Soil Properties, Growth and Yield of Maize as Affected by Organic Manure (Teak Fresh Leave) in Makurdi, North Central, Nigeria

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***Abstract:*-An experiment entitled "Soil properties, growth and yield of maize as affected by organic manure (teak fresh leave) in Makurdi, North Central, Nigeria" was carried out at Teaching and Research Farm of Federal University of Agriculture, Makurdi, Benue State, Nigeria during the year 2011 and 2012. The experiment was laid out in Randomized Complete Block Design with six treatments replicated three times. Organic manure (teak fresh leaves) was subjected to all plots except control. Data were recorded on different parameters such as soil chemical properties, plant height, number of leaves and grain yield. The statistical analysis of the data showed that organic manure significantly affected some chemical properties and all growth and yield studied attributes. The highest plant height, number of leave and grain yield was recorded in plants received 7.5 t ha^{-1}organic manure. It was concluded that 7.50 t ha^{-1}of organic manure among the different rates performed best and hence recommended for the soil sustainability and maize production.**

***Key words:* Organic manure; maize; soil properties; number of leaves; yield**

I. INTRODUCTION

Maize (*zea mays* L.) is grown in virtually every country in the world. It is now grown largely in warm temperate regions (Shaw, 1997) and only three out of thirteen countries are producing maize that is in million tons per year. These are mainly tropical Brazil, Mexico and India. Maize is the world's highest supplier of calorie with caloric supply of about 19.5%. It provides more calorie than rice (16.5%) and wheat (15.0%). Maize is one of the most important staple foods in the world today; maize, rice and wheat combine to supply more than 50% of global caloric intake (World Atlas, 2017).

Maize is the most important staple food in Nigeria and it has grown to be local 'cash crop' most especially in the southwestern part of Nigeria where at least 30% of the crop land has been devoted to small-scale maize production under various cropping systems (Ayeni, 1991). The diverse use of maize as food for man and his livestock and raw materials for industries has made the crop in continuous production. Compared to other arable crops such as millet, the nutrients requirement of maize is quite higher and hence, constituting major constraints to its production. Application of inorganic fertilizer to increase crop growth and yield is well known since the nutrients are readily available for plant use but continuous and inappropriate use of inorganic fertilizer is harmful both to the soil and the environment. It increases soil acidity, and nutrient imbalance and pollution of underground water. In view of the well documented detrimental effects of inorganic fertilizer, its rising cost and unavailability has limited its use among poor farmers in Nigeria (Taminu *et al*., 2007), hence, attention has been directed to the use of organic manure in recent times.

The addition of organic materials to soils have a direct effect on soil organic matter content, can improve soil fertility, soil physical characteristics, and augment microbial activities, can ameliorate metal toxicity (Escobar and Hue, 2008; Hue *et al*., 1986 and Wong and Swift, 2003). Soil organic matter undergoes mineralization and releases substantial quantities of nitrogen, phosphorus, sulfur and micronutrients (Rahman *et al.*, 2013). Organic farming practices deliberately integrate traditional farming practices and make use of locally available resources. As such they are highly relevant to smallholder farmers who produce for themselves and local markets (Kolavalli and Adam, 2011). Organic farming contributes to achieve public goals at the national and local levels in Africa (IFOAM, 2009). Organic fertilizer supplies the essential macro- and micro-nutrient elements to plants, as well as improves soil physico-chemical conditions for better maize growth and yield (Martin *et al*., 1998). As highlighted by Beckman (1973), the application of poultry manure is expected to enhance soil productivity, increase the soil organic carbon content, soil flora and fauna, improve soil crumb structure and the nutrient status of the soil towards attaining sustainably high yields. The role of organic manure in maintaining organic matter and raising the growth and yield of cereal crops had long been recognized in most agro-ecological zones (Eneji *et al*., 1997 and Enwezor *et al.*,1995).

