Environment and Ecology 41 (2) :772—780, April—June 2023
ISSN 0970-0420

Response of Integrated Nutrient Management on Growth and Yield of Cauliflower (*Brassica oleracea* var. *botrytis*)

Komal Sagar, Deepak Kumar, Navdeep Singh, Anju Pathania

Received 1 November 2022, Accepted 8 February 2023, Published on 24 April 2023

ABSTRACT

An investigation entitled "Response of Integrated Nutrient Management on Growth and Yield of Cauliflower (*Brassica oleracea* var. *botrytis*)" was conducted at Horticulture Research Farm. The experiment was laid out in Randomized Block Design with 12 treatments and 3 replications. Data were recorded on various growth and yield attributes of cauliflower namely, number of leaves per plant, plant height, leaf area per plant, stem diameter, number of days taken to curd initiation and curd maturity, weight of curd, yield per plot of cauliflower and economics of different treatments at 30, 45 and 60 DAT. The objectives of the study were to assess the effect of application of plant nutrients through different organic and inorganic sources in different combinations on growth and yield parameters of cauliflower along with relative economics of cauliflower production. The results of present investigation revealed that 25% N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizers gave best results for growth and yield parameters among different treatments. The number of leaves per plant, plant height, stem diameter, curd weight and yield per plot were maximum with the application of this treatment.

Keywords Cauliflower, INM, Manures, Fertilizers, Growth.

INTRODUCTION

Cauliflower (*Brassica oleracea* var. *botrytis*) a "Cole Crop" belonging to family Brassicaceae is one of the most important vegetable crops grown in India. Cauliflower is grown for its curd which represents 20-30% of whole plant. The curds are rich in phenolic compounds, minerals, vitamin C, vitamin A and glucosinolates that can decrease the risk of cancer (Shams and Farag 2019). The curd is formed by the shortened flower parts which are fleshy and closely crowded. It may be cooked alone or mixed with other vegetables (Kashyap *et al.* 2017). It is momentous winter vegetable and grown as annual plant (Akhter *et al.* 2012).

Cauliflower being a heavy feeder of nutrients needs constant supply of large amount of nutrients and water for its exuberant growth. Although production

Komal Sagar[1]
Department of Agricultural Sciences, DAV University, Jalandhar Punjab, India

Deepak Kumar*[2]
[2]Research Scholar, Department of Vegetable Science, College of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut 250110, UP, India

Navdeep Singh[3]
[3]Research Scholar, Department of Vegetable Science, Punjab Agricultural University, Ludhiana Punjab, India

Anju Pathania[4]
[4]Associate Professor, Faculty of Agriculture, DAV University, Jalandhar Punjab, India

Email: deepakkr094@gmail.com
*Corresponding author

Table 1. Mean performance integrated nutrient management on growth parameters of cauliflower.

