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Influence of FYM, biochar and biofertilizers on growth, yield, quality and economics of cauliflower (*Brassica oleracea* L. var. *botrytis*) cv. Jyoti

Amit Kumar Sharma, Vijay Bahadur, Saket Mishra, Alok Kumar Mishra and Mashetty Rakesh Kumar

Abstract
A Research was carried out under Prayagraj agro-climatic conditions at the experimental field of Department of Horticulture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Prayagraj, U.P during the year 2021 and 2022. The experiment was designed in a randomized block design with consisting 17 treatments and 3 replications. The seventeen treatments were allocated randomly to each plot. The primary objective of this study was to compare the growth and yield of cauliflower grown under different levels of Inorganic fertilizers, organic manures, and biofertilizers. maximum plant height noted in treatment T_4 (13.43, 36.10 and 46.50 cm at 30, 45 and 60 DAS, respectively), maximum number of leaves also noted in treatment T_4 (7.65, 11.55 and 19.61 at 30, 45 and 60 DAS, respectively) and were all reported in T4 (Biochar 20t + 75% NPK + PSB + Azotobacter) over both years and also the pooled analyzed data. On the other hand, T_{17}-100% NPK (Control) had the lowest values for these indicators. In relation to yield attributes maximum diameter of curd (17.34 cm), weight of trimmed curd T_4 (1050.60 g) total weight of plant without roots (40.50 g), curd yield per plot (8.00 kg/plot), and yield per hectare (35.56 t/ha) during both the years and pooled were recorded in T_4- Biochar 20t + 75% NPK + PSB + *Azotobacter*. Whereas the minimum value regarding these parameters were recorded in T_{17}-100% NPK (Control).

Keywords: Cauliflower, organic manure, FYM, biochar, inorganic fertilizers, growth, yield, azotobacter and PSB

1. Introduction

The cauliflower (*Brassica oleracea L. var. botrytis*) descended from a single wild predecessor *Brassica oleracea* L. var. *sylvestris* through introgression, mutation, human selection and adaptation. A cauliflower is named after two Latin words: caulis, which means cabbage and floris which means flower. "Curd" is a highly suppressed "prefloral fleshy apical meristem" used as a vegetable, soup, and pickle throughout the country (Choudhury, 2006). Originally from southern Europe in the Mediterranean region, the crop was introduced to India in 1822 from England (Chatterjee, 1986) [18]. A tender curd (aborted floral meristem) is used as a vegetable, soup and pickle all over the country (Choudhury, 1996) [20]. Cauliflower is cultivated in India on 470.3 thousand hectares with a production of 9436.7 thousand MT and productivity of 19.7 tons per hectare. In Madhya Pradesh grown cauliflower in area about 61.2 thousand hectares with a production of 1368.7 thousand metric tonnes and productivity 22.4 t/ha (Anonymous, 2022). Cole crops are plants which belong to the mustard family and which are descendants of wild cabbage. The cauliflower (*Brassica oleracea L. var. botrytis*) descended from a single wild predecessor *Brassica oleracea* L. var. *sylvestris* through introgression, mutation, human selection and adaptation. A cauliflower is named after two Latin words: caulis, which means cabbage and Floris which means flower. "Curd" is a highly suppressed "prefloral fleshy apical meristem" used as a vegetable, soup, and pickle throughout the country (Choudhury, 2006). Originally from southern Europe in the Mediterranean region, the crop was introduced to India in 1822 from England (Chatterjee, 1986) [18]. A tender curd (aborted floral meristem) is used as a vegetable, soup and pickle all over the country (Choudhury, 1996) [20]. Cauliflower is cultivated in India on 470.3 thousand hectares with a production of 9436.7 thousand MT and productivity of 19.7 tons per hectare. In Madhya Pradesh grown cauliflower in area about 61.2 thousand hectares with a production of 1368.7 thousand metric tonnes and productivity 22.4 t/ha (Anonymous, 2022).

