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Growth and uptake of N, P, K as influence by housing and packaging systems of two animal manure types under *Telfairia occidentalis* (Hook f.) Production

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Abstract

The housing system of animal manure prior to field application is one of the major factors affecting its nutrient composition. Field trials were conducted in 2017 and 2018 to study the performance of *Telfairia occidentalis* as influenced by poultry and cattle manures under different housing systems at the Organic Agricultural Research Farm, FUNAAB, Ogun State. Amendments were: bagged poultry manure in zinc house(ZPB) at 5.6tha^{-1} and stacked (ZPS) at 6.0tha^{-1}, bagged poultry manure in open space (OPB)at 5.5tha^{-1}and stacked (OPS) at 6.8tha^{-1}, bagged poultry manure in palm frond house (PPB)at 5.4tha^{-1} and stacked (PPS) at 6.9tha^{-1}, bagged cattle manure in zinc house (ZCB)at 6.5tha^{-1} and stacked (ZCS) at 5.6tha^{-1}, bagged cattle manure in open space (OCB)at 5.3tha^{-1} and stacked (OCS)at 5.9tha^{-1}, bagged cattle manure in palm frond house (PCB) at 5.1tha^{-1} and stacked (PCS) at 5.5tha^{-1} and control. The experiment was a factorial fitted into Randomized Complete Block design. Data collected were agronomic parameters and uptake of nitrogen, phosphorus and potassium. Data were subjected to Analysis of Variance (ANOVA) and significant means were separated using Duncan's Multiple Range Test. Results obtained show that plants amended with PPB at 5.4t/ha gave the highest vine length, number of leaves, number of branches and stem girth in both years and also enhance uptake of essential nutrients. Based on this finding, poultry manure bagged in palm fronds house (PPB) at 5.4t/ha is therefore recommended to farmers for optimum growth of *Telfairia occidentalis* plants in the study area.

Keywords: *Telfairia occidentalis*, palm fronds, zinc house, bagged, open space, stacked

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1.0 Introduction

Soil fertility preservation is very important in achieving a high crop yield. In the past, most of the agricultural land used for traditional farming was based on the bush fallow system and shifting cultivation (Miguel, 2008). A long fallow period is no longer feasible due to population pressure. Addition of organic materials such as animal manure constitutes an alternative (Escobar *et al.,* 2008). Animal manure is associated with bulkiness, flies, unpleasant odour which can be controlled with the usage of an appropriate housing system. The methods used to store the litter prior to land application can significantly affect the nutrient content thereby enhancing crop productivity (Lekasi, 2000 and Kristin, 2016).

In Africa, indigenous vegetables remain popular in rural areas where they are often considered to be more nutritive than exotic vegetables (Horsfall and Spiff, 2005). *Telfairia occidentalis* had gained medicinal recognition because it has been discovered to be a blood purifier (Aletor *et al.,* 2002) and could therefore be useful in the maintenance of good health. Despite the importance of *Telfairia occidentalis* in the Nigerian diet, farmers are facing a lot of challenges concerning its production.

Poultry manure has long been recognized to be the most desirable organic fertilizer (Farhad *et al.,* 2009) as it improves soil fertility by adding nutrients as well as soil organic matter which improves moisture and nutrient retention (Farhad *et al.,* 2009). Poultry manure has been reported to have a high nutrient composition compared to other animal manures (Egbuchua and Enujeke, 2013, Golestaneh *et al*., 2013) though some research works have reported higher nutrient levels in cow dung compared with poultry manure (Olowokere *et al*; 2014, Makinde and Ayoola, 2012).

Housing medium has been reported to be among the factors that affect the nutrient composition of animal manure (Makinde and Ayoola, 2012). Housing of animal manures also helps to destroy weed seeds as well as pathogens (Karen, 2009). With more people going into organic agriculture, manure is now becoming scarce to get (Sharma, 2017). Manure needs to be allowed to cure for at least three (3) months before it can be applied to the field (Harrison and Smith 2004). Thus, there is a need to research how best manure can be housed and packaged for optimum benefits.

