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N cycling and the composition of terpenes and tannins in boreal forest soils: Effects of logging residues

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There is increasing evidence available that certain terpenes and tannins may mediate substantial changes in nitrogen cycling processes in boreal forest soils. Terpenes and tannins are two important groups of plant secondary metabolites: Terpenes are hydrocarbons having different number of isoprene-derived units and tannins are complex polyphenolic compounds able to interact with proteins. Logging residues, consisting of fresh tree tops and branches with needles contain large amounts of terpenes and tannins. Currently there is increasing demand for forest biomass for bioenergy production. Therefore, harvesting of logging residues has become more common from both clear-cutting and thinning stands, instead of conventional stem-only harvest where logging residues are retained on the site. Our aim was to determine how logging residues affect soil N cycling processes in Scots pine and Norway spruce thinning stands in long-term, and how these processes are related to the composition of terpenes and tannins in the soil. Samples were taken from the humus layer of pine and spruce experiments which had been thinned 4-to-19 years before; in the thinning different amounts of logging residues had been distributed on the plots. Logging residues had only little effect on soil microbial biomass N or C. However, in several sites logging residues increased the rate of net N mineralization and the ratios net N mineralization/ C mineralization and net N mineralization/microbial biomass N, and these positive effects were very long-lasting. Logging residues also changed the composition of different terpenes and condensed tannins in soil. In general, with regard to the processes and ratios indicating N availability, stem-only harvest seems to be more favorable than whole-tree harvest. The results from long-term field experiments will be discussed in relation to the effects of different terpenes and tannins, observed in short-term laboratory experiments, on N cycling processes.