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Contrastive Responses of Organic Manure (Poultry Manure) and Inorganic Fertilizer (N:P:K 15:15:15) on Growth and Yield of Okra (*Abelmoschus esculentus* (L.) Moench)

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ABSTRACT

The use of poultry dung and chemical fertilizers to enhance crop productivity has long been practiced, however their agronomic importance and manner of utilization for optimum yield demand further investigation. This study aimed to observe the effect of organic and inorganic fertilizer on the performance of Okra. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. Treatment administered comprised of poultry manure (5 tonnes/ha and 10 tonnes/ha) and N:P:K 15:15:15 fertilizer as (20kg N/ha and 40kgN/ha), combination of both organic and inorganic fertilizers and a control. The growth parameters assessed included plant height, leaf number, pod number and pod circumference at different growth stages. Data were analysed using analysis of variance (ANOVA), and treatment means were separated by least significant difference (LSD) at 5% probability. Results revealed that poultry manure at 10 tonnes/ha significantly improved plant height (44.7 cm) and leaf number (8) compared to control and organic fertilizer. However, yield components such as pod number and circumference performed best under combined application of poultry manure and NPK, combination PM5t/ha+NPK20kgN/ha had the highest mean pod number (0.75) and combination PM5t/ha+NPK40kgN/ha had the highest mean pod circumference (1.83 cm) and while the control recorded the lowest pod number and circumference. From the results, this study recommends the application of poultry manure in combination with NPK fertilizer by farmers for better growth and yield of Okra.

Keywords: Okra, Poultry manure, N.P.K 15:15:15, Growth, Yield

Introduction

Okra (*Abelmoschus esculentus* (L.) Moench) is a popular vegetable of the tropics and subtropics region. It is cultivated in India, Nigeria, Sudan, Pakistan, Ghana, Egypt, Benin, Saudi Arabia, Mexico and Cameroon (Adesida *et al.,* 2019). It belongs to the family Malvaceae and semi-pollinated in nature. Okra plays a crucial role in Nigerian agriculture and significantly contributes to small-scale farmers' food security and income generation (Akinola, 2025). It is mainly cultivated for its pods which are cooked and eaten in processed form. The fresh leaves, bud, flowers, pods, stems and seeds of Okra plant are used for different purposes (Minhretu *et al*., 2014). The seed is used as a source of seed oil and as a non-caffeinated substitute for coffee (Atijegbe *et al*., 2014). Its pod contains 8.20% carbohydrates, 2.10% protein and a significant amount of riboflavin (Benchasri, 2012). The mature stem contains crude fibre which is used in paper

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industries and for making ropes (Ojo *et al*., 2012). The mucilage has medicinal importance as it is used as a plasma replacement or blood volume expander and binds cholesterol and bile acid carrying toxins dumped into it by the liver (Gemede, 2015). The nutritional constituents of okra include carbohydrate, protein, phosphorus, calcium, magnesium, iron, vitamin A and C with traces of vitamin B (Chawla *et al*., 2025). These nutrients are specific in function and must be supplied to plants at the right quantity. Lack of sufficient amounts of these nutrients result in poor performance of the crop with growth being affected resulting in low yield (Periakaruppan *et al*., 2023)

Chemical/Inorganic fertilizers are synthetic materials added to the soil which are most important to increase the growth and yield of crops. Their application is necessary to enhance the soil nutrient status and increase crop yield (Olaniyi *et al*., 2010). The use of inorganic fertilizer changes the physical, chemical and biological properties of the soil, reduces the fertility status of soil, deplete soil organic matter and consequently leading to reduction in crop yield and serious degradation and decline in soil productivity (Nnah et al., 2016). They are also costly and are not always affordable to poor farmers (Adewole and Adeoye, 2008). Hence the use of organic manures as a means of maintaining and increasing soil fertility has been advocated (Neemisha & Rani, 2022).

