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# Hotspots in the rhizosphere

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Rhizosphere is an interface in soil with very intensive interactions between living (roots and microorganisms), solid (minerals and organics), liquid (water with dissolved organic and mineral substances) and gaseous phases. Biogeochemical environment in the rhizosphere is completely different from that of the root free soil. These differences are mainly induced by the release of easily available organic substances by roots into the soil and subsequent changes of microbial composition, activity, turnover rates of organics and weathering rates etc.
An overview of microbial hotspots in rhizosphere is presented. 14C budget studies showed that the amount of easily available organics released by roots in such hotspots is very large and corresponds to 15-25% of net assimilated plant C. As shown by autoradiography and phosphor imaging, these high amounts of available C are allocated mainly on root tips and so, produce small hotspots with properties completely different from the root free soil. The lifetime of the individual hotspots in the rhizosphere is short – not longer than 10 days. Thereafter, the released exudates are completely decomposed and partly utilized by rhizosphere microorganisms. The spatial extension of the rhizosphere based on diffusion of 14C labeled exudates released from roots is maximal 10-15 mm from the root surface. However, based on diffusion profiles of the main nutrients to the roots, the extension of the rhizosphere is much shorter and does not extend 2-3 mm. As shown by microbial growth kinetics after substrate addition, the rhizosphere microorganisms have 25% higher specific growth rates compared to that of the root-free soil. Wright-Hobbie approach reveals that maximal mineralization potential for organic substances increase in the rhizosphere for 2.5 times. All these changes induced by growing roots, lead to accelerated turnover of soil organic matter for 10% to more than 100%. Also the weathering of minerals is accelerated for 2-20 times in the rhizosphere compared to the root-free soil due to released carboxylic acids.
Concluding, the release of easily available organics by roots leads to changes of interface properties in the rhizosphere compared to the root-free soil and especially of the process rates on the interfaces. These root induced changes should be considered by evaluation of fate of substances on biogeochemical interfaces and by modeling.