THE INFLUENCE OF PHOSPHORUS FERTILITY AND LIMING ON THE FORMS AND FRACTIONS OF PHOSPHORUS LEACHED FROM ORGANIC SOILS

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Abstract

Acid Organic soils often require extensive development for intensive agriculture. One key limitation to pastoral productivity is soil acidity, which is corrected by the application of lime. However the application of lime also increases P solubility and the mineralisation of organic matter (OM), releasing phosphorus (P) that if lost from land may impair water quality. The aim of this study was to identify the effect of changing pH in an Organic soil on the quantities and forms of P lost in leachate. Our hypothesis was that the quantity and bioavailability of P lost from organic soils would increase with pH and that this would be exacerbated when P was also applied. An acid mesic Organic soil of very low anion storage capacity (< 3%) was collected (30-60 cm) from a single paddock, dried and sieved (8 mm) then packed into lysimeters at field bulk density. Lysimeters received treatments of superphosphate (equivalent to 0, 50, 100 or 200 kg P/ha) and lime designed to generate an initial soil pH of 4.5, 5.5 and 6.5, sown in ryegrass, artificial rainfall applied over 1 months approximating the mean annual rainfall at the collection site, and leachate collected.

Mean soil Olsen P, water extractable P and $CaCl_2$ extractable P increased with P application rates. Dissolved reactive P (DRP) and dissolved organic P loads in leachate were greatest from the pH 4.5 treatment, with the pH 6.5 treatments losing the least DRP. Dissolved organic P (DOP) was also greatest from pH 4.5 treatments, but was not significantly different between pH 5.5 and 6.5 treatments. Fractionation data showed that most P was housed in NH_4Cl and $NaHCO_3$ extractable (and highly bioavailable) P forms. More P was extracted by HCl with increasing pH. Changes associated with leaching were largely due to bioavailable and HCl extractable pools; NaOH extractable P was very low (P associated with Al/Fe oxides and humic material) and changed little. The findings of this study demonstrate that in soils with few Al and Fe metal oxides (i.e. very poor ASC), insoluble Ca-phosphates can play a significant role determining P losses. We therefore recommend the addition of lime in this soil to raise soil pH >5.5 to prevent P losses. Furthermore, this did not appear to influence mineralisation and enhance P losses as originally hypothesized. However, this could change if more P is bound in organic matter as fertility is raised.