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EFFECT OF DIFFERENT BIO FERTILIZERS ON YIELD AND QUALITY ATTRIBUTES OF BROCCOLI (*BRASSICA OLERACEA* L. VAR. *ITALICA*) UNDER GWALIOR CONDITION OF INDIA

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ABSTRACT

The research study titled "Effect of different bio fertilizers on yield and quality attributes of broccoli (*Brassica oleracea* L. var. *italica*) under Gwalior condition" was carried out at the Research Field CRC-3, Turari, ITM University, Gwalior (M.P), India. As a member of the Brassicaceae family of plants, broccoli belongs to a wide variety of agricultural plants that originated in the Mediterranean Sea and have evolved throughout time via breeding and selection. Broccoli is a major crop within its genus, with its compact flower head forming what we commonly eat as the green curd, which quickly develops into a mass of fertile flower buds. China produces the most broccoli globally, followed by India, which is the second-largest producer. The experiment was organized using a Randomized Block Design with three replications. Each replication comprised twelve treatments with different concentrations of RDF fertilizers administered to Azotobacter and Phosphate Solubilizing Bacteria. The findings indicated that the various treatments involving Azotobacter and Phosphate Solubilizing Bacteria, along with different fertilizer doses, had a significant impact on the growth, yield and quality parameters of broccoli at different growth stages. The treatment T_4 (100% RDF + PSB + Azotobacter) emerged as the best treatment among all, yielding the highest growth, yield and quality parameters for the broccolis.

Key words : Broccoli, Biofertilizers, Chemical fertilizers, Azotobacter, PSB.

Introduction

Broccoli (*Brassica oleracea* L. var. *italica*) is a member of the Brassicaceae plant family, which includes a diverse range of crop plants that began in the Mediterranean Sea and have been adapted through years of selection and breeding (Decoteau, 2000). The word "broccoli" comes from the Latin "Brachium", meaning "arm of branch," and it's also sometimes called "cauliflower" or "Italian asparagus". Broccoli is a major crop within its genus, with its compact flower head forming what we commonly eat as the green curd, which quickly develops into a mass of fertile flower buds. The curd of broccoli is formed from a compact flower head and produces a green curd that rapidly develops into a mass of fertile flower buds (Biggs, 1993). In 2009, FAOSTAT reported that China produces the most broccoli globally, followed by India, which is the second-largest producer. Though, it hasn't been cultivated much in India, farmers there are starting to grow broccoli because of its excellent nutritional value and rising appeal among tourists. It is mostly grown in hilly regions such as the Northern Plains, the Nilgiri Hills, Jammu & Kashmir, Uttar Pradesh and Himachal Pradesh. Bio-based materials, including bio-fertilizers, consist of safe organic components to use and enhance crop growth and yield, while also improving soil health. Additionally, they assist in inhibiting pathogenic entities and serve as agents of biological control. The use of bio-fertilizers is cost-effective, environmentally friendly, and ensures the farming system's long-term viability (Chand *et al.*, 2017).

Biofertilizers are solutions containing living or latent cells of microorganisms responsible for fixing nitrogen from the atmosphere, solubilizing phosphate and potassium, mobilizing nutrients, absorbing water and decomposing cellulolytic water components (Kumar *et al*., 2017). Without the need for a symbiotic association, bacteria that are free-living called azotobacters stabilize atmospheric nitrogen in plants and crops. They don't have a predilection for any particular host plant. They also boost seed germination and young plant vigour, resulting in better crop stands (Siddique *et al*., 2014). Azotobacter, comprising free-living nitrogen-fixing bacteria, is essential for enriching soil fertility and stimulating crop growth by converting atmospheric nitrogen into a usable form for plants. Unlike symbiotic nitrogen-fixing bacteria, Azotobacters work autonomously, making them crucial contributors to agricultural sustainability. Their adaptability and lack of host plant preference highlight their significance across diverse agricultural and ecological settings. Azotobacter plays a vital role in sustainable agriculture and ecosystem functioning by enriching soil fertility and promoting plant growth through nitrogen fixation.

