Effect of Organic and Inorganic Fertilizers on Growth, Yield and Quality of Brinjal (*Solanum melongena* L.)

Abstract

The present investigation was carried out at Agricultural Research Farm, School of Agriculture, Suresh Gyan Vihar University, Jaipur (Rajasthan) to study the Effect of Organic and Inorganic Fertilizers on Growth, Yield and Quality of Brinjal (*Solanum melongena* L.) during *kharif* season of the year 2023-24. The experiment was laid down in RBD which consisted 9 treatment combinations viz; T_1-Control (100 %) (125:100:50), T_2-100 % N through FYM (25t/ha), T_3-100 % N through vermicompost (5t/ha), T_4-100 % N through poultry manure (5t/ha), T_5-100 % N through neem cake (2t/ha), T_6-50 % NPK + 50 % N through FYM, T_7-50 % NPK + 50 % N through vermicompost, T_8-50 % NPK + 50 % N through poultry manure, T_9-50 % NPK + 50 % N through neem cake and treatments were replicated three times. The treatment (T_7) significantly affected various vegetative growth, yield and quality parameters. Results further indicated that the highest (3.27) benefit: cost ratio was observed in treatment (T_7). Whereas, the lowest benefit: cost ratio (1.51) was recorded under control.

Keywords: Vermicompost, Poultry manure, Neem cake,

1. Introduction

One of India's most valued tropical and sub-tropical crops is eggplant, or brinjal (*Solanum melongena* L.). While the name eggplant comes from the shape of some types of fruit, which are white and resemble chicken eggs, the name brinjal is common in the Indian subcontinent and comes from Arabic and Sanskrit. In Europe, it is also known by the French word aubergine (Pramila *et al.,* 2015). Various names for it exist in different parts of India, including Baigan (Orria), Venkaya (Telugu), Kathiri (Tamil), Bagun (Bengali), Ringna (Guajarati), Baingan (Hindi), Badane (Kannada), Waangum (Kashmiri), Vange (Marathi), Baigan (Orria), and Vazhuthana (Malayalam). Since it is well-liked by individuals from all social classes, it is appropriately referred to as a vegetable (Patel and Sarnaik, 2003).

Organic and inorganic fertilizers are essential for plant growth. Both fertilizers supply plants with the nutrients needed for optimum performance. Organic fertilizers have been used for many centuries whereas chemically synthesized inorganic fertilizers were only widely developed during the industrial revolution. Inorganic fertilizer has significantly supported

global population growth, it has been estimated that almost half the people on the earth are currently fed as a result of artificial nitrogen fertilizer use (Erisman *et al.,* 2008).

Vermicompost means a mixture of worm casting, organic materials, humus, living earthworms, their cocoons and other organisms. Vermicompost is a slow nutrient-releasing organic manure that has most of the macro as well as micro nutrients in chelated form and fulfill the nutrient requirement of plants for a longer period. Vermicompost is a stable fine granular organic matter, when added to soil, it loosens the soil and improves the passage to the entry of air. The organic carbon in vermicompost releases the nutrients slowly and steadily into the system and enables the plant to absorb the nutrients. The soil enriched with vermicompost provides additional substances that are not found in chemical fertilizers. It is also an added advantage of the vermicompost. Vermicompost is made up primarily of Carbon (C), Hydrogen (H), and Oxygen (O) and contains nutrients such as Nitrate (NO_3),Phosphat (PO_4), (Calcium) Ca, Potassium (K), Magnesium (Mg), Sulfur (S) and micronutrients which exhibit similar effects on plant growth and yield as inorganic fertilizers applied to soil (Singh *et al.,* 2008). Vermicompost an organic source of plant nutrients contains a higher percentage of nutrients necessary for plant growth in readily available forms (Nagavallemma *et al.,* 2004).

The Farm Yard Manure (FYM) enhances the physio-chemical characteristics of the soil and promotes soil microbial activity, which increases the soil's plant-food components' accessibility to the crop. Soil inoculation with FYM also results in increased nutrient availability, particularly for nitrogen and phosphorus, which is beneficial for the soil's residual value.

2. Material &Methods

Field experiment was conducted at the experimental farm, Department of Horticulture, School of Agriculture, Suresh Gyan Vihar University, Jaipur (Rajasthan), during the Kharif season of 2023. The experiment was laid out in a Randomized Block Design with three replications and 13 treatments. Treatment combinations were, T_1-Control (100 %) (125:100:50), T_2-100% N through FYM (25t/ha), T_3-100 % N through vermicompost (5t/ha), T_4-100 % N through poultry manure (5t/ha), T_5-100 % N through neem cake (2t/ha), T_6-50 % NPK + 50 % N through FYM, T_7-50 % NPK + 50 % N through vermicompost, T_8-50 % NPK + 50 % N through poultry manure, T_9-50 % NPK + 50 % N through neem cake. The plot size was 3 m × 3 m and the spacing followed was 60 × 60 cm to keep 25 plants per plot for each treatment. The land was brought to a fine tilth through tillage

and ploughing. Bunds and irrigation channels were maintained properly. Different intercultural practices like gap filling, staking, irrigating, weeding, etc. were performed as per crop requirements. The five plants of each plot were randomly selected and tagged. The data was recorded for various growth, yield and quality parameters in brinjal during investigation subjected to statistical analysis by using factorial RBD for analysis of variance (ANOVA) as suggested by online OPSTAT software by **Sheoran *et al.* (1998).**

