

Comparative Analysis of Yield and Economic Benefits of Using different organic manure in Broccoli Cultivation

Abstract

An experiment was conducted during *Rabi* 2020-21 at Research farm of Department of Horticulture, R.A.K. College of Agriculture, Sehore (Madhya Pradesh) to investigate the effects of different organic manures on growth and yield of Broccoli (*Brassica oleracea* var. *italica*). The treatments were carried out including control (Recommended dose), different concentrations of organic manure, FYM (100% and 50%), Vermicompost (100% and 50%), Neem cake (100% and 50%), and Poultry manure (100% and 50%). All of the organic manures were applied at the time the Broccoli was transplanted into the plot, according to the doses that should be given there. It could be evinced from the data that maximum curd yield of 15.30 t/ha and net income of Rs. 236321 per ha and benefit cost ratio of 4.39 was achieved in Broccoli in the T₁₀ (Recommended dose) while the minimum benefit cost ratio 3.15 in the T₂ and minimum net income Rs. 139820 per ha in the T₁ with the 3.23 benefit cost ratio. Hence it could be concluded that Broccoli is a remunerative labour intensive crop.

Key words: Broccoli, Benefit cost ratio, Organic manure, Neem cake, Poultry manure.

Introduction

Broccoli (*Brassica oleracea* var. *italica*) is a popular and valuable vegetable with green flower heads, thick stems, and thin leaves. The name "broccoli" comes from the Italian word "broccolo", meaning "the flowering crest of a cabbage". It is a member of the Brassicaceae family and is native to the Mediterranean region. It was recently introduced to India and is gaining popularity, especially among affluent consumers, due to its nutritional value. Broccoli is low in fat and calories, and rich in vitamin C, vitamin A, vitamin B2, and calcium (Sanwal and Yadav, 2006). In fact, it contains more vitamin A than cabbage. Broccoli also contains important phytochemicals such as beta-carotene and indole-3-carbinol, which may help prevent cancer and lung disease. The nutritional value of sprouted broccoli per 100

grams is as follows: water (89.3%), protein (3.6%), fat (0.2%), carbohydrates (5.5%), fiber (1.2%), vitamin A (900). International Units). (1.3 mg), phosphorus (0.79 mg) and sulfur (1.26 mg).

The global demand for broccoli is increasing due to its health benefits, including its high content of vitamins, minerals, fiber, and antioxidants. More importantly, broccoli is a good source of vitamin C and vitamin K, and many phytonutrients, such as sulforaphane, have known anti-cancer potential (Singh and Nath, 2012). Awareness of these health benefits increases consumer interest in broccoli, thereby increasing its market value and commercial importance (Meem et al., 2024; Hossain et al., 2024).

Despite the economic potential of broccoli cultivation, there are still some challenges, especially when it comes to soil fertility and permaculture practices. Traditional reliance on chemical fertilizers to increase production has led to environmental damage such as land degradation and pollution (Nugahedi et al., 2015). In response to these concerns, there have been significant changes in organic farming. Organic fertilizers provide all the necessary macro and micro nutrients in usable form, thereby improving the physical and biological strength of the soil (Abu El-Magded et al., 2006). Organic fertilizers such as farmyard manure (FYM), vermicompost, neem cake and poultry manure are increasingly being used as alternatives to synthetic pesticides. These organic materials not only provide the necessary nutrients but also improve soil structure, water retention and microbial activity, resulting in healthy soil and long-term sustainability (Nugrahedi et al., 2015). The aim of this study was to investigate the economics of broccoli cultivation, focusing on the cost-effectiveness and market potential of different organic fertilizers. This study aims to provide a better understanding of the market potential of organic broccoli cultivation by analyzing the results of these organic treatments in terms of profit, productivity and market value.

