Geophysical Research Abstracts
Vol. 17, EGU2015-15064-1, 2015
EGU General Assembly 2015

Catalytic properties of enzymes hydrolyzing soil organic matter in the rhizosphere and detritusphere

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We established a field experiment to determine the effects of contrasting substrate quality, namely, soil organic matter, maize shoot litter and rhizodeposites on microorganisms and their extracellular enzymes in an arable soil. Additionally, enzyme kinetics (β-cellobiohydrolase, β-glucosidase, acid phosphates and β-xylosidase) were measured in 0–10 and 10–20 cm to elucidate the effect of substrate amount on substrate affinity and catalytic efficiency of extracellular enzymes hydrolyzed soil organics.
A clear plant effect was observed only in topsoil compared to litter amended and fallow soil, indicating higher microbial activity and enzymatic turnover. Consequently, a lower enzyme affinity to the specific substrate demonstrated the domination of r-strategists, which are favored in the decomposition of easily available substrates. This resulted in higher microbial biomass and microbial respiration in planted topsoil compared to litter amended and fallow soil.
These effects disappeared in 10–20 cm, reflecting lower abundance of rhizodeposits as regular substrate input. The consistent reduction of the Km with depth indicated higher substrate affinity of hydrolytic enzymes in 10–20 cm as a consequence of decreasing amounts of substrates with the depth. Enzyme affinity to specific substrates increased from 0–10 to 10–20 cm. This pointed to a shift towards a more K-selected microbial community. The catalytic efficiency showed clear responses due to substrate quality and soil depth. The increasing catalytic efficiency for all measured extracellular enzymes with depth reflected that the decreasing amount of substrates resulted in clear changes in functioning of enzymatic system. In conclusion the catalytic efficiency clearly reflected microbial substrate utilization and enzymatic flexibility on contrasting hotspots of substrate quality in an arable field.