Organic manure apart from supplying all essential nutrients required by plants, improve soil structure, aeration and encourage good root growth (Udom *et al*., 2007). Organic manures also enhance nitrogen availability, improve soil structure, water retention and increases soil organic matter (Ancheng and Sun, 1994). All these are essential for proper growth and yield of crops. Therefore, the objective of the study was to evaluate the effect of different rates of organic manure (teak fresh leave) on soil properties, growth and yield of Maize

II. MATERIALS AND METHOD

The experiment was conducted at the Teaching and Research Farms of the Federal University of Agriculture, Makurdi, Benue State (latitude 7^0 45^1N and longitude 8^0 35^1E) during the 2011 and 2012 cropping seasons. The site was previously cropped to maize but fallowed for two years. The predominant weeds were guinea grass (*Panicum maximum*) and spear flower (*Cumulinebenghalensis*). This Location falls within the Southern Guinea Savanna Agro ecological zone of Nigeria. The soil of the experimental site was classified as Typic Ustropepts and Typic Haplustults (USDA) or Eutric Cambisols and Haplic Lixisols (FAO) (FDALR, 1990).

This experiment comprised organic manure (teak fresh leaves) at six different rates: 0.0 (control), 3.5, 5.5, 7.5, 9.5 and 11.0 t ha-^{1}. The treatments were laid out in a Randomized Complete Block Design and replicated three times giving a total of 18 plots with each plot measuring 4 x 3 m with an alley of 0.5 m between plots and 1m between replications. The site was cleared and ridged manually. White maize which was used as test crop was planted in June in the two cropping seasonings. The seeds were planted on the spacing of 75 by 25 cm. The seedlings were later thinned to one per stand two weeks after planting. Weeding was done manually at three weeks interval.

Organic manure (teak fresh leaves) was collected from the forest. The fresh leaves were harvested at the ages of five - ten years of establishment of the plantation. Teak fresh leaves were incorporated into the soil four weeks before planting.

A composite soil sample from 10 auger points was collected at random within the experimental site using the soil auger at the 0-20cm depth from the commencement of the experiment. The soil was air dried and sieved through a 2 mm mesh. Post planting soil samples were collected from each plot based on the treatment at 30, 60 and 90 days after planting and taken to the laboratory analysis for particle size distribution which was determined by the Bouyoucos (Hydrometer) method procedure (Udo *et al* (2005) and IITA (1979), soil pH was determined in a soil/water (1: 2) suspension using a digital electronic pH meter. Soil organic carbon was determined by the Walkley and Black procedure by wet oxidation using chromic acid digestion (Nelson and Sommers, 1996). Total N was determined using micro-Kjeldahl digestion and distillation techniques (Bremner, 1996). Available phosphorus was determined by Bray-1 method as described by IITA (1979). Exchangeable K, Ca and Mg were extracted with a 1 M NH_4OAc, pH 7 solution. Thereafter, K was analyzed with a flame photometer and Ca and Mg were determined with an atomic absorption spectrophotometer (Okalebo*at al.,* 2002).

The organic manure (teak fresh leaves) was analyzed for nitrogen, phosphorus, Potassium, Magnesium, Calcium and Sodium. Total N was determined using macro-Kjeldahl method. Available phosphorus was determined by Bray-1 method. The exchangeable K and Na were determined on a flame photometer while Mg and Ca were determined on Atomic Absorption Spectrophotometer (AAS) and organic carbon was determined by wet oxidation using chromic acid digestion (Nelson and Sommers, 1996).

The growth parameters (plant height and number of leaves) were measured at 2 weeks interval up to 10 weeks after planting. The total grain yield was measured by harvesting and threshing all the middle rows of each plot. The grain yield was oven-dried at 13 – 14 % moisture content.

Data collected were subjected to analysis of variance (ANOVA) and significantly different mean values were separated using least significant different (LSD) at 5% level of probability.

