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**Kaushal Singh**  
 M.Sc. Student, Rama  
 University, Mandhana,  
 Kanpur, Uttar Pradesh, India

**Jitendra Kumar**  
 Assistant Professor, Rama  
 University, Mandhana,  
 Kanpur, Uttar Pradesh, India

**Vinay Joseph Silas**  
 Assistant Professor, Rama  
 University, Mandhana,  
 Kanpur, Uttar Pradesh, India

**Aneeta Yadav**  
 Associate Professor, Rama  
 University, Mandhana,  
 Kanpur, Uttar Pradesh, India

**Ashish Srivastava**  
 Assistant Professor, Rama  
 University, Mandhana,  
 Kanpur, Uttar Pradesh, India

**Sarvesh Kumar**  
 Assistant Professor, Rama  
 University, Mandhana,  
 Kanpur, Uttar Pradesh, India

**Syed Mohd Quatadah**  
 Assistant Professor, Rama  
 University, Mandhana,  
 Kanpur, Uttar Pradesh, India

**Corresponding Author:**  
**Jitendra Kumar**  
 Assistant Professor, Rama  
 University, Mandhana,  
 Kanpur, Uttar Pradesh, India

## Study of the different organic manures and bio-fertilizers on growth and yield of cauliflower (*Brassica oleracea* L. var. *botrytis*.) Cv. Pusa Snowball - 1, under agro-climatic condition of Kanpur

**Kaushal Singh, Jitendra Kumar, Vinay Joseph Silas, Aneeta Yadav, Ashish Srivastava, Sarvesh Kumar and Syed Mohd Quatadah**

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### Abstract

The field experiment was conducted at Agricultural Research Farm, Rama University, Kanpur, U.P. during rabi season 2023-24. The experiment was deliberated in randomized block design with eight treatments replicated thrice. Results revealed that combination of vermicompost and bio fertilizer (PSB) resulted maximum growth attributes (plant height 41.08 cm, green leaves per plant 22.08, leaf area 701.99 cm<sup>2</sup>, plant spread 36.66 cm<sup>2</sup>) and minimum time required in (flowering days 46.97 days, no. of curd initiation 79.65 days, no. of days to curd maturity 91.72 days). Yield parameters were recorded highest with combination of vermicompost and bio fertilizer (PSB) as (curd size 150.83 cm<sup>2</sup>, curd weight 981.05 gm and curd yield 246.09 q ha<sup>-1</sup>). The net return of Rs. 168285 ha<sup>-1</sup> and B:C ratio (2.11) were recorded highest with combination of vermicompost and bio fertilizer (PSB). Combination of vermicompost and bio fertilizer (Azotobacter) proved next best treatment with respect to plant growth, yield and economics of cauliflower. The lowest values of these parameters were recorded under control.

**Keywords:** Cauliflower, organic manures, bio fertilizers, economics, vermicompost

### Introduction

Cauliflower (*Brassica oleracea* var. *botrytis* L. 2n=18) is one of the important members of the 'Cole crop' group of the Cruciferae family. The origin of cauliflower is the Mediterranean region. It is one of the most popular and widely cultivated crops throughout India and abroad for its nutritive value, high productivity and wide adaptability to various ecological conditions. If we analyse the production trend of cauliflower, there has been a satisfactory increase in the productivity of the crop in the last five years.

Being a heavy feeder, the role of macronutrients (NPK) and micronutrients (Boron, Zinc and Molybdenum) is essential for the vigorous growth and high yield of cauliflower. To get higher yields, farmers are using huge amounts of fertilizers without adding adequate amounts of organic fertilizers. Continuous use of these fertilizers and other agricultural chemicals reduces the beneficial micro-organisms from the soil which causes infertility in the soil. In recent years, there has been a growing global concern about the adverse effects of chemical fertilizers on the environment and human health. This concern has led to an increased interest in organic farming practices, including the use of organic manures and bio-fertilizers. Organic farming promotes sustainable agricultural practices by utilizing natural inputs that enhance soil fertility, improve crop health, and minimize environmental pollution.

The use of organic manures, such as compost, farmyard manure, and vermicompost, along with bio-fertilizers containing beneficial microorganisms like nitrogen-fixing bacteria, mycorrhiza, and phosphate-solubilizing bacteria, offers a sustainable alternative to chemical inputs. In order to achieve the target of sustainable production along with better economic returns the use of biofertilizers and other safer products of organic origin is only viable option. Bio-fertilizer are naturally occurring products with living microorganisms which are resulted from the roots or cultivated.

Growing of crops with the combination of organic manure and bio fertilizers brings forth of organic farming which is a vogue today. Vermicompost is a nutritive 'organic fertilizer' rich in nitrogen 23%, potassium around 2% and phosphorus 1.55-2.25%, and micronutrients, beneficial soil microbes like 'nitrogen-fixing bacteria' and 'mycorrhiza fungi' and are scientifically proving as miracle growth promotes and protects.

