Impact of organic manures on the growth and yield of cauliflower

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Abstract Organic manures are made from natural materials such as plant leftovers, manure, and compost. They provide a comprehensive method of enhancing soil. Adding organic matter improves the structure of the soil, encourages microbial activity and releases nutrients gradually. Organic farming produces legume-based cropping systems with decreased carbon and nitrogen losses. This indicates improved soil health, which is essential for healthy cauliflower development. In the Rabi season of 2023–2024, the current experiment, "Impact of organic manures on the growth and yield of cauliflower (*Brassica oleracea var. botrytis*)," was carried out at the Amity Institute of Organic Agriculture (AIOA), Amity University, Sec.126, Noida (U.P.), India. The sandy loam soil in the experimental field has a pH of 8.2, making it rather alkaline in nature. Several nutrients are applied during the trial, including poultry manure, vermicompost, farm yard manure, and azotobacter. The experimental field's structure was established using a Randomized Block Design (RBD) with three replications. Suggested dosage for vermicompost (T2), poultry manure (T3), farm yard manure (FYM) (T1), poultry manure + azotobacter (T4), vermicompost + azotobacter (T5), and control (T6). Findings showed that, in comparison to all other treatments, the treatment of [vermicompost + azotobacter (T4)] produced the highest plant height (36.37 cm), number of leaves (21.00), leaf area (529.42 cm2), curd diameter (19.22 cm), curd weight (1.30 kg), yield per plot (11.50 kg/plot), and total yield (16.43 t/ha).

Keywords : Organic manures, vermicompost, poultry manure, azotobacter.

1 Introduction

One of the most significant winter vegetables among cole crops, Cauliflower (*Brassica oleracea var. botrytis*) is a member of the family Cruciferae and genus Brassica, with chromosomal number 2n = 18. The Latin terms floris (flower) and caulis (cabbage) are the origin of the word "cauliflower. The majority of the governorates in the nation cultivate it. Its composition includes 91.7% water, 4.9 g of carbohydrates, 2.4 g of protein, 78 mg of ascorbic acid, 25 mg of calcium, 56 mg of phosphorus, and a few other significant vitamins and minerals like calcium and iron.

Its origins are in the wild types that may be found in the Mediterranean region, which is where the first cauliflower cultivators found them [1]. About two millennia ago, in ancient Rome, cauliflower is thought to have been first domesticated. Cauliflower, which at this time resembled broccoli more, underwent centuries of slow, selective breeding to become the unique vegetable we know today [2].

Cauliflower and other cultivars belonging to the *Brassica oleracea* species share the species name “oleracea”. To differentiate it from other *Brassica oleracea* kinds, the varietal name “botrytis” refers exclusively to the distinctive structure of the cauliflower head [3].This taxonomy nomenclature captures the genetic and physical traits that distinguish cauliflower as a unique cultivar [4].

Brassica oleracea is further classified into various cultivated groups within the subspecies classification, including the Italica Group (broccoli), the Gemnifera Group (brussels sprouts), and the Botrytis Group (cauliflower) Inomata et al.(1995). Cultivars are the lowest rung of the taxonomic hierarchy, with different types of cauliflower categorized according to characteristics such as color, size, and maturity time [5].

Plant breeding, agricultural techniques, and botanical classification all depend on an understanding of cauliflower taxonomy [6]. This taxonomy is used by scientists and breeders to create better cultivars with desired characteristics, assisting in the sustainable production of cauliflower as a lucrative vegetable crop [7].

Low in calories, cauliflower is primarily composed of carbohydrates as its macronutrient. Cauliflower is a great option for anyone watching their carb consumption because it has a high carb content but a low sugar content [8]. Cauliflower’s high vitamin

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content is one of its nutritional advantages. It has a lot of vitamin C, which is an antioxidant that is very important for collagen synthesis and immune system function. The mineral content of cauliflower is noteworthy, with potassium being one of the main components. The significance of potassium for preserving electrolyte balance and promoting cardiovascular health is examined in the conversation. In addition, the relationship between bone health and the presence of calcium, magnesium, and phosphorus in cauliflower is investigated [9]. Dietary fiber is a crucial part of cauliflower's nutritional profile.