The objective of this study is to evaluate the effect of poultry manure and cow dung derived from different housing systems on the growth and nutrient composition of *Telfairia occidentalis.*

2.0 Materials and Methods

Experimental Site: The experiment was conducted at the Organic Farm of the Federal University of Agriculture, Abeokuta (latitude 7° 13 N and longitude 3° 28 E). It is characterized by mean annual rainfall of about 1400 mm with bimodal rainfall distribution. The mean annual minimum temperature is 22.2°C while the mean annual maximum temperature is 33.3°C.

Housing Systems: Poultry manure used was obtained from Isekolowo farm, Egbeda, along Alabata road, Abeokuta while cow dung was obtained at the cattle unit of College of Animal Sciences farm, Federal University of Agriculture, Abeokuta. Three different housing systems were used for the experiment. The housing systems are Zinc house, Palm Fronds house and Open space. Each housing system was constructed with space measuring 5m x 6m ($30m^2$).

Packaging Methods: 100kg of fresh manure was packed in a Jute sack (bagco) type using Mettler weighing balance and the same quantity was left stacked in each housing system and it was replicated 3 times. Manure was left in the housing systems for 12 weeks (Harrison and Smith 2004).

Amendment and Soil Analysis: Each sample collected was analyzed for the following: Organic Carbon, Nitrogen, Phosphorus and Potassium. The phosphorus content of the manure was analyzed using the Vanado-molybdate method (Aduayi and Gatitu, 1973). The organic carbon content was determined using the wet oxidation method (Nelson and Sommers, 1996). Total Nitrogen was determined using modified Micro-Kjeldahl digestion techniques (Jackson, 1964). Available Phosphorus in soil was determined using Bray-1 (Bray and Kurtz, 1945) while Potassium was determined using Flame Photometer.

*Data Analysis***:** All data collected were subjected to Analysis of Variance (ANOVA) using Statistical Analysis System (SAS, 1999). Significant means were separated using Duncan's Multiple Range Test (DMRT) at a 5 % level of probability.

3.0 Results

Chemical Properties of the Organic Materials (Fresh Manure) used for the Experiment

The chemical properties of the initial (Fresh) organic materials used for the experiment are shown in Table 1. It was observed that the nitrogen, potassium, magnesium and calcium contents of poultry manure were higher than that of cow dung, while Phosphorus, sodium, organic matter content, pH and C: N ratio of cow dung supersedes that of poultry manure (Table 1).

Chemical and Physical Properties of Soil used for the Experiment

The physical and chemical properties of the soil used for the study are shown in Table 4. The soil was slightly acidic. The total nitrogen contents are low. Available phosphorus contents are also low. The organic matter contents were very low. The potassium and sodium contents of the soil are moderate. It was also observed that the soil had very low calcium and magnesium contents (Table 2).

Effect of Poultry Manure and Cow dung from Different Housing Systems and Method of Packaging on Vine Length of Telfairia occidentalis (Hook F.) in 2017 and 2018

In the year 2017 (figure 1), the vine length of *Telfairia occidentalis* was significantly influenced with the application of poultry manure bagged in zinc house (ZPB) at 5.6 tha^{-1}, although this value did not significantly differ from the vine length of all other amended *Telfairia occidentalis* it significantly differs from the vine length of unamended (control) *Telfairia occidentalis* plants.

Whereas, in the year 2018, the vine length of *Telfairia occidentalis* plants was significantly influenced by the application of poultry manure bagged in the palm fronds house (PPB) at 5.4 t/ha. Although, it was not significantly higher than all other amended *Telfairia occidentalis* plants it was significantly higher than the vine length of unamended (control) *Telfairia occidentalis* plants (Figure 1).

Effect of Poultry Manure and Cow dung from Different Housing Systems and Method of Packaging on Number of Leaves of Telfairia occidentalis (Hook F.) in 2017 and 2018

Number of leaves of *Telfairia occidentalis* plants (Figure 2) significantly influenced with the application of poultry manure bagged in open space (OPB) at 5.5 tha^{-1} in the year 2017. This value was significantly different from the value observed on unamended (control) *Telfairia occidentalis* plants but was not significantly different from the value of all other amended *Telfairia occidentalis* plants. Meanwhile, in the year 2018, *Telfairia occidentalis* plants amended with poultry manure bagged in the palm fronds house (PPB) at 5.4 tha^{-1} gave the highest number of leaves which was not significantly higher than all other amended *Telfairia occidentalis* plants but was significantly higher than unamended (control) *Telfairia occidentalis* plants (Figure 2).

