

Influence of Enriched Organic Manures and Bio-enhancer on Growth and Yield of Cauliflower (*Brassica oleracea* var. *botrytis*)

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ABSTRACT: Conventional farming had a negative impact on soil and plant health. The more use of chemical fertilizers has long-term consequences on soil health, beneficial soil microorganisms and human beings. Therefore, the present investigation entitled “Influence of enriched organic manures and bio-enhancer on growth and yield of cauliflower (*Brassica oleracea* var. *botrytis*)” was carried out during *rabi* season, 2020 at College Farm, College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Dist. Mehsana, Gujarat. An experiment was laid out in randomized block design with factorial concept with three replications comprised of two factors *viz.*, different organic manures with six level *i.e.* 80% RDN through FYM (o₁), 80% RDN through Poultry manure (o₂), 80% RDN through Vermicompost (o₃), 60% RDN through FYM (o₄), 60% RDN through Poultry manure (o₅) and 60% RDN through Vermicompost (o₆) and bio-enhancer with two level *i.e.* NPK consortium @ 5 lit/ha (f₁) and Ghan-Jeevamrut @ 250 kg/ha (f₂). Among different application of organic manures, 80% RDN through Vermicompost performed significantly superior over other treatment with respect to plant height (30.29 cm), number of leaves per plant (15.80), plant spread of North-South (34.72 cm) and East-West (34.44 cm) at harvest, day taken to curd initiation (39.07) and day taken to curd harvesting (56.57), fresh weight of curd (206.90 g), yield per plot (3.30 kg) and yield per hectare (152.93 q). Among different bio-enhancer, NPK consortium @ 5 lit/ha was found significantly superior with respect to plant height at harvest (27.94 cm), fresh weight of curd (196.10 g), yield per plot (3.13 kg) and yield per hectare (144.91 q). The interaction effect of both organic manures and bio-enhancer found superior with application of 80% RDN through Vermicompost and NPK consortium @ 5 lit/ha with regards to plant height at harvest (33.21 cm), fresh weight of curd (241.63 g), yield per plot (3.85 kg) and yield per hectare (178.40 q).

Keywords: Organic manures, Bio-enhancer, NPK consortium, cauliflower.

INTRODUCTION

Cauliflower (*Brassica oleracea* var. *botrytis* L.) is one of the most popular cruciferous vegetable crops. It is originated from Mediterranean region with chromosome number 2n=18. It is introduced in India in 1822 from England by Dr. Jemson during the period of the East India company (Swarup and Chatterjee 1972). Generally, the white flesh is eaten and called "curd". Cauliflower is primarily grown for consumption as a vegetable eaten after bowel or steaming or drying as pickling and it has anti-cancer property also and protects against bowel cancer due to presence of indol-3-Corbinol with anti-inflammatory properties due to its omega-3 and vitamin K. Globally cauliflower is growing in United States, France, Italy, India and China. In India, Cauliflower is cultivated in almost all the states, but the main states are West Bengal, Madhya Pradesh, Bihar, Odisha, Haryana, Gujarat, Jharkhand, Assam and Uttar Pradesh. In India, the area under cultivation of the cauliflower is 4,73,000 ha with an

annual production of 92,83,000 MT and productivity is only 19.63 MT/ha (Anon., 2022a). In Gujarat, the area under cultivation of cauliflower is 34,805 ha with an annual production of 7,70,777 MT and productivity is 22.15 MT/ha. In Gujarat, mainly it is cultivated in Sabarkantha, Vadodara, Kheda, Banaskantha, Gandhinagar and Rajkot district. It is mainly grown in late *kharif* and *rabi* season (Anon., 2022b).