Around the world, cauliflower is essential to cuisines. Because of its versatility, it may be used in a variety of ways, such as mashed or roasted dishes or raw florets in salads. Due to its mild flavor, cauliflower is a flexible component that can be used to improve the texture and nutritional value of a variety of recipes [8]. Because cauliflower is cruciferous, research has indicated that it may help prevent cancer. Sulforaphane, a compound present in cauliflower that has anti-cancer qualities, is one of the compounds being researched for its potential to stop the development of cancer cells, especially those from the prostate and breast. Cauliflower contains a high concentration of phytochemicals, it has anti-inflammatory and antioxidant properties[10].

The crop cauliflower is sensitive to temperature. Cauliflower is cultivated in vast expanses of India with a temperate and humid climate. The many kinds of cauliflower are highly temperature-sensitive. A high temperature at maturity will cause the curds to be green and yellow. For this reason, selecting the right variety to be sowed at the right time is crucial. 10–21°C is the ideal temperature range for seed germination. The ideal temperature range for the crop's growth and curd production is thought to be between 15 and 21°C. An array of factors, including variety, planting date, climate, and growing conditions, can impact the duration of a cauliflower crop. Conversely, cauliflower usually takes 60 to 90 days from planting to harvest [11].

Together, China and India account for over 70% of global cauliflower output, with China being the world's largest producer at 10,263,746 tons annually. Next with 92,35,000 tons annually is India. With a yield of 8,668.2 MT and a productivity of 19.2 MT/Ha, cauliflower is cultivated over an area of approximately 552.6 ha in India (NHB, 2018). India's top vegetable crop, cauliflower, is mostly grown on 4,58,000 hectares of land in the states of Bihar, Uttar Pradesh, Orissa, West Bengal, Assam, Maharashtra, Haryana, and Himachal Pradesh. Its output is 19.13 tons per hectare.

In 2022, 4,81,000 hectares yielded 95,66,000 tons of cauliflower. In 2022, the production of cauliflower was 19.888 kg/ha. In 2022, India exported cauliflower for a total of Rs. 20,442,329 in revenue and 794.65 tons of cauliflower were exported [12].

Chemical fertilizers play a significant role in providing crops with the nutrients they need, but frequent, excessive, and uneven application of these fertilizers degrades the soil's physico-chemical qualities, lowers the quality of the products, and ultimately lowers crop yields. Some crops may yield more when chemical fertilizers are applied extensively at first, but this boost in yield is not sustainable over time. However, the advent of marketable varieties and intensive cultivation systems for agricultural production sustainability has led to an increase in the demand for micronutrients. Using all available techniques, such as chemical, organic, and biological fertilizers, is crucial to maintaining the level of soil fertility. Therefore, it is essential to apply all available nutrient sources in accordance with economic factors and to use chemical fertilizers to augment the crop's required nutritional balance [13].

Organic fertilizers are made from natural materials such as plant leftovers, manure, and compost. They provide a comprehensive method of enhancing soil. Adding organic matter improves the structure of the soil, encourages microbial activity and releases nutrients gradually. By promoting microbial diversity, organic fertilizers help the cycling of nutrients. Organic farming produces legume-based cropping systems with decreased carbon and nitrogen losses. This indicates improved soil health, which is essential for healthy cauliflower development [14]

The study's most important component is the comparison of the nutrients found in chemical and organic fertilizers. Rich in a variety of nutrients, organic fertilizers help to provide soil with a more balanced nutrition. On the other hand, chemical fertilizers might not contain the organic matter needed to strengthen the soil's structure. Organic fertilizers support steady nutrient release, which promotes steady and slow plant growth. Chemical fertilizers cause faster initial growth responses because of their rapid nutrition availability. However, recognizing the long-term benefits linked with organic fertilizers is vital for sustainable cauliflower cultivation [15].

Costs, yields, and long-term sustainability are all taken into account when evaluating economic viability. Chemical fertilizers could initially appear to be more affordable, but their long-term effects on soil health could have an adverse influence on the viability of the economy as a whole. Despite requiring larger initial outlays, organic fertilizers support robust and sustainable agricultural systems.

