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Growth, Yield and Nutritional Compositions of Fluted Pumpkin (*Telfairia Occidentalis*) as Affected by Fertilizer Types in Ogbomoso, South West Nigeria

*** Olaniyi Joel Oyekunle and Oyerele Titilayo Abosede**
Department of Agronomy, Ladoke Akintola University of Technology,
P M B 4000, Ogbomoso, Nigeria.
*Corresponding Author's E mail: olaniyikunle2005@yahoo.com

ABSTRACT

Field trials were conducted at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso in 2010 and 2011 to determine the effect of fertilizer types on the growth, yield and nutritional composition of fluted pumpkin (Telfairia occidentalis). The treatments involved nine fertilizer types namely; Aleshinloye grade A, Aleshinloye grade B, Sunshine grade A, Sunshine grade B, Pace setter grade A, Pace setter grade B, Neem compost, Poultry manure and Tithonia compost. Fluted pumpkin served as the test crop. The fertilizer types were applied at two levels each (0 and 60 kg. N ha^{-1}). The treatments were assigned into a randomized complete block design with three replicates. Data were collected on growth parameters, nutritional composition and yield attributes of fluted pumpkin. The parameters assessed were significantly influenced (P≤0.05) by the applied fertilizer types. The highest vine length, number of leaves, nutritional composition, fresh shoots and seed yields were recorded at 60 kg. N ha,$^{-1}$ irrespective of the fertilizer types. Although, the best performance of fluted pumpkin in terms of growth and fresh shoot yield were obtained from neem compost fertilizer type, this was comparable with results obtained with tithonia compost. The highest P (0.83%), K (0.82%), Mg (3.20%), Ca (0.48%), Fe (4.63%) and protein (4.60 mg/kg) contents of fluted pumpkin shoot were obtained from the plants under poultry manure treatment while plants receiving no fertilizer application recorded the least values for all nutritional attributes assessed. Neem compost (86.1 kg/ha) closely followed by tithonia compost (62.7 kg/ha) gave highest seed yield of fluted pumpkin as compared to other fertilizer types. Although, neem compost and poultry manure gave the best performance in terms of yield and nutritional composition respectively, there is no significant difference between the values obtained from these treatments and that recorded from tithonia compost. In conclusion, the growth, nutritional composition and yield of fluted pumpkin were improved by fertilizer types and neem compost, poultry manure and tithonia compost in that descending order are adjudged as the best fertilizer types for Ogbomoso, the Guinea Savanna zone of south west Nigeria.

***Key words**: Telfairia occidentalis, compost, manure, organomineral fertilizers, organic fertilizers, yield, shoot quality*

INTRODUCTION

In Africa indigenous vegetables remain popular in rural areas where they are often considered to be more nutritive than exotic vegetables [1]. *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 [2-3].

The leaf is of high nutritional, medicinal and industrial values rich in protein (29%), fat (18%) and minerals and vitamins (20%) [4].The nutritional value of pumpkin seeds is different from that of leaves. The protein contents of seeds and leaves are 20.5g and 2.9g, respectively [5]. Seeds have high nutritive and calorific values which make it necessary in diets. Fluted pumpkin is of local ethnobotanical importance in the folklore, dietary and cropping systems of Igbos. The level of iron is the factor for use of the leaf extraction as blood tonic which can be administered to weak patient [6].

Nitrogen is usually ascribed with the building up of leaf tissues. This is one of the essential elements most commonly used to increase crop yield. It is a constituent of all protein and chlorophyll. Plant tissue, usually contains more nitrogen than any other nutrients. Nitrogen application is used to produce rapid vegetative growth of vegetables [7]. It promotes luxuriant growth, and increases number of leaves. These encourage photosynthesis and partitioning of photosynthesis rate into the economic parts of the plant. It is also necessary for reproduction and

promotes the uptake of phosphorus and potassium by plants. However, nitrogen requirement for vegetable is 50kg N/ha or more in savannah zone of Nigeria [8]. It has been reported that 100kg N/ha is suitable for vegetable based on dual purposes (leaf+ fruit). The recommended rate for the production of fluted pumpkin is 16okgN/ha [9].

