Geophysical Research Abstracts
Vol. 12, EGU2010-5339, 2010
EGU General Assembly 2010

Temporal dynamics of available and microbial phosphorus and organic phosphorus mineralization in a grassland soil

Frank Liebisch (1), Fabrizio Keller (1), Emmanuel Frossard (1), Olivier Huguenin-Elie (2), Astrid Oberson (1), and Else Bünemann (1)

(1) ETH Zurich, Institute of Plant, Animal and Agroecosystem Sciences, Group of Plant Nutrition, Switzerland (frank.liebisch@ipw.agrl.ethz.ch), (2) Agroscope Reckenholz-Tänikon, Research Station ART, Switzerland

Turnover of phosphorus (P) through the microbial biomass and P mineralization have been reported as two main biological factors controlling P availability in soils. This is particularly true for grassland soils where organic matter is accumulated in the topsoil and microbial activity is high. The amounts of plant available inorganic P and microbial P can fluctuate over the season, but their interaction and responses to changes in environmental conditions, fertilization and cutting are not yet well understood. Also, gross P mineralization has not yet been measured in grassland soils.

We studied P mineralization and immobilization in a species rich grassland managed at low intensity (with three harvests per season) under different P inputs. The trial was established in 1992 in Watt (Switzerland). Three different P input treatments were selected: no P (NK), mineral P (NPK) and organic P (NPKorg) fertilization, with 17 kg P $ha^{-1}yr^{-1}$ applied as superphosphate and slurry, respectively (rates according to Swiss fertilizer recommendations).

We used two different approaches. Firstly, available (anion exchange resin extractable) and microbial P (hexanol labile P) were measured in fresh samples periodically taken throughout the vegetation period. Secondly, an isotopic dilution technique was applied on composite topsoil samples (0-5 cm) to determine rates of basal P mineralization and microbial immobilization of P in an incubation experiment.

During the season available P ranged from 0.9-3.5, 5.3-11.2 and 1.9-6.7 mg kg^{-1} $soil^{-1}$ and microbial P from 20-44, 43-59 and 61-93 mg kg^{-1} $soil^{-1}$ in NK, NPK and NPKorg, respectively. Thus, microbial P was highest in NPKorg whereas available P was highest in NPK. Both P pools were lowest in NK. Average annual yield was lowest in NK (4.5 t ha^{-1}), NPKorg (6.5 kg ha^{-1}) and highest in NPK (7.5 t ha^{-1}). However, no consistent relationship between changes in microbial and available P and plant productivity was found. Changes in weather conditions were reflected by changes in available and microbial P measured in the field. Phosphorus flushes were observed after dry periods (microbial P reduced and available P increased). Whereas fluctuations show microbial P release and P immobilization, an expected counteraction of microbial and available P could not be fully confirmed. In the incubation experiment microbial and available P were similar to average values in the field. A higher respiration rate measured in NPKorg indicated a higher microbial activity than in the other two treatments. Despite the differences in microbial P and respiration, the ^{33}P recovery in the microbial biomass between 3 and 30 days of incubation was about 30% in all treatments.

In conclusion we found complex interactions of available and microbial P with climate, fertilization, sward cutting and plant growth. An increased immobilization of P indicated by higher microbial P in the organic fertilized treatment was not confirmed in the isotope study. Gross and net mineralization data are still under analysis and will be presented at the conference.