III. RESULTS AND DISCUSSION

3.1 Initial soil properties and organic manure analysis

The results of the physical and chemical analysis of the soil used for the trials before seeding were sandy loam in texture with pH of 6.14 and 6.10 for the two cropping seasons respectively (Table 1). Total nitrogen were 1.00 and 1.01 %, K were 0.30 and 0.31cmolkg^{-1}, while available P were 5.50 and 5.40 mgkg^{-1}in the two cropping seasons respectively indicating that the quantities of these nutrients were inadequate for optimum plant growth. The results agrees with the observation of Aduayi *et al* (2002) that most Nigerian soils are deficient in nitrogen and phosphorus, where for this elements less than 1.5g kg^{-1} Total N and less than 8 mg kg-1 (Bray- 1-P) are considered respectively to be below critical level. From the results of the physical and chemical analysis of the soil used for the trial, it is obvious that the fertility status of the soil is inherently low, according to the nutrient rating for soil fertility classes in Nigeria (Obigbesan, 2000) and this implies that cropping the soil without the use of soil amendments will not be economical

The nutrient concentrations of organic material used is shown in Table 1. The results indicated that Nitrogen, phosphorus, potassium, magnesium and organic carbon were 3.8 %, 11.2%, 1.8 cmol kg^{-1}, 2.2 cmol kg-1 and 4.60 % respectively. The nutrient content of the materials is quite high as compared to the control, which makes it suitable as organic fertilizer. This is evident in the growth response obtained in this trial where compost appliedplots performed better than the untreated plots as shown for number of leaves, plant height and stem girth.

Table 1: Initial soil analysis and nutrient composition of organic manure source

Parameters	Soil 2011	Soil 2012	Organic manure source (%)
Sand (%)	88.80	88.20	
Silt (%)	7.20	7.80	
Clay (%)	4.00	4.00	
Textural class	Sandy loam	Sandy loam	
pH (H_2O)	6.14	6.10	
Organic carbon (%)	1.60	1.54	4.60 (%)
Total Nitrogen (%)	1.00	1.01	3.80 (%)
Available P (mg/kg)	5.50	5.40	11.20 (%)
Exchange Mg ($Cmolkg^-1$)	0.90	0.92	2.12
Exchange Ca ($Cmolkg^-1$)	3.40	3.50	13.60
Exchange K ($Comlkg^{-1}$)	0.30	0.31	1.80
Exchange Na($Comlkg^{-1}$)	0.16	0.18	1.60
CEC ($Cmolkg^{-1}$)	2.40	2.60	

3.2 Manurial effect on particle size distribution, pH and organic carbon

Tables 2 represent manurial effect on particle size distribution, pH and organic carbon. The results of the organic manure on soil particle size distribution for the two cropping seasons. The highest sand particles of 83.37% was obtained from 11.5 t ha-^{1}, followed by the control (82.30%) and 9.5 t ha-^{1} (82.30%) with the lowest at 5.5 t ha-^{1} (77.70%). Highest silt particle was obtained from 5.5 t ha-^{1} (14.67 %), followed by 7.5 t ha-^{1} (14.33%), and lowest was recorded at 11.5 t ha-^{1} (12.00%). The highest clay particle was obtained with the application of 5.5 t ha-^{1} (7.63%), 7.5 t ha-^{1} (7.04%) and least at 11.5 t ha-^{1} (4.63%). Application of organic manure did not affect the soil textural class significantly in both two cropping seasons.

The pH result obtained at 30 day after planting indicated that 7.5 t ha-^{1} produced the highest value of pH (6.85) and significantly higher than other treatments. It was followed by 11.5 t ha-^{1} (6.40), 5.5 tha-^{1} (6.13), and 5.5 t ha-^{1} (6.13) and the control (5.41). The control was statistically lower than all other treatments. However, there was not statistical different at 60 days after planting, the highest pH was obtained at 7.5 t ha-^{1} (6.45) of organic manure followed by the control (6.40) and least was at 11.5 t ha-^{1} (6.06). the pH at 90 days after planting has 7.5 t ha-^{1} treatment recorded the highest value of 6.75 which was statistically higher than others and followed by 5.5 t ha-^{1} (6.52), 3.5 t ha-^{1} (6.43) and the lowest was the control (5.98). The similar trend was observed in 2012 cropping season. The slight increases in the pH could be due to biochemical processes of mineralization. This could be attributed to the application of organic manure which contains high exchangeable cations, the presence of these exchangeable bases led to that increased pH (Agbede 2010; Onwu *et al*., 2014). Boateng *et al.* (2006) also reported that organic manure increased pH which was attributed to the slow release of basic cations by the organic amendments.

