Geophysical Research Abstracts
Vol. 15, EGU2013-8785, 2013
EGU General Assembly 2013

Organic Phosphorus Characterisation in Agricultural Soils by Enzyme Addition Assays

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Phosphorus (P) is a non-renewable resource and it is a building block of many molecules indispensable for life. Up to 80 per cent of total soil P can be in organic form. Hydrolysability and thereby availability to plants and microorganisms differ strongly among the multitude of chemical forms of soil organic P. A recent approach to characterise organic P classes is the addition of specific enzymes which hydrolyse organic P to inorganic orthophosphate, making it detectable by colorimetry. Based on the substrate specificity of the added enzymes, conclusions about the hydrolysed forms of organic P can then be made. The aim of this study was to determine the applicability of enzyme addition assays for the characterisation of organic P species in soil:water suspensions of soils with differing properties. To this end, ten different soil samples originating from four continents, with variable pH (in water) values (4.2-8.0), land management (grassland or cropped land) and P fertilization intensity were analysed. Three different enzymes were used (acid phosphatase, nuclease and phytase). Acid phosphatase alone or in combination with nuclease was applied to determine the content of P in simple monoesters (monoester-like P) and P in DNA (DNA-like P), while P hydrolysed from myo-inositol hexakisphosphate (Ins6P-like P) was calculated from P release after incubation with phytase minus P release by acid phosphatase. To reduce sorption of inorganic P on soil particles of the suspension, especially in highly weathered soils, soil specific EDTA additions were determined in extensive pre-tests. The results of these pre-tests showed that recoveries of at least 30 per cent could be achieved in all soils. Thus, detection of even small organic P pools, such as DNA-like P, was possible in all soils if a suitable EDTA concentration was chosen. The enzyme addition assays provided information about the hydrolysable quantities of the different classes of soil organic P compounds as affected by various soil specific variables. Thus, the characterisation of soil organic P by enzyme addition assays was further developed and shown to be applicable on a very wide range of soil types. The method also bears the potential for describing translocation processes of dissolved organic P species in soil – aquifer systems.

Key words: soil organic phosphorus characterisation, enzyme additions, dissolved organic P