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Engineering and Agronomic Properties as Influenced by Vegetable Cultivation in Obubra, Nigeria

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Abstract— *Engineering and agronomic properties of soil as influenced by vegetable cropping in Obubra, Nigeria was considered. An experimental site measuring of 336 m^2 was used. Four treatments with three replicates each were laid in a Randomized Complete Block Design (RCBD). The treatments included, T = Cultivation of Tomato, O = Cultivation of Okra, F = Cultivation of Fluted Pumpkin, N = No cultivation (Control). A total of 12 sub-plots were laid on the field. Each subplot measured 4 m x 4 m with a distance of 1m inter-blocks and 1m in-between the plots and within the replication. Soil samples were collected randomly at 10 points before cultivation and on each of the 12 plots at three months after cultivation using soil cores and auger for soil analysis. The soil samples were air-dried, sieved with 2 mm mesh and were subjected to standard laboratory analysis to obtain physical and chemical properties. Data on growth of the vegetables were collected based on the following parameters – height, width, number of branches and of leaves. Treatment N with no cropping plots had the highest cone index and bulk density and lowest porosity. This is closely followed by treatments T and O respectively. Treatment F had the lowest cone index and bulk density; and highest porosity. Analysis of variance for effects of vegetable cropping on engineering and agronomic properties of soil showed that all the treatments were significant at p-value of 0.97. Farmers should ensure that they plant their vegetables also in rotation. Creeping vegetables like fluted pumpkin should be planted followed by vegetables like okra and others which does not creep on the soil. This practice will ensure proper conservation and utilization of engineering and agronomic properties for enhanced agricultural production.*

Keywords— *Engineering, Agronomic, Properties, Vegetable, Cultivation, Soil.*

I. INTRODUCTION

A vegetable crop is a name given to any edible part of plant, particularly the herbaceous garden plants. These plants can either be annual or perennial. Assorted vegetables include: Pepper, tomato, okra, Amaranthus and fluted pumpkin, water leave, bitter leave. Vegetables are daily soup requirements, basically, for nourishment and maintenance of balance diet. Vegetable is a primary agricultural produce available in the market throughout the year (Bailey, 2002).

According to USDA (2015) vegetables are important components of the daily diets of most people in the world over because of the nutritional benefits that come with them. Diets deficient in vegetables and fruits lead to various ailments including cancers, neuro-degenerative diseases, immune system diseases function and heart disease (Mc Bride, 1992). Vegetables especially leafy vegetables therefore feature regularly in gardens, markets and homes. These leafy vegetables are now recognised as an ally in the fight against deficiencies of macro and micro nutrients although they have long been over shadowed by other green leafy vegetables of European origin such as cabbage and lettuce which can have a lower nutritional content and especially from the conventional intensive production methods. When vegetables are included in the diet, there is found to be a reduction in the incidence of cancer, stroke, cardiovascular diseases and other chronic ailments. Terry (2011) revealed that, compared with individuals who eat less than three servings of fruits and vegetable each day, those that eat more than five servings have an approximately twenty percent lower risk of developing coronary heart disease or stroke. The nutritional content of vegetables varies considerably; some contain useful amounts of protein though generally they contain little fat, (Thomas, 2008) and varying proportions of vitamins such as vitamin A, vitamin K and vitamin B_6, pro-vitamins, dietary minerals and carbohydrates (Gruda, 2005, Steinmetz and Potter, 1996)

Since cultivation of vegetable crops involves intensive cultural operations starting from sowing to marketing, it provides more and regular employment opportunities in rural areas. More yield per unit area-vegetables give higher total yield per unit area per unit time than cereals and other crops e.g. crops Average Yield per hectare, Wheat 20-25, Rice 25-30, Cauliflower 125-175, Watermelon 200-225 (Addy, 2009; FAO, 2007).

II. INFLUENCE OF CROPS ON SOIL PROPERTIES

The soil status of most Nigeria soils have continuously been depleted as a result of over use and poor management techniques. The availability of vegetables in the market and homes can only be ensured if the best soil amendments are identified that will expand the production of vegetables and lead to sufficient and reliable yields without depleting the soil resources base. The production and nutritional value of vegetables are limited due to the low fertility of native soils in most parts of Nigeria (Law-Ogbomo *et al*, 2012). The use of organic fertilizer to increase crop yield has been found to be limited by its bulkiness demanding consistent use on long-term basis (Ojeniyi *et al*, 2003). The hazardous environmental consequences and high cost of inorganic fertilizers make them not only undesirable but also uneconomical and out of reach of the poor farmers who still dominate the Nigeria agricultural sector (Shiyam and Binang, 2011).

