Journal of
Current Opinion in Crop Science
Journal homepage: www.jcocs.com; ISSN(O):2583-0392

RESEARCH ARTICLE

Effect of Mexican Sunflower (*Tithonia diversifolia),* cow dung and poultry droppings on the growth of okra (*Abelmoschus esculentum*)

Yohanna Christopher Tumba[1*], Davou Dung Nyam[2], Ilyas Ibrahim[1], Barnabas Sani Bello[1], Adams A. Chaskda[1]

[1]A.P Leventis Ornithological Research Institute, Laminga, Jos East, Plateau State, Nigeria.
[2]University of Jos, Department of Plant Science and Biotechnology, Plateau, Nigeria.

Edited by:
M. Murugan, CRS, Kerala Agricultural University, Idukki, Kerala, India.

Reviewed by:
Tijesunimi Grace Ajiboye, Department of Agronomy, Delta State University, Abraka. Nigeria; Enrique Jr Biñas, West Visayas State University, Philippines.

Article history:

Received: May 28, 2025
Accepted: June 15, 2025
Published: June 30, 2025

Citation:

Tumba, Y. C., Nyam, D. D., Ibrahim, I., Bello, B.S., & Chaskda, A. A. (2025). Effect of Mexican Sunflower (*Tithonia diversifolia),* cow dung and poultry droppings on the growth of okra (*Abelmoschus esculentum*). *Journal of Current Opinion in Crop Science, 6*(2), 81-90. https://doi.org/10.62773/jcocs.v6i2.316

*Corresponding author e-mail address: tumbachristopher@aplori.org (Yohanna Christopher Tumba)

ABSTRACT

This study evaluated the effect of Mexican sunflower (*Tithonia diversifolia*), cow dung, and poultry droppings on the growth performance of *Abelmoschus esculentum* (okra). Being environmentally friendly and rich in essential nutrients, organic fertilizers are often used as alternatives to chemical fertilizers. The study aimed to determine which organic amendment promotes optimal growth of okra. The experiment was conducted at the Federal College of Forestry experimental farm, Jos, Nigeria. It was laid out in a Randomised Complete Block Design (RCBD) with three replicates, and the data collected were statistically analyzed. The results showed that poultry droppings significantly enhanced all measured growth parameters, making it the most effective treatment. Okra plants treated with poultry droppings had the highest plant height (9.03cm), leaf count (4.09), collar girth (1.30cm), leaf length (6.89 cm), leaf width (7.99 cm), dry weight (1.47 g), and fresh weight (7.66 g) compared to the other treatments. Cow dung also improved the growth parameters of okra, though it was less effective than poultry droppings. The control group, which received no organic amendments, consistently exhibited the lowest values in all parameters measured, including plant height (6.21 cm), leaf count (3.99), collar girth (1.00 cm), leaf length (4.74 cm), and leaf width (5.37 cm). Root length (9.44 cm), root hairs (22.72), dry weight (0.96 g), and fresh weight (4.18 g) were also significantly lower than in the treated groups. These findings suggest that organic fertilizers, particularly poultry droppings, are viable options for improving okra production and overall plant health.

Keywords: *Abelmoschus esculentum;* Cow dung; Fertilizers; *Tithonia diversifolia*

INTRODUCTION

Okra (*Abelmoschus esculentum*) is a widely cultivated vegetable in tropical and subtropical regions, prized for its edible green pods. It belongs to the Malvaceae family and is commonly grown for its tender, mucilaginous fruits, an important part of traditional diets in several communities (Andualem, 2023). Okra is a rich source of vitamins A and C, calcium, potassium, and dietary fibre, making it nutritionally significant. Additionally, it contains antioxidants and bioactive compounds that contribute to health benefits such as improving digestion and regulating blood sugar levels (Moradi *et al*., 2020). The economic importance of okra extends to smallholder farmers, particularly in developing countries, where it provides a significant source of income. Its adaptability to various soil types and climates and its relatively short growth cycle make okra valuable for food security and rural livelihoods (Benchasri, 2012). Furthermore, the plant's ability to thrive under organic farming practices aligns with the growing interest in sustainable agriculture.

Organic fertilizers play a vital role in sustainable agriculture, offering a viable alternative to chemical fertilizers. Among the widely used organic fertilizers are cow dung, poultry droppings, and plant residues like *Tithonia diversifolia* (Mexican sunflower). These organic materials not only improve soil structure but also enhance nutrient availability for crops. Okra (*Abelmoschus esculentum*), a popular vegetable in tropical and subtropical regions, responds positively to organic amendments, improving growth and yield (Omololu *et al.*, 2023).