Organic manure helps to improve the physical condition of soil and provide adequate amount of necessary nutrients for the soil productivity (Verma *et al*., 2024). It is usually applied at higher rates, relative to inorganic fertilizers to give residual effects on the growth and yield of succeeding crops (Aluko *et al*., 2021). Animal manures, when efficiently and effectively used, ensure sustainable crop productivity by immobilizing nutrients that are susceptible to leaching. The nutrients contained in them are released more slowly and are stored for a longer time in the soil to ensure longer residual effect, improved root development and higher crop yields (Priya *et al*., 2024). It is environmentally friendly and promotes population of beneficial microorganisms and generally improves the soil health (Oyewole *et al.,* 2012).

Poultry manure is a good source of major and minor mineral elements that are capable of enhancing soil fertility (Agbede, 2025). It has high percentage of nitrogen and phosphorus for the healthy growth of plants (Kacprzak *et al.*, 2022). It is widely recognized as soil conditioner for raising soil PH and exchangeable bases levels (Awe *et al.*, 2011) It is a good source of Nitrogen for sustainable crop production, but its availability remains an important issue due to its bulky nature, while inorganic fertilizer is no longer affordable to poor farmers due to its high cost (Rahman *et al.,* 2014).Therefore, a combination of organic materials and mineral fertilizers is important for management of the soils for high yield and quality harvest of Okra (Akande *et al.,* 2010). Due to the economic and nutritional benefit of okra in Nigeria, exploring the type of fertilizer application that would improve its yield is therefore necessary.

2.0 Materials and Method

Experimental site

The experiment was conducted in the pavilion (open space) of the Department of Agronomy, Faculty of Agriculture, University of Ilorin, Ilorin, Kwara State during the rainy season from August to November, 2024. The area lies between Latitude 8.485^{o}N and Longitude 4.675^{o}E. The annual rainfall ranges between 990.3mm to 1318mm and average relative humidity of about 75%, the average minimum temperature is about 25°C and average maximum temperature is 35.5°C (Olubanjo, 2019).

Experimental Layout

The experiment was laid out in a Randomized Complete Block Design (RCBD), with 4 replicates involving 36 homogenous pots containing a single variety (Syndicate 121) of the Okra (obtained from National Institute for Horticultural Research, Ibadan) each with 4 different treatments on a plot of 18m by 6m with furrow path of 0.5m. The treatments used were organic (poultry) manure at 5000 kg/ha (30g/pot) and 10,000 kg/ha (60g/pot), inorganic fertilizer (NPK 15:15:15) at 20 kg/ha (0.8g/pot) and 40 kg/ha (1.6g/pot); individually and in possible combinations. The control was without treatment.

Soil and manure preparation

Topsoil, taken from botanical garden at a depth of 0-15cm were weighed (12kg) into each of the 36 pots. Soil analysis (Table 1) was conducted before the study (AOAC, 1990).

Poultry manure (layers manure) without wood shavings was obtained from a poultry farm in University of Ilorin and incorporated into soil of each pot 5 days before planting while the inorganic fertilizer (N:P:K 15:15:15) was purchased from an Agro-Allied Shop at Sawmill Garage, Ilorin. Both the Poultry manure and NPK fertilizer were measured at (30g & 60g) and (0.8g &1.6g) respectively. The fertilizer was applied 2 weeks after planting by side placement 3 to 4 inches away from each plant's base. Weeding was done by hand pulling. Manual irrigation was done in the morning and sometimes late in the evening. Pest management was carried out at intervals of 3 weeks using Laraforce pesticide – Lambda-Cyhalothrin 2.5% EC.

Data collection

The plants germinated 5 days after planting. Data was collected on growth and yield parameters including plant height, number of leaves, pod number and pod circumference. Data collection began at 21 Days after Planting. Meter rule was used to measure Plant height from the soil level to the terminal bud. The leaves and pods number was counted, while the pod circumference was determined with a digital vernier caliper. All these parameters were monitored at one-week intervals till the end of the eighth week (56 DAP).

Data Analysis

Data were subjected to analysis of variance (ANOVA) using Statistics for Agricultural Scientist (SAS) software, and treatment means were separated by least significant difference (LSD) at 5% probability level.

