Improving Selected Chemical Properties of a Paddy Soil in Sabah Amended with Calcium Silicate: A Laboratory Incubation Study

ABSTRACT

In Malaysia, the main constraints of rice yield and productivity are infertile soils and poor management practices because these soils are characterized by low pH, low nutrient availability, low organic matter, and high exchangeable Al and Fe ions, due to high rainfall and hot temperatures. Thus, an incubation study was conducted to determine the optimum amount of calcium silicate (HmbG brand) to improve the soil pH, electrical conductivity (EC), exchangeable Al, available P, and cation exchange capacity (CEC) of a paddy soil in Sabah, Malaysia. The Kelawat series (Typic Dystrudept) soil was incubated with calcium silicate at the application rates of 0 (T1), 1 (T2), 2 (T3), and 3 t ha^{-1} (T4) using a Completely Randomized Design (CRD) in triplicates for 30, 60, 90, and 120 days. The calcium silicate used significantly improved soil pH because of the release of SiO_4^{4-} and Ca^{2+} ions, which neutralized and immobilized H^+ ions. Furthermore, the neutralizing effects of the amendment impeded Al hydrolysis by up to 57.4% and this resulted in an increase in the available P in the soil by 31.26% to 50.64%. The increased availability of P in the soil was also due to the high affinity of SiO_4^{4-} to desorb P from soil minerals and it is believed that SiO_4^{4-} can temporarily adsorb exchangeable base cations such as K^+, Ca^{2+}, Mg^{2+}, and Na^+. Moreover, applying calcium silicate at 3 t ha^{-1} improved soil CEC by up to 54.84% compared to that of untreated soils (T1) because of increased pH and the number of negatively charged sites. The most suitable application rate of the calcium silicate was found to be 3 t ha^{-1} (T4). These findings suggest that calcium silicate can improve soil productivity and agronomic efficiency in rice farming. Greenhouse and field trials are necessary to ascertain the effects of the recommended treatments of this incubation study on soil productivity, rice growth, and yield.