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Research Article

Soil Properties and Vegetative Growth of Fluted Pumpkin (*Telfairia occidentalis* Hook F) as Influenced by Organic Fertilizer

[1]Adebayo A. Olowoake and [2]Olumuyiwa P. Adeyemo

[1]Department of Crop Production, Kwara State University, PMB 1530, Ilorin, Nigeria
[2]Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, PMB 5029, Ibadan, Nigeria

Abstract

Background and Objective: Application of organic fertilizers on soil can contribute to improvement in soil fertility and yield of crop. The trial was aimed at assessing the soil properties and vegetative growth of fluted pumpkin as affected by application of compost amended with mineral fertilizer. The experiment was a randomized complete block design. The experiment involved six treatments: Organic fertilizer plus (OFP) at 3, 4, 5 and 6 t ha^{-1}, NPK at 60 kg N ha^{-1} and control. **Results:** Organic fertilizer plus at 4 t ha^{-1} significantly increased the vine length, number of branches, number of leaves, fresh shoot marketable yield and shoot dry weight of pumpkin. Higher concentration and uptake of nitrogen, phosphorus and potassium was observed in the shoot of the plants which received OFP at 4 t ha^{-1}. The OFP at 4 t ha^{-1} had a significant and additive effect on soil nutrients after harvesting of pumpkin when compared with NPK. **Conclusion:** The use of organic fertilizer plus could be used effectively in increasing soil fertility for *Telfairia occidentalis* production.

Key words: Alfisol, fluted pumpkin, nutrient uptake, organic fertilizer, soil properties, *Telfairia occidentalis*

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Corresponding Author: Adebayo A. Olowoake, Department of Crop Production, Kwara State University, PMB 1530, Ilorin, Nigeria

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Telfairia occidentalis commonly called fluted pumpkin is an important leaf and seed vegetable indigenous to Southern Nigeria and grown in the forest zone of west and central Africa (Nigeria, Ghana and Sierra Leone being the major producers. It probably originated in south east Nigeria and distributed by Igbos who have been cultivated this crop since time immemorial[1]. The tender vine and foliage are consumed as pot herbs while the seed is consumed as nut. The leaf finds herbal use in the treatment of anaemia and diabetes[2]. The vegetable contains 20.5 g proteins, 45 g fat, 23 g carbohydrate, 2.2 g fibre and 4.8 g total ash and the seed oil could be used for the preparation of margarine and pomade as well as for use as carrier for drugs[3].

One of the problems of crop production in the tropics is that tropical soils have low fertility status[4]. The soils are highly weathered and leached, low in organic matter and available nutrients, thus leading to low productivity within few years of cultivation[5]. Applying inorganic fertilizer is one of the widely accepted ways of increasing soil nutrients both in the temperate and tropical zones of the world. However, long term studies have shown that there is a limit to which inorganic fertilizer can sustain the productivity of intensely cultivated soil. This is because of problem of decrease in yield with time, enhancement of soil acidity, leaching losses and degradation of soil physical and organic matter status[6].

The use of organic manure cannot be over emphasized because of its usefulness in the improvement of physical and biological conditions of soil which in turn improves the crop growing environment and culminates in the better production of economic plants. Apart from the role of organic manure as a store house for plant nutrients it acts as a major contributor to cation exchange capacity and as a buffering agent against undesirable pH fluctuations[7]. Research has shown that organic based fertilizers are less leached into ground water than the chemical fertilizer[8]. The utilization of organic waste fertilizer has found favour in enhancing crop production in Nigeria, because it is inexpensive and less possible to pollute the ground water as far as inorganic fertilizer. It developed soil fertility status along with the increment of farmer's income thru increase in yield. Thus, there is an increase in studies on organic wastes as alternative fertilizers. Organic wastes provide a continuous decomposing substrate and consequent gradual input of soil organic matter, thereby increasing soil nutrients and improving the soil physical properties[8].

