

APPLICATION RATES OF POULTRY MANURE AND SEED SIZE EFFECTS ON THE GROWTH AND YIELD OF FLUTED PUMPKIN (*Telfairia occidentalis* HOOK F.) IN UYO, AKWA IBOM STATE

EFFA, E. B.¹, UKO, A. E.¹, AND OFEM, U. E.²

¹Department of Crop Science, University of Calabar, Nigeria

²Department of Extension and Rural Sociology, University of Calabar, Nigeria

Corresponding author: emmaeffa@unical.edu.ng

Abstract

The study evaluated the effects of poultry manure (PM) application rates and seed size on the growth and yield of *T. occidentalis* under humid tropical conditions, at the University of Uyo Teaching and Research Farm during the 2020 early cropping season, using a 3 × 4 factorial experiment in Randomized Complete Block Design (RCBD). Treatments comprised three seed sizes from small (<14 g), medium (14–20 g), to large (>20 g); and four rates of PM (0, 5, 10, and 15 t ha⁻¹), replicated thrice. PM significantly ($P \leq 0.05$) increased vine length, number of leaves, tendrils, and foliar yield, with PM at 15 t ha⁻¹ producing the highest values. Similarly, pod number, girth, and total foliar yield increased with increasing PM rates, attaining a maximum of 13.15 t ha⁻¹ at 15 t ha⁻¹ PM. Seed size significantly influenced early vegetative growth, as large seeds produced more vigorous seedlings and higher leaf biomass only. The interaction was not significant. The application of 15 t ha⁻¹ poultry manure is recommended to enhance soil fertility, growth, and yield of fluted pumpkin under sandy loam conditions. Adoption of this practice offers a sustainable, low-cost pathway to boost productivity among smallholder farmers.

Keywords: seed technology, yield, fluted pumpkin, leafy greens

Introduction

Fluted pumpkin (*Telfairia occidentalis* Hook F.), known in local Nigerian parlance as *Ugwu*, *Ikong Ubong*, or *Apiroko*, is important in West African cuisine and agriculture. This perennial, dioecious vine, of the Cucurbitaceae family, is prized not only for its highly nutritious leafy greens but also for its protein- and oil-rich edible seeds. While traditionally cultivated across the humid lowland tropics of Nigeria, Ghana, and Sierra Leone, its potential for addressing food and nutritional security is gaining renewed scientific and commercial interest (Adewumi and Adebayo, 2023). The exact origin of fluted pumpkin is debated, but a strong consensus identifies it as indigenous to West Africa. Nwonuala and Akani (2022) report that it is widely believed that wild populations have been largely replaced by cultivated forms, making it a true domesticate of the region. Fluted pumpkin is a vigorous climber, able to reach lengths of over 20 meters in branched tendrils. It is dioecious, meaning individual plants are either male or female. Female plants are typically more robust, with larger leaves and longer vegetative periods, making them more desirable for leaf harvest (Obiagwu and Madukwe, 2021). The large, fluted pods are a distinctive feature, measuring up to 70 cm long and containing 40-110 flat, oily seeds.

Fluted pumpkin is adaptable but thrives in deep, well-drained, loamy soils rich in organic matter, with a slightly acidic to neutral pH (5.5-6.5). It requires a warm, humid climate with annual rainfall between 1,000 mm and 2,500 mm. Although moderately drought-tolerant, consistent soil moisture is crucial for high leaf yield, and irrigation can enable year-round production (Akinrotimi *et al.*, 2021). Cultivation is primarily from seeds, sown on mounds, ridges, or beds. Close spacing is used for intensive leaf production, while wider spacing with staking is preferred for fruit and seed development. Smallholder farmers

often intercrop it with staples like yam and cassava, where it serves a dual purpose as a food source and a soil cover for weed suppression (Okon *et al.*, 2022).

The economic and nutritional importance of fluted pumpkin cannot be overstated. The leaves are a rich source of protein, vitamins (A, C, and E), minerals (iron, calcium, magnesium), and antioxidants. Recent analyses confirm that the leaves contain significant amounts of iron and folate, making them a potent dietary tool in combating anaemia, a prevalent public health issue (Airaodion *et al.*, 2020). The seeds are exceptionally nutritious, containing up to 30% protein and 50-60% high-quality oil, rich in essential fatty acids. This oil has potential applications in the food and cosmetic industries (Olaniran *et al.*, 2023).

