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RESEARCH ARTICLE

Effect of different organic nutrient sources on growth, yield and quality of cauliflower and post-harvest available NPK in soil

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Abstract

Field investigation was conducted at Bahadari Farm, College of Horticulture, Mandsaur, during *the Rabi* season 2020-21. Eleven treatments, *viz.,* T_1 - 30 t/ha farmyard manure (FYM), T_2 - 20 t/ha poultry manure (PM), T_3 - 10 t/ha vermicompost (VC), T_4 - 30 t/ha FYM + *Azotobacter* + PSB + KMB, T_5 - 20 t/ha PM + *Azotobacter* + PSB + KMB, T_6 - 10 t/ha VC + *Azotobacter* + PSB + KMB, T_7 - 20 t/ha FYM + *Azotobacter* + PSB + KMB + *Panchagavya* (PG), T_8 - 15 t/ha PM + *Azotobacter* + PSB+ KMB + PG, T_9 - 5 t/ha VC + *Azotobacter* + PSB + KMB + PG, T_{10} - 10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC + *Azotobacter* + PSB + KMB + PG, and T_{11} - RDF-120 kg N + 80 kg P_2O_5 + 60 kg K_2O/ha were laid out in a randomized block design with three replications. Observations were recorded on growth, yield and quality attributes. Findings revealed that the application of 10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC+ *Azotobacter* + PSB + KMB + PG (T_{10}) was superior in terms of growth, yield and quality attributes as well as yield. It had secured highest B:C ratio and, registered a significantly higher NPK content in curd and plant of cauliflower as well as NPK uptake by curd and plant with maximum availability of NPK in soil after harvesting.

Keywords: Cauliflower, organic nutrient sources, growth, yield, quality, NPK, soil

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Introduction

Cauliflower (*Brassica oleracea* var. *botrytis* L.) is a popular cole crop grown in the subtropical and temperate zones of the world. In India, two different groups of cauliflowers, *viz.,* tropical annual Indian cauliflower and temperate cauliflower (commonly known as snowball) types, are grown. The edible part of cauliflower is a cluster of prefloral fleshy apical meristems called a curd, which is used in curries, soups and pickles (Gopalakrishnan, 2007; Singh et al., 2018). The curd is a good source of minerals as well as vitamin A and C (Nath & Swamy, 2016). Nutrition plays a crucial role in determining cauliflower yield, as it is a heavy feeder. A continuous and adequate supply of nutrients is essential for achieving higher yield. Therefore, farmers often apply chemical fertilizers indiscriminately without considering soil nutrient status and crop requirements, which adversely affects soil health and long-term productivity (Basnet & Shakya, 2016). This necessitates the incorporation of organic amendments into cauliflower production systems (Simarmata et al., 2016).

Use of organic manures like farmyard manure, vermicompost and poultry manure in conjunction with biofertilizers such as *Azotobacter*, phosphorus-solubilizing bacteria, potassium-mobilizing bacteria and *Panchagavya* helps in improving the growth and yield of cauliflower and makes it more nutritious. Although the organic manures

contain small quantities of plant nutrients and release them slowly as compared to the fertilizers, the presence of growth-promoting principles like enzymes and hormones, besides plant nutrients, makes them vital for the improvement of soil fertility and productivity (Srimathi, 2015). Despite the well-documented benefits of organic manures and biofertilizers in vegetable production, their integrated effects and optimal combinations, particularly involving multiple organic sources and liquid bioformulations such as *Panchagavya*, remain insufficiently standardized under field conditions. Therefore, the present study was undertaken to evaluate the effect of different organic nutrient sources and their combinations with biofertilizers and *Panchagavya* on growth, yield, quality, and soil nutrient status of cauliflower and to identify the most effective and economically viable nutrient management strategy for sustainable production.