In Nigeria, farmers realize the need for soil amendments by using available resources such as crop wastes, farmyard manure and poultry waste [10]. The use of organic fertilizer as source of nutrients to crops has recently received comprehensive review by Awodun, [11]; Akanbi *et al.* [12] and Ojetayo *et al*. [7]. This fertilizer type improves soil's physical, chemical and biological conditions, which in turns improve crop growing environment and culminate in the better production of economic plant parts [13].

Organic fertilizer fortified with inorganic materials specially formulated to replenish the soil and improve plant fertilization. It releases nutrients in soil in the form that plants can easily absorb, it will activate soil micro-organism and increase microbes, which will help decomposition process of organic matter and transform them into nutrients that plants can easily absorb. This will promote higher plant growth, healthier crops and better fruit yield. It reduces the needs of chemical fertilizer, which will lead to lower production cost and indirectly increases income [14, 15].

Organic crops contained higher levels of 21 essential nutrients than their conventionally grown counter parts including iron, magnesium, phosphorus and vitamin c. The organic crops also contained lower levels of nitrates, which can be toxic to body [16].

Although, many research activities have reported better performance of crops with fertilizer application one of the method through which plants would display its potential genetic capability is by supplying the plants with adequate amount and types of fertilizer at the right time [17,18]. Research efforts are therefore required to recommend fertilizer types for sustainable production of *Telfairia occidentalis* in Ogbomoso, the Guinea Savanna zone of south west Nigeria.

MATERIALS AND METHODS

Experimental Site: Experiments were conducted during 2010 and 2011 cropping seasons at the Ladoke Akintola University of Technology (LAUTECH) Teaching and Research farm, Ogbomoso (8^0 10'N and 4^0 10'E), Nigeria. The bimodal rainfall of the area is between 1100mm and 1250mm of rain. The temperature regime is high all year round. The mean minimum temperature is 28^0C and the maximum temperature is 33^0C with a high humidity of about 74^0C all year round except in January when the dry wind blows from the North [18]. During the period of the experiment, the mean minimum temperature is 27^0C and the maximum temperature is 31^0C with a high humidity of about 75% while the rainfall of the area is 1126mm of rain.

Soil Sampling and Analysis: The experimental site soil was well drained sandy loam. Initial soil samples were collected from surface 15cm for laboratory analysis prior to land clearing. The soil particle size was done by hydrometer method [19]. The pH was determined in 1:2 soils: water suspension using a pH meter. The organic carbon was determined by dichromate oxidation [20], total N by the Micro-Kjedahl method [21] and available P by the Bray P-1 method [22]. The exchangeable bases were displaced by neutral N NH_4OAC. The K and Na contents in the extract were determined with atomic absorption spectrophotometer. The exchangeable acidity (A1 and H) was extracted with 1 N KCl and estimate titrimetrically [23].

Field Preparation and Treatments: The conventional tillage operations which include land clearing and preparation of beds were carried out to conserve the soil and its nutrients. The land was cleared and beds were constructed. The experimental land was divided into three blocks each containing 10 beds to give a total of 30 beds. Each bed size was 4.0m x 1.2m and with about 1m gap between beds. The blocks were spaced 1m apart to ease movement during cultural operations. A bed contained 10plants.

The treatments involved nine organic fertilizer types namely; Alesinloye grade A, Alesinloye grade B, Sunshine grade A, Sunshine grade B, Pace setter grade A, Pace setter grade B, Neem compost , Tithonia compost and Poultry manure**,** with fluted pumpkin as the test crop. The organic fertilizer types were applied at the equivalent weight of 60 kg. N ha^{-1} [4, 24] with non-fertilized plot as a control. The treatments were assigned into the plots in a randomized complete block design with three replicates.

