#7505 MAPPING OF SOIL NUTRIENT VARIABILITY IN SOME PLANTATION CROPS IN ABEOKUTA, OGUN STATE NIGERIA

E.C. Basil, B.A. Senjobi, R.T. Basil, A.O. Tobore
Department of Soil Science and Land Management, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria, charlesejike7@gmail.com +2348068904445

ABSTRACT

The activities of man in the soil and the undulating topography have great effects on soil nutrient variability. For near accurate application of nutrients in precision agriculture in order to reduce wastage of resources, the research was conducted to acquaint the research farm of the institute with the nutrient variability at specific location. A detailed soil survey was carried out at the Teaching and Research Farms of Federal University of Agriculture, Abeokuta. Following observed soil variations, surface (0-15cm) and sub-surface (15-30 cm) soil samples were taken viz: Arboretum, Cashew, Oil palm. A Fallow land was also sampled. The samples were subjected to physical and chemical analyses for some nutrients determination. The results were digitally mapped using ARC GIS software package. The result showed variability in organic carbon in oil palm plantation, variability in the bulk density, available phosphorus and organic carbon in the fallow. Cashew plantation recorded a variation in the bulk density while the arboretum had variations in the available phosphorus. In order to minimize fertilizer wastage, concern should be given to these areas of variability.

INTRODUCTION

A great deal of inference can be drawn from the morphology of the soil as they were seen on the field and make interpretation and prediction about its qualities. However, for accurate interpretation and prediction, especially for modern agriculture and non-agricultural uses of soils, quantitative data on composition of the soils are needed for characterization (Buol, 1997). Soil is a vital resource for producing the food and fiber needed to support an increasing world population (Pappendick and Parr, 1992), therefore, characterizing and evaluation of the soil for suitability purpose for desired crops cannot be over emphasized. The objectives of this study are to characterize the soil and map the variability shown in the nutrients in the various plantations.

MATERIALS AND METHODS

The study was conducted at the Teaching and Research Farms of the Directorate of University Farms (DUFARMS), Federal University of Agriculture, Abeokuta (FUNAAB). The area is located between latitude 7^0 12' N and 7^0 23', Longitude 3^o 20' E and 3^0 23' and on Elevation 108 m. The vegetation is basically derived savanna, which has been modified by various agricultural practices over time. The climate of Abeokuta falls between the humid and sub-humid tropics with mean annual rainfall of about 1113 mm, two peaks distribution pattern and five dry months in the year. Three different crop plantations and a fallow were considered for this study namely: Arboretum, Cashew, Oil palm and Fallow. At each of the chosen land use type, an area of 4 ha was demarcated for the study. Surface (0-15 cm) and sub-surface (15-30 cm) soil samples were collected with the aid of soil auger at the intersections of traverses using Rigid Grid method at 100 m interval. A representative profile pit (2 x 1 x 2 m) was dug at each of the predominate land types or slope segments and soil types/mapping units

encountered at each of the chosen land use types. The profile pits were described morphologically after FAO (2006) guidelines. They were sampled and placed in labeled bags and then processed in the laboratory after air-drying. Soil colour was determined using Munsell colour chart. The air-dried soil samples were, grinded and sieved with a 2 mm mesh sieve and sub-samples were further sieved with 0.5 mm sieve for the organic carbon and nitrogen determination. The Organic Carbon was determined using Walkley and Black method. Soil pH in water (1:1) was determined with the use of a glass electrode pH meter (Mclean,1965). Exchangeable cations were extracted with 1M NH_4OA_C (pH7.0), sodium and potassium were determined using flame photometer and exchangeable Mg and calcium by Atomic Absorption Spectrometer (Spark,1965). Available P was extracted using Bray-1 extractant followed by Molybdenum blue colorimetric. Exchangeable acidity was determined by the KCl extraction method (Mclean, 1965). Total nitrogen was determined by the Macro-kjeldahl digestion method of Jackson (1962). The bulk density was determined by core method. Particle size distribution analysis was determined by the Bouyoucos hydrometer (1951) method using calgon as dispersing agent. The data were subjected to analysis of variance (ANOVA) to assess the effect of different land use types on the soil quality indices. Mean value were separated by Duncan's Multiple Range Test (DMRT) at $p<0.05$.

