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Effect of Organic and Inorganic Fertilizers on Growth, Yield and Quality of Okra (*Abelmoschus esculentus* L. Moench)

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ABSTRACT

The study, conducted at the Agricultural Research Farm, School of Agriculture, S.G.V.U., Jaipur (Rajasthan) during the Rabi season of 2022-23, examined the impact of organic and inorganic fertilizers on the growth, yield, and quality of Okra (Abelmoschus esculentus L. Moench). Using a Randomized Block Design (RBD) with 13 treatment combinations, including control and various mixes of fertilizers with organic amendments like farmyard manure, vermicompost, poultry manure, neem cake, and biofertilizers, the research found that treatment T5 (75% RDF + 25% N through Vermicompost) had a notable impact on vegetative development, yield, and quality indices, also showing the highest benefit-to-cost ratio of 2.26 compared to the control group's 1.14. The combined application of organic and inorganic fertilizers significantly improved Okra's growth, yield, and quality, with T5 demonstrating the best performance in plant height, fruit yield, and quality traits like ascorbic acid and sugar content, highlighting its potential for sustainable and profitable okra production and the benefits of integrating organic manures with inorganic fertilizers for enhancing crop productivity and soil health.

Keywords: *Vermicompost, Poultry manure, Neem cake, Horticulture, Economics.*

INTRODUCTION

Okra, scientifically known as *Abelmoschus esculents* (L.) Moench, is a significant vegetable crop that thrives during the wet and summer seasons. It belongs to the Malvaceae family and has a chromosome count of 2n=130, indicating that it is polyploid. Several local names in different regions of the world refer to it. The vegetable is referred to as lady's finger in England, guino-gombo in Spanish, gumbo in the United States of America, guibeiro in Portuguese, and bhindi in India. Due to its ease of growing, reliable yield, and ability to adapt to different moisture conditions, it has gained significant popularity in India (Navneet et al., 2018; & Kachari & Gogoi, 2020).

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The production statistics of Okra in India for the top 10 states in the year 2021-22 are shown in Figure 1 (National Horticulture Board, GOI) and the Percentage share of Okra production of the top 10 states in India is shown in Figure 2.

