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**Divya Choudhary**
Department of Horticulture, School of Agricultural Sciences, JRNRV University, Udaipur, Rajasthan, India

**AS Jodha**
Department of Horticulture, School of Agricultural Sciences, JRNRV University, Udaipur, Rajasthan, India

**Damini Visen**
Department of Horticulture, School of Agricultural Sciences, JRNRV University, Udaipur, Rajasthan, India

**Surbhi Tyagi**
Department of Energy and Environmental Sciences, School of Agricultural Sciences, JRNRV University, Udaipur, Rajasthan, India

**Saurabh Rathore**
Department of Agriculture Economics, School of Agricultural Sciences, JRNRV University, Udaipur, Rajasthan, India

**Vishal Pareek**
Department of Genetics and Plant Breeding, School of Agricultural Sciences, JRNRV University, Udaipur, Rajasthan, India

**Sonia Jaiswani**
Department of Soil Science and Agricultural Chemistry, School of Agricultural Sciences, JRNRV University, Udaipur, Rajasthan, India

**Corresponding Author:**
**Divya Choudhary**
Department of Horticulture, School of Agricultural Sciences, JRNRV University, Udaipur, Rajasthan, India

# Effect of integrated nutrient management practices on growth, yield and quality of broccoli (*Brassica oleracea* L. var. *italica*)

**Divya Choudhary, AS Jodha, Damini Visen, Surbhi Tyagi, Saurabh Rathore, Vishal Pareek and Sonia Jaiswani**

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**Abstract**
An experiment was conducted on entitled "Effect of Integrated Nutrient Management Practices on Growth, Yield and Quality of Broccoli (*Brassica oleracea* L. var. *italica*)" was conducted during *Rabi*, 2024-25 at Instructional Farm, School of Agricultural Sciences, Dabok, Udaipur. The experiment comprised of ten treatments *viz.*, $T_1$ (Control), $T_2$ (100% RDF ), $T_3$ (100% Vermicompost), $T_4$ (100% FYM), $T_5$ (75% RDF + 25% N through FYM), $T_6$ (75% RDF + 25% N through Vermicompost), $T_7$ (50% RDF + 50% N through FYM), $T_8$ (50% RDF + 50% N through Vermicompost), $T_9$ (75% RDF + 25% N through FYM + PSB @3kg/ha) and $T_{10}$ (75% RDF + 25% N through Vermicompost + PSB @ 3kg/ha) with replicated three in Randomized Block Design.
The results revelled that during experiment use of different integrated nutrient on growth, yield and quality of broccoli its effect among all treatments $T_{10}$ (75% RDF + 25% N through Vermicompost + PSB @3kg/ha) was found to significantly increase growth, yield and quality of parameters, yield as well as economic of broccoli. It was found that maximum value of growth parameters *viz.*, The maximum plant height (22.88, 30.43 and 36.75 cm) at 30, 60 and harvest, maximum leaf length (42.55 cm), leaf width (24.83 cm), maximum number of leaves plant$^{-1}$ (21.64), yield attributes and yield *viz.* The maximum fresh weight of head (412.44 g), maximum yield per plot (10.31 kg), The maximum yield (15.34 t ha$^{-1}$), quality parameters *viz.*, maximum total soluble solid (8.87 $^0$Brix), maximum ascorbic acid (89.44 mg 100 g$^{-1}$), economic parameters *viz.*, maximum net return of □ 60567 ha$^{-1}$ maximum B:C ratio (1.92) were found under $T_{10}$ (75% RDF + 25% N through Vermicompost + PSB @ 3 kg/ha).

**Keywords:** Broccoli, practices on growth, yield and quality, *Brassica oleracea* L. var. *italica*

## Introduction
Broccoli (*Brassica oleracea* var. *italica*, 2n=18), has originated in the Mediterranean region commonly known as Hari ghobi, Kholrabi, Sea cabbage etc. It is a member of cole group, belongs to the family Brassicaceae earlier known as crucifereae. Broccoli derived its name from the Latin word Brachium meaning an arm or branch. It is cooked with potatoes as a solitary vegetable or combined with them to make pickels, soups, and curries. It can also be eaten as a salad. (Thamburaj and Singh, 2001) [10]. Sprouting broccoli is a high value exotic vegetable is a fast-growing annual plant that grows 60-90 cm (24-35 inches) tall. Upright and branching with leathery leaves, broccoli bears dense green clusters of flower buds at the ends of the central axis and the branches. Broccoli has a large flowering head, stalk and small associated leaves are eaten as a vegetable. Broccoli is classified in the *italica* cultivar group of the species *Brassica oleracea*.
Through the optimisation of all available organic, inorganic, and biotic resources in an integrated manner, suitable for each cropping system and farming situation with its ecological, social, and economic ramifications, integrated nutrient management (INM) aims to maintain and improve soil fertility for sustainable crop productivity. The recent energy crisis and the rise in chemical fertilizer prices due to the lack of suitable alternatives have raised interest in organic recycling for sustainable crop production globally and the poor purchasing power of the agricultural community. (Agarwal, 2000). There is an urgent need to adopt an integrated nutrient supply and management system for promoting efficient and balanced use of plant nutrients.

