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Effects of inorganic fertilizers rates on shoot yield, pod yield and nutritional quality of *Telfairia occidentalis* in Ogbomoso

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Abstract

Fluted pumpkin (*Telfairia occidentalis* H.) is cultivated for its edible leaves and seeds, which are high in protein, fats, potassium and iron contents, contributing to a balanced diet of man. However, despite the importance of this crop in human diet, the production is limited by low soil fertility and paucity of information on fertilizer recommendation. Therefore, this study examined the effects of inorganic fertilizer rates on growth, shoot yield and nutritional quality of *Telfairia occidentalis* in Ogbomoso.

The treatments consisted of three fertilizers applied at five rates each namely: N (0, 30, 45, 60 and 75 kgN/ha), P (0, 15, 30, 45 and 60 kg P₂O₅/ha) and K (0, 15, 30, 45 and 60 kg K₂O/ha). The experiment was laid out in a Randomized Complete Block Design (RCBD), replicated thrice. Data were collected on number of leaves, shoot yield, mineral and proximate contents. Data collected were subjected to Analysis of Variance (ANOVA) and treatments means separated using Duncan Multiple Range Test at 5% probability level.

The results showed that fertilizers significantly ($P=0.05$) influenced the growth parameters, shoot yield, mineral and proximate contents of *Telfairia occidentalis*. Plant treated with 60kg N/ha gave the highest number of leaves (118.00), while control gave the least value (85.00). It was observed that 60kg P₂O₅/ha recorded the highest number of leaves (83.00) while control gave the least values (76). The application of 45 kg K₂O/ha gave the highest number of leaves (98.00), while control had the least (74.00). Plant fertilized with 45 kg N/ha, 60 kg P₂O₅ and 45 kg K₂O/ha produced the highest shoot weight (683.00, 774.90, and 629.10 g/plant, respectively), while plant with no fertilizer application gave the least values. It was also observed that plant treated with 75 kg N, 60 kg P₂O₅, and 60 kg K₂O/ha recorded the highest N (0.39, 0.42 and 0.40 mg/100g), Ca (0.41, 0.37 and 0.53 mg/100g), Mg (0.38, 0.42 and 0.48 mg/100g), CF (1.19, 1.44 and 1.35 mg/100g) and CP (3.79, 4.24 and 3.86 mg/100g) content respectively, while control gave the least values.

In conclusion, the applied fertilizers enhanced the growth, shoot yield mineral, and proximate contents of *Telfairia occidentalis*. The optimum performance of *Telfairia occidentalis* was obtained at 45kg N, 60 kg P₂O₅ and 45 kg K₂O/ha, therefore these rates are recommended for the optimum production of *Telfairia occidentalis* in Ogbomoso.

Keywords: Fluted pumpkin, growth, shoot yield, nutritional quality, and fertilizers

Introduction

Fluted pumpkin (*Telfairia occidentalis* Hook. F.) is a vital indigenous leafy vegetable widely cultivated and consumed in West Africa, particularly in Southern Nigeria. As a creeping perennial vine with large, lobed leaves and long tendrils, it plays a significant role in local diets and rural economies. Traditionally valued for its edible leaves and seeds, recent studies have reinforced its importance as a functional food due to its rich nutritional composition, including essential vitamins, minerals, proteins, and antioxidants (Egbekun *et al.*, 2022; Akinola *et al.*, 2023) [7, 4]. In addition to its culinary value, the plant exhibits potential medicinal properties such as anti-inflammatory and hypo-glycemic effects, thus highlighting its relevance in both ethno medicine and modern healthcare (Ibrahim *et al.*, 2024) [8].

Both the leaves and seeds of *T. occidentalis* are nutritionally distinct. While the leaves are abundant in micronutrients such as iron and calcium, the seeds are rich in protein and fats, making them a high-calorie supplement in local diets (Akinyosoye *et al.*, 2020) [5]. The seed oil also possesses potential for industrial applications, including its use as a source of oleo chemicals.

Furthermore, *T. occidentalis* contributes substantially to income generation among smallholder farmers, especially women, thereby supporting household livelihoods (Oluwale *et al.*, 2020) [12].