One kind of bacterium that helps dissolve insoluble phosphate in soil is called phosphate solubilizing bacteria (PSB). Roughly 95% of the phosphorus in soil is insoluble, meaning plants cannot absorb it directly. By generating acid, phosphate solubilizing bacteria or fungi may change insoluble phosphate into soluble phosphate. Farmers are beginning to understand the advantages of utilizing liquid bio-fertilizers for nitrogen fixation and growth-promoting chemical production, such as Azotobacter and Azospirillium. Additionally, phosphate-solubilizing bacteria, or PSBs are essential for the release of phosphorus and other nutrients, the development of plants, and the improvement of disease resistance. Because these biofertilizers are safe and organic, they are vital parts of integrated nutrient management plans. Farmers may lower production costs and preserve soil productivity by mixing chemical fertilizers, organic manures, and biofertilizers. The current experiment, "Effect of different bio fertilizers on yield and quality attributes of broccoli (Green magic) under Gwalior condition," was conducted with these considerations in mind was carried out in the Department of Horticulture, School of Agriculture, Horticulture Research Farm (CRC-3) at ITM University, Gwalior (M.P).

Materials and Methods

Experimental site

In the winter season of 2023-2024, practical field studies were conducted within the Horticulture department's field at the School of Agricultural, ITM University, Gwalior. The research activities took place at the Crop Research Center-3, located in Sithouli, Gwalior, Madhya Pradesh (474001). Gwalior falls within the subtropical zone and is positioned at latitude of 26.21240 N and a longitude of 78.17720 E.

Climatic conditions

The Crop Research Centre, ITM University, Gwalior's experimental field is located in the Gird belt (MLS) at 26.21240 N latitude and 78.17720 E longitude, or 211.5 meters above sea level. It is located in the northern region of MP and has a subtropical climate. The warmest months are May and June, when the mean maximum temperature ranges from 38.4°C to 47°C, respectively. The summers are hot and dry. The two coolest months of the year are December and January, with mean low temperatures of 5.3°C and 15.3°C, respectively. The three-month period between mid-June and the end of September receive 760–1060 mm of rain on average per year.

Soil type

The sandy loam soil in the experimental field had a homogeneous texture, adequate drainage and a very low, medium, and medium NPK status, in that order.

Soil

The texture of the soil in the experimental field was clay and the topography was consistent. Using a soil auger, random samples of soil were taken from each plot up to a depth of 20 cm prior to seeding. The purpose of collecting these samples was to identify the experimental area's textural class and reproductive status. In order to create composite samples of soil from each replication, primary samples were combined. These samples were then used to examine the physio-chemical characteristics of the area.

Experimental details

S. no.	Content	Component
1.	Crop Period	October 19 2023 to February, 23, 2024.
2.	Design of experiment	Randomized block design (RBD)
3.	Number of treatments	12
4.	Replication	3
5.	Total number of plots	36
6.	Plot size	2.5m × 1m
7.	Variety	Green Magic
8.	Field size	30m × 10m

9.	Sowing date	19.10.23
10.	Seed rate	400-500g/ha

Treatment details

S. no.	Treatment	Treatment details
1.	T_1	100% RDF
2.	T_2	100% RDF + Azotobacter
3.	T_3	100% RDF + PSB
4.	T_4	100% RDF + PSB + Azotobacter
5.	T_5	75% RDF
6.	T_6	75% RDF + Azotobacter
7.	T_7	75% RDF + PSB
8.	T_8	75% RDF + PSB + Azotobacter
9.	T_9	50% RDF
10.	T_{10}	50% RDF + Azotobacter
11.	T_{11}	50% RDF + PSB
12.	T_{12}	50% RDF + PSB + Azotobacter

Agronomic operations

Field preparation

The experimental field was twice harrowed and completely tilled down to a depth of 30 cm to eradicate all weeds and stubble. After clearing the field of weeds and stubble, it was levelled using a leveller. Once the field was clean and level, Plots were developed and the experimental layout was created.