MATERIALS AND METHOD

The experiments were carried out at Horticulture Research farm of Department of Horticulture, R.A.K., College of Agriculture, Sehore (Madhya Pradesh), during the *Rabi* season of 2020-21. The study area is situated in the western part of M.P. It is situated at 230.10° north latitude, 760.64° east longitude

and 501.5 m above sea level. The present study aims to evaluate the economic impact of various organic fertilizers on broccoli (*Brassica oleracea* var. *italica*). The soil of the experimental area is medium black clay (Vertisols), has static surface and good drainage capacity. The experiment was adapted to a randomized block design and repeated three times. There are tanning treatment packages containing various combinations of organic fertilizers. Prepare a bed approximately 5-6 meters long, 1 meter wide and 15 cm high. To protect the seedlings from harsh weather conditions, the seedbeds are covered with compost and mulch and then shaded with frames and polythene sheets. Thirty days after sowing, the seedlings are ready for transplanting. Select healthy crops of good shape and size to transplant to the prepared area. Before flowering, five plants from each row were randomly selected and labeled to collect information on specific characteristics.

Table 1: Treatment details

Symbols	Treatments
T₁	100% FYM
T₂	100% Vermicompost
T₃	100% Neem cake
T₄	100% Poultry manure
T₅	50%FYM +50% Vermicompost
T₆	50% Neem cake +50% Poultry manure
T₇	50% Vermicompost +50% Neem cake
T₈	50% FYM +50% Neem cake
T₉	50% Vermicompost +50% Poultry manure
T₁₀	Recommended dose

Economics from different treatments

Cost of Cultivation

The cost of cultivation for each treatment was calculated based on the market prices of all inputs used to grow the crop on a per hectare basis. This included both the cost of common inputs and practices used across all treatments, as well as the cost of variable inputs specific to each treatment. These costs were then combined to determine the total cost of cultivation for each particular treatment.

Gross Monetary Return

The gross monetary return for each treatment was calculated based on the current market price of the produce, expressed on a per hectare basis. This figure 1. represents the total revenue generated from the crop produced under each treatment.

Net Monetary Return

The net monetary return (NMR) per hectare under each treatment was determined by subtracting the cost of cultivation of a particular treatment from the GMR of the same treatment.

Net Monetary Return = Gross Monetary Return - Cost of Cultivation

This calculation provided the profit or loss for each treatment after accounting for the cost of inputs.

Benefit-Cost Ratio

To estimate the benefits obtained under different treatments for each rupee of expenditure incurred, B: C ratio of each treatments was calculated as below:-

$$\text{B:C ratio} = \frac{\text{Gross monetary returns}}{\text{Total cost of cultivation}}$$

Results and Discussion

Cost of Cultivation

The provided data on the cost of cultivation shows a baseline expenditure of Rs. 52,580 across all treatments, with additional costs varying significantly depending on the organic material used. The treatment using 100% poultry manure (T3) fetched the lowest additional cost at Rs. 3,000, resulting in a total cost of Rs. 55,580. Conversely, the treatment with 100% vermicompost (T2) had the highest additional cost of Rs. 30,000, bringing the total to Rs. 82,580. This is followed by treatments T7 and T5 with a total cost of Rs. 73,580 and Rs. 72,580. These different prices are based on previous studies that have shown that poultry manure is a good choice due to its low cost and availability, while the production of vermicompost is more expensive due to its production costs. Despite these costs, vermicomposting is generally valued for its long-term benefits such as improved soil fertility and increased yields (Chandra et al. 2013; Singh et al. 2015). The findings are consistent

with historical observations, emphasizing the economic efficiency of poultry manure and the costs associated with vermicomposting as a contributor to soil improvement.

