Research Article:

COMPARATIVE ANALYSIS OF ORGANIC MANURES TO CHEMICAL FERTILIZERS ON THE GROWTH AND YIELD OF OKRA AT SUNSARI, NEPAL

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ABSTRACT

Okra (*Abelmoschus esculentus*), a warm-season crop of the Malvaceae family, is widely cultivated in the tropical and subtropical regions of Nepal. Organic manure plays an important role in improving its growth and yield; however, optimal application rates remain insufficiently studied in the Terai region of Eastern Nepal. A field experiment was conducted from February to April 2025 in Inaruwa-3, Sakhuwagachhi, Sunsari to evaluate the effects of different organic manures on the growth and yield of okra variety NS-864. The experiment was arranged in a Randomized Complete Block Design (RCBD) with seven treatments: poultry manure, vermicompost, farmyard manure (FYM), goat manure, mustard oil cake, , and a control, each replicated three times. Data were collected from five randomly selected plants per plot. Early seed germination (90%) was recorded at 11 days after sowing in goat manure and FYM treatments. Among organic sources, poultry manure significantly enhanced growth and yield attributes, producing the highest number of primary branches and average pod weight, second only to NPK. FYM showed moderate performance, while vermicompost and mustard oil cake were less effective. The control produced the lowest yield. Overall, poultry manure proved to be the most effective organic alternative for sustainable okra production under Eastern Nepal conditions.

Keywords: *Abelmoschus esculentus,* NS-864, organic alternative, poultry manure, RCBD, sustainable

INTRODUCTION

Okra (*Abelmoschus esculentus*), a warm-season crop belonging to the Malvaceae family, is widely cultivated in tropical and subtropical regions (Kumar et al., 2013). In Nepal, it is commonly grown in districts such as Jhapa, Morang, Saptari, Dhanusha, Bara, Chitwan, and Kailali, particularly during the summer months (Khanal et al., 2020). The plant is valued for its edible green pods, which are consumed as vegetables, while various plant parts have applications in food, medicine, and industry (Basnet et al., 2023). Okra is also reported to possess medicinal properties that may aid in managing health conditions including diabetes, hypertension, and gastrointestinal disorders (Chawla et al., 2025).

According to MoALD (2024), Nepal produced 107,641 metric tonnes (MT) of Okra from 9,140 hectares (ha), with an average productivity of 11.78 MT/ha. In Koshi Province, Sunsari district ranks second after Jhapa in terms of area and production, cultivating 721 ha with a total production of 8,580 MT.

Fertilizers play a crucial role in enhancing crop productivity and soil fertility. They are broadly classified into organic and inorganic types. Organic fertilizers, derived from plant or animal sources such as compost, farmyard manure (FYM), poultry manure, vermicompost, oil cakes and crop residues, release nutrients gradually, improve soil structure and stimulate microbial activity. Inorganic fertilizers including urea, diammonium phosphate (DAP), and muriate of potash (MOP) provide nutrients in readily available forms. Both the sources supply essential macronutrients like Nitrogen (N), Phosphorus (P) and potassium (K) required for plant growth and development (Lamma, 2021; Sharma & Chetani, 2017). Okra needs a balanced supply of essential nutrients like N, P and K to achieve maximum yield (Silwal et al., 2023). The recommended dose of fertilizers for Okra in Nepal is 11.8 MT/ha of compost, 118 kg/ha of urea, 79 Kg of DAP, and 39 kg/ha of MOP (AITC, 2024). However, Nepal's heavy dependence on imported chemical fertilizers makes them costly and less accessible to smallholder farmers (Vista et al., 2022).

Organic fertilizers offer a sustainable and locally accessible alternative to chemical inputs. They enhance soil fertility without harmful residues and are generally more affordable for small-scale farmers (Murali-Krishna et al., 2024; Parwada et al., 2023; Uzoh et al., 2023). Several studies have highlighted the benefits of organic manures, particularly poultry manure, which has shown superior effects on both vegetative and reproductive growth parameters of Okra (Adhikari & Gyawali, 2024; Adhikari & Piya, 2020; Bhandari et al., 2019; Karki et al., 2025). Nevertheless, crop fertilizer requirements vary depending on soil type, nutrient status, cropping history, crop variety, season, irrigation practices, and climate conditions (Vista et al., 2022). Therefore, identifying appropriate nutrient sources tailored to specific agro-ecological conditions is essential.