Application of fertilizer

NPK is applied at the time of field preparation to supplement the soil's nutrient content. The biofertilizers (Azotobacter, PSB and Azotophos) were applied by drenching after transplanting of the seedlings.

Sowing

Sowing was done by preparing nursery beds in the protray with cocopeat and transplanting was done after 3 weeks.

Irrigation

Irrigation was provided immediately after sowing to ensure proper germination. Irrigated the nursery bed or pro tray regularly to keep the cocopeat or soil moist but not water logged. Irrigation was given by using a spray bottle to avoid strong stream of water as it can damage the delicate seedlings.

Intercultural operation

Hand weeding and earthing up were done regularly after transplanting to keep the experimental plots weed-free. Weeding, earthing up and other intercultural operations were carried out as needed throughout the cultivation period.

Observations recorded

Vegetative growth parameters

Plant height (cm) at 30, 45 and 60 DAT

In every plot, three plants were chosen at random and tagged. At 30, 45 and 60 days (DAT) following transplanting, the height of the plants was measured from the base to the top of the growth point (DAT). A meter scale was used to measure the average height of the plants.

Number of leaves at 30, 45 and 60 DAT

In every plot, three plants were chosen at random and tagged. After transplanting, at intervals of 30, 45, and 60 days, the total number of leaves was counted (DAT). Next, it was calculated how many leaves each plant had on average.

Length of leaves (cm) at 30, 45 and 60 DAT

In every plot, three randomly chosen plants were tagged. The length of the leaves was measured at intervals of 30, 45 and 60 days after the event, starting at the tip and ending at the lowest leaflets that touch the leaf stem. The mean value of the leaf length was reported.

Width of leaves (cm) at 30, 45 and 60 DAT

In every plot, three randomly chosen plants were tagged. In order to measure the width of leaves, one must position the measuring instrument perpendicular to the broadest point of the leaf and record the measurement in centimetres at various intervals of 30, 45 and 60 DAT.

Girth of main stem (cm) at 30, 45 and 60 DAT

In every plot, three randomly chosen plants were tagged. Girth of main stem was measured by wrapping a measuring tape around, and in the plain perpendicular to the axis of, the stem, at the correct height, at different level of interval 30, 45 and 60 DAT and mean value were given for girth of main stem.

Yield parameters

Chlorophyll content

Using a chlorophyll meter, the leaves of each of the two plants in each plot were measured separately. At the conclusion of the experiment, or harvest time, the average value was determined as per Perez *et al*. (2018).

Ascorbic acid content

The fresh curd of broccoli from each 3 plants of each plot were selected and average value was calculated in the laboratory at the end of experiment *i.e.* harvesting time measurement by done as per Sadasivam and Manickam (2008).

Curd weight

The fresh curd weight from 3 plants of each plot was weighted one by one on digital weighing balance and average value was calculated at the of experiment *i.e.* harvesting time.

Statistical analysis

Least significant difference at 5% level was used for finding the significance differences among the treatment means. The data recorded on various parameters were analysed as per Randomized Block Design (RBD) design as suggested by Gomez and Gomez (1984). Based on the "F" test value and the critical difference (C.D.) calculation, the findings have been interpreted.

Results and Discussion

Plant height (cm)

The outcomes show how important it is to note the substantial differences between the different concentrations of inorganic and biofertilizers, both separately and in combination. It was noted that the tallest plant attainable (29.66, 41 and 53.66 cm) at 30, 45 and 60 DAT was noted in treatment T_4 (100% RDF + PSB + Azo) and the treatments T_1 (100%RDF), T_2 (100% RDF + Azo), T_3 (100% RDF + PSB), T_5 (75% RDF), T7 (75% RDF + PSB) were found at par at 30 DAT. The treatments T_1 (100% RDF) and T_{11} (50% RDF + PSB) were found at par at 45 DAT. The treatments T_1 (100% RDF), T_2 (100% RDF + Azo), T_{10} (50% RDF + Azo) and T_{12} (50% RDF + PSB + Azo) were found at par at 60 DAT. The treatment T_9 (50% RDF) was found minimum significant value at 30, 45 and 60 DAT. The increased height of plant might be attributed to the use of biofertilizers, which improves soil structure, nutritional and moisture status, hence promoting plant development. The findings are in the agreement with Chaudhary *et al.* (2017) and Pawde *et al.* (2019).

