



## EVALUATION OF GROWTH AND YIELD OF RADISH (*Raphanus sativus* L.) FERTILIZED WITH VARIOUS ORGANIC MANURES IN SOUTHERN GUINEA SAVANNAH, NIGERIA.

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Received 14<sup>th</sup> November, 2025; Accepted 3<sup>rd</sup> December, 2025

**ABSTRACT:** A field experiment was carried out in the 2025 cropping season at the Teaching and Research Farm within the Department of Crop Production at Joseph Sarwuan Tarka University, Makurdi, Nigeria. The study employed a Randomized Complete Block Design (RCBD) with three replications to evaluate the effects of different organic manures on radish. The experimental materials were radish variety (Sora) and four types of organic manure (Poultry Manure, cow dung, goat manure and a control plot that received no manure). Data were collected on growth and yield parameters, including plant height, number of leaves, leaf area index (LAI), crop growth rate (CGR), chlorophyll content, root weight, days to maturity, number of roots, and yield. The results indicated that all measured parameters were significantly ( $P < 0.05$ ) influenced by the application of organic manure. Among the treatments, poultry manure consistently produced superior results. It led to the highest values in plant height (8.23 cm), number of leaves (12.84), leaf area index (3.23 cm<sup>2</sup>), crop growth rate (3.27 g/m<sup>2</sup> per day), chlorophyll content (34.45 mg/g), root weight (621.89 g), root length (15.67 cm), root diameter (8.45 cm), and yield (3.50 t/ha) as compared to the other manure types and the untreated. Based on these findings, it is concluded that poultry dropping is the most effective organic manure for enhancing radish growth and yield in the study area. Consequently, it is recommended that local farmers adopt the use of poultry manure at a rate of 15 tons per hectare to achieve optimum radish production.

**Keywords:** Radish, Sora, Organic manure, growth and yield.

### INTRODUCTION

Declining soil fertility is a primary biophysical cause for reduced per capita food production on smallholder farms across tropical Africa (Adekiya *et al.*, 2019). The sustained use of synthetic fertilizers to address this issue has proven problematic. Their application can induce soil acidity, cause nutrient imbalances (Agbede *et al.*, 2017), and promote physical degradation that increases erosion (Adekiya *et al.*, 2019). Furthermore, the effectiveness of chemical

fertilizers alone is often limited, as crop response is highly dependent on existing soil organic matter (SOM) levels (Ojeniyi, 2012). Long-term use of chemical inputs can actually reduce SOM, cause soil acidification and crusting, and adversely alter microbial communities (Davies *et al.*, 2022). Soil organic matter is a critical component of soil health, significantly influencing physico-chemical properties, carbon sequestration, erosion control, and the prevention of land degradation (Galantini and Rosell, 2006; Ojeniyi *et al.*, 2012).

Organic fertilizers, produced from composted animal manure, human excrement, and various agricultural and municipal wastes (Chew *et al.*, 2019), present a promising alternative for enhancing environmental

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sustainability and plant growth (Zhou *et al.*, 2022; Liu *et al.*, 2024). Their application revitalizes soils by serving as a rich source of SOM and nutrients (Zheng *et al.*, 2016). The incorporation of organic fertilizers enhances soil organic matter, soil structure, nutrient accessibility, and microbial activity (Maltas *et al.*, 2018; Diacono & Montemurro, 2010). This leads to enhanced soil moisture, modified cation exchange capacity (CEC), and changes in acidic soil composition and fauna communities (Ojeniyi, 2012; Adekiya *et al.*, 2019). These improvements create a healthier, more resilient growing environment by enhancing the structure, water-holding capacity, and beneficial microorganism activity of the soil (Madina *et al.*, 2024). Consequently, organic fertilization results in significant increases in crop productivity (Liu *et al.*, 2010; Liu *et al.*, 2024), with studies showing substantial benefits for crops like tomato, maize, and rice (Yu *et al.*, 2010; Lal *et al.*, 2015; Niyungeko *et al.*, 2018). This approach can reduce reliance on inorganic fertilizers by up to 50%, lowering farmers' costs of production while improving soil fertility and environmental quality (Islam *et al.*, 2010; Tao *et al.*, 2016; Zheng *et al.*, 2016).

Radish (*Raphanus sativus* L.) is a nutritious, short-duration vegetable crop from the Brassicaceae family (Jin *et al.*, 2024). The primary edible component of radish is the root, abundant in several nutrients, including vitamin C, dietary fiber, and amino acids. Radish exerts considerable health benefits owing to its anticancer, antibacterial, antihypertensive, and immunostimulatory activities (Li *et al.*, 2020). Its productivity is highly dependent on a continuous and balanced supply of soil nutrients. Given the environmental concerns associated with the excessive use of chemical fertilizers including soil degradation and biodiversity loss (Etesami *et al.*, 2016), there is a renewed interest in sustainable practices like organic manures. Therefore, this study hypothesized that the application of different forms of organic manure would significantly improve soil properties and radish yield compared to a control with no organic amendment. The objective of this research was to examine the effects of poultry manure, goat manure,

and cow dung on soil properties and the yield of radish cultivated in Makurdi.