While the main emphasis was given on increasing the proper and balanced used of mineral fertilizers, the role of organic manure, biofertilizers, green manuring and recycling of organic wastes should be considered supplementary and not substitutable.

The integrated nutrient management paves the way to overcome these problems, which involves conjunctive use of chemical fertilizers and organic manures to sustain crop production as well as maintenance of soil health (Nanjappa *et al*., 2001) [7]. However, biofertilizers offer an alternative to chemical fertilizers, which have an ability to mobilize the nutritionally important elements from non-useable form to useable from through chemical processes and are known to increase yield in several other vegetables. The use of biofertilizers in combination with chemical fertilizers and organic manures offer a great opportunity to increase the production of broccoli with less cost. Hence, the present study was undertaken Effect of Integrated Nutrient Management Practices on Growth, Yield and Quality of Broccoli (*Brassica oleracea* L. var. *italica*).

## Materials and Methods

The field experiment was conducted during October, 2024 to May, 2025 Horticulture farm, Department of Horticulture, School of Agricultural Sciences, Dabok, Udaipur. Geographically, Udaipur is located at 24°37' N latitude and 73°53' E longitude at an elevation of 513 meters above MSL. This particular part of India falls under agro climatic zone IV an *i.e.* "Sub-Humid Southern Plain and Aravalli Hills" of Rajasthan. The geography of the experimental site was fairly levelled with an ample surface drainage and the field soil was having clay loam texture. An experiment was conducted ten treatments in RBD Design with three replications. The seeds of broccoli were sown on 18$^{th}$ September 2024. The size of the seed bed about 15 cm above ground level and 1 m width and covered with a thin layer of farmyard manure. Transplanting of broccoli seedling on 28, October, 2024.

## Results and Discussion

### Effect of Integrated Nutrient Management practices on Growth attributes

Data examine in Table 4.1 indicate that application of integrated nutrient management practices brought about a significant variation in growth parameters as *viz*., maximum plant height (22.88, 30.43 and 36.75 cm) at 30, 60 and harvest, The maximum leaf length (42.55 cm). The maximum leaf width (24.83 cm), the highest number of leaves plant$^{-1}$ (22.88) was found under $T_{10}$ (75% RDF + 25% N through Vermicompost + PSB @3kg/ha). Might in growth was shown to be significantly impacted by the addition of organic manures, which have solubilising effects on the soil nutrients. There are also chelating effects on metal ions. They thus increased the amount of nutrients that the plants could get. Similar results were observed Neupane *et al*., 2020 [8] and Singh and Deepanshu (2023) [9] in broccoli. A balanced C: N ratio and an abundance of available nutrients from the soil may be the cause of this trend of plant spread. This is because there is less retention in the roots and more translocation to the aerial portion for the synthesis of protoplasmic proteins and other metabolites, which allows the photosynthetic area to expand. A similar finding was observed in research conducted by Kannaujiya *et al*. (2023) [4], in cauliflower. Neupane *et al*. (2020) [8] also observed that applying 50% N through RDF + 50% N had maximum plant spread.

### Yield parameter

A glance of the data represented in Table 4.3 that there was significant effect of integrated nutrient management practices on yield, The maximum fresh weight of head (412.44 g), maximum yield per plot (10.31 kg), The maximum yield (15.34 t ha$^{-1}$) was recorded under $T_{10}$ (75% RDF + 25% N through Vermicompost + PSB @ 3 kg/ha) which was recorded significantly higher as compared to other treatment. The application of 75% RDF + 25% N through Vermicompost + PSB @ 3 kg ha$^{-1}$ contribution to increasing yields can be due to the balanced C: N ratio and improved availability of essential plant nutrients, resulting in increased rate and efficiency of metabolic processes and high protein and carbohydrate assimilation. The positive impact of organic manures in enhancing soil physical, chemical, and biological qualities is well documented, resulting in improved nutrient absorption by plants and higher yields. Other factors contributing to higher yields include greater nutrient availability throughout the growing season and the significant improvement in inorganic fertilizer efficacy with combined of organic manures. Such beneficial effects of Vermicompost and inorganic fertilizers have been established in cauliflower Wani *et al*., (2010) [11]. Mohanta *et al*. (2018) [6] also observed that the application of (50% N.P.K. + vermicompost @ 2.5 t per ha$^{-1}$) recorded maximum values for gross yield.

