International Journal of Plant & Soil Science

25(5): 1-7, 2018; Article no.IJPSS.45428
ISSN: 2320-7035

Influence of Mineral Fertiliser on Vegetative Parameters of Fluted Pumpkins (*Telfairia occidentalis* Cucurbitaceae) in Buea, Cameroon

Tange Denis Achiri[1*] and Victorine Bongkisheri[2]

[1]*Department of Plant Protection, Cukurova University, 01330 Balcali, Adana, Turkey.*
[2]*Department of Agronomic and Applied Molecular Science, University of Buea, Cameroon.*

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2018/45428
Editor(s):
(1) Dr. Yong In Kuk, Department of Development in Oriental Medicine Resources, Sunchon National University, South Korea.
Reviewers:
(1) Temegne Nono Carine, University of Yaoundé I, Cameroon.
(2) Gisel Chenard Díaz, Federal University of Rio de Janeiro (UFRJ), Brazil.
Complete Peer review History: http://www.sciencedomain.org/review-history/27806

Original Research Article

Received 27 September 2018
Accepted 26 November 2018
Published 17 December 2018

ABSTRACT

Telfairia occidentalis commonly called fluted pumpkin is an indigenous vegetable of Central Africa particularly in Benin, Nigeria and Cameroon. The leaves and seeds are widely implicated in the local gastronomy of these regions. The potential of this plant in the field of medicine is being investigated. Unlike Nigeria, fluted pumpkin is still in subsistent production in Cameroon. Among other factors, fertiliser plays a fundamental role in our understanding for mass production of many vegetables. We evaluated the role of urea (46% N) and NPK fertiliser on the vegetative parameters of fluted pumpkin in Buea, at the foot of Mount Fako South West Region of Cameroon in 2012-13. Soil physicochemical properties were examined before the experiment. 5 g, 10 g, 15 g urea/plant and 10 g NPK/plant were applied in a ring method 1 and 5 weeks after germination with 3 replications. A repeated measure multivariate analysis revealed an interaction between time and the fertiliser regimes. Soil analysis revealed a slightly high N and P concentrations. Number of leaves was significantly (P = .05) highest (280.7) for plant treated with 15 g urea/plant 10 weeks after planting, followed by 266.7, 263.0, 232.3, and 66.3 for plants treated with 10 g urea/plant, 10 g NPK/plant, 5 g urea/plant and control respectively. High urea concentrations had an antagonistic effect on vine length. Plant treated with 15 g urea/plant had a statistically significant (P = .05)

**Corresponding author: E-mail: achiritange@gmail.com;*

highest leaf length (8.57 cm) from all treatments except for plant treated with 10 g NPK/plant (7.77 cm) and 10 g urea/plant (7.63 cm). Correlation analysis revealed a strong positive correlation (r^2 = 0.621, *P* = .018) between number of leaves and length of leaves. We strongly recommend that farmers use 15 g urea/plant for maximum vegetative plant output. Other ramifications of this research are discussed.

Keywords: Cameroon fluted pumpkin; leaf; NPK; soil physicochemical parameters; urea; vine.

1. INTRODUCTION

Fluted pumpkin (*Telfairia occidentalis* Hook. F Cucurbitaceae) is a perennial climbing plant which is indigenous to West and Central Africa, particularly in Benin, Nigeria and Cameroon [1]. The leaves have 3-5 palmately arranged leaflets. The fruit is pale green, with waxy deposit, strongly ribbed at maturity, up to 25 cm in diameter and 3-6 kg in weight and with light yellow, fibrous flesh. The seeds are flattened, about 3.5 cm in diameter and each fruit produces about 30-70 seeds. Harvesting of female shoots and leaves may begin 70-90 days from sowing, and fruits mature about 120-150 days from sowing. This plant is popular as a food crop (leaves and seeds), medicine, oil and fibre [2]. The leaf is rich in protein (29%), fat (18%) and minerals like potassium, calcium and magnesium, and vitamins (20%) [1,3]. Seeds of fluted pumpkin have a high nutritive and caloric value. In recent times, not only has fluted pumpkin seen a soaring increase in the diet incorporation in Central and West Africa and beyond, but it has been a vast research interest in areas of animal feed and pharmaceutical disciplines [4,5,6,7,8], indicating an even greater and an untapped potential of fluted pumpkin. Another reason for this heightened popularity of fluted pumpkin is the low cost per unit of resources use in the production, the short gestation period and quick returns on investment on par with other vegetable crop [9].

