Effect of fertilizers and manures on the growth and yield of cauliflower

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Abstract: An experiment was set up in the Research Farm of Patuakhali Science and Technology University, during the rabi season of 2015 to evaluate the effect of fertilizers and manures on the growth and yield of cauliflower. The experiment was laid out in a Randomized Complete Block Design (RCBD) with seven treatment and three replications. The treatments were T_1 (Control), T_2 (100% NPKS) (180:80:180:28), T_3 (70%NK), T_4 (70% NK + 3 ton CD), T_5 (70% NK + 5 ton CD), T_6 (70%NK + 2 ton PM) and T_7 (70%NK + 3ton PM). The unit plot size was 6.0 m^2 (3.0 m x 2 m). Data were collected on plant height, leaf area, TDM(Total Dry Matter), while yield contributing attributes *viz.* curd weight with leaf, pure curd weight, curd height, marketable yield and biological yield were recorded. Fertilizer and manure played an important role on morphological characters of Cauliflower. T_7 (70% NK + 3 ton PM) treatment gave highest and T_1 (Control) gave lowest values in case of plant height (cm),leaf area of plant(cm^2) ,TDM (g),stem length (cm),curd weight with leaf (g), pure curd height (cm),and yield(t ha^{-1}), biological yield (t ha^{-1}) and harvest index%. From the present findings it was concluded that T_7 treatment is the most suitable to achieve the maximum return from the cauliflower because application of organic manure saved more than 30% of the inorganic fertilizer. Poultry manure not only gives higher growth and yield but also improves soil health which is necessary for sustainable crop production.
Key words: Cauliflower, integrated use of organic and inorganic fertilizers, growth and yield.

Introduction

Cauliflower (*Brassica oleracea* var. *botrytis* sub var. *cauliflora*) is one of the most important cole crop belongs to the family Brassicaceae. It is widely cultivated all over Bangladesh and abroad for its special nutritive values, high productivity and wider adaptability under different ecological conditions. Nutrient management is one of the most important factors that greatly affect the growth, development and yield of cauliflower. Inorganic fertilizer can be used to supply nutrients to plants quickly. Manures improve plant growth and development by improving soil health by releasing nutrients. Continuous use of chemical fertilizer degrades soil fertility; while manure alone cannot supply the required amount of nutrients to plants. So we need to use integrated nutrient management approach. Nitrogen encourages the vegetative development of plants by imparting a healthy green color to the leaves. It also helps in root and shoot development. Potassium enhances the ability of the plants to resist disease, insect attack, cold and other adverse conditions. Poultry manure and cowdung are the two good sources of organic manure. The use of poultry manure and cowdung improve soil health which is necessary for sustainable crop production. Therfore, the present research work was done to observe the effect of fertilizers and manures on the growth and yield of cauliflower.

Materials and Methods

The experiment was conducted at the Research Farm of Patuakhali Science and Technology University, Dumki, Patuakhali, during the period from 3rd October 2015 to 2nd January 2016. The area covered by Ganges Tidal Flood Plains under the AEZ-13. The general soil type of the experimental field is silty clay loam. Top soil is silty clay in texture. Organic matter content is very low and soil pH varies around 6.8. The land is above flood level and well drained. The crop variety used in this experiment was Cauliflower (*Brassica oleracea* var. botrytis sub-var. cauliflora cv. Snowball). The seeds were healthy, pure, well mature and free from mixture of the other seeds, weed seeds and extraneous materials. The seedlings were raised at the Germplasm Centre, Horticulture Farm, Patuakhali Science and Technology University, Dumki, Patuakhali. The size of seedbed was 3m × 1m. Seeds were sown on 1st September 2015. Germination of seeds was completed within seven days. The experiment was laid out in a Randomized Complete Block Design (RCBD) with seven treatment and three replications. The treatments were T_1 (Control), T_2 (100% NPKS) (180:80:180:28), T_3 (70%NK), T_4 (70% NK + 3 ton CD), T_5 (70% NK + 5 ton CD), T_6 (70%NK + 2 ton PM) and T_7 (70%NK + 3ton PM). The initial soil contains organic matter 1.20%, total N 0.085 %, available P 12.9 ppm, available S 6.5 ppm and exchangeable K 0.068 (meq/100g soil). So the amount of P and S that was required for plant growth, was supplied from soil to plants so that the other treatments (T2, T3, T4, T5, T6 and T7) contained only N and K. Total number of plot was 21, individual plot size was 3 m × 2 m (6.0 m^2), plot to plot distance was 0.5 m and block to block distance was 1.0 m. Manures and fertilizers were applied according to the experimental plot considering the recommended fertilizer doses for cauliflower as per treatment. The total amount of cowdung (3 & 5 tons), poultry manure (2 & 3tons), TSP (240g/plot), Gypsum (93g/plot) and 1/3rd of urea(133.3g/plot) and MoP (122.4g/plot) was applied as basal dose at the time of final land preparation and remaining 2/3rd of N and K were applied in two equal installments at 30 and 50 days after transplanting. Healthy and uniform sized 30 days old cauliflower seedlings were transplanted to the main field maintaining spacing 60 cm × 45 cm and different intercultural operations were done properly.

