



## Effects of varieties and organic manures on growth and yield of cauliflower

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### ABSTRACT

An experiment was conducted at the Landscaping section of the Department of Horticulture, Bangladesh Agricultural University, Mymensingh during the period from October 2018 to March 2019 to investigate the effects of varieties and organic manures on growth and yield of cauliflower. The experiment was laid out in Randomized Complete Block Design with three replications. The experiment consisted of two varieties *viz.* BARI Fulkopi-1 (RUPA) and BARI Fulkopi-2 and five types of organic manures *viz.* T0 = Control (no manure), T1 = Cowdung @ 20 t/ha, T2 = Mustard oilcake (MOC) @ 0.5 t/ha, T3 = Poultry manure @ 15 t/ha, T4 = Cowdung + MOC + Poultry manure @ 4 t/ha + 0.25 t/ha + 2 t/ha. The results of the experiment showed that the variety and organic manures had significant influence on almost all the parameters studied. BARI Fulkopi-2 produced the higher yield with increased plant height, number of leaves per plant, stem length, curd diameter compared to BARI Fulkopi-1 (RUPA). The results further revealed that the application of T4 (Cowdung + MOC + Poultry manure @ (4 t/ha + 0.25 t/ha + 2 t/ha) increased plant height, number of leaves per plant, stem length, curd diameter and curd yield compared to control treatment (T0). The highest curd yield (24.01 t/ha) was recorded in T4 (Cowdung + MOC + Poultry manure @ (4 t/ha + 0.25 t/ha + 2 t/ha) and the lowest curd yield (13.99 t/ha) was found in T0 (control). The effect of organic manures on yield were in order of T4>T3>T2>T1>T0. Among the treatment combinations V2T4 gave the highest plant height (47.26 cm), number of leaves per plant (11.22), curd yield (24.99 t/ha) where-as the lowest plant height (23.52 cm), number of leaves per plant (7.37), curd yield (13.3 t/ha) were obtained from V1T0. Therefore, the combined application of Cowdung + MOC + Poultry manure @ 4 t/ha + 0.25 t/ha + 2 t/ha along with BARI Fulkopi-2 was found to be better in respect of growth and yield of cauliflower.

**Keywords:** Cauliflower, variety, organic manures, growth, yield



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## 1 Introduction

Cauliflower (*Brassica oleracea* var. *botrytis* L.) is a cool season crop in the cruciferae family. Cauliflower is the second most important inflorescence vegetable after globe artichoke and before broccoli in many places of the world. While it is closely related to broccoli and cabbage, cauliflower is more exacting in its environmental requirements than other cole crops. Cauliflower is very sensitive to unusually

hot weather and drought. The leading cauliflower producing countries of the world are India, China, France, Italy, Spain, United States of America and the United Kingdom (FAO, 2020).

Cauliflower is a highly nutritious and delicious vegetable, rich in Vitamin A, C and minerals like calcium, iron and iodine (Haque, 1999). It supplies 50 mg vitamin C, 40 IU carotene, 25 kilocalories, 8 g carbohydrate and 90% water per 100 g edible part. The

edible part of cauliflower is known as curd, which is considered to be a pre-condition of inflorescence. Vegetable consumption in Bangladesh is very low, only 32 g per person per day against the minimum recommended quantity of 200 g per day (FAO, 2014). In 2018-2019 cauliflower covered an area of 4.99 ha with a total production of 284327 metric tons (BBS, 2019). The success or failure of cauliflower production is largely depends upon climate, especially temperature and this relationship is very intensive and complex. The suitable temperature for growth stages ranging from  $20 \pm 5$  °C and for curd growth and development is 15 °C-20 °C. Cauliflower requires a period of cold not only for curd production but also for flowering (Wiebe, 1972).

