Tree root systems and nutrient mobilization

mineral weathering by rhizospheres and deep roots

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B-19 Forests, roots and soil carbon

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The relationship between fine root and litterfall dynamics across various types of temperate deciduous and coniferous forests. An, J. (*Kyoto University, Japan; jiyoung.an.63c@st.kyoto-u.ac.jp*), Park, B. (*Chungnam National University, Republic of Korea; bbpark@cnu.ac.kr*), Osawa, A. (*Kyoto University, Japan; aosawa@kais.kyoto-u.ac.jp*), Park, G. (*Korea Forest Research Institute, Republic of Korea; graceh03@snu.ac.kr*).

We have little understanding of the relationship between litterfall and fine root dynamics in temperate forest ecosystems, even though these are major components in carbon and nutrient cycling. We studied litterfall, fine root biomass, and production in five deciduous and four coniferous forests at the Gwangneung Long Term Ecological Research Site in Korea. We used ingrowth cores to measure fine root turnover for 2 years. Collected roots were divided into living and dead roots of <0.5, 0.5–1, 1–2, and 2–5 mm in diameter. Litterfall was separated into leaves, twig, bark, seed, and others and all leaves were further separated by species. Our preliminary results show that fine root turnover rate was 1.68/year for deciduous forests and 2.07/year for coniferous forests. Annual fine root (<2 mm) production ranged from 47 to 335 g/m^2 in the first year and from 138 to 490 g/m^2 in the second year. The annual litterfall production ranged from 340 to 597 g/m^2. For further research, we will test the relationships between the fine root production, litterfall production, and environmental variables and the contribution of fine root and litterfall to nutrient dynamics by forest types.

Tree root systems and nutrient mobilization: mineral weathering by rhizospheres and deep roots. Boyle, J. (*Oregon State University, USA; forsol40@comcast.net*), Harrison, R. (*University of Washington, USA; robh@uw.edu*), Raulund-Rasmussen, K. (*University of Copenhagen, Denmark; krr@life.ku.dk*), Zabowski, D. (*University of Washington, USA; zabow@u.washington.edu*), Stupak, I., Callesen, I. (*University of Copenhagen, Denmark; ism@ign.ku.dk; ica@ign.ku.dk*), Hatten, J. (*Oregon State University, USA; Jeff.Hatten@oregonstate.edu*).

Roots mobilize nutrients via deep penetration and rhizosphere processes inducing weathering of primary minerals. These contribute to C transfer to soils and to tree nutrition. Assessments of these characteristics and processes of root systems are important for understanding long-term supplies of nutrient elements essential for forest growth and resilience. Research and techniques have significantly advanced since Olof Tamm’s 1934 base mineral index for Swedish forest soils, and basic nutrient budget estimates for whole-tree harvesting systems of the 1970s. Recent research in areas that include some of the world’s most productive intensively managed forests, including Brazil and the Southeast and Pacific Northwest regions of the United States, have shown that root systems are often several meters in depth, and often extend deeper than soil is sampled. Large amounts of carbon are also sometimes stored at depth. Other recent studies on potential release of nutrients due to chemical weathering indicate the importance of root access to deep soil layers. Release profiles clearly indicate depletion in the top layers and a much higher potential in B and C horizons. Review of evaluations of potential sustainability of nutrient supplies for biomass harvesting and other intensive forest management systems will advance understanding of these important ecosystem properties, processes, and services.

Tree species identity influences the accumulation of recalcitrant deep soil carbon. Godbold, D., Ahmed, I. (*University of Natural Resources and Life Sciences, Austria; douglas.godbold@boku.ac.at; iua@dhaka.net*), Smith, A. (*Bangor University, UK; a.r.smith@bangor.ac.uk*).

Using an acid hydrolysis approach, easily degradable labile and recalcitrant C pools in soils from single and mixed tree stands of *Betula pendula*, *Alnus glutinosa*, and *Fagus sylvatica* and adjacent grassland were determined, in relation to leaf litter inputs and fine root distribution and turnover. The vertical distribution and turnover of fine roots did not differ between species planted in monoculture or polyculture. In the upper layers, no significant differences in C storage or fractionation pools were found between the treatments; however, in the deeper soil layers, the greatest storage of recalcitrant C was found in the polyculture. The C storage in the polyculture soil at depth was significantly greater compared to the *B. pendula*, *A. glutinosa*, and grassland soil, but not statistically different compared to *F. sylvatica*. In the lower soil profile, both *F. sylvatica* and the polyculture had a statistically higher C storage in the recalcitrant pool compared to under grass. In the grassland soil, only 17% of the total recalcitrant C pool was accumulated within the 40- to100-cm layer, whereas in *F. sylvatica* and the polyculture soils, 53% of the total recalcitrant C pool was determined.

Revaluating the role of roots and mycorrhizal hyphae in belowground carbon and nutrient cycling in forests. Guo, D. (*Chinese Academy of Sciences, China; guodl@igsnrr.ac.cn*).

Fine roots of trees are complex branching structures composed of multiple branch orders. The two to three finest branch orders confined to primary development are truly absorptive roots that turn over quickly. These absorptive roots have much less biomass that that of the entire fine root pool, thus previous estimates of fine root mortality and turnover treating all fine roots as one dynamic unit may have substantially overestimated total absorptive root turnover. Moreover, these absorptive roots contain high concentrations of C and N, contributing to their slow decomposition. The absorptive roots of many tree species also bear abundant root hairs and/or mycorrhizal hyphae, which turn over more rapidly than absorptive roots. These microscopic structures also influence total C and nutrient input into the soil and subsequent soil C sequestration. Reevaluating turnover for absorptive roots and including mycorrhizal and root hair turnover would significantly improve the accuracy of total belowground C and nutrient turnover and subsequent C storage in the soil.