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Rani Meena

Research Scholar, Department of Horticulture, School of Agriculture, SGVU, Jaipur, Rajasthan, India

Manoj Kumar Bundela

Assistant Professor, Department of Horticulture, School of Agriculture, SGVU, Jaipur, Rajasthan, India

Dipayan Sarkar

Head, Department of Horticulture, School of Agriculture, SGVU, Jaipur, Rajasthan, India

Ajeet Singh Shekhawat

Dean, Department of Horticulture, School of Agriculture, SGVU, Jaipur, Rajasthan, India

To study the effect of organic manures and bio-fertilizers on growth parameters of okra var. pusa makhamali

Rani Meena, Manoj Kumar Bundela, Dipayan Sarkar and Ajeet Singh Shekhawat

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Abstract

Okra (*Abelmoschus esculentus* L.) is an important vegetable crop widely cultivated in India for its tender pods and nutritional value. A field experiment was conducted during Kharif 2025 at the Horticulture Farm, Suresh Gyan Vihar University, Jaipur, to study the effect of organic manures and bio-fertilizers on the growth parameters of okra cv. Pusa Makhamali. The experiment was laid out in a Factorial Randomized Block Design (FRBD) with sixteen treatment combinations comprising organic manures (FYM, poultry manure, and vermicompost) and bio-fertilizers (PSB and Azotobacter) replicated thrice. The results revealed that among organic manures, vermicompost significantly recorded the highest plant height (63.07 cm at 45 DAS and 113.40 cm at harvest) and stem diameter (19.38 mm). Among bio-fertilizers, the combined application of PSB and Azotobacter resulted in maximum plant height (69.64 cm at 45 DAS and 130.41 cm at harvest) and stem diameter (19.83 mm). The interaction effect between organic manures and bio-fertilizers was non-significant. The study concluded that vermicompost and the combined inoculation of PSB and Azotobacter were the most effective treatments for improving growth parameters of okra.

Keywords: Okra, vermicompost, bio-fertilizers, azotobacter, plant growth

Introduction

Okra [*Abelmoschus esculentus* (L.)] is commonly known as lady's finger or bhindi and it belongs to the malvaceae family. Okra is one of the most important vegetable crop grown in tropical and sub-tropical region and is said to be native of South Africa. In India, it is cultivated almost in all states throughout the year and consumed by bulk of the people. Okra is an important vegetable grown for its tender pods (fruits) which are used as a vegetable in various ways.

It is also a very good source of dietary fiber, vitamin A, C, K, thiamine, vitamin B₆, folate, calcium, magnesium and manganese. Its nutritive value varies in different cultivars depending upon the agro-climatic conditions. The dry seed contains 13-22 percent good quality edible oil and 20-24 percent protein.

In India, Okra is cultivated throughout the country for its immature tender pods (fruits), covering an area of 530.6 thousand hectares and production of 6465.6 thousand metric tonnes with productivity of 12.28 tonnes/ha (Anonymous, 2023). Okra is mostly growing in the states of Andhra Pradesh, West Bengal, Bihar, Gujarat, Orissa, Uttar Pradesh, Haryana and Rajasthan. In Rajasthan, it is grown in an area of 4.28 thousand hectares and annual production of 19.73 thousand metric tonnes with productivity of 4.61 tonnes/ha (Anonymous, 2023). Vegetable and vegetables based cropping system show that vegetable crops respond well to nutrient supply through organic manures and chemical fertilizers (Kale *et. al.*, 1991) ^[2].

Materials and Methods

A field experiment was conducted at Horticulture Farm, Suresh Gyan Vihar University, Jaipur during Kharif season 2024. Geographically, Jaipur, is situated at 26.89° North latitude and 75.77° East longitudes. The place falls under Agro-climatic zone-IIIa (Semi-Arid Eastern Plains), of Rajasthan.

Corresponding Author:

Rani Meena

Research Scholar, Department of Horticulture, School of Agriculture, SGVU, Jaipur, Rajasthan, India

The data on metrological observations recorded at the metrological observatory are presented in Table 1 and the physical and chemical composition of the soil is presented in Table 2. In this context, the present study aims to analyze the effect of organic manures and bio-fertilizers on growth parameters viz., plant height (cm) and stem diameter (mm) of Okra var. Pusa Makhamali.