Effect of Poultry Manure and Cow dung from Different Housing Systems and Method of Packaging on the Number of Branches of Telfairia occidentalis (Hook F.) in 2017 and 2018

Application of poultry manure bagged in the open space (OPB) at 5.5 tha^{-1} in the year 2017 (Figure 3) significantly influenced the number of branches of *Telfairia occidentalis* plants in the year 2017, although it was not significantly higher than all other *Telfairia occidentalis* plants amended it was significantly higher than *Telfairia occidentalis* plants unamended (Control). However, in the year 2018, *Telfairia occidentalis* plants amended with poultry manure bagged in palm fronds house (PPB) at 5.4 tha^{-1} gave the highest number of branches which was only significantly higher than unamended *Telfairia occidentalis* plants (Figure 3).

Effect of Poultry Manure and Cow dung from Different Housing Systems and Method of Packaging on Stem Girth of Telfairia occidentalis (Hook F.) in 2017 and 2018

Stem girth of *Telfairia occidentalis* plants (Figure 4) in the year 2017 was significantly influenced by the application of cow dung stacked in the zinc house (ZCS) at 5.6 tha^{-1}. This value was not significantly higher than the value of all other amended *Telfairia occidentalis* plants but was significantly higher than the value observed on unamended (control) *Telfairia occidentalis* plants.

In the year 2018, *Telfairia occidentalis* plants amended with poultry manure bagged in palm fronds house (PPB) at 5.4 tha^{-1} gave the highest stem girth which was not significantly higher than the stem girth of all other amended *Telfairia occidentalis* plants but was significantly higher than the stem

girth of unamended (control) *Telfairia occidentalis* plants (Figure 4).

Effect of Poultry Manure and Cow dung from Different Housing Systems and Method of Packaging on Leaf Area of Telfairia occidentalis (Hook F.) in 2017 and 2018

In both years (2017 and 2018), the highest leaf area was observed on *Telfairia occidentalis* plants amended with poultry manure stacked in palm fronds house (PPS) at 6.9 tha^{-1} which was not significantly higher than the leaf area of all other amended *Telfairia occidentalis* plants but was significantly higher than the leaf area of unamended (control) *Telfairia occidentalis* plants (Figure 5).

Effect of Poultry Manure and Cow dung from Different Housing System and Method of Packaging on Uptake of Nitrogen, Phosphorus and Potassium by Telfairia occidentalis Plant in 2017 and 2018

It was observed in the year 2017 (Table 3) that nitrogen uptake was highest by *Telfairia occidentalis* plants amended with poultry manure in zinc house (ZPB) at 5.6 tha^{-1} which was not significantly ($P < 0.05$) higher than the nitrogen uptake by all other amended plants but was significantly ($P < 0.05$) higher than the nitrogen uptake by unamended (control) plants (Table 3) However, in the year 2018, *Telfairia occidentalis* plants amended with PPB at 5.4 tha^{-1} had highest nitrogen uptake which was significantly ($P < 0.05$) higher than the nitrogen uptake by plants amended with OCB at 5.3 tha^{-1}, ZCB at 6.5 tha^{-1}, PCS at 5.5 tha^{-1}, ZCS at 5.6 tha^{-1}, OPS at 6.8 tha^{-1} and control (Table 3).

Phosphorus uptake in the year 2017 (Table 58) was observed to be highest by *Telfairia occidentalis* plants amended with ZPB at 5.6 tha^{-1} and it was significantly ($P < 0.05$) higher than the phosphorus uptake of unamended (control) plants (Table 3). Meanwhile, the highest phosphorus uptake in the year 2018 was observed by *Telfairia occidentalis* plants amended with PPB at 5.4 tha^{-1} Control (Unamended) *Telfairia occidentalis* plants were observed to have the least phosphorus uptake although, not significantly ($P < 0.05$) lower than the phosphorus uptake by plants amended with OCB at 5.3 tha^{-1}, OPS at 6.8 tha^{-1}, PCS at 5.5 tha^{-1} and ZCS at 5.6 tha^{-1} (Table 3).

