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Assessment of the Growth Performance and Productivity of *Vigna Unguiculata* Plants Using Chemical Fertilizer and Local Manure

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Abstract
Cowpea (Vigna unguiculata L. Walp.) is an important grain legume widely cultivated in Nigeria for food security, nutritional benefits and income generation. This study assessed the growth performance and productivity of Vigna unguiculata plants using chemical fertilizer and local manure. A Randomized Complete Block Design (RCBD) consisting of three treatments replicated three times was used. The treatments were unfertilized control (T_1), NPK 15:15:15 chemical fertilizer (T_2), and well-decomposed local manure (T_3). Growth and yield parameters were assessed at specified intervals. The results showed that both chemical fertilizer and local manure significantly improved the growth and productivity of cowpea compared with the untreated control. After eight weeks, plants treated with chemical fertilizer recorded the highest mean plant height (46.7 ± 1.2 cm), number of leaves (24.8 ± 0.6), number of branches (5.9 ± 0.1) and leaf area (32.4 ± 0.8 cm²), followed by local manure with 43.1 ± 1.0 cm, 22.6 ± 0.8 leaves, 5.4 ± 0.2 branches and 30.1 ± 1.2 cm², respectively. The control recorded the lowest values. Chemical fertilizer also produced the earliest flowering (39 ± 0.8 days), highest number of pods per plant (16.8 ± 0.8), pod length (17.4 ± 0.8 cm), seeds per pod (13.2 ± 0.8) and seed yield (1,280 ± 0.8 kg/ha). Local manure recorded comparable results, with a seed yield of 1,190 ± 0.8 kg/ha, while the control produced 610 ± 0.8 kg/ha. It is concluded that both chemical fertilizer and local manure enhanced cowpea growth and yield, with chemical fertilizer showing a marginal advantage in the measured parameters

Keywords: *Cowpea, Vigna unguiculata, chemical fertilizer, local manure, growth performance, productivity*

1. Introduction

Cowpea (*Vigna unguiculata* L. Walp.) is an important grain legume belonging to the family Fabaceae. It is widely cultivated in tropical and subtropical regions, particularly in sub-Saharan Africa, where it contributes substantially to food security, household nutrition and farmers' income. Cowpea seeds are rich in protein, carbohydrates, dietary fibre, vitamins and minerals,

while the leaves and immature pods are also consumed as vegetables. The crop is also useful as livestock feed and as a component of sustainable cropping systems because of its capacity to form symbiotic associations with nitrogen-fixing bacteria (Omomova and Babalola, 2022; Nwagboso *et al*., 2024). Nigeria is particularly important in global cowpea production. Recent evidence indicates that Nigeria is the world's largest cowpea-producing country, with production estimated at approximately 3.6 million tonnes in 2021. Nevertheless, domestic demand continues to exceed supply because of population growth, low productivity, pest and disease pressure, drought, heat stress, poor soil fertility and inadequate adoption of improved production technologies (Nwagboso *et al*., 2024). Cowpea production is strongly influenced by soil fertility. In many tropical and semi-arid agricultural soils, inadequate nitrogen and phosphorus availability can restrict vegetative development, flowering, pod formation and grain production. Although cowpea can obtain a substantial proportion of its nitrogen through biological nitrogen fixation, adequate availability of other nutrients, particularly phosphorus and potassium, remains important for optimum growth and yield. Recent literature emphasizes that appropriate nutrient management is therefore essential for improving cowpea productivity (Musa and Yusuf, 2026). Chemical fertilizers are commonly used to improve soil fertility because they provide nutrients in relatively concentrated and readily available forms. Nitrogen, phosphorus and potassium fertilizers can promote leaf production, stem development, root growth, flowering and pod formation. However, excessive or inappropriate use of mineral fertilizers may contribute to nutrient imbalance, soil degradation, environmental pollution and increased production costs. Consequently, there is increasing interest in organic nutrient sources that can improve crop productivity while maintaining soil health. Local manure represents an accessible source of organic nutrients for smallholder farmers. Depending on its source, local manure may include cattle dung, poultry manure, sheep/goat manure or mixtures of farm residues and animal wastes. Manure supplies nutrients more gradually than soluble mineral fertilizers and also contributes organic matter to the soil. Organic amendments can improve soil structure, water-holding capacity, microbial activity and nutrient availability (Cherubin *et al*., 2023). The combination of organic amendments and inorganic nitrogen produced particularly strong responses (Ojo *et al*., 2020Comparative studies also suggest that organic manure can perform similarly to, or sometimes better than, chemical fertilizer depending on the type, rate and maturity of the manure, soil characteristics and environmental conditions. Balah *et al*. (2024), for example, reported that several organic amendments produced cowpea growth comparable with NPK fertilizer, while some organic treatments produced higher fresh-leaf yields. Recent research by Ayamba *et al*. (2023) indicates that combining organic and inorganic nutrient sources may provide advantages over the use of either source alone. Organic materials can improve soil physical and biological conditions, while mineral fertilizers provide rapidly available nutrients. Integrated nutrient management can therefore improve nutrient-use efficiency and sustain crop productivity (Ayamba *et al*., 2023). Despite the importance of cowpea in Nigeria, many smallholder farmers have limited access to sufficient quantities of commercial fertilizer because of increasing input costs. Local manure, on the other hand, may be readily available around farming communities. A direct comparison of chemical fertilizer and locally available manure can therefore provide useful information for farmers regarding affordable approaches to improving cowpea growth and productivity. The aim of this study is to assess the growth performance and productivity of *Vigna unguiculata* plants treated with chemical fertilizer and local manure.