However, the average yield of cauliflower in Bangladesh is very low compared to other cauliflower growing countries of the world. This low yielding is not an indication of low yielding ability of the crop, but of the fact that low yielding variety, poor crop management practices and lack of improved technologies. The yield of cauliflower depends on variety, cultivation methods, climatic conditions, soil fertility as well as edaphic factors, etc. A suitable variety is needed for the continuous production from year to year (Rashid, 2019). In Bangladesh, a large number of cauliflower varieties are grown, which are of exotic origin and were developed long before. Most of them lost their potentiality due to genetic deterioration and disease contamination. In addition, the yield and quality of those exotic varieties are decreasing day by day due to unbalanced use of fertilizers and lack of proper organic matter management in the soil. Hence in order to improve the present situation of cauliflower cultivation in Bangladesh, it is essential to promote better varieties to the growers of Bangladesh.

Growth and yield of cauliflower also depend on nutrient availability in soil, which is related to the judicious application of manures and fertilizers. The continuous use of chemical fertilizer badly affects the soil texture, structure, colour, aeration, water holding capacity and microbial activity of soil. A good soil has an organic matter content of more than 3%. But in Bangladesh soil of most region have less than 2%, some soil have less than 1% organic matter. For continuous cropping, organic manures applied to the crop fields through cowdung, poultry manure, mustard oil cake, etc., are insufficient. In recent year poultry and livestock farming are increasing, which could supply more poultry litter and cowdung. On an average, well rotten cowdung contains 0.5% N, 0.2%  $P_2O_5$  and 0.5%  $K_2O$  (Yawalkar et al., 1984). In addition, the cost of inorganic fertilizers is very high and sometimes it is not available in the market. On the other hand, organic fertilizer is easily available to the farmers, and its cost is relatively low than the inorganic fertilizers (Haque, 2000). Among the organic

manures mustard oil cake contain higher amount of nutrient such as 4.93% N, 0.53%  $P_2O_5$ , 0.65%  $K_2O$  and it contains high amount of secondary and micronutrients in addition to N, P and K @ 5.1-5.2, 1.8-1.9 and 1.1-1.3%, respectively (BARC, 1997). Different manures contain different amount of nutrients in different proportions and their mode of nutrient release is not same. So, different varieties and manures may influence the growth and yield in different angles. Therefore, the current investigation was conducted to study the effects of varieties and organic manures on growth and yield of cauliflower.

## 2 Materials and Methods

### 2.1 Study location, climate and soil

The field experiment was conducted at the Landscaping Section of the Department of Horticulture, Bangladesh Agricultural University (BAU), Mymensingh during the period from October, 2018 to April, 2019 to determine the effects of varieties and organic manures on growth and yield of cauliflower. The selected land was medium high in nature and was situated in the subtropical climatic zone, characterized by heavy rainfall during the months from April to September and scanty rainfall during the rest period of the year (Edris et al., 1979). Rabi season is characterized by comparatively low temperatures and plenty of sunshine. The soil of the experimental plot was silty loam in texture and belonging to the Old Brahmaputra Flood Plain under AEZ-9 (UNDP, 2011).

### 2.2 Plant materials

The varieties of cauliflower selected for the experiment were the BARI Fulkopi- 1 (RUPA) and BARI Fulkopi-2. The seeds of the cauliflower varieties were collected from Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gajipur.

### 2.3 Treatments of the experiment

The two factor experiment consisted of two cauliflower varieties *viz.*, BARI Fulkopi-1 (RUPA) and BARI Fulkopi-2 and five types of organic manures *viz.*, T0 = Control (no manure), T1 = Cowdung @ 20 t/ha, T2 = Mustard oilcake (MOC) @ 0.5 t/ha, T3 = Poultry manure @15 t/ha, T4 = Cowdung + MOC + Poultry manure @ 4 t/ha+ 0.25 t/ha + 2 t/ha.

### 2.4 Design and layout of the experiment

The experiment was laid out in randomized complete block design (RCBD) with 3 replications. An area of 99 m<sup>2</sup> (16.5 m × 6 m) was divided into three equal blocks. The total numbers of unit plots were 30. Each

plot was measuring 1 m × 1 m. The treatment combinations of the experiment were assigned at random into 10 plots each at 3 replications. The distance retained between two plots was 50 cm and between blocks was 100 cm.

