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Effect of Integrated Nutrient Management on Growth, Yield, Quality and Economics of Cauliflower (*Brassica oleracea* L. var. botrytis) cv Poosi

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Abstract The percent investigation was carried out during *rabi* season of 2010-11 in randomized block design (RBD) for yield and quality contributing characters of cauliflower cv Poosi. The economics studies of the crop were done by computing the cost of cultivation and net profit in rupees per hectare. The experiment comprised of 15 different combinations of five different sources of nutrients including organic, inorganic and bio fertilizers alone and in combination which were applied following the proper procedures as per treatment. The effect of different treatments were observed and noted that maximum plant height (66.75), plant spread (58.64), curd diameter (16.09), depth of curd (11.76), curd volume (702.00), weight of curd (568.00)m, yield per hectare (252.48) and ascorbic acid (63.19) was noted by application of $^1/_2$ N:P:K (recommended dose) + FYM @ 5 t/ha + poultry manure @ 2 t/ha + *Azospirillum* (T_{14}). Maximum gross income (Rs 201984.00 ha^{-1}) as well as the net return (160057.00 ha^{-1}) was obtained from the treatment T_{14} ($^1/_2$ N:P:K + FYM @ 5 t/ha poultry manure @ 2 t/ha + *Azospirillum*). Hence it can be said that the application of $^1/_2$ recommended dose of NPK along with FYM @ 5 t/ha + poultry manure @ 2 t/ha as well as seedling inoculation with *Azospirillum* was found to be most effective treatment combination for getting enhanced yield.

Keywords Cauliflower, Integrated nutrient management, Economics.

Introduction

Cauliflower (*Brassica oleracea* var *botrytis* Linn.) is one of the most important vegetable crops belonging to the family Brassicaceae. It is being grown round the year for its white and tender curd. It is widely cultivated all over India and abroad for its special nutritive values, high productivity and wider adaptability under different ecological conditions. Like other vegetable crops of the family, cauliflower is a heavy feeder of mineral elements and it remove a large amount of macronutrients from the soil. However, continuous application of huge amount of chemical

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Table 1. Chemical composition of soil.

Sl. No.	Soil components	Value obtained	Methods adopted
1	Organic carbon (%)	0.53	Walkely and Black's rapid litration method (piper, 1950)
2	pH value	7.16	Glass electrode Elico-Model, pH method (Schofield and Taylor, 1965)
3	Available nitrogen (kg/ha)	212	Modified Kjeldahls method (A.O.A.C, 1980 & Jackson, 1963)
4	Available phosphorus (kg/ha)	45	Olsen's method (Olsen et al. 1954)
5	Available potassium (kg/ha)	285	Flame photometer method (Toth and Prince, 1944)

fertilizers hampers the soil health and generates pollution. Mineral nutrition does play an important role in influencing the quality of crops but it is a fact that the soil health deteriorates [1]. The integrated nutrient management paves the way to overcome these problems, which involves conjunctive use of chemical fertilizers and organic manures to sustain crop production as well as maintenance of soil health. Systematic approach to nutrient management by tapping all possible sources of organic and inorganic in a judicious manner to maintain soil fertility and crop productivity is the essence of integrated nutrient management (INM). In addition, utilization of biofertilizers, which have the ability to enrich the soil with beneficial microorganisms as well as to mobilize the nutritionally important elements from non-usable to usable forms through biological processes resulting in enhanced production of fruits and vegetables offer an alternative. Among the nitrogen fixing bacteria, *Azotobacter*, not only provides nitrogen, but also synthesizes growth promoting hormones such as IAA and GA. *Azospirillum* also helps in plant growth and increases the yield of crops by improving root development, mineral uptake. The positive role of these biofertilizers has been recorded in many vegetables and spice crops by different scientists. To minntain long term soil health and productivity there is a need for integrated nutrient management through manures and biofertilizers apart from costly chemical fertilizers for better yield of the crop [2]. The use of biofertilizers in combination with chemical fertilizers and organic manures offer a great opportunity to increase the production of cauliflower with enhanced net return. Hence, the present study was undertaken to develop a suitable integrated nutrient management module for improving production at the expense of relatively higher benefit cost ratio.

Materials and Methods

The present investigation entitled, effect of integrated nutrient management on growth, yield and quality of cauliflower was carried out in the *rabi* season of 2010-11 at vegetable research farm and the laboratory at

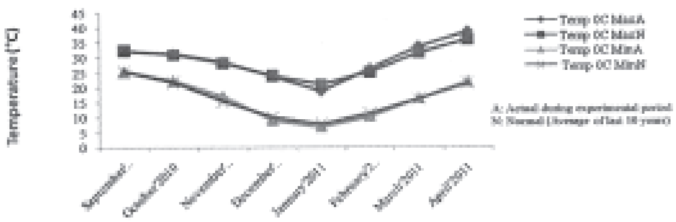

Fig. 1. Temperature (°C) during experimental period.