Planting and other Cultural Practices: Telfairia seeds were extracted from pods which were obtained from the Agronomy Department, LAUTECH, Ogbomoso. They were air dried for 24 hours before planting. Thereafter the beds were irrigated to improve soil moisture content, seed germination and seedling emergence. Planting was done in early October each year. Two seeds were sown per hole at a spacing of 1 m x 1 m and later thinned down to one seedling per stand at four weeks after sowing (WAS).

Application of fertilizer treatments was done a week before sowing by band placement. Each fertilizer types were applied at equivalent rate of 60 kg. Nha^{-1} [4]. Watering of seedlings was done every morning at two days interval during the dry season to avoid wilting and to improve the growth and development. Weeds were controlled twice manually by hoeing at 4 and 8 weeks after sowing. Defoliating Insect pests were controlled by spraying the crop with neem extract at 2 weeks interval starting from 2 weeks after sowing.

Data Collection and Analysis: At 10 WAS four plants were randomly selected from each plot for data collection. Data collected at the early bloom stage (10 WAS) included length of primary vine, number of leaves and fresh shoot yield. At pod maturity, the pod yield and the yield components collected included number of pods per plant, fruit weight (kg) per plant; number of seeds per pod, seeds yield (kg) per pod; seeds yield (kg) per plant and total seeds yield (ton) per hectare.

For the determination of plant shoot dry matter yield and tissue nutrient concentration, another three plants per plot were uprooted at 10 WAS and oven dried to constant weight at 65^0C for 48 hours. The dried samples were weighed for estimation of dry matter yield and milled and analyzed for nitrogen (N), using kjedahl digesting method, phosphorus (P) using technicon AA1, calcium (Ca) using flame photometer and magnesium (Mg) by the use of atomic absorption spectrophotometer [23, 25]. Iron (Fe) was also determined by AOAC method [27]. Data collected were subjected to analysis of variance using the SAS-GLM procedure [28]. The differences between treatment means were compared using least significant different at 5% level of probability.

RESULTS

Soil analysis

Results of the pre-cropping soil analysis are presented in Table 1. The soil was sandy loam with low organic matter content and pH (H_20) around the neutral range. The nitrogen, phosphorus, potassium and other cations are very low in the soil used in this study

Growth Parameters

The mean vine length and number of leaves of T*elfairia* as affected by organic fertilizer types application at 10 weeks after sowing is presented in Figure I. The growth parameters were significantly affected ($P \leq 0.05$) by application of different organic fertilizers. The highest vine length and the number of leaves were recorded at 60 kg N ha^{-1} while the least were obtained from 0 kg N ha^{-1}, irrespective of fertilizer types. The plants treated with neem compost gave the highest values for vine length (145.62 cm) and number of leaves (73.58) closely followed by tithonia compost while those under Pace setter B recorded the least values. Generally, the fortified organic fertilizer types such as alesinloye A, sunshine A and pace setter A recorded better performance in terms of vine length and the number of leaves than what was obtained from unfortified fertilizer types like alesinloye B, sunshine B and pace setter B, except neem and tithonia composts.

Marketable Shoot Yield

Telfairia fresh shoot yield was significantly influenced by fertilizer types (Figure II). Irrespective of fertilizer types, fertilized plants performed better than non fertilized ones. Among the plants that were nourished, the one fertilized with neem compost produced the best fresh shoot yield (566.65 kg ha^{-1}) followed by tithonia compost (333.75 kg ha^{-1}) while the unfertilized plants gave the least (153.15 kg ha^{-1}).

Table 1: Chemical and physical properties of the soil used for the experiment.

