

Advancement of Vegetative Growth of Okra (*Abelmoschus esculentus*) as it Responds to Different Organic Manure and Rates in Awka, South East of Nigeria.

Obidiebube, Eucharia. A., Obasi Chiamaka. C., Okolie, Henry., Muojiamma, Stella. O., and Ezeanya Chiazokam.

Department of Crop Science and Horticulture, Nnamdi Azikiwe University, Awka. Anambra State. Nigeria

DOI: <https://doi.org/10.51244/IJRSI.2026.1308000326>

Received: 07 September 2026; Accepted: 12 September 2026; Published: 24 September 2026

ABSTRACT

An experiment to determine the effects of different organic manure types and rates on the vegetative growth of okra was conducted in bags at the Teaching and Research Farm of the Department of Crop Science and Horticulture, Nnamdi Azikiwe University Awka, Anambra State. A factorial experiment consisting of two different organic manure types (at five different levels with 0t/ha as control treatment. The experiment was laid out in a completely randomized design. Data were collected on number of days to emergence, number of days to 50% emergence, number of leaves and branches, stem girth, plant height, whole body weight, shoot fresh and dry weight, root fresh and dry weight. All data collected were subjected to analysis of variance (ANOVA) and significant differences among treatment means were separated using the least significant difference (LSD) at a 5% level of significance. Pig manure significantly ($P<0.05$) gave the best performance in number of leaves, number of branches, plant height, whole body weight, shoot fresh and dry weight and root fresh and dry weight. Manure rate 15t/ha of pig significantly at $P<0.05$ produced the highest number of leaves at 6weeks after planting with mean value of 10.58 and had almost the same value with 20tons/ha on branches in the same 6weeks after planting with the mean value of 10.92 and 10.95 respectively. Pig manure at 20t/ha was significantly higher for the whole-body weight (58.7g), shoot fresh weight (48.0g) and shoot dry weight (37.6). Poultry manure applied at 20t/ha rate showed significantly higher performance than the other poultry manure rates in days to 50% emergence, number of branches, stem girth, whole body weight and shoot and root weight parameters. Pig manure at the rate of 15t/ha had the most positive effect on the vegetative growth of okra which gave the highest number of leaves and branches and high plant height and stem girth which aided photosynthesis.

Key words: Okra, Organic Manure, vegetative growth, rates, plant parameters

INTRODUCTION

Okra is an erect, coarse annual crop growing up to between 1m and 2m, resembling other mallows. The leaves are large, alternate, cordate and divided into 3-7 lobes with toothed margins; reaching about 30cm in length and generally hairy (Abdulraheem et al., 2017). Okra is a multipurpose crop due to its various uses of the fresh leaves, bud, flowers, pods, stems, and seeds (Minhretu et al. 2014), Okra plays an important role in the human diet by supplying carbohydrate, protein, fats, minerals and vitamins that are usually deficient in some staple foods (Abdulraheem and Charles 2016, Gemedet et al. 2014). Okra seeds may be roasted and ground to form a caffeine-free substitute for coffee (Calisir and Yildizi 2005). Okra is one of the most widely known and utilized species of the family Malvaceae (Naveed et al. 2009). Okra (*Abelmoschus esculentus*) also known as ladies' finger is one of the most important vegetables grown in the tropics. In Nigeria it is produced predominantly by peasant farmers' usually in home gardens or in mixture with other cereal crops (Iyagba, 2012).

In cultivation it is best advised to cultivate with organic fertilizer/manures than inorganic fertilizer. This is because even though inorganic consist of some essential elements like nitrogen, phosphorous etc when compared to organic, they still result in some side effects which include soil, air and water pollution through nutrients leaching destruction of soil physical characteristics and accumulation of some toxic chemicals as well as causing severe environmental problems and loss of biodiversity.

Organic manure which ranges from fresh/dried plant materials to animal's litters and agricultural by-products (Green, 2015) has helped to override the challenges of inorganic fertilizer to which many crops have responded positively. Owolabi et al., (2003), reported the role of organic manure for sustaining the fertility of the soil to enhance the performance of vegetables and for binding the fine soil particles together, thereby preventing erosion and leaching in agricultural soil. Organic manures improve soil moisture, soil nutrient retention and soil physical properties.

