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Biosolids Incorporation in Mediterranean Soils Increase Phosphate Adsorption

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Contradictory data exists on the impact of biosolids incorporation on ortho-phosphate (IP) binding to arid and semi-arid Mediterranean soils. We used two mature organic amendments (OA) with low IP solubility to study the effect of OAs addition on the IP adsorption parameters of Mediterranean soils. Seven soils, encompassing a wide range of mechanical, chemical and mineralogical properties, were mixed with a biosolids compost (DSC) at 9:1 ratio (w/w dry weight basis). The soils and mixtures were either incubated for seven years under constant temperature (30°C) and moisture content (80% of 30 kPa tension) or were unincubated. IP adsorption parameters were also measured in not-incubated soil DSC mixtures at 97:3 ratio. In all the soils, DSC addition significantly increased the IP adsorption capacities (by Langmuir's model) from 126 to 397 mg IP kg⁻¹ in the soils to 254 through 669 mg IP kg⁻¹ in the soil-DSC-mixtures. The increased capacities were accompanied by a significant decrease in the adsorption affinities, from values of 0.12 to 1.02 L kg⁻¹ in the soils to 0.05 and 0.25 L kg⁻¹ in the mixtures. Biosolids addition at 97:3 ratio had a similar effect on the IP adsorption parameters as the 9:1 ratio. These two IP adsorption parameters continued to change along the incubation. The other OA tested was a municipal solid waste compost (MSWC), which was mixed with two montmorillonitic soils at 97:3 ratio (soil:OA), one with high lime and low Al/Fe-oxides contents and the other with low lime and high Al/Fe-oxides content. OA addition increased the IP adsorption capacity in the lime-rich soil, while it did not affect the other. Overall, our results show that the solid matrix of the two OA's used by us embodied IP adsorption sites, most likely through metal bridging with Ca²⁺, which increases the total adsorption capacity of the soil-OA mixture. Concomitantly, DOM from the OAs competes with IP on adsorption sites reducing the soil's adsorption capacity. The magnitude of each one of these two processes depends on the soil and the added OA characteristic and will determine the overall change in the soil's capability to retain IP after biosolids incorporation.