Number of leaves

It was recorded that the number of leaves of treatment T_4 (100% RDF + PSB + Azo) was significantly superior and compared to treatments T_1 (100% RDF), T_2 (100% RDF + Azo), T_3 (100% RDF + PSB), T_5 (75% RDF), T_6 (75% RDF + Azo), T_{10} (50% RDF + Azo), T_{11} (50% RDF + PSB), T_{12} (50% RDF + PSB + Azo) were found at par at 30 DAT, whereas T_9 (50% RDF) was found least significant value. The treatments T_2 (100% RDF + Azo), T_3 (100% RDF + PSB), T_6 (75% RDF + Azo), T_7 (75% RDF + PSB), T_9 (50% RDF) and T_{10} (50% RDF + Azo) were found at par at 45 DAT. The treatments T_1 (100% RDF), T_2 (100% RDF + Azo), T_3 (100% RDF + PSB), T_6 (75% RDF + Azo) and T_7 (75% RDF + PSB) were found at par at 60 DAT. The increased amount of nutrients found in soil and their improved availability to support the development of growth characteristics may be the cause of the higher leaf count. The findings are in the agreement with Chaudhary *et al.* (2017) and Pawde *et al.* (2019).

Table 1 : Effect of different biofertilizers on plant height (cm) at 30, 45 and 60 DAT of broccoli.

Treatment symbols	Treatment details	Plant height (cm)		
		30 DAT	45 DAT	60 DAT
T_1	100% RDF	25.33	34.66	45
T_2	100% RDF + Azo	25.56	35.66	47
T_3	100% RDF + PSB	25	35.08	47.12
T_4	100% RDF+PSB+Azo	29.66	41	53.66
T_5	75% RDF	25	34.33	48
T_6	75% RDF + Azo	26.09	32.66	50.33
T_7	75% RDF + PSB	25.33	35	46.66
T_8	75% RDF+PSB+Azo	26.33	36	48.33
T_9	50% RDF	23	31.66	42.66
T_{10}	50% RDF + Azo	23.42	33	45
T_{11}	50% RDF + PSB	24.66	34.66	45.33
T_{12}	50% RDF+PSB+Azo	25.66	36.33	47
	C.D. @ 5%	**2.363**	**2.478**	**3.643**
	SEm±	**0.8**	**0.839**	**1.234**
	C.V.	**5.72**	**3.902**	**4.531**

Table 2 : Effect of different biofertilizers on number of leaves at 30, 45 and 60 DAT of broccoli.

Treatment symbols	Treatment details	Number of leaves		
		30 DAT	45 DAT	60 DAT
T_1	100% RDF	7.3	10.6	14.6
T_2	100% RDF + Azo	8.3	11.3	15.3
T_3	100% RDF + PSB	8	11.3	15.3
T_4	100% RDF+PSB+Azo	9.3	14	17.6
T_5	75% RDF	7.3	11	15
T_6	75% RDF + Azo	8	11.6	15.3
T_7	75% RDF + PSB	7.6	11.6	15.8
T_8	75% RDF+PSB+Azo	8.6	12.6	16.6
T_9	50% RDF	6.3	9.6	13.6
T_{10}	50% RDF + Azo	6.6	9.6	14
T_{11}	50% RDF + PSB	6.6	10	14.6
T_{12}	50% RDF+PSB+Azo	8.3	12.3	16.3
	C.D. @ 5%	**1.211**	**1.604**	**1.443**
	SEm±	**0.41**	**0.544**	**0.489**
	C.V.	**9.203**	**8.307**	**5.513**

Table 3 : Effect on different biofertilizers on leaf length (cm) at 30, 45 and 60 DAT of broccoli.