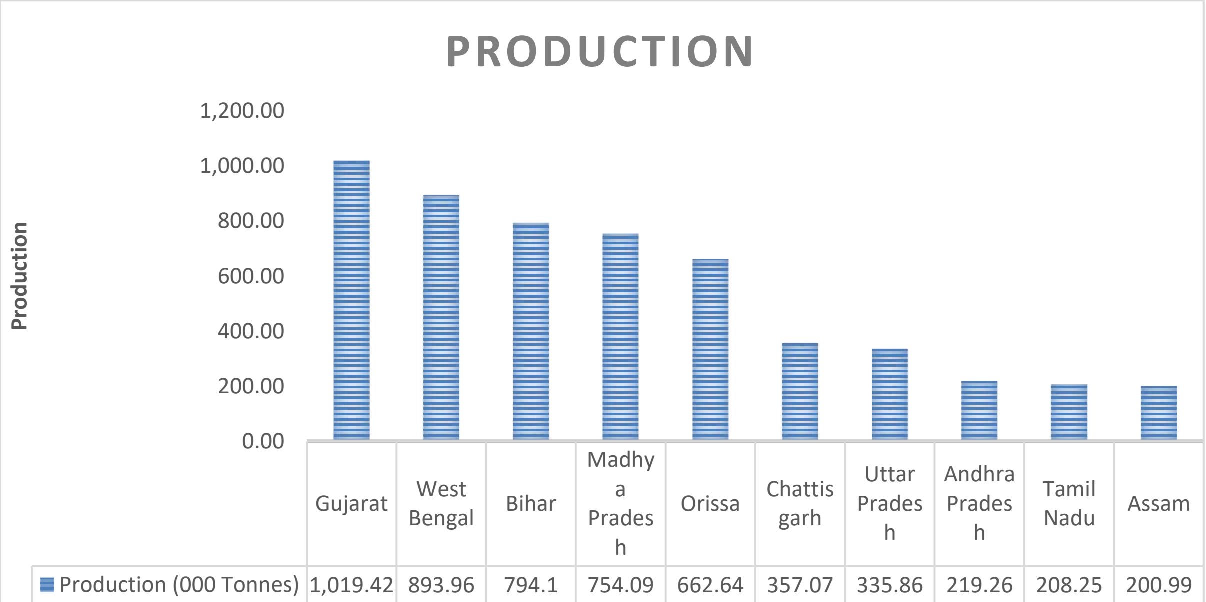

Figure 1 Production statics of Okra of top 10 states in India

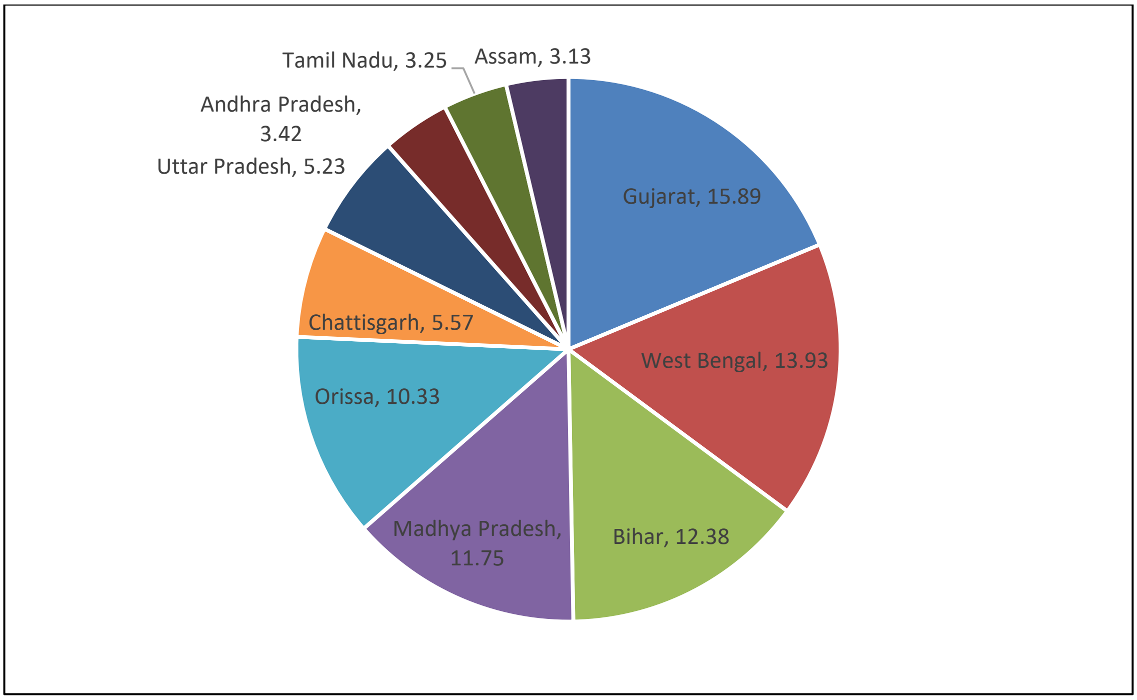

Figure 2 Percentage share of Okra production of top 10 states in India

In India, the practice of mixed farming, which combines livestock raising with crop production, is an essential component of agricultural activities. Farmyard manure is a highly organic substance that is utilized to enhance the nutrient levels for plants. FYM, or organic manure, enriches plants with essential nutrients and enhances soil texture by binding soil aggregates. According to Singh et al. (2020), organic manure enhances the cation exchange capacity (CEC), water retention ability, and availability of phosphate in the soil. Additionally, it improves the efficiency of fertilizer utilization and promotes the growth of microbial populations in the soil.

