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THE GROWTH AND YIELD OF TWO OKRA VARIETIES AS INFLUENCED BY DIFFERENT LEVELS OF POULTRY MANURE

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**Abstract**

The reliance on the use of organic fertilizers (OFs) to boost yields and quality of crops is on the increase all over the world. This guarantees not only food security, but also the production of healthy food especially where promising cultivars are used. Therefore, this field study was conducted during 2024 raining season at Federal University Gashua, Nigeria, to investigate the effect of different levels of poultry manure (PM) (0, 3, 6, and 9 t ha<sup>-1</sup>) on two varieties of okra (NHAR 47-4 and Jawa local). The experiment was laid out in a Randomized Complete Block Design (RCBD) and replicated three times. The effect of variety on plant height was significant as Jawa local variety produced the tallest plants at 7 and 10 weeks after sowing (66.75 cm and 125.36 cm) compared to (50.71 cm and 73.83 cm) from NHAR 47-4 improved variety. However, NHAR 47-4 variety produced significantly longer fruits/pods and highest number of fruits/pods throughout the harvest periods, and highest total fresh fruit weight (694.3 g) per plant compared to 65.9 g from Jawa local. The interaction results also revealed that the highest number of fruits were obtained from NHAR 47-4 variety when 9 t ha<sup>-1</sup> PM was added after the third harvest. Therefore, NHAR 47-4 variety performed better in some yield attributes than Jawa local variety especially with the addition of 9 t ha<sup>-1</sup>. Thus, 9 t ha<sup>-1</sup> of PM is recommended, especially under the Sahel agro-ecological condition.

**Keywords:** Growth, Jawa local, NHAR 47-4, Poultry manure, Okra varieties, Yield

**Introduction**

Okra (*Abelmoschus esculentus* L. Moench) is native to the African continent, was believed to have originated from Ethiopia and grown extensively in the tropics and subtropic areas of Africa and Asia (Dantas et al., 2021). Okra is an important vegetable crop, considering its

nutritive values. Okra is grown primarily for its soft immature fruits or pods that are nutrient-rich with many health benefits (Ntia et al., 2017). The pods are also used as appetite boosters and are also widely utilized as an aphrodisiac (Elkhalifa et al., 2021). In Nigeria, its production is ranked third, following tomato

and onion (Bello et al., 2023). Mucilaginous and low in calories, okra pods are high in nutrients and a wonderful source of dietary fiber that can be eaten (Romdhane et al., 2020) and the third most important fruit vegetable crop after tomato in Nigeria. Known for its cultivars has a significant impact on the productivity of okra, hence the need for growing improved varieties and hybrids that yield higher net returns than other varieties cultivated under the same climatic regimes and with the same inputs (Mashuubu et al., 2024; Meena et al., 2021). Compared to Jawa local, NHAR 47-4 developed and released by NIHORT is an early maturing okra variety (Umeri et al., 2025).

The OFs or inorganic fertilizers are sources of plant nutrients. In addition to providing plant nutrients for crop growth, fertilizers have an impact on the physiological functions of plants, which are crucial tools in enhancing crop yield (Salisu, 2020). The use of inorganic fertilizer such as NPK is known to boost the growth and yield of many arable crops. However, chemical fertilizer like NPK is very costly beyond the affordability of many common farmers. The use of chemical fertilizers may also pollute the environment and raise the production costs, hence the need for alternative sources that are relatively cheaper and environmentally friendly (Muhammad et al., 2020). The act of using OFs is more cost-effective than using inorganic ones as they do not leave behind harmful residues in the soil and don't harm it even if applied in excess (Ansar et al., 2021). High concentrations of essential nutrients can be found in organic manures, which can improve crop growth and soil quality (Zhao et al., 2021). The use of organic manures also

bility to heal, okra has been used traditionally to treat a variety of illnesses and external injuries and boils (Agregán et al., 2023).

Like with many other crops, studies have indicated that the use of low-yielding native improves soil physical properties such as porosity, water retention capacity, and lowers bulk density (Loper et al., 2010).

The use of PM has helped tremendously in improving crop production in many regions of West Africa (Ibeh et al., 2019). Poultry manure

has been reported to be the most effective OF that improved both the physico-chemical soil

properties and the performance of *Vigna unguiculata* and *Zea mays* (Onunwa et al., 2021). The growth and yield of maize as well as the soil properties were improved with the application of PM with urea fertilizers (Adekiya et al., 2020). The growth and yield of carrot were significantly improved with the addition of PM (Agbede et al., 2017).