The use of chemical fertilizer in disorganized manner causes serious environmental degradation and also increasing cost of the fertilizer is biggest constraint for the farmers. To overcome these problems alternative sources for fertilization are organic manures and bio-enhancer. The application of organic manure can improve the yield as well as keep the environment sound (Dhakal *et al.*, 2016). Generally, bulky organic manure has low concentrated nutrient and release nutrient slowly at initial stages, which may cause significantly reduction in crop yields and farm income. This can be overcome by enrichment of organic manure with beneficial microbial cultures (Jacob and Banerjee

2016). Vermicompost are products derived from the accelerated biological degradation of organic wastes by earthworms and microorganisms. Vermicompost is greatly humified through the fragmentation of the parent organic materials by earthworm sand colonization by microorganisms. Poultry manure is also an effective and exceptional source of organic fertilizer which contains high percentage of nitrogen, phosphorus, potassium and other important nutrients readily available for plant uptake as compared to other organic sources.

Biofertilizers are natural products containing living microorganisms derived from the roots or cultivated soil. These microorganisms play a crucial role in atmospheric nitrogen fixation and phosphorus solubilization. They also contribute to stimulating the production of plant growth hormones, leading to enhanced nutrient uptake and increased tolerance moisture stress. As a result, biofertilizers promote plant growth and overall crop productivity while reducing the need for expensive agrochemicals, thus reducing input costs in organic farming (Nehra and Choudhry 2015; Mir *et al.*, 2023; Sonkamble *et al.*, 2022). NPK Consortium contains five strains of agriculturally beneficial microorganism (two nitrogen fixer, two phosphate solubilizers and one potash mobilizer) is the one-time solution for all the macronutrients (N, P, K) requirement of crops. NPK Consortium contains *Azotobacter chroococcum* (ABA-1), *Azospirillum lipoferum* (ASA-1), *Bacillus coagulans* and two *Bacillus* spp. This formulation also provides additional benefits of protecting plant from phytopathogenic fungi and nematodes. Ghanjeevamrut is a solid form of

Jeevamrut, which is commonly prepared by farmers in areas where water availability is limited. It is typically produced by enriching liquid jeevamrut with Farm Yard Manure (FYM). The use of ghanjeevamrut in organic farming has demonstrated significant cost reduction compared to chemical farming, primarily due to the elimination of expensive agrochemicals from the farming process. Keeping all these in mind, a study on influence of enriched organic manures and bio-enhancer on growth and yield of cauliflower was conducted.

MATERIALS AND METHODS

An experiment was conducted at College Farm, College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Dist. Mehsana, Gujarat during *rabi*, 2020. The experiment was laid out in randomized block design with factorial concept with 12 treatment combinations and three replications.

Treatment details are as under:

Enriched Organic manures (O)
80% RDN through FYM (o ₁)
80% RDN through Poultry manure (o ₂)
80% RDN through Vermicompost (o ₃)
60% RDN through FYM (o ₄)
60% RDN through Poultry manure (o ₅)
60% RDN through Vermicompost (o ₆)
Bio-enhancer (F)
NPK consortium @ 5 lit/ha (f ₁)
Ghan-Jeevamrut @ 250 kg/ha (f ₂)

Treatment combination are as under:

Treatments combination	Treatment combinations
o ₁ f ₁	80% RDN through FYM enriched with NPK consortium @ 5 lit/ha
o ₁ f ₂	80% RDN through FYM enriched with Ghan-Jeevamrut @ 250 kg/ha
o ₂ f ₁	80% RDN through Poultry manure enriched with NPK consortium @ 5 lit/ha
o ₂ f ₂	80% RDN through Poultry manure enriched with Ghan-Jeevamrut @ 250 kg/ha
o ₃ f ₁	80% RDN through Vermicompost enriched with NPK consortium @ 5 lit/ha
o ₃ f ₂	80% RDN through Vermicompost enriched with Ghan-Jeevamrut @ 250 kg/ha
o ₄ f ₁	60% RDN through FYM enriched with NPK consortium @ 5 lit/ha
o ₄ f ₂	60% RDN through FYM enriched with Ghan-Jeevamrut @ 250 kg/ha
o ₅ f ₁	60% RDN through Poultry manure enriched with NPK consortium @ 5 lit/ha
o ₅ f ₂	60% RDN through Poultry manure enriched with Ghan-Jeevamrut @ 250 kg/ha
o ₆ f ₁	60% RDN through Vermicompost enriched with NPK consortium @ 5 lit/ha
o ₆ f ₂	60% RDN through Vermicompost enriched with Ghan-Jeevamrut @ 250 kg/ha

