**Effect of Different Organic Treatments on Growth, Yield and Quality of Okra (*Abelmoschus esculetus* L.) in Prayagraj Region**

 **ABSTRACT**

 The field experiment was conducted at Horticulture Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during the Kharif season of 2024 to study the effect of different organic treatments on the growth, yield, and quality of okra [Abelmoschus esculentus (L.) Moench]. The need to conduct this study arose from the growing demand for sustainable agricultural practices and the search for viable organic alternatives to conventional chemical fertilizers, which have been linked to environmental degradation and increasing production costs. Organic farming is increasingly being recognized for its potential to improve soil health, reduce environmental impacts, and provide economically viable solutions for farmers. In this context, the experiment aimed to evaluate the effectiveness of various organic amendments in enhancing okra cultivation under organic conditions.

The experiment followed a randomized block design with three replications and nine treatments:T0: 100% recommended NPK (100:80:50 kg/ha) (100%), T1: Phosphate Solubilizing Bacteria 5g + Farm yard manure (100%) (20 t/ha), T2: Phosphate Solubilizing Bacteria 5g + Poultry manure (100%) (15 t/ha), T3: Phosphate Solubilizing Bacteria 5g + Vermicompost (100%) (5 t/ha), T4: Phosphate Solubilizing Bacteria 5g + Neem cake (100%) (2 t/ha), T5: Phosphate Solubilizing Bacteria 5g + 50% FYM (10 t/ha) + 50% poultry manure (7.5 t/ha), T6: PSB 5g + 50% FYM (10 t/ha) + 50% vermicompost (2.5 t/ha), T7: PSB 5g + 50% poultry manure (7.5 t/ha) + 50% vermicompost (2.5 t/ha), T8: PSB 5g + FYM (5 t/ha) + Poultry manure (3.75t/ha)+ Vermicompost (1.25t/ha) + Neem cake (0.5t/ha) (1:1:1:1).

Results revealed that days to germination, days to 50% germination, plant height (cm), number of leaves per plant, number of branches/plant, days to 1st flowering, days to 50% flowering, fruit length (cm), fruit diameter (cm), fruit weight (g), number of fruit per plant, fruit yield per plant (g), fruit yield (t/ha), ascorbic acid (mg/100g) and TSS ( ̊Brix) were maximum with the application of the T8 [ PSB 5g + FYM (5 t/ha) + Poultry manure (3.75t/ha)+ Vermicompost (1.25t/ha) + Neem cake (0.5t/ha) (1:1:1:1)] in okra. It is also recorded that T8 gave maximum Gross Returns (INR 256560/ha), Net Return (INR 193785/ha) and Cost benefit ratio of 4.08. So, the treatment combination T8 can be taken for better income of farmers and stakeholders for okra cultivation in Prayagraj region due to its superior growth, yield, quality, and profitability under organic conditions.

**Keywords :- organic manure, NPK, PSB growth, yield, quality and okra**

**INTRODUCTION**

“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 and Asia. In India, it is cultivated almost in all states throughout the year and consumed by bulk of the people” **Lakra *et al.,* (2017).** “Okra (*Abelmoschus esculentus* L. Moench) belongs to the family of Malvaceae and has chromosome number 2n=130” **(Skovsted, 1935) “**being economically important vegetable crop grown in subtropical and tropical parts of the world. It is generally an annual plant.Okra is a good source of vitamins, minerals, calories, and amino acids found in seeds.” **(Schipper, 2000). “**It called ‘Bhinda’ or ‘Bhindi’ in India and very important summer vegetable. Fruits are also canned for green or dried for use in off-season. The roots and stems of okra plants are used to clean cane juice in the manufacture of Jaggery and Sugar” **(Chauhan 1972). “**In India, the major okra growing states are West Bengal, Gujarat, Bihar, Odisha, Jharkhand, Uttar Pradesh, Chhattisgarh, Madhya Pradesh, Andhra Pradesh etc. In India, okra is cultivated in area of 5.13 lakh ha and 6.17 million MT production with 12.24 MT/ha productivity” (NHB, 2018-19).