Despite its multifaceted importance, the production of *T. occidentalis* in Nigeria remains constrained by several agronomic challenges, particularly declining soil fertility. In the Southern Guinea Savanna agro-ecological zone, continuous cultivation and shortened fallow periods have led to nutrient depletion and reduced crop productivity (Oluwatoyinbo *et al.*, 2020; Adebayo *et al.*, 2018) [11, 1]. Sustainable soil fertility management practices, including the application of organic and inorganic fertilizers, are increasingly being promoted to restore soil health and enhance crop performance (Usman *et al.*, 2021) [13]. Integrated nutrient management approaches, combining mineral fertilizers with organic amendments such as poultry manure, are also gaining prominence in addressing these challenges.

Among essential plant nutrients, nitrogen (N), phosphorus (P), and potassium (K) are most frequently deficient and are critical for vegetative growth, flowering, and fruit development. Nitrogen plays a pivotal role in photosynthesis and protein synthesis and has been shown to enhance leaf yield in *T. occidentalis* when applied at optimal rates (Lawlor, 2013; Ojeniyi, 2013) [9, 10]. While 60 kg N ha⁻¹ is traditionally recommended, higher rates such as 100 kg N ha⁻¹ may be beneficial under intensive vegetable production systems (Adediran *et al.*, 2017) [12]. Phosphorus contributes to root development and metabolic activity, with single superphosphate (SSP) applications at 40-60 kg P₂O₅ ha⁻¹ significantly improving vegetative growth and nutrient use efficiency in cucurbitaceous crops (Adekiya *et al.*, 2019) [3]. Potassium enhances water regulation, photosynthesis, and stress tolerance, with application rates of 60-90 kg K₂O ha⁻¹ recommended for optimal performance (Duan *et al.*, 2022; Zhang *et al.*, 2020) [6, 14].

Although chemical fertilizers have demonstrated consistent benefits in improving crop yields, their high costs and inconsistent accessibility limit their use among resource-poor farmers. Conversely, organic inputs such as poultry manure are more accessible but may be limited in supply and nutrient uniformity. Thus, identifying the most effective fertilizer type and rate remains essential for optimizing yield and nutritional quality of *T. occidentalis*.

Despite its dietary and economic significance, the productivity of *T. occidentalis* under farmer-managed conditions remains lower than experimental yields, partly due to inadequate fertilization knowledge. This study, therefore, intended to determine the suitable fertilizer type and rate that will give the optimum vegetative growth, shoot yield and nutritional quality of *T. occidentalis* for the study area.

Materials and Methods

The experiment was conducted at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso. Ogbomoso lies on latitude 8°10' N and longitude 4°10' E with mean annual rainfall of between 1,150mm and 1,250mm.

The conventional tillage operations were carried out. The land was cleared and beds were constructed. The experimental land was divided into three replicates, each consisting of fifteen beds to make a total of forty-five beds.

Each bed size was 1.44m² (1.2 x 1.2 m) and with 1m between beds and replicates to ease movement during cultural practices. Each bed contained nine plants. The treatment involved three fertilizer types and five rates namely; urea (0, 30, 45, 60 and 75 kg N/ha), Muriate of potash (0, 15, 30, 45 and 60 kg K₂O/ha), single superphosphate (0, 15, 30, 45 and 60 kg P₂O₅/ha). These treatments were applied to the respective plots within each replicate. The experiment was arranged in a Randomized Complete Block Design and replicated three times.

Seeds were extracted from the pods and air dried for 24 hours before sowing directly to remove the gelatinous materials around the seeds to aid germination. One seed was sown per stand at a depth of 5cm at a spacing 0.5 x 0.5 m. Application of fertilizer was done one week after sowing by drilling method. Watering was carried out at two days interval till rain set in, and this was done every morning. Manual weeding was carried out at two-week interval starting from four weeks after sowing.