Materials and Methods

The experiment was conducted during the *Rabi* season of 2020-21 at Bahadari Farm, College of Horticulture, Mandsaur, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M. P.). The soil of the experimental site was black, having a clay loam texture with a pH of 7.50, EC 0.18 dSm^{-1} and available N (188.50 kg ha^{-1}), P (26.80 kg ha^{-1}), K (320 kg ha^{-1}). The field experiment was laid out in randomized block design (RBD) with three replications. About 35 day-old, healthy and uniform vigour seedlings with 4 to 5 leaves were transplanted on 13 December 2021 in plots of 2.70 x 2.40 m size at the spacing of 45 x 30 cm. The treatments consisted of T_1 - 30 t/ha farmyard manure (FYM), T_2 - 20 t/ha poultry manure (PM), T_3 - 10 t/ha vermicompost (VC), T_4 - 30 t/ha FYM + *Azotobacter* + Phosphorus solubilizing bacteria (PSB) + Potassium mobilizing bacteria (KMB), T_5 - 20 t/ha PM + *Azotobacter* + PSB + KMB, T_6 - 10 t/ha VC + *Azotobacter* + PSB + KMB, T_7 - 20 t/ha FYM + *Azotobacter* + PSB + KMB + *Panchagavya* (PG), T_8 - 15 t/ha PM + *Azotobacter* + PSB+ KMB + PG, T_9 - 5 t/ha VC + *Azotobacter* + PSB + KMB + PG, T_{10} - 10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC + *Azotobacter* + PSB + KMB + PG, and T_{11} - RDF-120 kg N + 80 kg P_2O_5 + 60 kg K_2O/ha. The calculated quantities of organic manures were applied to the respective plot. The sources of nutrients were farmyard manure (0.6% N, 0.3% P_2O_5, and 0.5% K_2O), vermicompost (1.4% N, 1.0% P_2O_5, and 1.5% K_2O) and poultry manure (2.3% N, 1.2% P_2O_5 and 0.7% K_2O) with bio-fertilizer (*Azotobacter*, PSB and KMB). *Panchagavya* (5%) was applied at 25, 40 and 60 days after transplanting as spray. The full dose of P and K and half dose of N were applied at the time of transplanting and the remaining half dose of N was given in two equal doses at 45 days after transplanting. Other intercultural operations and crop management practices were carried out in accordance with the recommended package of practices. Observations on growth, yield and quality-attributing characters were recorded for each replication of all the treatments during the investigation. The observations recorded for growth, yield and quality-attributing characters *are* plant height (cm) at 30, 45, 60 DAT and at the harvesting stage; number of leaves $plant^{-1}$ at 30, 45, 60 DAT and at harvesting stage, fresh weight of shoot per plant (g) at 30, 45, 60 DAT and at the harvesting stage; fresh weight of shoot per plant (g) at 30, 45, 60 DAT and at the harvesting stage; diameter of curd (cm); curd length (cm); curd yield (g $plant^{-1}$); marketable curd yield (q ha^{-1}), total curd yield (q ha^{-1}); harvest index (%), TSS content, ascorbic acid content; and dry matter content in curd.

Results and Discussion

Growth attributes

The results pertaining to growth parameters of cauliflower, *viz*., plant height, number of leaves per plant, fresh weight of shoot per plant and dry weight of shoot per plant at 30, 45, 60 DAT and at harvesting stage, and days to 50% curd initiation indicated significant influence of different organic nutrient sources as presented in Table 1.

Plant height was recorded at 30, 45, and 60 DAT and at the harvesting stage showed the highest plant height with treatment T_{10} -10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC + *Azotobacter* + PSB + KMB + *Panchagavya*. It was followed by the treatments T_8, T_5 and T_7 in descending order, respectively. The treatment T_1 - 30 t/ha FYM recorded the lowest plant height as compared to the other treatments. It may be due to an increase in plant height by the combined use of FYM, vermicompost and poultry manure with bio-fertilizers which improved the physical, chemical and biological properties of the soil, resulting in increased root growth of plants, leading to increased absorption and efficient translocation of nutrients towards the plant system. Organic manures in conjunction with *Panchagavya* significantly improved the growth of the cauliflower crop in comparison to chemical fertilizers alone. Similar results were also observed by Kumar et al. (2018) and Devkota et al. (2021).