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Thus, chemical fertilizers should be reduced to a minimum and replaced with biochar, manure, fertilizers and biofertilizers. An integrated plant nutrient system aims to sustain productivity while minimizing the impact of chemicals on soil health and the environment. In order to produce biochar, biomass, such as wood, manure, or leaves, must be burned in a controlled container with little or no available air. In technical terms, biochar is produced by the thermal decomposition of organic material at low temperatures (<70°C) and with limited oxygen supply. Adding organic and inorganic materials to biochar can improve soil properties and crop production since more nutrients will be added from enriching materials. Biochar is an important soil conditioner and buffer that can increase or decrease the pH of acidic and alkaline soils. Addition of biochar to the soil has been shown to reduce leaching losses of nitrogen and phosphorus, as well as decrease the bioavailability of contaminants in the soil. Utilization of biochar in horticulture crop production and its effect on soil properties in India is limited. The production, characterization, and use of biochar as a soil amendment are very limited. It is predicted that if biochar is used widely to improve soil fertility or to reduce carbon emissions, it could have a dramatic impact on society as well as on agriculture and horticulture world-wide.

Vegetable crops have been found to benefit greatly from the use of biofertilizers. In addition to reducing external inputs, biofertilizers improve the quality and quantity of internal sources. As the name implies, biofertilizers are preparations containing primarily active microorganisms in sufficient numbers, capable of fixing atmospheric nitrogen or solubilizing phosphorus otherwise unavailable to growing plants. These inputs contain microorganisms capable of mobilizing nutrients from non-usable to usable forms through a variety of biological processes. As a result, it increases the yield of plants by supplying nutrients like nitrogen, phosphorus, calcium, magnesium and zinc etc. Furthermore, they produce growth-promoting substances such as IAA, gibberellins, etc. Additionally, they are less expensive, eco-friendly, sustainable, do not require non-renewable sources of energy during their production, and improve growth and quality of crops by producing plant hormones. Since they are biocontrol agents, they control many plant pathogens and harmful microorganisms (Asokan *et al*., 2000) [6] and they produce substances that promote growth and reduce fungal growth (Das *et al*., 2006) [24]. Various biofertilizers commonly used are *Azotobacter*, *Azospirillum*, phosphate solubilizing bacteria, vesicular arbuscular mycorrhiza etc. *Azotobacter* (free living) and *Azospirillum* (associative symbiotic) are nitrogen fixing bacteria, fixes about 30 Kg N ha^{-1}.

2. Material and Methods

A study was conducted on cauliflower (*Brassica oleracea* L. var. *botrytis*) cv. Jyoti was carried out under Prayagraj agro-climatic conditions at the experimental field of Department of Horticulture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Prayagraj, U.P during the year 2021 and 2022. Randomized block design with consisting 17 treatments and 3 replications. The seventeen treatments were allocated randomly to each plot so that each plot received only one treatment within the replication during both years of experimentation. Table.1 Each treatment received a unique combination of inorganic fertilizers, organic manures (including FYM and Biochar), and biofertilizers (including Azotobacter and PSB). Growth attributes like Plant height (cm), number of leaves per plant and Yield attributes like diameter of curd (cm), weight of trimmed curd (g), total weight of plant without roots, curd yield per plot (Kg) & curd yield per hectare (t/ha) were all successfully measured to determine the best treatment combination for cauliflower cultivation.

Table 1: Treatment Details & Treatment combinations

Sr. No.	Treatment symbol	Combination
1.	T_1	Biochar 20t + 75% NPK
2.	T_2	Biochar 20t + 75% NPK + *Azotobacter*
3.	T_3	Biochar 20t + 75% NPK + PSB
4.	T_4	Biochar 20t + 75% NPK + PSB + *Azotobacter*
5.	T_5	FYM 20t + 75% NPK
6.	T_6	FYM 20t + 75% NPK + *Azotobacter*
7.	T_7	FYM 20t + 75% NPK + PSB
8.	T8	FYM 20t + 75% NPK + PSB + *Azotobacter*
9.	T_9	Biochar 30t + 50% NPK
10.	T_{10}	Biochar 30t + 50% NPK + *Azotobacter*
11.	T_{11}	Biochar 30t + 50% NPK + PSB
12.	T_{12}	Biochar 30t + 50% NPK + PSB + *Azotobacter*
13.	T_{13}	FYM 30t + 50% NPK
14.	T_{14}	FYM 30t + 50% NPK + *Azotobacter*
15.	T_{15}	FYM 30t + 50% NPK + PSB
16.	T_{16}	FYM 30t + 50% NPK + PSB + *Azotobacter*
17.	T_{17}	100% NPK (Control)