Treatment symbols	Treatment details	Length of leaves (cm)		
		30 DAT	45 DAT	60 DAT
T_1	100% RDF	22	27.1	32.5
T_2	100% RDF + Azo	22.5	27.9	33.4
T_3	100% RDF + PSB	22.8	27.4	33.1
T_4	100% RDF+PSB+Azo	23.2	28.4	35
T_5	75% RDF	22	26	32.2
T_6	75% RDF + Azo	21.5	27.1	33
T_7	75% RDF + PSB	21.5	26.2	32.2
T_8	75% RDF+PSB+Azo	22.3	27.7	34.1
T_9	50% RDF	21.8	26	32.1
T_{10}	50% RDF + Azo	21.5	26.4	32.5
T_{11}	50% RDF + PSB	21.9	26.6	33
T_{12}	50% RDF+PSB+Azo	22.2	27.1	33.6
	C.D. @ 5%	**0.762**	**0.969**	**1.109**
	SE(m) ±	**0.34**	**0.299**	**0.344**
	C.V.	**3.285**	**2.302**	**2.169**

Table 4 : Effect on different biofertilizers on leaf width (cm) at 30, 45 and 60 DAT of broccoli.

Treatment symbols	Treatment details	Width of leaves (cm)		
		30 DAT	45 DAT	60 DAT
T_1	100% RDF	10.9	14.8	19.6
T_2	100% RDF + Azo	11.1	15.2	19.6
T_3	100% RDF + PSB	11.5	15.4	20.1
T_4	100% RDF+PSB+Azo	12.6	16.9	21.8
T_5	75% RDF	11.3	15.4	19.8
T_6	75% RDF + Azo	11.6	15.7	20.9
T_7	75% RDF + PSB	11.6	15.4	19.5
T_8	75% RDF+PSB+Azo	12.3	16.4	21.7
T_9	50% RDF	11.1	15.1	19.3
T_{10}	50% RDF + Azo	11.8	15.9	20
T_{11}	50% RDF + PSB	11.9	16.1	20.3
T_{12}	50% RDF+PSB+Azo	12	16.2	21.1
	C.D. @ 5%	**0.573**	**0.597**	**0.572**
	SE(m) ±	**0.195**	**0.221**	**0.236**
	C.V.	**3.48**	**2.953**	**2.447**

Table 5 : Effect on different biofertilizers on girth of main stem (cm) at 30, 45 and 60 DAT of broccoli.

Treatment symbols	Treatment details	Girth of main stem (cm)		
		30 DAT	45 DAT	60 DAT
T_1	100% RDF	2	3.1	4.1
T_2	100% RDF + Azo	2.2	3.3	4.3
T_3	100% RDF + PSB	2.1	3.2	4.3
T_4	100% RDF+PSB+Azo	2.4	3.6	4.6
T_5	75% RDF	2	3.2	4.2
T_6	75% RDF + Azo	2.1	3.2	4.2
T_7	75% RDF + PSB	2	3.1	4.1
T_8	75% RDF+PSB+Azo	2.3	3.3	4.3
T_9	50% RDF	2	3.1	4.1
T_{10}	50% RDF + Azo	2	3.1	4.1
T_{11}	50% RDF + PSB	2	3.2	4.2
T_{12}	50% RDF+PSB+Azo	2.3	3.4	4.4
	C.D. @ 5%	**0.244**	**0.256**	**0.268**
	SE(m) ±	**0.077**	**0.078**	**0.082**
	C.V.	**7.597**	**5.035**	**4.023**

Length of leaves (cm)

