Geophysical Research Abstracts
Vol. 17, EGU2015-15061, 2015
EGU General Assembly 2015

The fate of P solubilization during decomposition of soil organic matter as regulated by drying-rewetting and freeze – thawing events

llya Yevdokimov (1) and Evgenia Blagodatskaya (1,2)

(1) Institute of Physicochemical and Biological Problems in Soil Science, Pushchino, Russia, (2) Dept. of Agricultural Soil Science, University of Göttingen, Germany

Drying-rewetting and freeze-thawing events are known to provoke solubilization of nutrients in soil. However, immobilization-mineralization cycles of such an important nutrient as phosphorus under these abiotic perturbations are still poorly understandable, mainly because the P pulses are often disguised by fast processes of P sorption on soil particles. Our research aimed to elucidate the P release and its uptake by soil microorganisms depending on drying-rewetting and freeze-thawing events.

The effect of abiotic factors was studied in incubation experiments with soil sampled from four soil types: Podzol (Corg 3.3%, pHH_2O 3.5), Phaeozem (Corg 1.4%, pHH_2O 5.6), Chernozem (Corg 3.4%, pHH_2O 6.9), and Calcisol (Corg 1.9%, pHH_2O 8.3). Three treatments were used: control (soil incubated at 22oC and 70% WHC), drying-rewetting (DRW) and freeze-thawing (FTH). Air-drying in DRW treatment was provided at 22oC temperature during 12 h, followed by 6 d exposition at this temperature, rewetting to 70% WHC and measuring water-extractable and microbial P pools 12 h after rewetting. Soil in FTH treatment was exposed to freezing at -10oC, 6 d exposition at the same temperature and 12 h thawing at 4oC followed by the same analytical procedures as for DRW treatment. Microbial and water extractable P pools were analyzed in control soil in parallel with those in DRW and FTH. Soil in all the treatments was labeled with a spike of 33P- orthophosphate. Microbial P was determined using the “direct” fumigation-extraction where 24 h exposition of soil to chloroform vapors was substituted by direct water/chloroform extraction; both water extractable and microbial P were analyzed after sorption on anion-exchange membranes.

Despite the variability of soil pH and Corg content, all the soil types tested demonstrated similar trends: freeze-thawing led to increase in water extractable 33P, while soil in DRW treatments had lower 33P values compare to control. Microbial 33P followed the pattern FTH<control<DRW, i.e. the maximal immobilization of labeled phosphorus was in soil exposed to drying-rewetting. High microbial 33P immobilization can be explained by the use of additional C solubilized at drying-rewetting as a substrate for microbial growth. Low 33P input to microbial biomass after freezing-thawing was found probably due to low temperature of thawing (4oC) compared to much higher temperature for DRW and control treatments (22oC). The trends in total water extractable and microbial P pools were not that prominent probably due to an effect of changes in other, more recalcitrant pools of soil P. Therefore, the use of 33P spike allowed simulating a combination of fast processes in soil caused by abiotic perturbations.

The recovery of labeled P in water extractable and microbial P varied depending on soil type and treatment: 31- 58% (mean 39%) for DRW; 40 – 62 % (mean 48%) for the control, and 62-77% (mean 67 %) for FTH, respectively. Hence, the extreme events demonstrated oppositely directed effect on P sorption in soil: drying –rewetting led to increase, while freeze-thawing – to decrease in P not recovered as a sum of water soluble and microbial P pools as compared to the soil under optimal moisture and temperature.