With this growing utilisation of fluted pumpkin, unlike in Nigeria where the plant is grown on industrial scale and all plant parts like vines, leaves and seeds are highly used, Cameroon is still lagging behind with production in subsistence conditions with only leaves being consumed in most instances. Nitrogen fertilisation plays a fundamental role in vegetative tissue build up of plants, especially for large scale production. In this study, we attempted to characterise the role of nitrogen - based fertilisers for large scale production of fluted pumpkin, which is widely harvested for its leaves, on the volcanic soils of Buea; South West Region, Cameroon.

2. MATERIALS AND METHODS

2.1 Study Site

This experiment was conducted at the University of Buea Research farm (04°08.966´ N, 09° 17.035´ E), Cameroon in 2012-13. Buea is in the monomodal humid-forest rainfall zone. It has a humid tropical climate with an annual rainfall of about 2,000 mm. The mean annual temperature is 28ºC while the average relative humidity ranges from 70 to 80% and annual sunshine is between 900 and 1,200 hrs per annum. The topography is mountainous; the soil type is basically volcanic and rich in minerals making it suitable for agriculture.

2.2 Experimental Design and Field Preparation

Soil was tilled with a tractor and 5 raised beds were constructed (9 m x 1 m) and separated by 1m in the experimental area. Five treatments (4 fertiliser treatments and a control - no fertiliser) arranged in a completely randomize design (CRD) – each treatment was randomly assigned to each plot.

2.3 Planting and Field Management

The seeds were extracted from pods which were obtained from the local market in Buea. The seeds were air dried for 2 days before direct planting, singly. The seeds were sown in mid October 2012. Each bed had 10 plants and measurements were made from 3 crops selected randomly. Each plant in a plot received the same treatment, however different from plants of the other plots. The treatments were: T_1 = Treatment One (5 g urea/plant ≈ 55 kg/ha), T_2 = Treatment Two (10 g urea/plant ≈ 110 kg/ha), T_3 = Treatment Three (15 g urea/plant ≈ 160 kg/ha), T_4 = Treatment Four (10 g NPK/plant ≈ 110 kg/ha) and T_5 = Treatment Five (no fertiliser applied; Control). Ring (5 cm from plant) fertiliser application was done twice in the experiment; 1 and 5 weeks after germination. Commercial Urea (46% pure N) and NPK (20:15:15) were obtain from a local market for this study. Plant parameter measurements began 4 weeks after sowing. After sowing, watering was done 3 times per week. Creeping vines were controlled not to cross into another plot. Weeding, removing of diseased leaves and other cultural practices were done as need aroused. Insect pest was not a major problem, thus no control measure was taken.

2.4 Soil Analysis

Composite soil samples (0-15 cm depth) were taken randomly from the site before clearing. The soil samples were analysed in the Laboratory of Soil Science in IRAD (Instiitute of Agriculture and Rural Development Research) Ekona, South West Region Cameroon, for physical and chemical properties. Mylavapus and Kennelley [10] standard laboratory procedures were used with slight modifications. Soil texture was determined by hydrometer method. The pH of soil samples was determined electrometrically both in water (pH water) and in 1 M potassium chloride (KCl) at a 1:2.5 soil/solution ratio (weight/volume). The organic carbon was determined by dichromate oxidation, total nitrogen by the Micro-Kjedatil method, and available Phosphorus by the Bray P-2 method. Exchangeable acidity was determined by KCl extraction. The exchangeable bases were displaced by neutral N NH4OAc (pH = 7.0). The potassium (K) and sodium (Na) contents in the extract were determined with atomic absorption spectrophotometer.

