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Effect of Different Nutrient Media on Okra (*Abelmoschus esculentus* L. Moench) Production in Kailali, Nepal

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Abstract An experiment was conducted in Kailali district, Nepal, to evaluate the effect of different nutrient media on the production of okra (*Abelmoschus esculentus* L. Moench). The study employed a single-factorial Randomized Complete Block Design (RCBD) with eight treatments replicated three times. The treatments included farmyard manure (FYM), vermicompost, poultry manure, synthetic fertilizer (NPK), 50% NPK + 50% FYM, 50% NPK + 50% vermicompost, 50% NPK + 50% poultry manure, and a no-fertilizer control. The okra variety Arka Anamika was used, and data were collected on growth and yield parameters such as plant height, number of leaves and branches per plant, fruit count per plant, fruit length and diameter, and total yield (ton/ha). Measurements were taken from ten randomly selected plants from the central rows of each plot, and data were analyzed using R software. Results indicated that poultry manure led to the highest yield at 21.18 ton/ha and significantly improved growth characteristics such as plant height and leaf number while control being the lowest 9.95 ton/ha. Conversely, the control and synthetic fertilizer treatments showed the poorest performance. The findings suggest that poultry manure is an effective nutrient source for enhancing okra growth and yield.
Keywords Okra (*Abelmoschus esculentus* L. Monech); Organic fertilizer; Poultry manure; Kailali Nepal; Yield Performance

1 Introduction

Okra (*Abelmoschus esculentus* L. Monech) is a widely cultivated vegetable in tropical and subtropical regions, grown for its pods (Sylvester et al., 2014). It belongs to the hibiscus family, Malvaceae, and exhibits the characteristic floral features of this family. In Nepal, the average yield of okra is 11.54 metric tons per hectare, with a total production of 110,565 metric tons over an area of 9,584 hectares (MoALD, 2022). It constitutes 3.32% of Nepal's total vegetable cultivation area (MoALD, 2022). India is the leading producer of okra, contributing over 72% to the global output (FAOSTAT, 2020). According to FAOSTAT, (2020) India produced 6.35 million tonnes of okra from 0.52 million hectares of land.

Vegetable crops, including those in vegetable-based cropping systems, respond well to nutrient supplementation from organic manures and chemical fertilizers (Kale et al., 1991). Over time, soil nutrient levels decline as crops are harvested, and these nutrients must be replenished either through natural decomposition or fertilizer application. Fertilization is therefore a crucial aspect of modern agriculture. Fertilizers supply essential nutrients categorized as macronutrients (nitrogen, phosphorus, potassium, calcium, magnesium, sulfur) and micronutrients. Fertilizers have become indispensable to modern agriculture, helping to feed the growing global population. While chemical fertilizers have greatly benefited humanity by alleviating hunger and saving lives, their exclusive use can pose risks to human health and the environment (Arisha and Bradisi, 1999). While mineral fertilizers assure rapid and short-term growth and yield improvement but It doesn't ensure the sustainability of agricultural production (Bhandari et al., 2019).

In recent years, the use of organic manures such as farmyard manure (FYM), poultry manure, vermicompost, and goat manure has gained importance because of its significance. Organic manures improve soil texture and water retention (Kale et al., 1991) and provide food for soil microorganisms, which enhances microbial activity and aids

in converting unavailable nutrients into plant-available forms. Additionally, organic manures help maintain yields in continuous cropping systems and enhance the fertility of degraded soils (Adhikari and Piya, 2020). The application of organic manures can also help neutralize acidic soil conditions, improving crop productivity (Toluwase Oreoluwa et al., 2020). It is also reported that optimum poultry manure significantly influenced the growth, yield, and nutritional quality of lettuce (Masarirambi et al., 2012). Beyond nutrient release, poultry manure enriches soil organic matter, enhancing its physical properties. Poultry manures increases soil pH, organic matter content, available P, exchangeable cations and micro nutrients, reduced exchangeable Al and Fe contents and bulk density (Uwah and Ogar, 2014). Earthworm manures counteract the negative effects of chemical fertilizers, improve soil properties, and support crop growth (Lim et al., 2015). The continuous use of vermicompost can rehabilitate and rejuvenate soil. Similarly, applying goat manure has been shown to improve okra growth, pod number, and yield (Awodun et al., 2007). "Given the increasing interest in sustainable agriculture and the need to reduce chemical inputs in vegetable cultivation in Nepal, this study aims to identify effective organic alternatives that can enhance okra productivity while maintaining soil health.