Sl. No.	Treatment notation	Treatments	Plant height (cm)			Stem diameter (cm)				Number of leaves per plant		
			30 DAT	45 DAT	60 DAT	30 DAT	45 DAT	60 DAT	At harvest	30 DAT	45 DAT	60 DAT
1	T_1	Control	17.50	22.93	25.67	2.35	4.26	7.60	8.71	7.40	12.36	15.40
2	T_2	100% Recommended dose of fertilizer (N : P:K= 125:60:40 kg/ha)	23.83	28.47	30.73	2.32	4.38	7.70	8.80	10.87	13.33	15.83
3	T_3	50% N through FYM + 50% N through inorganic fertilizer	21.73	25.80	29.67	2.33	4.37	7.64	8.74	8.73	11.73	15.36
4	T_4	50% N through neem cake + 50% N through inorganic fertilizer	16.13	23.93	26.60	2.30	4.48	7.55	8.50	7.90	12.40	14.60
5	T_5	50% N through vermicompost + 50% N through inorganic fertilizer	18.80	24.30	27.83	2.34	4.54	7.73	8.82	9.33	13.26	16.40
6	T_6	50% N through poultry manure + 50% N through inorganic fertilizer	19.87	24.80	28.53	2.33	4.58	7.64	8.74	9.33	13.13	16.06
7	T_7	25% N through FYM + 25% N through poultry manure + 50% N through inorganic fertilizer	17.57	23.60	26.00	2.32	4.53	7.56	8.71	8.00	11.93	15.60
8	T_8	25% N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizer	24.33	28.97	32.87	2.36	4.59	7.73	8.83	9.73	13.73	16.80
9	T_9	25% N through FYM + 25% N through neem cake + 50% N through inorganic fertilizer	20.13	25.26	28.73	2.30	4.52	7.63	8.74	9.46	13.72	17.20
10	T_{10}	25% N through neem cake + 25% N through poultry manure + 50% N through inorganic fertilizer	22.27	27.43	30.27	2.27	4.54	7.61	8.72	9.13	13.06	16.13
11	T_{11}	25% N through vermicompost + 25% N through poultry manure + 50% N through inorganic fertilizer	21.33	25.40	29.60	2.28	4.41	7.55	8.69	8.40	13.73	15.86
12	T_{12}	25% N through neem cake + 25% N through vermicompost + 50% N through inorganic fertilizer	20.53	25.27	29.30	2.29	4.45	7.66	8.81	8.26	12.86	15.40
		CD at 5% level	0.66	0.75	0.94	0.02	0.05	0.04	0.04	0.35	0.34	0.44
		SEm±	1.95	2.21	2.78	0.05	0.15	0.10	0.13	1.04	1.01	1.30

of cauliflower can be enhanced by increased use of chemical fertilizers but indiscriminate use of chemical fertilizers extend soil acidity, diminishes soil physical condition, lessens organic matter, initiate micro nutrient deficiencies, enhances plant susceptibility to pests and diseases, reduces soil lives, enhances soil, water and air pollution via agriculture run-off and straining (Bashyal 2011). With the escalation

Table 2. Details of experiment.

Crop	Cauliflower (*Brassica oleracea* var. *botrytis*)
Season	2019
Experimental design	Randomized Block Design (RBD)
Variety	Megha hybrid
No. of treatment	12
No. of replication	03
Total no. of plots	36
Spacing	45 cm × 45 cm
Plot size	3×3.5 m²
	Treatment details
Treatment notation	Treatments
T_1	Control
T_2	100% Recommended dose of fertilizer (N:P: K= 125:60:40 kg/ha)
T_3	50% N through FYM + 50% N through inorganic fertilizer
T_4	50% N through neem cake + 50% N through inorganic fertilizer
T_5	50% N through vermicompost + 50% N through inorganic fertilizer
T_6	50% N through poultry manure + 50% N through inorganic fertilizer
T_7	25% N through FYM + 25% N through poultry manure + 50% N through inorganic fertilizer
T_8	25% N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizer
T_9	25% N through FYM + 25% N through neem cake + 50% N through inorganic fertilizer
T_{10}	25% N through neem cake + 25% N through poultry manure + 50% N through inorganic fertilizer
T_{11}	25% N through vermicompost + 25% N through poultry manure +50% N through inorganic fertilizer
T_{12}	25% N through neem cake + 25% N through vermicompost + 50% N through inorganic fertilizer

in the prices of chemical fertilizers, farmers have overloaded with extra cost of chemical fertilizers which leads to trimming in benefit : Cost ratio of the crop and provoke the condition of poor people being non-comfortable and untrustworthy for extravagant external inputs (Basnet *et al.* 2017).

The concept of integrated nutrient management (INM) has come out as crucial tool for maintaining soil fertility and crop productivity. INM refers to integration of organic, inorganic and biological components to increase productivity and conservation of soil fertility for future use without any detrimental effect on physical, chemical and biological properties of the soil on a long-term basis (Devi *et al.* 2018). The integrated use of organic materials and inorganic nitrogenous fertilizers has gained attention to fulfil the farmer's economic requirement as well as to manage ecological conditions on long-term basis (Chahal *et al.* 2019).