“Composition per 100 g of edible portion of okra contains, Calories 35.0 mg, Calcium 66.0 mg, Moisture 89.6 g, Iron 0.35 mg, Carbohydrates 6.4 g, Potassium 103.0 mg, Protein 1.9 g, Magnesium 53.0 mg, Fat 0.2 g, Copper 0.19 mg, Fibre 1.2 g, Riboflavin 0.01 mg, Minerals 0.7g, Thiamine 0.07 mg, Phosphorus 56.0 mg, Nicotinic acid 0.06 mg, Sodium 6.9 mg, Vitamin C 13.10 mg, Sulphur 30.0 mg and Oxalic acid 8.0 mg” **(Gopalan et al. 2007). “**Fresh okra heals constipation, leucorrhea, spermatorrhea, diabetes, and jaundice; the mucilage can cure diarrhea, dysentery, gastric ulcer, and syphilis, etc. The polysaccharides from okra modulate and improve organisms‟ immune response due to S. aureus infection. Okra pods contain polyphenols and flavonoids such as quercetin that have higher antioxidant activity can scavenge free radicals and decrease oxidative stress in the cells. The polyphenols and flavonoids can also protect the liver from the toxic effects of xenobiotics intoxication” **Yadav *et al.,* (2024).**

“Using organic manures to meet the nutrient requirements of crops would be an unavoidable activity for sustainable agriculture in the years to come, as organic manures typically enhance the soil’s physical, chemical and biological properties while retaining the soil’s moisture-bearing ability, resulting in improved crop production and maintaining crop quality. While, organic manures contain plant nutrients in small amounts compared with inorganic fertilizers, the existence of growth promoting principles such as hormones and enzymes make them necessary in ordered to boost soil fertility and crop productivity” **(Premsekhar and Rajshree, 2009).** “Organic manure increases cation exchange capacity, water holding capacity and soil phosphate availability besides enhancing fertilizer use efficiency and soil microbial population, reducing nitrogen losses due to slow nutrient release” **(Tadesse *et al.,* 2013).**

**MATERIALS AND METHODS**

The present investigation entitled “Effect of Different Organic Treatments on Growth, Yield and Quality of Okra (*Abelmoschus esculetus* L.) in Prayagraj Region *"* was carried out at the Horticulture Research Farm, Department of Horticulture. Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad during the (*kharif*) season of 2024-2025. The area of Prayagraj district comes under subtropical belt in the South east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 320C – 340C and seldom falls as low as 40C – 50C. The relative humidity ranged between 20 to 94 per cent. The average rainfall in this area is around 1013.4 mm annually. The variety was used Laxmi 500 for the experiment.

The experiment was conducted under field conditions in 1 m × 1 m plot using a randomized complete block design (RCBD) with three replications and nine treatments (including an unfertilized control). Seeds were sown at 30 cm x 40 cm spacing on 28-07-2024. The treatments were: T0 : NPK (100,80,50 kg/ha) 100%, T1 : PSB 5g + Farmyard manure (100%) (20 t/ha), T2 : PSB 5g + Poultry manure (100%) (15 t/ha), T3 : PSB 5g + Vermicompost (100%) (5 t/ha), T4 : PSB 5g + Neem cake (100%) (2 t/ha), T5 : PSB 5g + Farmyard manure 50% (10 t/ha) + Poultry manure 50% (7.5 t/ha), T6 : PSB 5g + FYM 50% (10 t/ha) + Vermicompost 50% (2.5 t/ha), T7 : PSB 5g + Poultry manure 50% (7.5 t/ha) + Vermicompost 50% (2.5 t/ha) and T8 : PSB 5g + FYM + Poultry manure + Vermicompost + Neem cake (1:1:1:1) (5 t/ha) + (3.75 t/ha) + (1.25 t/ha) + (0.5t/ha). The data were taken from randomly selected five plants from each plot on various characters viz., days to germination, days to 50% germination plant height (cm), number of leaves per plant, number of branches, days to first flowering, days to 50% flowering, fruit length (cm), fruit weight (g), fruit diameter (mm), number of fruits/plant, yield per plant (g), fruits yield t ha-1, ascorbic acid (mg/100g) and TSS (oBrix).