Table. 2. Treatment details and their symbols.

Sl. No.	Treatment details	Sym
01	Recommended dose of N:P:K: 120:80:80: kg/ha	T_1
02	$^1/_2$ N:P:K	T_2
03	$^1/_2$ N:P:K + FYM @ 10 t/ha	T_3
04	$^1/_2$ N:P:K + Vermicompost @ 4 t/ha	T_4
05	$^1/_2$ N:P:K + poultry manure @ 4 t/ha	T_5
06	$^1/_2$ N:P:K + FYM @ 5 t/ha + vermicompost @ 2 t/ha	T_6
07	$^1/_2$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha	T_7
08	$^1/_2$ N:P:K + Vermicompost @ 2 t/ha + poultry manure @ 2 t/ha	T_8
09	$^1/_2$ N:P:K + *Azospirillum*	T_9
10	$^1/_2$ N:P:K + FYM @ 10 t/ha + *Azospirillum*	T_{10}
11	$^1/_2$ N:P:K+Vermicompost @ 4 t/ha+*Azospirillum*	T_{11}
12	$^1/_2$ N:P:K + poultry manure @ 4 t/ha + *Azospirillum*	T_{12}
13	$^1/_2$ N:P:K + FYM @ 5 t/ha + vermicompost @ 2 t/ha + *Azospirillum*	T_{13}
14	$^1/_2$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha + *Azospirillum*	T_{14}
15	$^1/_2$ N:P:K + VC @ 2 t/ha + poultry manure @ 2 t/ha + *Azospirillum*	T_{15}

Bihar Agricultural College, Sabour. The climatic condition of this place is tropical to sub-tropical, slightly semi-arid in nature and is characterized as very dry summer, moderate rainfall and very cold winter. December and January are usually the coldest months, where May and June are the hottest months. The major rainfall precipitates generally between June to October. The details of meteorological observations recorded as monthly maximum and minimum temperature and rainfall from September 2010 to April 2011 collected form Agro-meteorological observatory, Bihar Agricultural College, Sabour, Bhagalpur have been depicted graphically in Figure 1 and Figure 2. The weather conditions prevailling during the period of investigation for the year 2010-11 was close to the normal for the place and could be termed congenial for the growth and development of cauliflower.

The soil of experimental plot was typically gangetic alluvial in origin. The details about the soil of the experimental plot including the methods adopted for analysis have been presented in Table 1. The design of experiment was RBD, replicated thrice and a popular cauliflower variety for this region i.e. Poosi was used. The experiment comprised of fifteen treatments (Table 2). The plants were planted at a spacing of 45 cm each way and the plot size was 3.60 m × 2.25 m. Twenty five days old seedlings were used for transplanting in the main field. Different organic manures viz. farm yard manure (FYM), vermicompost and poultry manure were applied before transplanting as per the treatment and mixed thoroughly in the soil. Treatment wise different microbial inoculants @ 10 g/liter of water were mixed and required quantity of solutions was prepared. The roots of uprooted seedlings were dipped in this solution for 20 minutes before transplantation. Half dose of nitrogen as urea with full dose of phosphorus (P_2O_5) as single super phosphate and potash (K_2O) as murate of potash were applied before planting of seedling as basal dressing commensurating with the treatments specification. The fertilizers as per treatments were mixed thoroughly and the mixture was placed and incorporated in the top 6–8 layer of soil on the point marked for transplanting of each seedlings. After placement and incorporation of the fertilizers mixture, seedlings were transplanted. The remaining half amount of nitrogen was top dressed in two equal split doses at 30 days and 50 days after transplanting. Five plants in each treatment combination and in each replication were randomly selected and tagged properly.

Tagged plants were used for recording various observations. The observations recorded for the aforesaid five plants were worked out to give means in respect of growth, yield and quality parameters, which were utilized in statistical analysis by the method of analysis of the variance prescribed by Panse and Sukhatme [3]. Comparison of the treatments was made with the help of critical differences (CD). Ascorbic acid was determined by titration method, using 2, 6 dicholoroindophenol solution [4].

The economics studies of the crop were done by computing the cost of cultivation and net profit in rupees per hectare on the basis of the prevailing rate of inputs and outputs obtained from the college farm office and the local market.