In the year 2017 (Table 58), potassium uptake was observed to be highest by *Telfairia occidentalis* plants amended with ZPB at 5.6 tha^{-1} which was significantly ($P < 0.05$) higher than the potassium uptake of unamended (control) plants. Whereas, in the year 2018, *Telfairia occidentalis* plants amended with PPB at 5.4 tha^{-1} gave the highest potassium uptake which was significantly ($P < 0.05$) higher than the potassium uptake by plants amended with OCB at 5.3 tha^{-1}, OPS at 6.8 tha^{-1}, PCS at 5.5 tha^{-1}, ZCS at 5.6 tha^{-1}, ZPS at 6.0 tha^{-1} and control (Table 3).

Table 1: Chemical Properties of Organic Materials (Fresh Manure) used for the Experiment

Properties	**Poultry Manure**	**Cow dung**
N Content (g^{-kg})	34.7	20.3
P Content (mg^{-kg})	18.18	25.79
K Content (mg^{-kg})	16.41	14.33
Na Content (mg^{-kg})	1.85	1.92
Mg Content (mg^{-kg})	2.87	1.43
Ca Content (mg^{-kg})	9.82	4.57
O. M. (g^{-kg})	65.4	73.6
pH	6.8	7.2
C/N Ratio	1.09	2.10

Table 2: Chemical and Physical Properties of Soil used for the Experiment

Soil Properties	**2017**	**2018**
pH (H_20)	6.4	6.5
pH (KCl)	6.2	6.3
O. M. (g^{-kg})	9.10	9.50
TN (g^{-kg})	1.00	1.00
Av. P (mg^{-kg})	10.26	10.69
K ($cmol^{-kg}$)	0.11	0.11
Na ($cmol^{-kg}$)	0.53	0.51
Mg ($cmol^{-kg}$)	0.31	0.28
Ca ($cmol^{-kg}$)	0.14	0.12
Sand (g^{-kg})	806	811
Clay (g^{-kg})	123	146
Silt (g^{-kg})	71	43
Textural Class	Sandy Loam	Sandy Loam

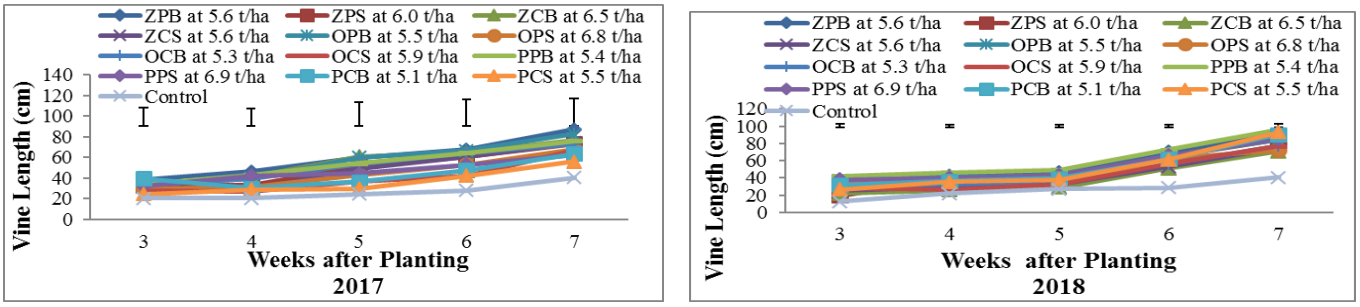

Figure 1: Effect of Poultry Manure and Cowdung from Different Housing Systems and Method of Packaging on Vine Length of *Telfairia occidentalis* (Hook F.) in the Year 2017 and 2018

