been made with regards to the genetic variability of root system morphology (topology) in conjunction with forest nursery cultural practices.

In this study, we investigated genetic variation in the morphological characters of (1+0) seedlings grown under two substrate fertilities (*optimal or low*) for 75 open-pollinated white spruce families. Particular attention was paid to root systems. An experimental design was installed in an unheated production tunnel at Centre de production de Plants Forestiers du Québec Inc. (CPPFQ, Sainte Anne de Beaupré, QC) in May 2004. A destructive sampling on October 25, 2004 allowed us to measure the morphological characters (height, root collar diameter, root and shoot dry mass,...) and calculate their genetic parameters (heritabilities and genetic correlations).

Given a family heritability estimated to be 0.42 ( $\pm 0.18$ ), under optimal substrate fertility, genetic control of root dry mass is strong enough to permit genetic selection for larger root systems. Moreover, root dry mass has a strong, positive genetic correlation with root collar diameter ( $0.91 \pm 0.09$ ). Thus, by selecting families having the greatest root collar diameters, we can attain 71.4% of the potential improvement of a direct selection for the largest root systems. Meaning that genetic selection for greater root collar diameters favours larger root systems. Finally, some families performed very differently under the two different substrate fertility regimes. Some of these families lost their growth superiority under lower substrate fertility. This is an indication that growth capacity under different environmental conditions should be taken into account when families are selected for seedling production.

A thorough examination of root system morphology for the first year of growth (length, diameter, surface area, ...) is yet to be completed. The entire study will be repeated at the end of the second growing season.