Furthermore, organic manure lowers nitrogen loss by gradually releasing nitrogen into the soil. Vermicompost has been increasingly recommended for usage in vegetable crops in recent years. Vermicompost is a blend of worm excrement, organic substances, decayed plant matter, living earthworms, their eggs, and other species. Vermicompost is an organic fertilizer that releases nutrients slowly. It contains a high concentration of both macro and micronutrients, which are in a form that plants easily absorb. This fertilizer provides plants with the necessary nutrients for an extended period of time. Vermicompost contributes to the reduction of the carbon-to-nitrogen ratio, as well as the increase in humic acid content, cation exchange capacity, and water-soluble carbohydrates (Kaur et al., 2022). Additionally, it includes bioactive compounds such as phytohormones.

The utilization of organic, inorganic, and biofertilizers has significantly influenced agricultural production in recent years. Integrated nutrient management aims to optimize soil fertility and plant nutrient supply over time to achieve the ideal level for sustainable crop production. This involves utilizing a combination of inorganic fertilizers, biological sources, and organic manures to maximize benefits (Singh et al., 2017). Despite its higher cost, fertilizer is crucial for achieving higher crop yields and should be provided in sufficient quantities as it plays a vital role in crop production. Certain soil microorganisms have a significant impact on enhancing soil fertility and crop productivity. This is because they possess the ability to convert atmospheric nitrogen into a usable form, dissolve insoluble phosphate, and break down agricultural waste, thereby releasing essential nutrients for plants. Microbial inoculants or biofertilizers are specialized micro-organisms that, when their quantity and activity are increased, enhance biological activity and improve the availability of plant nutrients. They have practical applications in the field of sustainable agriculture. Recently, there has been an attempt to enhance the output of vegetable crops by utilizing biofertilizers such as Azospirillum, Azotobacter, and PSB. In the future, it will be necessary to use organic manures to provide nutrients for crops in order to practise sustainable agriculture. This is because organic manures have the ability to improve the physical, chemical, and biological properties of the soil. They also help to retain moisture in the soil, leading to increased crop productivity and maintaining the quality of the crops. While organic manures may have lower levels of plant nutrients compared to fertilizers, their inclusion of growth-promoting substances such as enzymes and hormones, along with plant nutrients, makes them crucial for enhancing soil fertility and production (Bhuma, 2001).

This research paper aims to evaluate the comparative impacts of organic and inorganic fertilizers on Okra's growth, yield, and quality. This research is essential to optimize agricultural practices for better crop production, ensuring sustainable and environmentally friendly farming methods. It also seeks to determine different fertilizer types' economic viability and cost-effectiveness, providing practical recommendations for farmers. This study assesses the nutritional quality of the produce and the long-term effects on soil health, thereby contributing to scientific knowledge and helping in the formulation of improved agricultural policies.

MATERIAL AND METHODS

A field experiment was done during the summer season of 2023 at the experimental farm of the Department of Horticulture, School of Agriculture, Suresh Gyan Vihar University, Jaipur (Rajasthan). The trial was conducted using a randomized block design, consisting of three replications and 13 different treatments. The treatment combinations used in the study were given in Table 1.

Table 1 Treatment details

Treatment	Details
T0	Control
T1	100% recommended dose of fertilizer (RDF)
T2	100% RDF + Farmyard Manure (FYM) at a rate of 1.5 tonnes per hectare
T3	75% RDF + Azotobacter + Azospirillum + PSB at a rate of 2 kilogrammes per hectare each
T4	75% RDF + 25% nitrogen (N) through FYM
T5	75% RDF + 25% N through Vermicompost
T6	75% RDF + 25% N through Poultry Manure
T7	75% RDF + 25% N through Neem cake
T8	50% RDF + 25% N through FYM + 25% N through Vermicompost
T9	50% RDF + 25% N through FYM + 25% N through poultry manure
T10	50% RDF + 25% N through Neem cake + 25% N through FYM
T11	25% N through FYM + 25% N through Vermicompost + 25% N through Poultry manure + 25% N through Neem cake
T12	25% N through FYM + 25% N through Vermicompost + 25% N through Poultry manure + 25% N through Neem cake + seaweed extract at a rate of 15 kilogrammes per hectare

