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Understanding the effect low molecular weight organic acids on the desorption and availability of soil phosphorus

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The mobility and resupply of inorganic phosphorus (P) from the soil solid phase after equilibration with increasing doses of citric acid (CA) and oxalic acid (OA) were studied in 2 soils with contrasting P status. The combined methods of diffusive gradients in thin films (DGT), diffusive equilibration in thin films (DET) and the DGT-induced fluxes in sediments model (DIFS) were used as tools to evaluate the changes in solid-to-solution interchange kinetics. A significant effect of CA and OA in soil solution P was observed only for doses over 1 mMol kg-1. Curiously, low organic acid doses (0.5-1 mMol kg-1) were associated with a steep increase in microbial biomass P, which was not seen for doses over 2 mMol kg-1. The trivalent CA was able to promote a higher increase in soil solution P than the bivalent OA for both soils. Organic phosphorus was only significantly mobilized by organic acids in the low P soil, possibly because in the high P soil these P forms were less labile than inorganic P. Both CA and OA promoted a decrease in the adsorbed-to-solution distribution coefficient, desorption rate constants and an increase in the response time of solution P equilibration. The extent of this effect was shown to be both soil specific and organic acid specific. Since both organic acids negatively affected the kinetics of P interchange between the soil matrix and the soil solution, their net effect on P bioavailability is expected to be much lower than the observed increase in solution concentration.