Many experiments have been carried out with the use of organic waste and inorganic fertilizers for fluted pumpkin production in diverse formulations[9,10]. Aleshinloye grade A and Sunshine grade A fertilizers was used by Olaniyi and Oyelere[1] to increase the growth, yield and nutritional compositions of fluted pumpkin. Little or no research has been conducted on the response of soils and pumpkins to these fertilizers in Ibadan, Nigeria. Thus, an experiment was set up to investigate the effect of organic fertilizer plus on the growth, nutrient uptake and yield of *T. occidentalis* and to evaluate its effect on the soil properties.

MATERIALS AND METHODS

Description of study area: The field experiment was carried out at the Federal College of Agriculture at Southern farm, Institute of Agriculture Research and Training (IAR and T) Moor Plantation, Apata, Ibadan, Oyo State, Nigeria, between April and November, 2018. The area is characterized by a tropical climate marked with wet and dry seasons. The mean annual rainfall recorded for a period of 10 years was 1382 mm[11]. Rainfall peaks occur mostly in June and September. Annual temperature ranges from 21.3-31.2°C. There are 2 cropping seasons: Early (March/April-early August) and late (mid-August-October/November) seasons. The soil of the study site belongs to Alfisol, classified as Typic Kanhaplustalf according to USDA classification and locally classified as Iwo series[12].

Two seeds were sown in a nursery and later thinned down to one seedling per stand at 4 weeks after sowing (WAS). Defoliating Insect pests were controlled by spraying the crop with neem extract at 2 weeks interval starting from 2 weeks after transplanting. The site was cleared manually, each plot size measured 3.0×3.0 m with 1.0 m between blocks.

Soil sampling and analysis: Soil samples were randomly taken from 0-15 cm depth using soil auger before the study. The samples were bulked and air-dried and were taken to Laboratory for analysis. The particle size analysis was determined by hydrometer method[13]. Organic carbon was determined by Walkley-Black dichromate digestion method as described by Nelson and Sommers[14] and total nitrogen by Bremner and Mulvaney[15]. The P was determined by Brays P1 method[16]. Exchangeable K, Na, Ca and Mg were extracted by leaching the soil with neutral ammonium acetate (NH_4OAC). The K and Na concentrations were determined by flame photometer, while Mg and Ca were determined by atomic absorption spectrophotometer. Soil pH determination was carried out using a 1:2 (soil:water) ratio with a glass electrode pH meter and electrical conductivity in deionized water suspension of 1:5 (w/v).

Experimental design and treatments: The experimental design used in this study was randomized complete block design (RCBD) replicated 3 times. Four week old grown fluted pumpkin seedlings were transplanted form the nursery. The fertilizers were applied to the pumpkin and the field trials had six major treatment combinations comprising the following:

- Control 0.0 t ha^{-1}
- Organic fertilizer plus 3.0 t ha^{-1}
- Organic fertilizer plus 4.0 t ha^{-1}
- Organic fertilizer plus 5.0 t ha^{-1}
- Organic fertilizer plus 6.0 t ha^{-1}
- NPK 15:15:15

The mineral fertilizer were applied at the equivalent weight of 60 kg N ha^{-1} as recommended by Olaniyi and Oyelere[1]. The treatments organic plus were applied 2 weeks before transplanting while NPK was applied 2 weeks after transplanting (2 WAT). Fertilizer plus (organomineral) is a commercial fertilizer from Agricultural Demonstration Enterprises Monatan, Ibadan, Oyo State Nigeria.

Data collection: Hoe weeding and other cultural practices were carried out as at when required. Four plants were selected randomly per plot for data collection. The growth parameters measured were vine length, number of leaves, stem girth, number of branches, fresh shoot yield (g) and dry weight (g). For the determination of plant shoot dry matter yield and tissue nutrient concentration, four plants/plot were uprooted at 6 WAT and oven dried to constant weight at 65 °C for 48 h. The dried samples were weighed for estimation of dry matter yield and milled. The 2.0 g ground plant samples were taken into beaker and digested using wet digestion of a mixture of nitric, sulphuric and perchloric acid[17]. Phosphorus was determined by Bray's method and total nitrogen using the Kjeldahl procedure and potassium determination by flame photometry[17]. Nutrient uptake was determined by multiplying total dry matter yield (g) with nutrient content (%).