The meteorological conditions during the crop season showed considerable variation. Maximum temperature ranged from 30.5 to 37.9°C and minimum temperature from 8.5 to 25.9°C. The crop experienced humid conditions

during the monsoon period, with relative humidity reaching up to 83.5%. Most of the rainfall was received during July and August, with the highest weekly rainfall of 70.0 mm recorded during SMW 31. Sunshine hours and evaporation remained low during the rainy season but increased steadily from September onwards as rainfall ceased. Overall, the season was characterized by adequate rainfall and high humidity during the initial growth period, followed by dry weather with higher sunshine and evaporative demand during the later stages of crop growth.

Table 1: Mean weekly meteorological data for crop season

SMW No.	Period From	Period To	Max Temp (°C)	Min Temp (°C)	Mean RH (%)	Evaporation (mm/day)	Sunshine (hrs)	Rainfall (mm)
29	16/07/2024	22/07/2024	32.7	25.9	68	0.44	0.44	15.4
30	23/07/2024	29/07/2024	31.4	25.1	72.5	0.45	0.85	36.4
31	30/07/2024	05/08/2024	31.4	24.5	81.5	0.36	0.86	39.0
32	06/08/2024	12/08/2024	31.9	24.9	81.5	0.35	0.12	41.8
33	13/08/2024	19/08/2024	31.9	24.2	76.4	0.40	0.43	0.8
34	20/08/2024	26/08/2024	31.9	24.2	76.4	0.40	0.45	0.0
35	27/08/2024	02/09/2024	30.5	24.5	83.5	0.38	0.19	0.0
36	03/09/2024	09/09/2024	32.5	22.5	60	0.44	0.29	0.0
37	10/09/2024	16/09/2024	34.9	22.4	59	0.56	0.27	0.0
38	17/09/2024	23/09/2024	37.9	23.7	56	0.66	0.56	0.0
39	24/09/2024	30/09/2024	37.1	22.7	59	0.66	0.89	0.0
40	01/10/2024	07/10/2024	34.3	23.6	72	0.64	0.81	0.0
41	08/10/2024	14/10/2024	35.2	20.5	61	0.64	0.22	—
42	15/10/2024	21/10/2024	35.3	15.5	47	0.65	0.81	—
43	22/10/2024	28/10/2024	34.3	14.6	51	0.65	0.39	—
44	29/10/2024	04/11/2024	33.0	11.0	55	0.46	0.57	—
45	05/11/2024	11/11/2024	32.0	08.5	49	0.64	0.32	—

Table 2: Physico-chemical characteristics of the experimental soil

S. No.	Parameters	Value	Method adopted
A	Mechanical analysis		
1.	Coarse sand (percent)	26.2	International pipette method as described by Robenson (Piper, 1950)
2.	Fine sand (percent)	56.3	International pipette method as described by Robenson (Piper, 1950)
3.	Silt (percent)	9.3	International pipette method as described by Robenson (Piper, 1950)
4.	Clay (percent)	8.3	International pipette method as described by Robenson (Piper, 1950)
5.	Textural class	Loamy and	USDA, Triangle (soil survey Piper, 1950)
B.	Physical analysis		
1.	Field capacity (percent)	10.6	Method No. 33, USDA Hand Book No. 60 (Richards, 1954)
2.	Particle density (mg/m ³)	2.58	Method No. 39, USDA Hand Book No. 60 (Richards, 1954)
3.	Permanent wilting point (percent)	3.6	Method No. 31, USDA Hand Book No. 60 (Richards, 1954)
4.	Bulk density (mg/m ³)	1.51	Method No. 31, USDA Hand Book No. 60 (Richards, 1954)
5.	Porosity (percent)	41.58	Method No. 31, USDA Hand Book No. 60 (Richards, 1954)
C.	Chemical analysis		
1.	Organic carbon (percent)	0.15	Walkely and Black rapid titration method (Piper, 1950)
2.	Available nitrogen(kg/ha)	140.56	Alkaline potassium permagnate method (Subhiah and Asija, 1956)
3.	Available phosphorus (kg/ha)	18.40	Olsen's method (Olsen <i>et al.</i> , 1954)
4.	Available potassium (kg/ha)	157.60	Flame photometer method (Matson, 1956)
5.	Available sulphur (mg/kg)	8.30	Turbidometry method (Chesnin and Yien, 1957)
6.	ECe of saturation extract of soil at 25 ^o C (ds/m)	0.80	Method No. 4, USDA Hand Book No. 60 (Richards, 1954)
7.	pH (1:2 soil water suspension)	8.1	Method No.21(b), USDA Hand Book No. 60 (Richards, 1954)

To maintain the proper plant population thinning was done at 25 days after sowing, leaving single plant per hill. Hoeing and weeding were done twice *i.e.* at 30 and 55 days after sowing.

