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A novel phosphorus biofertilizer based on cattle manure and phytases-nanoclay complexes

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Phytate and other phytase labile organic phosphorus (P) are abundant in both soils and manures. These recalcitrant forms of P accumulate in soils by their interaction with mineral particles. The aim of this work was to evaluate the potential of treating cattle manure with phytases stabilized in allophanic nanoclays, as a novel P biofertilization technology for crops grown in volcanic soils (Andisol). Two Andisols and two manures with contrasting inorganic Pcontent were used: Low P soil from Piedras Negras series (SPN-LP); High P soil from Freire Series (SF-HP); Low P Waste (WPN-LP); High P Waste (WF-HP). The used Andisols and manures were incubated with phytase-nanoclay complexes and the inorganic P was determined in the NaOH-EDTA and bicarbonate extracts. The WPN-LP was also inoculated with an alkaline β-propeller phytase (BPP) producing bacterium. The incubated SPN-LP and SPN-LP-WPN-LP mixture were evaluated for their P supplying capacity to wheat plants under greenhouse conditions. Our resultsindicated that the treatment of cattle manure with phytase stabilized in nanoclays resulted in a significant ($P \leq 0.0.5$) increase in the inorganic P. The use of phytase treated cattle manure increased 10% plant dry weight and 39% P concentration in wheat plants under greenhouse conditions, being equivalent to a P fertilizer dose of about 150 kg of P ha-1. In the case of low P cattle manure inoculated with BPP producing bacterium, inorganic P increased 10% in soil extracts (NaOH EDTA and Bicarbonate). However, the application of this treated manure did not result in a significant response to wheat growth and P acquisition. Our results suggest that this novel approach of incubating cattle manure with phytase stabilized in nanoclays enhances organic P cycling and P nutrition of plants grown under P-deficient soils.