The data recorded during the course of investigation on growth, yield and quality components were subjected to two-way classification analysis of variance (ANOVA) as outlined by Panse and Sukhatme (1985) where the ‘F’ test was significant for comparison of the treatment means, CD values were worked out at 5% probability level.

**RESULTS AND DISCUSSION**

The data presented on days to germination and days to 50% germination in table 1, clearly revealed that significant differences due to effect of organic manures, NPK and PSB on days to germination and days to 50% germination was recorded. The minimum days to germination (3.40) and days to 50% germination (4.03) was noted in T8 treatment (PSB 5g + FYM + Poultry manure + Vermicompost + Neem cake (1:1:1:1) (5 t/ha) + (3.75 t/ha) + (1.25 t/ha) + (0.5t/ha), which was statically at par with T7 : PSB 5g + Poultry manure 50% (7.5 t/ha) + Vermicompost 50% (2.5 t/ha). Whereas the maximum day to germination (6.30) and day to 50% germination (6.90) was found in treatment T0 NPK (100,80,50 kg/ha) 100%. Similar results were found by **Singh *et al.* (2010)** in okra.

The data presented on plant height (cm), number of leaves per plant, number of branches, days to first flowering, days to 50% flowering, fruit length (cm), fruit weight (g) and fruit diameter (mm) in Table 1 clearly revealed that significant differences due to effect of organic manures, NPK and PSB on plant height (cm), number of leaves per plant, number of branches, days to first flowering, days to 50% flowering, fruit length (cm), fruit weight (g) and fruit diameter (mm) was recorded. The maximum plant height (cm) at 60 days after sowing (35.09) was noted in T8 treatment (PSB 5g + FYM + Poultry manure + Vermicompost + Neem cake (1:1:1:1) (5 t/ha) + (3.75 t/ha) + (1.25 t/ha) + (0.5t/ha). Whereas the minimum plant height (cm) (24.81) at 60 days after sowing was found in treatment T4 PSB 5g + Neem cake (100%) (2 t/ha). PM and VC improve soil structure, water retention, and nutrient availability, providing a balanced and sustained nutrient supply. PSB enhances phosphorus availability, promoting root development and overall plant growth. This combination ensures a steady and enhanced nutrient release, improving microbial activity and soil health, resulting in better plant height compared to other fertilizer combinations. Similar findings were reported by **Abbas *et al.,* (2019); Nayak *et al.,* (2019)** in Okra.

