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Afforestation of former pastures with Picea abies in a subalpine ecosystem affects the microbial community composition

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This study was conducted to assess the implications of afforestation on soil microbial communities, which are a key driver for many processes within the plant-soil system. In Switzerland, the forested area in the Alps has increased by 7.6% between 1982 and 1993 (Swiss National Forest Inventory, 1999) mainly due to economical reasons. This leads to significant changes in quantity and quality of the organic matter (SOM) input into soils and concomitantly influences soil microbes, which govern SOM decomposition and carbon turnover.
Analysis of phospholipid fatty acids (PLFA) was used to investigate microbial community composition in soils under pasture, various afforestations differing in age and an old growth forest. The study site is located on a uniform slope between 1500-1800 m a.s.l. in the canton of Fribourg, Switzerland, in a subalpine ecosystem. Soils were classified as cambisols. To asses the vertical distribution of soil microbes, samples were taken from 10 profiles under pasture and afforestation (40y) respectively in 0-10cm, 10-40 cm and >40cm. Additionally, 5 replicates (0-10cm) each were sampled in 3 pasture plots, 4 afforestation plots (25y-25y) and the old growth forest (>120y). Abundance of soil microbes decreased with depth as well as the relative proportion (mol%) of gram negative bacteria and arbuscular mycorrhiza while the contrary was observed for actinomycetes. Principal component analysis revealed a significant effect of land use on soil microbial communities only in 0-10 cm but not for greater depths. In the uppermost soil horizon, wider carbon to nitrogen (C:N) ratios of soils led to an increase of fungi while the proportion of bacteria decreased. High pH affected gram negative bacteria positively. Arbuscular mycorrhiza were most abundant in pasture soils and declined with increasing age of afforestation with a minimum in the old growth forest. Total PLFA concentration in the old growth forest was about 20% smaller compared to grassland. However, no consistent decline with stand age could be observed.
Our results showed that afforestation significantly affected the composition of soil microbial communities in this subalpine ecosystem. However, this effect was limited to the uppermost soil horizon (0-10cm). C:N-ratio and soil pH were most important factors governing microbial communities. In contrast to other studies, neither an increase in fungi nor a decrease of total PLFA under afforestations could be observed.