Despite the widespread cultivation of Okra, limited field-based research has systematically evaluated the comparative effects of different organic and inorganic manures on its growth and productivity during spring season in Nepal. Moreover, no documented study has specifically examined the influence of various organic fertilizers on seedling emergence, vegetative growth and fruit yield of the NS-864 Okra variety under field conditions. Hence, this study aims to assess the response of Okra to different organic manures and chemical fertilizers in Sunsari district, with the objective of identifying the most effective organic alternative for improving seedling emergence, growth performance and yield.

RESEARCH METHODS

Geographical location and climatology of the study area

The research was conducted in Inaruwa Municipality-3, Sakhuwagachhi, Sunsari District, Koshi Province, Nepal. Geographically, the study site is situated at 26.6145709°N latitude and 87.1584466°E longitude, at an elevation of approximately 101.47 meters above sea level (masl). The region experiences a subtropical climate characterized by hot and humid summers, mild winters, and a well-defined monsoon season, creating favorable condition for Okra cultivation.

Experimental design

The experiment was conducted in a Randomized Completed Block Design (RCBD) with seven treatments and three replications comprising of 21 plots each measuring 2m × 1.5 ($3m^2$). The plots were arranged with 50 cm spacing between the plots and 1m between the blocks, covering a total experimental area of 131.5 m^2. Okra seeds were soaked in water for 24 hours and shade dried for 8 hours before sowing. The field, initially barren and hard, was ploughed thrice with a rotavator and twice with a cultivator to achieve fine tilth followed by bed formation and pre-sowing irrigation. Basal application of poultry manure ($5kg/3m^2$), vermicompost ($2.55kg/3m^2$), FYM ($4.5kg/3m^2$), goat manure ($3kg/3m^2$), mustard oil cake ($1.8kg/3m^2$), a half dose of urea ($38.94g/3m^2$), full dose of DAP ($28.15g/3m^2$) and MoP ($19.98g/3m^2$) was incorporated during final land preparation with remaining urea top dressed in two equal splits at 30 DAS and at flowering and fruiting stages. Seeds were sown at the rate of 20 seeds per plot with a spacing of 50 cm × 30 cm. Irrigation was provided regularly for germination and subsequently at 3 to 5-day intervals as required. Plots were properly tagged for identification and weeding was carried out first at 20-25 DAS and thereafter as needed. Plant protection measures included application of Copper Oxychloride 50% WP (2-3 g/L) against damping off and spraying of Azadirachtin 0.03% EC (5ml/L) and Imidacloprid 17.8% SL (1-2 ml/L) for insect management. Harvesting was performed manually at two-day intervals using sterilized scissors when pods were green, tender and fully grown with immature seeds.

Sample plant and parameters under study

Five plants were randomly selected and tagged from each plot for recording all observations. Twenty seeds were sown per plot and germination was recorded at three-day interval, considering germination completed when 90% (18 out of 20) of the seeds had emerged with fully expanded cotyledons above the soil surface. Vegetative parameters including plant height (measured from ground level to the tip of the longest leaf using measuring scale), the number of leaves and number of primary branches were recorded at ten-day intervals. Reproductive parameters such as number of buds and open flowers were counted at five-day intervals. During harvest at three-day intervals, the number of marketable pods per plant was recorded and five random pods from each plot were selected to measure pod length (cm) using a measuring scale, pod weight (g) using a digital balance and pod girth (mm) using a digital Vernier caliper. Yield (MT/ha) was calculated based on the average number of pods per plant, average pod weight, number of plants per plot and plot area.

Statistical analysis

All the recorded data were subjected to analysis of variance (ANOVA) using R Studio (Version 5.5.1). Treatment means were compared using Duncan's Multiple Range Test (DMRT) at the 5% level of significance to test the hypotheses and determine significant difference among the treatments.

RESULTS AND DISCUSSION

Germination percentage (90%)

The effect of fertilizers on the germination percentage of Okra seeds is shown in Table 1. Organic manure application significantly influenced 90% germination (18 out of 20 seeds germinated) of Okra at 11 DAS. Farm Yard Manure (18.00 seeds germinated) and Goat manure (18.67 seeds germinated) recorded the earliest and highest germination, while mustard oil cake showed the lowest (7.00 seeds germinated). Improved germination under FYM and goat manure may be attributed to enhanced microbial activity and gradual nutrient release, which improve seedling vigor as reported by Kaleri et al. (2024).