2.5 Data Collection and Analysis

Data were analysed for normality and homogeneity of variance using Kolmogorov-Smirnov test and Levene's test respectively. A General Linear model (GLM) repeated measure analysis was conducted to evaluate the influence of different concentrations of N-based fertilisers on some vegetative parameters (number of leaves, vine length and number of shoots and leaf length) over time: 1 month after sowing and then every fortnight for 10 weeks. Data for Length of leaf was collected at the end of the study, and then subjected to One-way analysis of variance (ANOVA). Means were separated using Duncan's Multiple Range Test (DMRT) at 95% level of significance. The data was Bootstrapped between 1000 times using the Bias corrected accelerated (Bca) confidence interval level at 95% for better estimates of the standard deviation (S.D) of the sample means, which was approximated to the population standard error (S.E) per treatment. A correlation analysis was conducted for vegetative parameters. All analyses were done using SPSS (ver. 23). Microsoft excel (2007) was used to create the bar chart.

3. RESULTS AND DISCUSSION

3.1 Pre-planting Soil Physicochemical Properties of Experimental Site

The initial soil analysis revealed that the soil texture was sandy/clay/loam. This kind of soil texture is ideal for maize cultivation; allowing for root penetration and proper irrigation. The soil also had low fertility, acidity with low amounts of organic carbon and total exchangeable cation, however, nitrogen was slightly high and available phosphorus was high based on [11] classification. The results of the pre-plant soil analysis thus indicated the need for soil nutrient amendment as observed by Agboola [12].

Table 1. Chemical and physical properties of the soil in this experiment

Parameters	Quantity
Texture	
Clay (%)	47.19
Silt (%)	44.44
Sand (%)	8.37
Textural class	Clay loamy
Chemical properties	
Moisture (105°c) %	11.3
Organic Carbon %	2.16
Total N%	0.17
Available P (Bray-2) mg/kg	29
pH(H_20) 1:2.5	5.42
pH(KCl) 1:2.5	4.82
Exchangeable cation (Cmol/Kg)	
Na^+	0.35
K^+	0.47
Mg^{2+}	4.23
Ca^{2+}	18.08
Al %	0.41
CEC pH 7 (cmol/Kg)	23.54

3.2 Number of Leaves

A General Linear Model (GLM) repeated measure multivariate test was conducted to evaluate the interaction effect between N – concentration rates and Time on the number of leaves. The interaction effect significantly influenced the number of leaves (Wilk's Lambda

F = 3.649, df = 12, 21, *P* = .004, partial square eta = 0.625). Four weeks after planting, the smallest number of leaves (10.7) was recorded from the control plots while the highest number of leaves (22.0) was recorded from plots treated with 15 g Urea/plant. The number of leaves was not statistically significantly different for N – treated plots, but differed from controlled plot (Table 2). This same pattern was observed for 6WAP, 8WAP and 10WAP. Although not statistically significantly different, the number of leaves increased with the increased rate of nitrogen. In 10WAP, the mean number of leave was 66.3, 232.3, 266.7, 263.3, and 280.7 from control plots, 5 g urea/plant plots, 10 g urea/plant plots, 10 g NKP/plant and 15 g urea respectively. Okoro-Robinson and Bello [13] reported an increase in the number of leaves with increase N-fertiliser rates. They recorded 202.31 leaves from field treated with 75 kg N/ha (commercial urea – 45% N). 75 kg N/ha was their highest N – concentration, this could explain the disparity in the number of leaves relative to the highest N – concentration in our study. Also, the rich nitrogenous volcanic soil could have played a role in number of leaves observed. In another related study, [14] strongly recommended that farmers in Nigeria use 60 kg N/ha. Olaniyi and Odedere [15] experimented with this recommended N – rate and recorded 187.7 leaves at harvest, similar to the number of leaves (232.3) obtained in our study from plants treated with 5 g urea/plant (≈ 55.5 kg/plants). Our study showed that increased N – rates increased the number of leaves especially considering that the leaves are the most priced parts in the market. Although our research found no statistically significant increase in the number of leaves amongst N – treated plots, it is there imminent that we further evaluate the cost – benefit analysis resulting from the small increments in number of leaves with increasing N – rates.