“The maximum number of leaves per plant at 60 days after sowing 19.93) was noted in T8 treatment (PSB 5g + FYM + Poultry manure + Vermicompost + Neem cake (1:1:1:1) (5 t/ha) + (3.75 t/ha) + (1.25 t/ha) + (0.5t/ha). Whereas the minimum number of leaves per plant (15.93) at 60 days after sowing was found in treatment T4: PSB 5g + Neem cake (100%) (2 t/ha). The maximum number of branches per plant at 60 days after sowing (15.87) was noted in T8 treatment (PSB 5g + FYM + Poultry manure + Vermicompost + Neem cake (1:1:1:1) (5 t/ha) + (3.75 t/ha) + (1.25 t/ha) + (0.5t/ha). Whereas the minimum number of branches per plant (10.53) at 60 days after sowing was found in treatment T4 PSB 5g + Neem cake (100%) (2 t/ha). The number of leaves per plant increased might be due to the okra with treatment Vermicompost along with poultry manure which enhances development of root and increase uptake of nutrients in cowpea” **(Mishra *et al.,* 2017) and Abha *et al.,* (2019)** in okra. The minimum days to first flowering (39.73) and days to 50% flowering (41.73) was noted in T8 treatment (PSB 5g + FYM + Poultry manure + Vermicompost + Neem cake (1:1:1:1) (5 t/ha) + (3.75 t/ha) + (1.25 t/ha) + (0.5t/ha). Whereas the maximum days to first flowering (43.73) and days to 50% flowering (47.47) was found in treatment T5 PSB 5g + Farmyard manure 50% (10 t/ha) + Poultry manure 50% (7.5 t/ha). Similar findings were reported by **Abbas *et al.,* (2019); Sharma *et al.,* (2014) and Nayak et al., (2019) in Okra.** The maximum fruit length (cm) (16.17) and fruit diameter (cm) (6.85) was noted in T8 treatment (PSB 5g + FYM + Poultry manure + Vermicompost + Neem cake (1:1:1:1) (5 t/ha) + (3.75 t/ha) + (1.25 t/ha) + (0.5t/ha). Whereas the minimum fruit length (cm) (10.48) and fruit diameter (cm) (4.17) was found in treatment T4 PSB 5g + Neem cake (100%) (2 t/ha). This might be attributed to the increased availability of NPK and water at the critical stages of the crop growth resulting early establishment, vigorous growth and development of plants leading to longer and wider fruits. Higher value in fruit diameter of okra observed due to integrated application of fertilizers as reported by **Kumar (2017).** Similar findings have been reported by **Jamala *et al.* (2011) and Singh *et al.* (2014)** in okra. This might be attributed to the increased availability of NPK and water at the critical stages of the crop growth resulting early establishment, vigorous growth and development of plants leading to longer and wider fruits. Higher value in fruit diameter of okra observed due to integrated application of fertilizers as reported by **Kumar (2017).** The maximum fruit weight (g) (14.03) was noted in T8 treatment (PSB 5g + FYM + Poultry manure + Vermicompost + Neem cake (1:1:1:1) (5 t/ha) + (3.75 t/ha) + (1.25 t/ha) + (0.5t/ha). Whereas the minimum fruit weight (g) (8.53) was found in treatment T0 NPK (100,80,50 kg/ha) 100%. It involved in the various functions of endogenous hormonal regulation in the plant tissues and responsible for promoting pollen germination and pollen tube growth and ultimately leads to fruit length and weight. The higher fruit weight in these treatments might be due to accelerated mobility of photosynthetic from the source to the sink as influenced by the growth hormone, released or synthesized due to the organic sources of fertilizers. The findings of this study are in accordance with those of **Mal *et al.