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Changes in microbial structure and functional communities at different soil depths during 13C labelled root litter degradation

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Soil organic matter turnover depends on substrate quality and microbial activity in soil but little is known about how addition of freshly added organic material modifies the diversity of soil microbial communities with in a soil profile. We took advantage of a decomposition experiment, which was carried out at different soil depths under field conditions and sampled litterbags with 13C-labelled wheat roots, incubated in subsoil horizons at 30, 60 and 90 cm depth for up to 36 months. The effect of root litter addition on microbial community structure, diversity and activity was studied by determining total microbial biomass, PLFA signatures, molecular tools (DNA genotyping and pyrosequencing of 16S and 18S rDNAs) and extracellular enzyme activities. Automated ribosomal intergenic spacer analysis (ARISA) was also carried out to determine the differences in microbial community structure.
We found that with the addition of root litter, total microbial biomass as well as microbial community composition and structure changed at different soil depths and change was significantly higher at top 30cm soil layer. Moreover, in the topsoil, population of both gram-positive and gram-negative bacteria increased with root litter addition over time, while subsoil horizons were relatively dominated by fungal community. Extra-cellular enzyme activities confirmed relatively higher fungal community at subsoil horizons compared with surface soil layer with bacteria dominant microbial population. Bacterial-ARISA profiling illustrated that the addition of root litter enhanced the abundance of Actinobacteria and Proteobacteria, at all three soil depths. These bacteria correspond to copiotrophic attributes, which can preferentially consume of labile soil organic C pools. While disappearance of oligotrophic Acidobacteria confirmed the shifting of microbial communities due to the addition of readily available substrate. We concluded that root litter mixing altered microbial community development which was soil horizon specific and its effects on soil microbial activity may impact on nutrient cycling.