Large and branched root systems can speed up growth of spruces

March 5 2019

There were no differences in the above-ground growth rates of the seedlings.Credit: Sannakajsa Velmala, Luke

The growth rate of trees varies: some trees grow slower and others faster by nature. The amount of nutrients and water a tree receives depends on its root system and the symbiotic mycorrhizal fungi growing in the root system. Earlier studies have determined that fast-growing spruce clones have more diverse selection of symbiotic fungi in their root systems. One cannot determine based on this result whether the diversity is the underlying reason for the fast growth rate or its consequence, however.

"Our goal was comparing the root systems of seedlings before the growth differences appear to find out whether small seedlings already show any external characteristics that anticipate good growth. We utilised Luke's tree breeding data on the origins of fast- and slow-growing spruces," explains Taina Pennanen, Principal Scientist at Luke.

Fast-growing spruces grow extensive root systems already as seedlings

The 54 spruce seedlings that were included in the study were grown at a nursery garden and examined when they were 1.5 years of age and their sprouts were of the same height. Even though there were no differences in the height of the sprouts or the weight of the roots, the structures of the fast- and slow-growing spruces' root systems were already clearly different.

"Interestingly enough, there were more branches in the root systems of the fast-growing seedlings than in those of the slow-growing ones. There were more root tips than in the slow-growing seedlings and more lateral branches farther away from the base of the seedling than in the slow-growing seedlings, and the total length of the lateral branches was higher," explains Leena Hamberg, a Senior Scientist at Luke.

An illustration of the root system of a fast-growing seedling, modelled using the LIGNUM model. Credit: Sievänen et al, 2010.

The large number of root tips farther away from the base of the seedling may allow the fast-growing seedlings to obtain, over the course of time, more diverse fungal contacts and more nutrients from the forest soil where neither nutrients nor fungi are evenly spread. This also enables good nutrient and water carrying capacity.

"Trees are highly long-lived plants, and the differences in the structural characteristics of the roots may become even more pronounced over time. We already know based on our previous studies that the

characteristics of the roots of a spruce are hereditary. This phenomenon may, in part, explain the different growth rates of spruces," Taina Pennanen says.

More information: Early root growth and architecture of fast- and slow-growing Norway spruce (Picea abies) families differ—potential for functional adaptation. *Tree Physiology* 38: 853-864. academic.oup.com/treephys/article/38/6/853/4747888

Provided by Natural Resources Institute Finland