Table 1. Effect of organic manures on 90% germination of Okra at Sunsari, Nepal, 2025.

Treatment	No. of seeds germinated at 11 DAS
Poultry manure	14.67[b]
Vermicompost	17.33[ab]
Farm Yard Manure	18.00[ab]
Goat manure	18.67[a]
Mustard seedcake	7.00[c]
Chemical fertilizers (NPK)	17.67[ab]
Control	17.33[ab]
LSD (0.05)	3.53
SEm (±)	1.15
F probability	***
CV, %	12.55
Grand Mean	15.81

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '' 1

Note: The common letter(s) within the column indicates non-significant (NS) difference based on Duncan's Multiple Range Test (DMRT) at 0.05 level of significance. SEm=Standard Error of Means, LSD=Least Significant Difference, and CV=Co-efficient of Variation.

Plant height and number of primary branches

The effect of organic manures on the plant height and number of primary branches of Okra at 65 DAS is illustrated in the Table 2. Significant differences were observed in vegetative growth at 65 DAS. Chemical fertilizers (NPK) produced the tallest plants (96.47 cm), statistically at par with poultry manure (85.20 cm). The improved growth under NPK may be due to the immediate nutrient availability, while poultry manure enhances soil physical properties and supplies essential nutrients, supporting vegetative development (Akinfasoye et al., 2011, Ayeni, 2011; Garg & Bahl, 2008).

Poultry manure recorded the maximum number of primary branches (2.60). Baghlani et al. (2024) also stated that poultry manure is rich in essential nutrients (especially N, P and K) and often contains plant-growth promoting substances (like cytokinin and gibberellins) which tend to produce more branches since more lateral shoots can develop from healthy, and nutrient-sufficient stems.

Table 2. Effects of organic manures on vegetative performance of Okra at final measurement at Sunsari, Nepal, 2025.

Treatment	Plant height (cm)	No. of primary branches/plant
Poultry manure	85.20[ab]	2.60[a]
Vermicompost	66.20[b]	2.07[b]
Farm Yard Manure	71.47[b]	1.93[b]
Goat manure	74.13[b]	2.00[b]
Mustard seedcake	81.67[ab]	1.93[b]
Chemical fertilizers (NPK)	96.47[a]	2.20[b]
Control	69.20[b]	2.00[b]
LSD (0.05)	18.39	0.38
SEm (±)	5.97	0.12
F probability	*	*
CV, %	13.30	10.23
Grand Mean	77.76	2.11

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '' 1

Note: The common letter(s) within the column indicates non-significant (NS) difference based on Duncan's Multiple Range Test (DMRT) at 0.05 level of significance. SEm=Standard Error of Means, LSD=Least Significant Difference, and CV=Co-efficient of Variation.

Number of buds, number of pods and pod length

The Table 3 depicts the effect of organic manures on the number of buds (young, undeveloped flower parts of the Okra plant before they fully open), number of pods and pod length at 65 DAS. Chemical fertilizers produced the highest number of buds (25.33) and pods per plant (4.93), which were statistically at par with poultry manure (22.53 buds and 4.87 pods). On an average, 248.8 Okra pods or fruits were obtained from the sample plants over the productive period. Similarly, the longest pods were recorded under chemical fertilizers (17.73 cm), followed closely by poultry manure (17.07 cm). The enhanced reproductive performance under these treatments may be due to better nutrient availability, especially nitrogen and phosphorus which promote more vegetative growths, increase the number of sites for bud differentiation, flowering and pod development (Ongouya Mouekouba et al., 2025).

Poultry manure typically has a lower C: N ratio and higher N, P and K than other manures, so nutrients are released faster and taken up by the crop, leading to higher pod number (Aboyeji et al., 2021). Poultry manure also stimulates soil microbial activity that speeds nutrient cycling and P availability (important for fruit development), so flowers set better and pods develop longer as reported by Rasool et al. (2023).

Table 3. Effects of organic manures on the reproductive performance of Okra at 65 DAS at Sunsari, Nepal, 2025.

