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Composition of soil microbial carbon sources in a temperate beech forest

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In the global carbon cycle, soil organic matter (SOM) plays an important role as a dynamic carbon reservoir. This demonstrates soils to be important terrestrial carbon pools. The transformation of carbon in soils is mainly driven by microbial activity. Therefore, the analysis of microbial biomarker such as phospholipid fatty acids (PLFA) is a valuable tool to investigate the role of micro-organisms in soil carbon cycling. In addition, stable carbon isotope analysis of PLFA provides great information about soil microbial carbon sources such as fresh plant litter, SOM or recycled SOM. However, additional carbon sources like dissolved organic matter (DOM) or soil gases may also be recognized using stable isotope techniques.

For our study we used soil samples from a temperate beech forest (Hainich, Germany). Soil was sampled in autumn of 2004 at three characteristic seasonal points in time: four weeks prior to litter fall, during litter fall and three weeks after litter fall. Furthermore, soil samples were taken from four different study sites of a 5 hectare study area. Study sites were chosen to represent different soil characteristics like thickness of soil horizons, clay content, nitrogen and nitrate content.

The purpose of our study was to compare microbial community structures and to identify different microbial carbon sources in dependence of a) litter availability and quality and b) different soil characteristics.

Our results show that microbial community structures are very similar in all soil samples. Thus, soil characteristics and litter availability and quality do not influence the

composition of soil microorganisms. However, soil respiration measurements demonstrated an increased microbial activity after litter fall at all study sites. This is also in line with 13C measurements of individual PLFA at this time as PLFA clearly represent the isotopic signature of litter. Thus, compared to the time before and during litter fall, where also SOM contributes to microbial carbon sources, this demonstrates increased microbial degradation of fresh litter. However, variable microbial carbon sources could be identified for different microbial groups such as Gram-positive bacteria, Gram-negative bacteria and fungal biomass.

We conclude that soil microbial activity is highly influenced by litter quantity and quality, while it is less dependent by soil characteristics at the investigated study site.