Results and Discussion

The biometrical characters of cauliflower crop like plant height, plant spread, number of leaves, leaf length, width of leaf and leaf size was influenced by the combined application of NPK and biofertilizers along with different organic sources. Application of only biofertilizers or 100% chemical fertilizers alone could not influence the characters significantly as compared to combined application. The data pertaining to the various observations on growth and yield and parameters in cauliflower have been show in Table 3 and that regarding economics in Table 4. The increase in plant height, plant spread, number of leaves, leaf length, width of leaf and leaf size by application of 1/2 NPK along with organics and bio fertilizers (Table 3) might be 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 photosynthetic activity. The adequate supply of the three major nutrients viz; NPK is expected to regulate plant physiological functions and morphological responses favorably. It may also be due to the cell elongation by the presence of nitrogenous compounds. The present findings are in conformity with the findings of several workers in different vegetable crops. Marked effect in height of pant was observed due to application of different treatments. Application of $^{1}/_{2}$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha + *Azospirillum* (T_{14}) and T_1 (recommended dose of N:P:K :: 120:80:80: kg/ha) produced significantly taller plants i.e. 66.75 cm and 63.48 cm respectively. Nitrogen being a constituent of amino acids, nucleotides, nucleic acids, a number of coenzymes, auxins, cytokinins and alkaloids, induces cell elongation, cell enlargement and cell division. The increase in plant height could be because of certain growth promoting substances secreted by the *Azospirillum*, which in turn, might have led to better root development, better transportation of water, uptake and deposition of

Table 3. Effect of integrated nutrient management on growth and yield of cauliflower.

Tr. Sym.	Treatment details	Plant height (cm)	Plant spread (cm)	Stem diameter (cm)	No. of levels/ plant	No. of days taken to curd initiation	No. of days taken to curd maturity	Diameter of curd (cm)
T_1	Recommended dose of N:P:K :: 120:80:80 kg/ha	63.48	56.75	3.21	21.16	103.00	119.00	14.13
T_2	$^{1}/_{2}$ N:P:K	42.70	36.38	2.42	13.88	88.00	101.00	9.03
T_3	$^{1}/_{2}$ N:P:K + FYM@10 t/ha	56.59	54.92	2.88	11.56	91.00	103.00	11.74
T_4	$^{1}/_{2}$ N:P:K + vermicompost@ 4 t/ha	49.57	42.41	2.59	12.96	88.00	105.00	9.96
T_5	$^{1}/_{2}$ N:P:K + poultry manure@ 4 t/ha	51.16	44.38	2.68	14.26	89.00	10.00	9.35
T_6	$^{1}/_{2}$ N:P:K + FYM @ 5 t/ha+vermicompost @ 2 t/ha	54.82	50.63	2.83	17.90	93.00	104.00	11.16
T_7	$^{1}/_{2}$ N:P:K +FYM@ 5 t/ha+poultry manure @ 2 t/ha	55.12	52.74	2.86	18.76	94.00	106.00	11.55
T_8	$^{1}/_{2}$ N:P:K+vermicompost @ 2 t/ha+poultry manury @ 2 t/ha	50.75	45.68	2.70	15.80	87.00	96.00	10.50
T_9	$^{1}/_{2}$ N:P:K + *Azospirillum*	46.72	40.32	2.49	19.74	88.00	97.00	9.26
T_{10}	$^{1}/_{2}$ N:P:K +FYM @ 10 t/ha+*Azospirillum*	58.71	53.68	2.98	19.23	93.00	107.00	11.84
T_{11}	$^{1}/_{2}$ N:P:K+vermicompost @ 4 t/ha+ *Azospirillum*	51.68	47.22	2.74	16.97	91.00	103.00	10.63
T_{12}	$^{1}/_{2}$ N:P:K + poultry manure @ 4 t/ha+ *Azospirillum*	52.76	49.18	2.78	15.89	90.00	115.00	10.80
T_{13}	$^{1}/_{2}$ N:P:K + FYM @ 5 t/ha+vermicompost @ 2 t/ha+*Azospirillum*	64.56	57.36	3.06	20.84	96.00	118.00	14.82
T_{14}	$^{1}/_{2}$ N:P:K + FYM @ 5 t/ha+poultry manure @ 2 t/ha+*Azospirillum*	66.75	58.64	3.18	19.86	99.00	116.00	16.09
T_{15}	$^{1}/_{2}$ N:P:K + vermicompost @ 2 t/ha+ poultry manure@ 2 t/ha+*Azospirillum*	53.62	50.32	2.80	17.28	93.00	109.00	11.94
	CD (5%)	6.07	4.88	0.25	1.77	NS	12.71	1.17
	CV (%)	6.66	5.91	5.34	6.21	6.61	7.12	6.08

Table 3. Continued.