Organic manures are derived from organic materials either from green plants or animals that have undergone further decomposition or undergoing in a process of decomposition (Simarmata *et al.* 2016). Organic manures extend size, biodiversity and activity of microbial population in soil, exert influence on structure, nutrient turnover and many other related physical, chemical and biological properties of soil (Devi *et al.* 2018). Organic manures enhance the longevity during post-harvest operations in terms of deterioration and loss of weight due to presence of micronutrients which nourishes the cellular and sub cellular parts of curd (Basnet *et al.* 2017).

The use of bio-fertilizers enriches the soil with beneficial microorganisms and also mobilizes the nutritionally important elements from non-usable to usable forms through biological processes. The utilization of biofertilizers in combination with chemical fertilizers and organic manures results in increased production as well as quality of vegetables (Pawar and Barkule 2017). Use of organic manures and biological fertilizers alone cannot increase the

production of this heavy nutrient feeder crop in spite of sustainable soil health. Therefore, for attaining high yield and maintaining good soil health, a sustainable and cost-effective approach for nutrient management by tapping all possible organic and inorganic sources in a judicious manner is required (Pawar and Barkule 2017).

MATERIALS AND METHODS

The present investigation entitled "Response of integrated nutrient management on growth and yield of cauliflower (*Brassica oleracea* var. *botrytis*)" was carried out during 2019 at the Research Farm, Department of Horticulture, DAV University, Jalandhar (Punjab).

Experimental design and treatment details

The experiment was laid out in Randomized Block Design with three replications. The randomization of treatments was done for all the replications. The required area was marked and 36 plots were prepared according to layout plan.

RESULTS AND DISCUSSION

Growth parameters

Plant height (cm) : Plant height increased with the advancement of crop age. The data presented in Table 1, revealed that plant height of cauliflower was significantly influenced by different treatments. The data recorded on effect of INM on plant height is presented in Table 1. Among different sources of nutrients (Table 2), at 30, 45 and 60 DAT, treatment T_8 (25% N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizers) recorded the highest plant height (24.33 cm, 28.97 cm, 32.87 cm respectively) which was statistically at par with treatments T_2 (100% RDF [125:60:40 kg/ha] through inorganic fertilizers) (28.47 cm, 30.73 cm) and T_{10} (25% N through neem cake + 25% N through poultry manure + 50% N through inorganic fertilizers) (27.43 cm, 30.27cm) at 45 and 60 DAT. At 30 DAT, plant height in treatment T_8 (25% N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizers) was statistically at par with treatment T_2 (23.83 cm). However, the lowest plant height was recorded in treatment T_4 (16.13 cm) at 30 DAT and at 45 and 60 DAT, treatment T_1 (Control) resulted the lowest plant height (17.5 cm, 22.93 cm respectively) (Table 1).

The increase in plant height may be due to the availability of more nitrogenous compounds to the plant which increases the foliage of the plant and thereby increases the photosynthesis and also reported that application of half dose of NPK/ha + poultry manure @ 3 t/ha resulted in the highest plant height (Shanta *et al.* 2019). Ali and Kashem (2018) also reported that application of half dose of NPK/ha + vermicompost @ 5 t/ha resulted in the highest plant height in cabbage. Similar findings were also reported by Singh *et al.* (2020) that application of half dose of NPK/ha + vermicompost @ 2.5 t/ha resulted in the highest plant height in cabbage.