## 2.5 Manures and fertilizers application

Cowdung, mustard oil cake (MOC), poultry manure was applied in accordance with the doses in the responsible experimental plots. The entire amount of well decomposed cowdung, mustard oilcake, poultry manure were applied during final land preparation. Cowdung was collected from the Horticulture Farm, BAU. Poultry manure was collected from Poultry Farm, BAU. MOC was collected from local market near BAU.

## 2.6 Harvesting

Harvesting of the cauliflower was not possible on a certain or particular date because curd initiation as well as curd maturation period in different plants were not uniform or similar probably due to different management practices and genetic or other factors. Only the compact mature curds were harvested by using a sharp knife. The curds were harvested in compact condition before the flower buds opened. Before harvesting of the cauliflower curd, compactness of the curd was tested by pressing with thumbs. The crop under investigation was harvested at 28 January 2019 and the last harvesting was done on 13 February 2019 when the experiment was terminated.

## 2.7 Data collection

Five plants were randomly selected from the middle rows of unit plot for avoiding border effect, except yields of curds, which was recorded plot wise. Data were recorded on the growth and yield parameters such as plant height (cm), length and breadth of largest leaf (cm), number of leaves per plant, length and diameter of stem (cm), length and diameter of curd, yield per plant (g), per plot (kg) and per hectare (t). Data on height of the plant, number of leaves per plant, length of the largest leaf, breadth of the largest leaf were collected at 30, 40, 50, and 60 days after transplanting (DAT). All other parameters were recorded during maximum vegetative stage, harvest and after harvest.

## 2.8 Statistical analysis

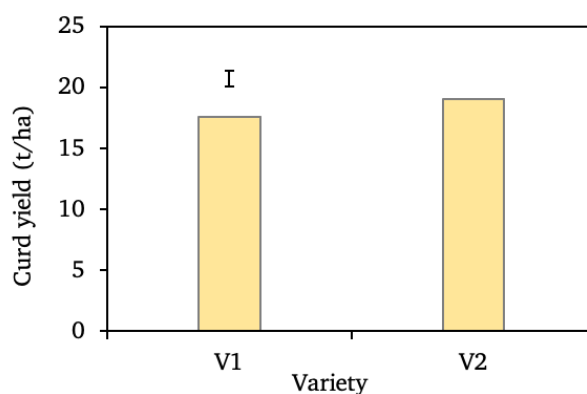
The data collected from the experimental plants per plot in respect of various characteristics were compiled and tabulated in proper form for statistical analysis. The means for all the treatments were calculated and the analysis of variances for most of the

characters under consideration was performed by 'F' variance test. The significance of difference between pairs of means was evaluated by the least significance difference (LSD) test at 1 and 5% levels of probability (Gomez and Gomez, 1984).

## 3 Results and Discussion

### 3.1 Varietal performances

Results revealed that varieties had significant effects on plant height, number of leaves per plant, length of the largest leaf, breadth of the largest leaf, length of stem, diameter of stem, length of curd, diameter of curd, yield per plant, yield per plot and yield per hectare of cauliflower. There was significant difference between two varieties of cauliflower (Table 1 and Fig. 1). The higher plant height (36.31 cm), number of leaves per plant (9.12), length of the largest leaf (30.32 cm), breadth of the largest leaf (13.27 cm) was recorded from BARI Fulkopi-2 at 60 days after transplanting (DAT) and the lower plant height (33.33 cm), number of leaves per plant (8.94), length of the largest leaf (29.93 cm), breadth of the largest leaf (12.28 cm) was recorded from BARI Fulkopi-1 (RUPA) at 60 DAT (Table 1). The observed differences in plant height, number of leaves per plant, length of the largest leaf, breadth of the largest leaf of varieties might be due to the genotypic character of each variety and this character might be genetically controlled. Srivastava et al. (2011) and Gabhale et al. (2014) also reported similar findings in cauliflower.