Parameters	Value
pH (H_20)	6.0
Total N (%)	0.10
Available P (ppm)	5.77
Organic Carbon (g/kg)	2.39
Exchangeable cations (c mol/kg)	

Ca^{2+}	2.25
Mg^{2+}	1.12
K^{+}	0.24
Na^{+}	0.40
Physical characteristics	
Sand %	86.70
Silt %	9.20
Clay %	4.10
Textural class	Sandy loam

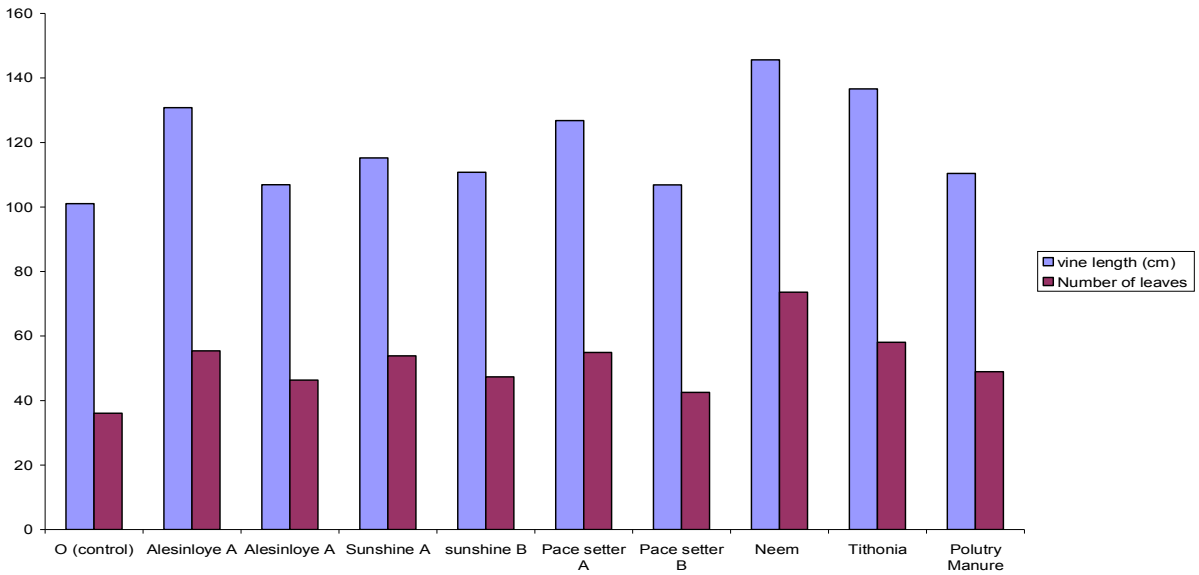

Figure 1: The vine length (cm) and number of leaves of *telfairia* as affected by organic fertilizer types 10 weeks after transplanting across the two years.
Where O= Control; AA= Aleshinloye grade A; AB= Aleshiloye grade B; SA= Sunshine grade A; SB; Sunshine grade B; PA= Pace setter grade A; PB= Pace setter grade B; N= Neem compost; T= Titonia compost. PO= Poultry manure.

