Charcoal and Sago Bark Ash on pH Buffering Capacity and Phosphorus Leaching

ABSTRACT

Soil-available P for crop use is limited because of fixation reaction and loss of organic matter through erosion and surface runoff. These factors cause an imbalance between inputs and outputs of P nutrients in acid soils. Several approaches to improve P availability have been proposed, however, little is known about the effectiveness of amending humid mineral acid soils with charcoal and sago bark ash on P dynamics. Thus, pH buffering capacity and leaching studies were conducted to determine: (i) pH buffering capacity upon application of charcoal and sago bark ash and (ii) the influence of charcoal and sago bark ash on P leaching in acid soils. pH buffering capacity was calculated as the negative reciprocal of the slope of the linear regression (pH versus acid addition rate). A leaching study was carried out by spraying distilled water to each container with soil such that leachates through leaching were collected for analysis. The ascending order of the treatments based on their pH buffering capacity and regression coefficient (R2) were soil alone (0.25 mol H+ kg−1 sample), soil with charcoal (0.26 mol H+ kg−1 sample), soil with sago bark ash (0.28 mol H+ kg−1 sample), charcoal alone (0.29 mol H+ kg−1 sample), soil with charcoal and sago bark ash (0.29 mol H+ kg−1 sample), and sago bark ash alone (0.34 mol H+ kg−1 sample). Improvement in the soil pH buffering capacity was partly related to the inherent K, Ca, Mg, and Na contents of charcoal and sago bark ash. In the leaching study, it was noticed that as the rate of sago bark ash decreased, the pH of leachate decreased, suggesting that unlike charcoal the sago bark ash has significant impact on the alkalinity of leachate. Soil exchangeable acidity, Al3+, and H+ reduced significantly following co-application of charcoal and sago bark ash with ERP. This could be attributed to the neutralizing effects of sago bark ash and the high affinity of charcoal for Al and Fe ions. The amount of P leached from the soil with 100% charcoal was lower because charcoal has the ability to capture and hold P-rich water. The findings of this present study suggest that combined use of charcoal and sago bark ash have the potential to mitigate soil acidity and Al toxicity besides improving soil pH buffering capacity and minimizing P leaching. A field trial to consolidate the findings of this work is recommended.