
Growth and yield of okra as influenced by organic manures and bio-fertilizers

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Abstract

Okra (Abelmoschus esculentus L. Moench) is an economically important vegetable crop valued for its nutritional, medicinal, and industrial applications. With increasing concerns over the high cost and negative environmental effects of inorganic fertilizers, organic nutrient management has emerged as a sustainable alternative for enhancing soil fertility and okra productivity. A field experiment was conducted during the Kharif season of 2024 at the Campus for Research and Advanced Studies, Dhablan, to evaluate the effect of planting methods and various organic manures and biofertilizers on the growth and yield of okra. The study was laid out in a split-plot design with two planting methods (plain and ridge) in the main plots and six organic treatments control, farmyard manure (25 t ha⁻¹), poultry manure (10 t ha⁻¹), vermicompost (5 t ha⁻¹), Azotobacter (3 kg ha⁻¹), and phosphate-solubilizing bacteria (3 kg ha⁻¹) in the subplots. Results revealed that ridge planting significantly improved vegetative traits, including plant height, canopy spread, and number of leaves, as well as yield parameters such as fruit length, fruits per plant, and total fruit yield compared to plain planting. Among the organic treatments, vermicompost proved most effective, producing the highest plant height (91.1 cm), plant spread (79.1 cm), number of leaves (18.5), fruit length (13.7 cm), fruits per plant (15.2), and yield (194.57 q ha⁻¹). Azotobacter and poultry manure were also highly effective, outperforming farmyard manure, phosphate-solubilizing bacteria, and the control. The superior performance of vermicompost and biofertilizers may be attributed to improved nutrient availability, soil structure, and microbial activity. Overall, the study demonstrates that ridge planting in combination with high-quality organic amendments particularly vermicompost offers a sustainable and efficient strategy for enhancing okra growth, yield, and soil health under semi-arid agroclimatic conditions.

Keywords: Inorganic fertilizers, Azotobacter, poultry manure, farmyard manure, biofertilizers

Introduction

Okra (*Abelmoschus esculentus* L. Moench) is a widely cultivated vegetable crop of considerable agronomic and economic importance across tropical, subtropical, and warm temperate regions of the world. Okra is valued primarily for its tender green pods, which contains a characteristic mucilaginous

substance used to thicken soups and stews. Beyond its pods, the leaves are consumed as leafy vegetables and possess medicinal properties, being traditionally used for treating ulcers and haemorrhages (Martin & Ruberte, 1978). Okra seeds also serve as a source of edible oil and have industrial applications in soap

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production (Oyolu, 1983). Enhancing okra yield has long been associated with the application of inorganic fertilizers, particularly NPK, which increases soil fertility and productivity (Donahue et al., 1990). However, the high cost, declining soil health, and negative environmental impacts associated with chemical fertilizers (Ullyses, 1982) have necessitated the search for sustainable alternatives. Previous investigations have demonstrated the efficacy of integrating organic and inorganic fertilizer sources for improved okra growth. For example, Okwuagwu *et al.* (2003) reported enhanced growth and yield when cattle manure was combined with NPK, while Akande *et al.* (2010) found significant increases in growth parameters with integrated applications of poultry manure and organic-based fertilizers.

In recent years, attention has shifted toward organic fertilizers, which are derived from decomposed plant or animal residues (Buob, 2008). Common organic sources including cow dung, poultry manure, rabbit manure, goat manure, and composts improve soil organic matter, enhance nutrient availability, and promote better physical and biological soil conditions (Bhata & Shukla, 1982). Organic manures have been shown to increase soil carbon, nitrogen, pH, cation-exchange capacity, and essential nutrients such as calcium, magnesium, and potassium, all of which contribute to higher crop productivity. Several studies highlight the positive effects of vermicompost and poultry manure in increasing growth and yield attributes of okra (Sameera *et al.*, 2005; Tiamiyu *et al.*, 2012). Despite the advantages, the nutrient release rate from organic manures is often slow and inconsistent (Miah, 1994), creating uncertainty in achieving optimal yields. Therefore, evaluating different organic fertilizer sources is essential for identifying the most effective manure type for improving okra productivity while reducing dependency on chemical inputs. In response to these concerns, the present study aims to assess the effects of various organic manures, particularly poultry and cattle manures, on the growth and yield performance of okra.