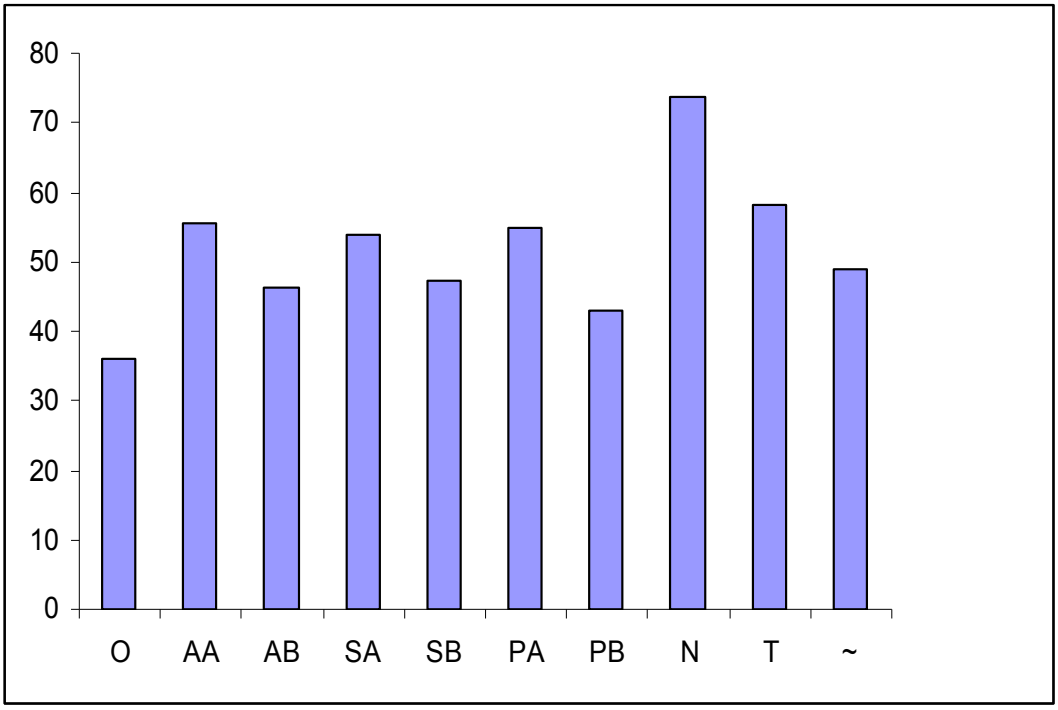

Figure 2: Shoot yield (kg ha^{-1}) of *telfairia* as affected by organic fertilizer types 10 weeks after transplanting across the two years.

Where O= Control; AA= Aleshinloye grade A; AB= Aleshiloye grade B; SA= Sunshine grade A; SB; Sunshine grade B; PA= Pace setter grade A; PB= Pace setter grade B; N= Neem compost; T= Titonia compost. PO= Poultry manure.

When compared performance of the plants nourished with fortified and non fortified organic fertilizer, the latter out performed the former.

Marketable Seed Yield and Yield Components:

Seed yield and yield components of T*elfairia* as affected by organic fertilizer types application at harvesting are presented in Table 2. The mean number of fruits, fruit weight, fruit diameter, number of seeds, seed yield per plant and per hectare significantly improved (P≤0.05) by the applied fertilizer types. For these seed yield and yield attributes, the least values were obtained with non fertilized plants. Among the fertilized pants, fruit weight per plant was highest (4.53 kg) with the use of neem compost while plants that received pace setter grade B gave the least (2.25 kg). In case of fruit diameter, neem compost gave the best (65.72 cm) result closely followed by tithonia compost while poultry manure produced the least (40.03 cm). Likewise, the highest number of fruits per plant (4.2), number of seeds per fruit (102), seed weight per fruit (2.05 kg) seed yield per plant (8.61 kg), fruit yield per hectare (42 kg ha^{-1}) and seed yield per hectare (86.1 ton ha^{-1}) of telfairia were obtained from Neem closely followed by tithonia compost while alesinloye grade B organic fertilizer recorded the least values.

Nutritional Compositions: The nutritional composition of telfairia shoot as affected by fertilizer types is presented in Table 3. The nutritional values of telfairia shoot (vines and leaves) were significantly improved by the applied fertilizer types. The telfairia plants that received various fertilizer types recorded highest protein, P, K, Ca, Mg and Fe contents as compared with the non fertilized plants. The P content of telfairia shoot was highest with the use of poultry manure (0.86%) closely followed tithonia compost (0.83%) while alesinloye grade A (0.59%) gave the least. Also, among the fertilized plants the highest K content was obtained from tithonia compost (0.82%) closely followed by sunshine grade B (0.75%) while the least (0.59%) was recorded from pace setter grade A.