The dimensions of each plot were 1.5 metres by 2.25 metres, and the spacing between plants was set at 30 centimetres by 45 centimetres. This arrangement allowed for a total of 25 plants per plot for each treatment. The soil was cultivated and prepared to a high quality by tilling and ploughing. The bunds and irrigation ditches were adequately maintained. The seeds were directly planted on the field. After seeding, a small amount of water was applied to the crops. All other suggested cultural measures were adhered to in order to cultivate a robust crop. The morphological traits, including plant height (cm), number of branches per plant, stem diameter (mm), number of flowers per plant, number of fruits per plant, fruit yield per plant (Kg), fruit yield per plot (Kg), fruit yield per ha (t), fruit length (cm), fruit diameter (cm), fruit fresh weight (g), fruit dry weight (g), total soluble solids (TSS 0Brix), ascorbic acid (Vitamin C) (mg/100g), reducing sugar, non-reducing sugar, total sugar (%), and economic parameters such as the B:C ratio, were recorded in five randomly selected and tagged plants for each replication. The measurements were conducted using standard procedures.

RESULTS AND DISCUSSION

Growth and yield parameters

The effects of different organic and inorganic fertilizer treatments on the growth and yield parameters of Okra are presented in Table 2. The treatments included various combinations of recommended doses of fertilizers (RDF), organic manures such as Farmyard Manure (FYM), Vermicompost, Poultry Manure, Neem Cake, and a combination of these along with seaweed extract.

The plant height measured at 30, 60, and 90 days after sowing (DAS) showed significant variation among treatments. At 30 DAS, the highest plant height was observed in T5 (56.21 cm) followed by T7 (56.09 cm) and T3 (53.46 cm). The control (T0) showed the lowest height (22.45 cm). At 60 DAS, T5 again recorded the highest plant height (82.77 cm) followed by T3 (80.80 cm) and T7 (81.86 cm). The control had the lowest height (51.42 cm). At 90 DAS, T5 maintained the highest height (128.99 cm) followed by T3 (124.19 cm) and T7 (125.78 cm). The control remained the shortest (92.89 cm).

The number of branches per plant varied significantly across treatments. T5 had the highest number of branches (5.42) followed by T7 (5.40) and T3 (5.25). The control had the least number of branches (3.37). Stem diameter was found to be highest in T5 (3.57 cm), followed by T7 (3.22 cm) and T3 (2.92 cm). The control had the smallest stem diameter (1.78 cm). The number of flowers per plant was significantly influenced by the treatments. T5 recorded the highest number of flowers (31.56), followed by T7 (31.53) and T3 (30.53). The control had the lowest number of flowers (17.44).

The number of fruits per plant showed significant differences among treatments. T5 had the highest number of fruits (28.52) followed by T7 (27.53) and T3 (26.54). The control recorded the lowest number of fruits (15.52). The fruit yield per plant was highest in T5 (234.06 g), followed by T7 (225.71 g) and T3 (218.03 g). The control had the lowest yield (143.26 g). The fruit yield per plot also varied significantly. T5 recorded the highest yield per plot (3.75 kg), followed by T7 (3.61 kg) and T3 (3.49 kg). The control had the lowest yield (2.29 kg). The fruit yield per hectare showed substantial differences among treatments: T5 had the highest yield per hectare (173.38 q/h), followed by T7 (167.19 q/h) and T3 (161.51 q/h). The control had the lowest yield (106.12 q/h).

The results indicate that the combined use of organic and inorganic fertilizers significantly improves Okra's growth and yield parameters compared to the control (T0) and the sole application of 100% RDF (T1). Among the treatments, T5 (75% RDF + 25% N through Vermicompost) consistently showed the best performance across all parameters. This could be due to the enhanced nutrient availability and improved soil structure resulting from the application of Vermicompost, which provides a steady release of nutrients and enhances microbial activity in the soil.

The treatments that included a combination of RDF and organic manures (T3 to T12) generally performed better than those with 100% RDF alone, suggesting the beneficial effects of integrating organic sources of nutrients. The presence of beneficial microorganisms in treatments like T3 (75% RDF + Azotobacter + Azospirillum + PSB) also contributed to improved plant growth and yield, likely due to enhanced nitrogen fixation and phosphorus solubilization. T5, T7 (75% RDF + 25% N through Neem cake), and T3 demonstrated particularly high yields, indicating the potential of these treatments for sustainable Okra production. The use of Neem cake (T7) not only provided nutrients but also potentially offered pest control benefits, contributing to healthier plant growth.