Significant effect of manure application was observed on the soil organic carbon (Table 2). At 30 days after planting, 7.5 t ha-^{1} gave the highest value of organic carbon (3.93 %) followed by 5.5 t ha-^{1}(3.90 %) these treatments were statistically higher than other and treatment 11.5 t ha-^{1} (2.53 %) recorded the lowest value of organic carbon. The highest organic carbon was observed at 7.5 t ha-^{1} (4.30) at 60 days after planting which was followed by 5.5 t ha-^{1} (3.80%) and were statistically higher than other. The control recorded the lowest value of organic carbon and was statistically lower than others. Treatment 7.5 t ha-^{1} (4.20 %) obtained the highest organic carbon and significantly higher than other treatments. The 2012 cropping season had similar trend. The organic manure contained essential plant nutrients for plant uptake. Soils treated with organic manures at 30, 60 and 90 days after planting have more stability of organic matter than the control. The increase in soil organic carbon in the organic manure applied plots has widely been reported in other studies by Osundare (2004), who reported increase of soil organic carbon from the applications of poultry manure, Akanbi and Ojeniyi (2007) who used *Chromolena mulch*, Schroeder *et al.* (2006) who incorporated feed lot, Okpara and Mbagwu (2003) and Maku *et al.* (2011) all reported increase in soil organic carbon due to the application of different plant manure sources.

Table 2: Manurial effect on Particle Size Distribution, pH and organic carbon

	Particle size distribution (%)						pH (H_20)						OC (%)					
	2011			2012			2011			2012			2011			2012		
Treatments	Sand	Silt	Clay	Sand	Silt	Clay	30D	60D	90D	30D	60D	90D	30D	60D	90D	30D	60D	90D
0.0 t ha^{-1}	82.30	12.67	5.03	81.00	12.67	6.33	5.41	6.40	5.98	5.42	6.42	5.99	2.54	2.31	2.24	1.93	1.82	1.73
3.5 t ha^{-1}	81.57	13.33	5.10	80.33	13.67	6.00	6.13	6.11	6.33	6.14	6.12	6.42	3.30	3.57	3.07	2.00	2.20	2.60
5.5 t ha^{-1}	77.70	14.67	7.63	78.00	17.33	5.67	6.13	6.21	6.32	6.13	6.23	6.53	3.90	3.80	3.50	2.10	2.43	2.83
7.5 t ha^{-1}	78.63	14.33	7.04	75.00	17.17	7.83	6.85	6.45	6.85	6.87	6.45	6.74	3.93	4.30	4.20	2.69	2.73	3.80
9.5 t ha^{-1}	82.30	12.67	5.03	81.07	13.33	5.60	5.98	6.14	6.16	5.79	6.13	6.17	2.63	3.47	3.33	2.00	2.03	2.40
11.5 t ha^{-1}	83.37	12.00	4.63	79.00	14.67	6.33	6.40	6.06	6.05	6.41	6.05	6.09	3.00	3.43	3.23	2.01	2.11	2.13
LSD	NS	NS	NS	NS	NS	NS	0.52	NS	0.42	0.50	0.6	0.51	0.36	0.57	0.47	0.32	0.37	0.41

D=days after planting

Table 3: Manurial effect on Soil Chemical Properties N P K.

