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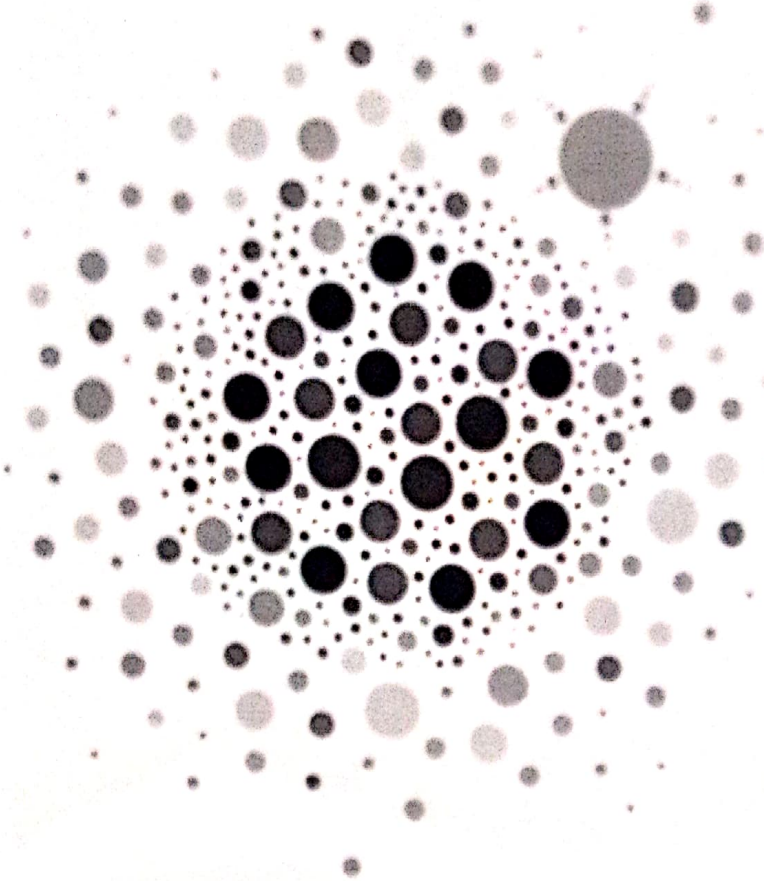

PROCEEDINGS
OF THE GLOBAL SYMPOSIUM ON SOIL ORGANIC CARBON 2017

GLOBAL SYMPOSIUM ON SOIL ORGANIC CARBON | 21 - 23 MARCH 2017 | FAO - ROME, ITALY

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An event co-organized by:

FAO | Food and Agriculture Organization of the United Nations

GSP | Global Soil Partnership

IPCC | Intergovernmental Panel on Climate Change

ITPS | Intergovernmental Technical Panel on Soils

UNCCD | United Nations Convention to Combat Desertification

UNCCD-SPI | Science-Policy Interface of the UNCCD

WMO | World Meteorological Organization

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CONTENTS

3.2.6. | IMPACT OF LAND USE AND SOIL DEPTH ON SOIL ORGANIC CARBON ACCUMULATION AND OTHER SOIL PROPERTIES IN MINNA, SOUTHERN GUINEA SAVANNA OF NIGERIA.

Uzoma, O.A, SAAD, F, Ugboko, F.A, Ighravwe, G.A, Abdullah, A and Bala, A

Department of Soil Science and Land Management, Federal University of Technology, Minna.
Corresponding e-mail: uzo_ozo@yahoo.com

ABSTRACT

Changes in soil organic carbon can be monitored by measuring changes in microbial population, microbial Carbon and Phosphorus (C: P)ratios and urease activities of marginal soils in the sub-Saharan Africa. This marginal soils are utilized for arable crop production or reserved for agroforestry or afforestation. A research was carried out at the afforestation site of the Federal University of Technology, Minna in February, 2016. The afforestation site falls under the Southern Guinea Savanna agro-ecological zone of Nigeria with a GPs location of Lat 09° 31' 214'' N , Long 06° 27' 604'' E and an elevation of 233 m. Minna has an average annual relative humidity of 48.9% and average annual temperature of 27°C. The forest was eleven years old at the time of the experiment and has 3 different tree vegetations comprising of Gmelina, Cashew and Teak. Each vegetation covered 4.5 km and had inter and intra row spacing of 5m. Adjacent the tree vegetations are arable lands cultivated by local farmers. The experiment was a 4 x 3 factorial experiment fitted to a Completely Randomized Design (CRD) replicated 3 times. Therefore the set of treatments are four land use types as follows: Arable land, Lands used for Cashew, Gmelina and Teak afforestation respectively. The 2nd set of treatments are 3 soil depths as follows: 0-5cm, 5-10cm, and 10-15cm. The aim of the experiment was to investigate the effect of these land uses on soil chemical and microbial properties and measure the variance of these soil properties with soil depth. The experiment would also reveal the land use that best conserves carbon and enhance soil health. The experiment was initiated by sampling soils under these vegetations at different soil depths. Prior to sampling across treatments, soil auger was sterilized with methylated spirit and flamed to prevent cross contamination. After sampling, soils were bulked according to treatments and taken to the laboratory for chemical and microbiological studies according to standard methods Results obtained revealed that Organic carbon (OC) was averagely highest under arable land than under tree vegetation especially at 0-5cm soil depth. Although Gmelina trees accumulated the highest OC of 11.9 g Kg-1 at 0 -5cm depth, Teak vegetation averagely recorded the highest OC followed by Gmelina and Cashew in that sequence. Soil available P followed the same pattern except that soils under Gmelina vegetation recorded the lowest available P. Soils under tree vegetation recorded the highest fungi population compared to soils under arable crop production probably as a result of higher lignin content found in the trees. Amongst the trees, Teak averagely recorded fungi populations values that were lower than the values recorded under the other trees even though these values were not statistically different. Conversely, soils under Arable land recorded the highest bacteria count while those under Gmelina recorded the lowest counts as a result of the presence of easily decomposable plant species and more biodiversity in the arable land. Microbial C: P ratio were narrowest under Cashew vegetation and widest under Gmelina vegetation suggesting that soils under Cashew were more mineralized than those under Gmelina. This may be difficult to understand considering the fact that litter falls from cashew are more difficult to decompose than litter falls from Gmelina. The potential of Cashew trees to improve P mineralization may come from the solubilization of P by their root exudates. Arable land recorded the lowest urease activity suggesting lowest ammonia loss through volatilization. This Arable land that was adjacent the Forest most likely enjoyed inputs from litter falls than organic inputs from grazing animals and that probably explained why ammonia loss through volatilization was minimal. The most likely reason why the Afforestation sites recorded the highest ammonia loss through volatilization may be linked to activity of Fulani herds men who graze their cattle in the forest reserve. The cow dung and urine from their cattle is high in ammonia. Another reason why the forest reserve recorded highest ammonia loss may come from the alkalinity of their soils which is a function of the quality of litter falls. Result obtained in this research has demonstrated that Land cultivated to arable crops in sub-Saharan Africa accumulated more organic carbon which inturn increased microbial life especially heterotrophic microbes. This microbes synthesize enzymes like urease when nitrogen is limiting and because nitrogen was not limiting under arable cropping system, urease activity was low and consequently, the microbial C:P ratio was the second narrowest.

Key words: Land use, soil depth, soil organic carbon, urease activity, microbial population, counts, C: P ratio, Arable land, Gmelina, Cashew, Teak