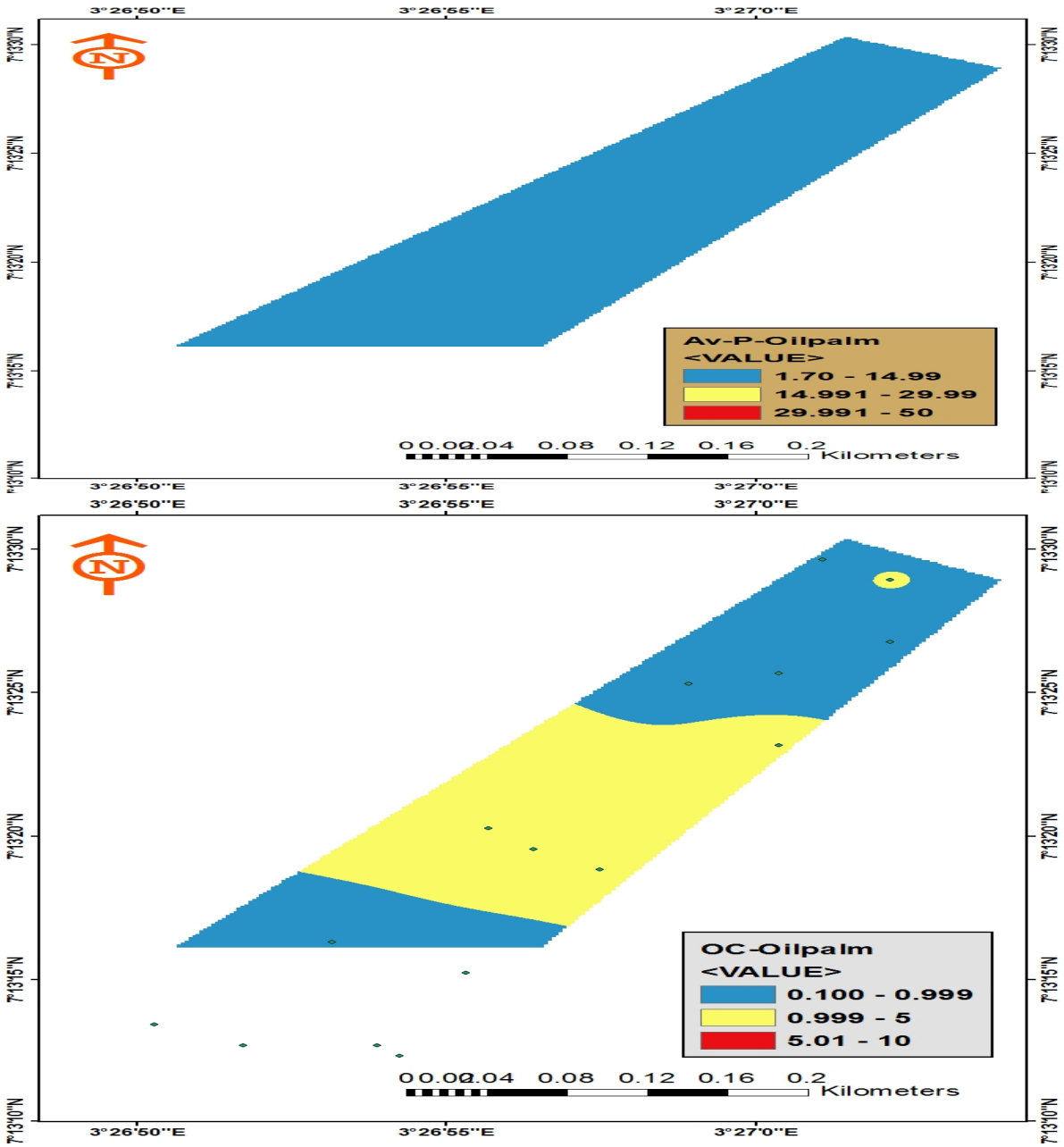
RESULTS AND DISCUSSION

Generally, the soil textural fractions of sand, clay and silt varied significantly with the different plantation. The particle size distribution showed that the pedons have very high sand contents (>800 g/kg) and this decreased with depth across the land uses. The clay contents also ranged from 120 g/kg in the arboretum to 450 g/kg in the oil palm across the profiles. The soils were so compacted and as a result, samples could only be taken from the Ap designated horizon. The high percentage of sand in all the land uses is a good indication of the observable high infiltration rate (Fagbemi and Udoh 1992; Senjobi 2007). The poor water holding capacity of the soils which is as a result of coarse texture of the studied soil, enhanced erodibility of the soil which may have been exposed through cultivation and livestock grazing. Bulk density >1.65g/cm3 may impede roots and inhibits development and water movement (Aminu *et al.*, 2013). The increase in soil bulk density can be probably attributed to the loss of organic matters through tillage practices. This is in conformity with Click (2005) and Bahramie *et al*., (2010). Ogunkunle *et al.,* (2014) also supported that soils with bulk density values ≥ 1.30 as recorded in almost all the land uses are indicative of compaction prone soils which will hinder root elongation, reduce aeration and impede water infiltration and movement