It was recorded that the length of leaves of treatment T_4 (100% RDF + PSB + Azo) was found superior and the treatments T_1 (100% RDF), T_2 (100% RDF + Azo), T_3 (100% RDF +PSB), T_5 (75% RDF), T_6 (75% RDF + Azo), T_{10} (50% RDF + Azo), T_{11} (50% RDF + PSB) and T_{12} (50% RDF + PSB + Azo) were found at par at 30 DAT. The treatments T_2 (100% RDF + Azo), T_3 (100% RDF + PSB), T_6 (75% RDF + Azo), T_7 (75% RDF + PSB), T_9 (50% RDF) and T_{10} (50% RDF + Azo) were found at par at 45 DAT. The treatments T_1 (100% RDF), T_2 (100% RDF + Azo), T_3 (100% RDF + PSB), T_6 (75% RDF + Azo) and T_{11} (50% RDF + PSB) were found at par at 60 DAT. The increase in the maximum length of leaves and changes to physiological processes might have been caused by the accessibility of nitrogen through biological fixation of nitrogen. The findings are in the agreement with Chaudhary *et al.* (2017) and Pawde *et al.* (2019).

Width of leaves (cm)

It was recorded that the width of leaves of treatments T_4 (100% RDF + PSB + Azo) was found superior and the treatments T_2 (100% RDF + Azo), T_5 (75% RDF), T_6 (75% RDF + Azo) and T_7 (75% RDF + PSB) were found at par at 30 DAT. The treatments T_3 (100% RDF + PSB), T_7 (75% RDF + PSB) and T_9 (50% RDF) were found at par at 45 DAT. The treatments T_1 (100% RDF) and T_2 (100% RDF + Azo) were found at par at 60 DAT. The increase in leaf maximum width and changes to physiological processes might have been caused by the availability of nitrogen through biological nitrogen fixing. The findings are in the agreement with Chaudhary *et al.* (2017) and Pawde *et al.* (2019).

Table 6 : Effect on different biofertilizers on chlorophyll content of broccoli.

Treatment symbols	Treatment details	mg/100g
		Chlorophyll content
T_1	100% RDF	5.1
T_2	100% RDF + Azo	6.2
T_3	100% RDF + PSB	5.3
T_4	100% RDF + PSB + Azo	6.8
T_5	75% RDF	4.8
T_6	75% RDF + Azo	5.3
T_7	75% RDF + PSB	5.7
T_8	75% RDF + PSB + Azo	6.4
T_9	50% RDF	4.3
T_{10}	50% RDF + Azo	4.8
T_{11}	50% RDF + PSB	5.1
T_{12}	50% RDF + PSB + Azo	5.7
	C.D. @ 5%	**N/S**
	SE(m) ±	**0.924**

Table 7 : Effect of different biofertilizers on ascorbic acid content.

Treatment symbols	Treatment details	mg/100g
		Ascorbic acid content
T_1	100% RDF	11.66
T_2	100% RDF + Azo	12.46
T_3	100% RDF + PSB	13.33
T_4	100% RDF + PSB + Azo	16.66
T_5	75% RDF	11.66
T_6	75% RDF + Azo	14.00
T_7	75% RDF + PSB	12.34
T_8	75% RDF + PSB + Azo	16.12
T_9	50% RDF	11.00
T_{10}	50% RDF + Azo	11.66
T_{11}	50% RDF + PSB	13.67
T_{12}	50% RDF + PSB + Azo	15.00
	C.D. @ 5%	**N/S**
	SE(m) ±	**1.548**

Girth of main stem (cm)

It was recorded that the girth of main stem of treatments T_4 (100% RDF + PSB + Azo) was found superior and the treatments T_1 (100% RDF), T_3 (100% RDF + PSB), T_5 (75% RDF), T_6 (75% RDF + Azo), T_7 (75% RDF + PSB), T_9 (50% RDF), T_{10} (50% RDF + Azo), T_{11} (50% RDF + PSB) and T_{12} (50% RDF + PSB + Azo) were found at par at 30 DAT. The treatments T_1 (100% RDF), T_2 (100% RDF + Azo), T_3 (100% RDF + PSB), T_5 (75% RDF), T_6 (75% RDF + Azo), T_7 (75% RDF + PSB), T_8 (75% RDF + PSB+ Azo), T_9 (50% RDF), T_{10} (50% RDF + Azo) and T_{11} (50% RDF + PSB) were found at par at 45 DAT. The treatments T_1 (100% RDF), T_2 (100% RDF + Azo), T_3 (100% RDF + PSB), T_5 (75% RDF), T_6 (75% RDF + Azo), T_7 (75% RDF + PSB), T_8 (75% RDF + PSB+ Azo), T_9 (50% RDF) and T_{10} (50% RDF + Azo) were found at par at 60 DAT. This maximum stem girth may be the result of the stem's greater succulence, balanced C: N ratio and enough supply of soil-available nutrients. The findings are in the agreement with Meena *et al*. (2017) and Pawde *et al.* (2019).

