Website : www.asthafoundation.in
Progressive Research : An International Journal
Vol 19 (2) : 146-149 (July-2024), Print ISSN : 0973-6417, Online ISSN : 2454-6003
Society for Scientific Development in Agriculture and Technology, Meerut (U.P.) India

Effect of Organic Manure and NPK on Growth and Yield of Cauliflower (*Brassica oleracea* L. Var. Botrytis)

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Abstract

The field experiment titled "Effect of Organic Manures and NPK on Growth and Yield of Cauliflower (*Brassica oleracea* L. var. *botrytis*) Under Open Field Conditions" was conducted at the Research Farm, Department of Horticulture, Mahatma Gandhi Chitrakoot *Gramodaya* Vishwavidyalaya, Satna, M.P. during the Kharif season of 2022-23. The experiment was arranged in a randomized block design with twelve treatments and three replications. Results indicated that varying levels of organic manures and NPK significantly enhanced growth and yield. Treatment T12 (50% FYM + 50% Vermicompost) achieved the highest values in all growth parameters, including plant height (51.45 cm), number of leaves per plant (18.25) and root length (22.52 cm). Yield parameters such as curd diameter (43.82 cm), average curd weight (0.521 kg/curd), average curd weight per plot (13.50 kg) and curd yield (32,180 kg/ha) were also highest in treatment T12 (50% FYM + 50% Vermicompost).

Key words : *Organic manures, NPK, cauliflower, growth and yield parameters.*

Introduction

Cauliflower (*Brassica oleracea* L. var. *botrytis*) a thermosensitive Cruciferae crop known as "Phul gobhi" was introduced to India in 1822 by Dr. Jemson from England. Its origin lies in the Mediterranean coastal areas with a chromosome number of 2n=18. The name "cauliflower" stems from the Latin words 'Caulis' (stem) and 'Floris' (flower). India leads globally in cauliflower production with varieties developed through intercrossing Cornish and European types, originating from Brassica cretica (1). The edible part of cauliflower is the "curd" comprising tightly packed, undeveloped flower buds attached to nutrient-rich stalks. Cruciferae plants are characterized by six stamens (four long, two short) and four petals arranged oppositely in a square cross-section. Cauliflower features a unique pod type called siliqua. It thrives in sandy to heavy organic-rich soils but is susceptible to diseases in saline soils. In India, cauliflower covers 458 thousand hectares, producing 8,840 tonnes annually with Punjab contributing significantly (2). Cauliflower consumption benefits health significantly. It's versatile in fresh dishes, soups and pickles. Vegetables like cauliflower from the Brassicaceae family contain cancer-preventing indole-3-carbinol. The Indian Council of Medical Research recommends 200-300 grams of vegetables daily per person. Cauliflower is packed with minerals, vitamins (including Vitamin C and folate) and nutrients like protein and essential minerals per 100 grams. It also provides vitamins like carotene, thiamine, riboflavin and niacin with a total of 4 Kcal in carbohydrates. Chemical fertilizers are crucial for meeting crop nutrient needs but their excessive and unbalanced use harms soil physico-chemical properties, product quality and yields. The demand for micronutrients has risen with high-yield varieties and intensive cultivation, emphasizing the need for balanced soil fertility management. Integrated approaches combining chemical, organic and biological fertilizers are essential to sustain crop productivity economically and environmentally (3, 4). In agriculture, chemical fertilizers remain essential but integrated nutrient management advocates for combining organic, inorganic and bio-sources for sustainable productivity (5, 6). Farmers in Punjab traditionally use organic manures like FYM, poultry manure and vermicompost. Integrating organic materials with inorganic nitrogenous fertilizers supports economic and ecological goals long-term (7). Cauliflower a heavy feeder plant requires substantial nutrients for high yields (8). Haphazard chemical fertilizer application without assessing soil nutrient status and crop needs harms soil health. Local organic sources like FYM, poultry manure and vermicompost are crucial but insufficient on their own for maximizing cauliflower production while maintaining soil health.

Materials and Methods

The study of the "Effect of organic manure and NPK on growth and yield of Cauliflower (*Brassica oleracea* L. var.