Materials and Methods

A field experiment was conducted during *Kharif* season 2024 at the Campus for Research

and Advanced Studies, Dhablan. The experimental site is situated at about 30°20' N latitude and 76°28' E longitude at an altitude of 249 m above the mean sea level. Patiala falls under a semi-arid climatic zone, characterized by distinct seasonal variations. The region experiences hot and dry conditions from April to June, transitioning to hot and humid weather during the monsoon period from July to September, and turning cold from November to February. At the Campus for Research and Advanced Studies, Dhablan, Patiala, the climate remains subtropical throughout the year, marked by dry summers, a humid monsoon phase, and chilly winters. After the preparation of the field, the experiment was laid out in split plot design with 12 treatments and three replications. Okra variety Samarth was sown on 5th April, 2024 with spacing 45x15cm and plot size of 4.0x 3.25 meters. All manures were applied as per the requirement. The required quantity of FYM at 25 t ha⁻¹, poultry manure at 10 t ha⁻¹, and vermicompost at 5 t ha⁻¹ were applied before sowing. Azotobacter (3 kg ha⁻¹) and phosphate solubilizing bacteria (3 kg ha⁻¹) were also applied. The plots were maintained weed free throughout the growth period of crop. To reduce the crop weed competition, three weeding were done.

Main plots = Planting methods:

P1: Plain

P2: Ridge

Sub plots = Organic manure and bio-fertilizers:

M1: Control

M2: Farm yard manure 25t ha⁻¹

M3: Poultry manure 10t ha⁻¹

M4: Vermicompost 5t ha⁻¹

M5: Azotobacter 3kg ha⁻¹

M6: Phosphate solubilizing bacteria 3kg ha⁻¹

Results and Discussion

Growth parameters

The results clearly demonstrate that both planting methods and organic nutrient sources significantly influenced the vegetative growth of okra, as reflected in plant height, plant spread, and number of leaves per plant. Ridge planting (P₂) produced taller plants (90.4 cm), wider canopy spread (78.2 cm), and more leaves (18.1) compared to plain

Table 1: Growth parameters of okra as influenced by organic manure and bio-fertilizers

Treatment	Plant height (cm)	Plant spread (cm)	No. of leaves per plant
Main Plot (Planting methods)			
P1 : Plain	85.7	73.5	16.3
P2 : Ridge	90.4	78.2	18.1
SEm±	0.82	0.95	0.31
CD (5%)	2.50	2.81	0.90
Sub Plot (Type of organic treatments)			
M1 : Control	64.6	68.1	14.1
M2 : FYM 25t ha ⁻¹	87.6	75.3	17.2
M3 : PM 10t ha ⁻¹	89.4	76.8	17.7
M4 : VC 5t ha ⁻¹	91.1	79.1	18.5
M5 : Azotobacter 3kg ha ⁻¹	90.2	78.1	18.3
M6 : PSB 3 kg ha ⁻¹	88.6	75.9	17.4
SEm±	1.12	1.18	0.41
CD (5%)	3.22	3.43	1.23

planting (P_1), indicating that improved soil aeration and drainage under ridge conditions enhanced root development and nutrient uptake. Among the organic treatments, the untreated control (M_1) recorded the lowest growth performance across all parameters, confirming the insufficiency of inherent soil fertility. In contrast, all organic amendments improved vegetative growth, with vermicompost at 5 t ha⁻¹ (M_4) resulting in the greatest plant height (91.1 cm), plant spread (79.1 cm), and leaf production (18.5), followed closely by Azotobacter (M_5) and poultry manure (M_3). Farmyard manure (M_2) and PSB (M_6) also enhanced growth but to a comparatively lesser extent. Overall, the findings suggest that ridge planting combined with high-quality organic inputs, particularly vermicompost, substantially enhances vegetative performance in okra.

Ridge planting produced taller and more vigorous plants, which aligns with the reports of Adekunle (2013) who noted enhanced vegetative growth of okra under improved soil aeration and drainage conditions associated with suitable land preparation. Organic treatments, especially vermicompost, poultry manure, and Azotobacter, significantly increased plant height and canopy spread, reflecting the nutrient-enriched environment described by Khandaker *et al.* (2017), who emphasized that organic manures improve soil

carbon content, nutrient availability, and biological activity. Similarly, Kumar *et al.* (2017) found significant increases in plant height and leaf production with the application of vermicompost and FYM, attributing these effects to enhanced nutrient mineralization and soil structure. Meena *et al.* (2019) further confirmed vermicompost as the most effective organic source for promoting vigorous vegetative growth in okra due to its high humus content, microbial activity, and slow but steady nutrient release.