Data were collected on three tagged plants starting from four weeks after sowing at four-week interval for twelve weeks. The growth, yield and yield components data collected were; number of leaves/plants, harvested fresh shoot yield, pod diameter, pod weight. Number of leaves/plant was determined by visual observation and directing counting of fully opened leaves. Harvested fresh shoot yield was determined by weighing harvested shoot with sensitive weighing scale. Pod diameter was determined with the use of vernier caliper. Pod weight was determined with the use of weighing scale.

For determination of elemental mineral contents and proximate composition, harvested fluted pumpkin shoot were oven dried to constant weight at 65°C for 48 hours. The dried samples were milled and analyzed for Nitrogen (N), using Kjeldahl digestion method, Phosphorus (P) using technicon AAI, Calcium (Ca) using flame photometer and magnesium (Mg) by the use of Atomic absorption spectrometer. Iron (Fe), ash content, and crude fiber were also determined by AOAC Method (AOAC, 2012). Data collected were subjected to analysis of variance (ANOVA) using Genstat 12th edition and treatment means were separated using Duncan Multiple Range Test (DMRT) at 5% probability level.

Results and Discussion

Effect of inorganic fertilizer rates on number of leaves/plant of *Telfairia occidentalis*: Nitrogen Fertilizer:

Effect of nitrogen fertilizer rates on number of leaves/plant of *Telfairia occidentalis* is presented in Table 1. It was observed that the effects of fertilizer rates was significant at 12 WAS. At 12 WAS, it was observed that nitrogen fertilizer application at 60 kg N/ha produced the highest number of leaves (117.57) while least value (85.43) was observed at control plants.

- **Phosphorus Fertilizer:** Effect of phosphorus fertilizer rates on number of leaves/plant of *Telfairia occidentalis* is presented in Table 1. It was observed that the effect of phosphorus fertilizer rates was significant at 12 WAS, but not significant at 4 and 8 WAS. At 12 WAS, it was observed that 45 kg P₂O₅/ha produced the highest leaf number (98.00) while control plant produced the least value (53.57)

- **Potassium Fertilizer:** Effect of potassium fertilizer rates on number of leaves/plants of *Telfairia occidentalis* is presented in Table 1. It was observed that the potassium fertilizer rates was significant at 12 WAS but not significant at 4 and 8 WAS. At 12 WAS, plant treated with 60 kg K₂O/ha gave the highest leaf number (82.67) while control plants gave the least (76.20).

Effect of inorganic fertilizer rates on yield and yield components of *Telfairia occidentalis*

- **Nitrogen Fertilizer:** Effect of nitrogen fertilizer rates on yield and yield components of *Telfairia occidentalis* is presented in Table 2. It was observed that nitrogen fertilizer application at 60 kg N/ha produced the highest harvested shoot weight (683.00 g/plant), pod diameter (58.67 cm/pod) and pod weight (2.30 kg/pod) while control plant recorded the least values 370.50 g/plant, 44.85 cm/pod and 1.21 kg/pod respectively).
- **Phosphorus Fertilizer:** Effect of phosphorus fertilizer rates on yield and yield components of *Telfairia occidentalis* is presented in Table 2. Result showed that phosphorus fertilizer had no significant effect on the harvested shoot yield but a significant effect was observed on the pod diameter and pod weight. It was observed that 60 kg P₂O₅/ha produced the highest harvested shoot weight (774.90 /plant), pod diameter (62.67 cm/pod) and 30 kg P₂O₅/ha recorded the highest pod weight (4.00 kg/pod) while control plant produced the least value (186.20 g/plant, 37.45 cm/pod and 2.13 kg/pod respectively)
- **Potassium Fertilizer:** Effect of potassium fertilizer rates on yield and yield components of *Telfairia occidentalis* is presented in table 2. Result showed that potassium fertilizer had no significant effect on the harvested shoot yield but a significant effect was observed on the pod diameter and pod weight. Plant treated with 45 kg K₂O/ha gave the highest harvested shoot weight (629.10 g/plant), pod diameter (64.60 cm/pod) and pod weight (2.97 kg/pod) while control plant produced the least value (432.70 g/plant, 49.30 cm/pod and 1.30 kg/pod respectively).