The integration of organic manures with inorganic fertilizers (particularly Vermicompost and Neem cake) appears to be a promising strategy for enhancing the productivity of Okra. The findings are in line with the previous research of Singh et al., 2020 and Kayesh et al, 2023.

Fruit physical characters

The treatment T5, which consisted of 75% RDF (Recommended Dose of Fertiliser) combined with 25% N (Nitrogen) through Vermicompost, resulted in the longest fruit length seen, measuring 13.60 cm (Table 3). The treatment T7, which consisted of 75% RDF combined with 25% N with Neem cake, resulted in a slightly shorter fruit length of 13.38 cm. The smallest fruit length, measuring 8.47cm, was seen in the control group (T0).

The treatment T5, which consisted of 75% RDF (Recommended Dose of Fertiliser) combined with 25% N (Nitrogen) through Vermicompost, resulted in the largest fruit diameter of 2.72 cm. This was closely followed by treatment T7, which involved 75% RDF combined with 25% N with Neem cake, resulting in a fruit diameter of 2.61 cm. The smallest fruit diameter (1.39 cm) was reported in the T0 (Control) treatment. This could be attributed to the synergistic effect of using both organic manures and inorganic fertilizers, which functioned in a complimentary and supplementary manner, resulting in a consistent and gradual release of nutrients. The presence of essential nutrients during the crucial phases of crop growth led to prompt establishment, robust growth, and advancement of plants, producing larger and broader fruits. Mal et al. (2013) found that applying integrated nutrients to Okra significantly increased fruit length and diameter.

Treatment T5, which consisted of 75% RDF and 25% N through Vermicompost, resulted in the highest fresh fruit weight of 15.53 g. This was followed by treatment T7, which had 75% RDF and 25% N through Neem cake, with a fresh fruit weight of 14.61 g. The control group (T0) exhibited the lowest fresh fruit weight, measuring 11.47 g. Yadav et al. (2006), and Mal et al. (2013) have also found similar findings in Okra.

The highest dry fruit weight of 6.52 g was recorded in treatment T5, which consisted of 75% of the recommended dose of fertilizer (RDF) combined with 25% nitrogen (N) supplied through vermicompost. This was closely followed by treatment T7, which had a dry fruit weight of 6.39 g and consisted of 75% RDF combined with 25% N supplied through neem cake. The lowest dry fruit weight (2.42 g) was recorded in the T0 treatment (Control).

Quality parameters

The highest concentration of Total soluble solids (2.72°Brix) was recorded in treatment T5 (75% recommended dose of fertilizer + 25% nitrogen through Vermicompost), followed by T7 (75% recommended dose of fertilizer + 25% nitrogen through Neem cake) with a concentration of 2.53°Brix (Table 3). The lowest Total soluble solids (1.39 °Brix) were found in T0 (Control). Kalalbandi et al. (2007) showed similar findings in cabbage.

The highest concentration of ascorbic acid (17.43mg/100g) was found in treatment T5, which consisted of 75% of the recommended dose of fertilizer (RDF) combined with 25% nitrogen (N) supplied through vermicompost. The second highest concentration (17.32 mg/100g) was seen in treatment T7, which involved 75% RDF combined with 25% N supplied through neem cake. The lowest detected ascorbic acid level (13.47 mg/100g) was found in T0 (Control). The increased supply of nitrogen may contribute to a balanced C:N ratio, which enhances vegetative growth and leads to good photosynthetic activity in okra crops (Gayathri & Krishnaveni, 2015). Laxmi et al. (2015) reported similar findings in tomato cultivation.

The highest concentration of reducing sugar (1.01%) was found in treatment T5, which consisted of 75% recommended dose of fertilizer (RDF) combined with 25% nitrogen (N) supplied through vermicompost. This was closely followed by treatment T7, which had a reducing sugar concentration of 0.99% and consisted of 75% RDF combined with 25% N supplied through neem cake. The lowest concentration of reducing sugar (0.80%) was recorded in T0 (Control).