**Figure 1.** Effects of varieties on yield of cauliflower. Vertical bar indicates the LSD at 5% level of significance. Here, V1= BARI Fulkopi-1 (RUPA), and V2= BARI Fulkopi-2

The longer stem length (6.70 cm) and curd diameter (9.21 cm) were recorded at BARI Fulkopi-2 while the shorter stem length (5.86 cm) and curd diameter (8.85 cm) were recorded BARI Fulkopi-1 (RUPA). The observed differences in stem length and curd diameter might be due to the genotype and phenotype of each variety. The results of the experiment sup-

port the findings of Gabhale et al. (2014) and Singh et al. (2015). Yield was also significantly influenced by cauliflower cultivars (Table 1). BARI Fulkopi-2 gave higher individual curd weight (211.73 g), yield per plot (1.91 kg), yield per hectare (19.05 t), whereas the lower individual curd weight (195.86 g), yield per plot (1.76 kg), per hectare (17.62 t) were obtained from BARI Fulkopi-1 (RUPA) (Table 1 and Fig. 1). The differences in yield and yield contributing characters of cauliflower could be due to the genotypic characters of two varieties. Larger size curd and higher yield of cauliflower closely correlates with the average and total curd weight, which could be genetically controlled. Srivastava et al. (2011) and Gabhale et al. (2014) also reported similar findings in cauliflower.

### 3.2 Effect organic manures

It was found that organic manures had significant influence on all the vegetative and yield contributing characters of cauliflower under study (Table 2 and Fig. 2). The highest plant height (45.52 cm), number of leaves per plant (10.83), length of the largest leaf (39.91 cm), breadth of the largest leaf (16.59 cm) were recorded when T4 (cowdung @ 4 t/ha+ mustard oil cake @ 0.25 t/ha +poultry manure 2 t/ha) was applied whereas the lowest plant height at (25.07 cm), number of leaves per plant (8.47), length of the largest leaf (21.69 cm), breadth of the largest leaf (8.97 cm) were recorded from T0 (control) at 60 DAT (Table 2). The utmost augment in vegetative growth of cauliflower under these treatments is supported by nitrogen supply especially through organic manures, which accelerates the synthesis of amino acids which might have indirectly exhibited increase in plant height, number of leaves per plant, length of the largest leaf and breadth of the largest leaf. Kumar et al. (2013) also reported similar findings in case of plant height, number of leaves per plant, length of the largest leaf and breadth of the largest leaf.

The maximum length of stem (7.96 cm) and curd diameter (13.57 cm) were recorded when T4 (cowdung @ 4 t/ha + mustard oil cake @ 0.25 t/ha +poultry manure 2 t/ha) was applied and the minimum length of stem (4.06 cm) and curd diameter (4.60 cm) were recorded from T0 (control) (Table 2). It was revealed that stem length and curd diameter increased with organic manure application. This might be due to slow and continuous nutrient supply. It helps to store energy, cell division and cell enlargement. The results of the experiment support the findings of Murlee et al. (2007) and Ahmed (1999). Maximum individual curd weight (266.83 g), yield per plot (2.40 kg) and per hectare (24.01 t) were recorded at T4 (cowdung @ 4 t/ha + mustard oil cake @ 0.25 t/ha + poultry manure 2 t/ha) and the minimum individual curd weight (155.50 g), yield per plot (1.40 kg) and per hectare (13.99 t) were recorded at T0 (control) (Ta-

ble 2 and Fig. 2). The higher dose of mixed organic manures provided the plants with enough nutrient components which facilitated synthesis of metabolites and activation of certain enzymes that resulted higher yield. This could also be due to the effects of different organic manures on germination, growth, flowering and yields of plants (Rashid, 2019). This finding is agreed with the result of other researchers in cauliflower (Bhardwaj et al., 2000; Simarmata et al., 2017).

### 3.3 Combined effects of varieties and organic manures

Result showed that combined effects of varieties and organic manures had significant influence on all the growth parameters of cauliflower under study (Table 3 and Fig. 3). The highest plant height at (47.26 cm), number of leaves per plant (11.22 cm), length of the largest leaf (39.93 cm), breadth of the largest leaf (17.41 cm) were recorded when V2T4 (cowdung @ 4 t/ha+ mustard oil cake @ 0.25 t/ha +poultry manure 2 t/ha with BARI Fulkopi-2) was applied whereas the lowest plant height at (23.52 cm), number of leaves per plant (8.22), length of the largest leaf (20.26 cm), breadth of the largest leaf (7.59 cm) were recorded from V1T0 (Control with BARI Fulkopi-1 (RUPA) (Table 3). In comparison with mixed organic manures treatment in farmland denoted that mixed organic manures increased the soil concentrations of organic carbon, nitrogen, phosphorus, and potassium that lead to rapid vegetative growth in case of mixed organic manures in treatment (T4). Islam et al. (2020) also reported similar findings in case of plant height, leaf spread of plant and length of largest leaf in their study. The results of the experiment partially support the findings of Ali et al. (2018).