Inadequate or imbalanced nutrient supply is one of the major constraints in harvesting higher yields. The deteriorating productivity of crops has been found to be associated with deterioration of soil physical and biological qualities besides imbalance in micronutrients (Parmar, 2014). Production constraints of okra in Nigeria have been attributed to low input supply system, where green fruit yields, in most instances, have been relatively low (Ibrahim and Hamma, 2012).

Despite the numerous potentials of okra fruit production, its level of production and yield per hectare has been very low in Nigeria (about 2.7 M t ha^{-1}) compared with India (10.5 M t ha^{-1}), Sudan (10.2 M t ha^{-1}), Egypt (15.7 M t ha^{-1}), and Saudi Arabia (11.5 M t ha^{-1}) (Varmudy 2011). Among the many factors responsible for low yield is the low fertility status of most soils in the growing areas,

Although the organic manures contain plant nutrient in small quantities as compared to inorganic fertilizer, the presence of growth promoting principles like enzymes and hormones, beside plant nutrients make them essential for improvement of soil fertility and productivity.

MATERIALS AND METHODS

Experimental Site: The study was carried out at the Teaching and Research farm of the Department of Crop Science and Horticulture Nnamdi Azikiwe University, Awka, Anambra State. Awka is characterized by tropical rain forest with temperature of 27° - 30° . The area is located between latitude $06^{\circ}15' \text{ N}$ and longitude $07^{\circ} 08' \text{ E}$. It has a minimum and maximum average temperature of 25.3°C and with average annual rainfall of 1828cm (Uko et al., 2018). The experiment was carried out between February and May 2023, it was a bag experiment.

Materials: Okra seeds were sourced from a reputable seed marketer; the organic manures (poultry manure and pig manure) were obtained from the department of Animal Science and Technology Nnamdi Azikiwe University, Awka and the bags sourced from the market at Eke – Awka.

Soil and organic manures sampling and analysis: Soil samples from 015cm depth of the experimental site was taken by simple random sampling method and the physicochemical properties of the soil at the beginning of the experiment was analyzed. Ten sub-samples were randomly taken and mixed thoroughly to get a composite sample. The soil sample was then pretreated by air drying and passed through a 2mm sieve before analysis. The various types of organic manure samples were collected, shade dried and taken to the laboratory for analysis.

Experimental Treatments: The treatments comprised of two different manure sources at five different rates which includes; poultry manure at 0 t/ha, 5t/ha, 10 t/ha, 15t/ha and 20t/ha and pig manure at 0 t/ha, 5 t/ha, 10 t/ha, 15t/ha and 20t/ha. T1 (poultry manure) and T2 (pig manure). The manures were allowed to cure for three weeks before applying.

Experimental Design: The experimental design was a 2 x 5 factorial laid out in a Completely Randomized Design CRD replicated three times. This was 10 treatment combinations. Factor A being the organic manure, factor B being the different rates of the organic manure. This was replicated 3 times making it 30 experimental units.

Planting: The soil obtained from the experimental farm of Crop Science and Horticulture Department Nnamdi Azikiwe University Awka, was carefully packed into the polybags, the polybags were half filled. The bags were punctured at the base to ensure proper aeration and drainage. The okra seeds were sown at a depth of 2-5cm, 4 seeds per bag. The planting was done in March 2023.

Manuring: The different organic manures were incorporated into the soil 2 weeks before sowing the Okra seeds to ensure proper decomposition and prevent toxicity effect on the seedlings.

Weeding and Irrigation: Weeding was carried out manually by hand picking at two weeks interval. Watering was done every evening and the quantity was 1.5 liters per bag.

Data Collection: On Growth Parameters, readings on growth parameters were taken from 2 weeks after planting, this data was collected on a weekly basis till harvest.

Days to emergence: Counting from the day of planting to the day of first seed emergence

Days to 50% emergence: Counting the days from planting to when half (50%) of the seeds planted emerged

Plant height (cm): This was done by using a meter rule to measure the plant from soil to the tip of the plant

Number of leaves per plant: This was calculated by counting the leaves on each plant, added all and divided by number of plants stand to get the average for each treatment combination

Plant girth per plant (cm): This was measured using a thread. This was wrapped around the stem and then placed in a ruler to get the reading.