Several studies have demonstrated that applying *Tithonia diversifolia* as green manure enhances soil fertility and increases the growth and yield of various crops, including okra. *Tithonia diversifolia* is particularly rich in essential nutrients, which can significantly improve soil fertility by adding organic matter, enhancing microbial activity, and improving soil structure (Dewanti et al., 2020). Similarly, animal manures like cow dung and poultry droppings supply crops with essential nutrients, especially nitrogen, phosphorus, and potassium, enhancing crop growth and productivity (Adekiya & Agbede, 2017). The synergistic effect of these organic materials on soil fertility and plant growth has gained attention in recent years. This study aims to evaluate the effect of *Tithonia diversifolia*, cow dung, and poultry droppings on the growth of okra.

MATERIALS AND METHODS

Study area

The research was carried out at Federal College of Forestry Jos experimental farm. It lies within the Northern Guinea Savannah Zone of the Nigeria, it is on latitude 8°30'N and longitude 8°20' and 9°30'E of the equator and covers an area of 1,695 km with an average altitude of about 1,200meters above sea level (Dewanti et al., 2020).

Sampling

A Randomize Complete Block Design (RCBD) was used as the experimental design for this study with four treatments replicating three times having a total of twelve observation plots. The experimental bed measured 3m × 2m giving a total of 6m^2. Hence a total net plot of 72m and a gross plot of 104.5m^2.

Growth Parameter

Plant height was determined by measuring the heights of the tagged plants with a meter rule from the top soil level to the tip of the terminal buds and the average record taken for each of the treatment. Collar girth was estimated by wrapping a thread round the basal/collar region of the plants stem. This was stretched and read off on a meter rule. Five stands were randomly sampled per mini plot and the mean of the replicates per treatment was obtained. The number of leaves per plant was determined by counting all fully opened leaves on each of the tagged plants and the average value was recorded for each of the treatment. Root length was determined by uprooting the plant carefully by using spatula in order not to break the tip of the root and this was successfully done by properly soaking the soil for each of the removal without damage to the plant being assessed. Measurement was then taken weekly using the meter-rule. The leaf length was measured by taking the largest leaf, medium and smaller leaves respectively and their mean calculated. This measurement was taken for five stands on each plot.

Data Analysis

The data were subjected to Analysis of Variance (ANOVA) appropriate to randomized complete block design technique using the SAS computer software program, version 30 (SAS, 2008). Where significant difference

existed between the treatment means, comparison of the means was done using the Duncan Multiple Range Test (DMRT) at 5% probability level.

RESULTS AND DISCUSSION

Plant Height

Plant height significantly increased for all treatments from week 1 to week 5. The mean plant height by week 5 was extremely significant between all treatments. *Abelmoschus esculentum* grown under treatment with poultry droppings recording the highest plant height (9.03cm) at week 5. This was followed by *Abelmoschus esculentum* grown with cow dung (8.34cm). The treatment with *Tithonia diversifolia* had a mean plant height of 7.16cm at week 5 while the control had the least mean plant height (6.12cm) at week 5. The study also showed there is an interaction effect between the treatment and weeks, as the week goes by there is an increase in plant height.

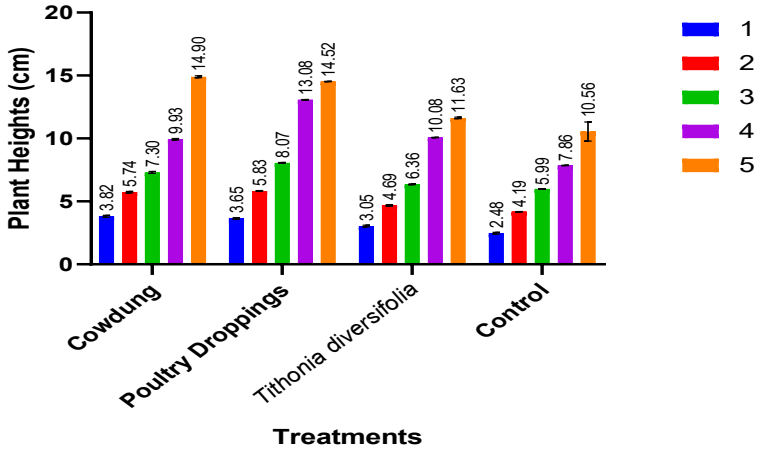

Figure1. Multiple bar charts showing the mean plant height of *Abelmoschus esculentum* under different treatments. 1, 2, 3, 4, 5 represents weeks 1, 2, 3, 4 and 5 respectively