3.3 Vine Length (cm)

Like number of leaves, a general linear model (GLM) repeated multivariate test was done to evaluate the interactions effect between N – concentration rates and Time on the length of vines. The interaction was statistically significantly influenced (Wilk's Lambda F = 6.989, df = 12, 21, *P* < .0001, partial eta = 0.754) the length of vines. The findings are presented in Table 3. Four weeks after planting, the shortest vine (17.5) was recorded from the control plots, which also produced the shortest vine length for the entire experiment. Throughout the study, the vine from plots treated with 5 g urea/plant surprisingly was higher than those from plots treated with 10 g urea/plant. For the fourth and sixth week, the vine lengths from plots treated with 15 g urea/plant were higher than those treated with 10 g NPK/plant; the reverse trend was true for the eighth and tenth week. At the end of the study, plant treated with 5 g NPK/plant had a statistically significant highest vine length, followed by plants treated with 10 g urea/plant, 10 g NPK/plant, 15 g urea/plant and control. Interestingly, higher N - concentrations had a significant antagonistic effect on vine length compared. Field experiments conducted in 2007 – 2018 cropping season at the Teaching and Research farm of Ladoke Akintola University of Technology (LAUTCH) Ogbomoso Nigeria by Olaniyi et al. [16] showed that higher rates of nitrogen application (80 g N/ha) had an antagonistic effect on vine length relative to lower rate (60 g N/ha) six weeks after sowing. This may indicate a ceiling of N requirement for vine length at about 60 kg N/ha, which is approximately 55 kg N/ha as in our study.

Table 2. Mean (±SE) number of leaves of *T. occidentalis* weeks after treatment with different fertiliser regimes in Buea - SWR, Cameroon

Fertiliser treatment	Mean (±SE) number leaves of *T. occidentalis* weeks after planting (WAP)			
	4WAP	6WAP	8WAP	10WAP
5g urea/plant	21.3 ± 1.6 bA	43.7 ± 5.3 bB	117.0 ± 6.3 bC	232.3 ± 6.6 bD
10g urea/plant	22.3 ± 1.3 bA	43.0 ± 3.8 bB	128.7 ± 9.8 bC	266.7 ± 13.2 bD
15g urea/plant	22.7 ± 2.2 bA	49.7 ± 3.3 bB	150.0 ± 10.9 bcC	280.7 ± 30.5 bD
10g NPK/plant	22.0 ± 1.4 bA	58.3 ± 6.7 bB	180.3 ± 12.7 cC	263.0 ± 14.3 bD
Control (no fertiliser)	10.7 ± 0.8 aA	17.7 ± 0.9 aAB	41.0 ± 4.7 aB	66.3 ± 3.2 aB

Linear independent pair-wise post hoc mean separation was done for the estimated marginal means. Means are compared column wise (with small letters) and row wise (with a capital letter). Means with the same letter(s) are not statistically different (p < .05). S.E – standard error of means. WAP-weeks after planting

Table 3. Vine length of *Telfairia occidentalis* as influenced by N – fertilisation

