

Performance of Fluted Pumpkin (*Telfairia occidentalis* Hook F.) Under Different Nitrogen Fertilizer Grades in a High Humid Ecology of Southern Nigeria

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Abstract

Fluted pumpkin (*Telfairia occidentalis* Hook F.) is a significant vegetable crop consumed by millions of Nigerians mainly in the South-Eastern Region. A field experiment was conducted in 2024 at the Teaching and Research Farm of Akwa Ibom State University, Obio Akpa Campus, to evaluate the effect of different fertilizer grades on the growth and yield of fluted pumpkin. The experiment was arranged in a randomized complete block design (RCBD) with three replications. The treatments included NPK 15:15:15, NPKMg 12:12:17:2, NPK 20:10:10, urea, and a control (no soil amendment). Growth and yield data were subjected to analysis of variance (ANOVA), and significant means were separated using the least significant difference (LSD) at a 5% probability level. Results showed that urea application significantly increased vine length, with recorded values of 73.45 cm, 145.67 cm, and 170.42 cm at 4, 6, and 8 weeks after planting (WAP), respectively. This was followed by NPK 20:10:10, which produced vine lengths of 69.50 cm, 139.33 cm, and 150.80 cm at the same growth stages. The shortest vines (31.11 cm, 46.12 cm, and 69.55 cm at 4, 6, and 8 WAP, respectively) were observed in the control treatment. Urea also resulted in the highest number of leaves per plant, with 46, 87, and 121 leaves recorded at 4, 6, and 8 WAP, respectively. NPK 15:15:15 produced 100 leaves per plant at 8 WAP, while the control treatment had the lowest leaf count (14, 29, and 38 leaves per plant at 4, 6, and 8 WAP). Foliar yield was significantly higher in the urea treatment (17.23 t/ha), followed by NPK 20:10:10 (14.41 t/ha) and NPK 15:15:15 (13.60 t/ha). Pod yield was highest with NPKMg 12:12:17:2 (25.29 t/ha), followed by NPK 15:15:15 (23.60 t/ha) and NPK 20:10:10 (21.31 t/ha). Based on these findings, urea may be recommended for optimal foliar yield, while NPKMg 12:12:17:2 recommended for optimal pod production.

Keywords: Fluted pumpkin, Inorganic fertilizer, Soil properties, Agronomic practices, Growth, Yield

1.0 Introduction

Fluted pumpkin (*Telfairia occidentalis* Hook F.) is a significant vegetable crop that thrives in the humid tropical regions of Africa, playing a crucial role in local diets and economies. This plant belongs to the genus *Telfairia*. The genus includes two primary species: *Telfairia occidentalis* and *pedata*. Fluted pumpkin is commonly known for its edible leaves and seeds (Idem et al., 2012; Ekwere et al., 2019).

Telfairia occidentalis belongs to the Cucurbitaceae family, which consists of approximately 90 genera and over 700 species distributed across warm regions of the world (Schippers, 2000). Among indigenous vegetables, fluted pumpkin is widely consumed in southern Nigeria and cultivated for its edible succulent shoots and leaves, as well as its immature seeds, which are also edible. The leaves are particularly rich in iron and protein, containing about 85% moisture and 11% crude protein (Idem et al., 2012).

As fluted pumpkin shift from being a backyard crop to a commercially cultivated vegetable, maximizing profitability becomes essential for maintaining productivity. To ensure that its production plays a significant role in enhancing food security and improving nutrition in Nigeria, it must be both economically viable and environmentally sustainable.

Farmers in southern Nigeria infrequently employ inorganic fertilizers when cultivating fluted pumpkin. Soil fertility management is crucial for optimizing the growth and yield of crops, and nitrogen fertilizers play a significant role in providing essential nutrients for plant development. There are numerous nitrogen fertilizer grades available, each incorporating a different combination of macro and micronutrients, which can substantially influence crop performance.

Research conducted by Ikeh (2010) demonstrated significant variations in yam tuber yields when different fertilizer grades were applied, specifically comparing NPK-15:15:15, NPK-20:10:10, and NPKMg-12:12:17:2 blends. Additionally, Esang and Ikeh (2021) highlighted the impact of various fertilizer grades and sources on rice yields, underscoring the importance of selecting the appropriate nutrient composition for optimal growth.