3. Results & Discussion

Statistics were used to analysed the observation of Kharif Cauliflower (*Brassica oleracea* L. var. *botrytis*) cv. Jyoti growth and yield characteristics. The analysis of the data reveals that the application of various levels of FYM, Biochar and biofertilizers significantly improved all the attributes. The data shows that the variances were significant since the F Cal value was higher than the F Tab value.

3.1 Growth attributes

The results of the observations regarding plant height (cm) are shown in Table 3; Fig 1, 2. From the data it was observed that plant height increased throughout the period of observation till the harvest stage during both the years (2021-22) of study. The results pertaining to plant height reveals that during 2020-21 the higher plant height (13.35, 35.70 and 46.00 cm at 30, 45 and 60 DAS, respectively) was determined in T_4- Biochar 20t + 75% NPK + PSB + *Azotobacter* which was observed statistically *at par* with T_{12}- Biochar 30t + 50% NPK + PSB + *Azotobacter* (34.80 and 45.00 cm at 45 and 60 DAS, respectively) and T_3- Biochar 20t + 75% NPK + PSB (44.02 cm at 60 DAS) and the lowest (6.30, 26.00 and 34.00 cm at 30, 45 and 60 DAS, respectively) recorded in T_{17}-100% NPK (Control). During 2022, the T_4- Biochar 20t + 75% NPK + PSB + *Azotobacter* had the higher plant height (13.50, 36.50 and 47.00 cm at 30, 45 and 60 DAS, respectively) which was observed statistically *at par* with T_{12} (35.50 and 46.10 cm at 45 and 60 DAS, respectively) and the lowest (6.35, 27.50 and 35.10 cm at 30, 45 and 60 DAS, respectively) recorded in T_{17}-100% NPK (Control). Pooled analysis of data displayed the maximum plant height noted in treatment T_4 (13.43, 36.10 and 46.50 cm at 30, 45 and 60 DAS, respectively). In the treatment T4, there was the maximum increase in the plant height, which could be attributed to the microbial inoculations being able to produce compounds that were promoting growth, which could have resulted in enhanced cell division and increased cell elongation. As a result, sufficient availability of nutrient will have a significant impact on the plant's growth, and in turn, this will result in the plant growing taller. Also, Sable and Bhamare (2007) reported similar results, stating that the combination of Azotobacter and Az spirillum increased the plant height. The findings are consistent with those of Laird *et al.