Statistical analysis: The data collected were subjected to statistical analysis of variance and significant differences among the treatment means were evaluated using Duncan's multiple range test (DMRT) at 5% probability level.

RESULTS

Results of soil analysis: Table 1 shows the soil physical and chemical properties of experimental soil. The textural class of the soil is sandy clay loam, the soil had pH (H_2O) 5.9 which could be described as slightly acidic. The organic carbon, total N and available p-values were 0.75, 0.09 (g kg^{-1}) and 2.87 mg kg^{-1}, respectively. The exchangeable K, Mg, Na and Ca are 0.3, 1.7, 0.3 and 2.9 cmol kg^{-1}, respectively.

Table 2 shows the effect of fertilizer treatments on vine length, number of branches, number of leaves, fresh shoot marketable yield and shoot dry weight of *Telfairia occidentalis*. Significant differences ($p<0.05$) were observed on all growth and yield parameters considered. The effect of organic fertilizer plus (OFP) at 4 t ha^{-1} and NPK fertilizers on vine length of *T. occidentalis* was significantly different while plants treated with OFP at 4 t ha^{-1} had mean vine length of 312.3 cm which was significantly higher than other fertilizer treatments including control. All OFP treatments and NPK significantly enhanced the production of number of branches

Table 1: Physico-chemical properties of experimental soil

Parameters	Measurements
pH (H_2O)	5.90
Organic C (g kg^{-1})	0.75
Total N (g kg^{-1})	0.09
P Mehlich (mg kg^{-1})	2.87
Exchangeable bases (cmol kg^{-1})	
K	0.30
Mg	1.70
Na	0.30
Ca	2.90
CEC	5.43
Extractable micronutrients (cmol kg^{-1})	
Fe	106.90
Zn	1.02
Mn	55.92
Cu	2.20
Textural class (%)	
Sand	70.06
Silt	8.70
Clay	21.24
Textural class	Sandy clay loam

Table 2: Vine growth and yield of *Telfairia occidentalis* as affected by OFP and NPK

Treatments	Vine length (cm)	Number of branches	Number of leaves	Fresh shoot marketable yield (kg ha^{-1})	Shoot dry weight (kg ha^{-1})
Control	213.0^{e}	3.8^{d}	52.0^{e}	494.4^{f}	130.0^{d}
OFP 3.0 t ha^{-1}	285.0^{c}	5.8^{c}	56.5^{d}	1111.1^{e}	170.0^{c}
OFP 4.0 t ha^{-1}	312.3^{a}	9.9^{a}	118.0^{a}	2222.2^{a}	240.0^{a}
OFP 5.0 t ha^{-1}	292.4^{d}	7.8^{b}	91.0^{b}	1333.3^{c}	203.0^{b}
OFP 6.0 t ha^{-1}	237.2^{d}	7.9^{b}	57.8^{d}	1042.2^{d}	200.0^{b}
NPK (60 kg N ha^{-1})	306.0^{a}	6.0^{c}	87.3^{c}	1888.9^{b}	205.0^{b}

Means having the same letter along the columns indicate no significant difference using Duncan's multiple range test at 5% probability level, OFP: Organic fertilizer plus (amended compost) than control throughout the period of investigation. However, application of OFP at 4 t ha^{-1} on number of branches were significantly higher ($p<0.05$) when compared with NPK fertilizer including the control. The number of leaves per plant differed significantly ($p<0.05$) among the different fertilizer treatments (Table 2). All the fertilized treatments had higher number of leaves per plant than the control treatment. The OFP at 4 t ha^{-1} had 23-56% more number of leaves than other treatments.