Received : July-2024; Revised : July-2024; Accepted : July-2024

botrytis)" was carried out at the Research Farm, Department of Horticulture, Mahatma Gandhi Chitrakoot *Gramodaya* Vishwavidyalaya, Chitrakoot, Satna, Madhya Pradesh, India during the Kharif season of 2022-23. The experiment was laid out in a randomized block design with 3 replications. The total number of treatments was 12 and each treatment was randomly allocated during the investigation period. For growth and development studies, observations were recorded at 30-day intervals. Minor weeds were removed by hand and deep hoeing was avoided to prevent root damage. The field was irrigated immediately after transplanting the seedlings to avoid shock. Cauliflower is a shallow-rooted crop with its root system lying within 45-60 cm of the topsoil. For tagging, five plants were randomly selected from each plot after they attained a reasonable growth and height. Plant height and the number of leaves in various plant components, such as root leaves were recorded for five plants. The sample plants were randomly selected. Plant height was measured in centimeters (cm) using a meter scale at 30, 60 and 90 days after sowing (DAS) and at harvest from the ground level to the tip of the longest leaf. The number of leaves was counted from five randomly selected plants at 30, 60 and 90 days after transplanting (DAT) and at harvest. All leaves of each plant were counted separately, excluding only the smallest young leaves at the growing point of the plant. The average number of leaves per plant was determined from the selected five plants in each plot. Root length was measured from the rooting depth. A small portion of the root sample was measured using a meter scale. The average length of five plants at harvest was recorded and expressed in centimeters (cm). Curd diameter was measured in several directions with a meter scale at the matured stage from five randomly selected plants and each plant was measured separately. After separating all parts except the curd, the weight of five randomly selected plants was measured in grams per curd and each curd was measured separately. The mature curd of the plant, including a well-sized stem with half-cut several leaves was weighed and recorded from five randomly selected plants using an electronic weighing machine. The data were statistically analyzed using the method suggested by (9).

Layout Detail :

Experimental design : Randomized Block Design (R B D)

Number of treatment : 12

Number of replication : 3

Total number of plots : 36

Net plot size : 2 m x 2 m (4 m^2)

Width of bunds : 30cm

Width of main irrigation channel : 1.0 m

Width of sub irrigation channel :0.5 m

Length of the field : 28.6 m

Width of the field : 8.8 m

Net cultivated area : 144 m^2

Gross cultivated area : 251.68 m^2

Results and Discussion

Effect of different level of organic manures and NPK on growth parameters of cauliflower : As the crop grows, plant height greatly increases. With a height of 28.15 cm, T12 (50% FYM + 50% Vermicompost) had the tallest plants, while T1 (Control) had the smallest measuring 20.87 cm. Plant height was consistently affected by diverse sources of organic manure at different times (30, 60, 90 DAT and at harvest) with an increasing trend observed over time (10). Plant heights at 60 days of age varied from 35.78 cm in T1 to 48.52 cm in T12. 90 days later, T12 had the tallest plants (51.45 cm), while T1 had the lowest (38.80 cm). The trend of increasing plant height over time with different organic manure sources remained similar throughout the study (11). The highest number of leaves was observed in T12 (50% FYM + 50% Vermicompost) with 11.25, while the minimum was in T1 (Control) with 8.93. The effects of organic manure on the number of leaves per plant were consistent across different dates (30, 60 and 90 DAS) with an increase over time (12). At 60 DAS, T12 had the highest number of leaves at 15.52 and T1 had the lowest at 10.48. At 90 DAS, T12 again showed the highest number of leaves at 18.25 with the minimum in T1 at 12.50. The trend of increasing leaf numbers over time with different organic manure sources remained similar throughout the study (Pathak *et al.,* 2013). Root length is a crucial plant characteristic for higher yield performance and varies over time. The longest roots at 30 DAT were 8.05 cm in T12 (50% FYM + 50% Vermicompost), whereas the shortest ones were 5.77 cm in T1 (Control). Addition of organic matter improved soil structure and promoted healthy root development, which resulted in an increase in root length (13). T12 had the longest root length at 60 DAT, 12.88 cm while T1 had the shortest 10.13 cm. Vermicompost's physio-chemical impacts enhanced soil structure, which aided in plant development and root growth. Once more, at 90 DAT, T12 had the longest root length (20.15 cm), while T1 had the shortest (15.60 cm). The improved soil structure from vermicompost continued to favor root growth and plant health.

Effect of different level of organic manures and NPK on yield and quality parameters cauliflower : Different nutrient sources significantly affected cauliflower curd

Table-1 : Treatment combination.

Sr. No.	Treatment No.	Treatment combination
1.	T_1	Control (Farmers Practices)
2.	T_2	RDF (200: 125:150 kg ha^{-1}) NPK
3.	T_3	FYM 25 t ha^{-1}
4.	T_4	Vermicompost 10 t ha^{-1}
5.	T_5	SPNF (Bijamrit + Jivamrit ++ Mulching)
6.	T_6	50% FYM + 50% RDF
7.	T_7	50% Vermicompost + 50% RDF
8.	T_8	SPNF + Panchgavya
9.	T_9	50% FYM + Panchgavya
10.	T_{10}	50% Vermicopost + Panchgavya
11.	T_{11}	50% RDF + Panchgavya
12.	T_{12}	50% FYM + 50% Vermicompost

Table-2 : Effect of different level of organic manures and NPK on growth parameters of cauliflower.

