



Unearthing mechanisms behind growth rate in Norway spruce

Taina Pennanen, Sannakajsa Velmala, Matti Salmela, Risto Sievänen, and Leena Hamberg
Natural Resources Institute Finland, Helsinki, Finland (taina.pennanen@luke.fi)

Our studies focus on the relationship of ectomycorrhizal (ECM) fungi and genetically determined growth traits of Norway spruce (*Picea abies*). A long-term field experiment revealed that high ECM species richness was associated with the fast-growing spruce families(1). ECM fungal richness increased functional complementary of the nutrient acquisition potential of the host by diversifying the production of fungal derived exoenzymes(2). Carbon allocation to above- and below-ground parts varied also between fast and slow families, especially in response to increasing fungal richness, including pathogens (3). In contrast to our hypothesis on the underlying mechanisms, genetic differences in susceptibility to ECM symbiosis formation in the host did not contribute to the variation in ECM fungal diversity. Instead, we found systematic, genetically controlled variation in root characteristics between the spruce families(4). Still even-sized but in future fast-growing seedlings showed a higher number of root tips, more frequent branching of root orders as well as allocation of root tips further away from the base of the seedling compared to slow-growing seedlings (5). This provides an advantage in nutrient limited, heterogeneous forest soil by enhancing exploration and contact with the soil microbiota. We conclude that over time, small differences in these specific allocation patterns for root growth create positive self-reinforcing mechanisms that may underlie the higher ECM fungal diversity and long-term growth performance of some spruce origins.

References:

(1) Korkama et al. 2006 New Phytologist 171:815-824; (2) Velmala et al. 2014 New Phytologist 201:610-622; (3) Velmala et al. 2014 Plant & Soil 385:329-342; (4) Velmala et al. 2013 Mycorrhiza 23:22-33; (5) Hamberg et al. 2018 Tree Physiology.