Fertiliser treatment	Mean (±SE) vine length of *T. occidentalis* weeks after planting (WAP)			
	4WAP	6WAP	8WAP	10WAP
5g urea/plant	44.0 ± 7.9bA	92.3 ± 0.9cB	159.3 ± 13.0bC	271.7 ± 6.8dD
10g urea/plant	26.1 ± 1.4bA	74.7 ± 1.7bB	142.0 ± 5.4bC	233.3 ± 5.7cD
15g urea/plant	71.1 ± 7.6cA	111.0 ± 4.2dB	151.7 ± 6.7bC	207.0 ± 2.7bD
10g NPK/plant	65.9 ± 5.6cA	108.3 ± 2.7dB	188.7 ± 11.2cC	210.0 ± 3.4bcC
Control (no fertiliser)	17.5 ± 2.7aA	32.3 ± 0.9aA	87.0 ± 5.5aB	126.7 ± 5.7aC

Linear independent pair-wise post hoc mean separation was done for the estimated marginal means. Means are compared column wise (with small letters) and row wise (with a capital letter). Means with the same letter(s) are not statistically different (p < .05). S.E – standard error of means. WAP-weeks after planting

3.4 Number of Shoots

A general linear model (GLM) repeated multivariate test was done to evaluate the interaction effect between N – concentration rates and Time on the number of shoots of *Telfairia occidentalis*. The interaction effect statistically significant influenced (Wilk's Lambda F = 3.104, df = 12, 21, *P* = .011, partial eta = 0.588). The findings are represented in Table 4. The number of shoots increased over time for all treatments and control. The number of shoots was highest from plants treated with 10 g NPK/plant 10 WAP, which was statistically significantly different (*P* = .05) from the other treatments. 15 g urea/plant showed an inhibiting effect on number of shoots compared to 10 g urea/plant treatment. The shoots are part of the reproductive system of a plant. Thus, they require more nutrient than solely nitrogen as the case of vegetative plant parts. This could explain why plants treated with 10 g NPK/plant had a statistically significantly higher mean number of shoots compared to the plants treated with urea. Olaniyi et al. [16] reported that the fresh shoot yield for *Telfairia occidentalis* plants treated with 60 kg N/ha was higher than those of plants treated with 80 kg N/ha. It is worth mentioning that although the parameter measured in Olaniyi et al. [16] in Nigeria was shoot yield and not number of shoots. However, we can infer that beyond 60 kg N/ha, the effect of N on number of shoots and eventually shoot yield is at best insignificant and at worst inhibiting as the case of our findings. Our result is also corroborated by the findings of Okoro-Robinson and Bello [13].

3.5 Leaf Length

The leaf length was measured in the 10th WAP from leaf apex to base of the leaf. Analysis revealed that the length of leaf was statistically significantly (F = 9.785, df = 4, 10, *P* = .002) influenced by the different fertiliser regimes. The highest mean leaf length (8.57 cm) was recorded from plants treated with 15 g urea/plant although not statistically significantly different from mean leaf length of plants treated with 10 g urea/plant and 10 g NPK/plant which were 7.63 cm and 7.77 cm respectively (Fig. 1). Increasing nitrogen rate is reported to have a significant effect on vegetative parameters of *Telfairia occidentalis* [1,2,16] and on other crops [17].

3.6 Correlation Analysis of Vegetative Parameters

The correlation matrix of measured parameters is shown in Table 5. The number of leaf was positively and statistically significantly correlated to vine length, number of shoots and leaf length,

Table 4. Number of shoots of *Telfairia occidentalis* as influenced by N – fertilisation

Fertiliser treatment	Mean (±SE) number of shoots of *T. occidentalis* WAP			
	4WAP	6WAP	8WAP	10WAP
5g urea/plant	2.7 ± 0.3aA	3.3 ± 0.3aA	9.7 ± 0.6aB	26.3 ± 3.3aC
10g urea/plant	2.3 ± 0.3aA	4.0 ± 0.0aB	12.7 ± 0.8aC	32.7 ± 4.8aD
15g urea/plant	2.3 ± 0.3aA	6.3 ± 0.5bB	12.0 ± 0.8baC	23.0 ± 2.7aD
10g NPK/plant	3.0 ± 0.4aA	7.3 ± 0.7bB	14.7 ± 1.9aC	51.3 ± 4.2bD
Control(no fertiliser)	3.0 ± 0.4aA	3.7 ± 0.3aA	10.0 ± 0.4aB	16.3 ± 1.3aB