Table 2: Yield and yield components of *telfairia* as affected by fertilizer types across the two years

Treatment (kg/ha)	No of fruits/ plant	Mean Weight of fruit (kg)	Fruit Diameter (cm)	Number of seeds/ fruit	Weight of seeds/fruit (kg)	Seed yield/ Plant(kg)	Seed yield (kg/ha)	Fruit yield (kg/ha)
O(control)	1.0^{D}	2.05^{F}	42.91^{E}	35^{E}	0.87^{D}	0.87^{F}	08.7^{F}	10^{D}
Neam compost	4.2^{A}	4.53^{A}	65.72^{A}	102^{A}	2.05^{A}	8.61^{A}	86.1^{A}	42^{A}
Thitonia compost	3.5^{AB}	4.15^{AB}	63.56^{AB}	95^{AB}	1.79^{B}	6.27^{AB}	62.7^{AB}	35^{ab}
Sunshine A	3.2^{B}	3.05^{CD}	51.73^{C}	83^{B}	1.01^{CD}	3.23^{B}	32.3^{B}	32^{B}
Sunshine B	1.1^{D}	2.70^{D}	45.28^{D}	46^{D}	0.91^{D}	$I.16^{DE}$	11.6^{DE}	11^{D}
Poultry manure	1.2^{D}	2.65^{D}	40.03^{E}	38^{E}	1.05^{CD}	1.26^{D}	12.6^{D}	12^{D}
Pacesetter A	2.4^{C}	3.56^{B}	45.17^{D}	50^{C}	1.05^{CD}	2.52^{C}	25.2^{C}	24^{C}
Pacesetter B	1.3^{D}	2.25^{E}	51.98^{C}	51^{C}	1.02^{CD}	1.33^{D}	13.3^{D}	13^{D}
Aleshinloye A	2.9^{B}	3.61^{B}	64.02^{AB}	92^{B}	1.15^{C}	3.34^{B}	33.4^{B}	29^{B}
AleshinloyeB	1.0^{D}	3.10^{C}	53.14^{C}	45^{D}	1.00^{CD}	1.00^{E}	10.0^{E}	10^{D}

Mean with the same letter within the column is not significantly different. (P≤0.05)

Likewise, plants under tithonia compost (0.48%) had higher Ca content followed by poultry manure (0.40%) while sunshine grade A (0.30%) had the least. In case of Mg content, the plants that received tithonia compost (3.20%) dose followed by pace setter grade B (2.94%) gave highest values while the plants treated with pace setter grade A (1.96%) had the least value. For the protein content, tithonia compost (4.63%) closely followed by poultry manure (4.31%) gave the best result while sunshine grade A (3.31%) produced the least. Moreover, Fe content was highest with the plants nourished with tithonia compost (4.60 mg/kg) followed by neem compost (3.57 mg/kg) while plants that received pace setter gradeA (2.94 mg/kg) gave the least. Although, all the fertilizer types used influenced the nutritional composition of telfairia shoot., the best P, K, Ca, Mg,

protein and Fe contents were obtained from plants nourished with composts (tithonia and neem composts) and organic fertilizer types (alesinloye, sunshine and pace setter grade B) as compared with the plants under organo mineral fertilizer types (alesinloye, sunshine and pace setter grade A).

Table 3: Nutritional values of Telfairia shoot as affected by organic fertilizer types at 10 weeks after planting