The application of fertilizer treatments significantly ($p<0.05$) increased the fresh shoot marketable yield and dry weight of pumpkin. The highest fresh marketable yield and shoot dry weight were obtained from plants which received OFP at 4 t ha^{-1}, with yields of 2222.2 and 240.0 kg ha^{-1}, respectively. The lowest fresh marketable yield and shoot dry weight was obtained from the plants which did not receive any fertilizer (control) with value of 494.4 and 130.0 kg ha^{-1}, respectively. Increased fresh marketable yield due to organic fertilizer plus application (OFP 3, 4, 5, 6 t ha^{-1}) and NPK over the control was 55.5, 77.8, 62.9, 52.6 and 73.8%, respectively.

Table 3: Mineral content of *Telfairia occidentalis* shoot

Treatments	N (%)	P (%)	K (%)
Control	3.50^{d}	0.93^{c}	3.40^{c}
OFP 3.0 t ha^{-1}	4.90^{b}	1.08^{b}	4.70^{b}
OFP 4.0 t ha^{-1}	5.50^{a}	1.20^{b}	5.40^{a}
OFP 5.0 t ha^{-1}	4.10^{c}	1.24^{b}	3.70^{c}
OFP 6.0 t ha^{-1}	5.30^{a}	1.30^{a}	4.50^{b}
NPK (60 kg N ha^{-1})	4.40^{c}	1.23^{b}	4.40^{b}

Means having the same letter along the columns indicate no significant difference using Duncan's multiple range test at 5% probability level, OFP: Organic fertilizer plus (amended compost)

Table 4: Nutrient uptake (kg ha^{-1}) in *Telfairia occidentalis* shoot

Treatments	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Control	270.6^{f}	1053.8^{e}	647.4^{f}
OFP 3.0 t ha^{-1}	699.2^{d}	11050.0^{c}	976.8^{c}
OFP 4.0 t ha^{-1}	1350.5^{a}	3042.8^{a}	4130.0^{a}
OFP 5.0 t ha^{-1}	512.1^{e}	1400.0^{b}	1125.5^{b}
OFP 6.0 t ha^{-1}	935.4^{b}	1099.5^{d}	719.6^{e}
NPK (60 kg N ha^{-1})	790.1^{c}	1165.6^{c}	849.6^{d}

Means having the same letter along the columns indicate no significant difference using Duncan's multiple range test at 5% probability level, OFP: Organic fertilizer plus (amended compost)

Mineral content of *Telfairia occidentalis* shoot: Table 3 shows that the application of OFP and NPK significantly improved the N, P and K contents of pumpkin shoot. *Telfairia occidentalis* plants that received OFP at 4 t ha^{-1} had higher N (5.5%) and K (5.4%) content. However, OFP at 6 t ha^{-1} had highest P content (1.3%). Control alone had the least nutrient content. Nitrogen was within the range of 3.50-5.50%, P content ranges between 0.93% and 1.30, while K content ranges between 3.40 and 5.40%.

Nutrient uptake by *Telfairia occidentalis*: Nutrient uptake for the N, P and K studied which is a product of the nutrient content and shoot dry matter of the pumpkin is presented in Table 4. Nitrogen uptake in OFP at 4 t ha^{-1} was significantly ($p<0.05$) higher than other fertilizer treatments including control. The least nitrogen uptake was observed in control, OFP 5 t ha^{-1} and NPK. Nitrogen uptake ranged from 270.6-1350.5 kg ha^{-1}. Similar trend of nitrogen uptake was also recorded in phosphorus and potassium uptake. The phosphorus uptake had values within the range of 1053.8 and 3042.8 kg ha^{-1}, while potassium uptake ranged from 647.48-4130.0 kg ha^{-1}.