Treatment Symbol	Treatment combination	Plant height (cm)	Leaves $plant^{-1}$	Root length (cm)
T_1	Control (Farmers Practices)	38.80	12.50	15.60
T_2	RDF (200: 125:150 kg ha^{-1}) NPK	46.65	14.59	19.42
T_3	FYM 25 t ha^{-1}	47.05	15.63	20.89
T_4	Vermicompost 10 t ha^{-1}	44.95	13.60	19.30
T_5	SPNF (Bijamrit + Jivamrit ++ Mulching)	44.63	13.97	18.40
T_6	50% FYM + 50% RDF	42.36	13.93	19.47
T_7	50% Vermicompost + 50% RDF	42.36	13.90	17.83
T_8	SPNF +Panchgavya	41.78	12.42	17.24
T_9	50% FYM + Panchgavya	46.25	13.55	21.33
T_{10}	50% Vermicopost + Panchgavya	47.44	14.15	21.52
T_{11}	50% RDF + Panchgavya	45.25	15.52	20.15
T_{12}	50% FYM + 50% Vermicompost	51.45	18.25	22.52
	F-test	S	S	S
	S.Ed. (±)	1.602	0.774	0.790
	C.D. at 0.05%	3.436	1.661	1.695

Table-3 : Effect of different level of organic manures and NPK on yield and quality parameters cauliflower.

Treatment Symbol	Treatment combination	Curd diameter (cm)	Curd weight kg/curd	Curd weight kg/plot	Curd yield kg/ha
T_1	Control (Farmers Practices)	33.00	0.258	8.28	18900
T_2	RDF (200: 125:150 kg ha^{-1}) NPK	34.70	0.331	11.88	29700
T_3	FYM 25 t ha^{-1}	36.92	0.355	12.6	31500
T_4	Vermicompost 10 t ha^{-1}	34.62	0.306	10.8	27000
T_5	SPNF (Bijamrit + Jivamrit ++ Mulching)	34.20	0.317	11.16	27900
T_6	50% FYM + 50% RDF	34.00	0.288	10.00	25000
T_7	50% Vermicompost + 50% RDF	33.13	0.266	9.36	23400
T_8	SPNF + Panchgavya	31.32	0.310	11.16	22500
T_9	50% FYM + Panchgavya	35.15	0.481	12.52	21800
T_{10}	50% Vermicopost + Panchgavya	32.41	0.505	11.45	30210
T_{11}	50% RDF + Panchgavya	38.15	0.482	10.78	31710
T_{12}	50% FYM + 50% Vermicompost	43.82	0.521	13.50	32180
F-test		S	S	S	S
S.Ed. (±)		1.338	0.768	2.604	2517.55
C.D. at 0.05%		2.870	0.1548	5.376	5399.62

diameter. T12 (50% FYM + 50% Vermicompost) had the largest curd diameter at harvest (43.82 cm), while T1 (Control) had the smallest (33.00 cm). Organic manure enhanced soil nutrient availability, increasing yield, consistent with findings from (14, 15, 16). Vermicompost improved soil fertility, yield and nutrient uptake due to its nutrient-rich composition (4). Different sources of organic manure significantly influenced cauliflower curd weight. T12 (50% FYM + 50% Vermicompost) recorded the highest curd weight per plant at 0.521 kg, while T1 (Control) had the lowest at 0.258 kg. Similar effects on curd weight were noted in studies by Steffen *et al.* (1994), possibly due to differences in fertilizer application and soil amendments in comparison to previously amended

treatments. Different organic manure sources significantly influenced the marketable yield of cauliflower curd per plant. T12 (50% FYM + 50% Vermicompost) recorded the highest yield per plant at 32,180 kg/ha, while T1 (Control) had the lowest at 18,900 kg/ha. Yield per plant was significantly affected by organic manure application, as observed in studies by Steffen *et al.* (1994), possibly due to differences in fertilizer and soil amendment practices compared to previously amended treatments. The application of organic manure improved soil nutrient availability, thereby increasing yield. Similar findings were reported by (14, 15).

Conclusions

From the research trial, it can be concluded that the T12 treatment (50% FYM and 50% Vermicompost mix) significantly enhances cauliflower growth and yield, achieving 32,180 kg/ha compared to the control (T1). The variety Poosi of cauliflower, when cultivated with FYM and Vermicompost is highly recommended for the Jatropha-based agroforestry system during the Rabi season in Satna. T12 consistently produced the tallest plants, most leaves, longest roots, largest and heaviest curds and highest marketable yield. This demonstrates that organic manures, particularly the combination of FYM and Vermicompost, effectively improve soil fertility, plant development and overall productivity in cauliflower cultivation. Furthermore, it does not cause environmental pollution. The application of fertilizers enhances plant traits, maintains soil fertility, and nourishes young seedlings with readily available nutrients. Fertilizer addition not only promotes vigorous plant growth but also improves disease resistance.

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