Stem diameter (cm) : Effect of INM on stem diameter at 30 DAT, maximum stem diameter (2.36 cm) in treatment T_8 (25% N through FYM + 25%N through vermicompost + 50% N through inorganic fertilizers) (Table 2) which was statistically at par with treatments T_1 (Control) (2.35 cm), T_5 (50% N through vermicompost + 50% N through inorganic fertilizers) (2.34 cm), T_6 (50% N through poultry manure + 50% N through inorganic fertilizers) (2.33 cm), T_3 (50% N through FYM + 50% N through inorganic fertilizers) (2.33 cm), T_2 (100% RDF [125:60:40 kg/ha] through inorganic fertilizer) (2.32cm) and T_7 (25% N through FYM + 25% N through poultry manure + 50% N through inorganic fertilizers) (2.32 cm). The lowest value (2.27cm) for stem diameter was observed in treatment T_{10} (25% N through neem cake + 25% N through poultry manure + 50% N through inorganic fertilizers). At 45 DAT, the maximum stem diameter (4.59cm) was observed in treatment T_8 (25% N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizers) which was at par (4.58 cm) with values of stem diameter obtained in treatments T_6 (50% N through poultry manure + 50% N through inorganic fertilizers), T_5 (50% N through vermicompost + 50% N through inorganic fertilizer) (4.54 cm), T_{10} (25% N through neem cake + 25% N through poultry manure + 50% N through inorganic fertilizers) (4.54 cm), T_7 (25%

N through FYM + 25% N through poultry manure + 50% N through inorganic fertilizers) (4.53 cm), T_9 (25% N through FYM + 25% N through neem cake + 50% N through inorganic fertilizers) (4.52 cm), T_4 (50% N through neem Cake + 50% N through inorganic fertilizers) (4.48 cm) and T_{12} (25% N through neem cake + 25% N through vermicompost + 50% N through inorganic fertilizer) (4.45 cm). The lowest stem diameter (4.26 cm) was noticed in treatment T_1 (Control). At 60 DAT, treatment T_8 (25% N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizers) and T_5 (50% N through vermicompost + 50% N through inorganic fertilizers) exhibited maximum stem diameter (7.73 cm) which was statistically similar to treatments T_2 (100% RDF [125:60:40 kg/ha] through inorganic fertilizer) (7.70cm), T_{12} (25% N through neem cake + 25% N through vermicompost + 50% N through inorganic fertilizers) (7.66 cm), T_3 (50% N through FYM + 50% N through inorganic fertilizers) (7.64 cm), T_6 (50% N through poultry manure + 50% N through inorganic fertilizers) (7.64 cm) and T_9 (25% N through FYM + 25% N through neem cake + 50% N through inorganic fertilizers) (7.63 cm). The minimum stem diameter (7.55 cm) was observed in treatment T_4 (50% N through neem cake + 50% N through inorganic fertilizers) and T_{11} (25% N through vermicompost + 25% N through poultry manure + 50% N through inorganic fertilizers). At harvesting, treatment T_8 (25% N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizer) recorded highest stem diameter (8.83 cm) which was at par with all the treatments except Treatments T_{11} (25% N through vermicompost + 25% N through poultry manure + 50% N through inorganic fertilizers) and T_4 (50% N through neem cake + 50% N through inorganic fertilizers). Treatment T_4 (50% N through neem cake + 50% N through inorganic fertilizers) resulted the lowest stem diameter (8.50 cm) at harvest stage (Table 1).

The stem diameter was significantly influenced by integrated use of nutrients due to rapid cell division, multiplication and cell elongation in meristematic region of plant which promoted vegetative growth of the plant (Devi *et al.* 2018). Results obtained during the present investigation have also been reported earlier by many workers. Singh *et al.* (2020) also reported that application of half dose of NPK/ha + vermicompost @ 2.5 t/ha gave the highest stem diameter in cabbage production. Ali and Kashen (2018) also reported that application of half dose of NPK/ha + vermicompost @ 5 t/ha resulted in the highest stem diameter in cabbage.