* (2014) and Abha *et al.,* (2019)** in okra. The data presented on number of fruits/plant, yield per plant (g), fruits yield (t/ha), ascorbic acid (mg/100g) and TSS (oBrix) in Table 1, clearly revealed that significant differences due to effect of organic manures, NPK and PSB on number of fruits/plant, yield per plant (g), fruits yield t ha-1, ascorbic acid (mg/100g) and TSS (oBrix) was recorded. The maximum number of fruit per plant (18.28), fruit yield (g) per plant (256.53) and fruit yield t ha-1 (21.38) was noted in T8 treatment (PSB 5g + FYM + Poultry manure + Vermicompost + Neem cake (1:1:1:1) (5 t/ha) + (3.75 t/ha) + (1.25 t/ha) + (0.5t/ha), which was statically at par with T7 PSB 5g + Poultry manure 50% (7.5 t/ha) + Vermicompost 50% (2.5 t/ha) and T0 NPK (100,80,50 kg/ha) 100%. Whereas the minimum number of fruit per plant (15.72), fruit yield (g) per plant (146.17) and fruit yield t/ha (12.18) was found in treatment T4 PSB 5g + Neem cake (100%) (2 t/ha). It involved in the various functions of endogenous hormonal regulation in the plant tissues and responsible for promoting pollen germination and pollen tube growth and ultimately leads to fruit length and weight. The higher fruit weight in these treatments might be due to accelerated mobility of photosynthetic from the source to the sink as influenced by the growth hormone, released or synthesized due to the organic sources of fertilizers. The findings of this study are in accordance with those of **Mal *et al.* (2014) and Abha *et al.,* (2019)** in okra. FYM and VC improve soil fertility, structure, and water-holding capacity, optimizing nutrient availability and uptake efficiency. PSB enhances phosphorus availability, essential for flowering, fruiting, and seed development. This balanced nutrient supply and improved soil microbiological activity promote vigorous vegetative growth, early flowering, and increased pod formation. Consequently, the combined effect ensures higher yield by facilitating optimal conditions for plant growth and maximizing the potential of each plant to produce more pods. Similar findings were reported by **Singh *et al.,* (2021)** in Okra. The maximum TSS (0Brix) (4.40) was noted in T8 treatment (PSB 5g + FYM + Poultry manure + Vermicompost + Neem cake (1:1:1:1) (5 t/ha) + (3.75 t/ha) + (1.25 t/ha) + (0.5t/ha). Whereas the minimum TSS (0Brix) (2.70) was found in treatment T4 PSB 5g + Neem cake (100%) (2 t/ha). The maximum ascorbic acid (mg/100g) (17.07) was noted in T8 treatment (PSB 5g + FYM + Poultry manure + Vermicompost + Neem cake (1:1:1:1) (5 t/ha) + (3.75 t/ha) + (1.25 t/ha) + (0.5t/ha). Whereas the minimum ascorbic acid (mg/100g) (10.37) was found in treatment T4 PSB 5g + Neem cake (100%) (2 t/ha).

