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Fractionation of soil organic carbon under different land management in dry tropics, south India

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An understanding of the mechanisms of soil organic carbon (SOC) stabilization is essential to develop the appropriate management for C sequestration and soil health. In southern India, where neutral-alkaline soils are mainly distributed, soil C stocks are inherently low in cropland, despite relatively high clay contents (Clay>ca. 30%, OC<ca. 5 g C kg^{-1} soil). To consider this reason of low SOC in this area, we evaluated the fractionated C contents and its controlling factors, by measuring the particulate organic matter (POM). The objective of this study was to evaluate the effect of land management on the amount and composition of each fraction of soil in southern India. We collected the surface soils (0-10 cm) from two representative sites of southern India; Vertisols with alkaline soil pH (8.4-8.8) and Alfisols with neutral soil pH (6.0-7.0). At each site, two different land management were selected; forest and cropland of Vertisols, and cropland with no organic matter application (no-OM) and with manure application (with-OM) of Alfisols. Soils were separated into the four fractions; (1) Light Fraction; LF (<1.7 g cm^{-3}) , (2) Coarse POM; cPOM (>1.7 g cm^{-3}, 250-2000 μm), (3) Fine POM; fPOM(>1.7 g cm^{-3}, 53-250 μm), and (4) Silt+Clay; S+C (>1.7 g cm^{-3}, <53 μm). Each fraction was analyzed by elemental analysis (C, N) and CPMAS ^{13}C NMR spectroscopy. In Vertisols, C contents of cPOM, fPOM, S+C were significantly higher in forest (0.65, 0.91, 4.8 g kg^{-1} soil, respectively) than those of cropland (0.17, 0.22, 4.1 g kg^{-1} soil, respectively), causing the higher total SOC in forest (7.8 g kg^{-1} soil) than in cropland (4.5 g kg^{-1} soil). C concentration of cPOM, fPOM, and S+C fractions were also significantly higher in forest (3.7, 7.6, 6.7 g kg^{-1} fraction, respectively) than those of cropland (1.0, 2.7, 5.4 g kg^{-1} fraction, respectively). In particular, increasing rates in cPOM and fPOM (180-280 %) were greater than S+C (24 %), possibly suggesting that forest management should increase the relatively active and intermediate SOC pools through the C accumulation in cPOM and fPOM fractions of Vertisols. In Alfisols, C contents in LF and S+C were significantly higher in with-OM (1.1 and 5.2 g kg^{-1} soil, respectively) than in no-OM (0.76 and 4.7 g kg^{-1} soil, respectively). C concentration of S+C fraction was significantly higher in with-OM (14 g kg^{-1} fraction) than in no-OM (11 g kg^{-1} fraction), but not of cPOM and fPOM fractions. It suggests that the OM application to cropland should increase the slow SOC pool through the C accumulation in S+C fractions of Alfisols. These results indicate that different fraction may contribute to SOC stabilization between Vertisols and Alfisols in southern India.