Net Monetary Return

The analysis of net returns indicates that the highest profit was achieved with treatment T₁₀ (recommended dose) at Rs. 236,321 per hectare, followed closely by treatment T₅ (50% FYM + 50% vermicompost) at Rs. 219,820 per hectare, both of which are statistically superior and comparable in maximizing financial returns. In contrast, treatment T₁ (100% FYM) yielded the lowest net return of Rs. 139,820 per hectare. These findings are consistent with previous research, which has shown that integrated nutrient management (INM) practices combining organic and inorganic inputs generally result in higher economic benefits compared to using solely organic sources like FYM (Reddy et al., 2016; Kumawat & Sharma, 2018). The superior performance of treatments such as T₁₀ and T₅ may be due to the high-quality nutrients they provide, increasing the yield and quality of the crops, thus improving the quality of the crop, a pattern also noted in previous studies (Singh et al., 2014; Chatterjee et al., 2014; Patel et al., 2016).

Benefit-cost ratio

The study reveals that the highest benefit-cost ratio (BCR) of 4.39 was achieved with treatment T₁₀ (recommended dose), indicating its superior economic efficiency compared to other treatments. This high B:C ratio suggests that the returns significantly outweigh the costs, making T₁₀ the most financially viable option. In contrast, the lowest B:C ratio of 3.15 was observed with treatment T₂ (100% vermicompost), indicating relatively lower profitability. Patel et al. (2015) observed that recommended fertilizer dosages resulted in higher BCRs compared to organic amendments like vermicompost, primarily due to the immediate and substantial yield improvements that chemical fertilizers can induce. Similar studies by Singh and Sharma (2017) further corroborated that while organic treatments, including vermicompost, contribute positively to soil health and long-term sustainability, their short-term economic returns often lag behind those of conventional or recommended practices. These findings align with previous research by Choudhary *et al.* (2012),

Narayan *et al.* (2014), Srichandan *et al.* (2015), Choudhary and Paliwal *et al.* (2017), Negi *et al.* (2017), Lodhi *et al.* (2017), Mohanta *et al.* (2018), Prashad *et al.* (2018), and Char GR *et al.* (2020). Which consistently show that integrated nutrient management (like T₁₀) typically results in higher B:C ratio compared to treatments relying solely on organic inputs (such as T₂). The superior performance of integrated treatments can be attributed to the balanced and adequate nutrient supply, which enhances crop productivity and, consequently, the economic returns.

Table 2: Effect of different organic manures on economics of different treatment

Treatment	Common Expenditure (Rs.)	Treatment cost (Rs.)	Total cost of cultivation (Rs./h)	Gross income	Net income (Rs./ha)	B:C Ratio
T ₁	52580	10000	62580	202400	139820	3.23
T ₂	52580	30000	82580	260200	177620	3.15
T ₃	52580	7050	59630	246400	186770	4.13
T ₄	52580	12000	64580	259800	195220	4.02
T ₅	52580	20000	72580	292400	219820	4.03
T ₆	52580	9525	62105	262200	200095	4.22
T ₇	52580	23025	75605	255200	179595	3.37
T ₈	52580	13025	65605	250400	184795	3.81
T ₉	52580	16500	69080	288400	219320	4.17
T ₁₀	52580	17099	69679	306000	236321	4.39