Yield parameters

The results indicate that both planting methods and organic nutrient sources exerted a significant influence on fruit length, number of fruits per plant, and overall fruit yield in okra. Ridge planting (P_2) consistently outperformed plain planting (P_1), producing longer fruits (13.4 cm), a higher number of fruits per plant (14.6), and greater fruit yield (183.35 q ha⁻¹), whereas plain planting recorded comparatively lower values (12.6 cm, 13.2 fruits, and 170.86 q ha⁻¹). This suggests that ridge planting facilitated better soil aeration, moisture distribution, and nutrient uptake, which translated into improved reproductive efficiency and yield. Across the organic treatments, the control (M_1) presented the lowest fruit length (11.2 cm), fruit number (11.6), and yield (157.34 q ha⁻¹), confirming the necessity of external

Table 2: Yield parameters of okra as influenced by organic manure and bio-fertilizers

Treatment	Fruit length (cm)	Fruit plant ⁻¹	Fruit yield (q ha ⁻¹)
Main Plot (Planting methods)			
P1 : Plain	12.6	13.2	170.86
P2 : Ridge	13.4	14.6	183.35
SEm±	0.14	0.17	4.75
CD (5%)	0.42	0.52	9.54
Sub Plot (Type of Organic components)			
M1 : Control	11.2	11.6	157.34
M2 : FYM 25t ha ⁻¹	12.9	13.8	169.93
M3 : PM 10t ha ⁻¹	13.2	14.3	177.39
M4 : VC 5t ha ⁻¹	13.7	15.2	194.57
M5 : Azotobacter 3kg ha ⁻¹	13.5	14.6	190.18
M6 : PSB 3 kg ha ⁻¹	13.1	14.1	184.84
SEm±	0.19	0.23	5.64
CD (5%)	0.58	0.68	14.51

nutrient supplementation for optimal okra productivity. All organic amendments enhanced yield parameters, with vermicompost at 5 t ha⁻¹ (M₄) recording the maximum fruit length (13.7 cm), highest fruit number (15.2), and greatest fruit yield (194.57 q ha⁻¹). This was closely followed by Azotobacter (M₅) and poultry manure (M₃), both of which showed substantial improvements over the control. FYM (M₂) and PSB (M₆) also improved yield attributes but to a lesser degree than vermicompost. Overall, the findings demonstrate that ridge planting combined with nutrient-rich organic amendments particularly vermicompost, Azotobacter, and poultry manure enhances fruit development and yield potential in okra.

Ridge planting produced longer fruits, more fruits per plant, and higher yield, which supports the findings of Adekunle (2013), who reported improved pod development and yield when soil conditions favour nutrient uptake and root expansion. Among organic treatments, vermicompost recorded the highest fruit length and yield, agreeing with the observations of Khandaker *et al.* (2017) and Meena *et al.* (2019), who both found vermicompost superior in enhancing reproductive traits and final yield due to its balanced nutrient profile and high microbial population. Poultry manure and Azotobacter also

produced significantly higher fruit yields, similar to the results of Kumar *et al.* (2017), who reported that organic sources, especially vermicompost and poultry manure, increase flowering, fruiting efficiency, and pod size. The lowest fruit yield recorded in the control plot parallels all four referenced studies, where the absence of organic amendments consistently resulted in poor fruit development.

Conclusion

The present study clearly demonstrates that both the method of planting and the application of organic nutrient sources plays a decisive role in determining the vegetative growth and yield performance of okra. Ridge planting consistently proved superior to plain planting, as it enhanced soil aeration, drainage, and nutrient uptake, ultimately resulting in improved growth attributes such as plant height, canopy spread, and number of leaves, as well as better reproductive parameters including fruit length, number of fruits per plant, and overall yield. Among the organic nutrient sources, vermicompost (5 t ha⁻¹) emerged as the most effective treatment, producing the highest values for both growth and yield parameters, followed closely by *Azotobacter* and poultry manure. These findings highlight the capacity of high-quality organic inputs to supply

balanced nutrients, stimulate microbial activity, and improve soil structure, thereby contributing to enhanced plant vigour and productivity. The consistently poor performance of the control confirms that inherent soil fertility alone is insufficient to support optimal okra growth and yield. This integrated approach not only boosts yield but also enhances soil health, making it a viable option for environmentally conscious and resource-efficient okra cultivation.

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