Despite the known benefits of PM, specific research on the ideal application rate for different okra varieties under the Sahel ecological conditions is limited. The use of PM as a fertilizer is a common practice in agriculture due to its rich nutrient content which can enhance soil fertility and crop productivity. Therefore, the ideal rate of PM for different okra (*Abelmoschus esculentus*) varieties under Sahel conditions need to be investigated.

## **Materials and Methods**

### **Experimental Site**

The experiment was conducted at the biological garden of the Federal University, Gashua, Yobe State, Nigeria (12° 53' N, 11° 00' E) from June to September, 2024. The experimental area lies within the Nigerian Sahel savanna and usually have rainfall between the months of June to September, with rainfall establishment basically in early July. This experiment was started in the middle of June, 2024 and completed in September 2024.

### **Planting materials and their sources**

This study involved two types of okra seeds. The improved variety NHAR47-4 was sourced from University of Maiduguri, and the local variety called Jawa local, from anearby village, Jawa. Both are early maturing varieties with a good draw property, with NHAR47-4 having a high yield potential.

### **Treatments and Experimental Design**

This experiment was a factorial combination of four levels of PM (0, 3, 6, and 9 tons ha<sup>-1</sup>) and two okra varieties, (NHAR 47-4 and Jawa local) making eight (8) treatments that were labelled as T1= 0 ton ha<sup>-1</sup> + NHAR 47-4, T2 = 0 ton ha<sup>-1</sup>+ local variety, T3 = 3 ton ha<sup>-1</sup> + NHAR 47-4, T4 = 3 ton ha<sup>-1</sup> + local variety, T5 = 6 ton ha<sup>-1</sup> + NHAR 47-4, T6 = 6 ton ha<sup>-1</sup> + local variety, T7 = 9 ton ha<sup>-1</sup> + NHAR 47-4, T8 = 9 ton ha<sup>-1</sup> + local varieties. These were replicated 3 times and arranged in a Randomized Complete Block Design (RCBD).

### **Agronomic Practices**

The experimental site was cleared of existing vegetation and tilled twice manually using hoe to ensure a fine tilth. The land was then marked and demarcated into plots and blocks. The gross plot size was marked into basins of 1.8 m x 1.8 m (3.24 m<sup>2</sup>) using manual hoe with a border space of 0.5 m, with 0.8 m between blocks, and 0.3 m between the plots. Each plot consisted of three rows spaced 60 cm apart, and also intra row spacing of 60 cm (i.e. 60 cm x 60 cm). The PM was collected from the Federal University, Gashua poultry farm. The PM (0, 3, 6, and 9 tons /ha) was applied 2 weeks before sowing to allow for mineralization. The seeds were sown by dibbling method at a depth of about 2 cm. Three seedlings were sown which were later thinned to one plant per hill two weeks after germination. Weeds were controlled manually using a hoe. There were nine plants per plot from which three were selected randomly and tagged to ease data collection. Harvesting was

carried out when the crop attained physiological maturity, as the pods were tender and attained the length of about 7cm. It was done manually by cutting the pod from the bud level and putting them inside different sacks for each plot and labelled. The okra was harvested at 5 days intervals.

### **Data Collection**

The data on growth parameters (plant height and number of leaves) were collected at 4, 7, and 10 weeks after sowing (WAS) while the yield data were measured at harvest.

### **Plant Height (cm)**

Plant height was measured using a retractable measuring tape from the three tagged plants per plot and the average was computed.

### **Number of Leaves per Plant**

The number of leaves of okra plant was obtained by counting the number of leaves from the three tagged plants, and the average was computed.

### **Number of Fruits**

The number of pods at each harvest from each plot was counted manually and recorded.

### **Fruits Length**

Five fruits (where obtainable) were sampled from each plot, cleaned and the length was measured using a ruler and the mean data were recorded from each plot. This was started from the second harvest.

### **Fresh Fruit Weight**

The harvested pods from each plot at each harvest were manually cleaned and weighed using sensitive weighing balance CAMRY (Model: EK3250/ 5 kg/11lb 1 g/0.05oz capacity). Later, the cumulative fresh weight across all harvests was calculated.