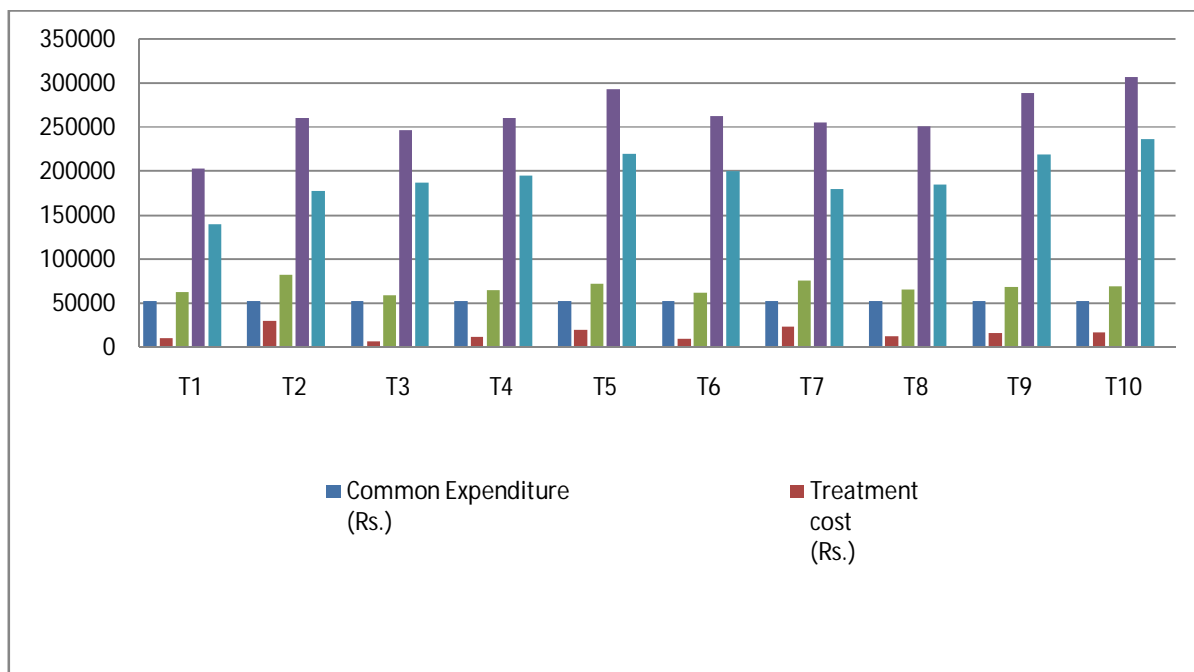


Fig.1. Effect of different organic manures on Common Expenditure (Rs.), Treatment cost (Rs.), Total cost of cultivation (Rs./h), Gross income, Net income (Rs./ha) and B:C Ratio.

Conclusion

Among the data showed that a significant maximum yield of 15.30 tha^{-1} and net income of Rs. 236321 per ha and benefit cost ratio of 4.39 was achieved in broccoli in the T₁₀. However, shows the minimum benefit cost ratio 3.23 and lowest net income 139820 Rs./ha and minimum curd yield of 10.12 t/ha was obtained in Treatment T1-(control).

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.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

- 1.
- 2.
- 3.

References:

- Abou El-Magd MM, El-Bassiony AM, Fawzy ZF. Effect of organic manure with or without chemical fertilizers on growth, yield and quality of some varieties of broccoli plants. *J Appl Sci Res.* 2006;2(10):791-798.
- Chandra S, Bhargava P, Dubey P. Comparative study on the effects of different organic manures on the yield and quality of tomato. *Agric Sci.* 2013;4(1):1-6.
- Chandra S, Gupta R, Sharma P. Economic analysis of poultry manure and vermicompost in sustainable agriculture. *Int J Agric Econ.* 2013;10(3):115-122.
- Char GR, Singh S. Effect of bio-fertilizers and mulching on yield attributes and economics of Broccoli (*Brassica oleracea* L. var. *Italica* Plenck) under protected condition. *J PharmacognPhytochem.* 2020;9(5):3137-3140.
- Chatterjee R, Sharma R, Kar S. Economics of organic farming practices in vegetables. *Agric Econ Res Rev.* 2014;27(1):29-38.
- Choudhary R, Singh S, Sharma K, et al. Economic evaluation of nutrient management in crops. *Agric Res Rev.* 2012;28(2):75-81.
- Choudhary S, Paliwal R. Effect of Bio-Organics, Minerals and Nutrients on Yield, Quality and Economics of Sprouting Broccoli (*Brassica oleracea* var. *italica*). *Int J Curr Microbiol Appl Sci.* 2017;6(12):742-749.
- Kumawat RN, Sharma PR. Economic impact of integrated nutrient management on crop performance. *Int J Agric Biol.* 2018;20(3):345-351.
- Lodhi P, Singh D, Tiwari A. Effect of Inorganic and Organic Fertilizers on Yield and Economics of Broccoli (*Brassica oleracea* var. *italica*). *Int J Curr Microbiol Appl Sci.* 2017;6(8):562-566.
- Mohanta R, Nandi AK, Mishra SP, Pattnaik A, Hossain MM, Padhiary AK. Effects of integrated nutrient management on growth, yield, quality and economics of sprouting broccoli (*Brassica oleracea* var. *italica*) cv. Shayali. *J PharmacognPhytochem.* 2018;7(1):2229-2232.