Number of Leaves per Plant

Mean umber of leaves per plant generally increased significantly with increase in the number of weeks. At week 5, a slight significant difference was varied between treatment with poultry droppings and all other treatments including the control. However, there was no significant differences between *Tithonia diversifolia*, cow dung and the control. The result indicates a significant interaction effect between the treatment applied and weeks: as the weeks goes by the number of leaves increases (Table 1).

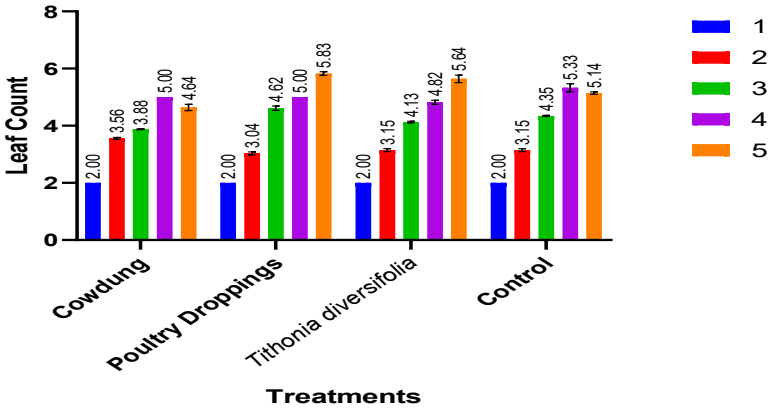

Figure 2. Multiple bar charts showing the mean leaves number of *Abelmoschus esculentum* under different treatments. 1, 2, 3, 4, 5 represents weeks 1, 2, 3, 4 and 5 respectively

Collar Girth (cm)

Collar girth varied from 1.00cm in the control and 1.30 cm in treatment with poultry droppings at week 5. No significant differences existed between treatments with cow dung and *Tithonia diversifolia.* The result also indicates interaction effect between the treatments applied and weeks (Table 3).

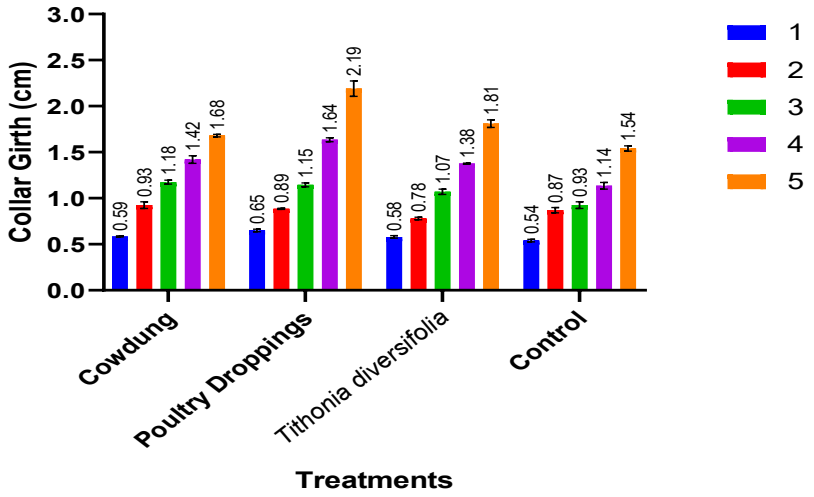

Figure 3. Multiple bar charts showing the mean collar girth of *Abelmoschus esculentus* under different treatments.

Leaf length

Mean leaf length varied significantly from 4.74 in the control to 6.89 in treatment with poultry droppings at week 5. Significant differences existed between *Tithonia diversifolia* 6.29, cow dung 6.00 and the control 4.74 respectively. The result also indicates interaction effect between the treatment applied and weeks: as the weeks goes by the number of leaves increases (Table 1).