### **Dry Fruit Weight**

After every harvest, the harvested pods were cleaned, sliced and air dried, then weighed using a sensitive weighing balance. The cumulative weight after all harvest was calculated and expressed in kilogram per hectare.

### **Statistical Analysis.**

The collected data were analyzed with the statistical analysis software (SAS Version 9.4)

and significant means were separated using Tukey's Honesty Significant Difference (HSD) at 5% level of probability.

## **RESULTS AND DISCUSSION**

### **Results**

#### **Effects of variety and poultry manure levels on plant height and number leaves of okra**

Table 1 shows the effect of PM levels on plant height and the number of leaves of okra. From the table, plant height differs significantly between NHAR47-4 and Jawa local, with the local variety providing the tallest plants averaging 66.75 and 125.36 cm at 7 and 10 WAS, respectively. The number of okra leaves did not differ significantly throughout the period of data collection.

However, the effect of PM was not significant on plant height and number of leaves of okra throughout the period of data collection.

Similarly, the interaction effect between PM and levels and okra varieties was not significant.

#### **Effects of variety and poultry manure levels on okra**

##### **fruit's length**

Table 2 shows the effect of variety and PM levels on okra fruit length at various harvest periods. The effect of variety on okra fruit length was highly significant across all harvest periods with NHAR 47-4 providing the longest okra pods of 15.38 and 11.83 cm compared to 2.47 and 4.44 cm produced by Jawa local variety at third and fourth harvests, respectively.

However, the influence of PM on the okra fruit length was not significant. Similarly, there was

no significant interaction between variety and PM levels on the okra fruit length.

### **Effects of variety and poultry manure levels on the number of fruits of okra**

The effect of variety and PM levels on the number of fruits of okra is shown on Table 3. The influence of variety on the number of fruits of okra was highly significant throughout the harvest periods and of course, on the cumulative number of fruits produced. The highest average number of fruits (13.08) per plant was obtained at the third harvest. The improved variety-NHAR 47-4 produced a total of 27.9 fruits per plant on the average, compared to only 1.42 produced by the local variety.

Similarly, the influence of PM on the number of fruits of okra was only significant after the 3<sup>rd</sup> harvest. The highest average number of okra pods (12.00) per plant was produced with the application of 9 tons ha<sup>-1</sup> of PM.

### **Interaction between variety and poultry manure rates on the number of okra fruits**

The interaction effect between PM and variety on the number of okra fruits at third harvest was also significant (Table 4). The application of 9 tons ha<sup>-1</sup> of PM on NHAR 47-4 variety yielded 23.7 fruits per plant on the average. There were no okra pods produced by the Jawa local variety with the application of 3 tons ha<sup>-1</sup> and where no PM was added.

### **Effects of variety and poultry manure levels on fresh weight of okra**

Table 5 shows the effect of variety and PM levels on fresh weight of okra fruits. Fresh fruit weight was significantly different between the

two okra varieties throughout the period of data collection except at the first harvest. Accordingly, the average heaviest fruits (358.05 g) were produced by NHAR 47-4 at the third harvest compared to 15.94 g provided by Jawa local variety. Similarly, the average total fresh fruit weight was highest (694.30 g) by NHAR 47 - 4 compared to 65.90 g produced by Jawa local.

Similarly, the influence of PM on okra fresh fruits weight was significant at the third harvest. The average heaviest fruits (349.18 g) were obtained with the application of 9 tons ha<sup>-1</sup> of PM. The average lowest fruit weight (102.53 g) was obtained from where no PM was added. There was no significant interaction between PM x V on the okra fresh fruits weight.

### **Effects of variety and poultry manure levels on plant height and number leaves of okra**

Table 6 shows the effect of variety and PM levels on the dry weight of okra fruit. There was significant difference in okra dry fruit weight throughout the harvest periods and on the cumulative dry weight and yield per hectare. The heaviest dry fruit weight (68.4 g) was obtained from NHAR 47-4 after the 3<sup>rd</sup> harvest. The total dry pod weight (113.9 g) and dry yield (351.7 kg ha<sup>-1</sup>) per plant was provided by NHAR 47-4 variety compared to 3.31 g and 24.1 kg ha<sup>-1</sup> produced by Jawa local variety.