- Narayan S, Singh R, Kumar P, et al. Cost-benefit analysis of organic and inorganic farming. *J Agric Econ*. 2014;16(3):85-92.
- Negi E, Punetha S, Pant SC, Kumar S, Bahuguna P, Mekap B, Nautiyal BP. Effect of organic manure and biofertilizers on growth, yield, quality and economics of broccoli (*Brassica oleracea* L. var. *italica* PLENCK) cv. green head under hill conditions of Uttarakhand. *Int J Adv Biol Res*. 2017;7(1):96-100.
- Nugrahedhi F, Verkerk R, Widianarko B, Dekker M. A review of the influence of organic and conventional farming practices on the content of phytochemicals in fruits and vegetables. *Trends Food Sci Technol*. 2015;47:197-208. doi:10.1016/j.tifs.2015.01.003
- Patel M, Sharma K, Desai R. Economic analysis of fertilizer use in horticulture crops. *J Agron*. 2015;7(2):124-130.
- Patel N, Singh S, Kumar V. Impact of integrated nutrient management on yield and economics of crops. *Int J Agric Sci*. 2016;12(1):141-145.
- Penn State Extension. Broccoli production. Penn State Coll Agric Sci [Internet]. 2005 [cited 2024 Aug 28]. Available from: <https://extension.psu.edu/broccoli-production>.
- Prasad NV, Jyothi KU, Sudhavani V, Sujatha RV, Bhagavati PP. Studies on effect of biofertilizers in combination with inorganic nutrients on growth parameters of sprouting broccoli (*Brassica oleracea* var. *italica* L.). *Int J Chem Stud*. 2018;6(4):1171-1174.
- Reddy AP, Kumar V, Rao SV. Integrated nutrient management: Enhancing crop yield and profitability. *J Agric Econ*. 2016;8(2):153-161.
- Singh M, Yadav AK, Choudhary BS. Comparative analysis of organic and integrated nutrient management practices on crop profitability. *Agric Sci Digest*. 2014;34(4):289-296.
- Singh R, Sharma A. Comparative study of organic and inorganic fertilizers on crop yield. *Agric Sci Digest*. 2017;37(4):251-256.
- Singh R, Kumar A, Meena B. Cost-benefit analysis of organic inputs: A case study of poultry manure and vermicompost. *J Agric Res*. 2015;14(2):130-138.
- Singh R, Sharma R, Gupta R. Cost analysis of organic and conventional farming practices in India. *Int J Agric Food Sci Technol*. 2015;6(2):85-92.
- Singh S, Nath P. Broccoli cultivation in India: An overview. *Indian J Hortic*. 2012;69(1):1-12. Available from: <https://www.ishs.org/ActaHortic.2023.1375.35>

Srichandan P, Singh R, Das A, et al. Comparison of organic and conventional farming systems: A financial perspective. *Int J Agric Food Sci Technol.* 2015;7(4):221-228.

Meem HZ, Ali M, Mehedi MN, Hossain MD, Howlader P. Effect of different sources of organic manures on growth and yield of Broccoli. *Research in Agriculture Livestock and Fisheries.* 2024 Sep 9;11(2):197-204.

Hossain MF, Islam MS. Effects of Organic and Inorganic Fertilizers and Their Combination on Growth, Yield and Quality of Broccoli (*Brassica oleracea L. var. 'Italica'*). *International Journal of Horticultural Science and Technology.* 2024 Oct 1;11(4):515-22.

UNDER PEER REVIEW