2 Materials and Methods

2.1 Study site

The research was conducted in Sudurpaschim province, Dhangadhi sub-metropolitan ward no. 5- Jai in the field of Mr. Ram Kishun Chaudhary, one of the progressive farmers of the region listed in Gharelu Tatha Sana Udhyog, from February to July 2023. Soil of the study site was sandy loam and the area received subsequent rainfall with sub-tropical climate during the time of research. The latitude and longitude of this geographic location are 28° 42′ 49″ N, and 80° 34′ 9″ E respectively and the elevation is 109 m (101.06 m^2) above sea level (Figure 1).

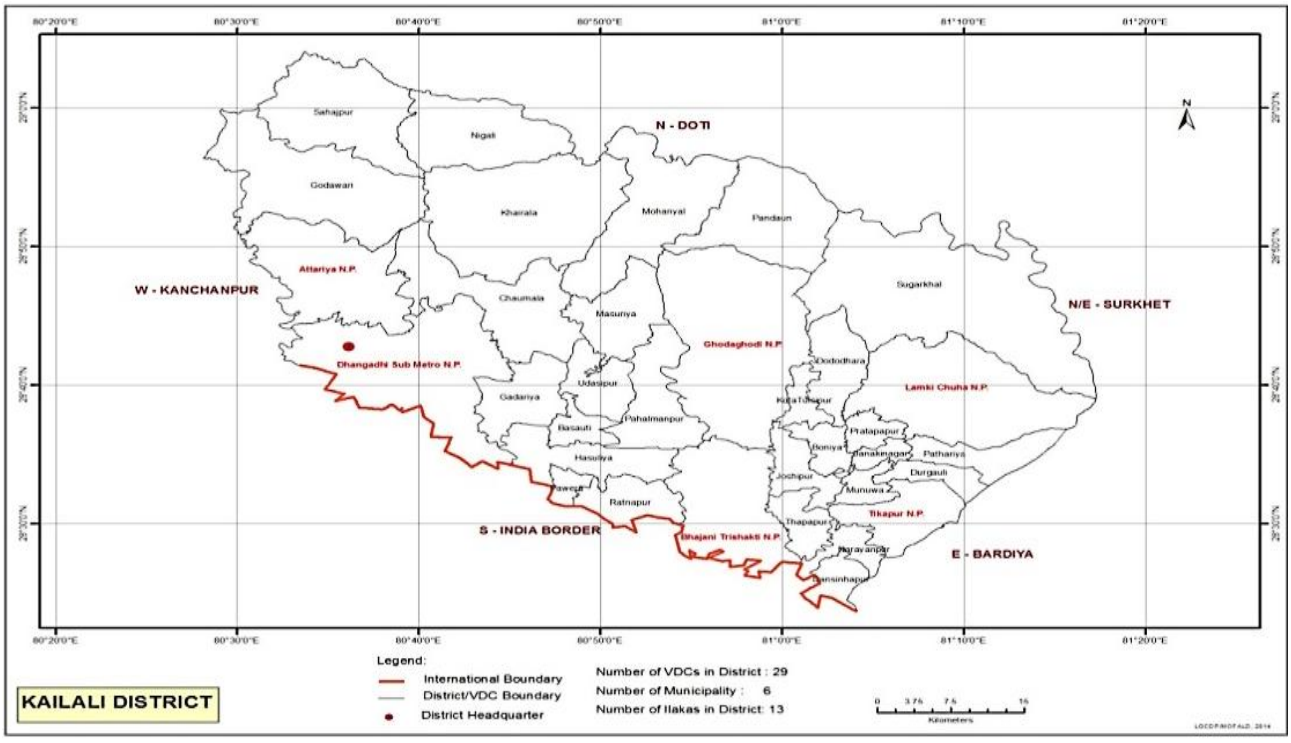


Figure 1 Map of Kailali District (Study site)

