

Studying soil microbial communities by ¹³C-PLFA analysis - combining form and function

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Soil microbes are the key players in soil carbon cycling. Yet still little is known about the soil microbial community structure and the functioning of specific microbial groups. This is largely due to methodological constraints, since more than 90% of the soil microorganisms are non-culturable. Modern tools, like ¹³C-PLFA analysis are necessary to advance the understanding of functional traits in soil microbial carbon cycling. We applied ¹³C-PLFA method in conjunction with a ¹³C pulse-chase labelling experiment to study the flow of plant-derived carbon through the soil microbial community in an extracted peatland cultivated with reed canary grass for bionenergy use. Three control plots were labelled with ¹³CO₂ (99 at%) for 6 h, and additionally three plots which received a lime treatment to study potential effects of increased pH on the flow of carbon. The ¹³C label was followed in PLFAs at days 0,1,3,5,7,21 100, 304, 365, 464 after labelling. The highest label was observed in PLFA 16:0 which is present in all microbial cells and the starting point for biosynthesis of longer chain fatty acids. Out of the group-specific biomarkers, highest label was observed in fungal biomarker 18:2 in the first year after labeling. Thus fungi seem to have an important role in the turn-over of rhizodeposits. The label peaked at day 1 after labeling, indicating that carbon is rapidly transported from the leaves into the soil. Liming increased the incorporation of label into PLFAs, mostly pronouncedly in fungal biomarkers in the first year. Thus, liming seemed to increase soil carbon cycling. Even though the amount of label varied in different PLFAs, the temporal pattern of label incorporation was rather similar in different microbial groups showing no specific hierarchy in the microbial food-web. This indicates that all of the microbial groups are closely connected with plant-derived organic matter. The reason for this could be low quality of the old peat serving only limited substrates for microbes. These results show the applicability of the ¹³C-PLFA technique to study the functioning of the soil microbes. First links between microbial groups and specific soil processes in bioenergy cultivations could be identified.