Number of leaves per plant : The effect of INM on number of leaves per plant increased with increase in crop age and significant increase was recorded from 30 DAT to 60 DAT. At 30 DAT, the highest number of leaves per plant (10.87) was recorded in treatment T_2 (100% RDF [125:60:40 kg/ha] through inorganic fertilizers) (Table 2) and the lowest number of leaves per plant (7.40) was recorded in control treatment. At 45 DAT, the highest number of leaves per plant (13.73) was recorded in treatments T_8 (25% N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizers) and T_{11} (25% N through vermicompost + 25% N through poultry manure + 50% N through inorganic fertilizers) which were statistically at par with treatment T_9 (25% N through FYM + 25% N through neem cake + 50% N through inorganic fertilizers) (13.72), T_5 (50% N through vermicompost + 50% N through inorganic fertilizers) (13.26), T_6 (50% N through poultry manure + 50% N through inorganic fertilizers) (13.13), T_{10} (25% N through neem cake + 25% N through poultry manure + 50% N through inorganic fertilizer) (13.06), T_{12} (25% N through neem cake + 25% N through poultry manure + 50% N through inorganic fertilizers) (12.86) and T_2 (100% RDF [125:60:40 kg/ha] through inorganic fertilizers) (12.36). The lowest number of leaves per plant (11.73) was recorded in treatment T_3 (50% N through FYM + 50% N through inorganic fertilizer) (Table 1).

Among the different nutrient sources, at 60 DAT, treatment T_9 (25% N through vermicompost + 25% N through poultry manure + 50% N through inorganic fertilizers) recorded highest number of leaves per plant (17.20) which was found at par (16.80) with treatments T_8 (25% N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizers), T_5 (50% N through vermicompost + 50% N through inorganic fertilizers) (16.40), T_{10} (25% N through neem cake + 25% N through poultry manure + 50% N through inorganic fertilizers) (16.13)

and T_6 (50% N through poultry manure + 50% N through inorganic fertilizers) (16.06). The lowest numbers of leaves per plant (14.6) were recorded in treatment T_4 (50% N through neem cake + 50% N through inorganic fertilizers) (Table 1).

Number of leaves was reported to be significantly influenced by the organic manures, the addition of which have solubilizing effects on the soil nutrients as well as chelating effects on metal ions. Hence, they increased the availability of nutrients to the plants (Neupane *et al.* 2020). Earlier, Jagtap *et al.* (2009) reported that treatment with application of 50% N through poultry manure and 50% N through urea resulted in highest number of leaves per plant in cabbage. Mal *et al.* (2015) also reported that the application of 50% N through RDF + 50% N through vermicompost yielded the highest number of leaves in sprouting broccoli. Khatkar *et al.* (2018) reported that the application of half dose of NPK + Vermicompost @ 5 t/ha yielded the highest number of leaves per plant in cabbage. Similarly, Neupane *et al.* (2020) also recorded the highest number of leaves per plant after application of 50% N through RDF + 50% N through vermicompost among various treatments in cauliflower production.

Leaf area per plant (cm²) : The effect of INM on leaf area per plant (cm²) is presented in Table 3, At 30, 45, 60 DAT, treatment T_2 (100% RDF [125:60:40 kg/ha] inorganic fertilizer) (Table 2) recorded the highest leaf area per plant (30.83 cm², 53.38 cm², 78.30 cm²) which was statistically at par (30.77cm², 52.48 cm², 77.73 cm²) with treatments T_7 (25% N through FYM + 25% N through poultry manure + 50%N through inorganic fertilizers), T_{12} (25% N through neem cake + 25% N through vermicompost + 50% N through inorganic fertilizers) (30.43 cm², 51.87 cm², 76.73 cm²), T_3 (50% N through FYM + 50% N through inorganic fertilizers) (30.00 cm², 51.48 cm², 74.81 cm²), T_{11} (25% N through vermicompost + 25% N through poultry manure + 50% N through inorganic fertilizers) (29.64 cm², 49.10 cm², 74.38 cm²) and T_6 (50% N through poultry manure + 50% N through inorganic fertilizers). Treatment T_{10} (25% N through neem cake + 25% N through poultry manure + 50% N through inorganic fertilizers) resulted the lowest leaf area per plant (20.38 cm², 40.15 cm² and 55.07 cm², respectively) at 30, 45 and 60 DAT (Table 3).

