

Degree of phosphorus saturation and soil phosphorus thresholds in an ultisol amended with triple superphosphate and phosphate rocks.

Abstract

Soil phosphorus (P) release capability could be assessed through the degree of P saturation (DPS). Our main objective was to determine DPS and, hence, P threshold DPS values of an Ultisol treated with triple superphosphate (TSP), Gafsa phosphate rocks (GPR), or Christmas Island phosphate rocks (CIPR), plus or minus manure. P release was determined by the iron oxide - impregnated paper strip (strip P), while DPS was determined from ammonium oxalate - extractable aluminum (Al), iron (Fe), and P. Soils were sampled from a closed incubation study involving soils treated with TSP, GPR, and CIPR at 0-400 mg P kg⁻¹, and a field study where soils were fertilized with the same P sources at 100-300 kg P ha⁻¹ plus or minus manure. The DPS was significantly influenced by P source x P rate, P source x manure (incubated soils), and by P source x P rate x time (field-sampled soils). Incubated soil results indicated that both initial P and total strip P were related to DPS by exponential functions: initial strip P = $1.38\exp^{0.18\text{DPS}}$, $R^2 = 0.82^{**}$ and total strip P = $8.01\exp^{0.13\text{DPS}}$, $R^2 = 0.65^{**}$. Initial strip P was linearly related to total P; total P = 2.45 , initial P + 8.41 , $R^2 = 0.85^{**}$. The threshold DPS value established was about 22% (incubated soil). Field soils had lower DPS values <12% and strip P was related to initial DPS and average DPS in exponential functions: strip P = $2.6\exp^{0.44\text{DPS}}$, $R^2 = 0.77^{**}$ and strip P = $1.1\text{DPS}^2 - 2.4\text{DPS} + 6.2$, $R^2 = 0.58^{**}$, respectively. The threshold values were both at $\approx 8\%$ and P release was 11-14 mg P kg⁻¹. Results are evident that DPS can be used to predict P release, but the threshold values are environmentally sensitive; hence, recommendations should be based on field trials.

Keyword: Phosphate rocks; Triple superphosphate; Degree of phosphorus saturation; Phosphorus release; Threshold point.