Changes in chemistry of rice husk compost and its effect on negative charge and nutriet content of a chemically degraded Oxisol

ABSTRACT

Rice husk application and its long-term effects on charge characteristics and elemental composition of a chemically degraded Oxisol have not been rigorously studied. The objective of the study was to determine the ability of composted rice husk (CRH) to preserve organic carbon (C), generate negative charge, and release various ions in heavy clay Oxisol. The topsoil and subsoil, representing natural and erosion conditions, respectively, were incubated with CRH for 24 months. Results showed carbon types of CRH, as revealed by solid-state cross-polarization magic angle spinning ^{13}C nuclear magnetic resonance (CP/MAS ^{13}C NMR) spectroscopy, were relatively unchanged from months 5 to 12 after incubation, indicating limited decomposition. Carbon types were dominated by O-alkyl and di-O-alkyl C with small proportions of alkyl, methoxyl, aromatic, phenolic, and carboxyl C. After 24 months of incubation, O-alkyl and di-O-alkyl C decreased, indicating susceptibility, whereas alkyl, methoxyl, aromatic, and phenolic C increased, indicating resistance to decomposition. Values of pH_0 and point zero net charge (PZNC) were measured using potentiometric titration and ion adsorption indices, respectively. Values of pH_0 and PZNC decreased during CRH incubation for both topsoil and subsoil, suggesting the increase of soil negative charge. Total negative charge for topsoil and subsoil increased from 2.7 to 3.5 $cmol_c/kg$ and 2.5 to 3.2 $cmol_c/kg$, respectively. This reflects that CRH was able to mask soil positive charge to increase negative charge. In situ soil solution study indicated CRH could release various elements in the order of potassium (K) > sulfur (S) > natrium (Na) > silicon (Si) > magnesium (Mg) > calcium (Ca). In addition, toxic elements, aluminum (Al) and manganese (Mn), were significantly suppressed. The implication of the study is that CRH offers a means to increase cation exchange capacity and nutrient content of highly weathered soils while preserving organic C, thereby reducing CO_2 emission from agriculture.

Keyword: Charge characteristics; Degraded soils; Organic matter; Oxisols; Rice husk