Beyond its nutritional value, fluted pumpkin holds profound medicinal importance in ethnobotanical practices. Extracts from the leaves and seeds have demonstrated anti-anemic, anti-inflammatory, anti-diabetic, and hepatoprotective properties in scientific studies, validating its traditional uses (Ejike *et al.*, 2021). The plant also contributes to rural livelihoods; it is a significant income source, particularly for women who often dominate its marketing. Its cultivation in home gardens enhances household dietary diversity and provides a safety net against food insecurity (Nwachukwu and Otekunrin, 2024). Despite its importance, the commercial production of fluted pumpkin remains suboptimal. The sector is dominated by resource-poor smallholder farmers who face numerous challenges. Among these challenges are inherently low soil fertility, particularly in the heavily weathered soils of the Niger Delta, and the high cost and limited access to inorganic fertilizers (Chukwuka and Uka, 2022). Another significant challenge in its cultivation is the recalcitrant (desiccation-sensitive) nature of its seeds, which lose viability rapidly if not planted soon after extraction from the pod, posing a constraint on seed storage and distribution (Eze *et al.*, 2020). Furthermore, a lack of improved, high-yielding cultivars constrain productivity.

These challenges create a significant gap between domestic supply and the soaring demand driven by rapid urbanization and population growth. Consequently, prices often become prohibitive, especially during the off-season, forcing consumers to seek less nutritious alternatives (Adewumi and Adebayo, 2023). This scenario underscores the urgent need for research into sustainable agronomic practices that can boost yield and make cultivation more profitable and resilient.

A promising strategy to overcome production constraints lies in the integrated use of organic soil amendments and improved planting material. The frequent and often inefficient use of mineral fertilizers is not only expensive but also associated with environmental pollution, such as soil acidification and water eutrophication. In contrast, organic manures like poultry manure offer a sustainable alternative. Poultry manure is rich in nitrogen, phosphorus, potassium, and micronutrients. Its application improves soil structure, enhances water-holding capacity, and promotes beneficial microbial activity, leading to sustained nutrient release (Ojo *et al.*, 2023). Studies on other indigenous vegetables have consistently shown that poultry manure application significantly improves vegetative growth, leaf yield, and overall plant health. Simultaneously, the selection of high-quality planting material is a critical factor often overlooked by traditional farmers. Seed size is a key physiological attribute that can influence germination vigour, seedling establishment, and subsequent crop performance. Larger seeds typically contain greater food reserves, which can support the young seedling until it becomes photosynthetically independent. While some studies on crops like cowpea and maize have confirmed a positive correlation between seed size and seedling vigour, research specific to fluted pumpkin has yielded conflicting results, indicating a knowledge gap that needs to be addressed (Nwonuala and Akani, 2022).

There is a clear, synergistic opportunity to investigate the combined effects of poultry manure application and seed size selection on the productivity of fluted pumpkin. Understanding this interaction can provide a low-cost, accessible, and sustainable protocol

for smallholder farmers to enhance their yields. By optimizing these two factors, farmers can potentially reduce their reliance on chemical inputs, improve germination rates, and achieve more robust plant growth for both leaf and seed production.

Therefore, this study is designed to generate knowledge to bridge the existing production gap. The study therefore determined the effect of different application rates of poultry manure and size of seeds on the growth and yield of fluted pumpkin.