Results

Soil and Poultry Manure Properties

Soil analysis results revealed the soil used for the experiment was sandy loam in texture, containing a higher percentage of sand 74% sand, and an equal percentage of loam and silt (13%). It had relatively low organic matter content (0.86%) and organic carbon (0.50%), with a total nitrogen level of 4.9. The soil pH was neutral to slightly acidic (pH-water 7.0; pH-KCl 6.3). Exchangeable bases were generally low, with calcium (0.70 Cmol/kg), magnesium (0.10 Cmol/kg), potassium (0.32 Cmol/kg), and sodium (0.17 Cmol/kg), while cation exchange capacity (1.46 Cmol/kg) was also low. Available phosphorus was 19.37 mg/kg (Table 1). These results indicate a soil with poor fertility status.

Table 1: Properties of the Soil Used

Standard diagnostic characteristics	Results
Depth of horizon of soil layer in cm	0.25 cm
Sand (%)	74
Silt (%)	13
Clay (%)	13
Organic carbon (%)	0.50
Organic matter (%)	0.86
Total nitrogen (Kjedldahl)	4.9%
pH-Water	7.0
pH-Kc 1	6.30
Ca Cmol/kg. of soil	0.70
Mg Cmol/kg. of soil	0.10
K Cmol/kg. of soil	0.32
Na Cmol/kg. of soil	0.17
Cation Exchange Capacity (Cmol/Kg)	1.46
Base saturation percent (%)	89.00
Available phosphorus	19.37

The Poultry manure sample (layers manure without wood shavings) was analysed for basic chemical nutrients before application. Results obtained were recorded as 30.1 (mg/kg) levels of phosphorus, 0.46 (Cmol/kg) levels of potassium, 8.75 (%) levels of nitrogen and a pH level of 6.85.

Plant Height at Different Growth Stages

Results revealed that the plant height of okra significantly varied across the treatments and sampling periods. At 21 DAP, the tallest plants (12.46 cm) were observed in PM 10t/ha, while the shortest plants (6.19 cm) occurred under NPK 20kgN/ha alone. From 28 to 56 DAP, PM 10t/ha consistently maintain the highest plant height while combined applications of poultry manure and NPK consistently produced taller plants after PM 10t/ha (table 2). This suggests that the use of significantly enhanced Plant height compared to other fertilizer application regimes.

Number of Leaves

At 21 DAP, all the plant irrespective of treatment had the same number of leaves (4). However, At 35 DAP, poultry manure 10t/ha and combined poultry manure and NPK treatments i.e. (PM10t/ha+NPK40kgN/ha) produced higher leaf counts (6 leaves) compared with the control (5 leaves). By 56 DAP, both PM5t/ha+NPK40kgN/ha and PM10t/ha+NPK40kgN/ha recorded the highest leaf number (6), while control and sole poultry manure or NPK treatments had fewer leaves (4–6) (table 3).

Number of Pods

Pod initiation was at 56 DAP and was strongly influenced by fertilizer treatments. At 56 DAP, the number of pods (2.86) was highest in the control (0.25) and in the most sole treatments, where pods were few or none (table 4). At 77 DAP, NPK 40kgN/ha produced 7 pods; combinations of poultry manure and NPK produced medium pod numbers. At 84 DAP, pod numbers decreased across most treatments; NPK 40kgN/ha produced the highest values. These results indicate that higher nutrient supply, especially from combined manure and NPK, supported higher yield than sole applications.

Pod Circumference

Pod circumference varied significantly across treatments and growth stages. The largest mean pod circumference (6.89 cm) was recorded at 56 DAP in the PM10t/ha+NPK40kgN/ha treatment (Table 5). Following were PM10t/ha+NPK20kgN/ha (4.04 cm) and control (0.63 cm). At subsequent sampling time points (63–84 DAP), pod diameter was highest in the integrated fertilized treatments and was significantly lower in the sole fertilized and unfertilized control treatments (Table 5). The data show that integration of organic and inorganic fertilizers has a beneficial effect on fruit size and yield quality.