FYM and Poultry Manure procured from the Live-stock Production and Management Department of this College and vermicompost procured from the unit of Soil Science Department and applied in the beds as per treatments and was thoroughly incorporated in to the soil before sowing and at the time of seed sowing according to RDF of Okra (102:60:60 kg NPK).

Application of bio-fertilizers was done as per treatment *Azotobacter* (200ml ha⁻¹) as seed treatment. 2-3 ml *Azotobacter* in Liquid form was mixed in one litre of water. Then seeds are soaked in this solution for 25 minutes. *PSB* also applied as seed treatment @ 5g/kg seed for this 125 g of Jaggery was mixed in one litre of boiled water. Appropriate quantity (2g) of was poured in Jaggery solution separately and stirred well.

Okra requires enough soil moisture for seed germination. It was maintained by pre-sowing heavy irrigation. Further irrigations were given at an interval of 6-10 days except during the period of intermittent rains.

To maintain the proper plant population thinning was done at 25 days after sowing, leaving single plant per hill. Hoeing and weeding were done twice *i.e.* at 30 and 55 days after sowing. To protect the crop from the attack of insect pests *viz.*, jassids and whitefly, spray of Imidacloprid 17.5 SL (0.25percent) was done after 30 days of sowing thereafter, sprays of Diamethoate 30 EC (0.03percent) were done as and when needed to control fruit borers in Okra crop.

Treatment combinations

The treatment involved in the study were seven in number as mentioned below:

T ₁	O ₀ B ₁	Control
T ₂	O ₁ B ₁	FYM @ 25 t/ha
T ₃	O ₂ B ₁	Poultry Manure @ 10 t/ha.
T ₄	O ₃ B ₁	Vermicompost @ 10 t/ha.
T ₅	O ₀ B ₃	<i>Azotobacter</i> @ 1.25kg/h
T ₆	O ₀ B ₂	PSB @ 4 kg/ha.
T ₇	O ₀ B ₄	<i>Azotobacter</i> @ 1.25kg/h + PSB @ 4g/ha.
T ₈	O ₁ B ₃	FYM @ 25 t/ha + <i>Azotobacter</i> @ 1.25 kg/ha.
T ₉	O ₁ B ₂	FYM @ 25 t/ha + PSB @ 4 kg/ha
T ₁₀	O ₁ B ₄	FYM @ 25 t/ha + <i>Azotobacter</i> @ 1.25 Kg/h + PSB 4 kg/h
T ₁₁	O ₂ B ₃	Poultry Manure @ 10 t/ha. + <i>Azotobacter</i> @ 1.25 kg/ha.
T ₁₂	O ₂ B ₂	Poultry Manure @ 10 t/ha. + PSB @ 4 kg/ha.
T ₁₃	O ₂ B ₄	Poultry Manure @ 10 t/ha. + <i>Azotobacter</i> @ 1.25 kg/h + PSB 4 kg/h
T ₁₄	O ₃ B ₃	Vermicompost @ 10 t/ha. + <i>Azotobacter</i> @ 1.25 kg/ha.
T ₁₅	O ₃ B ₂	Vermicompost @ 10 t/ha. + PSB @ 4 kg/ha.
T ₁₆	O ₃ B ₄	Vermicompost @ 10 t/ha. + <i>Azotobacter</i> @ 1.25 kg/h + PSB 4 kg/h

Experimental details

i.	Season and Year	Kharif 2025
ii.	Name of the crop	Okra
iii.	Name of variety	Pusa Makhamali
iv.	Treatment combination	4 X 4 = 16
v.	Replication	3
vi.	Total number of plots	48
vii.	Spacing	60 X 45 cm
viii.	Net plot size	3.60 X 2.25 = 8.1 m ²
ix.	Number of plant/Plot	30
x.	Experimental design	FRBD

Results and Discussion

Table 3 and Table 4 presents the effect of organic manures and bio-fertilizers on plant height (cm) and stem diameter (mm) at 45 DAS and at harvest, respectively.

Table 3: Effect of organic manures and bio-fertilizers on plant height (cm) at 45 DAS and at harvest.