Fertilizer type	P(%)	K(%)	Ca (%)	Mg(%)	Protein (%)	Fe (mg/kg)
Neam	0.69	0.57	0.37^{B}	1.96^{D}	3.63^{B}	2.94^{D}
O-(control)	0.50^{B}	0.48^{B}	0.24^{C}	0.68^{E}	$2,94^{D}$	1.48^{E}
Thitonia	0.86^{A}	0.67^{A}	0.40^{A}	2.20^{C}	4.31^{AB}	3.40^{BC}
Sun shine A	0.66^{A}	0.70^{A}	0.30^{B}	2.67^{B}	3.31^{C}	3.10^{C}
Sun shine B	0.64^{A}	0.75^{A}	0.36^{B}	2.62^{B}	3.81^{B}	$3.40B^{C}$
Poultry. Manure	0.83^{A}	0.82^{A}	0.48^{A}	3.20^{A}	4.63^{A}	4.60^{A}
Pace setter A	0.65^{A}	0.68^{A}	0.34^{B}	2.57^{B}	3.88^{B}	3.57^{B}
Pace setter B	0.60^{A}	0.66^{A}	0.32^{B}	2.55^{B}	3.81^{B}	3.55^{B}
Alesinloye A	0.59^{AB}	0.69^{A}	0.44^{A}	2.74^{B}	3.50^{B}	3.42^{C}
Alesinloye B	0.63^{A}	0.71^{A}	0.42^{A}	2.71^{B}	3.38^{C}	3.39^{C}

Mean with the same letters within the column is not significantly different. ($P \leq 0.05$)

DISCUSSION

Most of the nutrients in this soil were low and below the critical level [29], making it necessary for the application of soil amendment in form of inorganic or organic fertilizers.

The significant increased in number of leaves and plant height observed with applied fertilizer types as compared with the control might probably be due to increased N content of the applied fertilizers. This is in agreement with Akanbi *et al.* [29] and Ojetayo *et al*. [7] 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 [30], which promotes vegetative production. The 60kg N/ha obtained as the optimum level of organic fertilizers suitable for maximum yield performance of telfairia has also been recommended by Okoro [24]. Olsen *et a*l. [31] and Olaniyi [16] observed similar effects for pepper and melon, respectively.

The significant influence of organic fertilizer types on the growth and yield of telfairia revealed that the fertilizer types can be used as soil amendment to promote the yield of crops. These results reconfirmed the report of Schipper [3] and Awodun [12] that there is a significant influence on the growth and yield of telfairia by application of organic fertilizers. Although, neem gave the highest growth and yield attributes but tithonia compared favourrably with it and even performed better than all other organic fertilizer types used in this study. This showed that tithonia compost when well prepared is better and rich in nutrients than most commercial organic fertilizers in the market. The fruit weight and diameter obtained in this investigation were within the range of 3 – 6 kg fruit weight and 27 cm average width respectively, recorded at maturity for telfairia [32]. Also, the 35-102 seeds per fruit range recorded from this trial reconfirmed the work of Akoroda [2] who reported 60 seeds on average with a normal range of approximately 30 – 110 seeds per fruit of telfairia.

The highly significant influenced on the distribution of protein, fat and fibre and other minerals in the plant part of the Telfairia occidentalis by the applied fertilizer types showed direct relationships between soil nutrients contents and plant uptake of the nutrients. The 1.9 to 2.3% protein content obtained in this study is closer to 2.9% protein recorded for pumpkin leaves per 100g edible portion by FAO (1988). The leaves is nutritionally important [33, 34] making them a potential source of commercial vegetable oil which may be used for cooking or soap making [35].

CONCLUSION AND RECOMMENDATION

Organic fertilizer application is very essential for plant growth and yield, as it contained essential plant nutrients. The required amount of nitrogen fertilizer varies due to the type of crop, instability of crop and crop combination. The yield and yield components of telfairia were significantly

increased by the applied organic fertilizer types. The optimum values were recorded at 60 kg N ha. The highest yield and yield components of telfairia was recorded from neam organic fertilizer closely followed by tithonia compost while control gave the least value. The distribution of protein and other minerals in the plant part of the fluted pumpkin (Telfairia occidentalis) was highly influenced by the applied amendments. Poultry manure closely followed by tithonia compost gave high nutritional values of telfairia as compared to other organic fertilizers. Although, neem organic fertilizer and poultry manure gave the best performance in term of yield and nutritional compositions respectively, there are no significant different between the values obtained from these treatments and that recorded from tithonia compost. Therefore, neem compost, poultry manure and tithonia compost in descending order are adjudged as the best organic fertilizers for farmers because they are cheap and readily available.

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