* (2010). The results pertaining to number of leaves (Table 4.2 and Fig. 4.2) reveals that during 2021 the higher number of leaves (7.54, 11.45 and 19.34 at 30, 45 and 60 DAS, respectively) was determined in T_4- Biochar 20t + 75% NPK + PSB + *Azotobacter* which was observed statistically *at par* with T_{12}- Biochar 30t + 50% NPK + PSB + *Azotobacter* (7.51, 11.31 and 18.89 at 30, 45 and 60 DAS, respectively), T_3- Biochar 20t + 75% NPK + PSB (7.38, 11.25 and 18.65 at 30, 45 and 60 DAS, respectively), T_2- Biochar 20t + 75% NPK + *Azotobacter* (7.36, 11.23 and 18.54 at 30, 45 and 60 DAS, respectively) and T_{11}- Biochar 30t + 50% NPK + PSB (7.28 and 11.21 at 30 and 45 DAS, respectively) and the lowest (6.39, 10.19 and 15.76 at 30, 45 and 60 DAS, respectively) recorded in T_{17}-100% NPK (Control). During 2022, the maximum number of leaves (7.76, 11.65 and 19.88 at 30, 45 and 60 DAS, respectively) was determined in T_4- Biochar 20t + 75% NPK + PSB + *Azotobacter* which was observed statistically *at par* with T_{12}- Biochar 30t + 50% NPK + PSB + *Azotobacter* (7.65, 11.52 and 19.52 at 45 and 60 DAS, respectively), T_3- Biochar 20t + 75% NPK + PSB (7.62, 11.49 and 19.25 at 30, 45 and 60 DAS, respectively), T_2- Biochar 20t + 75% NPK + *Azotobacter* (7.57, 11.47 and 19.08 at 30, 45 and 60 DAS, respectively) and T_{11}- Biochar 30t + 50% NPK + PSB (7.54, 11.45 and 19.01 at 30, 45 and 60 DAS, respectively) and the lowest (6.67, 10.43 and 16.12 at 30, 45 and 60 DAS, respectively) recorded in T_{17}-100% NPK (Control). Pooled analysis of data displayed the maximum number of leaves noted in treatment T_4 (7.65, 11.55 and 19.61 at 30, 45 and 60 DAS, respectively) which was observed statistically *at par* with T_{12} (7.58, 11.42 and 19.21 at 30, 45 and 60 DAS, respectively), T_3 (7.50 and 11.37 at 30 and 45, respectively) and T_2 (7.47, 11.35 and 19.21 at 30, 45 and 60 DAS, respectively) and minimum in treatment T_{17} (6.53, 10.31 and 15.94 at 30, 45 and 60 DAS, respectively). The maximum number of leaves in treatment T_4 could be attributed to the timely supply of nutrients, specifically nitrogen, which is required by the plants of this treatment for them to reach their maximum vegetative growth. By using bio-fertilizers in the soil, we may have been able to enhance the biological nitrogen fixation and the availability of phosphorus needed for strong vegetative growth by increasing the biological nitrogen fixation. Therefore, the treatment ultimately results in a greater number of leaves being produced in the end. It is obvious that there is a minimum number of leaves in the control treatment. This may be due to a lack of proper amount of nutrients required for the establishment of a larger number of leaves in the control treatment. This significant increase in number of leaves is in agreement with Prabhu *et al.*, 2003 and Wange and Kale, 2004.