The maximum length of stem (8.41 cm) was recorded at V2T4 (cowdung@ 4 t/ha + mustard oil cake @ 0.25 t/ha + poultry manure 2 t/ha with BARI Fulkopi-2) and minimum length of stem (3.96 cm) was recorded at V1T0 (control with BARI Fulkopi-1 (RUPA) (Table 3). It might be due to increased metabolic activities resulting higher metabolite accumulation that lead to increase the length and number of roots. More number of roots absorbs more nutrients from soil, which makes the stem of cauliflower plant longer and thicker by applying mixed organic manures treatment as compared to control. These findings are in agreement with the observation of Azad (2000) who reported that application of manure increased length and diameter of stem as well as number of roots and fresh weight of roots. The results of the experiment support the findings of Singh et al. (2015).

Maximum individual weight of curd (277.66 g), yield per plot (2.50 kg) and per hectare (24.99 ton) were recorded at V2T4 (cowdung @ 4 t/ha+ mus-

**Table 1.** Main effect of varieties on growth and yield contributing characters of cauliflower

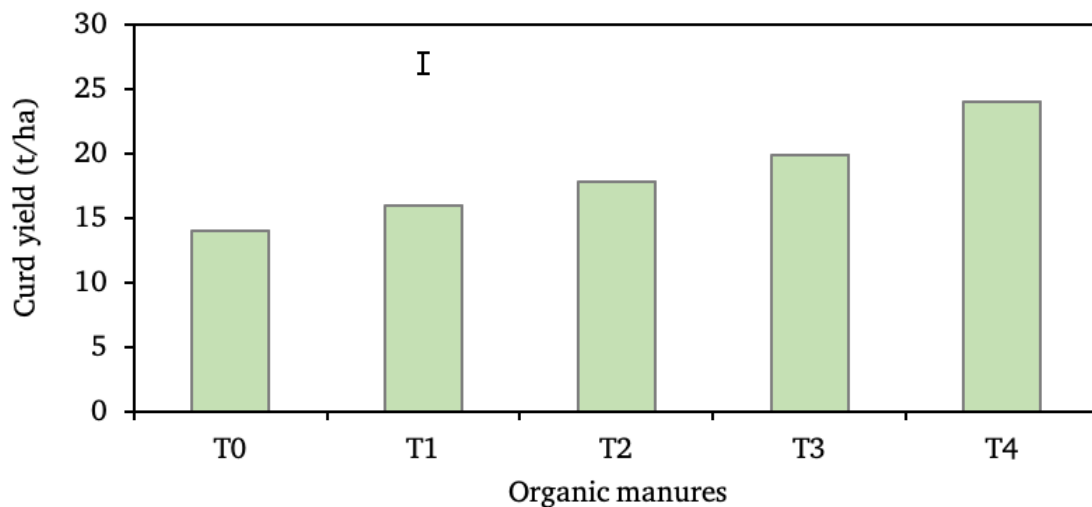
Variety	PH <sup>†</sup> (cm)	Leaves/ plant <sup>†</sup>	LLL <sup>†</sup> (cm)	LLB <sup>†</sup> (cm)	Stem length (cm)	Curd dia (cm)	Ind. curd wt. (g)	Curd yield (kg/plot)
V1	33.33	8.94	29.93	12.28	5.86	8.85	195.86	1.76
V2	36.31	9.12	30.32	13.27	6.7	9.21	211.73	1.91
LSD0.01	1.09	0.2	0.12	0.33	0.17	0.14	4.36	0.03
Sig. level	**	**	**	**	**	**	**	**