The current study on the "Impact of organic manures on growth and yield of cauliflower" was directed by the following objective – To study the impact of organic manures on growth and yield of cauliflower.

2 Materials and Methods

The current study, "Impact of organic manures on the growth & yield of cauliflower," was carried out in the Rabi season of 2023–2024. This chapter provides details on the instruments and methods utilized in the experiment.

2.1 Location

This experiment was conducted in the Amity University Organic Farm in Noida, Uttar Pradesh, which is located at 28.5440° N and 77.3330E longitudes. The experiment was conducted at an altitude of 200 meters above sea level during the Rabi season of 2023–2024.

2.2 Climate

The climate in Noida, which is in Uttar Pradesh, India, is semi-arid and subtropical, with hot, dry summers and cold winters. The area is inside the agroclimatic zone known as the "Trans-Gangetic plains". The warmest months are May and June, when maximum temperatures usually range from 40°C to 45°C.January usually has minimum temperatures between 4°C and 7°C, making it the coldest month. It gradually rises from February to June and then starts to gradually decrease as the south-west monsoon approaches. Over the course of the experiment, the mean highest temperature was 35.21°C, and the mean lowest temperature was 23.74°C. The monsoon brought approximately 141.26 mm of rain. There was about 4.0 hours of sunshine on average every day. The mean relative humidity (RH) was 60.5% for the experiment.

3 Results and discussion

This chapter presents the experimental results of the current study, "Study on impact of biofertilizers on the growth and yield of cauliflower," which was conducted at the Amity Institute of Organic Agriculture Farm, Amity University Noida, Uttar Pradesh, during the Rabi season of 2023 to 2024 to assess the impact of biofertilizers on cauliflower variety with regard to growth and yield parameter.Results have been statistically examined, clarified, and presented with the appropriate tables and graphs added as needed.

3.1 Growth parameters

The crop's key growth parameters, including as plant height, leaf count, curd diameter, and leaf area, were monitored by me. These measures were taken at various stages of the crop's growth in addition to before the crop was harvested.

3.1.1 Plant height (cm)

Plant height is the most significant element in crop growth. The plant height at 30 DAT, 45 DAT, and 60 DAT was measured in order to ascertain the effects of the different treatments, both alone and in combination, on development of the crop.

There were significant differences in plant height, as indicated by the data in Table 1 and Fig.1. Treatment T4 (Vermicompost + azotobacter) significantly raised the plant height at 30 DAT (25.32 cm) compared to other treatments, while Treatment T6 (control) significantly decreased it (20.51 cm).

There were significant differences in plant height, as indicated by the data in Table 1 and Fig.1. At 45 DAT, the treatment T4 (Vermicompost + azotobacter), which was comparable to the other treatments, had the highest plant height (31.63 cm), whereas the treatment T6 (control) had the lowest (26.03 cm) of all the treatments.

There were significant differences in plant height, as indicated by the data in Table 1 and Fig.1. Treatment T4 (Vermicompost + azotobacter) significantly increased plant height at 60 DAT (36.37 cm) compared to other treatments, while Treatment T6 (control) significantly decreased it (31.11 cm).

Table 1 Plant height (cm) of cauliflower at different growth stages as influenced by different treatments

Tr. No.	Treatments	Plant height (cm) at		
		30DAT	45DAT	60DAT
T1	Farm Yard Manure	21.75	27.44	32.58
T2	Vermicompost	22.63	28.78	33.71
T3	Poultry Manure	23.50	29.63	34.50
T4	Vermicompost + Azotobacter	25.32	31.63	36.37
T5	Poultry Manure + Azotobacter	24.23	30.51	35.56
T6	Control	20.51	26.03	31.11
	CD %	0.10	0.06	0.10
	SEm	0.03	0.02	0.03