Leaf area: the following equation was used to calculate the leaf area (LA) of each leaf; $L \times W \times K$ (1) Where, L= leaf length (cm), W= leaf width (cm) and K= 0.62 for Okra (Musa and Usman, 2016). This was done for three selected leaves per plant and averaged. The average for three plants was calculated per treatment combination.

Whole body weight, fresh shoot weight and fresh dry weight: The whole-body weight (both shoots and roots) per plant was measured by weighing soilless plant on a sensitive weighing scale; the shoot was separated from the roots and measured for fresh shoot weight. They were allowed to air dry at a constant weight and dry weight taken finally.

Statistical Analysis; All data collected were subjected to analysis of variance (ANOVA) and significant differences among treatment means were separated using the least significant difference (LSD) at a 5% level of significance.

RESULTS AND DISCUSSION

Animal manure application had positive effects on most of the plant parameters of okra (height, number of leaves, number of branches) measured. Okra responds very well to organic manure application (Boub, 2008). The growth characteristics of okra under soil amended with different rates of pig and poultry manure showed significant differences in number of leaves, plant height, number of branches, stem girth in this study. This is similar to the study of Akande et al 2010, which revealed that animal manure (pig and poultry) application had positive effects on most of the plant parameters (okra height, number of leave e.tc.). Manure

when decomposed increases both macro and micro nutrients as well as enhances the physico-chemical properties of the soil. This could have led to its high vegetative growth

Effect of Organic Manure Types and Rate on Number of Days to Emergence and 50% Emergence of Okra

There were equal days of emergence for all the manure types and rates according to the result in Table 1. This showed that organic manure did not have positive influence on days to emergence whereas it had significant ($P<0.05$) effect on days to 50% emergence. The findings on this work on days to 50% days to emergence were not in line with the work of Okoli et al., 2021, who found out that the effect of soil amendments on the seedling emergence percentage of fluted pumpkin showed that pig manure, cow manure and NPK fertilizer had the highest seedling emergence percentage but was not significant. Significant ($P<0.05$) effect on this study on percentage emergence was not also in consonant with the works of Cernac et al. (2006) and Ibe et al. (2014) which noted that germination percentage of plants propagated by seeds was not dependent on the nutrient status of the soil, but rather the sprouting seeds derived their nourishment from the food reserves stored in storage organs like cotyledons. However, on days to 50% emergence, okra responded best to 20t/ha poultry manure and this was statistically similar to 15 t/ha poultry manure and 20t/ha pig manure.

Table 1: Effects of Manure Rates on the Days to Emergence and 50% Emergence

Type of manure Rates(ton/ha)	Days of emergence	Days to 50% emergence							
pig			0			4.00			4.00
5			4.00				4.00		
10			4.00				4.00		
15			4.00				4.33		
20			4.00				5.00		
poultry		0			4.00		4.00		
5			4.00				5.67		
10			4.00				5.33		
15			4.00				6.33		
20			4.00				6.46		
LSD _{0.05}					NS				1.388

Effect of Organic Manure types and Rate on Number of Okra Leaves

In Table 2, number of leaves per plant is considered a crucial component for yield in okra because of its usefulness in the facility of photosynthesis (Sanjay et al., 2019). It was observed from this study that pig manure enhanced number of leaves, the reason was that 15t/ha of pig manure gave significantly the highest number of leaves. There was an increase in number of leaves following increase in manure rates in most weeks after planting in this study. This corresponds with findings from Waheed (2021) which states that increased number of leaves and leaf width due to increase in rate of manure application could be connected with the availability of such essential nutrients as N, P, K in appreciable amounts in the manure. In this study poultry manure on one hand at 15t/ha and 20t/ha gave significantly at $P<0.05$ higher number of leaves and statistically different from the control at 0t/ha poultry manure. Similarly, Khandaker et al., (2017) reported that poultry manure application increased the number of okra leaves by 37.8% as compared to the control treatment.