Chlorophyll content

It was recorded that the chlorophyll content of treatment T_4 (100% RDF + PSB + Azo) was found to be the highest content of chlorophyll and the treatments T_1 (100% RDF), T_3 (100% RDF + PSB), T_5(75% RDF), T_6 (75% RDF + Azo), T_7 (75% RDF + PSB), T_{10} (50% RDF + Azo), T_{11} (50% RDF + PSB) and T_{12} (50% RDF + PSB + Azo) were found at par. The treatment T_9 (50% RDF) was found least significant value. Broccoli leaf chlorophyll concentration may have risen as a result of increasing phosphate and nitrogen availability. The findings are in the agreement with Chaudhary *et al*. (2017) and Pawde *et al.* (2019).

Ascorbic acid content

It was recorded that the ascorbic acid content of the treatment T_4 (100% RDF + PSB + Azo) was found to be the maximum ascorbic acid content and the treatments T_1 (100% RDF), T_2 (100% RDF + Azo), T_3 (100% RDF + PSB), T_5 (75% RDF), T_7 (75% RDF + PSB), T_{10} (50% RDF + Azo) and T_{11} (50% RDF + PSB) were found at par. The treatment T_9 (50% RDF) was found least significant value. The enhanced capacity of microorganism inoculants to fix nitrogen in the atmosphere, the increased accessibility of phosphorus, and the release of chemicals that promote development and speed up physiological processes like the synthesis of carbohydrates are possible causes of the rise in ascorbic levels. The findings are in the agreement with Chaudhary *et al*. (2017) and Pawde *et al.* (2019).

Average curd weight (g)

It was recorded that the average curd weight of treatment T_4 (100% RDF + PSB + Azo) was found superior followed by T_8 (75% RDF + PSB + Azo), T_{12} (50% RDF + PSB + Azo), T_6 (75% RDF + Azo) and T_2 (100% RDF + Azo). The treatments T_2 (100% RDF + Azo) and T_6 (75% RDF + Azo) were found at par.

Table 8 : Effect of different biofertilizers on average curd weight of broccoli.

Treatment symbols	Treatment details	Curd weight (g)
T1	100% RDF	201.66
T2	100% RDF + Azo	226.34
T3	100% RDF + PSB	225.11
T4	100% RDF + PSB + Azo	276.29
T5	75% RDF	197.33
T6	75% RDF + Azo	226.66
T7	75% RDF + PSB	223.30
T8	75% RDF + PSB + Azo	242.21
T9	50% RDF	176.04
T10	50% RDF + Azo	202.66
T11	50% RDF + PSB	218.42
T12	50% RDF + PSB + Azo	236.66
	C.D. @ 5%	**5.929**
	SE(m) ±	**1.998**
	C.V.	**1.597**

Whereas T_9 (50% RDF) were found least significant value. This might be because to higher NPK levels and improved nutrient absorption by the plant, which results in a good chlorophyll content. This increases the plant's supply of carbohydrates and speeds up photosynthetic rates, which in turn causes a rise in curd weight. The findings are in the agreement with Chaudhary *et al.* (2017) and Pawde *et al.* (2019).

Conclusion

The growth and yield metrics of broccoli at different growth stages were shown to be strongly impacted by the different types of biofertilizers. According to the study, T_4 (100% RDF + PSB + Azo) was the best treatment for increasing broccoli growth and production.

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