Effects of fertilizer application on some soil chemical and physical properties at harvest: The results in Table 5 showed that the soil amendments significantly ($p<0.05$) improved the soil pH, with the highest pH value obtained from plots treated with 4 t ha^{-1} of OFP. This was followed by plots amended with OFP at 3 t ha^{-1}. The results showed a range value of 5.7-6.8. Generally, all the treated plots did improve the pH significantly ($p<0.05$) higher relative to the control. Table 5 also revealed a statistical ($p<0.05$) improvement on the soil organic carbon due to the amendment application. The result shows that the best improvement on the soil organic carbon was recorded in plots amended with OFP at 4.0 t ha^{-1}. This was followed by OFP at 5.0 t ha^{-1} treated plots, while the least improvement was obtained from plots without any amendment. The soil organic carbon values varied from 0.85-3.07 g kg^{-1}. Plot treated with 4.0 t ha^{-1} OFP had the highest total nitrogen

Table 5: Effects of OFP and NPK on some soil chemical and physical properties at harvest

Treatments	pH (H_20)	Available P (mg kg^{-1})	K (cmol kg^{-1})	OC (g kg^{-1})	N (g kg^{-1})	Na (cmol kg^{-1})	Ca (cmol kg^{-1})	Mg (cmol kg^{-1})	CEC (cmol kg^{-1})	Clay (%)	Silt (%)	Sand (%)
Control	5.7^{e}	5.67^{f}	0.36^{e}	0.85^{f}	0.08^{f}	0.27^{e}	4.48^{e}	1.75^{f}	4.47^{f}	22.71^{e}	16.87^{f}	60.42^{a}
OFP 3.0 t ha^{-1}	6.4^{b}	6.41^{c}	0.72^{b}	1.93^{c}	0.25^{c}	0.78^{a}	6.01^{d}	2.15^{e}	9.74^{d}	25.23^{d}	25.68^{c}	49.09^{c}
OFP 4.0 t ha^{-1}	6.8^{a}	14.26^{a}	0.87^{a}	3.07^{a}	0.35^{a}	0.87^{a}	12.8^{a}	3.93^{a}	17.80^{a}	27.73^{c}	35.04^{a}	37.23^{f}
OFP 5.0 t ha^{-1}	6.1^{c}	8.54^{b}	0.52^{d}	2.18^{b}	0.26^{b}	0.39^{b}	6.38^{c}	3.59^{b}	10.95^{b}	29.45^{b}	22.66^{e}	47.89^{d}
OFP 6.0 t ha^{-1}	6.1^{c}	5.72^{e}	0.72^{b}	1.72^{d}	0.22^{d}	0.34^{d}	1.97^{f}	2.33^{c}	8.05^{e}	17.93f	26.35^{b}	55.72^{b}
NPK (60 kg N ha^{-1})	5.9^{d}	6.10^{d}	0.67^{c}	1.47^{e}	0.20^{e}	0.36^{c}	6.99^{b}	2.23^{d}	10.46^{c}	32.89^{a}	24.69^{d}	42.42^{e}

Means having the same letter along the columns indicate no significant difference using Duncan's multiple range test at 5% probability level, OFP: Organic fertilizer plus (amended compost) value of 0.35 g kg^{-1}. Soil total nitrogen ranged from 0.08 g kg^{-1} in control plot to 0.35 g kg^{-1} in plot that received 4 t ha^{-1} OFP. Application of the soil amendments did increase the available phosphorous significantly ($p<0.05$) high. It was obtained that all the amended plots improved the available phosphorous significantly ($p<0.05$) better than the control. The results indicated that the highest value (14.26 mg kg^{-1}) was obtained from plots amended with OFP at 4 t ha^{-1}, followed by plots treated with OFP at 5 t ha^{-1} (8.54 mg kg^{-1}). The values of P ranged from 5.67-14.26 mg kg^{-1}. Exchangeable potassium (K^+) was significantly influenced by the soil amendments within the period of study. The OFP at 4 t ha^{-1} treated plots improved the exchangeable K higher than other treated plots including the control. Generally, all the amended plots did perform better than control plots. The results showed ranged values of K from 0.36-0.87 cmol kg^{-1}. These values indicate a general increase in N, P and K in soil treated with OFP at 4 t ha^{-1} compared with control and NPK.