2.2 Experimental details

The experimental materials used for the investigation comprise of different nutrient media of okra with 8 different treatments and 3 replications of Arka Anamika variety of Okra (Table 1). Seeds were sown in the spacing.of 40 × 30 cm with plot size of 3 × 1.2 m^2. Simple RCBD (Randomized Completely Block Design) was used to examine the effect of various nutrient media (Figure 2).

Table 1 Different sources of nutrient media used in experiment

Treatment	Media
T1	Farmyard manure (FYM)
T2	Vermi-compost
T3	poultry manure
T4	NPK
T5	50% NPK + 50% FYM
T6	50% NPK + 50% Vermi-compost
T7	50% NPK + 50% Poultry manure
T8	Control

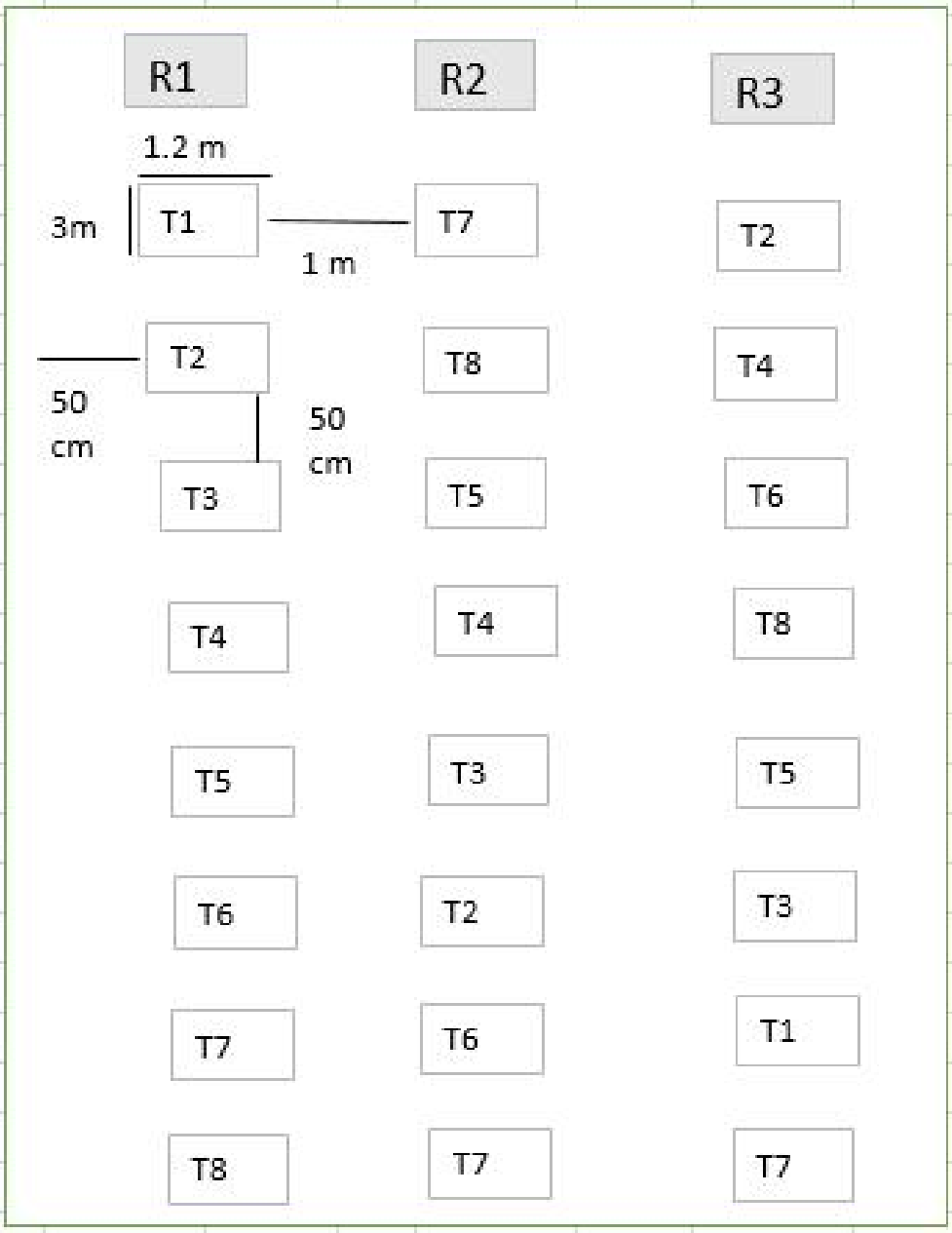


Figure 2 Layout of field (RCBD)

2.3 Data collection and analysis

Growth and yield parameters were measured to assess the performance of the plants during the experiment. For growth parameters, data were collected on the number of leaves, plant height, and number of branches per plant.

Yield parameters included measurements such as number of pods per plant, pod fresh weight, pod length, pod diameter, and total yield. Each experimental plot consisted of 30 plants, from which data were collected from ten randomly selected plants located in the central rows of each plot to minimize border effects and ensure a representative sample. Observations and measurements were recorded at regular intervals to monitor changes over time.

The collected data were systematically organized and tabulated using Microsoft Excel for easy reference and processing. Statistical analysis was performed using the R-STAT software package to evaluate differences and relationships among the treatments. To determine the significance of differences between treatment means, Duncan's Multiple Range Test (DMRT) was applied at a 5% level of significance. This ensured that the results were statistically robust and provided clear distinctions between the effects of different treatments.

3 Results and Analysis

3.1 Growth parameters