### Materials and Methods

The field experiment was carried out during rabi season of 2023-24 at department of horticulture at Rama University, Kanpur, Uttar Pradesh. The chemical analysis of the soil was done by collecting soil samples from the field by following the standard procedures. The soil was deficient in

available nitrogen 196 kg/ha and medium in phosphorus availability 48 kg/ha and available potash was 180 kg/ha. The pH of the soil was found to be 6.5. The experiment was conducted with eight treatments in randomized block design (RBD) with three replications. The growth parameters observed were plant height, number of leaves per plant, plant spread, time of flowering, time of fruiting and leaf area along with yield parameters contains days to curd initiation, curd size, curd weight and total yield obtained. The economic evaluated parameters were cost of cultivation, gross income, net income and benefit cost ratio. The statistical analysis of data in respect of the growth and yield components was done according to the standard procedure given for randomized block design by Panse and Sukhatme (1967) [3].

**Table 1:** List of treatments combinations used in the experiment

Treatment	Combination
T <sub>0</sub>	Control
T <sub>1</sub>	Farm Yard Manure @ 20 t/ha
T <sub>2</sub>	Vermicompost @ 5 t/ha
T <sub>3</sub>	Bio fertilizer ( <i>Azotobacter</i> + PSB) @ 5 kg/ha
T <sub>4</sub>	Farm Yard Manures @ 20 t/ha + Bio fertilizer (PSB) @ 5 kg/ha
T <sub>5</sub>	Farm Yard Manures @ 20 t/ha + Bio fertilizer ( <i>Azotobacter</i> ) @ 5 kg/ha
T <sub>6</sub>	Vermicompost @ 5 t/ha + Bio fertilizer ( <i>Azotobacter</i> ) @ 5 kg/ha
T <sub>7</sub>	Vermicompost @ 5 t/ha+ Bio fertilizer (PSB) @ 5 kg/ha

### Results and Discussion

#### Growth Parameters

The result of various growth parameters such as plant height, number of leaves, plant spread and leaf area were recorded maximum growth in the combination of organic manure and bio fertilizer in treatment T<sub>7</sub> (Vermicompost @ 5 t/ha+ Bio fertilizer (PSB) @ 5 kg/ha) and also minimum time required in flowering days, no of days in curd initiation with treatment T<sub>7</sub> (Vermicompost @ 5 t/ha+ Bio fertilizer (PSB) @ 5 kg/ha). The second best result was obtained by treatment T<sub>6</sub> (Vermicompost @ 5 t/ha + Bio fertilizer (*Azotobacter*) @ 5 kg/ha). The minimum growth in every parameters were observed in treatment T<sub>0</sub> (control) as presented in Table 2. In present investigation we were observed that organic manure or bio fertilizer dose not performs well separately on the other hand when their combinations were applied to the plants then they gives better performance. The best performance was obtained by

the combination of organic manure (Vermicompost) and bio fertilizer (PSB) however some more other combinations were also given they also performs well. The combination of Vermicompost and bio fertilizer performs best in growth attributes gets the support of Thapa, *et al.*, (2023) [14], Jaiswal *et al.*, (2020) [10]. Possible reason for better performance by combining them in growth related attributes because of certain growth promoting substance secreted by organic manures, better uptake of water, nutrients. As well as bio fertilizer Phosphorus solubilizing bacteria (PSB) plays a vital role in enhancing phosphorus availability for the crop, so it helps in phosphorus uptake, leading to better growth, development, and yield. Incorporating PSB into the soil or using PSB-containing fertilizers can help cauliflower plants access phosphorus more efficiently, resulting in healthier and more robust crops. The results in growth parameters were supported by the findings of Shree *et al.*, (2014) [3] in cauliflower.

**Table 2:** Impact of different organic manure and bio fertilizers on growth parameter

Treatments	Plant height (cm)	No of leaves	Leaf area (cm <sup>2</sup> )	Flowering days	Plant spread (cm <sup>2</sup> )
T <sub>0</sub>	33.14	16.54	462.60	58.73	20.62
T <sub>1</sub>	35.84	18.01	572.09	53.72	32.54
T <sub>2</sub>	36.42	18.56	597.47	53.44	33.80
T <sub>3</sub>	35.31	17.21	546.40	54.64	31.27
T <sub>4</sub>	37.59	19.61	663.96	52.71	34.90
T <sub>5</sub>	37.19	18.76	626.55	53.07	34.46
T <sub>6</sub>	38.45	20.92	693.46	52.04	35.38
T <sub>7</sub>	41.08	22.08	701.99	46.97	36.66
CD at 5%	2.772	0.917	21.532	2.792	0.427
SE(m) ±	0.905	0.299	7.031	0.912	0.14

