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Effect of organic amendments and bio-inoculant on economics of brinjal (*Solanum melongena* L.)

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Abstract
To assess the impact of organic amendments and bio-inoculant on the economic analysis of Brinjal, a trial was carried out at research farm, KVK, Damoh, Madhya Pradesh during the *rabi* season in 2021 and 2022. Nineteen different combinations of organic manures and bio-inoculants were used in the treatments, which were assessed using a randomized block design with three replications. The bioinoculants (*Azotobacter*, Phosphate solubilizing bacteria, and Potassium solubilizing bacteria) in various concentrations, in combination with two organic manures-vermicompost and farm yard manure were ingested in varying proportions. All of the organic manures and bioinoculants were applied at the time the brinjal was transplanted into the plot, according to the doses that should be given there.
It could be evinced from the data that maximum yield of 397.74 q/ha and net income of Rs. 219169.2 per ha and benefit cost ratio of 4.69 was achieved in eggplant variety Harsh in the T_{18}-[Vermicompost (3 t/ha) + *Azotobacter* + PSB + KSB (7.5 L/ha)] while the maximum benefit cost ratio 5.08 and net income Rs. 213477.8 per ha reported in treatment T_7-[FYM (30 t/ha) + *Azotobacter* + PSB + KSB (2.5 L/ha)]. Treatment T_1-(control) showed the fruits yield of 202.72 q/ha, with minimum benefit cost ratio 3.13 and lowest net income Rs. 96657.4 per ha. Hence it could be concluded that Brinjal is a remunerative labour intensive crop.

Keywords: Brinjal, benefit cost ratio, vermicompost, *Azotobacter*

Introduction
Brinjal (*Solanum melongena* L.) or egg plant belongs to the family Solanaceae and most common, popular and principal vegetable crops grown in India and around the world. Brinjal fruits are quite high in nutritive value and can justifiably be compared with tomato. Brinjal is a good source of vitamins like A, B and C (Singh *et al*. 2020) [10]. Bitterness in brinjal is due to the presence of high amount of glycoalkaloids (20 mg/100 g fresh weight). In the world, China highest producing country while India in the second position. In India 727 thousand hectare area and 126.80 lakh MT production in 2018-19 and 736 thousand hectare area and 127.77 lakh MT production in 2019-20 of brinjal crop (Anonymous, 2019-20) [2].
For greater growth, fruit and seed output, solanaceous vegetables require a high concentration of key nutrients such as nitrogen, phosphorus, and potassium, as well as minor minerals such as calcium and Sulphur (Manickam *et al.* 2021) [5] The cost of inorganic fertilizer has risen dramatically, putting it out of reach for small and marginal farmers while also destroying the ecological niche. In such a case, using biofertilizers is a financially viable option. Biological activity in soil is an essential indicator of soil fertility that may be increased by using biofertilizers (Singh and Kapoor, 1998) [11] A bio-fertilizer (also bio-fertilizer) is a product that contains live microorganisms that, when applied to seeds, plant surfaces or soil.
Knowledge of the cost of cultivation from each farm enterprise is required for good farming since it allows cultivators to manage and coordinate the available production resources in a profitable manner (Vasavada and Shiyani, 2021) [13]. Under the strain of constant rises in input prices, analysis of costs and returns in agriculture is crucial to make the farm industry economically sustainable as well as feasible (Kale *et al.* 2005) [3].
Brinjal being a long duration crop, requires a good amount of manures and fertilizers. It is a well-known fact that the organic matter is heart of fertile soil. Therefore, balanced application of manures and fertilizers is very important for sustainable crop production. The vermicomposting is known to modify the physical, chemical and biological properties of soil favourably, enhance nutrient cycling in the soil and increase the concentration of exchangeable Ca, Na, Mg, K and available N, P and Mo in the soil to direct effects of B:C ratio in the brinjal production.

In light of the foregoing facts, a research was conducted to assess the influence of various nutrient management practices on brinjal plant as well as the comparative economics of various treatment combinations.

Materials and Methods

The study envisaged was carried out at research farm, KVK, Damoh, Madhya Pradesh during the *rabi* season in two successive years, 2021 and 2022. A randomized block design was employed to set up the experiment, with 19 treatments spread across three replications, each consisting of a varied quantity of vermicompost and farmyard manure in addition to a different concentration of *Azotobacter*, PSB, and KSB. The plot area measured 3 m by 1.6 m, with a 60 x 40 cm spacing. Ploughing and tillage improved the land tilth. Proper irrigation was maintained up. Seedlings that were 30 days old and of uniform size were planted in the field. A week before transplanting, organic manures were applied, and a layout was made as per treatment for application of bio-inoculants and organic manures. Throughout the growing of the crop, all cultural customs were adhered to consistently, and observations were made. The system's economics were calculated using the current cost of inputs and output pricing.