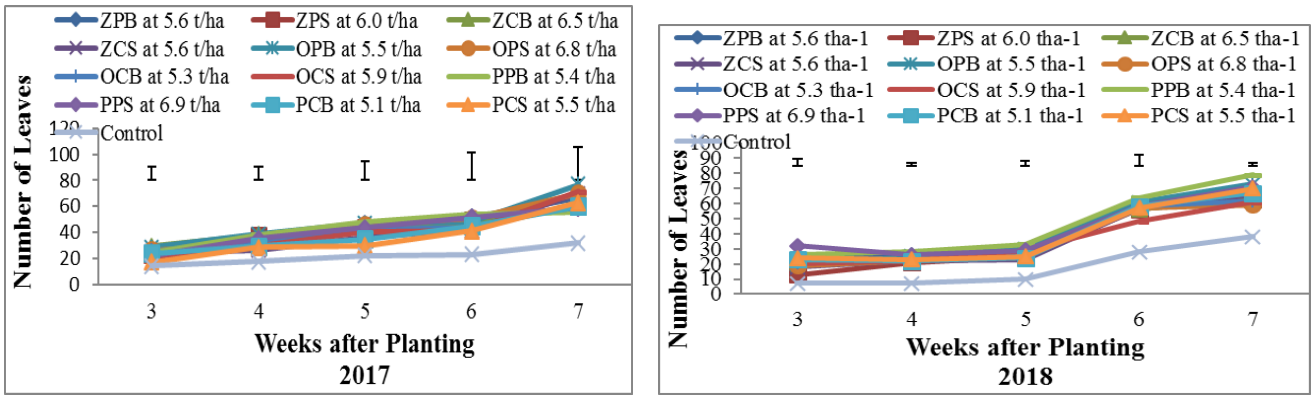

Figure 2: Effect of Poultry Manure and Cow dung from Different Housing Systems and Method of Packaging on Number of Leaves of *Telfairia occidentalis* (Hook F.) in Year 2017 and 2018

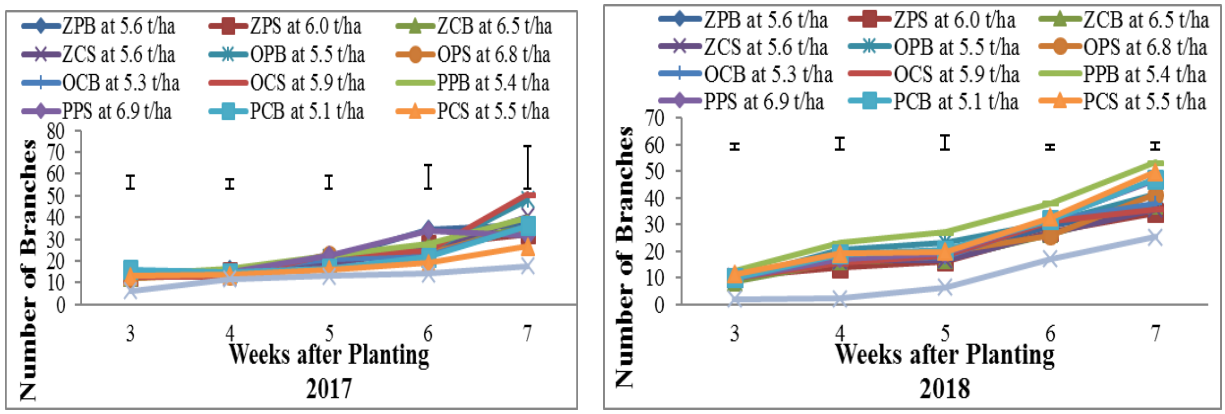

Figure 3: Effect of Poultry Manure and Cowdung from Different Housing Systems and Method of Packaging on *Telfairia occidentalis* (Hook F.) Number of Branches in Year 2017 and 2018