Five plants in each plot were randomly selected to measures morphological characters, growth character, yield and yield contributing characters. Plant height was measured in centimeter (cm) by a meter scale at 30, 40, 50, 60 days after transplanting (DAT) and at harvest from the point of attachment of stem to the ground level up to the tip of the leaves. Leaf area was measured by an automatic leaf area meter. The plant parts were detached and were kept separately in oven at 80±2^O C for 72 hours. The oven dried samples were weighed for dry matter production. The total dry matter production was calculated from the summation of shoots and roots.

Root portion of cauliflower plant was separated from the stem and the rest portion of the plant was weighted by using a weighing balance then it was expressed in kilogram. Only quality curd that was ready for marketing for considered. It was expressed in ton per hectare by converting the total yield of curd per plant of marketable weight of curd. Curd and leaf yields are altogether regarded as biological yield. The biological yield was calculated with the following formula:

Biological yield= Curd yield (t ha^{-1}) + Leaf yield (t ha^{-1})

Harvest index **(%)** denotes the ratio of economic yield to biological yield and was calculated with the following formula. Harvest index (%) = {(Curd yield ÷ Biological yield) × 100}. The data obtained from experiment on various parameters were statistically analyzed in MSTAT–C computer program. The mean values for all the parameters were calculate and the analysis of variance for the characters was accomplished by Duncan's Multiple Range Test (DMRT) and the significance of difference between pair of means was tested by the Least Significant Differences (LSD) at 5 % levels of probability (Gomez and Gomez, 1984).

Results and Discussion

Effect of manures and fertilizers on various morphological characters of cauliflower

Plant height: There was positive and significant difference among the different levels of treatment in respect of plant height at particular days after transplanting. The results of plant height at 30, 40, 50, 60 DAT and at harvest due to the application of different organic manure and fertilizer. At 30 DAT, the plant height ranged from 16.34 cm to 9.623 cm. The tallest plant height (16.34 cm) was found in T_7 (70 % NK+ 3 ton PM) treatment which was statistically similar with that of T_2 (100% NPKS), T_4 (70 % NK+ 3 ton CD), T_5 (70 % NK+ 5 ton CD) and T_6 (70 % NK+ 2 ton PM) treatments. The shortest plant (9.623 cm) was observed in control treatment (Table 1).

Table1. Effect of manure and fertilizer on plant height of Cauliflower

Treatment	Plant height (cm) at different DAT				
	30	40	50	60	Harvest
T_1: Control ($N_0P_0K_0S_0$)	9.623b	12.84e	15.84e	17.88d	19.20f
T_2: 100 % NPKS	15.51a	23.51ab	30.84ab	36.39a	39.22ab
T_3: 70 % NK	14.50a	19.07d	23.07d	26.10c	30.00e
T_4:70 % NK+ 3 ton CD	14.71a	21.97c	27.7c	30.96b	33.03d
T_5:70 % NK+ 5 ton CD	15.39a	21.84c	27.81c	31.97b	34.95c
T_6: 70 % NK+ 2 ton PM	15.36a	23.33b	30.13b	36.53a	38.20b
T_7: 70 % NK+ 3 ton PM	16.34a	24.35a	31.37a	37.85a	40.00a
CV (%)	10.18	12.23	10.52	11.43	5.10
Level of significance	**	**	**	**	*

**= significant at 1% level of probability and *= significant at 5% level of probability. Figures followed by same letter(s) are statistically similar as per DMRT at 5%. CD = Cowdung and PM = Poultry manure