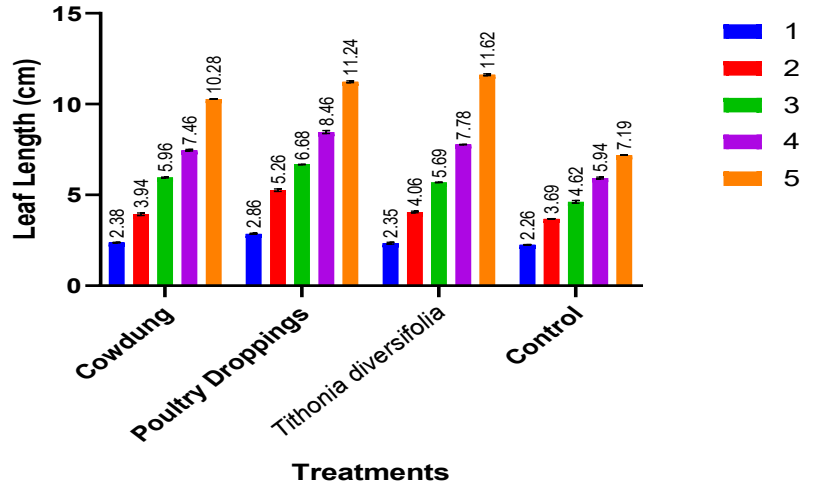

Figure 4. Multiple bar charts showing the mean Leaf length of *Abelmoschus esculentus* under different treatments.

Leaf width (cm)

Leaf width also varied significantly between control (5.37cm) and the treatment with poultry droppings (7.99cm). No significant difference existed between poultry dropping (7.99cm) and *Tithonia diversifolia* (7.27cm). However, a significant difference exists between cow dung (6.99) and control (5.37cm) (Table 1).

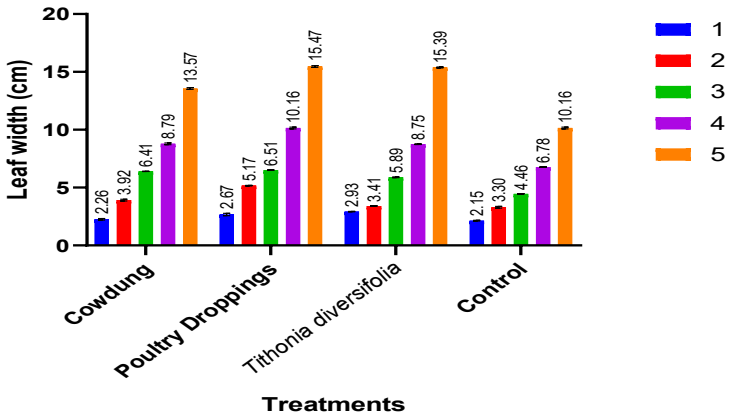

Figure 5. Multiple bar charts showing the mean Leaf width (cm) of *Abelmoschus esculentus* under different treatments.

Table 1. Showing the mean plant height, leave count, collar girth, leaf length and leaf width of *Abelmoschus esculentum* under different treatments.

Source of Variation	Plant Height	Leaf Count	Collar Girth	Leaf Length	Leaf Width
Treatments					
Cow dung	8.34^{b}	3.82^{b}	1.16^{b}	6.00^{c}	6.99^{b}
Poultry Droppings	9.03^{a}	4.09^{a}	1.30^{a}	6.89^{a}	7.99^{a}
Tithonia diversifolia	7.16^{c}	3.95^{b}	1.12^{b}	6.29^{b}	7.27^{a}
Control	6.21^{d}	3.99^{b}	1.00^{c}	4.74^{d}	5.37^{c}
L.S.D	0.36	0.20	0.06	0.08	0.36
S.F	****	*	**	***	***
WEEKS					
1	3.25^{e}	2.00^{e}	0.59^{e}	2.46^{e}	2.50^{e}
2	5.11^{d}	3.22^{d}	0.87^{d}	4.24^{d}	3.95^{d}
3	6.93^{c}	4.24^{c}	1.08^{c}	5.73^{c}	5.82^{c}
4	10.24^{b}	5.04^{b}	1.39^{b}	7.41^{b}	8.62^{b}
5	12.90^{a}	5.31^{a}	1.80^{a}	10.08^{a}	13.65^{a}
L.S.D	0.36	0.20	0.06	0.08	0.12
S.F	***	***	***	***	***
Interactions	****	****	****	****	****

Keys L.S.D= least significant difference, S.F= level of significance, *=slightly significant, **= moderately significant, ***=highly significant, ****= extremely significant. Means in the same columns having the same superscripts are not significantly different ($p \geq 0.05$).

