Effects of soil drying and rewetting on forms and quantities of phosphorus in leachate

Martin S.A. Blackwell[1], Philip C. Brookes[2], N. de la Fuente-Martinez[1], P.J. Murray[1], K.E. Snars[2], J.K. Williams[1], P.M. Haygarth[1,3]

[1] North Wyke Research , Okehampton, Devon, EX20 2SB, UK; [2] Rothamsted Research, Harpenden, Hertfordshire, AL5 2JQ, UK; [3] Lancaster Environment Centre, Lancaster University, LA1 4YQ, UK

martin.blackwell@bbsrc.ac.uk

The drying and rewetting of soils has long been known to result in the increased mobilisation of nutrients which potentially can transfer from the soil via leachate and contaminate surface waters. There are still many gaps in our knowledge of the processes, soil properties and sources involved in the regulation of the quantities of nutrients released in this way. In the laboratory we tested the hypothesis that the rate of rewetting of a dried soil affects the solubilisation and ultimately the concentrations of phosphorus (P) and other nutrients present in leachate (Blackwell et al. 2009). Firstly we prepared a grassland pelostagnogley soil by passing it through a 2 mm sieve and removing all visible live floral and faunal material. Half the soil was dried at 35 °C and half was maintained at approximately 40% water holding capacity. Both dried and moist soils were loosely packed into funnels plugged with glass wool and 25 ml of deionised water was added gradually over periods of 0, 2, 4 , 24 and 48 hours. The leachate was collected and analysed for dissolved and particulate reactive and total P. Soil microbial biomass was measured in the initial dried and moist soils, and subsequently in all soils following completion of rewetting. While drying caused a significant reduction in microbial biomass, there was no significant difference between the microbial biomass in soils rewetted at different rates. In all cases P concentrations were significantly higher in the leachate from the dried soil treatments than from the moist soil treatments. Dissolved P concentrations were highest in the leachate from the 2 hour treatment, while for particulate P, concentrations were highest in the 0 hour treatment. However, these differences could not be attributed to differences in release or response of the microbial biomass. The results probably reflect variables including the energy of the rewetting water available for mobilisation and transfer of particulates, optimisation of conditions for solubilisation of P and minimisation of opportunities for recycling of released P within the soil. In subsequent experiments we investigated the effect of rate of rewetting on intact soil cores to see if the effects were still apparent in structured soils. We also investigated whether the 2 hour peak concentration was in fact a true peak by replicating the first experiment but at a higher temporal resolution; rewetting was carried out over periods of 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5 and 4 hours. In both these experiments the relationships of P in leachate with nitrogen species were investigated. The results of these experiments are also presented. These experiments suggest that changes in patterns of rainfall as a result of climate change could significantly affect the quantities of P leached from soils.

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