Tr. Sym.	Treatment details	Depth of curd (cm)	Volume of curd (cc)	Weight of curd (g)	Yield (q/ha)	Dry mater in curd (%)	Ascorbic acid (mg/100g of juice)
T_1	Recommended dose of N:P:K :: 120:80:80: kg/ha	11.03	680.00	532.00	235.71	10.52	38.75
T_2	$^1/_2$ N:P:K	6.11	472.00	330.00	146.95	13.24	54.76
T_3	$^1/_2$ N:P:K + FYM@10 t/ha	9.41	602.00	462.00	206.13	11.02	44.15
T_4	$^1/_2$ N:P:K + vermicompost@ 4 t/ha	6.95	496.00	346.00	153.85	13.00	53.90
T_5	$^1/_2$ N:P:K + poultry manure@ 4 t/ha	7.20	488.00	352.00	156.82	12.96	63.12
T_6	$^1/_2$ N:P:K + FYM @ 5 t/ha+vermicompost @ 2 t/ha	9.10	576.00	435.00	193.80	11.35	47.28
T_7	$^1/_2$ N:P:K +FYM@ 5 t/ha+poultry manure @ 2 t/ha	9.26	598.00	458.00	204.16	11.12	46.12
T_8	$^1/_2$ N:P:K+vermicompost @ 2 t/ha+poultry manury @ 2 t/ha	7.59	425.00	382.00	170.63	12.85	52.65
T_9	$^1/_2$ N:P:K + *Azospirillum*	6.47	452.00	335.00	149.42	13.18	54.56
T_{10}	$^1/_2$ N:P:K +FYM @ 10 t/ha+*Azospirillum*	9.54	617.00	492.00	218.95	10.04	41.18
T_{11}	$^1/_2$ N:P:K+vermicompost @ 4 t/ha+ *Azospirillum*	8.52	538.00	408.00	181.47	12.65	51.98
T_{12}	$^1/_2$ N:P:K + poultry manure @ 4 t/ha+*Azospirillum*	8.74	527.00	415.00	184.93	12.28	51.57
T_{13}	$^1/_2$ N:P:K + FYM @ 5 t/ha+vermicompost @ 2 t/ha+*Azospirillum*	11.30	682.00	552.00	245.58	10.35	36.38
T_{14}	$^1/_2$ N:P:K + FYM @ 5 t/ha+poultry manure @ 2 t/ha+*Azospirillum*	11.76	702.00	568.00	252.48	10.18	34.19
T_{15}	$^1/_2$ N:P:K + vermicompost @ 2 t/ha+ poultry manure@ 2 t/ha+*Azospirillum*	8.88	532.00	426.00	189.36	11.96	50.38
	CD (5%)	0.81	56.16	53.32	20.39	1.23	4.17
	CV (%)	5.49	6.01	7.37	6.32	6.27	5.26

nutrients. The results of present investigation in terms of plant height are in concordance with the findings reported earlier in cabbage [5], in knol khol [6], in broccoli [7] and in brinjal [8].

There was a significant increase in plant spread due to different treatments. Higher plant spread (58.64 cm and 56.75 cm respectively) was noted with the application of $/_2$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha + *Azospirillum* (T_{14}) as well as recommended dose of NPK (T_1) while the minimum plant spread (36.38 cm) was observed in treatment T_1 (recommended dose of N:P:K:: 120:80:80: kg/ha). This can be substantiated with the fact that application of NPK along with *Azospirillum* might have increased the photosynthetic capacity and auxin levels in the plant. The effect of *Azospirillum* in enhancing the plant spread of cauliflower might be due to their ability to produce growth promoting substances such as IAA, gibberellins like substances, vitamin B_{12}, thiamine, riboflavin (B_2). These results in respect of this character are in complete agreement with the findings as reported earlier in cabbage [9] and in cauliflower and cabbage both [10].

It was observed that the diameter of stem was markedly influenced by different treatments. The plants getting the full recommended dose of NPK registered the highest stem diameter (3.12) which showed parity with $^1/_2$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha + *Azospirillum* (T_{14}) and $/_2$ N:P:K + FYM @ 5 t/ha + vermicompost @ 2 t/ha + *Azospirillum* (T_{13}). The results summarized above in respect of stem diameter are closely in consonance with findings reported earlier in cabbage [5] and in cauliflower [11].

The number leaves per plant was highest with application of full recommended dose of NPK and showed parity with the $^1/_2$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha + *Azospirillum* (T_{14}). This is probably due to the facts that nitrogen might have contributed towards an increase in leaf buds and finally increased leaf number.

