

Soil properties and phosphorus isotopic exchangeability in agricultural temperate soils

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Isotopically exchangeable phosphate (P) is the main source of P for most crops but there is no model yet describing soil P exchangeability in relation to soil properties other than the concentration of soil water extractable P (C_P). We make in this paper the hypothesis that it is possible, knowing C_P and selected soil properties determining P sorption, to predict the amount of P located on the solid phase of the soil that remains isotopically exchangeable (P_{r1day}) and the soil buffering capacity of isotopically exchangeable P ($PBC_{iso1day}$) both assessed for an exchange time of 1 day. This work was done in three steps. First, isotopic exchange kinetic experiments were carried on 9 soil samples (set A) sampled in 1998 that had been incubated in the presence of increasing concentration of water soluble P. Results from these experiments allowed developing a statistical model to calculate P_{r1day} and $PBC_{iso1day}$ as a function of C_P , soil pH, total organic carbon, clay, oxalate and dithionite extractable Fe. In a second step, we compared $PBC_{iso1day}$ to the PBC measured from sorption curves and to the PBC measured from Olsen P and water P extractions made in these soils in 1993 and 1998. These estimations of the PBC were strongly correlated with each other suggesting that the model was delivering relevant information on the PBC. In the third step, we compared P_{r1day} predicted with the model to the values derived from the experiment in an independent set of 52 samples (set B). Predicted and experimental values were different, but the model was able to reproduce the major trends observed in the experimental data. In both soil sets (A and B) highly significant relations were also observed between the $PBC_{iso1day}$ and the *Olsen-P* to C_P ratio for soils with C_P values larger than 0.1 mgP L^{-1} . The importance of the soil properties selected in the model on P exchangeability and the limits and applicability of the approach are discussed.