## **MATERIALS AND METHODS**

### **Experimental Location**

The study was conducted in 2025 at the nursery of the Teaching and Research Farm, Department of Crop Production, Joseph Sarwuan Tarka University, Makurdi. The site is located in the Southern Guinea Savannah Agro-Ecological Zone of Nigeria at coordinates 7.41°N and 8.28°E, with an elevation of 98 meters above sea level. The rainy season lasts from April to October, with the dry season lasting five months (November to March). The average annual rainfall is 1140 mm yr<sup>-1</sup> (Agada *et al.*, 2016). The mean annual temperature ranges from 29 – 32 °C. February and March are marked as the hottest months (Aguji *et al.*, 2024).

### **Experimental Design and Treatments**

The study was set up in a Randomized Complete Block Design (RCBD) and replicated thrice. The treatments consisted of one variety of radish (Sora) and four soil amendment types: poultry manure, goat manure, cow dung, and a control (no manure) applied at 15t/ha. All organic manures were sourced from the Livestock section of the University Teaching and Research Farm. Following established recommendations (Yusuf and Madina, 2018), the manures were subjected to a three-month period of partial decomposition under intensive care before being applied to the experimental plots.

### **Agronomic Practices**

#### **Land preparation and planting**

The land was manually prepared, and radish seeds were sown directly into the field. A total of twelve plots, each measuring 4 m<sup>2</sup>, were established with 1-meter spacing between plots and blocks. A planting spacing of 10 cm x 60 cm was used for the crop.

#### **Crop management**

Agronomic practices, such as weeding, were performed manually at two and four weeks after planting (WAP) to maintain weed-free plots. No

pesticides were applied as there were no significant pest infestations during the experiment.

### Organic Manure Analysis

Prior to application, samples of each manure type were analyzed for their chemical properties following standard methods. A sample of all the organic manure types of 0.5 kg was examined for Dry matter, Organic manure, Total Nitrogen and available P following the standard methods by Madina et al., (2024). The results of the analysis is presented in Table 1.

### Data Collection

Data on growth and yield parameters were collected from five randomly selected, tagged plants within the net plot area. Parameters measured included plant height, number of leaves, leaf area index, root diameter (using vernier calipers), chlorophyll content, crop growth rate, and root weight. Yield was determined by weighing the harvested roots. The radish plants were harvested 40 to 44 days after planting by uprooting the entire plant. The roots were then carefully separated from the shoot using a knife.

Formula for Leaf Area Index (LAI) is given below; as describe by Radford (2013)

$$LAI = \frac{\text{Total Leaf Area}}{\text{Unit Land Area}} \quad \text{---- (1)}$$

The crop growth rate (CGR) formula is provided below as described by Watson (1952).

$$CGR = \frac{W_2 - W_1}{P(t_2 - t_1)} \quad (\text{gm}^{-2}/\text{day}^{-1}) \quad \text{---- (2)}$$

In this equation,

P represents ground area

W1 represents the dry weight of plants per square meter at time t1.

W2 is the dry weight of the plant per square meter measured at time t2,

t1 and t2 are time intervals given in g/m<sup>2</sup>/day.

### Statistical Data Analysis

Using the GENSTAT statistical program (2015), the growth and yield data were analyzed using the ANOVA method. The Fishers' Least Significant Difference (F-LSD) test was performed at  $P \leq 0.05$  to compare all significant treatment means.

## RESULT AND DISCUSSION

### Chemical composition of different organic manure employed for the experiment

Table 1 shows the chemical composition of the different kinds of organic manure utilized in the experiment. The chemical composition of poultry manure was comparatively high in N, P, K, dry matter, and organic elements, at the level necessary for radish development (Adekiya et al., 2019), followed by cow dung, while goat manure chemical composition was the least.

