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Soil organic phosphorus characterisation on a glacial chronosequence (Damma, Switzerland)

Klaus A. Jarosch (1), María I. Requejo (2), and Else K. Bünemann (1)

(1) ETH Zurich, Institute of Agricultural Sciences, Group of Plant Nutrition, Lindau (ZH), Switzerland (klaus.jarosch@usys.ethz.ch), (2) Centro Agrario El Chaparrillo, Consejería Agricultura Castilla La-Mancha, Ciudad Real, Spain

Soil organic phosphorus (P) may play a significant role in ecosystem P dynamics, yet, little is known about the development of different organic P classes over time. According to the commonly accepted model, relative proportions of organic P are expected to increase quickly after the commencement of soil development, subsequently remaining relatively stable over time. We tested this hypothesis on a young soil chronosequence in the Damma glacier forefield (Switzerland), where we examined the development of different organic P classes over time. In detail, we hypothesized that organic P compounds resistant against broadly active phosphatase-enzymes would increase with soil age.

Soil samples (0-5 cm) were taken on 21 sites with 6 to 136 years of soil development. Using enzyme addition assays to soil extracts (0.25 M NaOH / 0.05 M EDTA), four organic P classes were detected: a) *Monoester-like P* (organic P hydrolysed by an acid phosphatase), b) *DNA-like P* (organic P hydrolysed by a nuclease in combination with an acid phosphatase, minus monoester-like P), c) *Inositol Phosphate-like P* (organic P hydrolysed by a phytase, minus monoester like P) and d) *Enzyme stable P* (difference between total extracted organic P and the three enzyme labile P classes a, b and c).

NaOH-EDTA extractable inorganic and organic P increased with soil age from 4.2 and 5.2 mg kg^{-1} at the youngest sites to 23.9 and 64.5 mg kg^{-1} at the oldest sites, respectively. On all sites, more organic than inorganic P was extracted. We observed a strong linear relationship between organic and inorganic P along the chronosequence. Between 60 and 100% of extractable organic P was hydrolysed by the added enzymes, without a clear trend with respect to soil age. On most sites, Inositol phosphate-like P was the most prominent organic P class (1.8-24.3 mg kg^{-1}). However, on some sites higher amounts of monoester-like P were detected (0.4-23.4 mg kg^{-1}). DNA-like P ranged from nil to 12.9 mg kg^{-1}.

Thus, we observed a significant increase in all forms of organic P with increasing soil age, except enzyme-stable P which fluctuated across the chronosequence. The results will be interpreted in relation to published data on microbial and plant community composition.

Keywords: Soil organic phosphorus, Damma chronosequence, Enzyme addition assays