Effect of inorganic fertilizer rates on nutritional quality of *Telfairia occidentalis*

- **Nitrogen Fertilizer:** Effect of nitrogen fertilizer rates on nutritional quality of *Telfairia occidentalis* is presented in Table 3. Result showed that nitrogen fertilizer had no significant effect on N, P, K, Mg, CF contents but a significant effect was observed on Ca and CP contents. It was observed that 75 kg N/ha produced the highest N(0.39%), P(11.11%), K(0.54%), Ca (0.41%), Mg(0.38%), CF(1.19%), and CP(3.79%) while control plant produced the least values (0.34%, 6.15%, 0.31%, 0.27%, 0.27%, 1.04%, and 2.77% respectively)
- **Phosphorus Fertilizer:** Effect of phosphorus fertilizer rates on nutritional quality of *Telfairia occidentalis* is presented in Table 3. Result showed that phosphorus fertilizer had no significant effect on N, P, K, Mg, CF contents but a significant effect was observed on Ca and

CP contents. Result showed that plant treated with 60 kg P₂O₅/ha gave the highest N(0.42%), P(14.52%), K(0.59%), Ca (0.37%), Mg(0.42%), CF(1.44%), and CP(4.24%) while control plant produced the least values (0.34%, 7.29%, 0.38%, 0.22%, 0.19%, 0.91%, and 2.74% respectively)

- **Potassium Fertilizer:** Effect of potassium fertilizer rates on nutritional quality of *Telfairia occidentalis* is presented in Table 3. Result showed that nitrogen fertilizer had no significant effect on N, P, K, Mg, CF contents but a significant effect was observed on Ca and CP contents. It was observed that 60 kg P₂O₅/ha produced the highest N(0.40%), P(15.81%), K(0.60%), Ca(0.53%), Mg(0.48%), CF(1.35%), and CP(3.86%) while control plant produced the least values (0.34%, 8.94%, 0.36%, 0.23%, 0.19%, 0.90%, and 2.73% respectively).

Discussion

Inorganic fertilizer application significantly influenced the growth, yield, and nutritional quality of *Telfairia occidentalis*. Nitrogen fertilization at 60 kg N/ha resulted in the highest shoot yield (683 g/plant), pod diameter (58.67 cm), and pod weight (2.30 kg), consistent with the findings of Akanbi *et al.* (2010), who reported enhanced vegetative growth and biomass accumulation with moderate N application. Phosphorus at 60 kg P₂O₅/ha produced the highest shoot weight (774.90 g/plant) and pod diameter (62.67 cm), while 30 kg P₂O₅/ha yielded the heaviest pods (4.00 kg), supporting the report by Adeniyi and Ojienyi (2005) that P enhances root development and yield. Potassium at 45 kg K₂O/ha resulted in maximum pod diameter (64.60 cm) and weight (2.97 kg), aligning with Ayeni *et al.* (2012), who reported K's role in enhancing translocation and carbohydrate accumulation.

Nutritionally, all fertilizer types improved crude protein (CP) and calcium (Ca) content significantly, with highest CP (4.24%) observed under 60 kg P₂O₅/ha, supporting reports by Akinfasoye *et al.* (2020) on nutrient enrichment in leafy vegetables following fertilizer application. Leaf number increased with fertilization, peaking at 60 kg N/ha at 12 WAT, reflecting findings by Ojetayo *et al.* (2011) on nitrogen's role in enhancing leaf expansion and chlorophyll content.

Conclusion and Recommendation

Results from this study showed that all the fertilizers rates tested enhanced the growth, shoot yield and nutritional quality of fluted pumpkin. From the result obtained in this study, it has shown that growth, shoot yield and nutritional quality of fluted pumpkin was influenced by the applied fertilizers rates. Nitrogen at 60 kg/ha, phosphorus at 60 kg P₂O₅/ha, and potassium at 60 kg K₂O/ha optimized leaf production, pod diameter, pod weight and enhanced nutrient content, especially crude protein and calcium. Therefore, for optimal growth, yield, and nutritional quality of *Telfairia occidentalis*, 60 kg/ha of N and P₂O₅, and 45-60 kg/ha of K₂O could be recommended for production of fluted pumpkin in the study area.