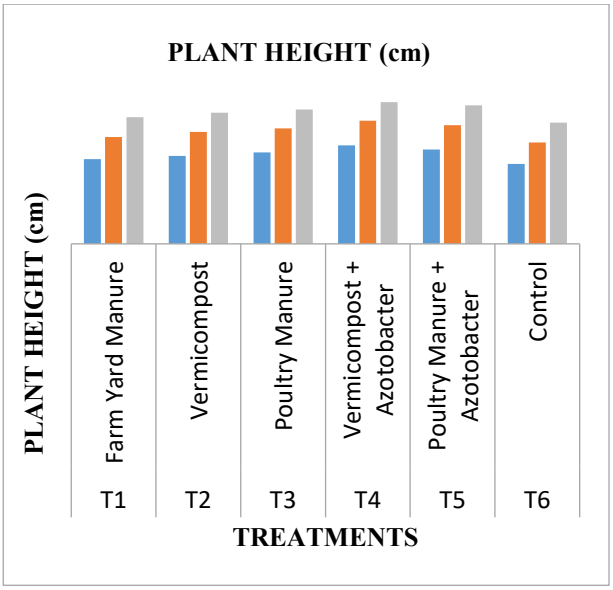

Fig. 1 Effect of different treatments on plant height of cauliflower

3.1.2 *Number of leaves per plant*

The number of leaves on each plant was counted at 30 DAT, 45 DAT, and 60 DAT . It was found that both organic manures and biofertilizers, either used separately or in combination, had an effect on the number of leaves per plant.

When it came to the number of leaves per plant at 30 DAT, there were noticeable variations across all treatments. Treatment T4 (Vermicompost + Azotobacter) had the most leaves (9.00) of all the treatments, while Treatment T6 (Control) had the fewest leaves (6.00).

The number of leaves per plant varied significantly across all treatments at 45 DAT. T4 (Vermicompost + Azotobacter) had the highest number of leaves (15.00), whereas T6 (control) had the lowest number of leaves (9.31).

A notable variation was also seen at 60 DAT in the number of leaves per plant for each treatment. T4 (Vermicompost + Azotobacter) had the most leaves (21.00) of all the treatments, while T6 (Control) had the fewest leaves (15.62).

Table 2 Number of leaves per plant of cauliflower at different growth stages as influenced by different treatments

Tr. No.	Treatments	Number of leaves per plant at		
		30DAT	45DAT	60DAT
T1	Farm Yard Manure	7.33	10.50	17.31
T2	Vermicompost	6.62	10.00	16.00
T3	Poultry Manure	7.66	11.33	17.67
T4	Vermicompost+ Azotobacter	9.00	15.00	21.00
T5	Poultry Manure + Azotobacter	8.00	12.00	18.00
T6	Control	6.00	9.31	15.62
	CD %	0.03	0.01	0.03
	SEm	0.01	0.003	0.01

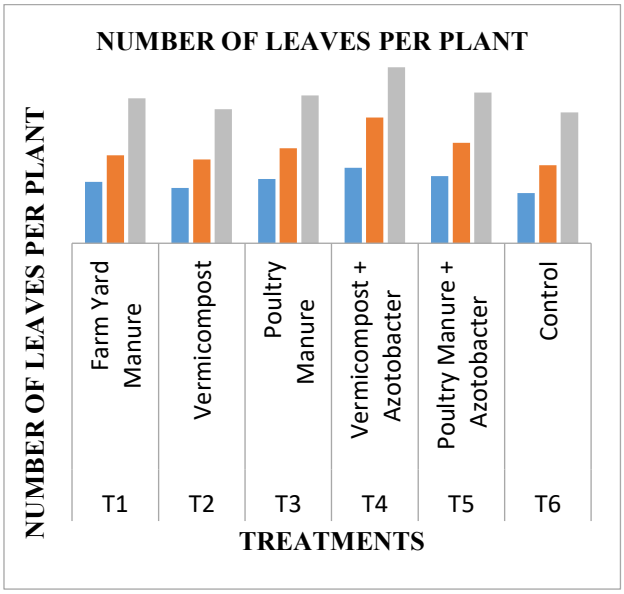

Fig. 2 Number of leaves per plant of cauliflower at different growth stages influenced by treatment

3.1.3 *Curd diameter (cm)*

In this study, the application of biofertilizers to organic manures affected the number of branches per plant, which was measured by counting the curd diameter of each plant at 45 DAT and 60 DAT respectively.

