Phosphorus sorption following the application of charcoal and sago (metroxylon sagu) bark ash to acid soils

ABSTRACT

Acidic cations such as Al, Fe, and Mn tend to fix P in soils, and this reaction make P unavailable for plant uptake. Several conventional strategies for farmers had been proposed to ameliorate Al toxicity either via liming or continuous P fertilization. However, these approaches are not only expensive but are also environmental unfriendly. Thus, a sorption study was carried out using charcoal and sago bark ash as soil amendments to determine their effects on P sorption characteristics of low pH soils. Phosphorus sorption determination was based on standard procedures and the P adsorption data for the samples tested in this study were fitted to the Langmuir equation. The results suggest that the combined use of charcoal and sago bark ash decreased P adsorption and increased P desorption relative to the untreated soils. Organic matter in the charcoal reduced P sorption by providing more negatively charged surfaces, thus increasing anion repulsion. Apart from increasing the amount of P adsorbed in the soil, the use of the sago bark ash increased the amount of P desorbed because the primary reaction between the sago bark ash and soils is an acid neutralization reaction. These improvements do not only reduce P fixation in acid soils but they also promote the effective utilization of nutrients via the timely release of nutrients for maximum crop production. In conclusion, the incorporation of charcoal and sago bark ash to the soil had a positive effect on replenishing the soil solution's P. The organic matter of the charcoal reduces P sorption capacity by blocking P binding sites, increasing the negative electric potential in the plane of adsorption, causing steric hindrance on the mineral surfaces and decreasing goethite and hematite-specific surface areas. However, there is a need for the inclusion of more soil chemical, physical, and mineralogical properties in predicting soil P sorption to enhance the reliability of the findings.