MICROAGGREGATE STABILITY AND ORGANIC CARBON FRACTIONS OF A TROPICAL LOAMY SAND AMENDED WITH PIG-COMPOSTED MANURE

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ABSTRACT

Soil organic carbon (SOC) is important in restoration of microaggregate stability of tropical soils. This study evaluated effect of pig-composted manure applied at 0, 5, 10 and 15 Mg ha^{-1} to cultivated land and forest re-growth land on distribution of organic carbon (OC) fractions and microaggregate stability using principal component analysis (PCA). The cultivated land was planted with two varieties of maize *"Zea mays"* : TZESR-W (improved variety) and OHORI (local variety). Soil samples were collected from 0-20 cm depth and analyzed for total organic carbon (TOC) within 2000-200 µm, 200-63 µm and < 63 µm aggregate fractions and free particulate organic carbon (fPOC), occluded particulate organic carbon (oPOC), acid-hydrolyzable organic carbon (HOC) and non-acid hydrolyzable organic carbon (NHOC) in whole soil. The microaggregate stability was estimated by dispersion ratio (DR), clay dispersion ratio (CDR), clay flocculation index (CFI) and aggregated silt + clay (ASC). Results show that TOC, oPOC and aHOC were significantly ($p \leq 0.05$) higher in forest re-growth land than the cultivated land. However, fPOC and nHOC were higher in cultivated land than forestland. The trend followed TOC > nHOC > fPOC > oPOC > aHOC. Distribution of TOC within aggregates was similar to OC fractions in whole soil. The result show that < 63 µm associated-OC was highest followed by 200-63 µm-OC while OC was least in 2000-200 µm aggregates. In cultivated land, higher accumulation of TOC in whole soil and in 2000-200 µm associated-OC was observed with application of 10 Mg ha^{-1} compost over other rates. There were significant correlation between water dispersible clay (WDC) and TOC ($r = 0.68^*$), while DR negatively correlated with TOC ($r = -0.77^*$). Correlations were very highly significant between ASC and TOC ($r = 0.84^{***}$) and ASC and < 63 µm associated-OC ($r = 0.85^{***}$); while correlation between CFI and 2000-200 µm associated-OC was high ($r = 0.70^*$). To remove multicollinearity, principal component analysis grouped the six correlated OC fractions (fPOC, aHOC, TOC, 2000-200 µmOC, 200-63 µmOC and < 63 µmOC) to two component defining variables (CDVs), i.e. fPOC and TOC. Multiple regression was used to show the relationship between the retained variables (fPOC and TOC) and the two indices of better microaggregation (ASC and CFI); and the results showed fPOC and TOC only correlated significantly ($r = 0.73^*$) with ASC. In conclusion, integrated use of PCA and multiple regression analysis revealed that TOC influenced best the stability of this fragile tropical soil at micro scale.

Keywords: **Microaggregate stability, organic carbon fractions, forest re-growth, cultivated land, principal component analysis, compost.**