	N (%)						Available P mg/kg						K(cmol kg^{-1})					
	2011			2012			2011			2012			2011			2012		
Treatments	30D	60D	90D	30D	60D	90D	30D	60D	90D	30D	60D	90D	30D	60D	90D	30D	60D	90D
0.0 t ha^{-1}	0.04	0.04	0.04	0.04	0.04	0.04	1.30	1.20	1.30	1.23	1.07	1.50	0.31	0.27	0.26	0.29	0.28	0.30
3.5 t ha^{-1}	0.02	0.04	0.11	0.03	0.07	0.12	1.57	1.88	1.65	2.13	1.57	2.16	0.35	0.38	0.39	0.34	0.39	0.41
5.5 t ha^{-1}	0.02	0.04	0.16	0.03	0.08	0.12	1.67	2.22	1.82	2.40	1.80	2.31	0.37	0.39	0.41	0.34	0.38	0.41
7.5 t ha^{-1}	0.0	0.05	0.26	0.04	0.08	0.29	2.50	2.30	2.29	2.61	1.90	2.60	0.37	0.47	0.47	0.39	0.46	0.48
9.5 t ha^{-1}	0.03	0.04	0.17	0.03	0.07	0.15	1.95	1.74	2.09	2.47	1.30	2.43	0.36	0.42	0.41	0.33	0.40	0.42
11.5tha^{-1}	0.03	0.06	0.14	0.03	0.06	0.13	1.47	1.56	1.90	2.40	1.20	2.23	0.35	0.38	0.41	0.33	0.39	0.40
LSD	NS	NS	0.08	NS	NS	0.12	NS	NS	NS	NS	NS	NS	NS	0.09	0.10	NS	0.07	0.08

D=days after planting.

3.3 Manurial effect on soil chemical properties N P K.

The effect of organic manure on total N is presented on Table 3. The results indicated no significant effect of the treatments on soil N at 30 and 60ays after planting in 2011. However, at 90 days after planting, at 7.5 t ha-^{1} (0.26%) gave significant higher values of N over all other treatments. The 0.0 t ha-^{1} (control) recorded the lowest value of nitrogen and statistically lower than all other treatments. The trend in 2012 was similar to 201. The nitrogen nutrient dynamics observed in this experiment shows the biochemical changes that accompany organic manure under field conditions. Adejuyigbe and Adeoye (2005) observed that organic matter and nutrient levels were much lower in shifting cultivation than natural forest soil. The initial decrease in soil nitrogen and subsequent increase from 60 days up to the end of the experiment is the mineralization and possible immobilization of initial nutrients by microbes involved in degradation process. Adegbite and Olayinka (2010) reported a similar trend with organic manures where the amount of nitrogen and phosphorus increased progressively but minimally up to 16 weeks after incorporation and the initial flush of microbiological activities of two weeks after incorporation. Onwu*et al*. (2014) reported that plant nutrient from organic manure were reduced by cultivated crops in their initial stages of growth but over time the soil nutrient levels were raised above control.

For the available P, there was increased in P value at 30, 60 and 90 although it did not show any statistical different among treatments. Highest P was obtained from application of 7.5 t ha-^{1} and lowest from 0.0 t ha-^{1} (control). Similar trend was observed in 2012 where there was no statistically different among the treatments and 7.5 and 0.0 showed the highest and lowest value of P respectively. This increase in P value was in agreement with Adegbite and Olayinka (2010) who reported a similar trend with organic manures where the amount of nitrogen and phosphorus increased progressively but minimally up to 16 weeks after incorporation and the initial flush of microbiological activities of two weeks after incorporation.

The results in 2011 indicated no significant effect of the treatments on soil K at 30 days after planting. Application of organic manure significantly K values at 60 and 90 days after planting. At 60 days after planting, application of 7.5 t ha-^{1} (0.47 cmol kg-^{1}), 9.5 t ha-^{1} (0.42 cmol kg-^{1}), 5.5 t ha-^{1} (0.37 cmol kg-^{1}.), 11.5 t ha-^{1} (0.38 cmol kg-^{1}) and the control (0.29 cmol kg-^{1}). At 60 and 90 days after planting treatment 7.5 t ha-^{1} had the highest K values and were statistically the same with all plots that received organic manure but significantly higher than the control. The trend in 2012 was a similar to 2011. The increase in k value in plots that received organic manure could be due to mineralization of the organic manure. The same increase in exchangeable calcium, potassium, magnesium and sodium with application of the organic manure sources could be due to possible nutrients immobilization by soil microbes and the subsequent slow increase indicates mineralization and slow release of soluble nutrients which is a characteristic of organic matter. These exchangeable cations has been reported by Azeez *et al.*, (2007) who observed increases in potassium and calcium from 30 to 90 days after incorporating plant residues.