Materials and Methods

Description of the Study Area and Experimental Procedures

The experiment was conducted during the 2020 early cropping season at the University of Uyo Teaching and Research Farm, Use-Offot, Uyo, Akwa Ibom State, Nigeria. Uyo lies within the humid tropical rainforest zone of southern Nigeria, between latitudes 5.18°–5.28°N and longitudes 7.26°–7.57°E, at an elevation of approximately 38 m above sea level. The region experiences wet and dry seasons, with mean annual rainfall ranging between 268.8 and 270.1 mm, mean monthly relative humidity of about 80%, and mean monthly temperature of 26.8–27.0°C. The site, previously fallowed for one year to restore fertility, had been used for growing cassava, maize, fluted pumpkin, yam, and garden egg. Experimental design and field layout followed a 3 × 4 factorial arrangement in Randomized Complete Block Design (RCBD), of three seed size categories; viz small (<14 g), medium (14–20 g), and large (>20 g) and four poultry manure (PM) levels: 0, 5, 10, and 15 t/ha. This yielded 12 treatment combinations replicated three times, giving 36 plots in total. Each plot measured 3.0 m × 2.5 m, separated by 1 m paths, with a total experimental area of 850 m². Poultry manure was incorporated two weeks before planting. Soil analysis was carried out using composite soil samples collected at 0–15 cm and 15–30 cm depths for physico-chemical analysis. The poultry manure used for the experiment was also analyzed. Parameters determined included pH (1:2.5 soil-water suspension), total nitrogen (Micro-Kjeldahl), available phosphorus (Bray P-1), exchangeable cations (Ca, Mg, K, Na), and particle size distribution (hydrometer method). The soil was classified as sandy loam. Poultry manure samples were oven-dried at 60–80°C, sieved through 2 mm mesh, and analyzed for N, P, K, Ca, Mg, Zn, Fe, Cu, and Mn (Jackson, 1964; Bray and Kurtz, 1945; Kampratt, 1970). Seeds were sourced from Afaha market, (Ibesikpo Asutan LGA, Akwa Ibom State, Nigeria), air-cured for two days, and planted on July 18, 2020, at 4–5 cm depth with 80 × 60 cm spacing, two seeds per hole. Major weeds included; *Ipomea involucrata*, *Axonopus compressus*, and *Chromolaena odorata*, and these were manually controlled at 5 and 11 weeks after planting (WAP). Chlorpyrifos (1 mL per 4 L water) was used for the control of pest infestations by termites, grasshoppers, and caterpillars. Data was collected from four central plants per plot tagged for weekly observations at 3, 6, 9, and 12 WAP. Growth parameters measured included vine length, number of leaves and tendrils and foliar yield. Yield components recorded were number of pods per plot, length of pods, pod girth and pod yield. Data were analyzed for Analysis of Variance (ANOVA), and post-hoc test using Fisher's Least Significant Difference (FLSD) at 5% probability level (Gomez and Gomez, 1984).

Results and Discussion

The baseline physico-chemical characteristics of the experimental soil are presented in Table 1. The soil was classified as sandy loam, with a high sand fraction (75.60 %) and lower silt (10.40 %) and clay (14.00 %) contents. This textural class typically promotes good drainage and aeration (Brady and Weil, 2008), which is beneficial for root development and prevents waterlogging. However, such soils are also known for their moderate to low inherent nutrient-holding capacity, making them susceptible to nutrient leaching. The soil was strongly acidic (pH 5.20 in H₂O), a condition that can influence the availability of essential

micronutrients. The exchangeable bases were dominated by calcium (4.80 cmol/kg) and magnesium (1.40 cmol/kg), while potassium (0.17 cmol/kg) was relatively low. The combination of a sandy loam texture and a potentially low potassium level underscores the likelihood that the soil would be responsive to organic amendments, such as poultry manure, which can improve cation exchange capacity and supplement essential nutrients. Poultry manure exhibited moderately high levels of organic carbon (4.05%), total nitrogen (2.86%), and available phosphorus (45.33 mg/kg).

The application of poultry manure (PM) significantly ($P \leq 0.05$) enhanced all measured growth attributes of fluted pumpkin at six weeks after planting (Table 2). Vine length, number of leaves, number of tendrils, and foliar yield exhibited a consistent, positive response to increasing PM rates. The application of 15 t/ha PM resulted in the most pronounced growth, producing the longest vines (91.06 cm), the highest number of leaves (36.45), and the greatest foliar yield (10.12 kg). This represents a substantial improvement over the control, clearly demonstrating the role of PM in mitigating the limitations of the sandy loam soil. The growth promotion observed can be attributed to the synergistic effects of PM. Poultry manure is a rich source of organic matter and nutrients, particularly nitrogen, which is crucial for vigorous vegetative growth and chlorophyll synthesis (Adekiya *et al.*, 2020). Its application improves soil structure, enhances microbial activity, and facilitates a slow, sustained release of nutrients, thereby matching the crop's demand and reducing losses through leaching—a critical factor in sandy soils.

Concerning seed size, large seeds produced significantly taller vines (81.48 cm), more leaves (37.61), and higher foliar yield (12.13 kg) compared to medium and small seeds. This is consistent with the principle that larger seeds possess greater food reserves, providing more energy and resources for seedling emergence and early establishment (Milberg *et al.*, 2000). A key finding from this study is the non-significant (NS) interaction between poultry manure and seed size (PM \times S) for all growth parameters. This indicates that the effects of PM application and seed size were independent and additive. In other words, the positive effect of using large seeds was consistent across all manure rates, and conversely, the benefit of applying PM was evident regardless of the seed size used. This suggests that the advantage conferred by larger seed reserves is not diminished by nutrient availability from manure, and both factors can be managed separately to optimize growth.