Effect of Organic Manure Types and Rate on Number of Branches

The number of branches of okra in this study was positively influenced by pig manure and as the rate of

application increased the number of branches increased and this was found on Table 3. The rate 15t/ha of pig manure gave significantly at $P<0.05$ the highest number of branches amongst the manure rates and was statistically similar to 20t/ha pig manure and 20t/ha poultry manure. Similar results had been found by Nweke et al (2013) who also gave similar results from his study that the poultry manure recorded the highest value in number of branches per plant in okra.

Pig manure rates had more positive influence on number of branches than poultry manure rates in this study which corresponds with findings of Okoli et al., (2021) that pig manure had the highest mean number of branches, while cow manure, poultry droppings followed respectively. Furthermore, Result from Nwanne et al., (2019) showed that organic manure had significant effects at $P<0.05$ on the number of branches of Okra produced and the most profuse branches were recorded at plots with poultry droppings in contrast to this study.

Effect of Organic Manure Types and Rate on Stem Girth

In Table 4. the widest stem girth was recorded in 20t/ha poultry manure and which was the highest in this study and is found in Table 4, which is in agreement with the findings of Adesida et al (2019) who observed that 20t/ha poultry manure gave the highest mean value for stem girth. The 20t/ha poultry manure stem girth was similar to 20t/ha pig manure. There was in this study a significant influence of manure rates on stem girth as seen in the trend of increasing stem girth with increasing rates of manure application and significantly higher than control treatment. The present result is in line with that of Adewole and Ilesanmi (2012), who found increases ($P<0.05$) in okra stem girth following the application of compost organic fertilizer relative to the control treatment.

Table 2: Effects of Different Manure Types and Manure Rates on Number of Leaves of Okra

Treatment	2WAP	3WAP	4WAP	5WAP	6WAP
Manure types					
PG	5.93	6.43	7.43	9.03	8.97
PM	5.13	4.63	6.09	7.65	8.24
LSD	0.432	0.432	0.744	0.730	1.013
Manure rates					
0	4.17	3.75	5.00	6.42	6.75
5	5.42	5.25	6.08	7.58	8.00
10	6.08	6.42	7.83	8.92	7.83
15	6.17	6.75	7.92	9.75	10.58
20	5.83	5.49	6.98	9.04	9.85
LSD _{0.05}	0.683	0.683	1.176	1.155	1.601

Pg (Pig Manure), Pm (Poultry Manure) and Wap (Weeks After Planting)

Table 3: Effects of Different Manure Types and Manure Rates on Number of Branches of Okra

Treatment	2WAP		3WAP		4WAP		5WAP		6WAP	
				Manure types						
PG	5.70		6.77		7.73		8.93		9.60	
PM		5.13 5.44 6.59 8.00 8.75								
LSD		0.472								

		0.703 0.887 1.088 1.213								
				Manure rates						
0		4.33		4.08		5.17		6.25		7.08
5		5.33	6.33 7.00 8.17 9.00							
10		5.33 7.17 7.17 7.75 7.92								
15		6.08 6.92 8.48 10.00 10.92								
20		6.00 6.01 7.99 10.17 10.95								
LSD _{0.05}	0.746 1.111 1.403 1.720 1.919									

Pg (Pig Manure), Pm (Poultry Manure) and Wap (Weeks After Planting)

Table 4: Effects of Different Manure Types and Manure Rates on the Stem Girth of Okra

Treatment	2WAP	3WAP	4WAP	5WAP	6WAP
Manure types					
PG	1.177	1.640	2.303	2.88	3.73
PM	0.960	1.414	2.688	3.30	4.33
LSD	0.1742	0.1007	0.3213	0.433	0.452
Manure rates					
0	0.400	0.908	1.477	1.87	2.23
5	1.028	1.550	1.972	2.39	3.33
10	1.290	1.725	2.688	3.25	4.29
15	1.320	1.725	3.050	3.58	4.71
20	1.306	1.726	3.292	4.35	5.58
LSD _{0.05}	0.2755	0.1592	0.5081	0.684	0.714

Pg (Pig Manure), Pm (Poultry Manure) and Wap (Weeks After Planting)