Treatment T5, which consisted of 75% RDF and 25% N through Vermicompost, had the highest level of non-reducing sugar at 1.78%. This was followed by treatment T7, which consisted of 75% RDF and 25% N through Neem cake, with a non-reducing sugar content of 1.69%. The lowest concentration of non-reducing sugar (0.62%) was found in T0 (Control).

Treatment T5, which consisted of 75% RDF and 25% N through Vermicompost, had the highest total sugar content at 2.79%. This was closely followed by treatment T7, which had 75% RDF and 25% N through Neem cake, with a total sugar content of 2.67%. The lowest overall sugar content (1.42%) was found in T0 (Control). The increased availability of important nutrients in RDF, FYM, and Vermicompost may have led to enhanced plant metabolic activity, resulting in increased sugar content, as reported by Mishra et al. (2009) and Meena et al. (2019).

Economic parameters

Gross return is a metric that calculates the total money generated from the sales of Okra, serving as a comprehensive indicator of financial income. The net return, in contrast, subtracts production costs from the gross return, representing the true profit derived from okra production. It aids growers in evaluating the profitability and economic feasibility of their farming methods. The BC ratio measures the profitability and efficiency of an investment in okra production by comparing the gross returns (benefits) to the costs paid. These measurements help growers examine the financial success of their okra crops, enabling them to make educated decisions about allocating resources, controlling costs, and evaluating the economic viability of cultivating Okra. The treatment T5

(75% RDF + 25% N through Vermicompost) achieved the highest gross yields of Rs.259950 ha^{-1}, whereas the lowest returns of Rs. 159150 ha^{-1} were seen in the control treatment T0 (table 3). The treatment T5, which consisted of 75% RDF and 25% N through Vermicompost, achieved the highest net returns of Rs.180146.36 ha^{-1}. On the other hand, the treatment T0 (Control) had the lowest net returns of Rs.84782.36 per hectare. The treatment T5, which consisted of 75% RDF and 25% N through Vermicompost, achieved the highest benefit-to-cost ratio of 2.26. On the other hand, the control treatment T0 had the lowest ratio of 1.14. Kumari et al. (1999) and Sharma et al. (2010) have found similar results in Okra.

Table2. Effect of organic and inorganic fertilizers on growth and yield parameters of the Okra

Treatment Combination	Plant height (cm)			No. of branches per plant	Stem diameter (cm)	Number of flowers per plant	Number of fruits per plant	Fruit yield/ plant (g)	Fruit yield/plot (kg)	Fruit yield /hectare (q/h)
	30 DAS	60 DAS	90 DAS							
T_0	22.45	51.42	92.89	3.37	1.78	17.44	15.52	143.26	2.29	106.12
T_1	26.12	54.61	94.91	4.08	1.82	18.45	16.25	151.21	2.42	112.01
T_2	31.07	60.75	97.68	4.13	1.90	19.20	17.15	161.99	2.59	120.00
T_3	53.46	80.80	124.19	5.25	2.92	30.53	26.54	218.03	3.49	161.51
T_4	50.78	76.54	115.85	5.04	2.77	27.87	23.50	196.54	3.15	145.59
T_5	56.21	82.77	128.99	5.42	3.57	31.56	28.52	234.06	3.75	173.38
T_6	44.20	72.57	114.69	4.47	2.72	24.59	22.09	190.09	3.04	140.81
T_7	56.09	81.86	125.78	5.40	3.22	31.53	27.53	225.71	3.61	167.19
T_8	53.08	77.81	118.81	5.08	2.85	28.50	25.69	203.55	3.26	150.78
T_9	34.98	63.39	110.50	4.24	2.54	22.15	20.57	174.31	2.79	129.12
T_{10}	40.83	63.53	113.33	4.33	2.72	23.54	21.53	182.41	2.92	135.12
T_{11}	33.91	60.88	110.29	4.18	2.51	21.48	20.50	168.83	2.70	125.06
T_{12}	53.20	79.58	119.85	5.24	2.88	29.42	26.41	210.42	3.37	155.86
$CD_{0.05}$	3.715	6.215	9.76	1.212	0.986	2.158	1.995	17.423	0.28	12.906
SE (m±)	1.265	2.117	3.324	0.413	0.336	0.735	0.679	5.934	0.095	4.396