Results in Table 5 also revealed that soil amendments significantly ($p<0.05$) increased the exchangeable magnesium in the soil of the studied area. It was recorded that exchangeable Mg^{2+} was statistically improved higher in plots treated with OFP at 4 t ha^{-1} within the period of study. This was followed by OFP at 5 t ha^{-1} treated plots, while the control plots gave the least values. It was obtained that the values ranged from 1.75-3.93 cmol kg^{-1}. It was generally observed that all the amended plots significantly ($p<0.05$) increased the exchangeable magnesium higher than the control within the period. Exchangeable calcium was significantly improved by soil amendments within the periods of study. It was obtained that among the treatments including the control, OFP at 4 t ha^{-1} gave the highest significant ($p<0.05$) values of exchangeable calcium in the study. The results indicated a higher increase in exchangeable sodium, though not significant, in soils where 4 t ha^{-1} of OFP and OFP at 3 t ha^{-1} were applied, followed by plots treated with OFP at 5 t ha^{-1}. The values varied from 0.27-0.87 cmol kg^{-1}. The results also indicated a significant ($p<0.05$) improvement on the soil cation exchange capacity (CEC) due to treatments application. It was obtained that the highest significant ($p<0.05$) increase on cation exchange capacity was made in plots treated OFP at 4 t ha^{-1}. This was followed by soil amended with OFP at 5 t ha^{-1}, while the control plots recorded the lowest values of cation exchange capacity within the period. The mean values of CEC varied from 4.47-17.8 cmol kg^{-1}. Generally, all the amended plots did increase the CEC higher relative to the control.

DISCUSSION

The pre-planting soil analysis showed that the soil of the experiential site was low in soil nutrient status. The values of total nitrogen, available phosphorus and potassium of the experimental soil were below the critical level as recorded by Olowoake[18], making it necessary for the application of soil amendment in form of inorganic or organic fertilizers. The significant increase in vine length, number of branches and number of leaves observed with applied organic fertilizer plus and NPK as compared with the control might probably be due to increased N content of the applied fertilizers. This is in agreement with and Olowoake and Ojo[19] who observed increased in growth parameters with applied fertilizer types, which might be due to the effective use of applied fertilizer at this rate by the plants. Also, the presence of other nutrient elements like P in the fertilizers used seems to increase the absorption of N[20], which promotes vegetative production. The significant influence of organic fertilizer plus on the growth and yield of telfairia revealed that the fertilizer can be used as soil amendment to promote the yield of crops. These results reconfirmed the report of Awodun[21] and Idem *et al.*[22] that there is a significant influence on the growth and yield of *Telfairia* by application of organic fertilizers.

The higher nutrient composition in the shoots of *T. occidentalis* plants that received organic fertilizer plus at 4 t ha^{-1} as shown in both nutrient concentration and uptake was due to an unconstrained nutrient supply of soil applied nutrients to the plants. This is shown in the higher level of Nitrogen, phosphorus and potassium in the organic applications. This implies that the use of organic soil amendments could be means of improving the growth of *T. occidentalis*. This result agrees with earlier reports of Oke[23] on the improved growth and chemical composition of crops which received balanced soil nutrients. The significant performance of fluted pumpkin over the control in growth and yield parameters could be due to the fact that organic fertilizer contained essential nutrient elements associated with high photosynthetic activities and this promoted roots and vegetable growth[22,24]. Improvements in growth parameters with application of organic fertilizers confirms the findings of Aminifard *et al.*[25] and Agbo *et al.*[26] who also observed significant increase in growth and yield of *T. occidentalis* and other vegetables with applied organic manures. Organic fertilizer apart from releasing nutrient elements to the soil has also been shown to improve other soil chemical and physical properties which enhance crop growth and development[18,27]. The low fertility status of the soil treated with NPK (15:15:15) observed after harvest might be partly due to early nutrient mineralization, thereby making the nutrients readily available for plant use and partly due to nutrient leaching. Hence, the application of inorganic fertilizers does not always improve soil organic matter which is a storehouse for nutrients.