Table 4: Manurial effect on Soil Chemical Properties Na, Ca and Mg (cmoltha^{-1})

	Na						Ca						Mg					
	2011			2012			2011			2012			2011			2012		
Treatments	30D	60D	90D	30D	60D	90D	30D	60D	90D	30D	60D	90D	30D	60D	90D	30D	60D	90D
0.0 t ha^{-1}	0.43	0.45	0.44	0.45	0.16	0.43	3.10	3.09	3.01	2.91	2.85	2.90	0.68	0.88	0.85	0.90	0.90	0.87
3.5 t ha^{-1}	0.54	0.52	0.53	0.54	0.27	0.69	3.76	3.74	3.64	3.56	3.62	3.64	1.90	1.90	1.90	1.86	1.72	1.89
5.5 t ha^{-1}	0.60	0.29	0.52	0.60	0.50	0.72	3.73	3.72	3.80	3.73	3.72	3.76	1.66	1.60	1.86	1.89	1.71	1.86
7.5 t ha^{-1}	0.61	0.62	0.61	0.61	0.51	0.61	4.67	4.76	4.74	4.67	4.73	4.84	1.87	1.69	1.89	1.93	1.67	1.82
9.5 t ha^{-1}	0.61	0.61	0.52	0.58	0.46	0.59	3.84	3.85	3.99	3.83	3.80	3.79	1.75	2.28	1.87	1.75	1.79	1.88
11.5 t ha^{-1}	0.58	0.61	0.39	0.51	0.54	0.50	3.71	3.73	3.65	3.67	3.75	3.78	1.75	1.82	1.83	1.82	1.86	1.72
LSD	NS	NS	NS	NS	NS	NS	0.60	0.49	0.57	0.56	0.52	0.53	0.25	0.23	0.15	0.20	0.23	0.15

D=days after planting.

3.4 Manurial effect on soil chemical properties Na, Ca and Mg

Table 4 showed the result of Na, Ca and Mg. The result of sodium in the soil indicated that there was increase Na in the plots treated with organic manure but not significant among treatments. The 7.50 t ha^{-1} of organic manure applied recorded the highest values of Na while least was observed at the plot with no manure (control). With the application of organic manure, the increased exchangeable cations especially Na could be attributed to the mineralization and release of nutrients of the leaf biomass that has appreciable quantities of Na. The increase in exchangeable bases has been reported for other plant manure sources including *Chromolaenaodorata* by Obatolu and Agboola (1993).

The significant effects of manure application were observed on the soil Ca and Mg (Table 4). At 30, 60 and 90 days after planting in the two cropping seasons, 7.5 t ha-^{1} gave the highest value of Ca and Mg and statistically higher than other treatments. Treatment 7.5 t ha-^{1} was followed by other plots that received organic manure and were significantly higher than the control. The controls recorded the lowest value of Ca and Mg and were statistically lower than others. The changes and increases in exchangeable cations with with application of organic manure were also reported by Obi and Eboh (1995) as well as Dikinya and Mufwaazala (2010). This result is in conformity with the studies of IITA (1994) reported that organic manure incorporated into the soil increased plant nutrients such as potassium, magnesium, calcium and sodium. Nutrients contained in organic manures are released more slowly and are stored for a longer period in the soil ensuring longer residual effects, improved root development and higher crop yields (Sharma and Mittra, 1991)