Table3. Effect of organic and inorganic fertilizers on the Okra's physical characters and quality parameters

Treatment Combination	Fruit length (cm)	Fruit diameter (cm)	Fresh fruit weight (g)	Dry fruit weight (g)	TSS (°Brix)	Ascorbic acid (mg/100g)	Reducing sugar%	Non reducing sugar%	Total sugar%	B:C ratio
T_0	8.47	1.39	11.47	2.42	1.39	13.47	0.8	0.62	1.42	1.14
T_1	8.55	1.43	12.43	2.54	1.43	13.49	0.81	1.03	1.84	1.21
T_2	8.56	1.44	12.49	2.53	1.44	13.56	0.83	1.22	2.04	1.28
T_3	12.10	2.53	14.53	5.63	2.50	16.24	0.98	1.58	2.56	2.02
T_4	10.53	1.60	13.56	3.53	1.61	15.53	0.93	1.54	2.48	1.7
T_5	13.60	2.72	15.53	6.52	2.72	17.43	1.01	1.78	2.79	2.26
T_6	10.42	1.53	13.53	3.5	1.60	15.18	0.93	1.55	2.48	1.57
T_7	13.38	2.61	14.61	6.39	2.53	15.53	0.99	1.69	2.67	2.1
T_8	10.59	1.97	13.57	4.56	1.97	17.32	0.94	1.59	2.53	1.76
T_9	9.55	1.46	13.32	2.55	1.50	14.53	0.85	1.43	2.29	1.39
T_{10}	9.59	1.50	13.43	2.57	1.53	14.61	0.88	1.5	2.38	1.49
T_{11}	9.54	1.45	12.51	2.55	1.46	14.43	0.84	1.39	2.23	1.29
T_{12}	11.40	2.50	13.58	5.45	2.45	15.58	0.96	1.59	2.55	1.84
$CD_{0.05}$	1.866	0.608	1.486	1.827	0.608	1.904	0.109	0.553	0.494	
SE (m±)	0.635	0.207	0.506	0.622	0.207	0.648	0.037	0.188	0.168	

CONCLUSION

The study concluded that the combined application of organic and inorganic fertilizers significantly improved Okra's growth, yield, and quality. Among all treatments, T5 (75% RDF + 25% N through Vermicompost) demonstrated the best performance across various parameters, including plant height, fruit yield, and quality traits like ascorbic acid and sugar content. T5 also showed the highest economic return with a benefit-to-cost ratio of 2.26, indicating its potential for sustainable and profitable okra production. Integrating organic manures such as Vermicompost and

Neem cake with inorganic fertilizers proved beneficial for enhancing crop productivity and soil health.

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

Author's contribution
Sanjay Yadav: Writing-original draft, Methodology, Investigation, Data curation, Conceptualization. **D C Meena:** Methodology, Formal analysis, Investigation, Writing-original draft, communication. **M.M. Sharma:** Writing: Review and editing. **Pushplata Kumari**: Review and editing, **Gurpreet Singh:** Data collection and Writing, **Mahipal Saharan:** Writing: Review and editing.

REFERENCES

Bhuma, M. (2001). Studies on the impact of humic acid on sustenance of soil fertility and productivity of greengram. MSc (Ag) Thesis, TNAU, Coimbatore.

Gayathri, K., & Krishnaveni, K. (2015). Effect of organic manures and inorganic fertilizers on certain quality parameters of Okra [*Abelmoschus esculentus* (L). Moench] cv. Arka Anamika. *Adv. Res. J. Crop Improv., 6*(2), 116-118.

Kachari, M., & Gogoi, S. (2020). Influence of Organic Manure and Bioagents on Growth, Yield and Quality of Okra under Assam Condition. *International Research Journal of Pure and Applied Chemistry*, *21*(23), 79-88.