3. Results & Discussion

3.1 Growth parameters

The data showed that the adoption of different treatments organic and inorganic had a significant effect on plant height of brinjal (Table 1). The maximum plant height at 30, 60 and 90 days after transplanting (38.65 cm, 51.65 cm and 70.31 cm) was noted in treatment T_7 (50% NPK + 50% N through Vermicompost) followed by T_6 – 50% NPK + 50% N Through FYM (36.47 cm, 48.62 cm and 65.28 cm) while the minimum plant height at 30, 60 and 90 days after sowing (27.65 cm 38.65 cm and 50.32 cm) was recorded from treatment T_0 (control). It might be due to the increase in the nutrient availability and preponderance of different groups of microorganisms in the soil, which create a favorable condition for proper vegetative growth in general and increased plant height in particular. The highest dose of nitrogen might have enhanced cell division and formation of more tissues resulting in luxuriant vegetative growth and thereby increasing plant height. These results are closely confined findings of Mishra *et al.,* (2017) and Waskel *et al.,* (2019) in brinjal, Meena and Meena (2018) in okra.

The data revealed that various treatments significantly enhanced the number of branches per plant at all stages of growth except at 90 days after transplanting and the maximum number of branches per plant 8.85 branches were recorded with T_7 (50% NPK + 50% N through Vermicompost) closely followed by T_6 – 50% NPK + 50% N Through FYM with 7.45 branches while the lowest number of branches per plant 2.80 was recorded with T_0 (control). Similar findings have also been reported by Waskel *et al.,* (2019) in Brinjal.

The minimum number of days to 50% flowering (39.35 days) was noticed under treatment T_7 (50% NPK + 50% N through Vermicompost) followed by T_6 (50% NPK + 50% N Through FYM) with 40.23 days and it was significantly superior over remaining treatments, however, a maximum number of days to 50% flowering of 46.85 was observed in the T_0 treatment (control). These results are closely confined to the findings of Meena and Meena (2018) in okra.

The number of flowers per plant significantly varied among different treatment combinations. The maximum number of flowers per plant (20.53 flowers) was observed with treatment T_7 (50% NPK + 50% N through Vermicompost) followed by T_6 (50% NPK + 50% N Through FYM) with 19.32 flowers. The minimum number of flowers per plant (11.02 flowers) was observed in T_0 (Control). The treatment consisting of a 50% recommended dose of fertilizer (NPK) along with the application of 50% nitrogen through vermicompost, showed a higher number of flowers per plant compared to other treatments. Several factors contribute to this outcome. Firstly, beneficial microorganisms in the treatments promote nutrient availability and uptake, leading to improved plant health and increased flower production. These microorganisms enhance nutrient cycling, fix atmospheric nitrogen and solubilize phosphorus, providing essential elements for flower development. Secondly, adding organic nitrogen through vermicompost stimulates overall plant growth and reproductive processes, including flower initiation and development. Additionally, the balanced nutrient supply from these treatments supports the plant's energy reserves, allowing it to produce a greater number of flowers. Overall, the combination of beneficial microorganisms and organic Nitrogen sources in these treatments contributes to enhanced flower production in brinjal plants. The findings were earlier published by Meena and Meena (2018).

3.2 Yield and yield attributes

The maximum number of fruits per plant (17.14 fruits) was noticed under treatment T_7 (50% NPK + 50% N through Vermicompost) followed by T_6 (50% NPK + 50% N Through FYM) with 16.62 fruits and it was significantly superior over the remaining treatments, however, the minimum value 10.54 fruits were in the control treatment. This might be due to the better availability and uptake of nutrients by plants for a longer duration of crop growth. Similar findings of the significantly higher number of fruits per plant by integrated application of fertilizers have also been reported by Yadav *et al.,* (2020) in brinjal and Meena *et al.,* (2019) in okra.

The maximum fruit yield per plant (1.24 kg/plant) was noticed under treatment T_7 (50% NPK + 50% N through Vermicompost) followed by T_6 (50% NPK + 50% N Through FYM) with 1.12 kg/plant and it was significantly superior over remaining treatments, however, a minimum value of 0.53 kg/plant was observed in the T_0 treatment (control). Similar findings have been reported by Yadav *et al.,* (2020) in Brinjal and Meena *et al.* (2019) in okra.