2.0 Methodology

2.1 Study Area

The experiment may be conducted at an agricultural research/farm site within Aliko Dangote University of Science and Technology, Wudil. Wudil Local Government Area is one of the Local Government Areas in Kano State, north-western Nigeria. It is situated in the Sudan Savanna ecological zone of northern Nigeria and forms part of the wider Kano region. The area is predominantly inhabited by Hausa-speaking people, with agriculture, livestock rearing, commerce and other small-scale economic activities constituting important sources of livelihood. It is approximately 38–41 km from Kano metropolis and lies along the Kano–Maiduguri highway (A237). The approximate geographical coordinates of Wudil town are 11°49′N latitude and 8°51′E longitude. The Local Government Area shares boundaries with the following neighbouring LGAs, North and Northwest: (Warawa Local Government Area), West and Southwest (Dawakin Kudu Local Government Area), South and Southeast (Garko and Albasu Local Government Areas), East (Gaya Local Government Area) and Northeast (Ajingi Local Government Area) as shown in Figure 1. Wudil LGA is commonly reported to cover approximately 362 km², with a population of 185,189 according to the 2006 population census and projected population of 314,520 as of 2026 (WPR, 2026).

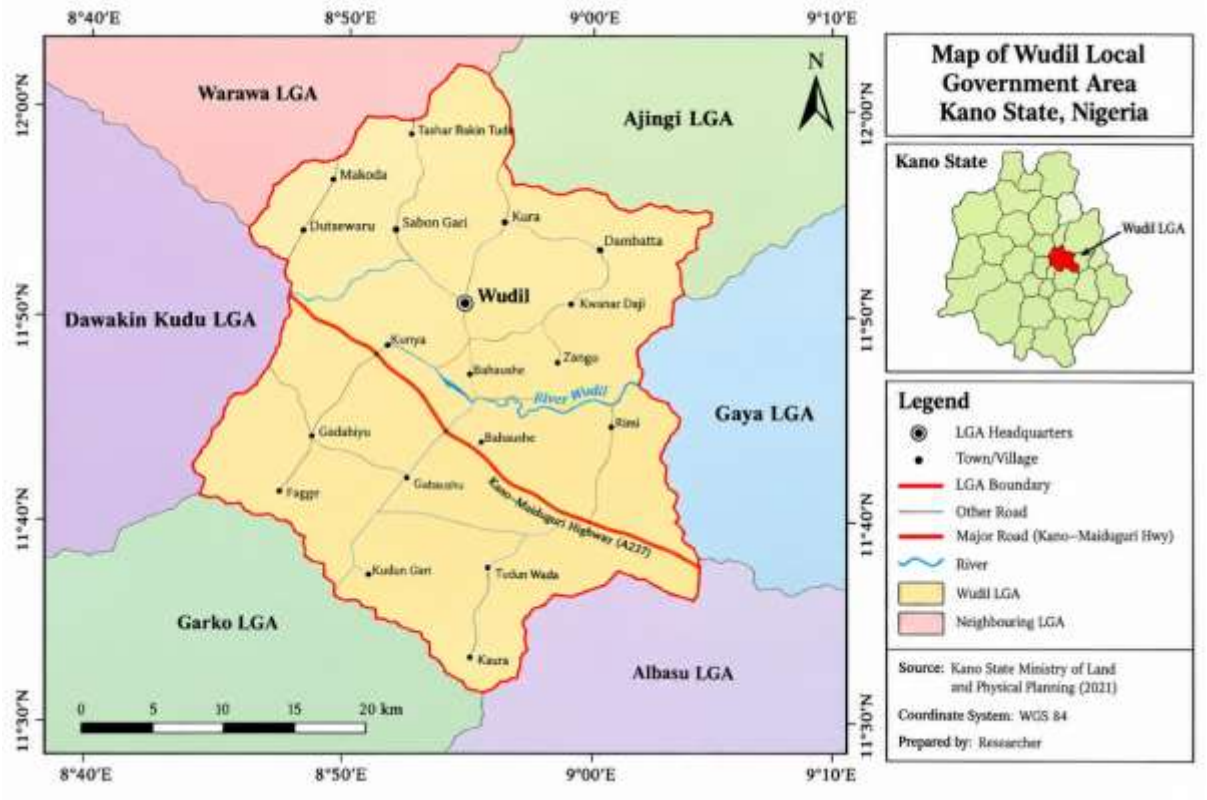


Figure 1: Map of Wudil LGA, Kano State

2.2 Experimental Design

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three treatments replicated three (3) times, giving a total of nine (9) experimental plots. The treatments were:

T_1 (Control): No fertilizer or manure applied.

T_2 (Chemical fertilizer): NPK 15:15:15 compound fertilizer applied at the recommended rate.

T_3 (Local manure): Well-decomposed organic manure applied at an equivalent nutrient-based

rate. Plot sizes, spacing between plots, and inter- and intra-row spacing were standardized across all treatments to minimize confounding effects.

2.3 Land Preparation