Linear independent pair-wise post hoc mean separation was done for the estimated marginal means. Means are compared column wise (with small letters) and row wise (with a capital letter). Means with the same letter(s) are not statistically different (p < .05). S.E – standard error of means. WAP-weeks after planting

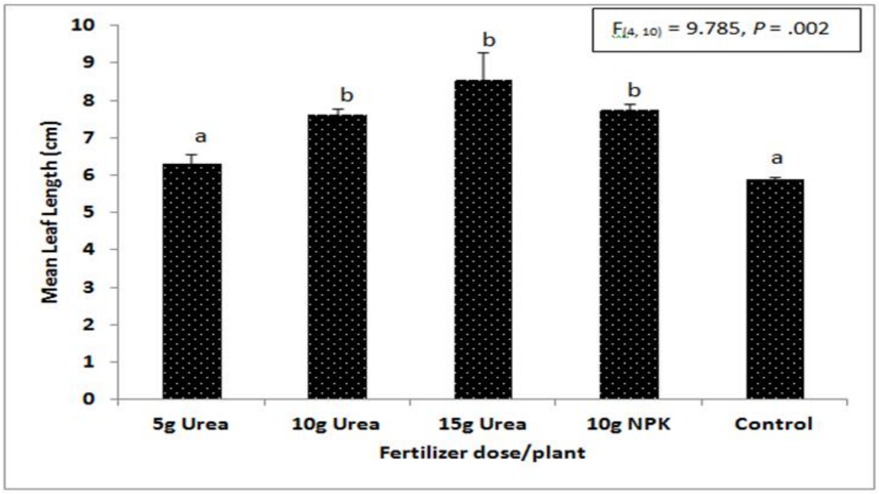

Fig. 1. Mean leaf length as influenced by different N – concentration
(*Mean bars with same letter(s) are not statistically significantly different at .05)*

Table 5. Vegetative parameters were correlated

Parameters	Number of leaves	Vine length	Number of Shoots	Leaf length
Number of leaves	-			
Vine length	r^2 = .791 (.001)	-		
Number of Shoots	r^2 = .781 (.001)	r^2 = .676 (.008)	-	
Leaf length	r^2 = .621 (.018)	r^2 = .521(.056)	r^2 = .325 (.257)	-

r2 – correlation coefficient, numbers in parentheses are the significant level (α)

number of shoots was positively and statistically significantly correlated to vine length but to leaf length. A positive and statistically correlation between vine length and number of shoots was also reported by Mrema and Maerere [18] although the finding was on watermelon, which is also a creeping plant.

4. CONCLUSION

Our findings, like many others concluded that N – regimes play a very fundamental role in the vegetative parameters of *Telfairia occidentalis* on the volcanic soil in Buea – South West Region, Cameroon. Plants treated with 15 g urea/plant gave an overall better performance on the vegetative parameters. Our research did not evaluate disease and pest attack on plants. We did not also conduct studies on fruit and seed quality. These other aspect will go a long way to improving our understanding and knowledge on the performance of this indigenous plant in this region for large-scale production. At this point though, we recommend that farmers use 15 g urea/plant for maximum vegetative production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kayode AAA, Kayoed OT. Some medical values of *Telfairia occidentalis*: A review. Am J Biochem Mol Bio: 2016;1:30-38.
2. Akanbi WB, Adebooye CO, Togun AO, Ogunrinde JO, Adeyeye SA. Growth, herbage and seed yield and quality of *Telfairia occidentalis* quality as influenced by cassava peel compost and mineral fertilizer. World J Agri Sci. 2006;3(40):508–516.
3. Nwurgu CE. Economic importance and growth rate of broiler chicken served fluted pumpkin (*Telfairia occidentalis*) leaf extract. African J Biotec. 2007;6(2):167-174.
4. Nwanna EE, Oboh G. Antioxidant and hepatoprotective properties of polyphenol extracts from *Telfairia occidentalis* (fluted pumkin) leaves on acetaminophen induced