Required quantity of different organic manures enriched with required quantity of different liquid organic substances as per treatment, which is given before 10 days of transplanting. Made twelve different heaps of organic manure with required quantity as per

treatment in the shade. Required quantity of liquid organic substances added in the heaps as per treatment and then mixed well. Covered the heaps with shade net and provided sufficient watered to maintained heaps wet.

Percentage of nitrogen available in organic manures.

Sr. No.	Organic manure	Nitrogen (%)
1.	FYM	0.49
2.	Poultry manure	2.91
3.	Vermicompost	1.17

Quantity of NPK consortium and Organic manures as per treatment.

Sr. No.	Bio-enhancer and organic manure	Per plot	Per hectare
1.	NPK consortium	2.43 ml	5 lit.
2.	Ghanjeevamrut	121.5 g	250 kg
3.	FYM	7.94 kg (80% RDN)	16326 kg (80% RDN)
		5.95 kg (60% RDN)	12244 kg (60% RDN)
4.	Poultry manure	1.34 kg (80% RDN)	2749 kg (80% RDN)
		1.00 kg (60% RDN)	2062 kg (60% RDN)
5.	Vermicompost	3.32 kg (80% RDN)	6838 kg (80% RDN)
		2.49 kg (60% RDN)	5128 kg (60% RDN)

All cultural practices were followed regularly during crop growth and observations were recorded on growth characters *i.e.*, plant height at harvest (cm), number of leaves per plant at harvest, plant spread at harvest (cm), day taken to curd initiation, day taken to curd harvesting, fresh weight of curd (g), yield per plot (kg) and yield per hectare (q). The data on these parameters were subjected to statistical analysis to draw logical conclusions.

RESULTS AND DISCUSSION

The biometrical characters of cauliflower crop like plant height, number of leaves per plant and plant spread at harvest, day taken to curd initiation and day taken to curd harvesting as well as yield parameters like fresh weight of curd (g), yield per plot (kg) and yield per ha (q) were observed.

A. Influence of organic manures on growth parameters of cauliflower

The differences in growth parameters *viz.*, plant height, number of leaves, plant spread, curd initiation and curd harvesting due to effect of organic manure were found significant. The results indicated that (Table 1) significantly highest plant height (30.29 cm), number of leaves (15.80), plant spread at North-South (34.72 cm) & East-West (34.44 cm) with minimum days taken for curd initiation (39.07) and curd harvesting (56.57) were found significantly better with the treatment o_3 (80% RDN through Vermicompost). It might be due to better availability of mineral elements contents and also their available forms and growth promoting substance in vermicompost which might have resulted in more and more growth of plant due to cell division and elongation which increases plant height, number of leaves and plant spread (Edwards *et al.*, 2011). Similar result was found in Meena *et al.* (2017); Atal *et al.* (2019) in broccoli, Narayan *et al.* (2018); Ibrahim *et al.* (2018) in Chinese cabbage, Sonkamble *et al.* (2022) in watermelon. This treatment also decreases the day taken to curd initiation due to the more mineral elements contents and also their available forms in vermicompost (Atal *et al.*, 2019). Further presence of growth promoting substance in vermicompost might

have caused cell elongation and cell multiplication which increase growth of plant than other organic manure (Edwards *et al.*, 2011). Days taken to curd initiation was significantly impacted the day taken to curd maturity in cauliflower by the application of vermicompost (Sharma, 2019).