3.2 Yield parameters

Table. 4; Fig 3 displays the collected data in terms of Diameter of curd (cm) during the year 2021-22, the maximum curd diameter was obtained in T_4- Biochar 20t + 75% NPK + PSB + *Azotobacter* (17.34 cm) which was statistically *at par* with T_{12}- Biochar 30t + 50% NPK + PSB + *Azotobacter* (17.20 cm), T_3- Biochar 20t + 75% NPK + PSB (17.12 cm), T_2- Biochar 20t + 75% NPK + *Azotobacter* (17.00 cm), T_{11}- Biochar 30t + 50% NPK + PSB (16.85 cm) and T_{10}- Biochar 30t + 50% NPK + *Azotobacter* (16.76 cm) and minimum was observed with T_{17}-100% NPK (Control) (15.34 cm). During 2022, curd diameter with maximum value (17.47 cm) being estimated in T_4- Biochar 20t + 75% NPK + PSB + *Azotobacter* which was statistically *at par* with T_{12}- Biochar 30t + 50% NPK + PSB + *Azotobacter* (17.32 cm), T_3- Biochar 20t + 75% NPK + PSB (17.25 cm), T_2- Biochar 20t + 75% NPK + *Azotobacter* (17.12 cm), T_{11}- Biochar 30t + 50% NPK + PSB (16.98 cm) and T_{10}- Biochar 30t + 50% NPK + *Azotobacter* (16.89 cm) and minimum was observed with T_{17}-100% NPK (Control) (15.47 cm). For the pooled mean values, T_4- Biochar 20t + 75% NPK + PSB + *Azotobacter* had the maximum value (17.41 cm) which was statistically *at par* with T_{12} (17.26 cm), T_3 (17.19 cm) and T_2 (17.06 cm) and T_{17} reported the minimum (15.41 cm) curd diameter. For the 1st year in 2021, the data on weight of trimmed curd of used treatments ranged from 500.00 to 980.30 g (Table 4.4 and Fig. 4.4). Maximum weight of trimmed curd (980.30) was recorded in T_4- Biochar 20t + 75% NPK + PSB + *Azotobacter* while, the minimum (500.00 g) was recorded with the treatment T_{17}-100% NPK (Control). In 2022 also, the maximum weight of trimmed curd was registered for T_4 (1050.60 g) and minimum with T_{17} (520.20 g). Pooled analysis of data revealed the similar trend, where, treatment T_4 had the maximum weight of trimmed curd (1015.45 g) and minimum with the treatment T_{17} (510.10 g). With respect to total weight of plant without roots showed that during 2021, T_4- Biochar 20t + 75% NPK + PSB + *Azotobacter* had the maximum value (40.50 g), while the treatment T_{17}-100% NPK (Control) recorded the minimum (21.40 g). In the year 2022, it was observed maximum (38.40 g) in T_4- Biochar 20t + 75% NPK + PSB + *Azotobacter*, which differed significantly with all other treatment and minimum (20.50 g) in T_{17}-100% NPK (Control). Pooled analysis reveals similar trend with maximum value (39.45 g) being recorded with treatment T_4 and minimum (20.95 g) with treatment T_{17}. For the 1st year in 2021, the data on curd yield of used treatments ranged from 2.00 to 8.00 kg/plot. Maximum curd yield (8.00 kg/plot) was recorded in T_4- Biochar 20t + 75% NPK + PSB + *Azotobacter* while, the minimum (2.00 kg/plot) was recorded with the treatment T_{17}-100% NPK (Control). In 2022 also, the maximum curd yield was registered for T_4 (7.50 kg/plot) and minimum with T_{17} (1.80 kg/plot). Pooled analysis of data revealed the similar trend, where, treatment T_4 had the maximum curd yield (7.75 kg/plot) and minimum with the treatment T_{17} (1.90 kg/plot). Similar result findings T_4 is the best in terms of curd yield per plot (kg) due to the influential effect of fym, biochar and biofertilizers. A close perusal of data reveals that during 2021 the values for curd yield ranged from 8.89 to 35.56 t/ha. Maximum value of curd yield (35.56 t/ha) was recorded with T_4- Biochar 20t + 75% NPK + PSB + *Azotobacter*. The minimum value (8.89 t/ha) was recorded with T_{17}-100% NPK (Control). While during 2022, higher yield (33.33 t/ha) was registered with T_4- Biochar 20t + 75% NPK + PSB + *Azotobacter* and minimum (8.00 t/ha) with T_{17}-100% NPK (Control). Pooled analysis of data revealed the similar trend where the treatment T_4 had the maximum curd yield (34.44 t/ ha) and T_{17} the minimum (8.44 t/ha). There might be an increase in photosynthetic activity associated with plant growth and an increase in chlorophyll content. As a result of further application of biochar, the soil would have been able to improve the nutrient status and the water holding capacity of the soil (Rahila *et al.*, 2014). As a result of the fact that biochar contains a lower amount of nutrients as compared to FYM and other organic manures, as well as its high carbon content, the plant availability of nutrients was significantly reduced in the use of only biochar treatments, without enrichment. Therefore, it cannot be advised to recommend biochar alone without the addition of enrichment (Lehmann *et al.*, 2002).

Table 2: Effect of FYM, biochar and biofertilizer on plant height of cauliflower (*Brassica oleracea* L. var. *botrytis*) cv. Jyoti