### Quality parameters

The maximum total soluble solid (8.87 $^{0}$Brix), maximum ascorbic acid (89.44 mg/100g) was recorded under $T_{10}$ (75% RDF + 25% N through Vermicompost + PSB @ 3kg/ha). This might have naturally led to the conversion of stored dietary material into soluble simple sugar since it is an important component that may be engaged in the respiratory process in the cell system and plant system. This might be the most likely reason why the amount of T.S.S. has increased. Several other workers have also observed similar results it was supported by Sharma *et al*, 2018, Vitamin -C influenced by factors such as nutrient balance, soil health, environmental conditions, and cultivar selection. Broccoli crop mineral accumulation and carbohydrate synthesis were impacted by the balanced nutrient supply that organic fertilizers offer, which may have contributed to increased ascorbic acid and TSS levels. Similar research confirming the findings were reported by Yadav *et al*., (2012) [12].

### Economics

The use of integrated nutrient management strategies in broccoli had a substantial impact on net return and the B-C ratio, according to the data (Table 4). Treatment $T_{10}$ (75% RDF + 25% N through Vermicompost + PSB @ 3 kg/ha) produced The maximum net return (□60567) maximum B-C ratio (1.92) was recorded under $T_{10}$ (75% RDF + 25% N through Vermicompost + PSB @ 3 kg/ha) which was recorded significantly higher over rest of the treatment The beneficial role of RDF and Vermicompost+ PSB in improving properties of soil like physical, chemical and biological, which is help in better nutrient absorption by plants, also resulted in higher values for yield contributing parameter. Similar results were found Kashyap *et al*. (2017) [5] in cauliflower and Dash *et al*. (2019) [2] in broccoli.

**Table 1:** Effect of integrated nutrient management practices on plant height at 30 DAT, 60 DAT and at harvest

| Treatment | Treatment combination | Plant height(cm) | | |
|---|---|---|---|---|
| | | At 30 DAT | At 60 DAT | At harvest |
| $T_1$ | Control (No Manure) | 12.54 | 18.65 | 22.54 |
| $T_2$ | 100% RDF | 20.62 | 29.84 | 35.68 |
| $T_3$ | 100% Vermicompost | 14.65 | 22.88 | 26.65 |
| $T_4$ | 100% FYM | 15.65 | 19.00 | 25.44 |
| $T_5$ | 75% RDF + 25% N through FYM | 16.65 | 23.76 | 27.86 |
| $T_6$ | 75% RDF + 25% N through Vermicompost | 16.43 | 24.65 | 27.97 |
| $T_7$ | 50% RDF + 50% N through FYM | 17.54 | 25.64 | 29.65 |
| $T_8$ | 50% RDF + 50% N through Vermicompost | 18.89 | 25.76 | 32.54 |
| $T_9$ | 75% RDF + 25% N through FYM + PSB @3kg/ha | 19.54 | 28.98 | 34.65 |
| $T_{10}$ | 75% RDF + 25% N through Vermicompost + PSB @3kg/ha | 22.88 | 30.43 | 36.75 |
| SEm± | | 0.94 | 0.93 | 1.19 |
| C.D. (P=0.05) | | 2.80 | 2.98 | 5.50 |

**Table 2:** Effect of integrated nutrient management practices on leaf length, leaf width, number of leaf and chlorophyll content in leaves

| Treatment | Treatment combination | Leaf length (cm) | Leaf width (cm) | Number of leaf |
|---|---|---|---|---|
| $T_1$ | Control (No Manure) | 29.65 | 19.94 | 12.54 |
| $T_2$ | 100% RDF | 39.97 | 24.94 | 20.62 |
| $T_3$ | 100% Vermicompost | 32.65 | 20.67 | 14.65 |
| $T_4$ | 100% FYM | 31.55 | 20.00 | 15.65 |
| $T_5$ | 75% RDF + 25% N through FYM | 36.76 | 23.00 | 16.65 |
| $T_6$ | 75% RDF + 25% N through Vermicompost | 36.86 | 24.00 | 16.43 |
| $T_7$ | 50% RDF + 50% N through FYM | 38.65 | 24.41 | 17.54 |
| $T_8$ | 50% RDF + 50% N through Vermicompost | 39.70 | 24.41 | 18.89 |
| $T_9$ | 75% RDF + 25% N through FYM + PSB @3kg/ha | 39.84 | 24.50 | 19.54 |
| $T_{10}$ | 75% RDF + 25% N through Vermicompost + PSB @3kg/ha | 42.55 | 25.74 | 22.88 |
| SEm± | | 0.52 | 1.22 | 1.12 |
| C.D. (P=0.05) | | 1.56 | 3.60 | 3.32 |