3.5 Manurial effect on plant height

Influence of organic manure on plant height is showed on figure 1. The result of plant height at 2 weeks after planting (WAP) indicated that there was increased height in the plots treated with organic manure but not significant ($p < 0.05$) different among treatments. At 4WAP, treatment 7.5 t ha^{-1} (83.33 cm) had the tallest plant and statistically higher than other treatments, this was followed by treatment 5.5 t ha^{-1} (73.00 cm) which was also statistically taller than other treatments. The control recorded shortest plant and statistically lower than other treatments. At 6, 8 and 10 WAP, treatment 7.5 t ha-^{1} gave the highest value of plant height statistically similar with all plots that received organic manure. All the plots that received organic manure were significantly higher than the control in 2011. The trend in 2012 was similar to what happened in 2011. The enhancement in growth attributes in plant due to application of organic manure may have been related to the direct addition of limiting plant nutrients. Organic manure has high N content as well as other nutrients which are gradually released to the plant to increase height (Khalil *et al*., 2005; Awodun, 2007) It can be adduced that increasing level of organic manure could have resulted in an increase in the amount of nitrogen made available to the plants through mineralization and nitrogen is known to stimulate growth in plants (Anyaegbu *et al*., 2010).The poor development of vegetative characters observed in treatment without manure (control) further confirmed the report of Akanbi*et al* (2000) and Akanbi 2002, that nutrient, availability especially nitrogen determine plant vegetative grow.

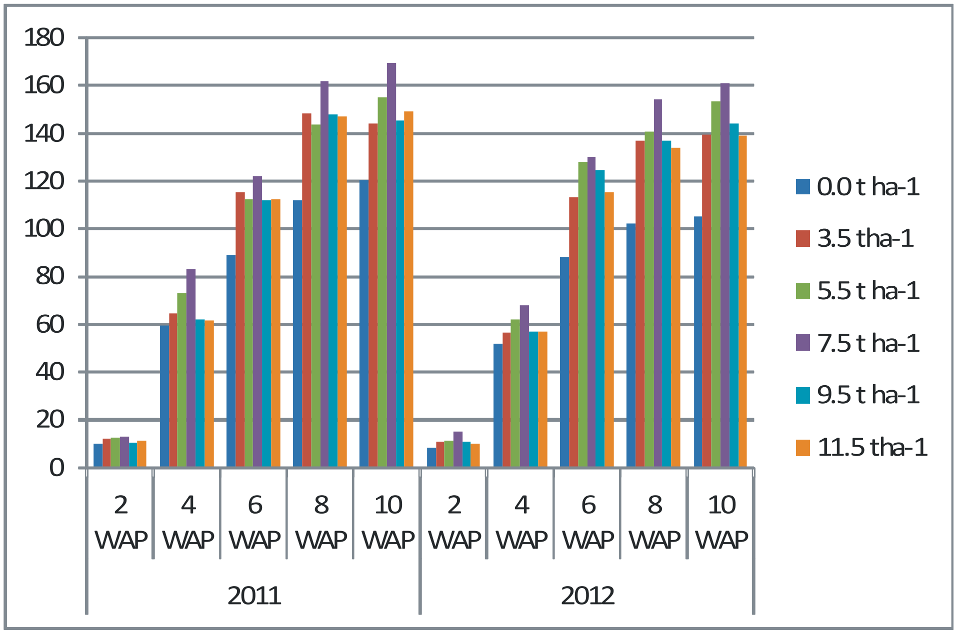

Figure 1: Manurial effect on plant height

3.6 Manurial effect of number of Leaves

The data regarding number of leaves is presented in figure 2. The statistical analysis of the data showed that organic manure significantly affected number of leaves. The highest number of leaves (15.33) was recorded in plots treated with 9.5 t ha-1 which was statistically similar to the plots treated with organic manure while the lowest number of leaves was recorded in plots treated as control. The highest number of leaves was recorded in plots treated with organic manure could be due to efficient nitrogen availability as a result the plant uptake more nitrogen and in turn more number of leaves were observed.

The results also agreed with the Balyeri *et al.*(2016) they studied that organic manure influenced growth, yield and nutritional quality of containerized aromatic pepper (*Capsicum annuum*L). They concluded that the poultry manure increased the number of leaves due to sufficient nitrogen availability which in turn improve the vegetative growth of the crop these finding are also confirmed by Shah *et al*.(2016) who found greater leaf area with the application of poultry manure. Also, Michael *et al.* (2010) reported that poultry manure has been found to enhance the number of leaves in lettuce by providing sufficient amount of nutrients that accelerate the growth of leaves.