Effect of Organic Manure Types and Rate on Plant Height

Plant height is an important plant characteristic which has direct link with plant biomass and crop yield (Khandaker et al., 2017, Unagwu et al., 2019). Study has shown in Table 5, that plants require essentially huge amounts of NPK nutrients for adequate growth and development which is in line with the work of Gholizadeh et al., (2009), which affirmed that deficiency of any of these those nutrients will hinder plant growth. Pig manure is a good source of these nutrients and can be used as fertilizers for agricultural soils as reported by Okoli et al 2021. In this study 20t/ha pig manure consistently gave the highest plant heights weeks after planting and this was similar to findings from Unagwu et al., (2021) where the plant height of okra was positively influenced following animal manure application but those effects varied $P < 0.05$ across the treatments applied. It was observed that amongst the manure types pig manure gave the best plant heights and was increasing with increase in pig manure rates also corresponding with the works of Adesida et al., 2019 and Nweke et al., 2013 that reported plant height and number of leaves increased with increase in the organic manure rates applied. The positive effect of organic manure on plant height could be due to the contribution made by manure to fertility status of the soils.

Effect of Organic Manure Types and Rate on Leaf Area

The result in Table 6 from this study shows that pig manure had a great influence on leaf area and was statistically significant ($P < 0.05$). At weeks 2, 3 and 4 after planting it was observed that leaf area increased in response to pig manure rates. Okra leaf area responded best to 15t/ha poultry manure and was statistically similar to 15t/ha pig manure. This finding was supported by the results of Ufera et al. (2013) who stated that the largest leaf area was produced by the application of poultry manure. Poultry litter had the overall highest leaf area which is in accordance with the findings of Oladotun (2002) who reported similar thing in okra. The pig manure rates all gave significantly high leaf area in comparison with the control treatment 0t/ha of pig manure which is similar to Chowdhury and Rahman (2021), who found out that the minimum values of leaf area were recorded in control treatment.

Effect of Organic Manure Types and Rate on Shoot Fresh and Dry Weights

Pig manure as was shown in Table 7 results of this study gave the highest shoot fresh weight (48.0) and root dry weight (37.6) at 20t/ha and was significantly ($P < 0.05$) different from other treatments. The findings here are uniform with the results of Umoh et al., (2022) who worked on maize on maize who found out that out of the three organic manures used (poultry, pig and goat) and rates (0,10,20, &30) that pig manure on higher application rates (up to 10–15 tons/ha) produce the highest shoot fresh and dry weights. It is in contrast with the findings of Shahriazzaman et al., (2014) who declared that organic manure significantly enhances okra's vegetative parameters and that poultry manure consistently produces the highest shoot fresh and dry weights, often peaking at application rates of 15 to 20 tons/ha. Other manures like cow dung, pig manure, and vermicompost improve growth over unfertilized controls, but typically yield lower biomass than poultry waste.

Table 5: Effects of Different Manure Types and Manure Rates on Plant Height of Okra

Treatment	2WAP	3WAP	4WAP	5WAP	6WAP
Manure types					
PG	10.80	11.09	12.35	35.23	49.0
PM	8.18	8.28	10.17	26.14	36.0
LSD	0.602	0.620	0.729	2.933	4.72
Manure rates					
0	7.22	7.30	8.47	12.48	17.4
5	10.03	10.13	12.12	30.70	41.7
10	10.26	10.61	11.93	37.43	55.8
15	10.36	10.64	12.42	36.05	48.8

20	9.58	9.74	11.39	36.77	48.8
LSD _{0.05}	0.951	0.981	1.153	4.637	7.46

Pg (Pig Manure), Pm (Poultry Manure) and Wap (Weeks After Planting)

Table 6: Effects of Manure Rates on Leaf Area of Okra

Types of manure rates	2WAP		3 WAP		4 WAP		5 WAP	6 WAP			
pig		0		15.2		16.4		20.0		67.6	73.3
5		49.6		51.4		58.9		196.4	210.6		
10		53.8		69.0		71.6		272.2	284.7		
15		82.9		80.1		85.4		408.0	424.7		
20		89.4		90.2		93.2		169.0	184.4		
poultry	0		13.0		13.6		15.1		160.0	164.3	
5		31.9		33.9		37.1		280.6	297.0		
10		30.5		33.2		38.2		320.3	365.0		
15		48.2		49.5		57.3		448.3	486.4		
20		22.6		19.8		21.6		55.2	65.8		
LSD _{0.05}			18.88		29.86		42.23		66.77	94.42	