The positive effects of PM application extended to the yield components of *T. occidentalis* (Table 3). Pod number, pod length, pod girth, and total pod yield all increased significantly with higher rates of PM application. The highest pod yield (13.15 t/ha), along with the longest (69.09 cm) and widest pods (59.08 cm), was recorded at the 15 t/ha PM rate, while the control plots yielded the lowest (5.88 t/ha). This robust response underscores the importance of adequate nutrition, particularly during the reproductive and pod-filling stages. The nutrient-rich environment provided by the high PM rate likely supported better flower formation, fruit set, and photosynthate allocation to the developing pods.

In contrast to the clear effects on vegetative growth, seed size had only a slight and non-significant influence on yield components. Although plots with large seeds recorded a marginally higher pod yield (13.60 t/ha), the differences were not statistically significant. This indicates that while seed size is a critical factor for initial vegetative vigor, its influence on ultimate yield may be superseded by post-emergence agronomic practices, particularly nutrient management, as the plant develops.

Once again, the interaction between PM and seed size (PM \times S) was not significant for any yield parameter. This reinforces the conclusion that the rate of poultry manure application is a far more dominant factor determining the yield of fluted pumpkin than the size of the seed planted. The absence of interaction simplifies agronomic recommendations, as the

benefits of optimal manure application can be realized irrespective of the seed size category used by farmers.

Summary and Conclusion

In summary, the results of this study demonstrate that the application of poultry manure is a highly effective strategy for enhancing both the growth and yield of fluted pumpkin cultivated on a sandy loam soil. The significant improvements in vegetative growth and pod yield with increasing PM rates up to 15 t/ha highlight the role of organic amendment in improving soil fertility and plant nutrition. While large seeds provided an advantage for early seedling growth, this effect was independent of manure application and did not translate into a significant yield advantage. The consistent lack of significant interaction between the two factors indicates that their effects are additive. Therefore, under the described soil and climatic conditions, the application of 15 t/ha poultry manure is recommended as the optimal practice for maximizing the productivity of fluted pumpkin.

Table 1: Soil physico- chemical properties of the experimental site before planting and poultry manure

Properties	Soil depth	Poultry manure	values
	0-15		
pH	5.20	pH (H ₂ O)	8.00
EC	5.80	pH (CaCl ₂)	6.21
Organic Matter (DS/M)	0.065	Available P	0.94
		(ppm)	
Total N (%)	2.99	Nitrogen (%)	2.86
Available P (mgkg ⁻¹)	45.33	Calcium (%)	5.72
Exchangeable Bases		Magnesium (%)	1.88
Exchangeable	Ca 4.80	Potassium (%)	0.50
(cmol/kg)			
Exchangeable	Mg 1.4	Sodium (%)	0.067
(cmol/kg)			
Exchangeable	Na 0.10	Organic carbon	4.05
(cmol/kg)		(%)	
Exchangeable	K 0.17	C/N Ratio	4.02
(cmol/kg)			
Exchange Acidity	2.80		
ECEC (cmol/kg)	9.27		
Base Saturation (%)	69.79		
Particle Size Analysis			
Sand (%)	75.60		
Silt (%)	10.40		
Clay (%)	14.00		
Textural Class	Sandy		
	Loamy		

Table 2: Effects of poultry manure (PM) and seed size on growth attributes of fluted pumpkin at 6 weeks after planting

Treatment	Vine length (cm)	Number of leaves	Number of tendrils	Foliar yield (kg)
Seed size				
Small	65.56	32.96	3.51	8.75
Medium	79.83	36.23	3.80	10.76
Large	81.48	37.61	3.95	12.13
LSD	2.38	1.67	NS	1.33
(P≤0.05)				
Poultry Manure				
0	46.42	20.19	2.18	3.01
5	60.14	32.27	3.08	5.78
10	74.80	35.81	3.28	9.16
15	91.06	36.45	3.63	10.12
LSD	17.33	4.21	1.11	3.02
(P≤0.05)				
PM x S	NS	NS	NS	NS

NS: Not significant

Table 3: Effects of poultry manure (PM) and seed size on number of pods per plant, length of pod (cm), girth of pod (cm) yield (t/ha) of fluted pumpkin

Treatment	Number of pods/plot	Length of pods (cm)	Girth of pod (cm)	Pod yield (t ha ⁻¹)
Seed size				
Small	5.25	64.71	56.86	12.75
Medium	5.40	68.84	58.12	13.33
Large	5.50	70.70	58.45	13.60
LSD	NS	NS	NS	NS
(P≤0.05)				
Poultry Manure				
0	4.11	45.51	43.31	5.88
5	5.12	60.33	51.40	8.35
10	5.18	65.19	55.40	12.30
15	5.89	69.09	59.08	13.15
LSD	NS	6.62	4.21	2.72
(P≤0.05)				
PM x S	NS	NS	NS	NS