Based on the table 2, treatment **T₈** (PSB + FYM + Poultry manure + Vermicompost + Neem cake in 1:1:1:1 ratio) recorded the **highest yield (21.38 t/ha)**, **gross return (Rs. 2,56,560/ha)**, **net return (Rs. 1,93,785/ha)**, and **B:C ratio (4.08)**, indicating superior performance in both productivity and profitability.

This was followed by **T₇** and **T₆**, which also showed high yield (19.87 t/ha and 17.64 t/ha respectively) and economic returns, though slightly lower than T₈. In contrast, the lowest yield and economic performance were observed under **T₄** and **T₁**, indicating that single organic inputs were less effective than integrated treatments.

**CONCLUSION**

On the basis of present investigation, it is concluded that the maximum days to germination, days to 50% germination, plant height, fruit length, number of leaves, number of branches, diameter of fruit, days taken to 1st flowering, 50% flowering, fruit weight, fruit yield, ascorbic acid and TSS was significantly highest in T8 [PSB 5g + FYM (5 t/ha) + Poultry manure (3.75t/ha)+ Vermicompost (1.25t/ha) + Neem cake (0.5t/ha)]. It is also recorded that T8 gave maximum Gross Returns (INR 256560/ha), Net Return (INR 193785/ha) and Cost benefit ratio of 4.08. So, the treatment combination T8 can be taken for better income of farmers and stakeholders for okra cultivation in Prayagraj region due to its superior growth, yield, quality, and profitability under organic conditions.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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**Table1: Effect of Different Organic Treatments on Growth, Yield and Quality of Okra (*Abelmoschus esculetus* L.) in Prayagraj Region**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Notation** | **Germination****parameters** | **Growth and flowering parameters** | **Yield Parameters** | **Quality Parameters** |
| **Days to germination** | **Days to 50% germination** | **Plant height (cm)** | **Number of leaves per plant** | **Number of branches** | **Days to first flowering** | **Days to 50% flowering** | **Fruit length (cm)** | **Fruit diameter (mm)** | **Fruit weight (g)** | **Number of fruits/plant** | **Yield per plant (g)** | **Fruits yield** **t ha-1** | **Ascorbic acid (mg/100g)** | **TSS (oBrix)** |
| T0 | 6.30  | 6.90 | 27.52 | 17.33 | 10.87 | 42.73 | 46.07 | 14.57 | 5.63 | 8.53 | 17.13 | 181.40 | 15.11 | 2.80 | 10.43 |
| T1 | 6.00  | 6.40 | 28.26 | 17.40 | 12.67 | 43.53 | 46.20 | 11.33 | 4.80 | 9.83 | 16.19 | 159.10 | 13.26 | 3.00 | 11.67 |
| T2 | 4.17 | 4.70 | 27.83 | 16.40 | 11.80 | 42.73 | 46.40 | 12.17 | 4.95 | 10.14 | 16.24 | 164.60 | 13.72 | 3.20 | 12.30 |
| T3 | 4.40 | 4.90 | 25.53 | 17.40 | 12.00 | 43.47 | 47.47 | 12.50 | 5.59 | 10.32 | 16.68 | 172.13 | 14.35 | 3.30 | 13.30 |
| T4 | 5.23 | 5.40 | 24.81 | 15.93 | 10.53 | 42.73 | 45.73 | 10.48 | 4.17 | 11.54 | 15.72 | 146.17 | 12.18 | 2.70 | 10.37 |
| T5 | 4.50 | 4.60 | 30.14 | 17.67 | 14.00 | 43.73 | 46.40 | 11.29 | 6.11 | 11.36 | 16.76 | 190.40 | 15.87 | 3.40 | 13.90 |
| T6 | 5.90 | 6.10 | 31.91 | 16.53 | 13.07 | 43.67 | 46.33 | 14.30 | 6.31 | 12.81 | 16.53 | 211.70 | 17.64 | 3.60 | 15.07 |
| T7 | 3.70  | 4.20 | 32.59 | 18.67 | 14.73 | 41.93 | 44.60 | 15.13 | 6.76 | 13.39 | 17.80 | 238.37 | 19.87 | 4.10 | 16.70 |
| T8 |  3.40  | 4.03 | 35.09 | 19.93 | 15.87 | 39.73 | 41.73 | 16.17 | 6.85 | 14.03 | 18.28 | 256.53 | 21.38 | 4.40 | 17.07 |
| **F Test** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** |
| **S.E (d) (±)** | **0.14** | **0.08** | **1.74** | **0.72** | **0.64** | **1.05** | **1.07** | **1.13** | **0.05** | **0.04** | **0.38** | **0.75** | **0.06** | **0.08** | **0.50** |
| **CD (P = 0.05)** | **0.30** | **0.16** | **3.68** | **1.52** | **1.35** | **2.23** | **2.27** | **2.39** | **0.10** | **0.09** | **0.77** | **1.59** | **0.13** | **0.17** | **1.07** |
| **CV%** | **3.62** | **1.79** | **7.26** | **5.03** | **6.08** | **3.01** | **2.97** | **10.53** | **1.06** | **0.48** | **3.57** | **0.48** | **0.48** | **2.95** | **4.59** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **NOTATION** | **TOTAL COST OF CULTIVATION** | **YIELD (t/ha)** | **SALE RATE****Rs./t** | **GROSS RETURN****Rs./ha** | **NET RETURN****Rs./ha** | **B:C RATIO** |
| T0 | 49734 | 15.11 | 12000 | 181320 | 131586 | 3.64 |
| T1 | 63975 | 13.26 | 12000 | 159120 | 95145 | 2.48 |
| T2 | 61975 | 13.72 | 12000 | 164640 | 102665 | 2.65 |
| T3 | 68975 | 14.35 | 12000 | 172200 | 103225 | 2.49 |
| T4 | 55975 | 12.18 | 12000 | 146160 | 90185 | 2.61 |
| T5 | 63025 | 15.87 | 12000 | 190440 | 127415 | 3.02 |
| T6 | 66525 | 17.64 | 12000 | 211720 | 145195 | 3.18 |
| T7 | 65525 | 19.87 | 12000 | 238400 | 172875 | 3.63 |
| T8 | 62775 | 21.38 | 12000 | 256560 | 193785 | 4.08 |

 **Table 2: Effect of Different Organic Treatments on economics of okra**