Some studies have explored the response of fluted pumpkin to varying rates of fertilizer types (Ogar and Asiegbo, 2005; Olaniyi and Akanbi 2007; Olaniyi and Odedere, 2009). However, there still remains a significant gap in the literature regarding its growth performance and yield response to different nitrogen fertilizer grades particularly in the high humid ecology of Nigeria. This preliminary study was undertaken to evaluate the effects of various nitrogen fertilizer grades on the growth parameters—such as plant height, leaf number, and overall biomass—as well as the yield of fluted pumpkin. Understanding these effects will provide valuable insights for farmers, helping them make informed decisions to enhance productivity and sustainability in fluted pumpkin cultivation

2.0 Materials and Methods

2.1 Experimental Site, Design and Treatment

The research was carried out at the Teaching and Research Farm of the Department of Crop Science, Faculty of Agriculture, Akwa Ibom State University, located at the Obio Akpa Campus in Oruk Anam Local Government Area, Akwa Ibom State, during the 2024 planting season. Obio Akpa is situated between latitudes 4° 30'S and 5° 30'N, and longitudes 7° 30'W and 8° 00'E (Slus, 1989). The mean annual rainfall ranges from 2000 mm to 2600 mm, exhibiting a bimodal pattern that peaks in June and October (Umoh *et al.*, 2017). Annual temperatures in Obio Akpa range between 24°C and 30°C, with the highest temperatures occurring in February and April, while relative humidity varies from 75% to 79% (Umoh *et al.*, 2017).

The site was cleared manually with a machete. Tilling was done with a spade after marking out the field with tape, rope, and pegs for proper spacing.

The experimental design used was a Randomized Complete Block Design (RCBD) with three replications. Four different fertilizers were used as treatment which includes NPK 20:10:10, NPK 15:15:15, NPKMg 12:12:17:2, and urea. There were 15 experimental plots each measuring 4 x 2.5m and demarcated from one another by 1m between row and 0.5m inter-row.

2.2 Agronomic Practices

Manual weeding was carried out three weeks after planting and thereafter at a three-week interval with the native weeding hoe.

The Fertilizer treatment were applied at 3 weeks after planting using the ring method of application. Staking was done at 8 weeks after planting.

2.3 Measurements of Growth Parameters

Six plants were randomly tagged within the plots for data collection, and the growth and yield parameters were accessed. Data was collected at 2, 4, 6, and 8 weeks after planting.

Number of leaves: The number of fluted pumpkin leaves was determined by physical counting of all the functional leaves per plant at a three weekly intervals from the time of planting.

Vine length (cm): The vine length was determined using a measuring tape to measure the length of the tagged plant.

Number of vines/ plant: This was determined by physical counting of the vine on the tagged plant.

Leaf area (cm): The Leaf area of the fluted pumpkin was determined by measuring the length multiplied by the width of all leaves of the tagged plant.

2.4 Measurements of Yield Parameters

Number of pods per plant: the numbers of pods were determined by counting the entire pods produced on each tagged plant per plot and the mean was recorded.

Circumference of pod (cm): The circumference of the pod was determined using a flexible measuring tape, to measure around the middle of the pod of each tagged plant and the mean was recorded.

Pod yield (t/ha): The pod yield was determined by weighing the pods from net plot with the aid of the top load weighing balance in kilograms and converted to tonnes per hectare.

Data collection and analysis: Data collected were subjected to a One-way Analysis of Variance (ANOVA). The significant differences between means were separated using the Fishers Least Significant Difference (LSD) at a 5% probability level.

3.0 Results

3.1 Soil Physicochemical Properties of the Experimental Site Before Planting

The result of the soil analysis are presented in Table 3.1.

Table 3.1 Soil samples at a depth of 10-15cm

Soil properties	Value
Sand(%)	71.95
Silt (%)	8.66
Clay (%)	19.39
Textural Class	Sand loam
pH	3.98
Organic Matter	2.26
Nitrogen	1.20
Available p(Mg/kg)	22.025
Exchangeable base (cmol/kg)	
K	0.08
Ca	8.30
Mg	4.12
Na	0.19
Exchangeable Acidity (Cmol/kg)	1.98
Electrical Conductivity (ds/m)	0.17
Effective cation exchangeable capacity (cmol/kg)	11.09
Base saturation (%)	85.5

3.2 Establishment Percentage and Vine Length

The result presented in Table 3.2 shows that the different fertilizer grade had no significant ($P>0.5$) effect on the establishment percentage of fluted pumpkin. The establishment percentage was between 99 and 100% across all fertilizer grades. Vine-length of fluted pumpkin were significantly different across fertilizer grades at all weeks of measurement except at 2 weeks after planting (WAP) (Table 3.2). Urea produced the longest vines 73.45, 145.67, and 170.42 cm at 4, 6, and 8(WAP), respectively. This was followed by 69.50, 139.33, and 150.80 cm vine length recorded with NPK-20:10:10. The shortest vine; 31.11, 46.12, and 69.55 cm, respectively was recorded with the control treatment.

