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## Impact of different enriched organic manures & bio-fertilizer on growth and yield parameter of Broccoli cv. Green Pia, under agro-climatic condition of Kanpur

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### Abstract

The present investigation on evaluation Impact of different enriched organic manures & bio-fertilizer on growth and yield parameter of Broccoli cv. Green Pia, under agro-climatic condition of Kanpur was carried out at the Agriculture Research Farm of Rama University, Mandhana, Kanpur, U.P, India, during Rabi season 2022-2023. The research material comprised of ten treatments along with three replications in Randomized Block Design (RBD). The results showed that application of T<sub>7</sub> [Vermicompost @ 5 t/ha + Bio fertilizer (*Azotobacter* + PSB) @ 5 kg/ha] has resulted in the maximum canopy spread (56.42 cm), maximum number of leaves (33.24), leaf area (53.47 cm), minimum time of flowering (62.43 days), minimum time of harvesting (74.25), curd length (16.34 cm), curd diameter (30.26 cm), curd weight (779.35g) and curd yield per hectare (369.35q/ha).

**Keywords:** Broccoli cv. Green Pia, Organic manures, *Bio-fertilizer*, Growth and yield parameter

### Introduction

The enormous flowering head of the Brassicaceae family member known as broccoli (*Brassica oleracea* L. var. *Italia*) is used as a vegetable. Sprouting broccoli or broccoli is a high value exotic vegetable cultivated for its tender flowering head and the secondary heads (spears). Generally, it can be classified into three distinct group viz., white purple and green, out of which green type is highly nutritious (Yoldas *et al.*, 2008) [16]. It's essential for human nourishment. It provides the nutrients necessary for a balanced diet, including carbs, lipids, minerals, vitamins, and roughages. Compared to other Cole crop vegetables, broccoli is more nutrient-dense, its fresh vitamin C concentration is nearly twice that of cauliflower. In one pound of edible broccoli, there are 9.10g of protein, 0.60g of fat, 15.20g of carbohydrates, 211.0 mg of phosphorus, 3.60 mg of iron, 970.00 LU of vitamin A, 327.00 mg of ascorbic acid, 0.59 mg of riboflavin, and 0.26 mg of thiamine. Apart from anti-cancerous properties, heads are rich sources of protein, minerals, vitamin and antioxidant. The ideal conditions for broccoli growth are moist, fertile soil that is between 6.0 and 7.0 pH and between 15.5 and 18 °C (60-65°F) in temperature. Due to the high nitrogen needs of broccoli and the fact that soil microbes are less active in the late fall and winter, organic matter should be given to the soil all year long to ensure an adequate supply of nutrients when broccoli is planted. The crop attracts very high price in urban market and can be exported too abroad. Organic manures also help in reducing C: N ratio, increasing humic acid content and provide nutrient in the readily available form to the plants such as nitrate, exchangeable phosphorus, soluble potassium, calcium and magnesium (Talashilkar *et al.*, 1999) [14]. In addition, organic manure improves soil physical properties like structure, water holding capacity. Bio- fertilizers play an important role in increasing availability of nutrients and productivity in sustainable manner. Azospirillum is free living bacteria which may add to non- legume crop under favorable condition and also secretes some growth promoting substances. Besides macro and micronutrients, it also contains humic acids, plant growth promoting substances like auxins, gibberellins and Cytokinin's, N-fixing and P-solubilizing bacteria, enzymes and vitamins, which increases the availability of essential plant nutrients in plants (Dominguez *et al.*, 2010) [3]. Application of organic manure such as FYM, Vermicompost, Poultry manure with or without combination and bio-fertilizers as *Azotobacter* and PSB have been reported that the better growth and yield in Broccoli cv. Green Pia.