#### Yield parameters and yield

The maximum curd weight (981.05 gm) and curd size (150.83 cm<sup>2</sup>) of the crop was recorded with the treatment T<sub>7</sub> (Vermicompost @ 5 t/ha+ Bio fertilizer (PSB) @ 5 kg/ha). Maximum curd weight and size leads to maximum curd yield (246.09 q ha<sup>-1</sup>) followed by treatment T<sub>6</sub>

(Vermicompost @ 5 t/ha+ Bio fertilizer (*Azotobacter*) @ 5 kg/ha). The application of organic manure provide a slow release of nutrients to the soil, including nitrogen, phosphorus and potassium which are essential for plant growth. These nutrients support healthy root development, flower formation and foliage growth and more

photosynthesis area which has resulted in more vegetative growth hence higher curd height and curd weight and also curd yield. On the other hand bio fertilizer contains beneficial microorganism like bacteria, fungi and mycorrhiza which form symbiotic relationship with plants. These microorganisms help enhance nutrient uptake by the

plants particularly nitrogen fixation, which is crucial for cauliflower growth. Together their combination create a balanced and fertile soil environment which leads in better plant growth. The result of the present experiment corroborates the findings of Jayant *et al.* (2015) [4] and Bashyal (2011) [1].

**Table 3:** Impact of different organic manures and bio fertilizers on yield parameter

Treatments	Curd size (cm <sup>2</sup> )	Curd Weight (gm)	Curd Yield (q ha <sup>-1</sup> )	No. of days to Curd Initiation	No. of days to curd maturity
T <sub>0</sub>	127.07	562.77	111.77	102.84	115.83
T <sub>1</sub>	134.44	687.16	194.86	96.78	107.50
T <sub>2</sub>	138.47	712.73	205.09	94.83	102.67
T <sub>3</sub>	130.81	623.68	169.47	101.44	112.50
T <sub>4</sub>	145.76	921.43	241.90	87.60	97.50
T <sub>5</sub>	142.37	780.77	232.31	87.00	99.17
T <sub>6</sub>	148.37	976.57	243.96	82.00	94.77
T <sub>7</sub>	150.83	981.05	246.09	79.65	91.72
CD at 5%	1.634	9.784	5.586	1.367	1.748
SE(m) ±	0.533	3.195	1.824	0.447	0.571

### Economics

It was calculated that maximum net return of (Rs 168285 ha<sup>-1</sup>) and benefit cost ratio of (2.11) were recorded with the treatment T<sub>7</sub> (Vermicompost @ 5 t/ha+ Bio fertilizer (PSB) @ 5 kg/ha) followed by treatment T<sub>6</sub> (Vermicompost @ 5 t/ha + Bio fertilizer (Azotobacter) @ 5 kg/ha) (Rs. 165908 ha<sup>-1</sup> and 2.10, net return and benefit cost ration respectively) as represented in table 4. The lowest net returns (Rs. 23889 ha<sup>-1</sup>) and benefit cost ratio (1.44) were recorded under control.

**Table 4:** Impact of different organic manure and bio fertilizers on its economics

Treatments	Cost of Cultivation (Rs/ha)	Gross Income	Net return	B:C
T <sub>0</sub>	54350	78239	23889	1.44
T <sub>1</sub>	146150	253318	107168	1.73
T <sub>2</sub>	140360	266617	126257	1.90
T <sub>3</sub>	130175	220311	90136	1.69
T <sub>4</sub>	150842	314470	163628	2.08
T <sub>5</sub>	148748	302003	153255	2.03
T <sub>6</sub>	151240	317148	165908	2.10
T <sub>7</sub>	151632	319917	168285	2.11

**Note:** Market price (8 Rs/Kg control and 13 Rs/Kg Treated)

### Conclusion

Based on the outcomes obtained from the current research, it concluded that the highest growth, yield and net returns of cauliflower *viz.*, maximum plant height (41.08 cm), maximum plant spread (36.66 cm<sup>2</sup>), maximum no. of leaves (22.08), minimum flowering days (46.97days), maximum leaf area (701.99 cm<sup>2</sup>), highest curd size(150.83 cm<sup>2</sup>), curd weight (981.05 gm) and curd yield per hectare (246.09 q ha<sup>-1</sup>) were observed with the treatment T<sub>7</sub> (Vermicompost @ 5 t/ha+ Bio fertilizer (PSB) @ 5 kg/ha). Highest net returns (Rs 168285) and B: C (2.11) were also found with same treatment. From this research it can be recommended that the application of different organic manures and bio fertilizers will be applied in cauliflower cv. Pusa Snowball to get maximum growth, yield and profit from crop.

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