Table 3.2 Establishment percentage and vine length of fluted pumpkin as influenced by inorganic fertilizer grades

Fertilizer grade	Establishment %	Weeks after Planting			
		2	4	6	8
0	100	23.02	31.11	46.12	69.55
NPK15:15:15	100	24.32	65.33	129.05	147.89
NPKMg-12:12:17:2	99	24.82	60.12	119.60	130.15
NPK-20:10:10	100	25.11	69.50	139.33	150.80
Urea	100	23.93	73.45	145.67	170.42
LSD($p<0.05$)	NS	NS	3.56	5.13	5.87

3.3 Number of Leaves of Fluted Pumpkin Treated with Different Fertilizer Grades

The number of leaves per plant as influenced by nitrogen fertilizer grade is shown in Table 3.3. The different fertilizer grades had a significant effect ($p>0.05$) on the number of leaves at the different stages after planting except at 2WAP. The highest number of leaves per plant were observed with the urea treatment 46.11, 87.23, and 121.30 at 4, 6, and 8WAP, respectively, this was closely followed by NPK 20: 10:10 which produced 35.90, 72.56 and 91.44 leaves at 4, 6 and 8WAP, accordingly. NPK 15:15:15 produced 100.54 leaves per plant at 8 WAP, the control treatment had the least number of leaves per plants; 14,16, 29.10 and 37.80 leaves per plant at 4, 6, and 8 WAP, respectively.

Table 3.3 Number of leaves per plant as influenced by inorganic fertilizer grades

Fertilizer Grade	Weeks after Planting			
	2	4	6	8
0	5.30	14.16	29.10	37.80
NPK15:15:15	5.91	31.11	70.11	100.54
NPKMg-12:12:17:2	6.01	27.77	63.67	73.19
NPK-20:10:10	5.61	35.90	72.56	91.44
Urea	5.77	46.11	87.23	121.30
LSD($p<0.05$)	NS	2.71	3.05	4.18

3.4 Vine Girth (cm) of Fluted Pumpkin Treated with Different Fertilizer Grades

Vine girth as influenced by nitrogen fertilizer grade is shown in Table 3.4. All the nitrogen fertilizer grades had no significant ($p < 0.05$) effect on the vine girth at 2 WAP, but significantly affected vine girth at 6 and 8 WAP. Like in other growth parameters, urea had the highest effect on vine girth having 2.33 cm and 2.85 cm at 6 and 8 WAP. NPK 20:10:10 and NPK 15:15:15 had vine girths of 2.81 and 2.46 cm, respectively at 8 WAP. The least vine girth, 1.39, 1.56, and 1.62 cm at 4, 6 and 8 WAP, respectively was recorded in the control treatment.

Table 3.4 Vine girth (cm) as influenced by inorganic fertilizer grades

Fertilizer Grade	Weeks after Planting			
	2	4	6	8
0	1.36	1.39	1.56	1.62
NPK15:15:15	1.37	1.93	2.07	2.46
NPKMg-12:12:17:2	1.33	1.90	2.01	2.40
NPK-20:10:10	1.40	2.01	2.30	2.81
Urea	1.35	2.08	2.33	2.85
LSD($p < 0.05$)	NS	NS	0.51	0.78

*NS=Not Significant

3.5 Number of Vines of Fluted Pumpkin Treated with Different Fertilizer Grades

The number of vines per plant as influenced by nitrogen fertilizer grade is shown in Table 3.5. Treatment of urea produced a significantly larger number of branches per plant; 3.10, 10.06, and 21.16 at 4, 6, and 8 WAP, respectively. This was followed by 2.75, 9.25, and 18.21 branches per plant, recorded in treatment of NPK 20:10:10. The least number of branches per plant; 0.00, 2.86, 5.31 at 4, 6, and 8 WAP, was recorded in the control treatment.