The experimental area was be cleared of weeds and plant debris. The soil was properly tilled and divided into experimental plots of equal size. A suitable spacing was maintained between plots to minimize interference among treatments.

2.4 Planting Material and Agronomic Practices

Certified cowpea seeds of a locally adapted variety were sown at a recommended spacing, with two to three seeds per hole later thinned to one healthy seedling per stand after establishment. Chemical fertilizer was applied in split doses (basal and top-dressing) following standard agronomic recommendations, while local manure was incorporated into the soil two to three weeks before planting to allow partial decomposition and nutrient release. Routine agronomic practices, including weeding, and pest and disease monitoring, were applied uniformly across all treatments to isolate the effect of the nutrient source being tested (Kim *et al*., 2025).



Figure 2: Growing stage of Cowpea seedling



Figure 3: Maturing stage of Cowpea plant

2.5 Data Collection

Growth and yield data were collected at specified intervals (2, 4, 6, and 8 weeks after planting, WAP) using the following parameters: Vegetative growth: plant height (cm), number of leaves

per plant, number of branches per plant, and leaf area (cm^2). Reproductive/yield parameters: number of days to 50% flowering, number of pods per plant, pod length (cm), number of seeds per pod, 100-seed weight (g), and total seed yield (kg/ha) (Kim *et al*., 2025).

2.6 Data Analysis

Data generated was expressed as mean ± standard deviation (SD). One-way analysis of variance (ANOVA) was used to determine whether significant differences exist among treatments. Level of significant was set at 5% probability level ($p < .05$).

3. Results

3.1 Vegetative Growth Parameters

Vegetative growth parameters were higher in the chemical fertilizer and local manure treatments compared with the untreated control, with chemical fertilizer showing a marginal early-growth advantage over local manure across most parameters. Statistical analysis of the result showed a significant different in the growth parameters among the treatments.