\*\* = Significant at 1% level of probability; V1= BARI Fulkopi-1 (RUPA), V2= BARI Fulkopi-2; PH = plant height, LLL = largest leaf length, LLB = largest leaf breadth; <sup>†</sup> data were recorded @ 60 days after transplanting (DAT)

**Table 2.** Main effect of organic manures on growth and yield contributing characters of cauliflower

Organic manures	PH <sup>†</sup> (cm)	Leaves/ plant <sup>†</sup>	LLL <sup>†</sup> (cm)	LLB <sup>†</sup> (cm)	Stem length (cm)	Curd dia (cm)	Ind. curd wt. (g)	Curd yield (kg/plot)
T0	25.07	8.47	21.69	8.97	4.06	4.6	155.5	1.4
T1	25.7	8.69	22.43	9.33	5.43	6.54	177.66	1.6
T2	32.61	8.94	30.31	13.05	6.74	8.83	198	1.78
T3	42.87	10	36.28	16.7	7.2	12.17	221	1.99
T4	45.52	10.83	39.91	16.59	7.96	13.57	266.83	2.4
LSD0.01	1.73	0.32	0.19	0.51	0.27	0.23	6.9	0.05
Sig. level	**	**	**	**	**	**	**	**

\*\* = Significant at 1% level of probability. T0 = (Control), T1 = Cowdung @ 20 t/ha, T2 = Mustard oilcake @ 0.5 t/ha, T3 = Poultry manure @ 15 t/ha, T4 = Cowdung+ Mustard oilcake+ Poultry manure @ 4 t/ha + 0.25 t/ha + 2 t/ha; PH = plant height, LLL = largest leaf length, LLB = largest leaf breadth; <sup>†</sup> data were recorded @ 60 days after transplanting (DAT)

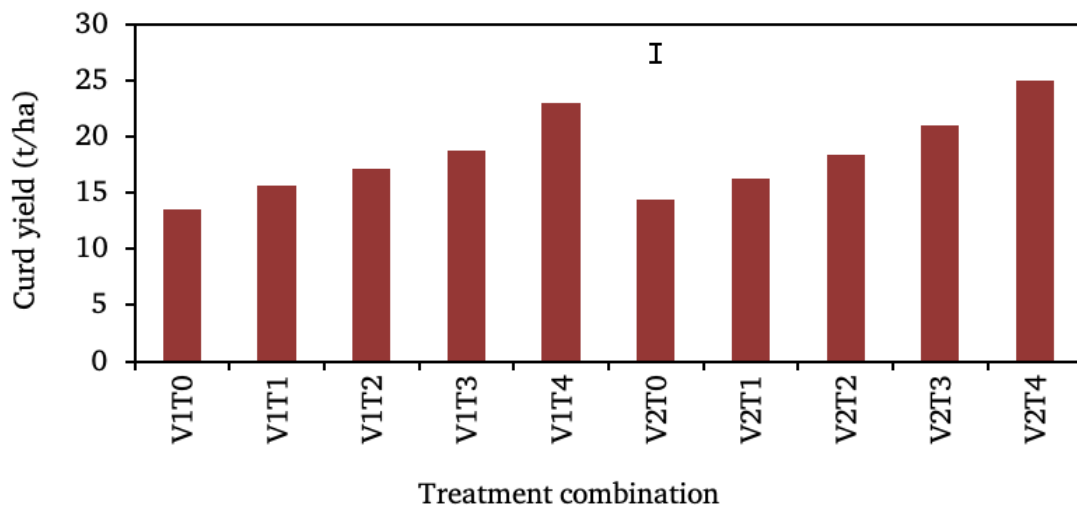


**Figure 2.** Effects of organic manures on yield of cauliflower. Vertical bar represents LSD at 5% level of significance. T0 = (Control), T1 = Cowdung @ 20 t/ha, T2 = Mustard oilcake @ 0.5 t/ha, T3 = Poultry manure @ 15 t/ha, T4 = Cowdung+ Mustard oilcake+ Poultry manure @ 4 t/ha + 0.25 t/ha + 2 t/ha

