



Effect of Different Biofertilizers and Organic Manure on Growth and Yield of Cauliflower (*Brassica oleracea* L. var. *botrytis*.) Cv. Pusa Deepali

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was conducted at the Agriculture Research Farm of Rama University, Mandhana, Kanpur, India, during 2024–2025, with the objective of studying the effect of organic fertilizers alone and integrated nutrient management on the growth and yield of cauliflower. The experiment was

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laid out in a Randomized Block Design (RBD) with nine treatments and three replications. Based on the results obtained from the present investigation, it can be concluded that the highest growth and yield parameters including plant height (17.25 cm), number of leaves (15.84), leaf length (18.72 cm), leaf width (15.64 cm), days to first curd emergence (64.22 days), leaf area index (1.88), curd diameter (10.88 cm), root length (16.88 cm), stalk length (10.74 cm), fresh weight of curd (1.32 kg), dry weight of curd (0.316 kg), yield per plot (28.28 kg), curd yield per hectare (276 q/ha), and benefit-cost ratio (1.86) were recorded under Treatment T₅: Farmyard Manure @ 25 t/ha + Biofertilizer (Azotobacter) @ 5 kg/ha. The lowest values of these parameters were observed under the control treatment. Thus, the application of FYM along with biofertilizers is found to be an effective integrated nutrient management strategy for improving cauliflower productivity.

Keywords: Cauliflower; organic manure; biofertilizer; yield; economic.

1. INTRODUCTION

Brassica oleracea var. *botrytis* L., commonly known as cauliflower, has a chromosome number of $2n = 2x = 18$ and belongs to the Cruciferae (Brassicaceae) family, also referred to as the mustard family. Cauliflower originated in the Mediterranean region. The name "cauliflower" is derived from two Latin words: cavolo meaning cabbage and fiore meaning flower. In Hindi, it is commonly known as phoolgobhi. Cauliflower is categorized into four groups based on sowing and maturity period: early, mid-early, mid-late, and late. Climatically, cauliflower is well suited to cool-season cultivation and is relatively resistant to low temperatures, but it is sensitive to adverse conditions such as high temperatures, drought, or extreme cold, which may result in premature curd formation. India is the second-largest producer of vegetables in the world, after China, which recorded a production of 204.61 million metric tonnes (Anonymous, 2022). The edible portion of cauliflower is the curd, which is a pre-floral fleshy apical meristem. It is cultivated for its delicious and nutritious curd, which is widely consumed in salads, cooked vegetables, curries, soups, and pickles. Cauliflower is popular due to its attractive appearance, palatable taste, ease of digestion, nutrient richness, and high productivity. It is an important source of protein, calcium, phosphorus, potassium, sodium, iron, and vitamins. Organic manures and biofertilizers play a crucial role in enhancing soil health and nutrient availability to plants, thereby improving agricultural productivity. Organic manures are considered environmentally friendly and sustainable, as they provide slow-release nutrients and enhance long-term soil fertility (Sastry et al., 2019). Biofertilizers, which are microbial inoculants, assist plant growth by fixing atmospheric nitrogen, solubilizing phosphorus, and improving the availability of nutrients (Sastry et al., 2019). Cauliflower is a nutrient-demanding

crop, especially in terms of nitrogen, phosphorus, and potassium. While chemical fertilizers have traditionally been used to fulfill these requirements (Maggoni et al., 2010), excessive reliance on chemical inputs has led to environmental concerns, soil degradation, and nutrient imbalances. These challenges highlight the need for sustainable nutrient management approaches, such as the combined use of organic manures and biofertilizers, which improve soil fertility, promote healthy plant growth, and enhance yields in an eco-friendly manner (Lim et al., 2013).