Whatever system is used for growing crops the effect of the crop helps in loosening of the soil, dropping leaves forms organic matter or fertilizers which reduced weed competition, helps retain moisture better in the soil and allows aeration also

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improves water-holding capacity, root penetration and ease tillage (Sullivan, 2004, Angers and Caron, 1998). Vegetable growth have been found to affect soil texture, structure, bulk density, soil compaction as indicated by cone index, hydraulic conductivity, organic matter, exchangeable cation (EC), sodium adsorption ration (SAR), pH values, available macronutrients (Millar, *et al*. (1995); Fathi,*et al*. (1991); Rabie *et al*. (1988); Abou (1999); Tiwari *et al*. (1995); Humberto, *et al*. (2009); Vanlauwe (2000); Beshay and Sallam (2001); (1988); Shreenivas *et al*. (2010); *Brock et al.* (2011); Risikesh, et *al*. (2011); (Foidi *et al*, 2001); Babatola and Olaniyi (1999).

At present vegetable farmers mostly apply soil amendments such as moringa biomass in combination with organic nitrogen-based fertilizer such as NPK (Ogungbile and Olukosi, 1990). Since soil amendment alone may not meet up the needs of vegetables, there is therefore the need to determine the best combination level of the soil amendment (moringa biomass) and organic fertilizers such as urea on the growth and yield of fast growing vegetables like *Telferia occidentalis, Abelmoschus esculentus and lycopersicum esculentum*. Singh, *et al*., (2009) studied the changes in status of organic carbon, phosphorus, potassium, pH, Exchangeable Cation and bulk density after an interval of about three decades in some soils of arid ecosystem dominantly under vegetable cropping sequence and under alternate land use systems. Depletion of soil organic carbon and available potassium was highest in the sandy soils, followed by coarse loamy soils, while phosphorus reduction was highest in the loamy-skeletal soils (Sanwal, 2007). Weil and Williams (2004) reported that deep-rooted cover crops may help alleviate effects of soil compaction, especially in no-till systems. Also planting cover crops such mucuna or velvet bean (*mucunapruriens*) helps alleviate soil compaction. Thus as mucuna leaves fall to the ground, they form thick mat of biomass. This biomass conserves moisture and provides organic matter encouraging earthworm activities which reduces soil bulk density and nutrients to the soil surface, alleviating soil compaction and restoring soil fertility (Balloli *et al.*, 2000).

III. Objective of the Study

The objective of this research is determine the Influence of cultivation of Okro, Tomato and Fluted Pumpkin on the engineering and agronomic properties of soil.

IV. Methodology

Experimental Site

The experimental site was located at the Teaching and Research Farm of Cross River University of Technology, Faculty of Agriculture and Forestry, Obubra Campus. (Latitude $5^0 4^1$ and $6^0 5^I$ North and Longitude $8^0 12^I$ East) with a mean annual rainfall of 2000-2500 mm (CRADP, 1992).

Experimental Treatments and Design

The experimental site measures 21m x 16m giving a total of 336 m^2. Four treatments with three replicates each were laid in a Randomized Complete Block Design (RCBD). The treatments included, T = Cultivation of Tomato, O = Cultivation of Okra, F = Cultivation of Fluted Pumpkin, N = No cultivation (Control).

Pre-Planting Operations

The site was covered predominantly with vegetation which comprised of spear grass (*Imperata cylindrical*). The existing vegetation was manually cleared and stumping was done on the 14^{th} of September, 2015. The plot was later measured and pegged. These activities were followed by tillage.

Planting Operations

The vegetable crops were planted on the 16^{th} of September, 2015 at a spacing of 70cm x 70cm (Okra), 90cm x 50cm (Tomato) and 1m x 80cm (Pumpkin) within and between the rows respectively. One seed was sown per hole for Pumpkin, two seed per hole for Okra while Tomato was transplanted from raised nursery. Varieties used were *Telfaira occidentalis* (Pumpkin), *Solanum lycopersicum* (Tomato), *and Abelmoschus esculentus*.*L.*(Okra).

Weed Control

Weed control was done manually with hoe and cutlass at every 2 weeks interval till maturity.