Root Length (cm)

The Root Length varied from 9.44cm to 11.55cm between the control and treatment with *Tithonia diversifolia*. However, a significant difference did not exist between cow dung (9.64cm), poultry droppings 9.14cm and control 9.44cm. The results also indicate interaction effects between the treatment applied and weeks, as the week goes by, the root length also increases (Figure 6).

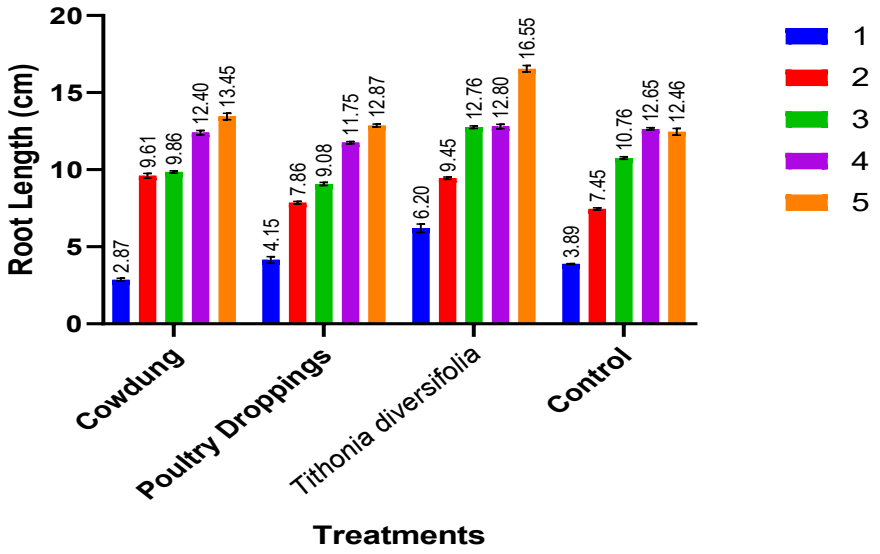

Figure 6. Multiple bar charts showing the mean root length of *Abelmoschus esculentus* under different treatments.

Root Hairs

Mean number of root hairs significantly differed between the control (22.72) and treatment with poultry droppings (32.00) in treatment with cow dung. Again, a significant difference was observed between treatment with *Tithonia diversifolia* (29.39) and poultry droppings (20.32). The results also indicate interaction effects between the treatment applied and weeks, as the week goes by the number of root hairs also increases.

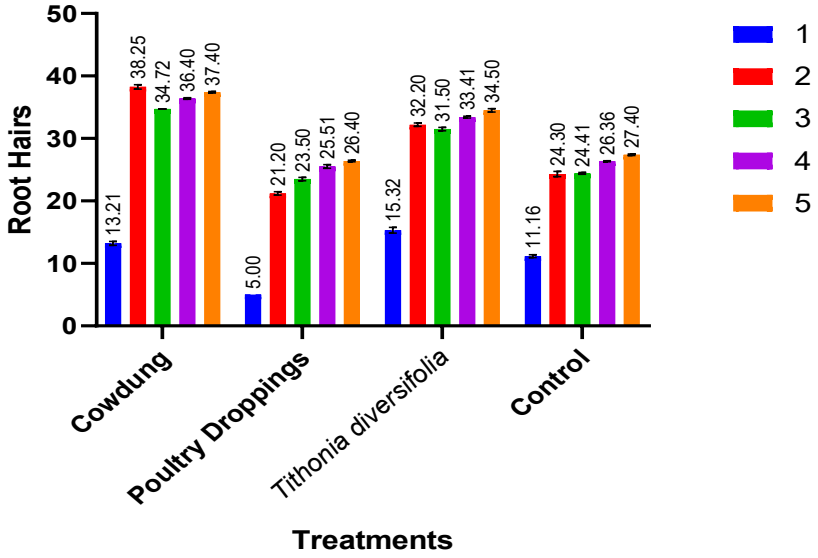

Figure 7. Multiple bar charts showing the mean root hairs of *Abelmoschus esculentus* under different treatments.

Fresh Weight (g)

Fresh weight varied from 4.18g in the control treatment to 7.66g in treatment with poultry droppings. No significant difference exists between *Tithonia diversifolia* 5.86g and cow dung 5.37g. The result also indicates the interaction effects between the treatment applied and weeks.