B. Influence of bio-enhancer on growth parameters of cauliflower

The differences in growth parameter *viz.*, plant height at harvest due to effect of bio-enhancer was found significant. The data indicated that (Table 1) significantly highest plant height (27.94 cm) was recorded in treatment f_1 (NPK consortium @ 5 lit/ha) and minimum plant height at harvest (26.48 cm) was recorded under the treatment f_2 (Ghan-Jeevamrut @ 250 kg/ha). It might be due to application of NPK consortium may supply all major macronutrients which ultimately increased plant height. However, bio-enhancer treatment failed to influence significant effect on other growth parameters.

C. Interaction effect of organic manure and bio-enhancer on growth parameters of cauliflower

Significantly maximum plant height at harvest (33.21 cm) was recorded in treatment combination of o_3f_1 (80% RDN through Vermicompost enriched with NPK consortium @ 5 lit/ha) and minimum plant height at harvest (23.88 cm) was recorded in treatment combination of o_4f_2 (60% RDN through FYM enriched with Ghan-Jeevamrut @ 250 kg/ha). It might be due to vermicompost with the NPK consortium enhanced the activities of soil microorganisms and increase of humidification of both native and added nutrient in soil (Kale *et al.*, 1992; Devi *et al.*, 2017). Superiority of vermicompost over other organic manures may also be attributed to its more mineral elements contents and also their available forms and growth promoting substance that might have caused cell elongation and cell multiplication (Edwards *et al.*, 2011). Similar result was also reported by Devi *et al.* (2017), Ibrahim *et al.* (2018); Narayan *et al.* (2018) in chinese cabbage, Meena *et al.* (2017) in broccoli and Gangadhar *et al.* (2020) in chilli.

Table 1: Influence of organic manures and bio-enhancer on growth parameters at harvest.

Treatments	Plant height (cm)	No. of leaves per plant	Plant spread (cm)		Day taken to curd initiation	Day taken to curd harvesting
			N-S	E-W		
o ₁	29.52	15.25	34.12	32.36	40.60	58.97
o ₂	28.00	15.00	32.66	31.63	40.98	59.98
o ₃	30.29	15.80	34.72	34.44	39.07	56.57
o ₄	25.00	14.15	31.13	30.59	41.37	62.15
o ₅	24.52	13.57	30.50	30.19	42.02	63.13
o ₆	25.95	14.47	31.81	31.18	42.10	60.32
S.Em. ±	0.758	0.404	0.989	0.934	0.681	1.223
C.D. at 5 %	2.22	1.19	2.90	2.74	2.00	3.59
f ₁	27.94	14.54	32.93	32.00	40.79	60.14
f ₂	26.48	14.87	32.05	31.46	41.25	60.23
S.Em. ±	0.438	0.234	0.571	0.539	0.393	0.706
C.D. at 5 %	1.28	NS	NS	NS	NS	NS

D. Influence of organic manures on yield parameters of cauliflower

The differences in yield parameters viz., fresh weight of curd (g), yield per plot (kg) and yield per hectare (q) due to the effect of organic manure were found significant. Maximum fresh weight of curd (206.90 g), yield per plot (3.30 kg) and yield per hectare (152.9 q) were influenced by organic manures and found significantly better with treatment O₃ (80% RDN through Vermicompost).

E. Influence of bio-enhancer on yield parameters of cauliflower

The differences in yield parameters viz., fresh weight of curd (g), yield per plot (kg) and yield per hectare (q) due to effect of bio-enhancer was found significant. The data was indicated that (Table 2) significantly highest fresh weight of curd (196.10 g), yield per plot (3.13 kg) and yield per hectare (144.91 q) were recorded in treatment f₁ (NPK consortium @ 5 lit/ha), whereas minimum plant height at harvest (cm) was recorded under the treatment f₂ (Ghan-Jeevamrut @ 250 kg/ha).