Table 3.5 Number of vine per plant as influenced by inorganic fertilizer grades

Fertilizer Grade	Weeks after Planting			
	2	4	6	8
0	0.00	0.00	2.86	5.31
NPK15:15:15	0.00	1.39	5.77	13.75
NPKMg-12:12:17:2	0.00	1.20	5.69	12.12
NPK-20:10:10	0.00	2.75	9.25	18.21
Urea	0.00	3.10	10.06	21.16
LSD($p < 0.05$)	NS	1.37	2.60	2.93

3.6 Leaf Area (cm³) as Influenced by Inorganic Fertilizer Grades

The effect of different fertilizer grades on the leaf area of fluted pumpkins is presented in Table 3.6. Urea fertilizer produced significantly larger leaf area; 89.78, 98.33, and 100.31 cm² at 4, 6, and 8 WAP, respectively. Treatment of NPK 20:10:10 had 82.13, 95.10, and 99.81 cm² at 4, 6, and 8 WAP, respectively. Treatment that received NPK 15:15:15 had leaf areas of 74.33, 79.19,

and 83.14 at 4, 6, and 8 WAP, respectively. The control treatment had the least leaf area; 61.71, 63.56, and 64.12 cm² at 4, 6, and 8 WAP, respectively.

Table 3.6 Leaf area (cm)² as influenced by inorganic fertilizer grades

Fertilizer Grade	Weeks after Planting			
	2	4	6	8
0	59.60	61.71	63.56	64.12
NPK15:15:15	59.56	74.33	79.19	83.14
NPKMg-12:12:17:2	60.40	72.91	82.40	89.40
NPK-20:10:10	59.81	82.13	95.10	99.81
Urea	60.44	89.78	98.33	100.31
LSD(p<0.05)	NS	3.58	4.72	5.39

3.7 Yield and Yield Components of Fluted Pumpkin as Influenced by Inorganic

Fertilizer Grades

Foliar yield: The foliar yield of fluted pumpkin as influenced by fertilizer grades is presented in Table 3.7. The treatment of urea produced a significant foliar yield of 17.23 t/ha, followed by 14.41 and 13.60 t/ha foliar yield recorded in the treatment of NPK 20:10:10 and NPK 15:15:15, respectively. The lowest foliar yield, 5.61 t/ha was recorded in the control treatment.

Number of pods per plant: The number of pods per plant as influenced by fertilizer grades is shown in Table 3.7. The treatment of NPK mg 12:12:17:2 had the highest significant number of 5.62, followed by 3.91 pods per plant (NPK 15:15:15); 0.20 was recorded in control treatment

Length of pods (cm): The length of pods as influenced by fertilizer grade is shown in Table 3.7. The longest pod: 41.11cm, was recorded with NPKMg12:12:17:2. The treatment of NPK 15:15:15 and 20:10:10 had pod lengths of 37.39 and 38.89 cm respectively. Urea treatment had a 25.78 cm pod length. The shortest pod, 18.42 cm was recorded in the control treatment.

Circumference of pods: Circumference of pods as influenced by different fertilizer grades varied significantly. A significantly bigger pod circumference, 33.40 cm was recorded in the treatment NPK 12:12:17:2. The smallest pod circumference, 20.51 cm was recorded in the control treatment.

Pod yield (t/ha): Pod yield as influenced by fertilizer grade varied significantly ($p < 0.05$) among treatments. The highest numerical pod yield, 25.92 t/ha was recorded in the treatment of NPKMg12:12:17:2. Treatment of NPK 15:15:15 produced 23.60 t/ha. The treatment of NPK 20:10:10 produced 21.31. The lowest pod yield, were recorded with the urea and the control at 18.12 and 6.17 t/ha.

Table 3.7 Yield and yield component of fluted pumpkin as influenced by inorganic fertilizers grades

Fertilizer grade	Foliar yield (t/ha)	Number of pod	Length of pod (cm)	Circumference of pod (cm)	Pod yield (t/ha)
0	5.61	0.20	18.42	20.51	6.17
NPK 15:15:15	13.60	3.91	37.39	31.67	23.60
NPKMg 12:12:17.2	10.89	5.62	41.11	33.40	25.92
NPK 20:10:10	14.41	3.09	33.89	30.33	21.31
Urea	17.23	2.23	25.78	26.10	18.12
LDS(p<0.05)	2.33	1.49	3.70	4.51	3.18

4.0 Discussion

For the soil analysis: the high sandy particle, low organic matter and percentage nitrogen as well as exchangeable bases are major characteristics of an ultisol as reported by many authors (Ikeh *et al.*, 2013; Akpaninyang *et al.*, 2022; Udounang *et al.*, 2022; Simeon and Essien, 2023; Ikeh *et al.*, 2023a; Akpan *et al.*, 2024).

