A concurrent time and depth assessment of soil and leachate phosphorus in poultry manure-amended soil columns

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Time and depth studies of phosphorus (P) transport and transformation in soils have previously focused on soil measurements taken initially or following a leaching experiment. In order to better-predict P loss potential from soils we must understand the time and depth scale over which changes in P solubility influence leaching characteristics. Three poultry-manured soil columns were fitted with soil sampling ports at 0-5, 5-10, and 10-15 cm depths as well as a spigot for leachate collection. Soil total P (TP) and metals (Ca, Mg, Al, Fe, Mn), water and bicarbonate extractable P (WEP/BEP), degree of P saturation (DPS), pH, and total C and N were measured biweekly. P species in NaOH-EDTA extracts of soils were assessed using solution ^{31}P nuclear magnetic resonance spectroscopy. Leachate pH, total P (TP_L), total dissolved P (TDP), and dissolved molybdate reactive P (DMRP) were measured weekly. Leachate dissolved unreactive P (DUP = TDP – DMRP) and total particulate P (TPP = TP_L – TDP) were calculated. Degree of phosphate saturation (DPS) in manured and control soils was high (>60%) and did not change appreciably with time. Increasing soil WEP and BEP concentrations were correlated with TDP concentrations during the ten weeks, particularly in the 10-15 cm depth (R^2=0.427, 0.532). Particulate-P leaching was enhanced following manure application and was likely mediated by organic matter. Microbial activity in the 0-5 cm depth, as indicated by the presence of pyrophosphate and orthophosphate diesters, likely contributed to the solubilization of organic P (OP) and resultant orthophosphate release to soil and leachate over ten weeks. *Myo*-inositol hexa*kis*phosphate (IHP) remained the dominant form of soil OP and showed little variation with time or depth. The results of this study suggest that: (1) soil extractable-P concentrations have short-term (<10 leaching events) influence on leachate-P characteristics; (2) biological cycling of P may influence soil and leachate-P characteristics; (3) the concurrent sampling strategy described here is useful for assessing the behavior of P in soils.