In 40 DAT, the plant height ranged from 24.35 cm to 12.84 cm and the highest plant height (24.35 cm) was found in T_7 (70 % NK+ 3 ton PM) treatment which was statistically similar with T_2 (100%NPKS) treatment. The treatments T_2 (100% NPKS) and T_6 (70 % NK+ 2 ton PM) identical to each other's and the treatments T_4 (70 % NK+ 3 ton CD) and T_5 (70 % NK+ 5 ton CD) identical to each others. The lowest plant height (12.84 cm) was obtained in control treatment. At 50 DAT, the plant height ranged from 31.37 to 15.84 cm. The maximum plant height 31.37 cm was found in T_7 (70 % NK+ 3 ton PM) treatment which was statistically similar with T_2 treatment. TheT_2 (100% NPKS) and T_6 (70 % NK+ 2 ton PM) identical to each others. On the other hand treatment T_4 (70 % NK+ 3 ton CD) and T_5 (70 % NK+ 5 ton CD) statistically similar. The shortest plant (15.84 cm) was observed in T_1 (control) treatment. Incase of 60 DAT, the plant height ranged from 37.85 cm to 17.88 cm. At 60 DAS the maximum plant height (37.85 cm) was found in T_7 (70 % NK+ 3 ton PM) treatment which was statistically similar to T_2 (100% NPKS) and T_6 (70 % NK+ 2 ton PM) treatments. The treatments T_4 (70 % NK+ 3 ton CD) and T_5 (70 % NK+ 5 ton CD) identical to each other. The lowest plant height (17.88 cm) was found in control treatment which was also statistically differed from other treatments. After harvest, the plant height ranged from 40.00 cm to 19.20 cm. The tallest plant (40.00 cm) was produced in T_7 (70 % NK+ 3 ton PM) treatment which was statistically similar to T_2 (100 % NPKS) treatment and shortest plant (19.20 cm) was found in control (Table 1). These results indicated that, plant height was gradually increased due to the increase of fertilizer and manures. This may due to the availability of more nitrogenous compounds to the plant from organic and inorganic sources together, which increases the foliage of the plant and thereby increases the photosynthesis. Nitrogen being a constituent of amino acids, nucleotides, nucleic acids, a number of co-enzymes, auxins, cytokinins and alkaloids, induces cell elongation, cell enlargement and cell division. Similar results have also been reported by Sangeeta *et al.* (2014) in cauliflower, Meena and Paliwal (2003) in cabbage, Patil *et al*. (2003) in knol khol, Bhardwaj *et al*. (2007) in broccoli and Harish (2009) in brinjal. The use of poultry manure not only gives higher plant height but also improves soil health which is necessary for sustainable crop production by maintaining soil fertility and productivity.

Leaf area of plant (cm^2): Effect of different treatment on the leaf area of plant was found to be statistically significant for cauliflower used in the experiment. Leaf area of plant increased continuously up to 60 DAT. The results of leaf area of plant at 30, 40, 50, 60 and harvest at days after transplanting have been presented **(**Table 2**)**. At 30 DAT, the leaf area of plant ranged from11.19 cm^2 to 37.31 cm^2. At 30 DAT the maximum leaf area of plant (37.31 cm^2) was found in T_7 (70 % NK+ 3 ton PM) treatment which was significantly similar that of T_2 (100% NPKS) and lowest leaf area of plant (11.19cm^2) was found in control treatment (T_1).

The leaf area of plant ranged from 42.29 cm^2 to 14.87 cm^2. The maximum the leaf area of plant of plant (42.29cm^2) was recorded from T_7 (70 % NK+ 3 ton PM) which was statistically similar with T_2 (100% NPKS) and T_6 (70 % NK+ 2 ton PM) treatments. The treatment T_2 (100% NPKS), T_4 (70 % NK+ 3 ton CD) and T_5 (70 % NK+ 5 ton CD) were statistically identical to each other .On the other hand the minimum the leaf area of plant (14.87cm2) was recorded from T_1 which was closely followed by T_3 treatment at 40 DAT.

Table 2. Effect of manure and fertilizer on number of leaves area per plant of Cauliflower

Treatment	Leaf area (cm^2) per plant at different DAT				
	30	40	50	60	Harvest
T_1: Control ($N_0P_0K_0S_0$)	11.19d	14.87d	23.79e	29.13c	32.15d
T_2: 100 % NPKS	33.64a	36.23ab	53.48ab	62.01a	68.65a
T_3: 70 % NK	13.36c	21.55cd	30.14de	49.58b	52.59c
T_4:70 % NK+ 3 ton CD	15.32c	27.70bc	39.92cd	60.07a	63.08b
T_5:70 % NK+ 5 ton CD	16.52c	34.86ab	44.98bc	60.73a	63.74b
T_6: 70 % NK+ 2 ton PM	28.11b	37.09a	54.76ab	65.34a	68.35a
T_7: 70 % NK+ 3 ton PM	37.31a	42.29a	62.98a	66.98a	69.99a
CV (%)	9.49	7.24	8.72	10.07	10.07
Sig. Level	**	*	*	**	**

**= significant at 1% level of probability and *= significant at 5% level of probability. Figures followed by same letter(s) are statistically similar as per DMRT at 5%. CD = Cowdung and PM = Poultry manure.