Significant differences in the curd diameter per plant were seen across all treatments at 45 DAT. Out of all the treatments, treatment T4 (vermicompost + azotobacter) had the highest curd diameter per plant (10.78 cm), while treatment T6 (Control) had the lowest curd diameter per plant by a significant margin (6.38 cm). Significant differences were also seen between treatments in the curd diameter per plant at 60 DAT. The curd diameter per plant for treatment T4 (vermicompost + azotobacter) was the biggest of all the treatments, measuring (19.22 cm), whereas the curd diameter per plant for treatment T6 (control) was significantly smaller, measuring (15.39 cm).

Table 3 Curd diameter (cm) of cauliflower as influenced by different treatments

Tr. No.	Treatments	Curd diameter (cm)	
		45 DAT	60 DAT
T1	Farm Yard Manure	8.00	17.00
T2	Vermicompost	7.40	16.33
T3	Poultry Manure	8.51	17.65
T4	Vermicompost + Azotobacter	10.78	19.22
T5	Poultry manure + Azotobacter	9.72	18.27
T6	Control	6.38	15.39
	CD %	0.17	0.22
	SEm	0.05	0.07

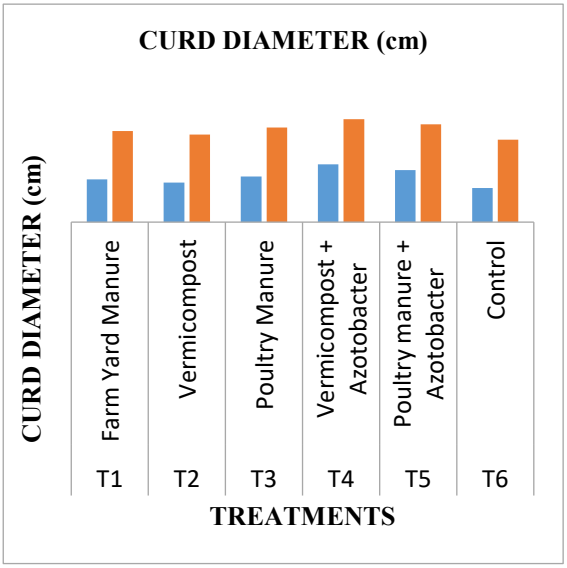

Fig. 3 Curd diameter (cm) of cauliflower influenced by the different treatments

3.1.4 *Leaf area (cm²)*

Table 4 shows the data about the mean leaf area of cauliflower acquired from various treatments. Figure 4 shows how it is shown graphically. At 30, 45, and 60 DAT, T4 (including Vermicompost + Azotobacter) had the highest leaf area per plant (186.39, 352.63, & 529.42 cm^2), followed by T5 (163.85, 343.37, & 509.93 cm^2) and T3 (152.59, 340.57, & 502.59 cm^2). The control treatment T6 yielded the minimum leaf area measurements of 132.40, 293.06, and 447.27 cm^2).

Table 4 Leaf area (cm^2) of cauliflower as influenced by different treatments

Tr. No.	Treatments	Leaf area per plant at		
		30 DAT	45 DAT	60 DAT
T1	Farm Yard Manure	150.63	326.82	487.69
T2	Vermicompost	170.08	314.57	478.03
T3	Poultry Manure	152.59	340.57	502.59
T4	Vermicompost + Azotobacter	186.39	353.63	529.42
T5	Poultry Manure + Azotobacter	163.85	343.37	509.93
T6	Control	132.40	293.06	447.27
	CD %	0.33	0.28	0.43
	SEm	0.11	0.09	0.14