This might be due to the favorable effect of chemical fertilizers along with organic material activates many species of living organisms, which release phytohormones and may stimulate the plant growth and absorption of nutrients. Pawar *et al.* (2017) recorded that application of 100% RDF gave highest leaf area per plant in cauliflower. Chahal *et al.* (2019) also reported that application of 100% recommended NPK through fertilizers gave the highest leaf area per plant in cauliflower.

Yield contributing and yield parameters

Number of days taken to curd initiation : Among different nutrient management treatments (Table 2), treatment T_2 (100% RDF [125:60:40 kg/ha] through inorganic fertilizers) took minimum days (45.33) for curd initiation which was at par with treatment T_5 (50% N through vermicompost + 50% N through inorganic fertilizers) (48.00), T_{11} (25% N through vermicompost + 25% N through poultry manure + 50% N through inorganic fertilizers) (48.00), T_7 (25% N through FYM + 25% N through poultry manure + 50% N through inorganic fertilizers) (48.00), T_{10} (25% N through neem cake + 25% N through vermicompost + 50% N through inorganic fertilizers) (47.67), T_{12} (25% N through neem cake + 25% N through vermicompost + 50% N through inorganic fertilizers) (47.67), T_6 (50% N through poultry manure + 50% N through inorganic fertilizers) (47.33), T_8 (25% N through FYM + 25% N through vermicompost+ 50% N through inorganic fertilizers) (46.67), T_9 (25% N through FYM + 25% N through neem cake + 50% N through inorganic fertilizers) (46.33). Maximum number of days for curd initiation (53.33) was taken by control treatment (Table 3).

The reason behind earliness might be due to vigorous vegetative growth of plant which resulted in better food assimilation by photosysthesis. The food material was translocated rapidly to the edible portion of plant (curd) resulting in early development (Yadav *et al.* 2014). Shree *et al.* (2014) also observed that application of 100% RDF took minimum days for curd initiation in cauliflower among different nutrient treatments.

Table 3. Mean performance of integrated nutrient management on growth and yield contributing and yield parameters of cauliflower.

Sl. No.	Treatment Notation	Treatments	Leaf area per plant (cm^2) 30 DAT	45 DAT	60 DAT	Number of days taken to curd initiation	Number of days taken to curd maturity	Weight of curd (g)	Yield per plot (kg)
1	T_1	Control	25.34	44.97	67.85	53.33	75.66	200	7.56
2	T_2	100% Recommended dose of fertilizer (N:P: K= 125:60:40 kg/ha)	30.83	53.38	78.30	45.33	62.53	255	10.90
3	T_3	50% N through FYM + 50% N through inorganic fertilizer	30.00	51.48	74.81	50.67	63.00	250	10.76
4	T_4	50% N through neem cake + 50% N through inorganic fertilizer	25.25	42.43	65.14	50.00	67.00	234	9.33
5	T_5	50% N through vermicompost + 50% N through inorganic fertilizer	25.30	43.33	67.78	48.00	63.00	235	9.63
6	T_6	50% N through poultry manure + 50% N through inorganic fertilizer	26.93	46.33	73.11	47.33	62.54	243	10.73
7	T_7	25% N through FYM + 25% N through poultry manure + 50% N through inorganic fertilizer	30.77	52.48	77.73	48.00	62.66	220	8.57
8	T_8	25% N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizer	25.50	45.00	70.61	46.67	62.56	275	11.23
9	T_9	25% N through FYM + 25% N through neem cake + 50% N through inorganic fertilizer	23.63	40.63	65.15	46.33	63.67	225	9.06
10	T_{10}	25% N through neem cake + 25% N through poultry manure + 50% N through inorganic fertilizer	20.38	40.15	55.07	47.67	62.56	215	8.43
11	T_{11}	25% N through vermicompost + 25% N through poultry manure + 50% N through inorganic fertilizer	29.64	49.10	74.38	48.00	63.33	235	10.56
12	T_{12}	25% N through neem cake + 25% N through vermicompost + 50% N through inorganic fertilizer	30.43	51.87	76.73	47.67	68.67	210	8.40
		CD at 5% level	1.54	2.38	2.23	1.12	2.09	2.99	0.55
		SEm±	4.56	7.01	6.57	3.32	6.17	8.85	1.63

Pawar and Barkule (2017) reported that application of 100% RDF took minimum days for curd initiation in cauliflower production.