Table.7: Influence of Manure Rates on whole Body Weight, Shoot Fresh and Shoot Dry Weight of Okra

Types of manure rates	Shoot dry weight										
Whole body weight											
Shoot fresh weight											
(ton/ha)	G/plant		G/plant		G/plant						
pig		0		9.2		7.7		4.3			
5		25.5		14.5		11.6					
10		24.9		18.9		20.1					
15		40.6		31.7		29.1					
20		58.7		48.0		37.6					
poultry		0	4.1		4.8		4.3				
5		11.9		7.4		1.5					
10		18.2		14.7		11.7					
15		14.2		19.3		7.2					
20		42.7		39.2		27.6					
LSD _{0.05}			27.87		13.74		13.04				

Influence of Manure Types and Rates on Root Fresh and Root Dry Weight of Okra

In Table 8, the results of the mean values for root fresh and root dry weight for root fresh weight 20t/ha pig manure gave significantly ($p<0.05$) the highest mean value and was statistically similar to 20t/ha poultry manure and 15t/ha pig manure. On the root dry weight 20t/ha pig manure gave significantly ($P<0.05$) the highest mean value followed by 20t/ha poultry manure while the least mean value was recorded from 0t/ha and 5t/ha poultry manure. The findings were in contrast with that of Arslanoglu, (2022) who in his study on manure applications, found out that the highest root dry weight (RDW) was achieved with poultry manure application. Debbarma et al. (2018) reported that vermi compost and PM increased the nitrogen constituent in cell sap of the meri-statimatic tissue ensuring enhanced vegetative growth and accumulating more carbohydrate for increase in root size accumulating more carbohydrate for increase in root size. Similarly results from Islam et al (2020) showed that different organic manures and fertilizer had significant effect on fresh weight of roots per plant. the lowest (14.63 g) was found from the treatment to (Control). Contrariwise, maximum percent dry weight (40.85 %) of roots was recorded in the treatment T7 (50 % Vermicompost + 50 % Poultry manure) and minimum per cent dry weight (21.52 %) of roots was recorded in the treatment T0 (Control)treatment.

Table 8: Influence of manure rates on root fresh and dry weight

Manure type	Rate(ton/ha)		Root fresh weight		Root dry weight				
pig		0			2.53				0.18
5		6.57				4.13			
10		7.74				5.46			
15		11.43				7.46			
20		17.93				10.40			
poultry	0			1.20				0.46	
5		3.00				0.80			
10		3.54				0.92			
15		4.98			3.56				
20		12.56				8.03			
LSD _{0.05}			7.065				4.30		

CONCLUSION AND RECOMMENDATION

Application of organic manure at different rates enhanced the growth and development of okra vegetation compared to the untreated controls in this study indicating that okra responded well to the different organic manure rates in this study. Pig manure was the best performing manure type in this experiment as it showed significantly positive influence on all the parameters measured. on days to 50% emergence, okra responded best to 20t/ha poultry manure. Pig manure rate 20t/ha gave the best performance in the weight parameters in this experiment as it showed highest whole-body weight, shoot fresh weight, shoot dry weight, root fresh weight and root dry weight. But on the vegetative parameters 15t/ha pig manure gave the highest values for number of leaves and number of branches and significantly high values for plant height, stem girth and the weight parameters. on the poultry manure rates only 20t/ha significantly gave highest performance for number of branches, stem girth and all the weight parameters measured.