Various organic manures and bio-fertilizers have shown significant effects on the number of leaves per plant at 30, 45, and 60 DAT and at the harvesting stage. The highest number of leaves per plant were recorded under treatment T_{10} -10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC + *Azotobacter* + PSB + KMB + *Panchagavya*. It was followed by treatments T_8, T_5 and T_7. It may be due to rapid cell division, multiplication and cell elongation in the meristematic region of the plant, which promoted vegetative growth as well as the number of leaves. These findings are in agreement with those reported by Devi et al. (2018) and Pal & Bala (2020).

The highest fresh weight and dry weight of shoots per plant was recorded at 30, 45 and 60 DAT and at the harvesting stage with treatment T_{10} - 10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC + *Azotobacter* + PSB + KMB + *Panchagavya*. It was followed by treatments T_8, T_5 and T_7. The minimum fresh weight and dry weight of the shoot were noted with

Table 1: Effect of different organic nutrient sources on growth attributes in cauliflower

Treatment	*Plant height*				*Number of leaves/plants*				*Fresh weight of shoot/plant*				*Dry weight of shoot/plant*				*Day to 50% curd initiation*
	30 DAT	*45 DAT*	*60 DAT*	*Harvest stage*	*30 DAT*	*45 DAT*	*60 DAT*	*Harvest stage*	*30 DAT*	*45 DAT*	*60 DAT*	*Harvest stage*	*30 DAT*	*45 DAT*	*60 DAT*	*Harvest stage*	
T_1	13.71	18.77	30.07	38.41	8.27	10.80	15.87	21.40	43.43	99.8	230.63	751.33	4.50	10.38	22.27	63.48	90.67
T_2	14.66	20.80	33.29	40.78	9.07	11.73	16.80	24.47	52.14	110.44	258.89	839.85	4.96	10.83	24.90	75.53	83.00
T_3	14.34	20.17	31.24	39.10	8.40	11.23	16.13	22.33	45.56	104.36	245.83	821.10	4.55	10.40	22.33	68.51	87.00
T_4	14.48	20.63	31.64	40.25	8.73	11.27	16.20	23.53	48.57	105.49	249.38	828.11	4.58	10.52	23.18	73.18	85.00
T_5	15.89	22.40	34.26	43.63	9.50	13.07	17.60	24.93	61.85	116.91	280.4	899.07	5.28	11.59	26.86	80.54	80.67
T_6	15.52	21.07	33.57	42.12	9.20	12.73	16.93	24.73	58.37	111.93	271.00	874.15	5.18	11.40	25.72	78.09	82.33
T_7	15.75	22.08	34.00	43.10	9.33	12.80	17.40	24.87	59.01	114.89	273.20	893.44	5.25	11.50	25.91	79.23	81.00
T_8	15.90	23.08	34.50	44.19	9.53	13.20	17.93	25.20	64.01	121.35	281.39	901.02	6.06	11.87	26.92	81.92	78.67
T_9	14.88	20.97	33.33	41.83	9.13	12.60	16.87	24.53	54.30	111.29	264.22	870.22	5.01	10.87	24.96	77.76	82.67
T_{10}	17.31	23.22	35.67	44.66	10.47	13.73	18.87	25.33	67.25	125.94	283.94	950.89	6.48	12.65	27.03	84.98	77.00
T_{11}	14.51	20.71	31.95	40.34	9.03	11.33	16.73	24.33	50.08	109.53	258.72	837.32	4.91	10.58	24.68	75.00	83.67
S.Em ±	0.37	0.49	0.58	0.76	0.18	0.28	0.31	0.36	1.42	2.81	6.25	19.64	0.17	0.26	0.61	2.18	1.41
CD 5%	1.08	1.43	1.71	2.25	0.54	0.83	0.92	1.07	4.18	8.29	18.43	57.94	0.50	0.78	1.80	6.44	4.15

treatment T_1. As it is directly associated with the number of leaves and vegetative growth of the plant, the result is in line with expectations. Simarmata et al. (2016), Yassen et al. (2019) and Islam et al. (2020) have also reported significant influence of different organic nutrient sources on fresh weight and dry weight of shoots, indicating that the nutrient sources can greatly affect plant growth and development.

