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# Amending soils with sediment material from constructed wetlands increases phosphorus sorption

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Sediment of agricultural constructed wetlands (CWs) is comprised of matter eroded from surrounding fields. This material is rich in aluminium (Al) and iron (Fe) (hydr)oxides that have a high affinity for phosphorus (P). Sediment material returned to fields could therefore affect soil P retention characteristics.

We incubated a clay soil with a high soil test P (STP, 24 mg $P_{Ac}$ $l^{-1}$; extracted with pH 4.65 ammonium acetate buffer) and a sandy loam with excessive STP (210 mg $P_{Ac}$ $l^{-1}$) for three weeks with increasing amounts of CW sediment: 0, 2, 5, 10 and 50% of the sample volume. After incubation, the soil-sediment mixtures were studied with the quantity/intensity (Q/I) technique, using chemical extractions and by exposing the mixtures to simulated rainfall.

Sorption affinity for P regularly increased with increasing the sediment share of the mixtures, the 0% sediment content having the lowest and 50% sediment content the highest P sorption. With 0% sediment application, the value of equilibrium P concentration ($EPC_0$) determined by Q/I technique, was 0.69 and 44.3 mg $l^{-1}$ for clay soil and sandy loam, respectively. With 2-5% sediment amendment, the $EPC_0$ decreased 13-36% for clay soil and 13-54% for sandy loam. The 50% sediment mixtures had $EPC_0$ of 0.05 mg $l^{-1}$ for both soils. At a practically feasible sediment addition rate of 5%, dissolved reactive P (DRP) in percolating water from simulated rainfall decreased by 55% in the clay soil and 54% in sandy loam ($p<0.001$ in both cases). Particulate-P (PP) also showed a decreasing trend with increasing sediment addition rate. Upon prolonged simulated rainfall, the decreasing effect of sediment on DRP and PP declined somewhat. The effects of sediment addition can be attributed partly to increased salt concentrations in the sediment, which have a short-term effect on P mobilisation, but mostly to increased concentrations of Al and Fe (hydr)oxides, increasing long-term P sorption capacity.

Amending the soils with sediment material would decrease P solubility and might at large application rates hamper P uptake by plants or, on the other hand, the sediment amendment in the soil might reduce P losses by runoff.