The maximum fruit yield per plot (31.12 kg/plot) was observed with treatment T_7 (50% NPK + 50% N through Vermicompost) followed by T_6 (50% NPK + 50% N Through FYM) with 28.10 kg/plot. The lower fruit yield per plot (13.27 kg/plot) was observed in T_0 (Control). Similar findings have been reported by Ramesh *et al.,* (2021) in Brinjal, Barman *et al.,* (2014) in Potato and Meena *et al.,* (2019) Ghosh *et al.,* (2018) in Okra.

The maximum fruit yield per hectare (345.75 q/ha) was recorded under the treatment T_7 (50% NPK + 50% N through Vermicompost) followed by T_6 (50% NPK + 50% N Through FYM) with 312.18 q/ha. The minimum fruit yield per hectare (147.44 q/ha) was recorded in T_0 (control) treatment. The reason for an increase in yield and yield attributing traits might be the solubilization effect of plant nutrients by the addition of RDF and Vermicompost as evidenced by the increase in the uptake of N, P, K, Ca, and Mg, etc. These results follow those reported by Yadav *et al.,* (2020) in brinjal and Yadav *et al.,* (2015) in onion, Meena *et al.,* (2019) and Ghosh *et al.,* (2018) in okra.

3.3 Fruit physical characters

The maximum fruit length (9.73 cm) was observed with treatment T_7 (50% NPK + 50% N through Vermicompost) followed by T_6 (50% NPK + 50% N Through FYM) with 9.33 cm. The minimum fruit length (7.21 cm) was recorded in T_0 (control). Similar findings have been reported by Waskel *et al.,* (2019) in Brinjal.

The maximum fruit diameter (6.21 cm) was observed with treatment T_7 (50% NPK + 50% N through Vermicompost) followed by T_6 (50% NPK + 50% N Through FYM) with 5.96 cm. The Minimum fruit diameter (4.21 cm) was observed in T_0 (Control) treatment. This might be due to the combined application of organic manures and inorganic fertilizers which might have acted complementary and supplementary to each other and resulted in an adequate slow but steady supply of nutrients. The availability of nutrients at the critical stages of crop growth resulted in early establishment, vigorous growth and development of plants leading to longer and wider fruits. High value in fruit length and fruit diameter was observed due to integrated nutrients application by Waskel *et al.,* (2019) in Brinjal, Mal *et al.,* (2013) in okra.

The maximum fruit weight (72.62 g) was observed with treatment T_7 (50% NPK + 50% N through Vermicompost) followed by T_6 (50% NPK + 50% N Through FYM) with 67.62 g. A minimum fruit weight (50.36 g) was observed in T_0 (Control). Similar findings have been reported by Waskel *et al.,* (2019) in Brinjal and Meena *et al.,* (2019) in Okra.

3.4 Quality parameters

The maximum Total soluble solids (5.11°Brix) were observed with treatment T_7 (50% NPK + 50% N through Vermicompost) followed by T_6 (50% NPK + 50% N Through FYM) with 4.95°Brix. The minimum Total soluble solids (3.32 °Brix) were observed in T_0 (Control). Similar findings have been reported by Yadav *et al.,* (2015) found in Onion.

The maximum ascorbic acid content (14.28mg/100g) was observed with treatment T_7 (50% NPK + 50% N through Vermicompost) followed by T_6 (50% NPK + 50% N Through FYM) with 13.52 mg/100g. Minimum ascorbic acid content (8.16 mg/100g) was observed in T_0 (Control). This might be due to the availability of nitrogen leading to a balanced C:N ratio enhancing the vegetative growth resulting in high photosynthetic activity Meena *et al.,* (2019) in okra crop and Laxmi *et al.,* (2015) found similarly in tomato crop.

3.5 Economic parameters

Gross return quantifies the total revenue from brinjal sales, providing an overall measure of financial income. Net return, on the other hand, deducts production costs from the gross return, reflecting the actual profit obtained from brinjal production. It helps growers assess the profitability and economic viability of their cultivation practices. BC ratio compares the benefits (gross returns) to the costs incurred in brinjal production, indicating the profitability and efficiency of the investment. These measurements assist growers in evaluating the financial performance of their brinjal crops, making informed decisions regarding resource allocation, cost management and assessing the economic feasibility of brinjal cultivation. The maximum gross returns were recorded in treatment T_7 (50% NPK + 50% N through Vermicompost) with Rs. 276,601.51 ha^{-1}, while the minimum (Rs. 117,954.31 ha^{-1} was observed in treatment T_0 (Control). Similarly, the maximum net returns were achieved with treatment T_7, reaching Rs. 192,080.51 ha^{-1}, compared to the minimum of Rs. 39,785.31 ha^{-1} in T_0. The highest benefit-cost ratio was also recorded in T_7 at 3.27, whereas the lowest (1.51) was noted in the control treatment (T_0). These findings align with those reported by Yadav *et al.* (2020) in Brinjal and Sharma *et al*. (2010) in okra.