Different organic nutrient sources significantly affected the number of days taken for 50% curd formation. Earliest 50% curd initiation was recorded with treatment T_{10} -10 t/ ha FYM + 5 t/ha PM + 2.5 t/ha VC + *Azotobacter* + PSB + KMB + PG. It was followed by treatments T_8, T_5 and T_7. The maximum days to 50% curd initiation were noted with T_1. Earlier, Chaterjee et al. (2005), Meena et al. (2017) and Lal et al. (2021) have also observed similar results.

Yield parameters and yield

The results (Table 2) on the yield parameters and yield of cauliflower have indicated significant influence of treatments. The diameter of curd (cm) and curd length in cauliflower were observed at the harvesting stage. The different organic manure and bio-fertilizers had a significant impact on the diameter of curd and curd length of cauliflower. The highest curd diameter and curd length was registered in treatment T_{10} (10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC + *Azotobacter* + PSB + KMB + PG), followed by treatments T_8, T_7 and T_5 in decreasing order, respectively. However, the minimum diameter of curd and curd length was measured in treatment T_{11}. This might be due to the increased number of leaves, which might have enabled the accumulation of more carbohydrates, resulting in an increase in curd diameter and curd length. These results are in agreement with the findings of Chand *et al.* (2018) and Devkota *et al*. (2021).

The curd yield per plant was significantly influenced by different organic manure, bio-fertilizers and *Panchagavya*. The maximum curd yield per plant was recorded under treatment T_{10} (10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC + *Azotobacter* + PSB + KMB + *Panchagavya*). It was followed by treatments T_8, T_7 and T_5. The lowest curd yield per plant was obtained under treatment T_{11}. These results are also in line with the findings of Prabhakar et al. (2015), Srimathi (2015) and Pal & Bala (2020). Total curd yield per plot was recorded at the time of harvesting, and it was converted to total curd yield per hectare and analyzed statistically. Different organic nutrient sources had significantly enhanced curd yield. The treatment T_{10} (10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC+ *Azotobacter* + PSB + KMB + *Panchagavya*) was significantly superior as compared to rest of the treatments. It was followed by treatments T_8, T_7 and T_5. The lowest total curd yield was observed under treatment T_{11}. The increase in curd yield per plant ultimately enhanced the total yield which could be attributed to the fact that FYM, VC and PM create favourable conditions for better nutrient absorption

Table 2: Effect of different organic nutrient sources on yield attributes, yield and quality of curd and B: C ratio in cauliflower

Treatment	*Diameter of curd (cm)*	*Curd length (cm)*	*Curd yield (g/ plant)*	*Total curd yield (q/ha)*	*Marketable curd yield (q/ha)*	*Harvesting index (%)*	*TSS (°Brix)*	*Ascorbic acid content (mg/100 g)*	*Dry matter content (%)*	*B:C ratio*
T_1	13.61	7.66	333.88	247.32	205.91	31.06	4.27	62.22	10.21	1.80
T_2	14.69	8.17	356.66	264.19	216.78	29.80	4.63	64.40	10.74	1.86
T_3	14.38	7.71	341.44	252.92	209.61	29.34	4.53	63.29	10.39	1.97
T_4	14.66	8.16	350.55	259.67	215.12	29.75	4.83	65.50	11.13	1.91
T_5	16.61	8.44	379.00	280.74	221.53	29.67	4.97	66.66	11.32	1.89
T_6	15.62	8.38	375.00	277.78	218.90	29.98	4.90	66.63	11.31	2.04
T_7	16.77	8.50	387.30	286.89	224.87	30.22	5.23	68.87	11.52	2.03
T_8	17.94	8.59	411.24	304.62	241.94	31.26	5.70	69.97	11.61	2.04
T_9	15.29	8.27	360.33	266.91	217.37	29.24	5.40	69.93	11.58	2.16
T_{10}	18.49	8.91	451.55	334.48	281.66	32.19	5.73	71.10	12.66	2.94
T_{11}	13.27	7.55	331.22	245.35	175.18	28.41	4.17	62.20	9.83	1.64
S. Em ±	0.53	0.53	9.52	7.05	4.77	0.39	0.17	1.17	0.29	-
CD 5%	1.56	1.56	28.07	20.79	14.06	1.15	0.50	3.45	0.86	-

and favour the growth and development of the root system, which in turn reflects better photosynthetic activity and dry matter accumulation. Consequently, a higher total yield is obtained under the treatments of organic nutrient sources. Prabhakar et al. (2015), Srimathi (2015) and Pal & Bala (2020) corroborate these results.