## Materials and Methods

The experiment was carried out during the *Rabi* season 2022-23 at the main experiment station is Agriculture Research Farm of Rama University, Mandhana, Kanpur, UP, India. Geographically Kanpur is situated in the Gangetic plain's alluvium of central U.P. It lies in altitude and longitude ranging between 25.28° to 28.50° north and 79.31° to 84.34° east at elevation of 125.90 m above mean sea level. The experiments were laid out in Randomized Block Design with three replications. There were ten treatments and each treatment was allocated randomly in each plot during the period of investigation. The experimental field was thoroughly ploughed and cross-ploughed thrice with the help of mould board plough with tractor, Stones, pebbles and residues of the previous crops were removed from the fields manually followed by planking and levelling to bring the field to a good tilth. Field was divided into three strips and plots of 1.8 x 1.5m were prepared with bunds of 30 cm width and paths and channels were also prepared according to the layout of the experiment. The seedlings were on 25<sup>th</sup> October 2022 in the evening. To protect the seedlings from the scorching effect of sunlight, an artificial shade was provided by using rice straw until the establishment of the seedlings. The plants were selected randomly from a plot for the observations. These plants were tagged for recording the various data on cauliflower. Measuring tape was used to measure Canopy spread (cm), Number of leaves, Time of flowering, Time of harvesting, Leaf area, Curd length (cm), Curd diameter (cm), Curd weight (g) and Curd Yield (q/ha). Other cultural practices like, gap filling, irrigation and weeding etc.

**Table 1:** Treatment combinations

Treatment	Treatment combinations
T0	Control
T1	Farm yard manures @ 15 t/ha
T2	Vermicompost @ 5 t/ha
T3	Poultry manure @ 5t/ha
T4	Biovita granules @ 50 kg/ha
T5	Bio fertilizer ( <i>Azotobacter</i> + PSB) @ 5kg/ha
T6	Farm yard manures @ 15 t/ha + Bio fertilizer ( <i>Azotobacter</i> +PSB) @ 5 kg/ha
T7	Vermicompost @ 5 t/ha + Bio fertilizer ( <i>Azotobacter</i> + PSB) @ 5 kg/ha
T8	Poultry manure @ 5t/ha + Bio fertilizer ( <i>Azotobacter</i> + PSB) @ 5kg/ha
T9	Biovita granules @ 50 kg/ha + Bio fertilizer ( <i>Azotobacter</i> + PSB) @ 5kg/ha

## Results and Discussion

The result of various growth parameters such as canopy spread (cm), number of leaves, leaf area (cm), time of flowering and time of harvesting Impact by different combination of organic manures and bio-fertilizer.

### Canopy Spread (cm)

In the present study, canopy spread was significantly influenced the growth over control by organic manures and *bio-fertilizers* treatment. Data recorded in respect of canopy spread presented in Table 2. The maximum canopy spread

(56.42cm) was observed in the treatment T<sub>7</sub> [Vermicompost @ 5 t/ha + *Bio-fertilizer* (*Azotobacter* + PSB) @ 5 kg/ha] whereas, the minimum canopy (41.26 cm) recorded with the T<sub>0</sub> (control). The increase in canopy spread gets the support with the findings of Chaubey *et al.* (2006)<sup>[1]</sup> in Broccoli and Shree *et al.*, (2014)<sup>[13]</sup> in cauliflower cv. Poosi.

### Number of leaves

Regarding the number of leaves, it was observed that the impact of different treatment combination has been presented in Table 2. The maximum numbers of leaves 33.24 were observed in the treatment T<sub>7</sub> [Vermicompost @ 5 t/ha + *Bio-fertilizer* (*Azotobacter* + PSB) @ 5 kg/ha]. whereas, the minimum number of leaves (19.21) recorded with the T<sub>0</sub> (control). Increase in number of leaves might be due to the application of organic manure and *bio-fertilizer*. This ultimately helped in increasing the uptake of nitrogen and other nutrients and produced a more and large leaves. Similar finding due to organic manures and *bio-fertilizer* were reported by Choudhry *et al.* (2012)<sup>[2]</sup> and Mal *et al.* (2015)<sup>[6]</sup> in Broccoli.

