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Carbon-nitrogen sequestration potentials and structural stability of a tropical Alfisol as influenced by pig-composted manure

J.K. Adesodun and O.E. Odejimi*

Department of Soil Science and Land Management, University of Agriculture, PMB 2240, Abeokuta 110001, Ogun-State, Nigeria

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A b s t r a c t. The organic carbon (OC) and total nitrogen (N) stocks (kg m^{-2}) within the aggregates were estimated from the elemental concentrations and bulk density values. Soil aggregation by water-stable aggregates (*WSA*) showed significant ($p \leq 0.05$) increase in the proportion of macroaggregates > 0.50 mm than aggregates < 0.50 mm with addition of the compost. Mean-weight diameter (*MWD*) was significantly higher in uncultivated forestland than cultivated land, whereas addition of compost to the cultivated land improved the stability of this soil over the control. The OC stocks (kg m^{-2}) within the aggregates of cultivated land amended with pig-composted manure followed the pattern observed for the forestland *ie* OC was preferentially sequestered within the macroaggregates (> 0.25 mm) than microaggregate fraction (< 0.25 mm); while the distribution of N was relatively uniform within the aggregates. Application of the compost to the cultivated plots significantly improved total N stocks (kg m^{-2}) over that observed for the forestland. The results also revealed that application of pig-composted manure improved the structural stability better at 10 Mg ha^{-1} than 5 and 15 Mg ha^{-1} rates. The C-N sequestration in cultivated land was also higher than the baseline forestland with addition of 10 Mg ha^{-1} manure over other rates. Overall, this study showed that application of compost at 10 Mg ha^{-1} is adequate to improve the stability and enhanced C-N storage within this fragile tropical soil.

K e y w o r d s: greenhouse effect, sequestration, aggregate stability, compost, tillage

and Elliot, 1992; Dalai and Mayer, 1987). The rate of soil organic carbon (SOC) loss upon conversion of natural ecosystem to agricultural use is more drastic in the tropics than temperate regions (Lal, 2001; Stalenga and Kawalec, 2008).

Soil organic matter (SOM) consists of series of fractions from very active to stable pools; and there is a similarity in the dynamics of C and N among the labile SOM pools (Adesodun *et al.*, 2005). Therefore, the amount of SOC and total N that exists in any given soil is determined by the balance between rate of OC input and output (CO_2) release into the atmosphere. Human activities in the last two centuries have elevated to an unprecedented levels the atmospheric concentration of CO_2, CH_4, N_2O and other greenhouse gases, and this has led to large scale alterations in the global climate (Houghton *et al.*, 2001). Concerns about the rising atmospheric CO_2 levels have prompted considerable interest in recent years regarding the sink potentials of soil organic carbon. While CH_4 dynamics are closely linked to livestock production practices and wetland agriculture such as rice production, CO_2 dynamics are related to energy use cycles and to soil management; while N_2O dynamics are related to soil-nitrogen management (fertilizer-nitrogen).

Soil C sequestration through changes in land use and management is one of the important strategies to mitigate