2. MATERIALS AND METHODS

The present investigation entitled "Effect of Different Bio-fertilizers and Organic Manures on Growth and Yield of Cauliflower (*Brassica oleracea* L. var. *botrytis*) Cv. Pusa Deepali" was conducted during the Rabi season of 2024–2025 at the Agricultural Research Farm, Faculty of Agricultural Sciences and Allied Industries, Rama University, Mandhana, Kanpur, India. The experiment was laid out in a Randomized Block Design (RBD) with nine treatments and three replications. The treatments consisted of various combinations of organic manures and bio-fertilizers, as outlined below: T₀ – Control, T₁ – Farm Yard Manure (FYM) @ 25 t/ha, T₂ – Vermicompost @ 6 t/ha, T₃ – Bio-fertilizer (Azotobacter + PSB) @ 6 kg/ha, T₄ – FYM @ 25 t/ha + Bio-fertilizer (PSB) @ 6 kg/ha, T₅ – FYM @ 25 t/ha + Bio-fertilizer (Azotobacter) @ 5 kg/ha, T₆ – Vermicompost @ 6 t/ha + Bio-fertilizer (Azotobacter) @ 6 kg/ha, T₇ – Vermicompost @ 6 t/ha + Bio-fertilizer (PSB) @ 6 kg/ha. Healthy seedlings of cauliflower cv. Pusa Deepali, procured from IARI, Pusa, New Delhi, were transplanted on October 5, 2024. Transplanting was done with a spacing of 60 cm between rows and 30 cm between plants, using a hand tool (khurpi). After transplanting, a light irrigation was applied to ensure proper

establishment of the seedlings. Observations were recorded on the following thirteen growth and yield parameters: Plant height (cm), Number of leaves per plant, Leaf length (cm), Leaf width (cm), Leaf area index (LAI), Days to first curd emergence, Curd diameter (cm), Root length (cm), Stalk length (cm), Fresh weight of curd (kg), Dry weight of curd (kg), Curd yield per plot (kg), Benefit-cost ratio (B:C ratio). All the collected data were subjected to statistical analysis using Analysis of Variance (ANOVA) as per the procedure outlined for RBD, and the critical difference (CD) at 5% level of significance was used to compare treatment means.

3. RESULTS AND DISCUSSION

The present investigation clearly demonstrated the significant effect of various combinations of organic manures and bio-fertilizers on the growth and yield attributes of cauliflower (cv. Pusa Deepali).

The maximum plant height (17.25 cm) was recorded in treatment T₅ (FYM @ 25 t/ha + Azotobacter @ 5 kg/ha), followed by T₇ (16.72 cm), T₆ (15.88 cm), and T₄ (15.12 cm), while the minimum plant height (12.88 cm) was observed in control (T₀). These findings are in accordance with Thapa et al. (2023). The highest number of leaves per plant (15.84) was also observed under T₅, followed by T₇ (15.12) and T₆ (14.88), whereas the lowest number (12.94) was recorded under control. Similar observations were reported by Ahmad et al. (2020). Maximum leaf length (18.72 cm) was recorded in T₅, followed by T₇ (17.88 cm) and T₆ (17.22 cm), with the minimum (14.12 cm) in control. These results corroborate the findings of Kabir et al. (2020). Regarding leaf width, T₅ again exhibited the highest value (15.64 cm), followed by T₇ (14.46 cm), while the control recorded the lowest (10.92 cm). This is in line with findings by Kabir

et al. (2020). Days to first curd emergence were significantly lowest (64.22 days) in T₅, followed by T₇ (64.94 days) and T₆ (65.34 days), while the maximum (69.14 days) was observed in control. These results align with Akhter et al. (2019). The leaf area index (LAI) was highest (1.88) under T₅, followed by T₇ (1.68), and the lowest LAI (0.72) was recorded under control, as also noted by Akhter et al. (2019). A significantly higher curd diameter (10.88 cm) was recorded in T₅, followed by T₇ (10.46 cm), while control recorded the lowest (8.42 cm). These findings are in agreement with Kameshwar et al. (2023). In terms of root length, T₅ produced the longest roots (16.68 cm), followed by T₇ (15.84 cm), while control had the shortest roots (10.96 cm), similar to the findings of Kameshwar et al. (2023). The stalk length was also highest in T₅ (10.74 cm), followed by T₇ (10.26 cm), and lowest in control (8.4 cm), corroborating Kabir et al. (2020). The fresh weight of curd was highest in T₅ (1.32 kg), followed by T₇ (1.23 kg), and the lowest (0.65 kg) was observed in the control. These results are consistent with Kameshwar et al. (2023). Similarly, the dry weight of curd was highest in T₅ (0.316 kg), followed by T₇ (0.298 kg), while the control recorded the lowest value (0.148 kg), in line with Akhter et al. (2019). Curd yield per plot was maximum under T₅ (28.28 kg), followed by T₇ (26.32 kg), whereas control recorded the lowest yield (18.24 kg). These findings support the results of Budha et al. (2021). The maximum curd yield per hectare (276 q/ha) was recorded in T₅, followed by T₇ (270 q/ha), and the minimum yield (235 q/ha) in control. Similar trends were reported by Ahmad et al. (2020). Regarding benefit-cost ratio (BCR), the highest value (1.86) was obtained under T₇, which was statistically at par with T₅ (1.80). The lowest BCR (0.70) was noted under control (T₀). This is consistent with the observations of Kumar and Singh (2022).