References

- Adekiya, A.O., Ogunboye, O.I., Ewulo, B.S. & Olayanju, A. (2020). Effects of Different Rates of Poultry Manure and Split Applications of Urea Fertilizer on Soil Chemical Properties, Growth, and Yield of Maize. *The Scientific World Journal*, 2020, Article ID: 4610515. <https://doi.org/10.1155/2020/4610515>.
- Adewumi, I. K., & Adebayo, A. G. (2023). Urbanization and the demand for indigenous vegetables: A case study of *Telfairia occidentalis* in Southwestern Nigeria. *Journal of Agricultural and Food Economics*, 11(1), 45-58.
- Airaodion, A. I., Ogbuagu, E. O., Ekenjoku, J. A., & Airaodion, E. O. (2020). Proximate and phytochemical composition of fluted pumpkin (*Telfairia occidentalis*) leaves and its potential in combating anaemia. *International Journal of Research and Scientific Innovation*, 7(10), 1-6.
- Akinrotimi, C. A., Ugbong, E. A., & Osuagwu, A. N. (2021). Response of fluted pumpkin (*Telfairia occidentalis* Hook F.) to deficit irrigation strategies in a humid tropical environment. *Agricultural Water Management*, 245, 106659.
- Bray, R.H. and Kurtz, L.T. (1945). *Determination of Total Organic and Available Forms of Phosphorus in Soils*. *Soil Science*, 59, 39-45. <http://dx.doi.org/10.1097/00010694-194501000-00006>.
- Chukwuka, K. S., & Uka, U. N. (2022). Soil fertility status and management strategies for sustainable vegetable production in the Niger Delta region of Nigeria. *Nigerian Journal of Soil Science*, 32(2), 112-125.
- Ejike, C. E., Nwachukwu, N. C., & Ezeanyika, L. U. (2021). Hepatoprotective and antioxidant activities of *Telfairia occidentalis* leaf extract in acetaminophen-induced liver damage in rats. *Journal of Ethnopharmacology*, 275, 114-122.
- Eze, S. C., Nwaogu, L. N., & Uchendu, C. M. (2020). Seed storage behaviour and germination studies in fluted pumpkin (*Telfairia occidentalis* Hook F.). *Journal of Applied Horticulture*, 22(2), 156-162.
- Gomez, K. A. & Gomez, A. A. (1984). *Statistical Procedure for Agricultural Research*. 2nd Edition, International Rice Research Institution, Wiley International Science Publication, 28-192.
- Jackson, M.L. (1964). *Soil Chemical Analysis*. Prentice Hall Verlag, Hoboken.
- Kamprath, E. J. (1970). "Determination of lime requirement for acid mineral soils of the Tropics". *Communications in Soil Science and Plant Analysis*, 1(2): 95-102.
- Milberg, P., P. E. Eriksson, and K. Skoglund. 2000. Large-seeded species are less dependent on light for germination than small-seeded. *Seed Science Research*, 10: 101-106.
- Nwachukwu, C. P., & Otekunrin, O. A. (2024). The role of women in the marketing of indigenous vegetables and its impact on household food security in Southeast Nigeria. *Gender, Technology and Development*, 28(1), 78-95.
- Nwonuala, A. I., & Akani, N. P. (2022). Evaluation of seed size variations on germination and early seedling growth of fluted pumpkin (*Telfairia occidentalis* Hook F.) in Rivers State, Nigeria. *Asian Journal of Agricultural and Horticultural Research*, 9(4), 1-9.
- Obiagwu, C. J., & Madukwe, D. K. (2021). Morphological characterization of male and female plants of fluted pumpkin (*Telfairia occidentalis* Hook F.) for crop improvement. *Journal of Plant Development*, 28, 45-55.
- Ojo, M. A., Olatunji, O. A., & Adekiya, A. O. (2023). Poultry manure improves soil properties and growth of okra compared to inorganic fertilizer in a derived savanna soil. *Scientific Reports*, 13(1), 2156.



- Okon, P. B., Asuquo, P. E., & Bassey, E. E. (2022). Productivity and economic returns of fluted pumpkin (*Telfairia occidentalis*) intercropped with cassava in smallholder farming systems. *Tropical Agriculture*, 99(2), 145-156.
- Olaniran, A. F., Abiodun, O. A., & Adeleke, R. O. (2023). Physicochemical properties and fatty acid profile of oil extracted from fluted pumpkin (*Telfairia occidentalis*) seeds: Potential for industrial applications. *Journal of Food Processing and Preservation*, 47(4), e14589.