Measurement of Soil Samples and Growth Parameters

Soil samples were collected randomly at 10 points before cultivation and on each of the 12 plots at three months after cultivation using soil cores and auger for soil analysis. Soil samples were collected on 17^{th} of December, 2015 after planting. Also penetration resistance (cone index) and moisture content were taken using penetrometer and moisture meter at 0 – 45cm, on all the plots before and after the treatments.

Data on growth of the vegetables were collected based on the – height, width, number of branches and of leaves and other parameters.

V. Laboratory and Statistical Analysis

The soil samples collected were air-dried, sieved with 2 mm mesh and stored in labelled polythene bags and were subjected to standard laboratory analysis to obtain physical and chemical properties. Bulk density, porosity, particle size analysis (Bouyoucous, 1992) were determined. Chemical properties were measured. Total Nitrogen was determined by Kjeldahl method (Bremner and Mulvaney, 1982) while OC was determined by the Walkey and Black (1984) dichromate oxidation procedure. Soil pH in water (1:2.5 soils to water ratio) was determined using glass electrode pH meter. The exchangeable bases were displaced by neutral N NH4OAC. The potassium (K) and sodium (Na) contents in the extract were determined with atomic absorption spectrophotometer. The exchangeable acidity (Aluminum (A1) and hydrogen (H)) was extracted with 1 N KCl and estimate titrimetrically (IITA, 1982). All data collected were subjected to analysis of variance (ANOVA) tests as described by Steel and Torrie (1980) and the means were separated using Least Significant Difference (LSD).

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VI. Results and Discussion

Effects of Vegetables Cropping on Engineering and Agronomic Properties

The effect of vegetables cultivation on soil properties are displayed on Table 1. The table showed how each of the cropping treatments affect the engineering and agronomic properties. Treatment N with no cropping plots had the highest cone index and bulk density and lowest porosity. This is closely followed by those of T and O plots. Treatment F had the lowest bulk density and highest porosity.

Analysis of variance for effects of vegetable cropping on engineering and agronomic properties is shown. It showed that all the treatments are significant at p-value of 0.970 level.

Figure 1 showed the mean bulk density of the different plots as affected by vegetables cropping. The plots with no vegetable cropping had the highest mean bulk density followed by the plots with tomato, okra and fluted pumpkin respectively. Figure 2 showed the effects of vegetables cropping on soil porosity and soil textural class. While Figure 3 showed the effects of vegetable cropping on soil chemical properties of different plots.

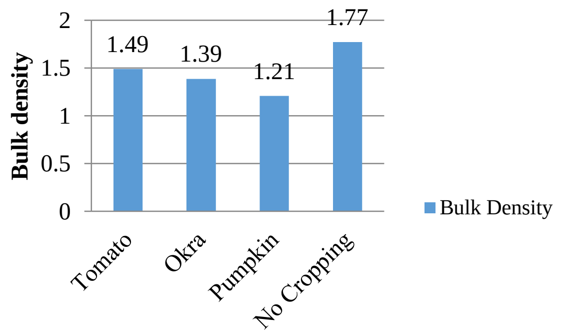

Figure 1: Bulk density of the different treatments taken 3 month after cropping

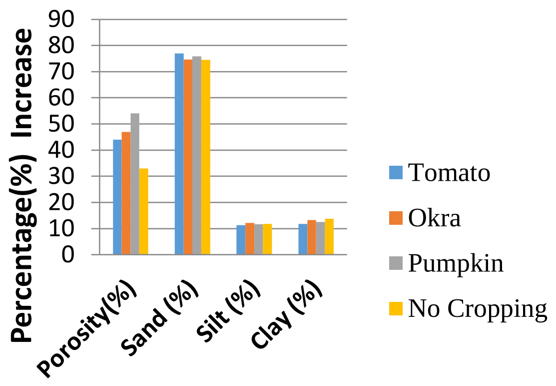

Figure 2: Effects of Treaments (Cropping) on Soil Physical Properties taken 3...