F. Interaction effect of organic manure and bio-enhancer on yield parameters of cauliflower

Significantly maximum fresh weight of curd (241.63 g), yield per plot (3.85 kg) and yield per hectare (178.40 q)

were recorded in treatment combination of o₃f₁ (80% RDN through Vermicompost enriched with NPK consortium @ 5 lit/ha), whereas minimum plant height at harvest (23.88 cm) was recorded in treatment combination of o₄f₂ (60% RDN through FYM enriched with Ghan-Jeevamrut @ 250 kg/ha) (Table 3). It might be due to beneficial effect of combined use of organic manure with bio-source in cauliflower, reported by Suklabadiya *et al.* (2017); Edwards *et al.* (2011). Increased yield attributes by the inoculation of biofertilizer might due to availability of sufficient amount of nitrogen present in soil and favour large uptake of nutrient to increase metabolism and synthesis of carbohydrates, greater vegetative growth (Sood and Vidyasagar 2007). Similar result found by Sharma (2019), Devi *et al.* (2017); Chetterjee *et al.* (2012) in cabbage, Meena *et al.* (2017); Negi *et al.* (2017); Atal *et al.* (2019) in broccoli, Ibrahim *et al.* (2018); Narayan *et al.* (2018) in chinese cabbage and Gangadhar *et al.* (2020) in chilli. According to Atal *et al.* (2019) was obtained highest weight of curd in broccoli in vermicompost with biofertilizer treatment. Similar result was found by Gangadhar *et al.* (2020) in chilli, Devi *et al.* (2017); Chetterjee *et al.* (2012) in cabbage, Mir *et al.* (2023) in tomato, Suklabaidya *et al.* (2017); Atal *et al.* (2019); Meena *et al.* (2017) in broccoli.

Table 2: Influence of organic manures and bio-enhancer on yield and yield attributes at harvest.

Treatments	Fresh weight of curd (g)	Yield per plot (kg)	Yield per hectare (q)
o ₁	204.10	3.27	151.31
o ₂	199.63	3.17	146.68
o ₃	206.90	3.30	152.93
o ₄	176.05	2.82	130.56
o ₅	164.35	2.64	122.15
o ₆	179.30	2.86	132.48
S.Em. ±	8.708	0.137	6.340
C.D. at 5 %	25.54	0.40	18.59
f ₁	196.10	3.13	144.91
f ₂	180.68	2.89	133.80
S.Em. ±	5.027	0.079	3.660
C.D. at 5 %	14.74	0.23	10.73

Table 3: Interaction effect of organic manures and bio-enhancer on growth and yield attributes at harvest.

Treatments	Plant height (cm)	Fresh weight of curd (g)	Yield per plot (kg)	Yield per hectare (q)
o ₁ f ₁	30.21	215.40	3.45	159.72
o ₁ f ₂	28.82	192.80	3.09	142.90
o ₂ f ₁	28.13	202.80	3.19	147.84
o ₂ f ₂	27.86	196.47	3.14	145.52
o ₃ f ₁	33.21	241.63	3.85	178.40
o ₃ f ₂	27.38	172.17	2.75	127.47
o ₄ f ₁	26.13	175.40	2.81	130.24
o ₄ f ₂	23.88	176.70	2.83	130.87
o ₅ f ₁	24.82	158.00	2.54	117.75
o ₅ f ₂	24.21	170.70	2.73	126.54
o ₆ f ₁	25.17	183.37	2.93	135.49
o ₆ f ₂	26.72	175.23	2.80	129.47
S.Em. ±	1.072	12.315	0.194	8.965
C.D. at 5 %	3.14	36.12	0.57	26.29

CONCLUSIONS

From the field study, it can be concluded that in cauliflower, among different application of organic manures, 80% RDN through Vermicompost increased growth and yield. Similarly, among different bio-enhancer, NPK consortium @ 5 lit/ha can enhanced growth and yield of cauliflower. Further, combined effect of 80 per cent RDN through Vermicompost enriched with NPK consortium @ 5 lit/ha produced the higher growth and yield attributes.

FUTURE SCOPE

In order to increase growth and yield of cauliflower, future studies have to be done further by employing the different organic manures and bio-enhancer treatment in different locality.

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Conflict of Interest. None.

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