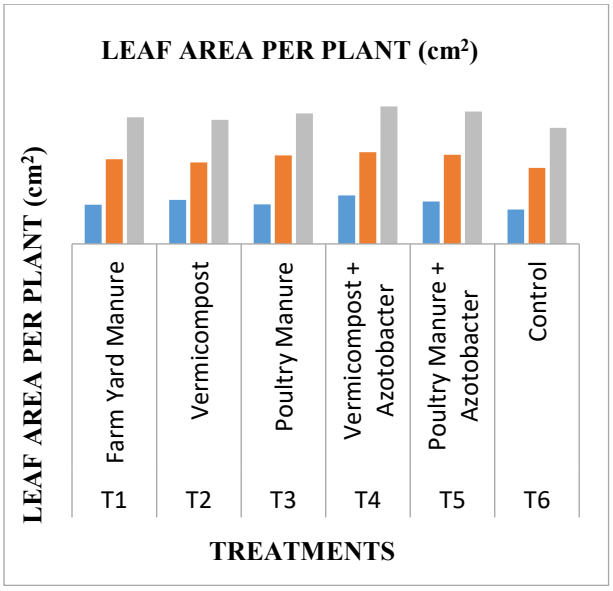

Fig.4 Leaf area (cm^2) of cauliflower influenced by the different treatments

3.2 Yield parameters

3.2.1 *Fresh weight of curd (kg)*

Fresh weight of the cauliflower curd was measured treatment-wise, and Table 5 displays the results of statistical analysis. The data clearly shows that T4 having (Vermicompost + Azotobacter) had the largest fresh weight of curd, which was found to be 1.30 kg. For the second and third most significant treatments, the maximum fresh weight of curd was reported at 0.95 kg for T5 (Poultry manure + Azotobacter) and 0.80 kg for T3 (Poultry manure). The combination of the organic fertilizers produced values that were all confirmed to be statistically equal. The control treatment T6 produced the least amount of fresh curd (0.43 kg), which was followed by T2 and T1 (0.68 to 0.54 kg).

Table 5 Fresh weight of curd (kg) of cauliflower as influenced by different treatments

Tr. No.	Treatments	Fresh weight of curd (kg)
T1	Farm Yard Manure	0.54
T2	Vermicompost	0.68
T3	Poultry Manure	0.80
T4	Vermicompost + Azotobacter	1.30
T5	Poultry Manure + Azotobacter	0.95
T6	Control	0.43
	CD %	0.01
	SEm	0.003

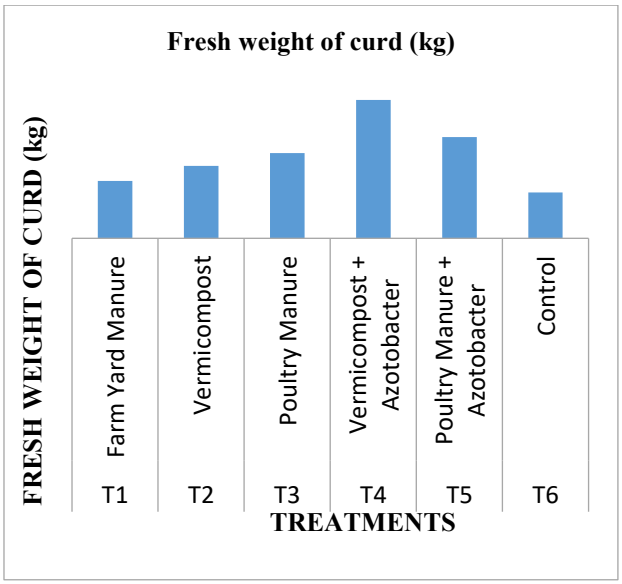

Fig. 5 Fresh weight of curd (kg) of cauliflower influenced by the different treatments

3.2.2 *Yield per plot (kg)*

Applying several treatments resulted in a notable divergence from this parameter. In terms of yield per plot (11.50 kg/plot), T4 (Vermicompost + Azotobacter) was shown to be the best treatment out of all of them. Additionally, it was discovered that T4, T5, and T2 were superior treatments. T2 and T5 (8.65 kg/plot and 9.53 kg/plot) came in close succession after this. The net yield per plot in the control treatment T6 was just (6.11 kg/plot), which was a significantly lower amount. Table 6 and Fig. 6 provide a graphic representation of the mean values.