Table 1. Effect of Bio-Fertilizers and Organic Manures on growth and yield parameters

| S. No. | Plant height (cm) | Number of leaves | Leaf length | Leaf width | Days to first curd emergence | Leaf area index | Curd diameter |
|----------------|-------------------|------------------|-------------|------------|------------------------------|-----------------|---------------|
| T ₀ | 12.88 | 12.94 | 14.12 | 10.92 | 69.14 | 0.72 | 8.42 |
| T ₁ | 13.42 | 13.1 | 14.44 | 11.12 | 68.11 | 0.78 | 8.56 |
| T ₂ | 14.92 | 13.98 | 15.78 | 12.78 | 66.24 | 1.12 | 9.46 |
| T ₃ | 14.56 | 13.76 | 15.32 | 12.24 | 66.78 | 0.86 | 9.12 |
| T ₄ | 15.12 | 14.26 | 16.56 | 13.34 | 65.86 | 1.34 | 9.76 |
| T ₅ | 17.25 | 15.84 | 18.72 | 15.64 | 64.22 | 1.88 | 10.88 |
| T ₆ | 15.88 | 14.88 | 17.22 | 13.89 | 65.34 | 1.52 | 10.14 |
| T ₇ | 16.72 | 15.12 | 17.88 | 14.66 | 64.94 | 1.68 | 10.46 |
| C.D. | 6.54 | 2.858 | 5.186 | 7.215 | 6.533 | 4.532 | 1.563 |
| SEm (±) | 9.54 | 0.457 | 1.274 | 2.125 | 1.575 | 1.335 | 0.542 |

Table 2. Effect of Bio-Fertilizers and Organic Manures on growth and yield parameters

| S. No. | Root length | Stalk length (cm) | Fresh weight of curd (kg) | Dry weight of curd (kg) | Yield per plot (kg) | Curd yield ha (q) | Cost benefit ratio |
|----------------|-------------|-------------------|---------------------------|-------------------------|---------------------|-------------------|--------------------|
| T ₀ | 10.96 | 8.4 | 0.65 | 0.148 | 18.24 | 235 | 0.7 |
| T ₁ | 11.12 | 8.12 | 0.7 | 0.156 | 21.66 | 240 | 0.8 |
| T ₂ | 13.56 | 9.24 | 0.94 | 0.216 | 23.78 | 260 | 1.26 |
| T ₃ | 11.88 | 8.88 | 0.86 | 0.188 | 22.64 | 255 | 0.95 |
| T ₄ | 14.64 | 9.68 | 1.1 | 0.256 | 25.12 | 264 | 1.46 |
| T ₅ | 16.68 | 10.74 | 1.32 | 0.316 | 28.28 | 276 | 1.8 |
| T ₆ | 15.46 | 9.98 | 1.12 | 0.278 | 25.88 | 267 | 1.62 |
| T ₇ | 15.84 | 10.26 | 1.23 | 0.298 | 26.32 | 270 | 1.86 |
| C.D. | 3.527 | 1.442 | 1.112 | 1.442 | 2.461 | 2.654 | 0.652 |
| SEm (±) | 1.543 | 2.165 | 2.232 | 2.854 | 0.514 | 0.577 | 0.545 |

4. CONCLUSION

Based on the results obtained from the present investigation, it can be concluded that the treatment T₅ Farm Yard Manure @ 25 t/ha + Biofertilizer (Azotobacter) @ 5 kg/ha recorded the highest values for key growth and yield parameters of cauliflower (*Brassica oleracea* var. botrytis), cv. Pusa Deepali. These included plant height (17.25 cm), number of leaves (15.84), leaf length (18.72 cm), leaf width (15.64 cm), minimum days to first curd emergence (64.22 days), leaf area index (1.88), curd diameter (10.88 cm), root length (16.88 cm), stalk length (10.74 cm), fresh weight of curd (1.32 kg), dry weight of curd (0.316 kg), yield per plot (28.28 kg), and curd yield per hectare (276 q/ha). Moreover, the benefit-cost ratio (1.86) was also highest under this treatment. Thus, it is recommended that farmers adopt integrated nutrient management involving FYM and biofertilizers like Azotobacter for sustainable and cost-effective cauliflower cultivation, which improves not only yield and quality but also soil health.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc have been used during writing or editing of this manuscript. 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. ChatGPT

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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