However, the effect of PM was not significant on the dry weight of okra throughout the harvest periods. Similarly, the influence of PM x V on the dry weight of okra fruit was not significant.

## **Discussion**

### **Growth and yield of okra as affected by poultry manure levels**

A significant increase in okra growth in terms of plant height was observed at 7 and 10 WAS with Jawa local variety. This could be because by then, the mineralization of the PM might have been completed and nutrients such as nitrogen are released to facilitate the growth of okra plant, which the local cultivar took advantage. The Poultry manure's beneficial role in boosting soil nutrients such as nitrogen, phosphorus, and potassium, may be the reason and released essential nutrients such as nitrogen, phosphorus and potassium that favored the production of more pods that are considerably longer. When compared to other forms of OFs, the use of PM had greatly improved the yield of okra in terms of number of pods and pod weight (Khandaker et al., 2017).

The length, thickness, and number of fruits or pods produced per plant are the main factors influencing the yield of okra. The yield is also equally influenced by the stage at which the pods are harvested (Meena et al., 2021). However, the influence of PM rates was not significant on most of the parameters measured across different harvest periods. This might be because OFs release nutrients very slowly and may take considerably long time for any substantial effect to manifest. This is why farmers' need to boost crop production can hardly be met by applying OF alone throughout the growing season due to its slow effect (Lu et al., 2024).

for the notable increase in plant height per plant that results from its application (Muhammad et al., 2020). In another study, it was reported that the height of okra plant was significantly improved by 30.4% with the application of PM (Fagwalawa & Yahaya, 2016). By 10 WAS, addition of PM has raised the plant height by 17.2%.

The influence of PM addition had also significantly increased the number of okra fruits and fruit length at third harvest. By this time, the PM might have decomposed and mineralized

### **Growth and yield of okra as affected by variety**

The improved variety NHAR 47-4 produced the average highest number of fruits (13.08) per plant with the application of 9 tons ha<sup>-1</sup> of PM by the third harvest. Generally, improved varieties of crops have high demand for nutrients. By the third harvest, mineralization of nutrients from the added PM might have been completed. Applying a sufficient quantity of organic manure to (good varieties of) plants enhances their performance and helps them produce more fruits (Makinde et al., 2024). Similarly, the addition of Gateway OF at the rate of 10 t ha<sup>-1</sup> has significantly enhanced the fruit yield production in cucumber (Alarima et al., 2022). Several studies have indicated that the use of improved crop varieties can improve agricultural productivity (Seydou et al., 2023). Modern crop varieties have more yield potentials compared to local varieties (Rahman & Connor, 2022), and that may be the reason why NHAR 47-4 outperformed Jawa local despite being not native to the study environment.

## Conclusion

The improved variety NHAR 47-4 performed better than the Jawa local variety in many yield parameters especially on the number of pods when 9 t ha<sup>-1</sup> of PM manure was added. The growth of okra plants in terms of plant height was better with Jawa local. Poultry manure did not affect most growth and yield parameters throughout the study period. Thus, the production of NHAR 47-4 variety of okra is recommended using 9 t ha of PM among farmers especially in the Sahelian agro-ecological conditions.

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Table 1: Effects of variety and poultry manure levels on plant height and number leaves of okra

Treatment	Plant height (cm)			Number of leaves			
	4 WAS	7WAS	10 WAS	4 WAS	7WAS	10 WAS	
<b><u>Variety(V)</u></b>							
NHAR 47-4	12.89	50.71b	73.83b	5.38	12.20	13.87	
Jawa local	11.36	66.75a	125.36a	5.52	10.44	11.05	
SE±	0.61	3.94	5.87	0.36	1.11	1.28	
<b><u>Poultrymanure(PM)(tha<sup>1</sup>)</u></b>							
0	11.10	52.02	82.50	5.17	9.67	10.82	
3	13.25	56.47	107.78	5.20	9.45	12.45	
6	12.05	64.95	108.50	6.27	12.05	12.02	
9	12.10	61.48	99.58	5.17	14.12	14.55	
SE±	0.87	5.57	8.31	0.36	1.58	1.81	
<b>V x PM</b>	ns	ns	Ns	Ns	ns	ns	

Note: Means followed by the same letter(s) in the same column are not significantly different using Tukey's HSD at 5% level of probability. ns = not significant.