At 50 DAT, the leaf area of plant ranged from 62.98 cm^2 to 23.79 cm^2. The higher leaf area of plant (62.98 cm2) was found in T_7 (70 % NK+ 3 ton PM) which was statistically similar with T_6 (70 % NK+ 2 ton PM) and T_2 (100%NPKS) treatments. On the other hand the minimum leaf area of plant (23.79 cm2) was recorded from T_1 treatment which was closely followed by T_3 (70%NK) treatment.

At 60 DAT, the leaf area of plant ranged from 66.98 cm^2 to 29.13 cm^2. The highest leaf area of plant (66.98cm2) was found in T_7 (70 % NK+ 3 ton PM) treatment which was statistically similar with the T_2 (100% NPKS), T_4 (70 % NK+ 3 ton CD),T_5 (70 % NK+ 5 ton CD)and T_6 (70 % NK+ 2 ton PM)treatments . The lowest leaf area of plant (29.13cm^2) was recorded from T_1 treatment.

At harvest , the leaf area of plant ranged from 66.99 cm^2 to 32.15 cm^2. The treatment T_7 (70 % NK+ 3 ton PM) gave the highest leaf area of plant (69.99 cm^2) which was statistically similar with T_2 (100% NPKS) and T_6 (70 % NK+ 3 ton PM) . The treatment T_4 (70 % NK+ 3 ton CD) and T_5 (70 % NK+ 5 ton CD) were statistically identical to each other. The lowest leaf area of plant (32.15 cm^2) was recorded from T_1 treatment.

The 70% NK + 3 t PM ha^{-1} showed the higher area of leaf compared other organic manures and inorganic fertilizers which might be due to the application of 70% NK + 3 t PM ha^{-1} had more capability to supply the proper nutrient to the plant by enhancing the studied soil nutrients. Besides, 70% NK + 3 t PM ha^{-1} ensured more and longest leaf in this study which ultimately resulted in the highest area of leaf. These results of this character are in complete agreement with the findings of Sangeeta *et al.* (2014) in cauliflower.

Effect of manure and fertilizer on various growth characters of cauliflower

Total dry matter (TDM) (g $plant^{-1}$) at different DAT: The application of fertilizer and manures had significant effect of total dry matter (TDM) of cauliflower at 30, 40, 50 and 60 DAT (Table 3). At 30 DAT, the maximum total dry matter per plant (14.20 g) was recorded from T_7 (70 % NK+ 3 ton PM) treatment which was statistically similar with T_2 (100% NPKS) and T_6 (70 % NK+ 2 ton PM) and the treatments T_4 (70 % NK+ 3 ton CD),T_5 (70 % NK+ 5 ton CD)and T_6 (70 % NK+ 2 ton PM) were statistically identical with respect to total dry matter (TDM) of cauliflower. The lowest total dry matter per plant (9.73 g) was recorded from T_1 treatment (control). The highest total dry matter per plant (16.43 g) was obtained from T_7 (70 % NK+ 3 ton PM) treatment which was statistically similar with T_2 (100% NPKS) and T_6 (70 % NK+ 2 ton PM) treatment (14.97g), The treatments T_4 (70 % NK+ 3 ton CD),T_5 (70 % NK+ 5 ton CD)and T_6 (70 % NK+ 2 ton PM) were statistically identical with respect to total dry matter (TDM) of cauliflower. The lowest total dry matter per plant (11.37 g) was recorded from T_1 treatment at 40 DAT.