Treatment	Number of buds	Number of pods	Pod length (cm)
Poultry manure	22.53[a]	4.87[a]	17.07[a]
Vermicompost	11.47[c]	2.40[b]	13.67[b]
Farm Yard Manure	11.93[c]	2.33[b]	15.73[ab]
Goat manure	11.93[c]	2.80[b]	15.73[ab]
Mustard seedcake	21.33[ab]	3.13[b]	16.40[a]
Chemical fertilizers (NPK)	25.33[a]	4.93[a]	17.73[a]
Control	14.27[bc]	2.67[b]	15.87[a]
LSD (0.05)	7.64	1.71	2.03
SEm (±)	2.48	0.56	0.66
F probability	**	*	*
CV, %	25.14	29.10	7.13
Grand Mean	17.08	3.31	16.03

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '' 1

Note: The common letter(s) within the column indicates non-significant (NS) difference based on Duncan's Multiple Range Test (DMRT) at 0.05 level of significance. SEm=Standard Error of Means, LSD=Least Significant Difference, and CV=Co-efficient of Variation.

Pod girth, pod weight and yield

The effect of organic manures on the pod diameter, pod weight and yield of Okra is depicted in the Table 4. Pod girth differed significantly among treatments. Synthetic fertilizers recorded the highest pod girth (16.19 mm), statistically at par with poultry manure (15.59 mm). This corresponds to the findings by Marschner (2012) who reported that poultry manure contains essential micronutrients such as Boron (B) that improves pollination and fruit set, Zinc (Zn) that supports hormone activity and fruit development and Calcium (Ca) that strengthens pod tissues and improves thickness.

Poultry manure produced the highest pod weight (20.56 g), statistically similar to synthetic fertilizers (20.37 g) Enhanced pod weight under poultry manure may result from improved soil physical properties; aggregation, porosity, and moisture retention leading to increased fruit biomass (Jalloh et al; 2024).

Yield was significantly affected by fertilizer treatments. Synthetic fertilizers recorded the highest yield (25.64 MT/ha), which was statistically at par with poultry manure (21.41 MT/ha). Lower yield was observed in control and FYM treatments. The superior yield under NPK and poultry manure may be attributed to enhanced soil structure, water retention, and microbial activity, creating a more favorable environment for root development and nutrient uptake which eventually leads to higher yields (Karim et al; 2020).

Table 4. Effect of organic manures on the pod diameter, pod weight and yield of Okra at final harvest at Sunsari, Nepal, 2025.

Treatment	Pod diameter (mm)	Pod weight (g)	Average yield (MT/ha)
Poultry manure	15.59^{ab}	20.56^{a}	21.41^{a}
Vermicompost	13.71^{d}	14.10^{b}	10.73^{b}
Farm Yard Manure	15.05^{bc}	14.01^{b}	8.96^{b}
Goat manure	15.05^{bc}	16.16^{b}	12.79^{b}
Mustard seedcake	14.55^{c}	15.13^{b}	12.53^{b}
Chemical fertilizers (NPK)	16.19^{a}	20.37^{a}	25.64^{a}
Control	14.61^{c}	15.57^{b}	7.37^{b}
LSD (0.05)	0.64	3.64	6.23
SEm (±)	0.21	1.18	2.02
F probability	***	**	***
CV, %	2.42	12.36	24.67
Grand Mean	14.97	15.56	14.20

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '' 1

Note: The common letter(s) within the column indicates non-significant (NS) difference based on Duncan's Multiple Range Test (DMRT) at 0.05 level of significance. SEm=Standard Error of Means, LSD=Least Significant Difference, and CV=Co-efficient of Variation.

CONCLUSION

The result of majority of the studied parameters in this study reflects that the application of synthetic fertilizers and poultry manure are equally significant. The Okra producing farmers can be suggested to use poultry manure as it supports high productivity while contributing soil health and sustainability compared to synthetic fertilizers. Thus, we may conclude that poultry manure could be the most practical organic alternative for optimizing Okra's performance in the tropical climate of Eastern Nepal.

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AUTHOR CONTRIBUTIONS

SBM: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft; **DT:** Conceptualization, Investigation, Validation, Writing – review & editing, Supervision; **UT:** Validation, Writing – review & editing, Supervision.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

ETHICAL APPROVAL AND PERMITS

No human participants or animals were involved during the study and prior approvals were obtained where applicable.

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