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Sustainable measures for sewage sludge treatment – evaluating the effects on P reaction in soils and plant P uptake

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Wastewater treatment, whether for water reusing or for releasing into the environment, results in sewage sludge rich in organic matter and nutrients. If free of pathogens and pollutants, this waste material is a widely used as soil amendment and source of valuable nutrients for agronomic use. Nevertheless, its P/N ratio largely exceeds plant P/N demand. Limiting its application rates according to the P demand of crops will largely limit its application rates and its beneficial effect as a soil amendment and as a source for other nutrients. An alternative approach, in which P is stabilized before application, was evaluated in this study. Anaerobically digested fresh sewage sludge (FSS) was stabilized by aluminum sulfate, ferrous sulfate, and calcium oxide (CaO), as well as by composting with shredded woody yard-waste to produce Al-FSS, Fe-FSS, CaO-FSS, and FSS-compost, respectively. Defined organic-P sources (glucose-1-phosphate and inositol-hexa-phosphate) and a P fertilizer (KH2PO4) were included as well and a control with no P amendments was included as a reference. Each material was applied at a fixed P load of 50 mg kg-1 to each of three soils and P speciation and plants P uptake were tested along 112 days of incubation at moderate (near field capacity) water content. Tomato seedlings were used for the P uptake test. The large set of data was used to evaluate the effect of each treatment on P reactions and mechanisms of retention in the tested soils and to correlate various P indices to P availability for plants. Plant P uptake was highly correlated to Olsen-P as well as to water-soluble inorganic-P, but not to water-soluble organic-P and not to total P or other experimentally-defined stable P fractions. We conclude that the P stabilization in the sludge will allow beneficial and sustainable use of sewage sludge as a soil amendment and source of nutrients, but the stabilization method should be selected in accordance with the target soil properties.