**Table 3:** Effect of integrated nutrient management practices on yield per plot and hectare

| Treatment | Treatment combination | Yield per plot (kg) | Yield (t $ha^{-1}$) | Harvest index (%) |
|---|---|---|---|---|
| $T_1$ | Control (No Manure) | 6.14 | 9.13 | 42.52 |
| $T_2$ | 100% RDF | 10.14 | 15.10 | 53.45 |
| $T_3$ | 100% Vermicompost | 7.26 | 10.81 | 46.50 |
| $T_4$ | 100% FYM | 6.52 | 9.70 | 44.66 |
| $T_5$ | 75% RDF + 25% N through FYM | 8.14 | 12.11 | 49.45 |
| $T_6$ | 75% RDF + 25% N through Vermicompost | 8.69 | 12.94 | 50.26 |
| $T_7$ | 50% RDF + 50% N through FYM | 9.41 | 14.00 | 51.36 |
| $T_8$ | 50% RDF + 50% N through Vermicompost | 9.52 | 14.16 | 52.85 |
| $T_9$ | 75% RDF + 25% N through FYM + PSB @3kg/ha | 10.08 | 15.00 | 53.23 |
| $T_{10}$ | 75% RDF + 25% N through Vermicompost + PSB @3kg/ha | 10.31 | 15.34 | 54.25 |
| SEm± | | 0.13 | 0.16 | 4.36 |
| C.D. (P=0.05) | | 0.39 | 0.47 | NS |

**Table 4:** Effect of integrated nutrient management practices on total soluble solid and ascorbic acid

| Treatment | Treatment combination | Total soluble solid (°Brix) | Ascorbic acid (mg 100 $g^{-1}$) |
|---|---|---|---|
| $T_1$ | Control (No Manure) | 6.80 | 72.23 |
| $T_2$ | 100% RDF | 8.70 | 86.65 |
| $T_3$ | 100% Vermicompost | 7.25 | 73.26 |
| $T_4$ | 100% FYM | 7.03 | 73.25 |
| $T_5$ | 75% RDF + 25% N through FYM | 7.86 | 78.20 |
| $T_6$ | 75% RDF + 25% N through Vermicompost | 8.02 | 82.50 |
| $T_7$ | 50% RDF + 50% N through FYM | 8.06 | 83.52 |
| $T_8$ | 50% RDF + 50% N through Vermicompost | 8.46 | 84.65 |
| $T_9$ | 75% RDF + 25% N through FYM + PSB @3kg/ha | 8.56 | 86.20 |
| $T_{10}$ | 75% RDF + 25% N through Vermicompost + PSB @3kg/ha | 8.87 | 89.44 |
| SEm± | | 0.11 | 1.10 |
| C.D. (P=0.05) | | 0.33 | 3.25 |

**Table 5:** Effect of integrated nutrient management practices on net return and B-C ratio

| Treatment | Treatment combination | Net return (□ ha$^{-1}$) | B-C ratio |
|---|---|---|---|
| $T_1$ | Control (No Manure) | 12086 | 0.49 |
| $T_2$ | 100% RDF | 59280 | 1.89 |
| $T_3$ | 100% Vermicompost | 36409 | 1.28 |
| $T_4$ | 100% FYM | 29737 | 1.05 |
| $T_5$ | 75% RDF + 25% N through FYM | 41721 | 1.35 |
| $T_6$ | 75% RDF + 25% N through Vermicompost | 46576 | 1.50 |
| $T_7$ | 50% RDF + 50% N through FYM | 52934 | 1.70 |
| $T_8$ | 50% RDF + 50% N through Vermicompost | 53793 | 1.72 |
| $T_9$ | 75% RDF + 25% N through FYM + PSB @3kg/ha | 58748 | 1.88 |
| $T_{10}$ | 75% RDF + 25% N through Vermicompost + PSB @3kg/ha | 60567 | 1.92 |
| SEm± | | 246.48 | 0.02 |
| C.D. (P=0.05) | | 732.32 | 0.07 |