Table 1: Treatment details

	Treatments
T_0	Control
T_1	FYM (10 t/ha) + *Azotobacter* + PSB + KSB (2.5 L / ha)
T_2	FYM (10 t/ha) + *Azotobacter* + PSB + KSB (5 L/ha)
T_3	FYM (10 t/ha) + *Azotobacter* + PSB + KSB (7.5 L/ha)
T_4	FYM (20 t/ha) + *Azotobacter* + PSB + KSB (2.5 L / ha)
T_5	FYM (20 t/ha) + *Azotobacter* + PSB + KSB (5 L / ha)
T_6	FYM (20 t/ha) + *Azotobacter* + PSB + KSB (7.5 L/ha)
T_7	FYM (30 t/ha) + *Azotobacter* + PSB + KSB (2.5 L/ha)
T_8	FYM (30 t/ha) + *Azotobacter* + PSB + KSB (5 L/ha)
T_9	FYM (30 t/ha) + *Azotobacter* + PSB + KSB (7.5 L / ha)
T_{10}	Vermicompost (1 t/ha) + *Azotobacter* + PSB + KSB (2.5 L/ha)
T_{11}	Vermicompost (1 t/ha) + *Azotobacter* + PSB + KSB (5 L/ha)
T_{12}	Vermicompost (1 t/ha) + *Azotobacter* + PSB + KSB (7.5 L/ha)
T_{13}	Vermicompost (2 t/ha) + *Azotobacter* + PSB + KSB (2.5 L/ha)
T_{14}	Vermicompost (2 t/ha) + *Azotobacter* + PSB + KSB (5 L / ha)
T_{15}	Vermicompost (2 t/ha) + *Azotobacter* + PSB + KSB (7.5 L/ha)
T_{16}	Vermicompost (3 t/ha) + *Azotobacter* + PSB + KSB (2.5 L/ha)
T_{17}	Vermicompost (3 t/ha) + *Azotobacter* + PSB + KSB (5 L/ha)
T_{18}	Vermicompost (3 t/ha) + *Azotobacter* + PSB + KSB (7.5 L/ha)

Economics from different treatments

Cost of cultivation

Cost of cultivation for each treatment was worked by using the market price of all inputs used for growing the crop on per hectare area basis. For this purpose, cost of common inputs/practices for all treatments sand cost of variable inputs as per treatment were determined separately and then total cost of cultivation was calculated by combining both common and variable cost of particular treatment.

Gross monetary return

The value of produce for a particular treatment was determined on the basis of existing market price of the produce on per hectare area basis. It refers the gross monetary return per hectare of the treatment.

Net monetary return

The net monetary return for each treatment was worked out by using the following formula:

Net monetary return = Gross monetary return of treatment - Cost of cultivation of the same treatment

Benefit and cost ratio (Profitability)

The benefit and cost ratio for each treatment was calculated by using the following formula:

$$\text{B:C Ratio} = \frac{\text{Gross monetary return per hectare for a treatment}}{\text{Cost of cultivation per hectare for the same treatment}}$$

Results and Discussion

Net return from each treatment combination

Among the data showed that treatment T_{18}-[Vermicompost (3 t/ha) + *Azotobacter* + PSB + KSB (7.5 L/ha)] received a significant maximum fruit yield of 397.74 q/ha, and net income of Rs. 219169.2 per ha and benefit cost ratio of 4.69 in eggplant variety Harsh. While the maximum benefit cost ratio 5.08 and net income Rs. 213477.8 per ha reported in treatment T_7- [FYM (30 t/ha) + *Azotobacter* + PSB + KSB (2.5 L/ha)]. The above finding supports the observation of Sahu *et al.*, (2022) [9] who found that the gross income (3,03,100 Rs./ha), net income (2,40,972 Rs./ha), benefit cost ratio (3.87) were maximum in the variety Kashi Taru, while the variety Sehore Selection-12 showed minimum response in terms of growth, yield and economics of brinjal. Similar findings were noted by Manickam *et al.* (2021) [5], Anayat *et al.* (2021) [1] and Mondal *et al.* (2019) [7].

Benefits: Cost ratio

T_1-(control) showed the minimum benefit cost ratio 3.13 and lowest net income Rs 96657.4 per ha and minimum fruits yield of 202.72 q/ha. Present findings supported that the findings of Singh (2004) the maximum brinjal yield (133q/ha) with FYM which was statistically at par with bio fertilizers, maximum protein (1.53 g/100 g) and ascorbic acid contents (13.42 g/100 g) were observed in FYM treatment. FYM treatment recorded the maximum BC ratio (3.33). The findings are in accordance with those of Patel *et al.* (2018) [8], Meshram *et al*. (2015) [6], and Kertagi *et al*. (2000) [4].

Table 1: Economics from different treatments

Treatments	Expenditure (Rs/ha)	Yield (q/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio
T_0	45250	202.72	141907.4	96657.4	3.13
T_1	48250	239.64	167748.0	119498.0	3.47
T_2	50250	243.55	170487.7	120237.7	3.39
T_3	52250	250.11	175078.6	122828.6	3.35
T_4	50250	281.70	197190.3	146940.3	3.92
T_5	52250	288.66	202063.8	149813.8	3.86
T_6	54250	291.29	203904.2	149654.2	3.75
T_7	52250	379.61	265727.8	213477.8	5.08
T_8	54250	386.75	270729.0	216479.0	4.99
T_9	56250	389.83	272886.8	216636.8	4.85
T_{10}	50250	269.14	188398.6	138148.6	3.74
T_{11}	52250	275.52	192866.8	140616.8	3.69
T_{12}	54250	281.17	196819.6	142569.6	3.62
T_{13}	52250	350.06	245047.4	192797.4	4.69
T_{14}	54250	356.54	249581.2	195331.2	4.60
T_{15}	56250	360.07	252055.0	195805.0	4.48
T_{16}	54250	388.72	272107.4	217857.4	5.01
T_{17}	56250	395.25	276675.7	220425.7	4.91
T_{18}	59250	397.74	278419.2	219169.2	4.69

Gross income: The prevailing market price for eggplant was considered @ 700 Rs./q

Conclusion
Among the data showed that a significant maximum yield of 397.74 q/ha and net income of Rs. 219169.2 per ha and benefit cost ratio of 4.69 was achieved in eggplant variety Harsh in the T_{18}-[Vermicompost + *Azotobacter* + PSB + KSB]. However, shows the minimum benefit cost ratio 3.13 and lowest net income 96657.4 Rs./ha and minimum fruits yield of 202.72 q/ha was obtained in Treatment T_1-(control).

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