Table 3. Effect of manure and fertilizer on Total dry matter (g $plant^{-1}$) of Cauliflower

Treatment	Total dry matter (g $plant^{-1}$) at different DAT				
	30	40	50	60	70
T_1: Control ($N_0P_0K_0S_0$)	9.73d	11.37d	12.69d	24.63e	26.53e
T_2: 100 % NPKS	13.61bc	15.84a	18.77a	34.25ab	36.15ab
T_3: 70 % NK	11.30c	13.34c	14.41c	29.67d	31.57d
T_4:70 % NK+ 3 ton CD	12.40bc	14.58b	16.36b	31.45c	33.35c
T_5:70 % NK+ 5 ton CD	12.50bc	14.68b	16.71b	32.86bc	34.76bc
T_6: 70 % NK+ 2 ton PM	12.86ab	14.97ab	17.83ab	34.03ab	36.00ab
T_7: 70 % NK+ 3 ton PM	14.20a	16.43a	19.34a	35.20a	37.10a
CV (%)	7.91	6.58	5.93	5.61	6.61
Level of significance	**	**	**	*	*

**= significant at 1% level of probability and *= significant at 5% level of probability. Figures followed by same letter(s) are statistically similar as per DMRT at 5%. CD = Cowdung and PM = Poultry manure

At 50 DAT, the highest total dry matter per plant (18.34 g) was founded from T_7 (70 % NK+ 3 ton PM) treatment which was statistically similar with T_2 (100% NPKS) and T_6 (70 % NK+ 2 ton PM) treatment (17.83 g), the treatments T_4 (70 % NK+ 3 ton CD),T_5 (70 % NK+ 5 ton CD)and T_6 (70 % NK+ 2 ton PM) were statistically identical with respect to total dry matter (TDM) of cauliflower. Again, the lowest total dry matter per plant

(12.69 g) was recorded from T_1treatment. The highest total dry matter per plant (35.20 g) was recorded from T_7 (70 % NK+ 3 ton PM) treatment which was statistically similar with T_2 (100% NPKS) and T_6 (70 % NK+ 2 ton PM) treatment (34.03 g) treatment, the treatments T_2 (100% NPKS) , T_5 (70 % NK+ 5 ton CD) and T_6 (70 % NK+ 2 ton PM) were statistically identical with respect to total dry matter (TDM) of cauliflower. On the other hand the lowest total dry matter per plant (24.63 g) was recorded from T_1 treatment at 60 DAT.

Incase of 70 DAT, The highest total dry matter per plant (37.10 g) was recorded from T_7 (70 % NK+ 3 ton PM) treatment which was statistically similar with T_2 (100% NPKS) and T_6 (70 % NK+ 2 ton PM) treatment and the lowest total dry matter per plant (26.53 g) was recorded from T_1. These results of this character are in complete agreement with the findings of Sangeeta *et al.* (2014) in cauliflower.

Yield and yield contributing characters

Curd weight per plant with leaf (g): A statistically significant difference was observed due to different effect of fertilizer and manure on curd weight with leaf of cauliflower (Table 4). The curd weight with leaf range was 1522.0g to 359.6g. The highest curd weight with leaf per plant 1522.0 g was recorded from T_7 (70 % NK +3 ton poultry manure) which was statistical similar with T_2 (100%NPKS) and superior to all other treatments. The second highest curd weight with leaf per plant was obtained from 1454.0 g by T_6 (70 % NK +2 ton Poultry manure). The lowest curd weight with leaf per plant 359.6 g was found from T_1 (control).

Marketable curd weight per plant (g): Marketable curd weight (g) per plant of cauliflower varied significantly due to the application of different fertilizer and manure (Table 4). The highest marketable curd weight per plant 1009 g was recorded from T_7 (70 % NK +3 ton Poultry manure) which was statistical similar to T_2 (100% NPKS) and T_6 (70 % NK +2 ton Poultry manure). The second highest marketable curd weight per plant was obtained from T_5 (70 % NK+ 5 ton CD) treatment which was closely followed by T_4 (70 % NK+ 3 ton CD) treatment and the lowest marketable curd weight per plant 168.8 g was found from T_1 (control). The increase in curd weight might be due to the more photosynthesis from a larger area of the leaves and the translocation of photosynthates to the sink which is ultimately the curd. The increase in the curd weight at this level might also be due to the increase in the length and width of the leaves, curd diameter. This result is in agreement with Sangeta *et al.* (2014).