**Table 1: Chemical composition of Different Organic Manure used for the experiment**

Parameters	Poultry manure	Goat manure	Cow dung
Dry Matter (%)	80.00	33.00	13.00
Organic Material (%)	34.00	23.00	18.00
Total Nitrogen	3.00	2.10	1.21
Available Phosphorus	2.40	1.10	1.03
Total Potassium	1.48	1.60	1.00

The potential of poultry manure to enhance soil qualities, crop output, and nutritional content has been emphasized by a number of authors, improving human nutrition in regions with depleted soils (Agbede, 2015; Agbede et al., 2017; Madina et al.,

2024). Maia et al. (2018) also affirmed that animal manure (bovine) enhances quality and productivity of the Apolo radish cultivar. Furthermore, Umar et al. (2019) concluded that the use of Kalli organic fertilizer considerably enhanced the yield of Radish in

the Jos Plateau. Working on lettuce, Madina et al. (2024) reported that poultry manure considerably improved lettuce growth and yield characteristics, with a significant difference from cattle dung or goat manure. Similarly, Ahmed et al. (2023) reported that Cow Dung manure significantly influenced the development and production of radish in Sudan Savannah, thus supporting the findings of the current study.

### The Effect of Organic Nutrient Sources on Radish Growth Performance

A comparative analysis of organic amendments (cow dung, goat manure, chicken manure, and an untreated control) revealed a significant effect ( $P < 0.05$ ) on all metrics of radish development, as detailed in Table 2.

**Table 2: Effect of organic nutrient source on Growth parameter of Radish grown in Makurdi, Nigeria**

Nutrient source (N)	Plant Height (cm)	Number of Leaves	Crop Growth Rate (m <sup>3</sup> )	Days to Maturity	Leaf Area Index (cm)
Poultry manure	8.23	12.84	3.27	41.13	3.23
Goat manure	7.52	10.16	2.71	42.32	2.32
Cow dung	6.65	9.43	2.13	44.45	2.00
Control	5.00	8.02	1.61	45.12	1.63
F-LSD ( $P \leq 0.05$ )	1.00	1.30	0.31	1.12	0.54

*F-LSD = Fishers' Least Significant Differences at 5% Level of Probability*

### Effect of organic nutrient source on yield related parameters of Radish

Table 3 delineates the effects of distinct organic nutrient sources specifically poultry manure, goat manure, cow dung and a control treatment on the yield attributes of radish cultivated in Makurdi, Nigeria. The results demonstrated statistically significant differences ( $P < 0.05$ ) across all treatments for each measured yield parameter. The application of poultry manure proved to be the most efficacious, producing the most substantial values for chlorophyll content (34.45 mg/g), root weight (621.89 g), root length (15.67 mm), and root diameter (8.45 mm). Goat manure application resulted in the second most favorable outcomes, whilst cow dung produced

Poultry manure application resulted in the highest values across all parameters, including plant height (8.23 WAP), number of leaves (12.84), crop growth rate (3.27 g/m<sup>2</sup>), and leaf area index (3.23). Goat manure performed second best, followed by cow dung. The control group consistently yielded the lowest results (Table 2). The results of the study corroborate other authors (Agbede et al., 2017; Adekiya et al., 2017; Ahmed et al., 2023; Madina et al., 2024) working on organic manure types on crops like Maize, radish and lettuce and found that poultry manure considerably improved growth characteristics of the crop. These results indicate that poultry manure is the most effective organic nutrient source for enhancing the performance of radish crop cultivated in the agro-climatic environment of Makurdi, Nigeria.

intermediate results. The control treatment consistently yielded the lowest values for all parameters (chlorophyll content: 25.89 mg/g, root weight: 5358.32 g, root length: 9.21 mm, root diameter: 4.67 mm). These results are consistent with and corroborate previous research by Umar et al. (2019), Adekiya et al. (2019), Odiaka et al. (2023), and Madina et al. (2024), who documented comparable positive effects of organic manure applications on radish, onion, and lettuce crops, respectively. Furthermore, these findings lead to the conclusion that poultry manure constitutes the most potent organic amendment for optimizing radish yield and quality under the prevailing environmental conditions of Makurdi, Nigeria.