Treatments	Plant Height (cm)								
	30 DAS			45 DAS			60 DAS		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
T_1	7.30	7.35	7.33	29.00	31.00	30.00	40.12	41.00	40.56
T_2	8.15	9.05	8.60	32.50	33.50	33.00	43.00	44.00	43.50
T_3	11.21	11.33	11.27	34.50	34.70	34.60	44.02	44.32	44.17
T_4	13.35	13.50	13.43	35.70	36.50	36.10	46.00	47.00	46.50
T_5	7.00	7.55	7.28	28.00	30.50	29.25	38.20	39.00	38.60
T_6	7.55	8.00	7.78	30.00	31.50	30.75	40.95	41.54	41.25
T_7	7.55	8.10	7.83	30.12	32.00	31.06	41.10	42.00	41.55
T_8	7.75	8.30	8.03	30.50	32.12	31.31	41.17	42.54	41.86
T_9	7.05	7.35	7.20	29.00	30.50	29.75	39.00	39.43	39.22
T_{10}	7.95	8.30	8.13	31.50	32.50	32.00	42.00	42.53	42.27
T_{11}	8.05	8.55	8.30	32.00	33.00	32.50	43.00	43.33	43.17
T_{12}	12.10	12.23	12.17	34.80	35.50	35.15	45.00	46.10	45.55
T_{13}	6.75	6.40	6.58	26.50	28.50	27.50	35.00	39.06	37.03
T_{14}	7.15	7.60	7.38	30.12	31.00	30.56	40.00	41.40	40.70
T_{15}	7.35	7.80	7.58	30.18	31.10	30.64	40.42	42.11	41.27
T_{16}	7.55	8.15	7.85	30.50	32.00	31.25	41.00	42.11	41.56
T_{17}	6.30	6.35	6.33	26.00	27.50	26.75	34.00	35.10	34.55
F – test	S	S	S	S	S	S	S	S	S
SEm±	0.09	0.10	0.07	0.51	0.37	0.32	0.74	0.58	0.60
CD at 5%	0.27	0.28	0.20	1.48	1.06	0.91	2.15	1.68	1.74

Table 3: Effect of FYM, biochar and biofertilizer on number of leaves of cauliflower (*Brassica oleracea* L. var. *botrytis*) cv. Jyoti

Treatments	Number of leaves/ plants								
	30 DAS			45 DAS			60 DAS		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
T_1	7.11	7.12	7.12	10.76	11.03	10.90	16.96	17.45	17.21
T_2	7.36	7.57	7.47	11.23	11.47	11.35	18.54	19.08	18.81
T_3	7.38	7.62	7.50	11.25	11.49	11.37	18.65	19.25	18.95
T_4	7.54	7.76	7.65	11.45	11.65	11.55	19.34	19.88	19.61
T_5	6.87	6.92	6.90	10.67	10.93	10.80	16.43	16.65	16.54
T_6	7.19	7.38	7.29	11.01	11.25	11.13	17.34	17.98	17.66
T_7	7.21	7.43	7.32	11.06	11.30	11.18	17.78	18.24	18.01
T_8	7.23	7.51	7.37	11.12	11.36	11.24	18.23	18.65	18.44
T_9	6.97	7.11	7.04	10.75	10.98	10.87	16.75	17.12	16.94
T_{10}	7.23	7.54	7.39	11.16	11.39	11.28	18.34	18.88	18.61
T_{11}	7.28	7.54	7.41	11.21	11.45	11.33	18.54	19.01	18.78
T_{12}	7.51	7.65	7.58	11.31	11.52	11.42	18.89	19.52	19.21
T_{13}	6.45	6.81	6.63	10.56	10.80	10.68	15.98	16.34	16.16
T_{14}	7.16	7.31	7.24	10.84	11.08	10.96	17.12	17.59	17.36
T_{15}	7.17	7.32	7.25	10.98	11.17	11.08	17.33	17.76	17.55
T_{16}	7.21	7.46	7.34	11.09	11.33	11.21	17.83	18.37	18.10
T_{17}	6.39	6.67	6.53	10.19	10.43	10.31	15.76	16.12	15.94
F – test	S	S	S	S	S	S	S	S	S
SEm±	0.10	0.09	0.07	0.15	0.15	0.10	0.24	0.34	0.20
CD at 5%	0.29	0.27	0.20	0.44	0.44	0.29	0.70	0.98	0.59