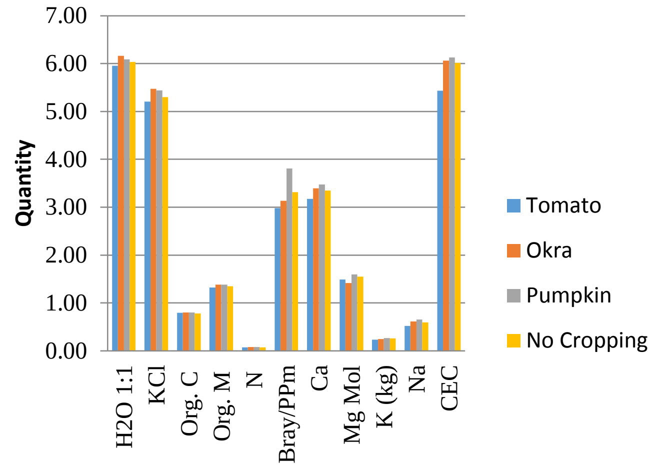

Figure 3: Chemical properties of different plots taken 3 months after cultivation

VII. Conclusion and Recommendations

This research was carried out at the Teaching and Research Farm of the Cross River University of Technology, Obubra during the 2015 planting season. The design of the experiment was Randomized Complete Block Design (RCBD) with 4 treatments which consisted of N (control 0), T (Tomato), O (Okra), P (Pumpkin). These treatments were replicated three (3) times with plot size of 4m x 4m ($16m^2$) and the gross experimental plots size is 21m x 16m ($336m^2$). The aim of this work was to evaluate the influence of vegetable cropping on engineering and agronomic properties.

The results obtained in this study have revealed that mean cone index and bulk densities of the different plots were affected by vegetables cropping. The plots with no vegetable cropping had the highest mean cone index and bulk density followed by the plots with tomato, okra and fluted pumpkin respectively. The soil porosity and particle sizes were affected in varying degrees. Thus the chemical properties of the soil were affected by the different vegetables cropping.

The results of this study has given us the impetus to recommend that vegetable cropping should be selectively done as they affect engineering and agronomic properties differently. Farmers should ensure that they plant their vegetables also in rotation. Vegetables that creep on the soil like fluted pumpkin should be planted followed by okra and others which does not creep on the soil. This practice will ensure proper conservation and utilization of soil properties/nutrients. It is also recommended that this experiment should be carried out for two cropping seasons ascertain the results of this study.

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Table 1: Effects of Vegetable Cropping on Engineering and Agronomic Properties of soil

Treatments	Cone Index MP	Bulk Density g/m^3	Porosity	Sand (%)	Silt (%)	Clay (%)	H_2O 1:1	KCl	Org. C (5)	Org. M (%)	N %	Bray/ PPm	Ca	Mg Mol	K (kg)	Na	CEC	Base Saturation
T1	0.12	1.44	0.46	75.6	11.1	13.3	6	5.2	0.88	1.38	0.07	3.25	3.46	1.55	0.28	0.59	6.08	78.8
T2	0.14	1.56	0.41	75.2	11.9	12.9	6.01	5.41	0.8	1.38	0.076	3.3	3.51	1.61	0.21	0.55	5.95	
T3	0.13	1.47	0.45	80.1	10.8	9.1	5.85	5	0.7	1.21	0.063	2.4	2.55	1.3	0.21	0.43	4.28	80.5
O1	0.14	1.34	0.49	73.5	12.5	14	6.12	5.3	0.75	1.3	0.08	3.08	3.5	1.6	0.28	0.62	6.18	88
O2	0.15	1.28	0.52	74.3	12.4	13.3	6.31	5.52	0.87	1.5	0.078	3.1	3.61	1.35	0.22	0.64	6.02	
O3	0.13	1.54	0.42	76.2	11.5	12.3	6.05	5.61	0.78	1.35	0.077	3.22	3.08	1.29	0.24	0.58	5.98	
F1	0.16	1.25	0.53	75.4	11.6	13	5.9	5.1	0.72	1.24	0.081	3.77	3.41	1.57	0.26	0.64	5.96	84.5
F2	0.14	1.14	0.57	77	12.1	10.9	6.11	5.9	0.8	1.38	0.079	3.83	3.51	1.6	0.26	0.66	6.21	
F3	0.12	1.23	0.54	75	11.3	13.7	6.25	5.33	0.88	1.52	0.075	3.82	3.5	1.62	0.27	0.67	6.22	85.3
N1	0.51	1.84	0.31	75.4	11.8	12.8	6.01	5.49	0.77	1.33	0.076	3.21	3.09	1.58	0.2	0.49	6.01	
N2	0.52	1.79	0.32	75.1	11.2	13.7	6	5.15	0.8	1.38	0.08	3.33	3.45	1.51	0.28	0.64	5.88	81.3
N3	0.45	1.68	0.37	73.1	12.3	14.6	6.1	5.25	0.77	1.33	0.07	3.4	3.51	1.56	0.29	0.66	6.15	85.6

Source: Field Data 2015 Cropping Season

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