From this study pig manure is recommended amongst the two organic sources for the growth, development and production of okra. Pig manure rates of 15t/ha and 20t/ha are the recommended rates from this study. Poultry manure at 20t/ha and 15t/ha can also be used to enhance the production of okra

REFERENCES

1. Abdulraheem, M.I., Omogoye, A.M., Charles, E.F. 2017. "Application Effects of Pig Manure and NPK Fertilizer on Soil Chemical Properties and Okra Leaf Nutrient Contents". Paper presented at the 6th

- International and 15th National Conference on ‘Dynamic Trends in Plant Science: Fostering Environment’. 9-11th May, 2017. Quetta, Pakistan.
2. Abdulraheem, M.I. and Charles, E.F. 2016. Soil and Okra Pod Nutrients Composition as affected by Combined Application of Oil palm Bunch Ash, Ammonium nitrate and NPK. as presented at the 40th Conference of the Soil Science Society of Nigeria held at University of Calabar, Calabar. 14th – 18th March.
3. Abdulraheem, M.I. and Ojeniyi, S.O. 2015. Combined Application of Ammonium nitrate and Sawdust Ash in Okra Production Effects on Yield and Nutrients Availability. Nigeria Journal of Soil Science. 25: 146 – 154
4. Akande, M.O, Oluwatoyinbo, F.I, Makinde, E.A, Adepoju, A.S, Adepoju, I.S., 2010. Response of okra to organic and inorganic fertilization. Nat Sci 8(11):261-266.
5. Arslanoglu, S.F. 2022. Effects on the root and plant development of soybean of organic fertilizer applications. Bioscience Journal. 38, e38036. <https://doi.org/10.14393/BJ-v38n0a2022-60382>
6. Buob T.(2008. Fertilizing the Organic Garden. University of New Hampshire Cooperative Extension, 2008; 1-4. 4.
7. Calisir S, Yildiz MU. 2005. A study on some physico-chemical properties of Turkeyokra (*Hibiscus esculenta*) seeds. J. Food Eng. 68: 73-78.
8. Cernac, A, andre, C., Hoffmann-Benning, S., and Benning, C. 2006. WRI1 is required for seed germination and seedling establishment. Plant Physiology, 141:745-757
9. Chowdhury Shabnur and M. K. Rahman 2021, Influence of Different Organic Manures on Growth, Yield sand Mineral Nutrient Accumulation In Lettuce (*Lactuca Sativa L.*) Dhaka Univ. J. Biol. Sci. 30(2):159-168 DOI: <https://doi.org/10.3329/dujbs.v30i2.54642>.
10. Debbarma, B., Kanawjia, A., Jaysawal, N. and Kanojia, R.K. 2018) Studies on effect of different organic manures on growth and yield of radish (*Raphanus sativus L.*). International Journal of Chemical Studies, 6(4):378-380.
11. Gemed, H.F, Ratta, N, Haki, G.D, Woldegiorgis, A.Z, Beyene, F. 2014. Nutritional quality and health benefits of okra (*Abelmoschus esculentus*): a review. Food Sci. Qual. Manage. 33: 87-96.
12. Gholizadeh A, Amin M.S.M, Anuar A.R, Aimrun, W. 2009. Evaluation of SPAD chlorophyll meter in two different rice stages and its temporal variability, European J Sci Res 37(4):591598.
13. Green, B.W. 2015. Fertilizers in aquaculture. In: Davis, D. A., editor. Feed and Feeding Practices in Aquaculture. Sawston, Cambridge: Woodhead Publishing Ltd. 27-52.
14. Ibe, A. E., onuoha, G. N., Madukwe, D. K., Adeyemi, A. A. and Nwakasi, C. E. 2014. Assessment of Early Growth Performance of *Treculia africana* Under Different Growth Media Journal of Tropical Forest Resources 30(2):57-61.
15. Ibrahim, U. and Hamma, I. L. 2012. Influence of Farmyard Manure and Weeding Regimes on Growth and Yield of Okra (*Abelmoschus esculentus L. Moench*) in, Zaria. World Journal of Agricultural Sciences. 8 (5):453-458.
16. Iyagba, A. G. 2012. Growth and Yield Response of Okra (*Abelmoschus esculentus (L.) Moench*) Varieties to Weed Interference in South-Eastern Nigeria. 12(7).
17. Khandaker MM, Fadhilah NM, Dalorima T, Sajili MH, Mat N 2017. Effect of different rates of inorganic fertilizer on physiology, growth and yield of okra (*Abelmoschus esculentus*) cultivated on BRIS soil of Terengganu, Malaysia. Australian J Crop Sci 11(07):880-887. <https://doi.org/10.21475/ajcs.17.11.07.pne552>.
18. Mihretu Y, Wayessa G, Adugna D. 2014. Multivariate Analysis among Okra (*Abelmoschus esculentus (L.) Moench*) Collection in South Western Ethiopia. J. Plant Sci. 9(2): 43-50.
19. Naveed A, Khan AA, Khan IA. 2009. Generation mean analysis of water stress tolerance in okra (*Abelmoschus esculentus L.*). Pak. J. Bot. 41: 195-205.
20. Nwanne, A. J., Okonkwo, P. N., Uche-Nwachi, M. N., 2019, Effect of Organic Manure on the Growth and Yield of Okra (*Abelmoschus esculentus (L.) Moench*) in Unwana.
21. Nweke, I. A., Ijearu, S.I. and Igili, D. N. 2013 Effect of Different Sources of Organic Manure on the Growth and Yield of Okra (*Abelmoschus Esculentus. L Moench*) in Ustoxic Dystropept at Enugu South Eastern, Nigeria, International Journal of Scientific and Technology Research, 2(3): 135-37.