CONCLUSION

All the fertilizers used were found to increase the growth parameters, nutrient uptake, fresh shoot marketable yield and shoot dry weight of *T. occidentalis* significantly, however, the effect of organic fertilizer plus were most prominent. The OFP were also found to have better residual effects on soil nutrients than NPK fertilizer.

SIGNIFICANCE STATEMENT

This study discovers the prospective of organic fertilizer plus on the growth of *Telfairia occidentalis* that can be beneficial for researchers and farmers. This study will help the researcher to uncover the critical areas of agriculture that many researchers were not able to explore. Thus a new theory on organic fertilizer to replace inorganic fertilizer may be arrived at.

REFERENCES

1. Olaniyi, J.O. and T.A. Oyerele, 2012. Growth, yield and nutritional compositions of fluted pumpkin (*Telfairia occidentalis*) as affected by fertilizer types in Ogbomoso, South West Nigeria. Bull. Environ. Pharmacol. Life Sci., 1: 81-88..
2. Eseyin, O.A., M.A. Sattar and H.A. Rathore, 2014. A review of the pharmacological and biological activities of the aerial parts of *Telfairia occidentalis* Hook.f. (Cucurbitaceae). Trop. J. Pharmaceut. Res., 13: 1761-1769.
3. Osadebe, V.O., B.C. Echezona and S.O. Bakare, 2015. Effect of weed control treatments and cutting frequency on weed dry matter and biomass in relation to the growth and yield of fluted pumpkin (*Telfairia occidentialis* Hook F). Agro-Sci.: J. Trop. Agric. Food Environ. Extens., 14: 1-8.
4. Agbede, T.M., 2010. Tillage and fertilizer effects on some soil properties, leaf nutrient concentrations, growth and sweet potato yield on an alfisol in Southwestern Nigeria. Soil Tillage Res., 110: 25-32.
5. Soremi, A.O., M.T. Adetunji, J.O. Azeez, C.O. Adejuyigbe and J.G. Bodunde, 2017. Speciation and dynamics of phosphorus in some organically amended soils of Southwestern Nigeria. Chem. Speciation Bioavail., 29: 42-53.
6. Yusuf, T.M., A.A. Olowoake and S.K. Subair, 2018. Effect of moringa leaves, poultry manure and NPK fertilizers on growth and yield of maize (*Zea mays* L.) in Ilorin, Southern Guinea Savannah of Nigeria. Global J. Sci. Front. Res. D: Agric. Vet., 18: 36-46.
7. Olaniyi, J.O. and A.E. Ojetayo, 2012. Effects of Nitrogen on growth, yield, nutrient uptake and quality of celosia (*Celosia argentea*) varieties. J. Agric. Biol. Sci., 3: 227-231.
8. Sridhar, M.K.C. and G.O. Adeoye, 2003. Organo-mineral fertilizers from urban wastes: Developments in Nigeria. Niger. Field, 68: 91-111.
9. Oloyede, F.M., I.O. Obisesan, G.O. Agbaje and E.M. Obuotor, 2012. Effect of NPK fertilizer on chemical composition of pumpkin (*Cucurbita pepo* Linn.) seeds. Scient. World J., Vol. 2012. 10.1100/2012/808196.
10. Awodun, M.A., 2007. Effect of poultry manure on the growth, yield and nutrient content of fluted pumpkin (*Telfaria occidentalis* Hook F). Asian J. Agric. Res., 1: 67-73.
11. IART., 2010. Rainfall data for the last 10 years for the prediction of time of planting. Annual In-house Report for 2009/2010 of the Institute of Agricultural Research and Training (IART), Moor Plantation, Ibadan, Nigeria.
12. Smyth, A.J. and R.F. Montgomery, 1962. Soils and Land Use in Central Western Nigeria. Government of Western Nigeria, Ibadan, Nigeria, Pages: 265.
13. Bouyoucos, G.J., 1962. Hydrometer method improved for making particle size analyses of soils. Agron. J., 54: 464-465.
14. Nelson, D.W. and L.E. Sommers, 1982. Total Carbon, Organic Carbon and Organic Matter. In: Methods of Soil Analysis, Part 2: Chemical and Microbiological Properties, Page, A.L., R.H. Miller and D.R. Keeney (Eds.). 2nd Edn., ASA and SSSA, Madison, WI., USA., pp: 539-579.
15. Bremner, J.M. and C.S. Mulvaney, 1982. Nitrogen-Total. In: Methods of Soil Analysis, Part 2: Chemical and Microbiological Properties, Page, A.L., R.H. Miller and D.R. Keeney (Eds.). 2nd Edn., ASA and SSSA, Madison, WI., USA., pp: 595-624.
16. Bray, R.H. and L.T. Kurtz, 1945. Determination of total and organic of phosphate in the soil. Soil Sci. J., 59: 45-49.
17. Okalebo, J.R., K.W. Gathua and P.L. Woomer, 1993. Laboratory Methods of Soil and Plant Analysis: A Working Manual. Tropical Soil Biology and Fertility Programme, Nairobi, Kenya, ISBN-13: 9789966989215, Page: 88.
18. Olowoake, A.A., 2014. Influence of organic, mineral and organomineral fertilizers on growth, yield and soil properties in grain amaranth (*Amaranthus cruentus* L.). J. Organics, 1: 39-47.
19. Olowoake, A.A. and J.A. Ojo, 2014. Effect of fertilizer types on the growth and yield of *Amaranthus caudatus* in Ilorin, Southern Guinea, Savanna Zone of Nigeria. Adv. Agric., Vol. 2014. 10.1155/2014/947062.