**Table 3.** Combined effects of varieties and organic manures on on growth and yield contributing characters of cauliflower

Treatment combination	PH <sup>†</sup> (cm)	Leaves/ plant <sup>†</sup>	LLL <sup>†</sup> (cm)	LLB <sup>†</sup> (cm)	Stem length (cm)	Curd dia (cm)	Ind. curd wt. (g)	Curd yield (kg/plot)
V1T0	23.52	8.22	20.26	7.59	3.96	4	150.33	1.35
V1T1	25.81	8.81	23.52	9.22	5.22	7.07	174	1.57
V1T2	35.33	9.22	31.59	13.98	5.93	9	190.66	1.72
V1T3	40.22	9.89	35.56	16.1	6.67	13.11	208.33	1.88
V1T4	43.78	10.44	39.89	16.33	7.52	12.89	256	2.3
V2T0	27.89	8.73	23.11	10.34	4.15	4.11	160.66	1.45
V2T1	33.78	9.07	22.89	9.99	5.63	6	181.33	1.63
V2T2	34.22	8.44	30.22	12.61	7.56	8.67	205.33	1.85
V2T3	45.52	10.44	37	17.3	7.74	11.22	233.66	2.11
V2T4	47.26	11.22	39.93	17.41	8.41	14.26	277.66	2.5
LSD0.01	2.44	0.46	0.27	0.73	0.38	0.32	9.76	0.07
Sig. level	**	**	**	**	**	**	**	**

\*\* = Significant at 1% level of probability. V1= BARI Fulkopi-1 (RUPA), V2= BARI Fulkopi-2, T0 = (Control), T1 = Cowdung @ 20 t/ha, T2 = Mustard oilcake @ 0.5 t/ha, T3 = Poultry manure @ 15 t/ha, T4 = Cowdung + Mustard oilcake + Poultry manure @ 4 t/ha + 0.25 t/ha + 2 t/ha; PH = plant height, LLL = largest leaf length, LLB = largest leaf breadth; <sup>†</sup> data were recorded @ 60 days after transplanting (DAT)



**Figure 3.** Effects of varieties and organic manures on yield of cauliflower. Vertical bar represents LSD at 5% level of significance. V1= BARI Fulkopi-1 (RUPA), V2= BARI Fulkopi-2, T0 = (Control), T1 = Cowdung @ 20 t/ha, T2 = Mustard oilcake @ 0.5 t/ha, T3 = Poultry manure @ 15 t/ha, T4 = Cowdung+ Mustard oilcake+ Poultry manure @ 4 t/ha + 0.25 t/ha + 2 t/ha

tard oil cake @ 0.25 t/ha + poultry manure 2 t/ha with BARI Fulkopi-2) while the minimum individual curd weight (150.33 g), yield per plot (1.503 kg) and per hectare (13.53 t) were recorded at V1T0 (control with BARI Fulkopi-1 (RUPA) (Table 3 and Fig. 3). This might be due to the combined application of organic manures with better varieties enhanced yield of cauliflower. The results of the experiment support the findings of Sharma and Sharma (2010) and Sharma (2016).

## 4 Conclusion

Results indicated that varieties and organic manures had significant effects on growth and yield of cauliflower. Higher plant height, number of leaves per plant, length of the largest leaf, breadth of the largest leaf, stem length, curd diameter and curd yield were obtained from BARI Fulkopi-2 and lower plant height, number of leaves per plant, length of the largest leaf, breadth of the largest leaf, stem length, curd diameter and curd yield were obtained from BARI Fulkopi-1 (RUPA). The highest plant height, number of leaves per plant, length of the largest leaf, breadth of the largest leaf, stem length, curd diameter and curd yield were obtained from combined treatment of T4 (cowdung @ 4 t/ha + mustard oil cake @ 0.25 t/ha + poultry manure 2 t/ha). The highest marketable yield was obtained from V2T4. In conclusion, combined application of cowdung @ 4 t/ha + mustard oil cake @ 0.25 t/ha + poultry manure 2 t/ha along with BARI Fulkopi-2 could be used for increasing the growth and yield of cauliflower.

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## Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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