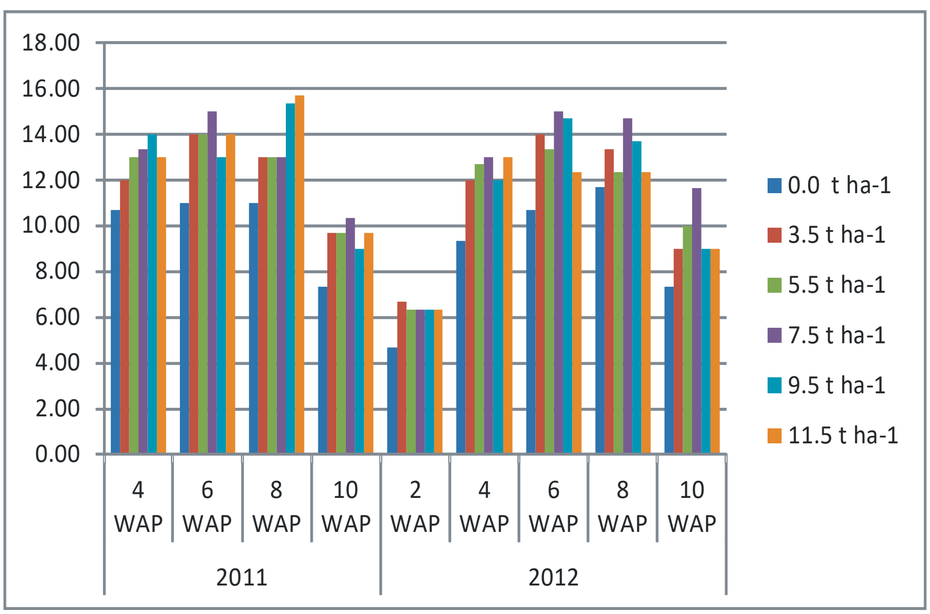

Figure 2: Manurial effect on number of leaves

Table 5: Manurial effect of organic manure on Yield (t ha^{-1})

Treatments	2011	2012
0.0 t ha^{-1}	0.96	0.93
3.5 t ha^{-1}	1.23	1.13
5.5 t ha^{-1}	1.33	1.34
7.5 t ha^{-1}	1.63	1.61
9.5 t ha^{-1}	1.30	1.21
1.5 t ha^{-1}	1.23	1.14
LSD	0.12	0.11

The grain yields were significantly affected by organic manure application at all levels in the two cropping seasons. The pattern of response was very clear, with lowest grain yield obtained from plants treated without manure application, whilst the highest grain yields were obtained at 7.5 t ha^{-1} (Table 5). The results of this experiment showed that organic manure application increased grain yield. From this study, the average yield varied from 0.96 to 1.63 t ha^{-1} between 0 and 7.5 t ha^{-1} suggests that the 7.5 t ha^{-1} may be regarded as the optimum level of the nutrient elements. The plants without manure treatment had the lowest yield which could have been partly due to deficiency of nutrients as revealed by low nutrient status of the soil. The effect of organic manure in 2012 followed the same trend as observed in 2011.The increase in grain yield due to manure application could be attributed to easy solubilization effect of released plant nutrient leading to improved nutrient status and water holding capacity of the soil. The results obtained were in agreement with the findings of Sanwal *et al*., (2007) in turmeric (*Curcuma longa*) Premsekhar and Rajashree (2009) in okra (*Abelmoscusesculentus*) in which they reported that higher yield response of crops due to organic manure application could be attributed to improved soil properties resulting in better supply of nutrients to plants. This confirms findings of Akande *et al.* (2003) that application of organic materials could ameliorate slightly acidic tropical soil to improve crop production.

IV. CONCLUSION

The application of organic manure had a significant effect on soil properties in both cropping seasons. The results obtained revealed that maize responded well to the application of organic manure compared to control treatment in the study. Based on the finding of this study, it may be recommended that applying 7.5 t ha^{-1}was adequate for soil sustainability and maximum growth and yield parameters studied.

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