Plant height was significantly higher in the poultry manure treatment, reaching 76.30 cm at 45 days after sowing (DAS) and 94.50 cm at 70 DAS, compared to the control, which recorded the lowest heights of 65.50 cm and 78.53 cm, respectively. Vermicompost and 50% NPK + 50% vermicompost treatments also showed notable heights at 70 DAS (90.77 cm and 90.80 cm, respectively), significantly outperforming the control (Table 2). The number of leaves was highest in vermicompost (72), followed by control (70), farmyard manure (FYM) (66), and poultry manure (64) at 70 DAS, with the lowest counts in 50% NPK + 50% FYM and 50% NPK + 50% poultry manure (59 each). However, leaf count differences were not statistically significant. Similarly, the number of branches varied slightly across treatments but showed no significant differences.

Table 2 Effect of different treatments on growth parameters of Okra

Treatments	Plant height		Number of leaves		Number of branches
	45DAS	70 DAS	45DAS	70 DAS	35 DAS
FYM	65.93	80.77^{bc}	60	66	4
Vermi compost	72.33	90.77^{a}	66	72	4
Poultry manure	76.30	94.50^{a}	59	64	4
NPK	69.77	81.87^{bc}	55	63	4
50%NPK + 50% FYM	70.80	86.83^{abc}	56	59	3
50%NPK+50%vermi compost	70.70	90.80^{a}	48	59	4
50%NPK + 50% poultry manure	71.00	88.60^{ab}	54	60	4
control	65.50	78.53^{c}	63	70	3
LSD	ns	7.80**	ns	ns	ns
SE_m (±)	1.22	0.19	1.55	1.60	0.25
Grand mean	70.29	86.58	70.29	86.58	4
CV%	8.52	5.14	13.12	12.09	30.68

Note: Means followed by or sharing the same letters within a column are not significantly different at 5% level of significance; CV=coefficient of variation, ns=non-significant, LSD=least significant difference at 5%, DAS= Days after sowing

3.2 Yield and yield components of okra

The number of fruits was significantly higher in poultry manure (14) and vermicompost (13) treatments compared to the control (8) and FYM (9). Fruit length was significantly greater in poultry manure (16.00 cm) than in the control (13.80 cm). Fruit diameter was significantly higher in poultry manure, 50% NPK + 50% poultry manure, and 50% NPK + 50% vermicompost (all 5.17 cm) compared to the control (4.73 cm). Total yield was significantly higher in poultry manure (21.18 ton/ha), followed by vermicompost (16.43 ton/ha), while the control (9.95 ton/ha) and FYM (10.85 ton/ha) recorded the lowest yields (Table 3).

