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Polymer coated novel controlled release rock phosphate formulations for improving phosphorus use efficiency by wheat in an Inceptisol

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ABSTRACT

Non-renewable nature of rock phosphate (RP) reserves coupled with low use efficiency of applied phosphorus (P) fertilizers in the soil system results in irreversible loss of huge quantity of P to the environment. The technology of controlled release fertilizers which harmonizes crop demand and release of P from fertilizers are promising to prevent the loss as well as improve the P use efficiency. This article aimed to synthesize and assess some polymer coated novel controlled release rock phosphate formulations to synchronize P release with crop demand and increasing P recovery by wheat. Polymer coated novel products were synthesized by partially acidulating RP with sulphuric and phosphoric acids followed by coating with polyvinyl alcohol and liquid paraffin @ 2 and 3% levels of coating. These products were characterized through X-ray diffraction, fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and transmission electron microscopy (TEM). Phosphorus release pattern from novel coated fertilizers were monitored under controlled conditions in a laboratory incubation experiment at different moisture and temperature regimes. The products were also evaluated for their P supplying capacity to wheat in a greenhouse experiment. Results emanated from incubation study in a P-deficient Typic Haplustept revealed higher release of P at 20% moisture regime and 30 °C temperature. Phosphoric acid based coated products produced greater biomass yield than commercial diammonium phosphate and sulphuric acid formulated products. Product coated with polyvinyl alcohol @ 2% coating released P gradually that synchronized well with the plant P demand and resulted in greater biomass yield, P uptake and recovery by wheat than that of liquid paraffin and 3% level of coating. It can be concluded that novel technology of controlled release RP formulations using different coating agents could be exploited commercially as the alternative to water soluble P-fertilizers for enhancing P use efficiency.