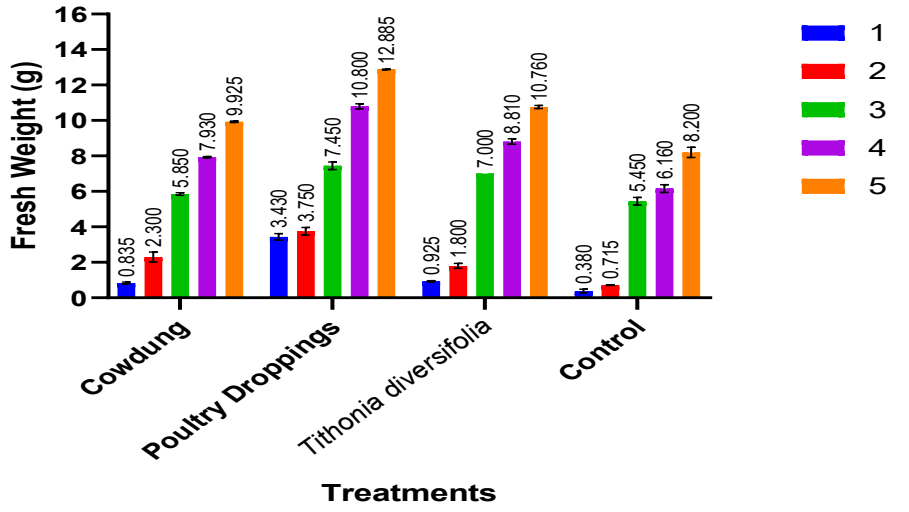

Figure 8. A multiple bar chart showing the mean fresh weight of *Abelmoschus esculentus* under different treatments.

Dry Weight (g)

Dry weight varied from 0.96g in control treatment to 1.47g in treatment with poultry droppings. Significant difference exists between *Tithonia diversifolia* 1.19g and cow dung 0.93g. The result also indicates interaction effects between the treatment applied and weeks.

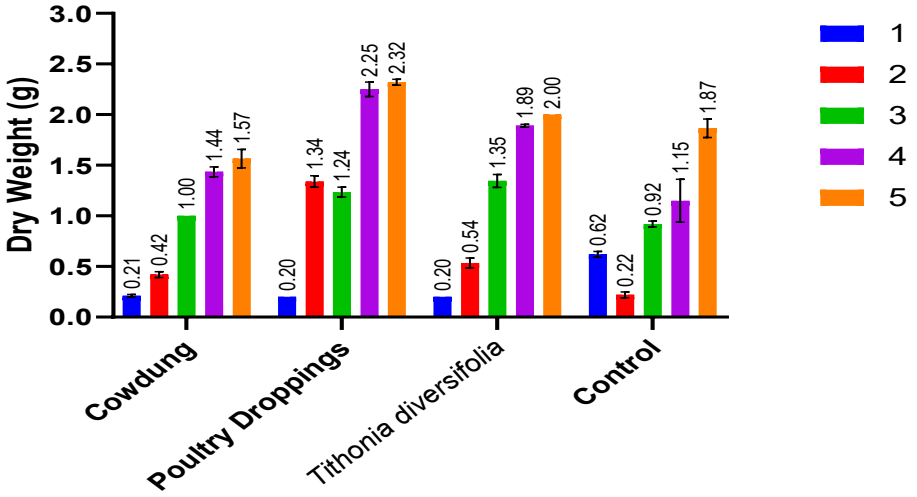

Figure 9. Multiple bar charts showing the mean dry weight of *Abelmoschus esculentus* under different treatments.

Table 2. Showing the mean root length, root hairs, dry weight and fresh weight of *Abelmoschus esculentus* under different treatments.