Number of days taken to curd maturity : Among different treatments (Table 2), treatment T_2 (100% RDF [125:60:40 kg/ha] through inorganic fertilizers) took minimum days (62.53) for curd maturity and was statistically at par with all treatments except treatment T_1 (Control) which took maximum days (75.66) for curd maturity (Table 3).

Earliness in curd maturity might also be due to physiological role of nutrients and rapid translocation of photosynthates towards the curd which might have enhanced the rate of curd development (Yadav *et al.* 2014). Shree *et al.* (2014) and Pawar and Barkule (2017) also recorded that application of 100% RDF resulted minimum days for curd maturity during cauliflower production.

Weight of curd (g) : The curd weight of cauliflowers is significantly influenced by different nutrients (Table 2). Among different nutrient management treatments, treatment T_8 (25% N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizers)

recorded the maximum curd weight (275g) which was significantly high from other treatments (Table 3).

The combined application of optimum levels of inorganic fertilizers and organic fertilizers might have improved the physico-chemical and biological characteristics of the growth medium and increased the concentration of essential nutrients in soil solution resulted in steady uptake of major nutrients, sturdy plant growth and improvement of curd weight (Devi *et al.* 2018). These findings agree with the findings of Devi *et al.* (2018) who reported that application of 80% NPK and 20% N through FYM and vermicompost (50:50) is best treatment for cauliflower production. Similarly, Singh *et al.* (2018) reported that application of 50% RDF + 25% vermicompost + 25% FYM is best treatment for increasing cauliflower production. Ola *et al.* (2019) also recorded that application of 50% RDF through inorganic fertilizer and 3.5 t/ha vermicompost resulted the highest curd weight of sprouting broccoli. Neupane *et al.* (2020) reported that application of 50% N through RDF + 50% N through vermicompost resulted the highest curd weight of cauliflower.

Yield per plot (kg) : The yield per plot of cauliflower was significantly influenced by different nutrient treatments (Table 2). Among different nutrient management treatments, treatment T_8 (25%N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizers) resulted the maximum yield per plot (11.23 kg) which was at par (10.90 kg) with treatment T_2 (100% RDF [125:60:40 kg/ha] through inorganic fertilizers), T_3 (50% N through FYM + 50% N through inorganic fertilizers) (10.76 kg), T_6 (50% N through poultry manure + 50% N through inorganic fertilizers) (10.73kg) and T_{11} (25% N through vermicompost + 25% N through poultry manure + 50% N through inorganic fertilizers) (10.56 kg), T_5 (50% N through vermicompost + 50% N through inorganic fertilizers) (9.63kg). Treatment T_1 (Control) exhibited minimum yield per plot (7.56 kg) among different treatments (Table 3).

CONCLUSION

In the present investigation, treatment T_8 (25% N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizers) resulted maximum increase in number of leaves per plant, plant height, stem diameter, curd weight at 30, 45, 60 DAT. On the basis of one-year study, it may be concluded that application of 25% N through FYM + 25% N through vermicompost + 50% N through inorganic fertilizers have been found suitable for achieving economic yield advantage in cauliflower.

REFERENCES

Akhter SR, Sen JS, Haque A , Noor S (2012) Efficacy of vermicompost to improve soil health, yield and nutrient uptake of cauliflower. *Dynamic Soil, Dynamic Pl* 5 : 199—203.

Ali S, Kashen MA (2018) Effect of Vermicompost on the growth and yield of cabbage. *J Agricult Engg Food Technol* 5 : 45—49.

Ali S, Kashen MA, Sarker MMH (2018) Effect of vermicompost on the growth and yield of cauliflower in arid soils of Bangladesh. *J Sylhet Agricut Univ* 5 : 37—43.