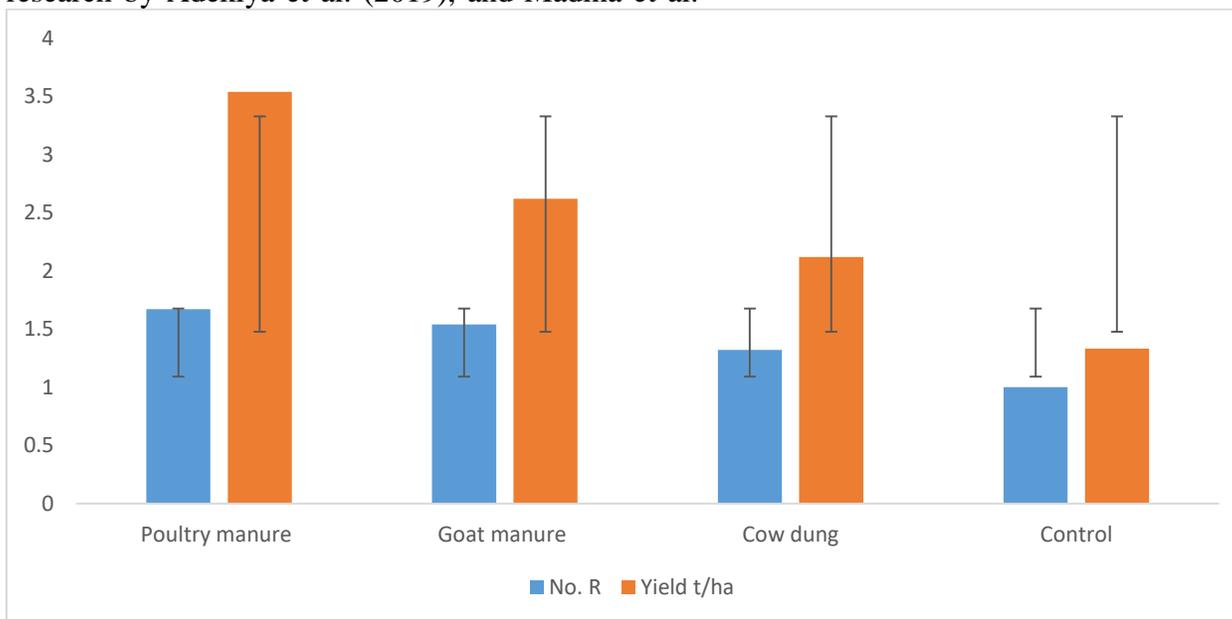
**Table 3: Effect of organic nutrient source on yield related parameters of Radish grown in Makurdi, Nigeria**

Nutrient source (N)	Chlorophyll content (mg/g)	Root weight (g)	Root length (mm)	Root diameter (mm)
Poultry manure	34.45	621.89	15.67	8.45
Goat manure	30.78	600.76	12.86	6.76
Cow dung	28.23	579.65	10.91	5.23
Control	25.89	5358.32	9.21	4.67
F-LSD ( $P \leq 0.05$ )	1.01	50.98	1.81	1.21

*F-LSD = Fishers' Least Significant Differences at 5% Level of Probability*

The graphical representation (figure 1) delineates the comparative efficacy of each treatment (various organic nutrient sources on radish root proliferation and aggregate yield parameters under growing conditions in Makurdi). The chart indicates that poultry manure application resulted in the most pronounced enhancement of root number and cumulative yield, as evidenced by the highest bars. Goat manure demonstrated secondary efficacy, while cow dung produced more moderate outcomes. The control treatment consistently yielded the lowest values for both measured parameters, underscoring the beneficial role of organic soil amendments. These results are consistent with and corroborate previous research by Adekiya et al. (2019), and Madina et al.

(2024). Similarly, Liu et al. (2024) has demonstrated that organic fertilizer application bolsters plant resilience to drought, salinity, and heat stress. This is achieved via a suite of physiological and biochemical improvements, such as enhanced leaf water status, nutrient uptake, chlorophyll synthesis, and the production of osmolytes and antioxidants, culminating in upregulated gene expression and greater stress tolerance. These results suggest that the incorporation of organic nutrient sources, with poultry manure being particularly effective, contributes significantly to improved radish root development and overall productivity in the agro-ecological context of Makurdi.



**Figure 1: Effect of organic nutrient source on number of root and yield related parameters of Radish grown in Makurdi, Nigeria**

## CONCLUSION

The findings of this study demonstrate that the application of poultry manure significantly enhanced both growth and yield parameters of radish, with results markedly superior to those obtained using cattle dung or goat manure. Radish plants cultivated in the control plots exhibited the lowest performance across all measured characteristics for the Sora variety under investigation. It is noteworthy, however, that amendments with both cow dung and goat manure still resulted in improved radish growth and productivity in contrast to the control treatment. Based on these findings, the study concludes that the application of poultry manure at a rate of 15t/ha is

recommended to achieve optimum growth and yield for the Sora radish variety under the edaphic and climatic conditions of Makurdi. In scenarios where poultry manure is unavailable, the use of either cattle dung or goat manure presents a viable alternative for local farmers seeking to enhance radish yields within the Southern Guinea Savanna agro-ecological zone of Nigeria.

## COMPETING INTERESTS

The authors declare no competing financial interests or personal relationships that could have influenced the work reported in this research work.

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**HOW TO CITE THIS ARTICLE:**

Madina, P. and Ugoo, T. R (2026) Evaluation of growth and yield of radish (*raphanus sativus* l.) Fertilized with various organic manures in southern guinea savannah, nigeria. *Nigeria Journal Of Plant Breeding* (<https://pbanjournal.org/>), 3(1), 76-83. ISSN: 2814-3531