Table 3 Yield attributing factors influenced by different nutrient media in 2023

Treatments	No. of fruit	Length of fruit (cm)	Diameter of fruit (cm)	Yield (ton/ha)
FYM	9^{de}	13.93^{bc}	4.97	10.85^{d}
Vermi compost	13^{ab}	14.60^{b}	5.10	16.43^{b}
Poultry manure	14^{a}	16.00^{a}	5.17	21.18^{a}
NPK	11^{cd}	12.73^{c}	4.73	13.07^{c}
50%NPK+ 50% FYM	11^{bc}	13.97^{bc}	5.17	14.08^{c}
50%NPK+50%vermi compost	12^{abc}	14.13^{b}	5.17	14.42^{bc}
50%NPK + 50% poultry manure	13^{ab}	13.80^{bc}	5.07	16.35^{b}
control	8^{e}	13.80^{bc}	4.73	9.95^{d}
LSD	2.40***	1.09**	ns	2.08***
SE_m (±)	0.28	0.15	0.04	0.24
CV%	11.91	5.23	4.19	14.54
Geand Mean	11.5	14.12	5.01	8.20

Note: Means followed by or sharing the same letters within a column are not significantly different at 5% level of significance; CV=coefficient of variation, ns=non-significant, LSD=least significant difference at 5%

4 Discussion

The superior plant height in poultry manure treatments likely results from its nutrient-rich composition, particularly high nitrogen content, which supports vegetative growth. This aligns with findings by Adhikari and Gyawali (2024), Adekiya et al. (2020), and Tiamiyu et al. (2013), who noted that poultry manure enhances plant height due to its ability to retain and supply nutrients efficiently. Poultry manure's organic nature improves soil structure and microbial activity, facilitating better nutrient absorption compared to chemical fertilizers like NPK.

The lack of significant differences in leaf count and branch number across treatments suggests that these parameters are less sensitive to nutrient source variations under the study conditions, consistent with Adhikari and Gyawali (2024). For yield components, poultry manure and vermicompost significantly increased fruit number, length, diameter, and total yield, corroborating studies by Premsekhar and Rajashree (2009), Khandaker et al. (2017), and Shahriazzaman et al. (2014). These outcomes are attributed to improved soil physical and biological properties, enhancing nutrient availability. Poultry manure outperformed NPK in reproductive traits, as supported by Adhikari and Adhikari (2020), likely due to its sustained nutrient release. The lower performance of FYM and control treatments highlights the limited nutrient availability in these media, as noted by Adekiya et al. (2020b) and Jamkatel et al. (2020).

5 Conclusion

In conclusion, the study demonstrated that okra showed superior performance in both growth and yield parameters when treated with poultry manure compared to other fertilizers and the control treatment. Poultry manure significantly enhanced plant height, number of leaves, branches, and various yield attributes such as pod number, weight, length, and total productivity. In contrast, plants in other fertilizer-treated plots and untreated control plots exhibited comparatively poor performance. These results highlight poultry manure as an effective and sustainable organic nutrient source, offering a viable alternative to synthetic fertilizers for enhancing okra productivity while promoting soil health.

Authors' Contributions

TCJ developed the concept of the experiment, design the experiment and involved in data interpretation and report draft review. NA involved in data collection, analysis and content writing. HPG also engaged in data collection, analysis and content writing. Likewise, RS and SD also involved in data collection, analysis and content writing. All authors read and approved the final manuscript.

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