Bashyal LN (2011) Response of cauliflower to nitrogen fixing biofertilizer and graded levels of nitrogen. *The J Agric Environ* 12 : 34—38.

Basnet M, Shakya SM, Baral BR (2017) Response of organic manures on post-harvest and soil nutrient restoration on cauliflower production. *The J Agric Environ* 18 : 67—72.

Chahal HS, Singh S, Dhillon IS, Kaur S (2019) Effect of integrated nutrient management on macronutrient availability under cauliflower (*Brassica oleracea* var. *botrytis* L.). *IntJ Curr Microbiol Appl Sci* 8 : 1623—1633.

Devi M, Spehia RS, Menon S, Mogta A, Verma A (2018) Influence of integrated nutrient management on growth and yield of cauliflower (*Brassica oleracea* var. *botrytis*). *Int J Chem Studies* 6 : 2988—2991.

Jagtap AD, Kadam AS, Jagtap DD, Patil SB (2009) Effect of organic manures and chemical fertilizers on growth, yield and economics of cabbage. *J Agric Univ* 34 : 278—282.

Kashyap L, Reddy CV, Tiwari A (2017) Effect of integrated management practices effect on carbon sequestration, carbon stock, plant growth parameters and economics of cauliflower. *Int J Curr Microb Appl Sci* 6 : 2319—2322.

Khatkar J, Shadap A, Longkumer T (2018) Effect of integrated nutrient management on the performance of cabbage. *J Pharmacog Phytochem* 7 : 225—228.

Mal D, Chatterje R, Nimbalkar KH (2015) Effect of vermicompost and inorganic fertlizers on growth, yield and quality of sprouting broccoli. *Int J Bio-resour Stress Manage* 5 : 507—512.

Neupane, B, Aryal K, Chhetri LB, Regmi S (2020) Effects of integrated nutrient management in early season cauliflower production and its residual effects on soil properties. *J Agric Natural Resour* 3 : 353—365.

Ola AL, Bairwa LN, Garhwal OP (2019) Interactive effect of integrated nutrient management and bio-regulators on yield and economics attributes of sprouting broccoli (*Brassica oleracea* L. var. italica Plenck). *The Pharma Innov J* 8 : 278—282.

Pawar R, Barkule S (2017) Study on effect of integrated nutrient management on growth and yield of cauliflower (*Brassica oleracea* var. *botrytis*). *J Appl Natural Sci* 9 : 520—525.

Ratna SA (2019) Effect of fertilizers and manures on the growth and yield of cauliflower. *Int J Agric Sci* 5 : 51—55.

Shams AS, Farag AA (2019) Implications of water stress and organic fertilization on growth, yield and water productivity of of cauliflower. *J Pl Prod* 19 : 807—813.

Shanta UK, Howlader MH, Hasan MM, Nabir AJMN, Singh A, Kumar A, Yadav S, Singh S (2019) Effect of integrated management on growth and yield of cabbage. *Int Nat J Chem Studies* 8 : 1196—1200.

Shree S, Singh VK, Kumar R (2014) Effect of integrated nutrient management on yield and quality of cauliflower (*Brassica oleracea* var. *botrytis*). *Int J Life Sci* 9 : 1053—1058.

Simarmata M, Susantiand L, Setyowati N (2016) Utilization of manure and green organic composts as alternative fertilizers for cauliflower production. *J Agricult Technol* 12 : 311—319.

Singh A, Kumar A, Yadav S, Singh S (2020) Effect of integrated nutrient management on growth and yield of cabbage (*Brassica oleracea* var. *capitata* L.). *Int J Chem Studies* 8 : 1196—1200.

Yadav PK, Kaswan PK, Jakhar RK, Kumawat A, Harish K (2014) Effect of foliar application of nitrogen and zinc on growth of cauliflower (*Brassica oleracea* var. *botrytis*). *Int J Curr Microbiol Appl Sci* 6 : 497—503.