Treatment	Plant height (cm)	
	45 DAS	at harvest
Factor A: Organic Manure		
Control (O ₀)	56.47	103.39
Farm yard manure (O ₁)	58.68	107.34
Poultry Manure (O ₂)	59.93	110.67
Vermicompost (O ₃)	63.07	113.4
S.Em±	0.70	1.00
CD at 5percent	2.04	2.92
Factor B: Bio-fertilizer		
Control (B ₁)	50.19	85.76
PSB (B ₂)	56.02	100.95
<i>Azotobacter</i> (B ₃)	62.30	117.76
PSB + <i>Azotobacter</i> (B ₄)	69.64	130.41
S.Em±	0.70	1.00
CD at 5 %	2.04	2.92
Interaction	NS	NS

Plant height was significantly influenced by both organic manures and bio-fertilizer treatments at 45 DAS and at harvest. Among the organic manure treatments, vermicompost (O₃) recorded the highest plant height (63.07 cm at 45 DAS and 113.40 cm at harvest), which was significantly superior to the control (56.47 cm and 103.39 cm, respectively). Poultry manure (O₂) and farmyard manure (O₁) also improved plant height over the control. Among the bio-fertilizer treatments, the combined application of PSB + *Azotobacter* (B₄) resulted in the maximum plant height (69.64 cm at 45 DAS and 130.41 cm at harvest), followed by *Azotobacter* alone (B₃). The lowest plant height was observed under the control treatment (B₁). The increase in plant height with bio-fertilizer application may be attributed to enhanced nutrient availability, biological nitrogen fixation, and improved root growth. The interaction effect between organic manures and bio-fertilizers was found to be non-significant at both stages, indicating that the effects of the two factors were independent of each other. Overall, vermicompost and the combined inoculation of PSB + *Azotobacter* were the most effective treatments for improving plant height.

Table 4: Effect of organic manures and bio-fertilizers on stem diameter (mm)

Treatment	Stem Diameter (mm)
Factor A: Organic Manure	
Control (O ₀)	19.04
Farm yard manure (O ₁)	19.14
Poultry Manure (O ₂)	19.27
Vermicompost (O ₃)	19.38
S.E.m $\pm$	0.03
CD at 5 %	0.10
Factor B: Bio-fertilizer	
Control (B ₁)	18.64
PSB (B ₂)	19.00
Azotobacter (B ₃)	19.36
PSB +Azotobacter (B ₄)	19.83
S.E.m $\pm$	0.03
CD at 5 %	0.10
Interaction	NS

Stem diameter was significantly influenced by both organic manure and bio-fertilizer treatments. Among the organic manure treatments, vermicompost (O₃) recorded the highest stem diameter (19.38 mm), followed by poultry manure (O₂) (19.27 mm) and farmyard manure (O₁) (19.14 mm), while the lowest stem diameter was observed in the control (O₀) (19.04 mm). The improvement in stem diameter with organic manures may be attributed to better nutrient availability and improved soil physical conditions.

Among the bio-fertilizer treatments, the combined application of PSB + Azotobacter (B₄) produced the maximum stem diameter (19.83 mm), followed by Azotobacter (B₃) (19.36 mm) and PSB (B₂) (19.00 mm). The control treatment (B₁) recorded the minimum stem diameter (18.64 mm). Enhanced nutrient solubilization, nitrogen fixation, and improved nutrient uptake under bio-fertilizer application might have contributed to increased stem thickness.

The interaction effect between organic manures and bio-fertilizers was non-significant, indicating that the individual effects of these factors on stem diameter were independent. Overall, vermicompost and the combined application of PSB + Azotobacter were found to be the most effective treatments for improving stem diameter.

Conclusion

The present investigation demonstrated that the application of organic manures and bio-fertilizers significantly improved the growth performance of okra cv. Pusa Makhamali. Among the organic manure treatments, vermicompost proved superior in enhancing plant height and stem diameter. Similarly, the combined application of PSB and Azotobacter recorded the best performance among bio-fertilizer treatments. Although the interaction effect was non-significant, the individual effects of vermicompost and the combined use of PSB and Azotobacter substantially enhanced vegetative growth. Therefore, the integrated use of vermicompost along with PSB and Azotobacter can be recommended as an eco-friendly and sustainable nutrient management practice for improving the growth of okra under semi-arid conditions of Rajasthan.

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