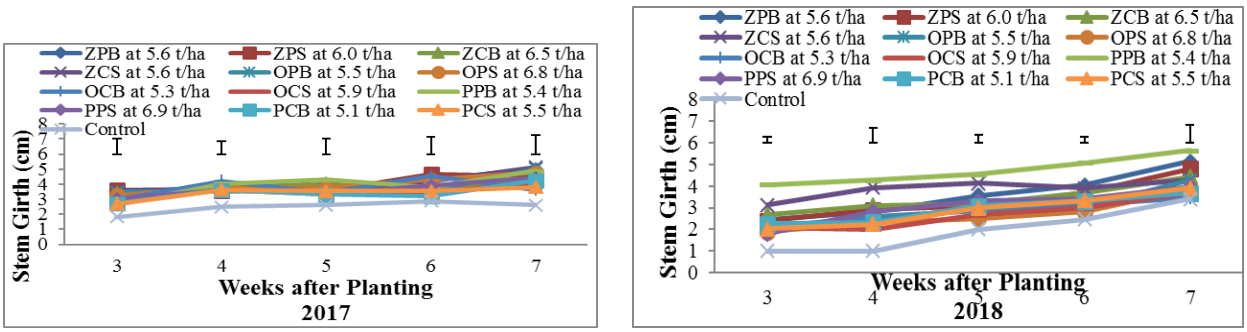

Figure 4: Effect of Poultry Manure and Cowdung from Different Housing Systems and Method of Packaging on Stem Girth of *Telfairia occidentalis* (Hook F.) in the Year 2017 and 2018

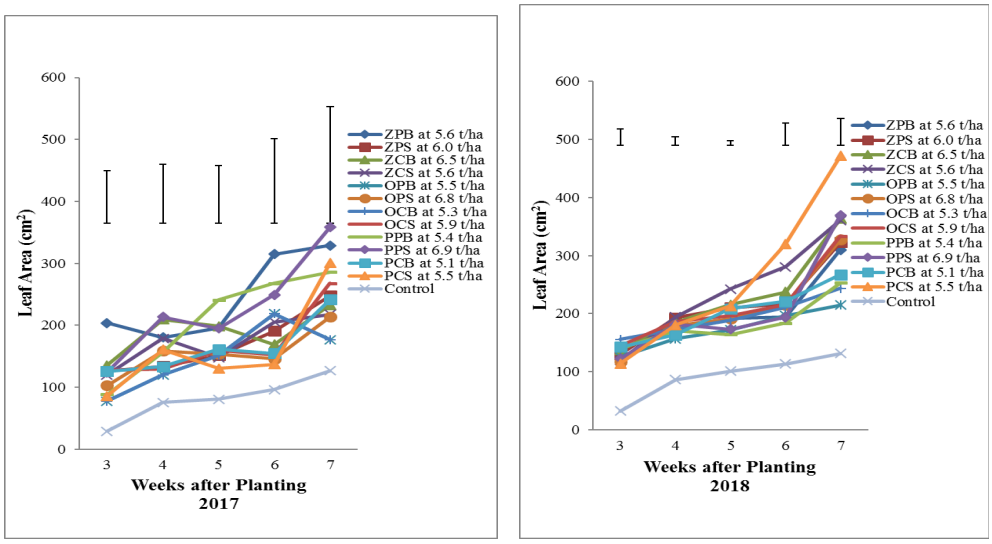

Figure 5: Effect of Poultry Manure and Cowdung from Different Housing Systems and Method of Packaging on Leaf Area of *Telfairia occidentalis* (Hook F.) in the Year 2017 and 2018

Table 3: Effect of Poultry Manure and Cow dung from Different Housing System and Method of Packaging on Uptake of Nitrogen, Phosphorus and Potassium by *Telfairia occidentalis* (Hook F.) Plant in 2017 and 2018

Amendments (t ha^{-1})	Nitrogen (g^{-plant})		Phosphorus (mg^{-plant})		Potassium (mg^{-plant})	
	2017	2018	2017	2018	2017	2018
ZPB at 5.6	69.07a	64.00ab	114.46a	118.48ab	242.13a	224.86ab
ZPS at 6.0	49.07ab	54.90ab	96.53a	107.84abc	177.54ab	99.49de
ZCB at 6.5	40.77ab	42.30bc	88.99ab	88.15abc	144.15ab	153.30abcd
ZCS at 5.6	35.27ab	39.20bc	68.52ab	66.68cd	120.50ab	120.52cde
OPB at 5.5	53.88a	49.40ab	97.09a	96.24abc	196.90a	177.58abcd
OPS at 6.8	37.77ab	36.30bc	75.49ab	75.56bcd	132.74ab	129.78cde
OCB at 5.3	43.03ab	43.50bc	96.86a	80.37bcd	164.53ab	140.77bcd
OCS at 5.9	56.88a	53.90ab	108.87a	106.13abc	190.06a	189.87abc
PPB at 5.4	51.10ab	74.20a	105.90ab	133.91a	213.76a	231.10a
PPS at 6.9	47.67ab	44.90ab	90.83ab	93.89abc	169.18a	153.53abcd
PCB at 5.1	49.72ab	54.60ab	98.47a	104.87abc	176.77ab	185.56abcd
PCS at 5.5	45.17ab	40.40bc	90.50ab	72.22bcd	156.62ab	127.51cde
Control	15.08b	13.80c	30.64b	34.47d	50.87b	47.24e
LSD (0.05)	36.79	29.80	61.13	50.85	128.03	88.00

