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Phosphorus mobilization in acid forest soils as affected by interactions of water regime and growth of beech

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Little is known how different water regimes affect the mobilization and bioavailability of phosphorus (P) in soils. Of particular interest are sequences of dry and wet periods, predicted to increase as a consequence of climate change. The study is carried out in the framework of the German priority program SPP 1685 – Ecosystem Nutrition focusing on P nutrition in forest ecosystems. P cycling is studied on five permanent monitoring sites, ranging from P poor (recycling system) to P rich (acquiring system) forests dominated by beech (Fagus sylvatica). In this project we study beech saplings and topsoil samples from the two most contrary sites, Bad Brückenau (P rich, Northern Bavaria, Skeletic Cambisol, Basalt) and Lüss (P poor, Lower Saxony, Folic Cambisol, Pleistocene sand). The objective of the study is to assess the effects of different water regimes on the mobilization of P and its availability to microorganisms and trees.

With drying re-wetting (DRW) experiments we want to test the hypotheses that the influence of DRW on P loss and P uptake is larger in recycling systems, that the indicators of microbial and plant-induced P mobilization potential react differently to DRW and that beeches compete with microbes for P most effectively at wet conditions.

Water regimes will be manipulated in fully randomized greenhouse experiments with beech saplings growing in naturally structured soil cores. Parallel to a control kept approximately at field capacity, soil cores will be dried to a water potential of -1000 hPa and then re-wetted at different rates to -10 hPa. The soil cores will be randomly probed by zymography to assess the spatial heterogeneity in phosphatase activity, which is considered an indicator of the potential to mineralize organic P. Ion exchange membranes will be applied in the same manner to sample low-molecular weight carboxylates, indicators of the potential to mobilise inorganically bound P. Labelling experiments with 33P will be done in order to study the competition between plants and microorganisms. A labelling pulse is traced into plant tissue, microbial biomass and exchangeable soil P.

On this poster, I will present results of preliminary 33P experiments, that are conducted in order to test the feasibility and validity of two analytical approaches to assess exchangeable and microbial P. The classical method, which involves a slurry extraction in water in the presence of an anion exchange membrane with and without hexanol, is compared to a direct application of the anion exchange membrane to a soil sample at a given soil moisture.