4. Conclusions

The combined use of 50% NPK and 50% nitrogen through vermicompost (T_7) proved to be the most effective treatment for enhancing the growth, yield, and quality of brinjal. This integrated nutrient management approach not only improved plant vigor and fruit quality but also achieved the highest benefit-cost ratio, making it a highly economical and sustainable option for brinjal cultivation. The synergy between organic and inorganic nutrients in T_7

offers a balanced and efficient fertilization strategy that optimizes both productivity and profitability.

Authors' contribution

Conceptualization and designing of the research work (MMS, DCM); Execution of field/lab experiments and data collection (DCM, RPM, PN); Analysis of data and interpretation (MK,MKB, NT); Preparation of manuscript (MMS, DCM, RPM).

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Table 1. Effect of organic and inorganic fertilizers on plant height (cm) 30, 60, and 90 DAT, number of branches per plant, number of days to 50% flowering, number of flowers per plant, number of fruits per plant, and individual fruit weight (g) of brinjal

Treatment	Plant Height (cm)			No. of Branch per weight (g)plant	No. of days to 50% flowering	No. of flowers per plant	No. of fruits per plant	Individual fruit
	30 DAT	60 DAT	90 DAT					
T_1-Control (100 %) (125:100:50)	27.65	38.65	50.32	2.8	46.85	11.02	10.54	50.36
T_2-100 % N through FYM (25t/ha)	30.85	40.25	53.64	3.85	44.25	14.56	13.95	56.58
T_3-100 % N through vermicompost (5t/ha)	29.23	39.58	52.65	3.36	45.26	11.53	12.6	54.65
T_4-100 % N through poultry manure (5t/ha)	31.45	41.85	55.29	4.65	43.18	13.25	14.62	59.58
T_5-100 % N through neem cake (2t/ha)	32.84	42.65	57.62	5.6	41.42	15.18	14.79	61.65
T_6-50 % NPK + 50 % N through FYM	36.47	48.62	65.28	7.45	40.23	19.32	16.62	67.62
T_7-50 % NPK + 50 % N through vermicompost	38.65	51.65	70.31	8.85	39.35	20.53	17.14	72.62
T_8-50 % NPK + 50 % N through poultry manure	33.65	44.48	59.64	5.95	42.35	15.46	15.24	63.25
T_9-50 % NPK + 50 % N through neem cake	35.21	46.85	61.85	6.76	40.78	18.7	15.88	65.62
S.Em (±)	1.27	1.32	1.77	0.282	1.29	0.93	0.44	1.82
CD at 5%	3.85	3.99	5.35	0.853	3.90	2.82	1.35	5.52
CV	6.70	5.22	5.23	8.923	5.24	10.42	5.30	5.15

Table 2. Effect of organic and inorganic fertilizers on yield and quality parameter of brinjal.

Treatment	Fruit length (cm)	Fruit diameter (cm)	Yield			TSS (^{o}Brix)	Ascorbic Acid (mg/100g)	B:C Ratio
			(kg/plant)	(kg/plot)	(q/ha)			
T_1-Control (100 %) (125:100:50)	7.21	4.21	0.53	13.27	147.44	3.32	8.16	1.51
T_2-100 % N through FYM (25t/ha)	8.05	4.6	0.79	19.73	219.25	4.12	9.45	1.73
T_3-100 % N through vermicompost (5t/ha)	7.76	4.37	0.69	17.21	191.28	3.48	8.92	1.68
T_4-100 % N through poultry manure (5t/ha)	8.34	4.86	0.87	21.78	241.96	3.84	10.06	2.17
T_5-100 % N through neem cake (2t/ha)	8.86	5.14	0.91	22.80	253.28	4.27	10.75	2.63
T_6-50 % NPK + 50 % N through FYM	9.33	5.96	1.12	28.10	312.18	4.95	13.52	2.78
T_7-50 % NPK + 50 % N through vermicompost	9.73	6.21	1.24	31.12	345.75	5.11	14.28	3.27
T_8-50 % NPK + 50 % N through poultry manure	9.11	5.37	0.96	24.10	267.76	4.45	11.22	2.56
T_9-50 % NPK + 50 % N through neem cake	7.86	5.68	1.04	26.05	289.46	4.78	12.36	2.98
S.Em (±)	0.454	0.318	0.06	1.01	7.63	0.21	0.51	
CD at 5%	1.374	0.961	0.19	3.055	23.06	0.63	1.54	
CV	9.274	10.673	12.28	7.71	5.24	8.46	8.05	