Organic manures significantly affected the marketable curd yield per hectare. The highest marketable curd yield was noted with treatment T_{10} (10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC + *Azotobacter* + PSB + KMB + PG), followed by treatments T_8, T_7 and T_5. The lowest marketable curd yield was recorded under treatment T_{11}. It may be due to the fact that organic manures, bio-fertilizer (*Azotobacter*, PSB, KMB) and *Panchagavya* ensure more nutrients availability to the plants, improve disease and pest resistance, and are also capable of producing anti-bacterial and anti-fungal compounds, etc., which in turn increases marketable curd among total curd yields. These results are in agreement with Mohanta et al. (2018) and Islam et al. (2020). The highest harvest index, 32.19%, was recorded under treatment T_{10} (10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC + *Azotobacter* + PSB + KMB + PG), which was significantly higher than other treatments. It was followed by treatments T_8, T_1 and T_7. The lowest harvest index of 28.41% was registered with treatment T_{11}. Ola et al. (2019) reported similar observations.

Quality attributes

The results on the quality parameters of cauliflower, *viz*., TSS, ascorbic acid and dry matter content, were recorded at the harvesting stage of cauliflower, and mean values have been presented in Table 2. The total soluble solids and ascorbic acid contents in curd were significantly influenced with application of organic manures and bio-fertilizers. Among the treatments, T_{10} - 10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC + *Azotobacter* + PSB + KMB + *Panchagavya,* resulted in the significantly highest TSS and ascorbic acid content over all other treatments. It was followed by T_8, T_9 and T_7. The treatment T_{11} had recorded significantly lowest TSS and ascorbic acid contents in curd as compared to all the remaining treatments. Chand et al. (2018), Kaur (2020) and Giri (2021) have reported similar findings.

The highest dry matter content in curd was recorded with the treatment T_{10} (10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC+ *Azotobacter* + PSB + KMB + PG), which was significantly higher than other treatments. It was followed by treatments T_8, T_9 and T_7. Treatment T_{11} recorded the lowest dry matter content in curd. This could be explained by the fact that the combined use of FYM, VC and PM with biofertilizers creates favorable conditions for better nutrient absorption. This would have promoted more rapid synthesis of carbohydrates and ultimately more dry matter accumulation in plant organs. These findings are in line with Chand et al. (2018), Mohanta et al. (2018), Kaur (2020) and Giri (2021).

Economics of the treatments

The highest B: C ratio (2.94) was obtained with treatment 10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC+ *Azotobacter* + PSB + KMB + PG (T_{10}). It was followed by treatment T_9 with a 2.16 B: C ratio. Treatments T_8 and T_6 recorded equal B: C ratio. The lowest B: C ratio was registered under T_{11}. Higher yield due to efficient combination for supplying nutrients resulted in increased yield with comparatively lower expenses, which ultimately led to higher net profit and B:C ratio. These findings are in line with those reported by Ola et al. (2019), Islam et al. (2020) and Pal & Bala (2020).