Table 2. Effects of variety and poultry manure levels on okra fruit length

Treatment	Fruit Length at Various Harvests (cm)		
	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>
<b><u>Variety (V)</u></b>			
NHAR 47-4	11.16a	15.38a	11.83a
Jawa local	0.00b	2.47b	4.44b
SE±	1.34	1.19	1.35
<b><u>Poultry manure (PM) (t ha<sup>-1</sup>)</u></b>			
0	5.13	6.92	10.12
3	4.68	9.45	10.75
6	5.60	8.75	5.43
9	6.90	10.57	6.25
SE±	1.89	1.67	1.91
<b>V x PM</b>	ns	Ns	Ns

Note: Means followed by the same letter(s) in the same column are not significantly different using Tukey's HSD at 5% level of probability, ns = not significant.

Table 3: Effects of variety and poultry manure levels on the number of fruits of okra

Treatment	Numbers of Fruits at Various Harvest				Total Number of Fruits
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	
<b><u>Variety (V)</u></b>					
NHAR 47-4	2.42a	7.17a	13.08a	5.25a	27.92a
Jawa local	0.08b	0.00b	0.50b	0.83b	1.42b
SE±	0.58	1.62	1.02	0.25	3.11
<b><u>Poultry manure (PM) (t ha<sup>-1</sup>)</u></b>					
0	0.17	1.33	4.33b	3.17	9.00
3	0.83	1.67	4.67b	3.33	10.50
6	1.00	4.00	6.17b	1.50	12.67
9	3.00	7.33	12.00a	4.17	26.50
SE±	0.82	2.29	1.44	0.36	4.40
V x PM	ns	Ns	**	Ns	Ns

Note: Means followed by the same letter (s) in the same column are not significantly different using Tukey's HSD at 5% level of probability, ns = not significant.

Table 4. Interaction effect between variety and poultry manure rate on the number of okra fruits at third harvest.

Variety	Poultry manure (PM) (t ha <sup>-1</sup> )			
	0	3	6	9
NHAR 47-4	8.67bc	7.67bc	12.33b	23.67a
Jawa local	0.00c	0.00c	1.67c	0.33c

Table 5: Effect of variety and poultry manure levels on fresh fruit weight of okra

Treatment	Fresh Fruit Weight (g) at Various Harvests				Total fresh weight (g)
	1st	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	
<b>Variety (V)</b>					
NHAR 47-4	32.36	193.36a	358.05a	110.56a	694.30a
Jawa local	28.59	0.00b	15.94b	21.38b	65.90b
SE±	21.2	53.6	38.3	15.8	95.8
<b>Poultry manure (PM)(t ha<sup>-1</sup>)</b>					
0	49.86	38.5	102.53b	68.98	259.90
3	22.20	45.1	132.53b	59.55	259.40
6	16.07	94.5	163.73b	35.42	309.70
9	33.78	208.6	349.18a	99.93	691.50
SE±	30.0	75.7	48.6	22.4	135.4
V x PM	ns	Ns	Ns	Ns	Ns

Note: Means followed by the same letter(s) in the same column are not significantly different using Tukey's HSD at 5% level of probability, ns = not significant.

Table 6: Effects of variety and poultry manure levels on the dry fruit weight of okra

Treatment	Dry Fruit Weight (g) at Various Harvests				Total dry weight (g)	Yield (kg/ha)
	1 <sup>ST</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>		
<b><u>Variety (V)</u></b>						
NHAR 47-4	7.67a	23.51a	68.36a	14.401a	113.96a	351.70a
Jawa local	0.71b	0.00b	3.31b	4.12b	7.78b	24.10b
SE±	2.28	7.20	7.79	2.29	16.5	72.1
<b><u>Poultry manure (PM) (t ha<sup>-1</sup>)</u></b>						
0	0.467	3.07	29.05	13.040	43.47	134.2
3	2.600	5.90	21.50	8.033	38.02	117.4
6	2.350	11.35	30.42	4.000	48.13	148.6
9	11.333	26.70	62.37	13.467	113.87	351.4
SE±	3.23	10.19	11.01	3.24	23.4	51.0
V x PM	Ns	ns	Ns	Ns	ns	Ns

Note: Means followed by the same letter(s) in the same column are not significantly different using Tukey's HSD at 5% level of probability, ns = not significant.