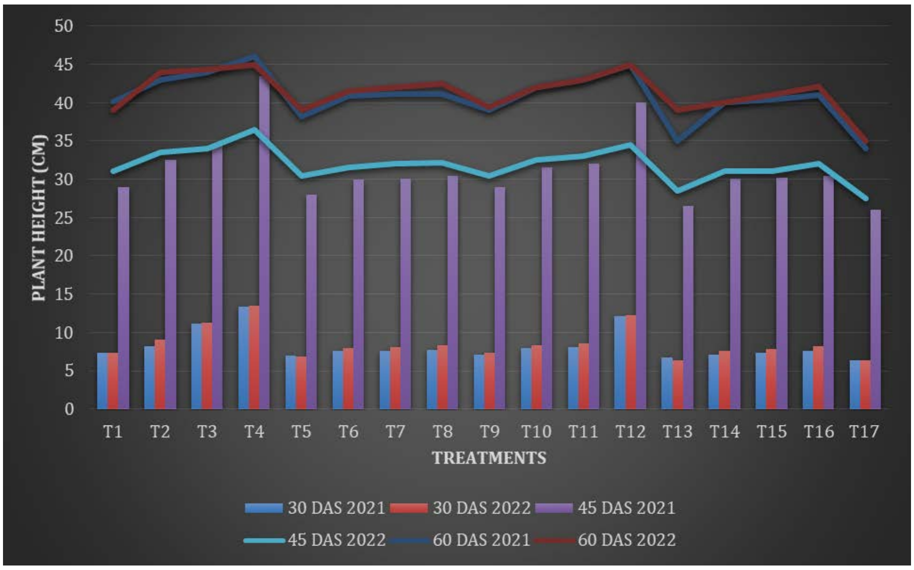

Fig 1: Effect of FYM, biochar and biofertilizer on plant height of cauliflower (*Brassica oleracea* L. var. *botrytis*) cv. Jyoti

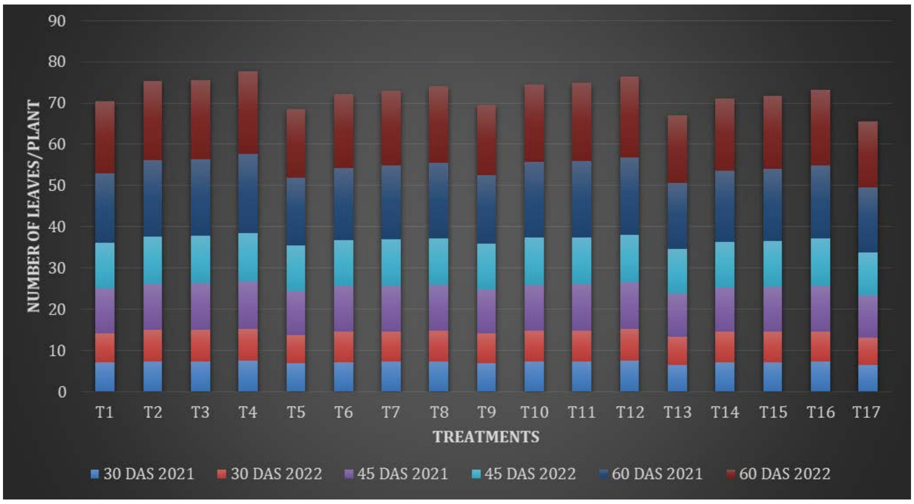

Fig 2: Effect of FYM, biochar and biofertilizer on number of leaves of cauliflower (*Brassica oleracea* L. var. *botrytis*) cv. Jyoti