20. Olowoake, A.A., 2017. Growth and nutrient uptake of maize (*Zea mays* L.) amended with compost-enriched palm Kernel cake. Ibadan J. Agric. Res., 12: 23-32.
21. Awodun, M.A., 2007. Effect of poultry manure on the growth, yield and nutrient content of fluted pumpkin (*Telfaria occidentalis* Hook F). Asian J. Agric. Res., 1: 67-73.
22. Idem, N.U.A., A.O. Ikeh, N.S. Asikpo and E.I. Udoh, 2012. Effect of organic and inorganic fertilizer on growth and yield of fluted pumpkin (*Telfaria occidentialis*, Hook F.) in Uyo, Akwa Ibom State, Nigeria. J. Agric. Social Res., 12: 74-84.
23. Oke, O.F., 2015. Vegetative growth, nutrient uptake and yield of pumpkin under liquid organic manures in a tropical agroecosystem. IOSR J. Agric. Vet. Sci., 8: 1-4.
24. Dauda, S.N., F.A. Ajayi and E. Ndor, 2008. Growth and yield of watermelon (*Citrullus lanatus*) as affected by poultry manure application. J. Agric. Soc. Sci., 4: 121-124.
25. Aminifard, M.H., H. Aroiee, H. Fatemi, A. Ameri and S. Karimpour, 2010. Responses of eggplant (*Solanum melongena* L.) to different rates of nitrogen under field conditions. J. Cent. Eur. Agric., 11: 453-458.
26. Agbo, C.U., P.U. Chukwudi and A.N. Ogbu, 2012. Effects of rates and frequency of application of organic manure on gowth, yield and biochemical composition of *Solanum melongena* L. (cv. 'Ngwa Local') fruits. J. Anim. Plant Sci., 14: 1952-1960.
27. Olowoake, A.A., O.S. Osunlola and J.A. Ojo, 2018. Influence of compost supplemented with Jatropha cake on soil fertility, growth and yield of maize (*Zea mays* L.) in a degraded soil of Ilorin, Nigeria. Int. J. Recycling Organic Waste Agric., 7: 67-73.