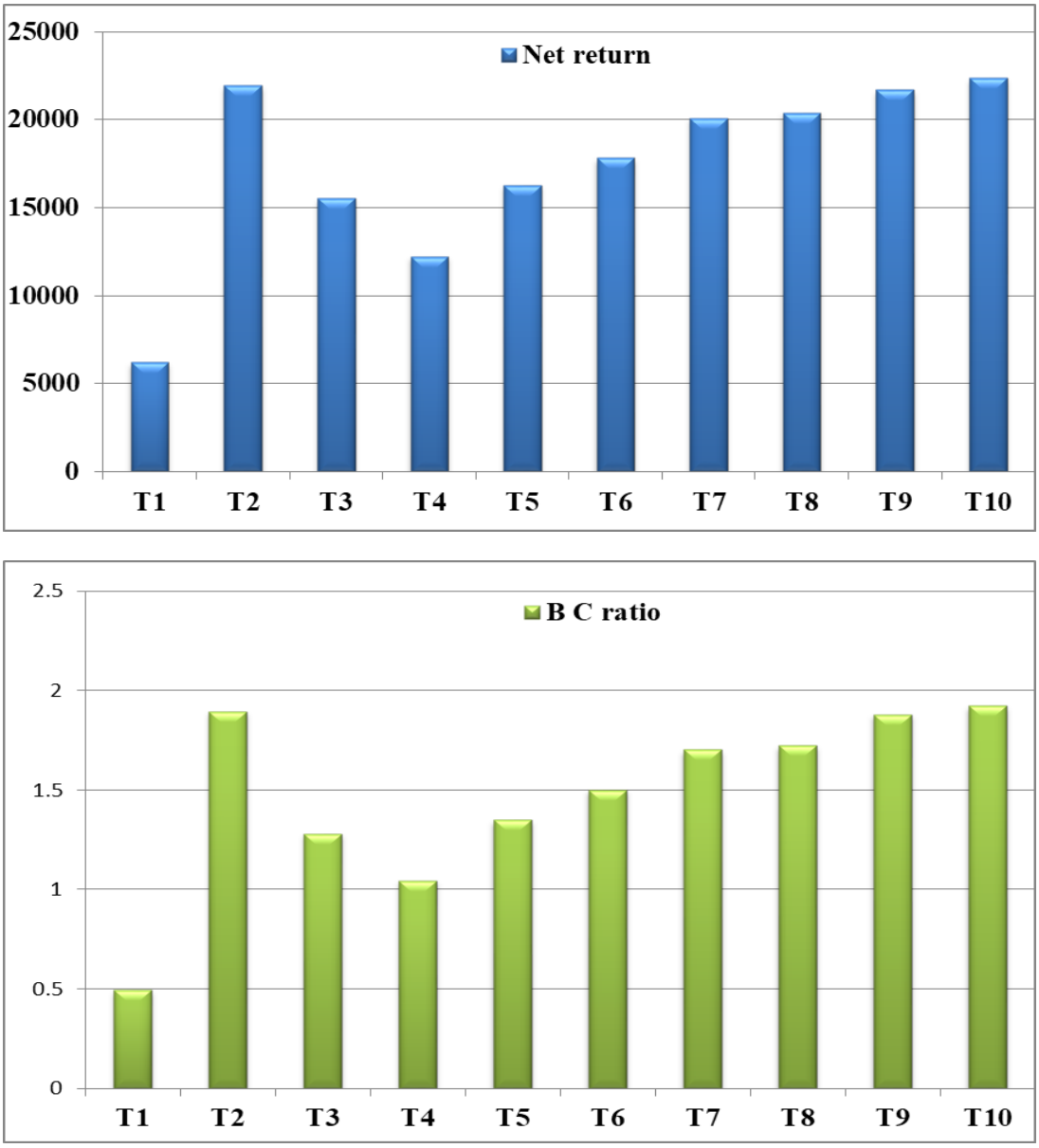


**Fig 1:** Effect of integrated nutrient management practices on net return and BC ratio

## Conclusion

On the basis of result from present investigation entitled "Effect of integrated nutrient management practices on growth, yield and quality of Broccoli (*Brassica oleracea* L. var. *italica*)" conducted during *Rabi* 2024-25, it may be concluded that under prevailing agro-climatic zone IVa of Rajasthan, a significant increase in growth, yield attributes, yield, quality as well as net returns of broccoli were found under application of $T_{10}$ (75% RDF + 25% N through Vermicompost + PSB @ 3kg/ha$^{-1}$. The maximum yield and net return were obtained with 75% RDF + 25% N through Vermicompost + PSB @3kg/ha.

Therefore, application of 75% RDF + 25% N through Vermicompost + PSB @ 3kg ha$^{-1}$ may be recommended for broccoli to obtain higher yield and net returns. However, these are one-year results and need further experimentation

for final recommendation.

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