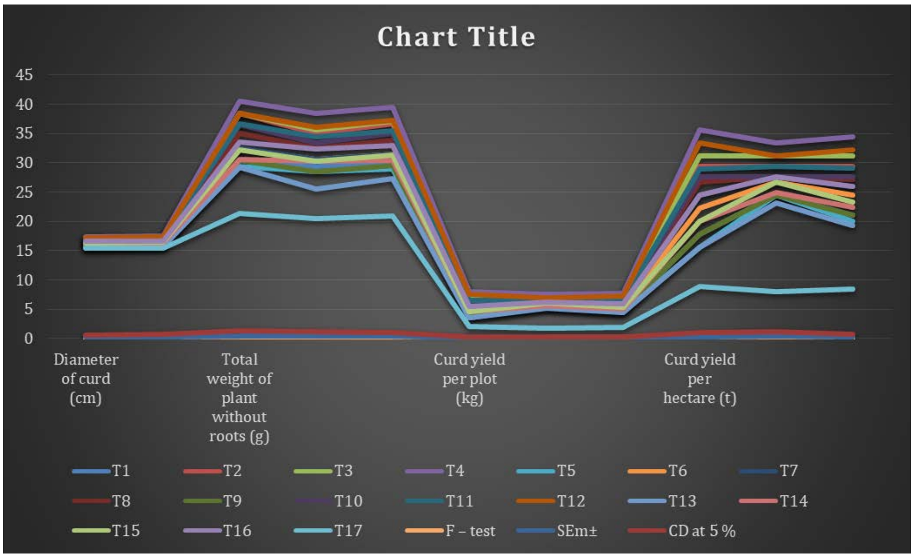

Fig 3: Effect of FYM, biochar and biofertilizer on Diameter of curd, Total weight of plant without roots, Curd yield per plot, Curd yield per plot of cauliflower (*Brassica oleracea* L. var. *botrytis*) cv. Jyoti

Table 4: Effect of FYM, biochar and biofertilizer on Diameter of curd, Total weight of plant without roots, Curd yield per plot, Curd yield per plot of cauliflower (*Brassica oleracea* L. var. *botrytis*) cv. Jyoti

Treatments	Diameter of curd (cm)		Total weight of plant without roots (g)			Curd yield per plot (kg)			Curd yield per hectare (t)		
	2021	2022	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
T_1	16.04	16.17	30.4	29.4	29.9	4	5.5	4.75	17.78	24.44	21.11
T_2	17	17.12	38.4	35	36.7	6.6	6.6	6.6	29.33	29.33	29.33
T_3	17.12	17.25	38.5	35.6	37.05	7	7	7	31.11	31.11	31.11
T_4	17.34	17.47	40.5	38.4	39.45	8	7.5	7.75	35.56	33.33	34.44
T_5	15.76	15.89	29.4	28.5	28.95	3.5	5.5	4.5	15.56	24.44	20
T_6	16.39	16.5	32.4	30.5	31.45	5	6	5.5	22.22	26.67	24.44
T_7	16.43	16.56	32.5	30.5	31.5	5.5	6.2	5.85	24.44	27.56	26
T_8	16.67	16.74	35	32.5	33.75	6	6.2	6.1	26.67	27.56	27.11
T_9	15.98	16.02	30.4	28.5	29.45	4	5.5	4.75	17.78	24.44	21.11
T_{10}	16.76	16.89	36.5	33.4	34.95	6.2	6.2	6.2	27.56	27.56	27.56
T_{11}	16.85	16.98	36.6	34.4	35.5	6.5	6.6	6.55	28.89	29.33	29.11
T_{12}	17.2	17.32	38.5	36	37.25	7.5	7	7.25	33.33	31.11	32.22
T_{13}	15.54	15.64	29.2	25.5	27.35	3.5	5.2	4.35	15.56	23.11	19.33
T_{14}	16.19	16.33	30.5	30.2	30.35	4.5	5.6	5.05	20	24.89	22.44
T_{15}	16.29	16.39	32.2	30.3	31.25	4.5	6	5.25	20	26.67	23.33
T_{16}	16.53	16.56	33.5	32.4	32.95	5.5	6.2	5.85	24.44	27.56	26
T_{17}	15.34	15.47	21.4	20.5	20.95	2	1.8	1.9	8.89	8	8.44
F – test	S	S	S	S	S	S	S	S	**S**	**S**	**S**
SEm±	0.21	0.22	0.46	0.39	0.34	0.11	0.09	0.08	0.32	0.42	0.24
CD at 5%	0.62	0.65	1.33	1.14	0.98	0.31	0.26	0.23	0.93	1.21	0.7

4. Conclusion

Based on the findings of the study, it was concluded that the different treatments of FYM, biochar and biofertilizers had significant effect in terms of growth, yield and quality of cauliflower. In this experiment also showed, these treatments had significant impact of the soil nutrients status and economic feasibility of the cultivation of cauliflower. Treatment T_4 had performed better in terms of growth, yield and quality of cauliflower. The maximum plant height, number of leaves, diameter of curd, weight of trimmed curd, total weight of plant without roots, curd yield per plot and curd yield were observed in treatment T_4.

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