SOIL TYPE AND MOISTURE AFFECTS PHOSPHORUS LOSS PATHWAYS FORMS AND RATES

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Abstract

Soil moisture plays an important role in phosphorus (P) losses in runoff. Under moisture-rich anaerobic conditions, the reduction of Fe-oxides releases sorbed P into the soil solution that may be available for loss by transport processes in dissolved form. Under very dry conditions, soil hydrophobicity induced by soil organic C can exacerbate infiltration-excess overland flow and soil erosion. Our hypothesis was that rainfall applied to dry soil would cause more P loss (especially as particulate P; PP) in overland flow from an Organic (C-rich) soil than from a Brown soil of much lower soil C, but fertilised with P at a similar rate due to hydrophobicity. However, when at high soil moisture, P losses would be largely dissolved and reflect the Fe concentration of the soil. An Organic and Brown soil with similarly low Olsen P concentrations (c. 9 mg/L) were collected (10-17.5 cm depth) and placed in boxes designed to collected overland flow and subsurface flow. Superphosphate was applied to increase Olsen P to 15, 40, 60 and 80 mg P/L for each soil type, equilibrated for 3 months and then divided into two soil moistures (field moist or air-dry). After three weeks, artificial rainfall was applied generating overland flow and subsurface flow.

The water drop penetration time for the Brown soil when dry was < 5 seconds, but 3600 s for the Organic soil. Consequently, the greatest runoff volumes were measured as infiltration-excess overland flow from dry Organic soil. Total P (TP) loads in overland flow from both soils increased linearly with increasing P rate. The relative proportion of TP as PP was greater in Brown soils. However, overland flow loads of TP and PP were much greater in the Organic soils. Under wet conditions the proportion of TP as DRP and dissolved organic P in subsurface flow was much greater. Nevertheless, due to a much lower anion storage capacity the load of all P fractions was still much greater from the Organic compared to the Brown soil – irrespective of the loss pathways. The findings of this study indicate that soil moisture affects loss pathways, but interacts with soil type to determine the form and quantity of P lost.