The soil pH which was slightly acidic may lead to a decrease in microbial populations. It can also impact the solubility and effectiveness of certain toxic chemicals, further affecting soil fertility (Umoh *et al.*, 2017). The organic matter content was measured at 4.26%, which is below the ideal threshold of 10% for soils in Akwa Ibom State (Udounnang *et al.*, 2023; Akata *et al.*, 2024a; Sam *et al.*, 2025). This shortfall indicates that the soil lacks essential nutrients and has a limited capacity to support crop growth.

The nitrogen (N) content measured at 1.20%, which is insufficient for supporting rapid plant growth and healthy development, underscores the importance of applying organic manure. At a depth of 0–15 cm, the available phosphorus was found to be 22.025 mg/kg, surpassing the critical threshold of 0.05 cmol/kg (Essien *et al.*, 2024; Ikeh *et al.*, 2023b).

Exchangeable potassium (K) was notably low at 0.08 cmol/kg, which may impede the uptake of calcium (Ca) and magnesium (Mg) by plants. Conversely, the exchangeable calcium level was 8.30 cmol/kg, well above the critical limit of <20 mol/kg. Likewise, the exchangeable magnesium content stood at 4.12 cmol/kg, exceeding the critical value of 0.05 cmol/kg. The exchangeable sodium level was measured at 0.19 cmol/kg, also surpassing the critical threshold of 0.1 cmol/kg. The effective cation exchange capacity (CEC) was recorded at 11.09 cmol/kg, considered suitable for crop production as it exceeds the critical value of <20 mol/kg. The base saturation reached 85.5%, likely attributed to the high concentrations of calcium, magnesium, and other essential cations, which are crucial indicators of soil fertility.

The low fertility of the experimental site is consistent with the findings of Essien *et al.* (2023) and Ikeh *et al.* (2023c), who noted that ultisols in southeastern Nigeria typically exhibit poor soil fertility. Given these conditions, the application of fertilizers is crucial for achieving high crop yields. Specifically, the use of nitrogen fertilizers has been shown to significantly enhance the growth and yield of fluted pumpkins, as nitrogen is a key factor in promoting plant development (Ekwere *et al.*, 2019; Ben *et al.*, 2024a). Nitrogen is essential for protein synthesis, cell multiplication, and elongation. It serves as a fundamental component of enzymes and chlorophyll, which are vital for cell division and photosynthesis, ultimately leading to increased plant growth and productivity (Akata *et al.*, 2024b; Ben *et al.*, 2024b).

The use of nitrogen fertilizers, especially urea, resulted in notable enhancements in vegetative growth, foliar development, and pod yield in fluted pumpkin. Plants treated with urea displayed longer vines, larger leaves, and a marked increase in overall vigor. Among the nitrogen fertilizers evaluated, urea yielded the most significant results, likely due to its capacity to promote lush vegetative growth (Ikeh *et al.*, 2017; Akpan *et al.*, 2024).

The application of NPKMg 12:12:17:2 resulted in significantly higher pod yields when compared to urea application. This outcome can likely be attributed to the sufficient supply of potassium (K), which supports nitrogen metabolism and enhances the synthesis of amino acids and proteins, ultimately leading to improved crop performance.

5.0 Conclusion

Based on the study findings, the following conclusions were drawn; nitrogen fertilizer improves the growth and yield of fluted pumpkins. Urea produced a significantly high foliar yield, followed by NPK 20:10:10, while control treatment produced the least. The treatment NPKMg 12:12:17:2 and NPK 15:15:15 produced a significantly larger pod yield, while control had the least. From the above conclusion, the following recommendations were made. Urea and NPK 20:10:10 encourage optimum foliar production. While NPK 12:12:17:2 should be applied for significantly larger pod production. It also emphasizes the importance of supporting the growth and yield of fluted pumpkin with fertilizers as all plants which received fertilizer treatments clearly out performed the control.

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