Table 1: Effects of inorganic fertilizer rates on number of leaves/plant of *Telfaria occidentalis* at different sampling period

FERT type	Rate	Weeks after transplanting		
		4	8	12
Urea (N)	0	19.10a	36.87a	85.43ab
	30	25.77a	47.67a	88.47ab
	45	24.87a	45.87a	90.87ab
	60	28.23a	58.77a	117.57a
	75	20.67a	35.00a	86.77ab
SSP (P ₂ O ₅)	0	23.00a	42.23a	76.43ab
	15	23.23a	39.63a	76.20ab
	30	28.43a	40.77a	78.97ab
	45	25.33a	47.00a	79.43ab
	60	26.10a	48.20a	82.67ab
MOP (K ₂ O)	0	25.00a	44.70a	73.67ab
	15	22.27a	36.43a	90.00ab
	30	27.33a	44.43a	53.57b
	45	18.83a	49.53a	98.00ab
	60	23.17a	46.30a	86.83ab
	LSD ($p \leq 0.05$)	Ns	Ns	ns

Table 2: Effects of inorganic fertilizers rates on yield and yield parameters of *Telfaria occidentalis*

FERT type	Rate	Harvest shoot weight	POD Diameter	POD Weight
		g/plant	cm/pod	kg/pod
Urea (N)	0	370.50a	44.85cde	1.21d
	30	475.70a	47.80bcde	1.48cd
	45	565.40a	54.84abcd	1.68bcd
	60	683.00a	58.67abc	2.30bcd
	75	497.20a	40.32de	1.52cd
SSP (P ₂ O ₅)	0	400.20a	37.45e	2.13bcd
	15	186.20a	46.78bcde	2.70abc
	30	499.40a	52.20abcde	4.00a
	45	489.30a	56.03abcd	1.48cd
	60	774.90a	62.67ab	2.47bcd
MOP (K ₂ O)	0	432.70a	49.30abcde	1.30d
	15	461.60a	50.27abcde	1.50cd
	30	479.50a	53.10abcde	2.48bcd
	45	629.10a	64.60a	2.97ab
	60	445.00a	57.50abc	2.18bcd
	LSD ($p \leq 0.05$)	Ns	16.89	1.37

Table 3: Effects of inorganic fertilizers rates on nutritional quality of *Telfaria occidentalis*

FERT type	Rate	N	P	K	Ca	Mg	CF	CP
				%				%
Urea (N)	0	0.34a	6.13a	0.31a	0.24ab	0.21a	0.93a	2.77ab
	30	0.36a	9.53a	0.43a	0.27ab	0.27a	1.04a	2.45b
	45	0.37a	9.73a	0.48a	0.33ab	0.31a	1.12a	3.34ab
	60	0.38a	10.41a	0.49a	0.40ab	0.33a	1.17a	3.56ab
	75	0.39a	11.11a	0.54a	0.41ab	0.38a	1.19a	3.79ab
SSP (P ₂ O ₅)	0	0.34a	7.79a	0.38a	0.22ab	0.19a	0.91a	2.74ab
	15	0.36a	9.69a	0.47a	0.32ab	0.30a	1.10a	3.26ab
	30	0.38a	10.40a	0.50a	0.35b	0.33a	1.15a	3.42ab
	45	0.40a	12.88a	0.55a	0.36ab	0.40a	1.31a	3.84ab
	60	0.42a	14.52a	0.59a	0.37ab	0.42a	1.44a	4.24a
MOP (K ₂ O)	0	0.34a	8.94a	0.36a	0.23ab	0.19a	0.90a	2.73ab
	15	0.37a	9.82a	0.49a	0.35ab	0.36a	1.13a	2.37b
	30	0.38a	10.74a	0.53a	0.41ab	0.35a	1.21a	3.45ab
	45	0.38a	11.42a	0.54a	0.43ab	0.42a	1.25a	3.56ab
	60	0.40a	15.81a	0.60a	0.53a	0.48a	1.35a	3.86ab
	LSD ($p \leq 0.05$)	0.03	4.54	0.16	0.14	0.09	0.10a	1.17

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