Table 6 Yield per plot (kg/plot) of cauliflower as influenced by different treatments

Tr. No.	Treatments	Yield per plot (kg/plot)
T1	Farm Yard Manure	7.17
T2	Vermicompost	8.65
T3	Poultry Manure	7.95
T4	Vermicompost + Azotobacter	11.50
T5	Poultry Manure + Azotobacter	9.53
T6	Control	6.11
	CD %	0.49
	SEm	0.16

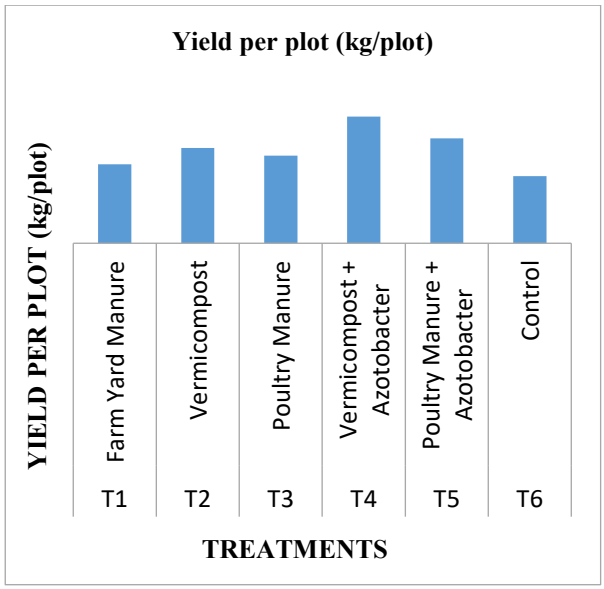

Fig. 6 Yield per plot (kg/plot) of cauliflower influenced by the different treatments

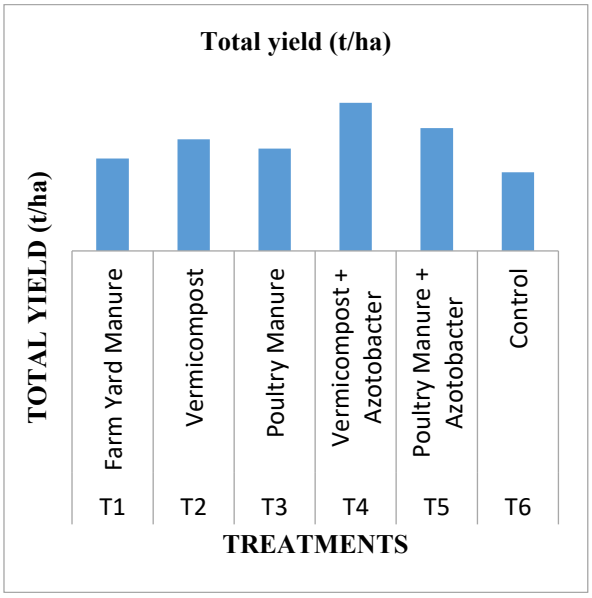

Fig. 7 Total yield (t/ha) of cauliflower influenced by the different treatments

3.2.3 *Total yield (t/ha)*

When comparing the T4 treatment with (Vermicompost + Azotobacter) to all other treatments, the curd production was found to be significantly greater (16.43 t/ha). But with a yield of (13.62 t/ha), the second-best treatment was T5, which included (Poultry manure + Azotobacter). The control treatment T6 had the lowest yield (8.73 t/ha).

Table 7 Total yield (t/ha) of cauliflower as influenced by different treatments

Tr. No.	Treatments	Total yield (t/ha)
T1	Farm Yard Manure	10.24
T2	Vermicompost	12.36
T3	Poultry Manure	11.36
T4	Vermicompost + Azotobacter	16.43
T5	Poultry Manure + Azotobacter	13.62
T6	Control	8.73
	CD %	0.70
	SEm	0.23

4 Conclusion

The results of this study along with the agro climatic traits of Noida, Uttar Pradesh, suggest that cultivating the cauliflower cultivar (*Brassica oleracea var botrytis*) with vermicompost + azotobacter will yield more crop production per hectare and more robust plants than cultivating it with other organic manures and biofertilizers.

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