Source of Variation	Root Length	Root Hairs	Dry Weight	Fresh Weight
Treatments				
Cow dung	9.64^{b}	32.00^{a}	0.93^{c}	5.37^{b}
Poultry Droppings	9.14^{b}	20.32^{d}	1.47^{a}	7.66^{a}

Tithonia diversifolia	11.55[a]	29.39[b]	1.19[b]	5.86[b]
Control	9.44[b]	22.72[c]	0.96[c]	4.18[c]
L.S.D	0.28	0.60	0.14	0.40
S.F	***	***	**	***
WEEKS				
1	4.28[e]	11.17[d]	0.31[e]	1.39[e]
2	8.59[d]	28.99[c]	0.63[d]	2.14[d]
3	10.61[c]	28.53[c]	1.13[c]	6.44[c]
4	12.40[b]	30.42[b]	1.68[b]	8.43[b]
5	13.83[a]	31.42[a]	1.94[a]	10.44[a]
L.S.D	0.28	0.60	0.14	0.40
S.F	****	***	***	***
Interactions	****	****	****	****

Note: L.S.D= least significant difference, S.F= level of significance, *=slightly significant, **= moderately significant, ***=highly significant, ****= extremely significant. Means in the same columns having the same superscripts are not significantly different (p≥0.05)

DISCUSSION

The results of this study on the effect of organic amendments such as poultry droppings, cow dung, and *Tithonia diversifolia* on the growth of *Abelmoschus esculentum* (okra) corroborate findings from several recent studies. Poultry droppings showed the highest values across most growth parameters, with significantly greater plant height (9.03 cm), leaf count (4.09), collar girth (1.30 cm), leaf length (6.89 cm), and leaf width (7.99 cm), indicating that it is the most effective treatment for promoting okra growth. These findings align with those of Rasool et al., (2021) who observed that poultry manure significantly increased plant growth and yield in vegetable crops due to its high nutrient content, particularly nitrogen, which is crucial for vegetative growth. The study showed that plants treated with poultry droppings had a mean fresh weight of 7.66 g and a dry weight of 1.47 g, values that were considerably higher than those observed with cow dung and *Tithonia diversifolia*. Interestingly, *Tithonia diversifolia* was particularly effective in promoting root length, with a mean value of 11.55 cm, which was significantly higher than cow dung and poultry droppings. This result is supported by the work of Jama *et al.* (2019), who demonstrated that *Tithonia diversifolia* is an excellent organic source for improving soil fertility and increasing crop yields. The ability of *Tithonia diversifolia* to enhance root development is likely due to its high potassium content, which is essential for root elongation and water uptake. However, despite its superior performance in root length, *Tithonia diversifolia* was less effective than poultry droppings in increasing above-ground growth parameters such as plant height and leaf count, indicating that it may be more suited for crops where root development is the primary focus.

Cow dung also demonstrated a moderate effect on plant growth, with significant improvements in plant height, leaf count, and root hair development compared to the control. This aligns with the findings of Eleduma et al. (2020), who observed that cow dung effectively enhances crop growth, although its effect is slower compared to poultry manure. The lower effectiveness of cow dung compared to poultry droppings could be attributed to the slower release of nutrients in cow dung, which takes longer to decompose and provide essential nutrients to the plants. Despite this, cow dung-treated plants had the highest root hair count (32.00), suggesting its potential in enhancing root surface area for nutrient absorption. Cow dung is rich in organic materials, nutrients, and beneficial microbes that promote plant growth and protect against diseases (Dhiman et al., 2021). The control group consistently exhibited the lowest values in all growth parameters, indicating the importance of organic amendments in boosting okra growth. This observation is consistent with the study by Anisuzzaman et al. (2021), who found that the application of chemical fertilizer alone or in combination with organic manure resulted in a significant increase in growth, yield component traits, and nutrient content.

CONCLUSION

In conclusion, this study demonstrates that poultry droppings are the most effective organic fertilizer for improving both above-ground and below-ground growth parameters in okra, followed by cow dung and *Tithonia diversifolia*. Given the environmental and economic advantages of using organic fertilizers, farmers are encouraged to adopt these practices to improve okra production. Further research is recommended to explore the long-term effects of these organic treatments on soil health and crop yield.

ACKNOWLEDGEMENTS

Not applicable.

AUTHORS CONTRIBUTIONS

CYT was responsible the development of the research idea, data collection, data analysis and manuscript write up. DDN, II, BSB and AAC were engaged in manuscript preparation, write up and proofreading..

CONFLICT OF INTERESTS

The authors declare no conflict of interest.

ETHICAL APPROVAL

Not applicable

FUNDING

No funds were obtained for this study.

AVAILABILITY OF DATA AND MATERIALS

All datasets analyzed and described during the present study are available from the corresponding author upon reasonable request.