### Leaf areas (cm)

Leaf area (cm), it was observed that the impact of different treatment combination has been presented in Table 2. The maximum leaf area 53.47 cm were observed in the treatment T<sub>7</sub> [Vermicompost @ 5 t/ha + *Bio-fertilizer* (*Azotobacter* + PSB) @ 5 kg/ha]. whereas, the minimum leaf area (41.25 cm) recorded with the T<sub>0</sub> (control). The increase in leaf area gets the support with the findings of Yadav *et al.*, (2012)<sup>[15]</sup> in cabbage cv. Pride of India and Mohanta *et al.*, (2018)<sup>[8]</sup> in Sprouting Broccoli cv. Shayali.

### Time of flowering

Regarding the time of flowering recorded at day of first flower initiation after transplanting, it was observed that the impact of different treatment combination has been presented in Table 2. The minimum time of flowering (62.43days) were observed in the treatment T<sub>7</sub> [Vermicompost @ 5 t/ha + *Bio-fertilizer* (*Azotobacter* + PSB) @ 5 kg/ha]. whereas, the maximum time of flowering (78.90 days) recorded with the T<sub>0</sub> (control). The minimize time of flowering gets the support with the findings of Kumar *et al.*, (2013)<sup>[13]</sup> in broccoli and Ghulam *et al.*, 2012<sup>[4]</sup> and Shree *et al.*, 2014<sup>[13]</sup> in cauliflower cv. Poosi.

### Time of harvesting

Regarding the time of harvesting recorded at day of first picking flower after transplanting, it was observed that the impact of different treatment combination has been presented in Table 2. The minimum days of time of harvesting (74.25 days) were observed in the treatment T<sub>7</sub> [Vermicompost @ 5 t/ha + *Bio-fertilizer* (*Azotobacter* + PSB) @ 5 kg/ha]. Whereas, the maximum days of time of harvesting (89.76 days) recorded with the T<sub>0</sub> (control). The minimize time of flowering gets the support with the findings of Shree *et al.* 2014<sup>[13]</sup> in cauliflower cv. Poosi and Rana *et al.*, (2020)<sup>[10]</sup> in cabbage.

**Table 2:** Impact of organic manures & bio-fertilizer on growth parameter

Treatment	Canopy spread (cm)	Number of leaves	Leaf area (cm)	Time of flowering	Time of harvesting
T0	41.26	19.21	41.25	78.90	89.76
T1	46.49	20.65	46.65	67.56	83.98
T2	48.35	24.61	48.36	69.24	81.35
T3	47.64	23.54	46.32	72.64	88.36
T4	50.25	26.35	51.63	75.65	79.52
T5	43.68	21.62	42.21	76.35	85.65
T6	51.43	30.24	50.36	64.96	77.34
T7	56.42	33.24	53.47	62.43	74.25
T8	54.62	31.25	52.84	64.32	74.63
T9	52.24	29.32	47.25	66.31	76.36
S.Em(±)	1.02	1.36	0.96	1.01	1.05
C.D. (P=0.05)	0.65	1.20	0.36	0.32	0.25

The result of various yield parameters such as curd length (cm), curd diameter (cm), curd weight (g) and curd Yield (q/ha) Impact by different combination of organic manures and bio-fertilizer.

### Curd length (cm)

Regarding the curd length, it was observed that the impact of different treatment combination has been presented in Table 3. The maximum curd length (16.34 cm) was observed in the treatment T<sub>7</sub> [Vermicompost @ 5 t/ha + Bio-fertilizer (*Azotobacter* + PSB) @ 5 kg/ha]. whereas, the minimum curd length (10.75 cm) recorded with the T<sub>0</sub> (control). These results get support of the findings of Mohanta *et al.*, (2018)<sup>[8]</sup> in Sprouting Broccoli cv. Shayali and Rana *et al.*, (2020)<sup>[10]</sup> in cabbage.