Means with the same letter(s) in a column are not significantly different from each other at P < 0.05

KEY:

ZPB: Bagged poultry manure from zinc house
OCS: Stacked cow dung from open space
ZCS: Stacked cow dung from zinc house
PCB: Bagged cowdung from palm fronds house
OCB: Bagged cow dung from open space
ZCB: Bagged cow dung from zinc house
PPS: Stacked poultry manure from palm fronds house
OPS: Stacked poultry manure from open space
ZPS: Stacked poultry manure from zinc house
PPB: Bagged poultry manure from palm fronds house
OPB: Bagged poultry manure from open space
PCS: Stacked cowdung from palm fronds hous

4.0 Discussion

The increase in vine length, number of leaves, number of branches and stem girth observed on *Telfairia occidentalis* plants amended with poultry manure bagged in palm fronds house (PPB) at 5.4 tha^{-1} could be as a result of the lower C: N ratio observed on PPB before application which could have made the amendment to mineralize easily when compared to other amendments. This assertion is in line with the finding of Flavel and Murphy (2006) who established that the nature of organic materials affects the rate of mineralization. Also, the superior growth attributes observed by the application of PPB at 5.4 tha^{-1} has been reported by Akanni and Ojeniyi (2008), Ayoola and Makinde (2009) and Uwah *et al.* (2011). It was also observed that application of ZPB at 5.6 tha^{-1} and PCS at 5.5 tha^{-1} promote higher leaf area of *Telfairia occidentalis* plants which could be attributed to the fact that probably because nitrogen and calcium contents were higher in poultry manure which could hasten the development of leaf area. This corroborates the findings of Torres-Olivar *et al.* (2014) who asserted that nitrogen and calcium have a close relationship in the nutritional role of the plants.

The highest *Telfairia occidentalis* plants agronomic parameters observed as a result of the application of PPB at 5.4 tha^{-1} could be attributed to PPB at 5.4 tha^{-1} having higher pH, organic carbon and nitrogen which would have assisted in promoting the growth and yield parameters. This corroborates the findings of Myint *et al.* (2010) who stated that organic

manure had been proven to enhance efficiency and improve soil fertility and soil health. Uwah *et al*. (2012) affirmed that poultry manure contributes to the availability and adequate supply of organic matter. Also, Watson, *et al*. (2002) asserted that organic farming systems rely on the management of soil organic matter to optimize crop production because consumers are demanding organically grown produce because of its health benefits as confirmed by Dimitri and Greene (2002). Furthermore, Mugisa (2002) and Muhereza (2005) also established that animal manure is widely used to improve crop yield. Ndor *et al*. (2012) also stated that to keep the soil more productive, it must be supplemented with adequate nutrients.

5.0 Conclusion

Application of bagged poultry manure in palm fronds house (PPB) at 5.4 tha^{-1} had a significant effect on the number of leaves, the number of branches, stem girth and leaf area. The result obtained also revealed that *Telfairia occidentalis* responded well to the application of PPB at 5.4 tha^{-1} compared with every other amendment and control in the study. Therefore, based on the result of this finding, it is recommended that bagged poultry manure stored in palm fronds house (PPB) at 5.4 tha^{-1} will be adequate for maximum growth of *Telfairia occidentalis* as well as helps in the uptake of essential nutrients in the study area.

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