REFFRENCES

Adekiya, A.O. and Agbede, T.M. (2017) Effect of Methods and Time of Poultry Manure Application on Soil and Leaf Nutrient Concentrations, Growth and Fruit Yield of Tomato (Lycopersicon esculentum Mill). Journal of the Saudi Society of Agricultural Sciences, 16, 383-388. https://doi.org/10.1016/j.jssas.2016.01.006

Andualem M, 2023. Nutritional and anti-nutritional characteristics of okra (Abelmoschus esculents (l.) Moench) accessions grown in Pawe district, northwestern Ethiopia. Int J Agri Biosci, 12(1): 18-21. https://doi.org/10.47278/journal.ijab/2022.040

Dayo-Olagbende, Olufemi & Akingbola, Oo & Afolabi, Gbolahan & Ewulo, B. (2019). Influence of Tithonia Diversifolia on Maize (Zea mays L.) Yield, Fertility and Infiltration Status of Two Clay Varied Soils. International Annals of Science. 8. 114-119. 10.21467/ias.8.1.114-119.

Dewanti, F.D., Koetjoro, Y., & Pribadi, D.U. (2020). Mexican Sunflower (Tithonia diversifolia) as a Source of Organic Matter in Potato Cultivation. *Nusantara Science and Technology Proceedings*. DOI: 10.11594/NSTP.2020.0613

Eleduma, AF & Aderibigbe, ATB & Ola, Obabire. (2020). Effect of cattle manure on the performances of maize (Zea mays L) grown in forest-savannah transition zone Southwest Nigeria. International Journal of Agricultural Science and Food Technology. https://doi.org/110-114. 10.17352/2455-815X.000063

Dewanti, F.D., Koetjoro, Y., & Pribadi, D.U. (2020). Mexican Sunflower (Tithonia diversifolia) as a Source of Organic Matter in Potato Cultivation. *Nusantara Science and Technology Proceedings*. DOI:10.11594/NSTP.2020.0613

Benchasri, S. (2012). Okra (Abelmoschus esculentus (L.) Moench) as a Valuable Vegetable of the World. *Ratarstvo i Povrtarstvo, 49*, 105-112. DOI:10.5937/RATPOV49-1172

Dhiman, Sandhya & Kumar, Sandeep & Baliyan, Nitin & Dheeman, Shrivardhan & Maheshwari, Dinesh. (2021). Cattle Dung Manure Microbiota as a Substitute for Mineral Nutrients and Growth Management Practices in Plants. 10.1007/978-3-030-65447-4_4.

Anisuzzaman, M., Rafii, M. Y., Jaafar, N. M., Izan Ramlee, S., Ikbal, M. F., & Haque, M. A. (2021). Effect of Organic and Inorganic Fertilizer on the Growth and Yield Components of Traditional and Improved Rice (*Oryza sativa* L.) Genotypes in Malaysia. *Agronomy*, *11*(9), 1830. https://doi.org/10.3390/agronomy11091830

Jama, B. & Palm, C.A. & Buresh, R.J. & Niang, Amadou & Gachengo, C. & Nziguheba, Generose & Amadalo, B.. (2000). Tithonia diversifolia as a green manure for soil fertility improvement in western Kenya: A review. Agroforestry Systems. 49. 201-221. 10.1023/A:1006339025728.

Rasool, A., Ghani, A., Nawaz, R., Ahmad, S., Shahzad, K., Rebi, A., Ali, B., Zhou, J., Ahmad, M. I., Tahir, M. F., Alwahibi, M. S., Elshikh, M. S., & Ercisli, S. (2023). Effects of Poultry Manure on the Growth, Physiology, Yield, and Yield-Related Traits of Maize Varieties. *ACS omega*, *8*(29), 25766–25779. https://doi.org/10.1021/acsomega.3c00880

Omololu, P. A., Omololu, V. O., Ogunrinde, B. A., Ogunrinde, A. T., & Onah, J. I. (2023). The effect of organic manure on growth and yield of okra (Abelmoschus esculentus L.). *International Journal of Science and Research Archive*, 10(01), 605–610. DOI: https://doi.org/10.30574/ijsra.2023.10.1.0784

Moradi, A., Tarrahi, M. J., Ghasempour, S., Shafiepour, M., Clark, C. C. T., & Safavi, S. M. (2020). The effect of okra (Abelmoschus esculentus) on lipid profiles and glycemic indices in Type 2 diabetic adults: Randomized double blinded trials. *Phytotherapy research: PTR*, *34*(12), 3325–3332. https://doi.org/10.1002/ptr.6782