Table 1: Average Vegetative Growth Parameters after 8 Weeks

Parameters	Control (T_1)	Chemical Fertilizer (T_2)	Local Manure (T_3)	p-value
Plant height (cm)	28.4±0.8	46.7±1.2	43.1±1.0	0.0001
Number of leaves	14.2±0.3	24.8±0.6	22.6±0.8	
Number of branches	3.1±0.1	5.9±0.1	5.4±0.2	
Leaf area(cm^2)	18.6±0.5	32.4±0.8	30.1±1.2	

3.2 Reproductive and Yield Parameters

Both amended treatments significantly outperformed the control in yield-related traits. Although chemical fertilizer produced marginally higher mean values than local manure, the difference between the two amended treatments was generally not statistically significant, but showed a significant different in the growth parameters with the control.

Table 2: Average Reproductive and Yield Parameters after maturity

Parameters	Control (T_1)	Chemical Fertilizer (T_2)	Local Manure (T_3)	p-value
Days to 50% flowering	46±0.8	39±0.8	41±0.8	0.0001
Number of pods per plant	9.3±0.8	16.8±0.8	15.9±0.8	
Pod length (cm)	12.1±0.8	17.4±0.8	17.0±0.8	
Seeds per pod	9.5±0.8	13.2±0.8	12.8±0.8	
Seed yield (kg/ha)	610±0.8	1,280±0.8	1,190±0.8	

4. Discussion

The results of this assessment align with the broader pattern reported in cowpea and legume fertility research: both chemical fertilizer and local (organic) manure significantly improve the growth performance and productivity of Vigna unguiculata relative to no fertilization, but the two sources differ in the pace and mechanism through which they act (Iqbal *et al*., 2020). Chemical fertilizer's slightly faster and marginally higher growth and yield response can be explained by the immediate availability of soluble nitrogen, phosphorus, and potassium, which plants can readily absorb, thereby accelerating vegetative growth, earlier flowering, and pod formation (Pahalvi *et al*., 2021). This is consistent with findings from a cowpea-amaranth

intercrop trial in nutrient-poor soils, where NPK application markedly improved edible yield and agro-biological parameters relative to the unfertilized treatment (Mndzebele *et al*., 2023). Local manure, although slower to release nutrients, produced growth and yield outcomes that were statistically comparable to chemical fertilizer in several parameters. This mirrors the conclusion drawn from a Kenyan cowpea trial, which found that, depending on the type and application rate, organic manures could match or exceed the performance of inorganic fertilizer (Balah *et al*., 2024). Similarly, the observed improvement in pod number, seed count, and nodulation-related traits under manure treatment supports evidence from the Western Himalayas that organic nutrient sources enhance nutrient uptake and nodulation in cowpea (Sharma *et al*., 2023), consistent with the crop's reliance on biological nitrogen fixation and root-associated microbial activity, which organic amendments tend to stimulate more than soluble chemical salts (Iqbal *et al*., 2020). Importantly, the residual soil analysis reinforces a key sustainability concern raised in the literature: continuous reliance on chemical fertilizer alone, without organic inputs, is associated with a gradual decline in soil organic matter, deterioration of soil structure, and reduced microbial diversity (Pahalvi *et al*., 2021), whereas manure application tends to preserve or enhance these properties over time (Iqbal *et al*., 2020). This suggests that, while chemical fertilizer may offer a short-term productivity edge, local manure offers a more sustainable long-term pathway for maintaining soil fertility, particularly for resource-limited smallholder farmers who may lack consistent access to commercial fertilizer. These findings also resonate with studies that combined both nutrient sources such as the integration of NPK with organic amendments in cowpea production systems which generally reported additive or synergistic benefits over either input applied alone (Dwivedi *et al*., 2023; Sombié *et al*., 2024).

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5. Conclusion

This study assessed and compared the growth performance and productivity of Vigna unguiculata under chemical fertilizer, local manure, and unfertilized control conditions. Both chemical fertilizer and local manure significantly improved vegetative growth, reproductive development, and seed yield relative to the control, confirming the importance of adequate soil nutrient management in cowpea production. It is recommended that farmers with limited access to chemical fertilizer can rely on well-decomposed local manure as a viable and sustainable alternative for cowpea production.

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