Kalabandi, B. M., Dabhade, R. S., & More, S. S. (2007). Effect of organic and inorganic fertilizers on growth, yield and quality of cabbage *(Brasssica oleracea* var. capitata*). Asian Journal of Horticulture*, 2(2), 144-147.

Kaur, A., Pati, P. K., Ohri, P., & Kaur, A. (2022). Effects of Vermicompost and vermicompost leachate on the biochemical and physiological response of Withania somnifera (L.) Dunal. *Journal of Soil Science and Plant Nutrition*, *22*(3), 3228-3242.

Kayesh, E., Gomasta, J., Bilkish, N., Koly, K. A., & Mallick, S. R. (2023). A Holistic Approach of Organic Farming in Improving the Productivity and Quality of Horticultural Crops. In *Organic Fertilizers-New Advances and Applications*. IntechOpen.

Kumar, A. B., & Gowda, N. C. (2010). Effect of different organic manures and inorganic fertilizers on growth and yield of brinjal (*Solanum melongena* L.), *Asian Journal Horticulture*, 5(2), 444-449.

Kumari, Usha, K., Prabha Kumari, P., & Padamaja, P. (1999). Efficiency of vermicompost on growth and yield of summer crop of Okra (*Abelmoschus esculentus*). *Journal of Tropical Agriculture*, *37*(1/2), 87-88.

Laxmi, R. P., Saravanan, S., & Naik, M. L. (2015). Effect of organic and inorganic fertilizers on plant growth, yield, fruit quality and shelf-life of tomato (*Solanum Lycopersicon* L.) cv.PKM-1. *International Journal of Agriculture Science and Research. 5*(2), 7-12.

Mal, B., Mahapatra, P., Mohanty, S., & Mishra, H. N. (2013). Growth and yield parameters of Okra (*Abelmoschus esculentus*) influenced by diazotrophs and chemical fertilizers, *Journal of Crop and Weed. 9*(2), 109-112.

Meena, D. C., Meena, M. L., & Kumar, S. (2019). Influence of organic manures and biofertilizers on growth, yield and quality of Okra (*Abelmoschus esculentus* L. Moench). *Annals of Plant and Soil Research*, *21*(2), 130-134.

Mishra, T. D., Singh, S. K., Chaurasia, S. N. S., Kemariya, P., & Singh, T. B. (2009). Effect of vermicompost and biofertilizers on Okra (*Abelmoschus esculentus* L. Moench) under graded dose of nitrogen and phosphorus. *New Agriculturist* 20.1/2 pp. 9-13 ref.8.

Navneet, A. R. T., Gupta, K., Patel, G. P., Sahu, P. S., & Khan, H. H. (2018). Screening of different okra genotypes against major sucking pests. *Journal of Entomology and Zoology Studies*, *6*, 71-75.

Sharma, T. R., Pandey, A. K., Updhyaya, S. D., & Agrawal, S. B. (2010). Effect of vermicompost on yield and quality of kharif season okra (Abelmoschus esculentus (L) Moench). *Veg. Sci. 37*(2), 181-183.

Singh, J., Sharma, M. K., Bano, Rukshana, Mahawar, A. K., & Singh, S. P. (2020). Comparative Effect of Organic and Inorganic Sources of NPK and Biofertilizer on Growth Attributes and Yield of Sweet Potato cv. IGSP-14. *Chem. Sci. Rev. Lett.*, *9*(35), 728-733.

Singh, N., Singh, D. K., Sati, U. C., Rawat, M., & Pandey, P. (2017). Genetic analysis studies in Okra [Abelmoschus esculentus (L.) Moench]. *International Journal of Pure and Applied Bioscience*, *5*(4), 361-367.

Singh, S. P., Patel, C. R., & Paikra, K. K. (2020). Organic farming: prospects, constraints, opportunities and strategies for sustainable agriculture in Chhattisgarh-A Review. *International Journal of Plant & Soil Science*, *32*(4), 35-50.

Yadav, S. S., & Yadav, N. (2010). Effect of integrated nutrient management on yield of Okra in zaid crop. *Bhartiya Krishi Anusandhan Patrika. 25*(2&4), 103-108.