Nutrient content

The result of the nutrient analysis, viz., NPK in plant, curd and soil, was significantly influenced by application of different organic nutrient sources along with bio-fertilizers. The NPK mean values have been presented in Table 3. The application of different organic nutrient sources with bio-fertilizers had exerted significant impact on the NPK content in the plant and curd of cauliflower. The treatment 10 t/ha farmyard manure + 5 t/ha poultry manure + 2.5 t/ha vermicompost + *Azotobacter* + PSB + KMB + *Panchagavya* (T_{10}) had recorded highest NPK content in plant as well as curd. It was followed by treatments T_8, T_7 and T_5. The lowest NPK content in plant and curd was found with treatment T_{11}. The increased availability of macronutrients (N, P and K) in cauliflower plants with the addition of organic nutrients might be due to the acceleration of microbial nitrogen fixation, improved physical condition of soil, root development, more moisture retention and thus increased absorption of water and nutrients. Higher nutrient content in plants might have served as a source which resulted in higher NPK content in curd as a sink. These results are in agreement with the findings of Yassen et al. (2019). Different organic nutrient sources significantly affected the availability of NPK in the soil after harvesting. The treatment 10 t/ha farmyard manure + 5 t/ha poultry manure + 2.5 t/ha vermicompost+ *Azotobacter* + PSB + KMB + *Panchagavya* (T_{10}) had recorded highest available NPK in the soil. It was followed by treatments T_8, T_7 and T_5. The lowest NPK availability was estimated with treatment RDF T_{11}. The combined use of FYM, vermicompost and poultry manure with biofertilizers has a positive effect on microbial activity in the root zone, which decomposes manure and increases nutrient availability in the soil. It also converts unusable mineral nutrients into usable forms in the soil, thereby enhancing plant growth and overall soil fertility. Devi et al. (2018) corroborate these findings.

Various organic nutrient sources had shown significant influence on nutrient uptake by cauliflower plant and curd. Among different treatments, 10 t/ha farmyard manure + 5 t/ha poultry manure + 2.5 t/ha vermicompost+ *Azotobacter* + PSB + KMB + *Panchagavya* (T_{10}) recorded maximum NPK uptake by both curd and plant. It was followed by T_8, T_7 and

Table 3: Effect of different organic nutrient sources on post-harvest available NPK in soil (kg/ha), NPK (%) and nutrient uptake

Treatment	Post-harvest available NPK in soil			NPK content						Nutrient uptake					
				Plant			Curd			Curd			Plant		
	N (kg/ha)	P (kg/ha)	K (kg/ha)	N (%)	P (%)	K (%)	N (%)	P (%)	K (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)	N (kg/ha)	P (kg/ha)	K (kg/ha)
T_1	190.21	27.70	321.68	1.56	0.49	1.49	2.41	0.56	3.10	73.78	17.15	94.62	69.42	20.32	69.16
T_2	203.05	32.10	344.20	1.59	0.54	1.55	2.54	0.58	3.17	98.11	22.75	122.16	87.76	30.03	85.52
T_3	190.33	29.83	331.72	1.57	0.51	1.50	2.48	0.57	3.11	82.37	19.00	105.90	78.71	25.04	76.92
T_4	199.85	31.38	337.56	1.58	0.54	1.54	2.49	0.57	3.13	93.63	21.62	117.23	85.27	27.76	81.90
T_5	207.37	33.67	351.71	1.65	0.55	1.61	2.61	0.61	3.35	106.83	25.11	137.26	96.86	32.50	96.24
T_6	206.64	32.90	349.73	1.64	0.55	1.61	2.58	0.60	3.20	105.50	24.25	130.22	94.73	32.06	94.13
T_7	209.88	33.83	357.33	1.68	0.56	1.62	2.69	0.62	3.40	110.29	25.53	139.91	100.18	33.11	99.24
T_8	214.65	34.87	359.22	1.72	0.58	1.62	2.70	0.66	3.43	113.83	27.62	144.92	104.41	35.44	102.64
T_9	204.05	32.90	346.35	1.63	0.54	1.56	2.57	0.60	3.18	104.69	24.25	127.45	94.40	31.34	93.50
T_{10}	219.64	35.33	360.80	1.76	0.60	1.65	2.72	0.66	3.50	138.33	33.49	177.67	110.93	37.87	107.43
T_{11}	187.66	26.97	313.26	1.48	0.43	1.32	2.37	0.55	3.09	74.19	17.06	91.99	88.66	30.52	88.24
S.Em ±	3.73	1.00	4.14	0.03	0.02	0.03	0.04	0.01	0.06	4.77	1.07	5.32	3.14	0.79	2.77
CD 5%	11.01	2.95	12.21	0.09	0.05	0.10	0.13	0.04	0.17	14.07	3.17	15.69	9.27	2.32	8.18

T_5. The lowest NPK uptake by plants was obtained with T_{11}. However, the least N uptake by curd was recorded from T_{11}, and PK uptake by curd was registered under T_1. These findings are in agreement with Patel et al. (2011) and Nazir et al. (2019).