liver damage. Pak J Bio Sci: 2007;10(16):2682-2687.
5. Ejike CE, Ugboaja PC, Ezeanyika LU. Dietary incorporation of boiled fluted pumkin (*Telfairia occidentalis* Hook. F) seed: Growth and toxicity in rats. Res J Biol Sci. 2010:140–145.
6. Ejike CECC, Ezeanyika LUS. A *telfairia occidentalis* seed incorporated diet may be useful in inhibiting the induction of experimental andropause. Ann Med and Health Sci Res. 2012;2(1):41-45.
7. Onu PN. Effect of aqueous extract of *Telfairia occidentalis* leaf on the performance and haematological indices of starter broilers. International Scholarly Research Network (ISRN). Vet Sci: 2012:1-4.
8. Akindele AJ, Ajao MY, Aigbe FR, Enumah US. Effect of *Telfairia occidentalis* (fluted pumkin, Cucurbitaceae) in mouse models of convulsion muscle relaxation and depression. J Med Food. 2013;16(9):810-816.
9. Udoh EJ, Akpan SB. Measuring technical efficiency of waterleaf (*Talinum triangulare*) production in Akwa Ibom State, Nigeria. Amer-Eurasin J Agri & Environ Sci. 2007;2(50):518-523.
10. Mylavapus RS, Kennelley DE. Analytical procedures and training manual, Institute of Food and Agricultural Science. University of Florida, IFAS extension soil testing laboratory (ESTL), Gainsville, USA. 2002;28p
11. Olatunji O, Ayuba SA. Effect of combined applications of poultry manure and NPK 20-10-10 fertilizer on soil chemical properties and yield of maize (*Zea mays* L.). Proceeding of the 35th Annual Conference of the Soil Science Society of Nigeria (SSSN). Federal University of Technology, Minna, Nigeria. 7th – 11th March. 2012.
12. Agboola AA. The problem of improving soil fertility by the use of green manure in tropical farming system. FAO Soil Bulletin. 1975;27:147-163.
13. Okoro-Robinson MO, Bello WB. Nitrogen fertilizer effect on the yield and quality of flutted pumpkin (*Telfairia occidentalis* Hook. F). Nigerian J Hort Sci. 2012;17:27–32.
14. Okoro N. Effect of Nitrogen fertilizer on growth, yield, chemical composition on *Telfairia occidentalis*. Master thesis – Department of Agronomy, Faculty of Agriculture, Ladoke Akintola University of Agriculture University of Technology, Ogbomoso, Nigeria. 2006.60p
15. Olaniyi JO. Odedere MP. The effects of mineral N and compost fertilizers on the growth, yield and nutritional values of fluted pumpkin (*Telfairia occidentalis*) in the South western Nigeria. J Anim Plant Sci. 2009;5(1): 443 – 449.
16. Olaniyi JO, Modupeola TO, Idowu-Agida OO, Bidmo FA, Egbekunle KO, Ogunsakin IF. Effects of nitrogenous and phosphatic fertilizer, yield, nutrient uptake and nutritional values of *Telfairia occidentalis* Hook. F. Am J Plant Nutr and Fert Tech. 2014;4(1):18–26.
17. Achiri TD, Tsague ZSM, Konje CN, Njualem DK. Effect of NPK fertilizer and Animal manure on some biometric parameters of Irish potato *Solanum tuberosum* L. in Bougham, West Region of Cameroon. Asian J Res Crop Sci. 2018;2(1):1–10.
18. Mrema E, Maerere AP. Growth and yield performance of watermelon during dry and wet seasons under control conditions. Inter J Veg Sci: 2018:1-7 doi/abs/10.1080/19315260.2018.1439554

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history/27806