22. Okoli, E., Nworji, M. and Ekesiobi, I.A..2021. Effect of Organic Manure (Poultry Droppings, Cow Manure and Pig Manure) and Inorganic Fertilizer (N. P.K. 15:15:15) on the Growth and Yield of Fluted Pumpkin (*Telfairia Occidentalis*). The International Journal of Science & Technoledge. 9. 10.24940/theijst/2021/v9/i1/ST2101-013.
23. Owolabi, A.O., Ojeniyi, S.O., Amodu, A.O. and Hazzan, K. 2003'b'. Response of cowpea, okra and tomato to sawdust and manure. Moor Journal of Agricultural Research. 4(2), 178 -182.
24. Parmar, D.K., 2014. Yield produce quality and soil health under vegetable cropping systems as influenced by INM in mid hill zone of Himachal Pradesh. Journal of the Indian society of Soil Science 62, 45–51
25. Sanjay, K. J., Jaiswal, R.K., Sonendra, J., Dharmendra, K. K. 2019, Impact of different varieties/hybrids of okra [*Abelmoschus esculentus* (L.) Moench.] on yield and Growth parameters under late sown condition of Malwa region. Pharma Innovation 8(3):303-305.
26. Shahriazzaman, M. C., Mazed, H. E. M. K., Pulok, M. A. I., 2014. Responses of Organic Manures on Growth and Yield of Okra (*Abelmoschus esculentus*). Journal of Science, Technology & Environment Informatics, 01(02), 60–67.
27. Ufera, N. U., S. C. Kanayo and M. Iwuagwu, 2013. Relative effect of organic and inorganic fertilizers on the growth of okra (*Abelmoschus esculentus* L. Moench). Journal of Agricultural Sciences, 58 (3): 159-166.
28. Uko, I., Anyanwu S.C, Ndukwe, O.O and Okonkwo N.J. 2018. Residual effect of pre-emergence herbicide application of weed emergence, growth and yield of Cucumber (*Cucumis sativus* L.) International Journal of Pure and Applied Sciences and Engineering 6(1): 10-15.
29. Umoh, Florence O. Patrick I. Udounang and Janet E. Charlie 2022. Effects of Animal Manure on the Growth and Yield of Maize (*Zea mays* l.) AKSU JournalOf Agriculture and Food Science 6(3) 179-190, 2022
30. Unagwu, B. O. 2019. Organic amendment applied to a degraded soil: short term effect on soil quality indicators. African Journal of Agricultural Research, 14(4):218-225. Doi: 10.5897/AJAR2018.13457.
31. Varmudy V. 2011. Marketing Survey needed to boost okra exports. Department of economic Vive Kananda College, Puttur Karnataka
32. Waheed Idowu 2021. Effect of pig manure rates, planting methods and harvesting stages on productivity of *panicum maximum* and performance of growing red sokoto bucks. a thesis submitted to the school of postgraduate studies, ahmadu bello university, zaria, Nigeria.