Conclusion

Findings of the experiment revealed that application of 10 t/ha FYM + 5 t/ha PM + 2.5 t/ha VC+ *Azotobacter* + PSB + KMB + PG (T_{10}) was superior in terms of growth, yield and quality attributes as well as yield of curd and had secured highest net profit as well as the B:C ratio. It had also registered a significantly higher NPK content in curd and plant of cauliflower as well as NPK uptake by curd and plant with maximum availability of NPK in soil after harvesting. Hence, it can be concluded that application of 10 t/ha FYM + 5 t/ha poultry manure + 2.5 t/ha vermicompost+ *Azotobacter* + PSB + KMB + *Panchagavya* (T_{10}) may be advocated for more profitable and commercial cultivation of cauliflower cv. Snowball K-1.

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सारांश

रबी मौसम2020-21 के दौरान, उद्यानिकी महाविद्यालय, मंदसौर के बहादरी फार्म पर एक प्रक्षेत्रीय अनुसंधान किया गया। इसके अंतर्गत ग्यारह उपचारों :टी1 - 30 टन/हे -गोबर की खाद, टी2 - 20 टन/हे -मुर्गी की खाद, टी3- 10 टन/हे -केंचुआ खाद, टी4 - 30 टन/हे -गोबर की खाद+ एजोटोबैक्टर +पीएसबी +केएमबी, टी5 - 20 टन/हे -मुर्गी की खाद + एजोटोबैक्टर + पीएसबी + केएमबी, टी6 - 10 टन/हे -केंचुआ खाद+ +एजोटोबैक्टर +पीएसबी + केएमबी, टी7- 20 टन/हे -गोबर की खाद+ +एजोटोबैक्टर +पीएसबी + केएमबी + पंचगव्य, टी8- 15 टन/हे -मुर्गी की खाद+ एजोटोबैक्टर +पीएसबी + केएमबी+ पंचगव्य, टी9 - 5 टन/हे -केंचुआ खाद+ एजोटोबैक्टर +पीएसबी + केएमबी + पंचगव्य, टी10 - 10 टन/हे -गोबर की खाद5 + टन/हे -मुर्गी की खाद+ + 2-5 टन/हे -केंचुआ खाद+ एजोटोबैक्टर +पीएसबी + केएमबी + पंचगव्य, और टी11 - (अनुशंसित उर्वरक खुराक120 - (किग्रा नत्रजन80 + किग्रा फास्फोरस60 + किग्रा पोटाश प्रति हेक्टेयर, को यादृच्छिक खंड अभिकल्पना के तहत तीन पुनरावृत्तियों में व्यवस्थित किया गया। इसमें पौधों की वृद्धि, उपज और गुणवत्ता संबंधी विशेषताओं पर आधारित प्रेक्षणों को दर्ज किया गया। निष्कर्ष के तौर पर यह पाया गया कि10 टन/हे -गोबर की खाद5 + टन/हे -मुर्गी की खाद2-5 + + टन/हे -केंचुआ खाद+ एजोटोबैक्टर +पीएसबी + केएमबी + पंचगव्य) टी10) का प्रयोग, पौधों की वृद्धि, सर्वाधिक उपज और गुणवत्ता संबंधी मानदंडों पर सबसे बेहतर साबित हुआ। इसके साथ ही, इससे सर्वाधिक शुद्ध लाभ और सबसे अच्छा लाभ-लागत अनुपात प्राप्त हुआ। टी10 उपचार से फूलगोभी के फूल और पौधे में एनपीके की मात्रा में उल्लेखनीय वृद्धि दर्ज की गई, साथ ही फूल और पौधे द्वारा एनपीके का अवशोषण भी अधिक हुआ और कटाई के बाद मिट्टी में एनपीके की अधिकतम उपलब्धता पाई गई। अतः टी10 उपचार बेहतर है और फूलगोभी की स्नोबॉल के1- किस्म की अधिक लाभदायक और व्यावसायिक खेती के लिए इसे अपनाया जा सकता है।