Table 2: Mean of Plant Height (cm) at 21-56 Days after Planting (DAP)

	DAP					
Treatments	**21**	**28**	**35**	**42**	**49**	**56**
Control	8.60	13.24b-f	14.67b-f	20.2c-h	27.4b-c	24.4c-h
PM 5t/ha	8.791	12.26b-g	17.62	21.7b-g	24.1b-h	24.9c-g
PM 10t/ha	12.46	18.85a	24.30ab	30.6ab	35.3ab	39.5ab
NPK 20kgN/ha	6.19	9.95e-g	13.88c-i	16.6c-i	18.4c-i	20.7c-i
NPK 40kgN/ha	9.4	15.63a-d	19.65a-e	25.2a-d	28.1b-d	31.3a-e
PM5t/ha+NPK20kgN/ha	10.55	16.40ab	20.80abc	25.5abc	29.6abc	33.8abc
PM5t/ha+NPK40kgN/ha	9.30	14.73a-e	20.12a-d	24.7a-e	26.9b-f	29.5b-f
PM10t/ha+NPK20kgN/ha	7.75	15.80a-d	19.30a-f	23.3b-f	24.2b-g	33.0a-d
PM10t/ha+NPK40kgN/ha	11.90	18.95a	27.20a	32.9a	40.1a	44.7a
LSD	NS	5.376	8.031	8.930	11.820	13.640

Table 3: Mean of Number of Leaves at 21-56 Days after Planting (DAP)

	DAP					
Treatment	**21**	**28**	**35**	**42**	**49**	**56**
Control	4	4b-d	5	6a-f	6	5a-d
PM 5t/ha	4	3c-e	4	4e-h	4	4b-i
PM 10t/ha	4	5ab	6	6abc	5	5a-h
NPK 20kgN/ha	4	3c-e	4	4d-g	5	5a-e
NPK 40kgN/ha	4	5ab	5	7ab	6	5a-g
PM5t/ha+NPK20kgN/ha	4	5a-c	5	6a-f	6	5a-f
PM5t/ha+NPK40kgN/ha	4	5a-c	5	6abc	5	6abc
PM10t/ha+NPK20kgN/ha	4	5ab	5	5a-f	6	5a-f
PM10t/ha+NPK40kgN/ha	4	5a	6	8a	7	6ab
LSD		1.144	NS	1.923	NS	1.990

Table 4: Mean of Pod Number at 56-84 Days after Planting (DAP)

Treatment	DAP 56	63	70	77	84
Control	0.25	0.00	0.00	0.00	0.00
PM 5t/ha	0.75	0.00	0.25	0.25	0.50
PM 10t/ha	0.75	0.25	0.00	0.00	0.00
NPK 20kgN/ha	0.00	0.00	0.00	0.00	0.00
NPK 40kgN/ha	0.75	0.25	0.00	7ab	0.00
PM5t/ha+NPK20kgN/ha	0.25	0.00	0.00	0.50	0.75
PM5t/ha+NPK40kgN/ha	0.50	0.25	0.50	0.50	0.50
PM10t/ha+NPK20kgN/ha	1.00	0.75	0.00	0.50	0.25
PM10t/ha+NPK40kgN/ha	2.86	0.97	0.05	0.61	0.33
LSD	1.09	NS	NS	NS	NS

Table 5: Mean of Pod Circumference at 56-84 Days after Planting (DAP)

Treatment	DAP 56	63	70	77	84
Control	0.63	0.00	0.00	0.00	0.00
PM 5t/ha	2.75	0.00	0.68	0.57	0.38
PM 10t/ha	0.78	0.83	0.00	0.00	0.00
NPK 20kgN/ha	0.03	0.00	0.00	0.00	0.00
NPK 40kgN/ha	2.88	1.58	0.00	0.00	0.00
PM5t/ha+NPK20kgN/ha	1.25	0.01	1.00	1.68	1.38
PM5t/ha+NPK40kgN/ha	2.25	1.98	0.95	1.73	1.83
PM10t/ha+NPK20kgN/ha	4.04	1.00	0.00	0.88	0.88
PM10t/ha+NPK40kgN/ha	6.89	2.18	0.11	0.85	0.95
LSD	1.09	NS	NS	NS	NS