within the root zone. The total nitrogen content in all the soils of land use types was moderate (0.11-0.22%) compared to the TSQI used (0.1 - 0.5 %). This is due to the accumulation of litter falls. This could be as a result of an imbalance in the accumulation of litter-falls and the rate of decomposition by micro-organisms. This means that the rate of mineralization is on a reduction trend compared to the rate of accumulation. Though there was nutrient variability as shown in Figure 1, the maps designated with different colour did show with the legend the areas that had the nutrients very low, low, moderate or high. Maps with a colour showed no variation while maps with multiple colours showed variation.

CONCLUSIONS

It could be inferred from the study that different crop plantation has different soil characteristics and there were variations in the soil nutrient distribution with space with respect to the physical, chemical and biological parameters under different plantations. In the oil palm plantation, most of the nutrients were leached down the profile or probably held up in the clay

content which was highly improved and compacted. The nutrients maps could be used to offer solutions to nutrient deficiencies and accurate application of nutrients to avoid wastage of resources.



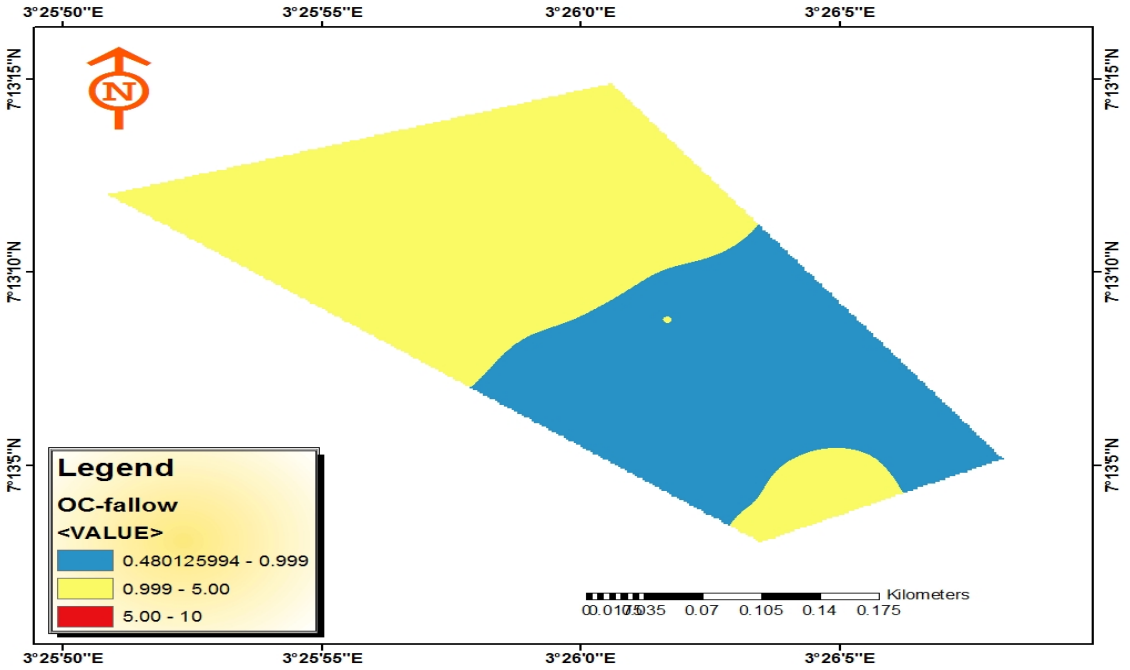


Figure 1. Nutrient map of organic carbon in the fallow.

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