Curd Yield (t ha^{-1}): Yield per hectare of cauliflower varied significantly due to application of fertilizer and manure. The curd yield range from 32.83 t ha^{-1}to 7.183 t ha^{-1}. The highest yield (32.83 t ha^{-1}) was founded from T_7 (70 % NK+ 3 ton PM) treatment which was statistically similar (32.01 t ha^{-1}) with T_2 (100% NPKS) and T_6 (70 % NK+ 2 ton PM) treatment. The second highest yield was obtained from T_5 (70 % NK+ 5 ton CD) treatment which was statistically similar with T_4 (70 % NK+ 3 ton CD) treatment. The lowest yield (7.183 t ha^{-1}) was recorded from control treatment (Table 4). The use of poultry manure not only gives higher yield but also improves soil health which is necessary for sustainable crop production by maintaining soil fertility and productivity. Use of pouitry manures in combination with chemical fertilizers was efficient in yield increase over the exclusive application of chemical fertilizers and can be attributed to increase in uptake of nutrients resulting in faster synthesis and translocation of photosynthates from source (leaves) to sink (curd).The increase also might be due to the fact that these nutrients are important constituents of nucleotides, proteins, chlorophyll and enzymes, which are involved in various metabolic process which have direct impact on vegetative and reproductive phase of the plants. Kumar (2013) have reported that integration of organic and inorganic fertilizers application significantly increased the yield in broccoli over inorganic fertilizers alone and also over control. Similar trends of result was also obtained by Sangeta *et al.* (2014) in cauliflower and Sarker *et al* (2014) in tomato.

Biological Yield (t ha^{-1}): Biological yield of cauliflower under the present trail varied significantly due to the different treatments. The biological yield range from 55.48 t ha^{-1} to 13.11 t ha^{-1}. The highest biological yield (55.48 t ha^{-1}) was recorded from T_7 (70 % NK+ 3 ton PM) treatment which was statistically similar with T_2 (100% NPKS) treatment and superior to all other treatments. The second highest result was obtained from T_6 (70 % NK+ 2 ton PM) treatment. The treatments T_4 (70 % NK+ 3 ton CD) and T_5 (70 % NK+ 5 ton CD) were statistically similar to each other. The lowest biological yield (13.11 t ha^{-1}) was found in control treatment (Table 4).

Table.4. Effect of manure and growth fertilizer on yield contributing characters and yield of Cauliflower

Treatment	Curd weight with leaf (g)	Marketable weight (g/plant)	Curd yield (t/ha))	Biological yield (t/ha)	Harvest Index (%)
T_1: Control ($N_0P_0K_0S_0$)	359.6f	168.8d	7.183d	13.11e	42.94d
T_2: 100 % NPKS	1517a	1098a	31.88a	54.62a	69.00a
T_3: 70 % NK	588.4e	387.8c	11.84c	21.45d	48.91c
T_4:70 % NK+ 3 ton CD	908.3d	624.4b	19.37b	30.51c	59.23b
T_5:70 % NK+ 5 ton CD	933.6c	648.4b	20.66b	31.37c	63.74ab
T_6: 70 % NK+ 2 ton PM	1454.0b	1044.0a	32.01a	48.73b	68.98a
T_7: 70 % NK+ 3 ton PM	1522.0a	1109.0a	32.83a	55.48a	69.09a
CV (%)	8.02	7.77	9.92	11.00	6.42
Sig. Level	*	*	*	*	*

**= significant at 1% level of probability and *= significant at 5% level of probability. Figures followed by same letter(s) are statistically similar as per DMRT at 5%. CD = Cowdung and PM = Poultry manure

Harvest Index (%): Harvest index (%) showed statistically significant variation was recorded due to application of fertilizer and manure. The harvest index range from 69.09% to 46.94%. The highest harvest index 69.09% was observed from T_7 (70 % NK+ 3 ton PM) treatment which was statistically similar with T_2 (100%

NPK), T_5 (70 % NK+ 5 ton CD) and T_6 (70 % NK+ 2 ton PM) treatment. The treatments T_4 (70 % NK+ 3 ton CD) and T_5 (70 % NK+ 5 ton CD) were statistically similar to each other. The lowest harvest index was recorded from control treatment (Table 4).

Treatment T_7 (70% NK + 3 ton Poultry Manures) gave highest Morphological characters *viz,* Plant height, no. of leaf per plant, leaf length, root length, leaf area, growth parameters viz. TDM, AGR, CGR and RGR, while yield contributing attributes *viz.* stem diameter, stem length, curd weight with leaf, pure curd weight, curd height, curd diameter, marketable yield and biological yield. From the present findings, it was concluded that treatment T_7 (70% NK + 3 ton Poultry Manures) can be recommended for cauliflower to achieve the maximum return in Patuakhali region and similar soils of AEZ-13 because application of manure saved more than 30% of the inorganic fertilizers. The use of poultry manure not only gives higher results but also improves soil health which is necessary for sustainable crop production. Further research works are needed to be carried out for the confirmation of the present findings.

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