Discussion

Findings from this study demonstrate that the integration of poultry manure with inorganic fertilizer i.e NPK 15:15:15 significantly improved okra yield and growth. However, with respect to plant height, PM 10t/ha application recorded the highest plant height while a combination of poultry manure (5 t/ha) plus NPK of 20kgN/ha had the highest plant height after the PM 10t/ha application compared to control which showed the least Plant height after NPK fertilizer of 20kgN/ha application. This finding is in line with the work of Adekiya *et al.* (2020) who reported that organic manure especially poultry manure, increased plant height when compared with other sources of manure. Also, Al-yasari and Al-jbwry (2024) reported that a combination of organic and inorganic fertilizer significantly improved morphological parameters such as plant height.

This study revealed varying effects of different levels of manure and NPK fertilizer on the number of leaves of Okra plant. There were significant differences between 28, 42 and 56 days after planting. At 42 Days, poultry manure of 10 tonnes plus NPK at 40kgN/ha (PM10t/ha+NPK40kgN/ha) had the highest number of leaves (8) and is significantly different to other treatments such as poultry manure of 5tonnes/ha and NPK fertilizer of 20kgN/ha and even the control which showed lesser number of leaves. This correlates with the findings of Sharma *et al*. (2022), who stated that the increase in number of leaves per plant with organic manures application is important during the vegetative phase of crop plants. Also, it has been observed that leaf production was always greater in combined treatments indicating that balanced nutrient supply stimulated vigorous vegetative growth. The increased number of leaves in combined treatments is important especially

because leaf area directly affects photosynthetic capacity and assimilative production which in turn influences yield i.e. pod abundance.

With respect to the effect of treatments on pod number, There were significance differences between treatments in the days after planting especially 56-84 DAP, both combined treatment PM10t/ha+NPK20kgN/ha and PM10t/ha+NPK 40kgN/ha showed the highest pod number. Highlighting the efficacy of combined organic and inorganic fertilizer in improving yield of okra. This finding further corroborated with the findings of Han *et al*. (2022) who reported that higher yield response of crops due to organic manure application could be attributed to improved physical and biological properties of the soil resulting in better supply of nutrients to the plants.

The efficacy of combined fertilizer application on the yield is further maintained, with respect to pod circumference, Poultry manure of 10t/ha plus NPK 20kgN/ha i.e. (PM10t/ha+NPK40kgN/ha) at 56 days DAP showed the highest number of pod circumference followed by PM10t/ha+NPK 20kgN/ha. This enhanced yield was maintained throughout the growing period. It is evident that Pod yield (number and circumference) was greatest under integrated fertilizer treatments, especially PM10t/ha+NPK40kgN/ha. This demonstrates the importance of integrated nutrient management to improve reproductive growth, fruit quality, and yield potential. The higher yields achieved from integrated treatments can be explained by a synergistic effect: poultry manure improves soil physical and biological conditions while NPK provides readily available nutrients that are necessary for rapid plant growth. This synergy has the effect of reducing nutrient losses with the application of only inorganic fertilizer and offsets the slow release of nutrients from organic matter. This effect is in line with works of Ahmed *et al*. (2023) who reported superior yield in maize when organic and inorganic fertilizer are combined.

Conclusion

The study showed that both poultry manure and NPK fertilizer had a significant impact on the growth and yield of okra, but the two combined gave better results than either alone. At 10 t/ha poultry manure increased the vegetative growth (mainly plant height and leaf number) while the addition of poultry manure with NPK fertilizer produced the greatest number of pods and pod circumference. The control always had the lowest results, illustrating the importance of nutrient supplementation in okra cultivation. These results show the complementary functions of organic and inorganic fertilizers where poultry manure improves the soil condition and nutrient retention while NPK supplies nutrients that are immediately available and needed for rapid growth of the crop. Farmers are therefore advised to embrace the use of poultry manure in combination with NPK fertilizer to enhance optimum growth and yield of Okra, thereby scaling up supply to meet the ever increasing Okra demands in foods, nutraceutical and cosmetics industries.

Competing Interests

The authors declare no conflict of interest.

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