### Curd diameter (cm)

Curd diameter (cm), it was observed that the impact of different treatment combination has been presented in Table 3. The maximum curd diameter (30.26 cm) was observed in the treatment T<sub>7</sub> [Vermicompost @ 5 t/ha + Bio-fertilizer (*Azotobacter* + PSB) @ 5 kg/ha]. Whereas, the minimum curd diameter (21.64 cm) recorded with the T<sub>0</sub> (control). This may be due to an increase in the photosynthetic activity of the plant with overall growth and an increase in chlorophyll content. Increased chlorophyll content produced more photosynthesis that was diverted for curd growth and resulted in better curd nutrition, leading to an increase in curd diameter. These results get support of the findings of Mohanta *et al.*, (2018)<sup>[8]</sup> in Sprouting Broccoli cv. Shayali and Rana *et al.*, (2020)<sup>[10]</sup> in cabbage.

### Curd weight (g)

Regarding the curd weight was recorded after harvesting of curd, it was observed that the impact of different treatment combination has been presented in Table 3. The maximum curd weight (869.43 g) was observed in the treatment T<sub>7</sub> [Vermicompost @ 5 t/ha + Bio-fertilizer (*Azotobacter* + PSB) @ 5 kg/ha]. whereas, the minimum curd weight (646.54 g) recorded with the T<sub>0</sub> (control). These results get support of the findings of Pandey *et al.*, (2008)<sup>[9]</sup> and Mehedi. *et al.*, (2018)<sup>[7]</sup> in broccoli.

### Curd Yield (q/ha)

Regarding the curd yield (q/ha) was recorded after harvesting of curd, it was observed that the impact of different treatment combination has been presented in Table 3. The maximum curd yield (q/ha) was observed in the treatment T<sub>7</sub>

[Vermicompost @ 5 t/ha + Bio-fertilizer (*Azotobacter* + PSB) @ 5 kg/ha]. whereas, the minimum curd yield (q/ha) recorded with the T<sub>0</sub> (control). The maximum in curd yield can be attributed to the increase in canopy spread, maximum number of leaves, curd length and diameter which may have enhance the photosynthetic surface area and led to greater synthesis and translocation of photosynthetase towards curd formation. These findings are in line with the findings of Sharma (2002)<sup>[11]</sup> in cauliflower, Sharma *et al.*, (2008)<sup>[12]</sup> in broccoli and Mehedi. *et al.*, (2018)<sup>[7]</sup> in broccoli.

**Table 3:** Impact of organic manures & bio-fertilizer on yield parameter

Treatment	Curd length (cm)	Curd diameter (cm)	Curd weight (gm)	Curd yield (q/ha)
T0	10.75	19.21	646.54	89.76
T1	14.79	20.65	684.36	103.54
T2	12.31	24.61	742.31	101.36
T3	12.64	23.54	689.43	92.21
T4	14.36	26.35	723.14	98.32
T5	11.84	21.62	692.42	91.41
T6	15.42	30.24	786.21	111.68
T7	16.34	33.24	869.43	121.46
T8	15.65	31.25	845.32	119.25
T9	15.24	29.32	809.24	112.34
S.Em(±)	1.56	1.36	0.87	1.02
C.D. (P=0.05)	1.36	1.20	0.23	0.38

### Conclusion

Based on the results obtained from the present investigation, it is conducted that the highest growth and yield of broccoli *viz.*, maximum canopy spread (56.42 cm), maximum number of leaves (33.24), leaf area (53.47 cm), minimum time of flowering (62.43 days), minimum time of harvesting (74.25), curd length (16.34 cm), curd diameter (30.26 cm), curd weight (779.35g) and curd yield per hectare (369.35q/ha) were observed with the treatment T<sub>7</sub> [Vermicompost @ 5 t/ha + Bio-fertilizer (*Azotobacter* + PSB) @ 5 kg/ha]. From this study it can be recommend that the application of organic manures and bio-fertilizer a can be applied to obtain maximum growth and yield of Broccoli cv. Green Pia.

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