The number of days taken to curd initiation and

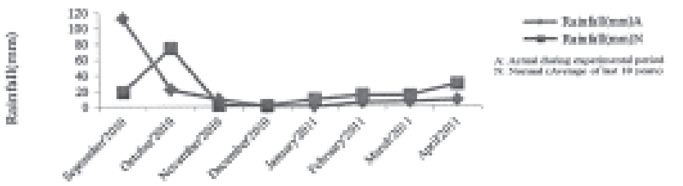

Fig. 2. Rainfall (mm) during experimental period.

curd maturity was significantly affected due to application of different treatments as shown in Table 3. The plots getting the $^1/_2$ N:P:K + + Vermicompost @ 2 t/ha + poultry manure @ 2 t/ha (T_8) reached first to curd initiation (87) and curd maturity (96) while treatments T_1 (Recommended dose of N:P:K:: 120:80:80 kg/ha) significantly delayed to curd initiation and curd maturity. Similar results have also been reported in cabbage [12]. It was also observed in cabbage that higher fertility level favored the maturity time whereas the process of growth and development was slower at lower fertility level [13].

The maximum diameter (16.04), depth (11.76) and volume (5.68) of curd were obtained with application of $^1/_2$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha + *Azospirillum* (T_{14}) which was at par with $^1/_2$ N:P:K + FYM @ 5 t/ha + vermicompost @ 2 t/ha + *Azospirillum* (T_{14}) which was at par with $^1/_2$ N:P:K + FYM @ 5 t/ha + vermicompost @ 2 t/ha + *Azospirillum* (T_{13}). This may be due to increased vegetative growth as induced by integrated nutrient management which might account for increased carbohydrates accumulation as a result of increased photosynthesis. However the minimum diameter, depth and volume of curd were was produced by the treatment T_2 ($^1/_2$ N:P:K).

A cursory glance over the Table 3 indicates that the weight of curd was markedly influenced by the application of different treatments. The heaviest curd (568.00 g) developed in the plants grown under the influence of treatment T_{14} ($^1/_2$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha + *Azospirillum*) which was at par with treatments T_{13} ($^1/_2$ N:P:K + FYM @ 5 t/ha + vermicompost @ 2 t/ha + *Azospirillum*). 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, plant spread, curd diameter and curd depth. Similar findings in various cole crops have also been reported from ecrlier studies [11, 14, 15]. The lowest curd weight (330.00 g) was recorded in the treatment T_2 ($^1/_2$ N:P:K) which was statistically similar to T_9 ($^1/_2$ N:P:K + *Azospirillum*), T_4 ($^1/_2$ N:P:K + Vermicompost @ 4 t/ha), T_5 ($^1/_2$ N:P:K + poultry manure @ 4 t/ha) and T_8 ($^1/_2$ N:P:K + Vermicompost @ 2 t/ha + poultry manure @ 2 t/ha).

The highest curd yield in quintal per hectare (252.48) was obtained with application of $^1/_2$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha + *Azospirillum* (T_{14}) which was at par with $^1/_2$ N:P:K + FYM @ 5 t/ha + vermicompost @ 2 t/ha + *Azospirillum* (T_{13}). The increase in yield and yield components due to the application of biofertilizers can be attributed to the release of bioactive substances having similar effect as that of growth redulators besides enhancement of nutrient absorption. Use of biofertilizers 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 lower yield with inorganic fertilizers alone could be due to reduction in adequate supply of mineral nutrients because of fixation. Integration of organic and inorganic fertiliz-

Table 4. Effect of integrated nutrient management on economics of the treatments under study.

Tr. Sym.	Treatment details	Yield (q/ha)	Gross income (Rs/ha)	Total cost of cultivation (Rs/ha)	Net return (Rs/ha)	Benefit cost ratio
T_1	Recommended dose of N:P:K :: 120:80:80: kg/ha	235.71	188568.00	35530.00	153.38.00	4.31
T_2	$^1/_2$ N:P:K	146.95	117560.00	33425.00	84135.00	2.52
T_3	$^1/_2$ N:P:K + FYM @ 10 t/ha	206.13	164904.00	43425.00	121479.00	2.80
T_4	$^1/_2$ N:P:K + vermicompost @ 4 t/ha	153.85	123080.00	53425.00	69655.00	1.30
T_5	$^1/_2$ N:P:K + poultry manure @ 4 t/ha	156.82	125456.00	39425.00	86031.00	2.18
T_6	$^1/_2$ N:P:K + FYM @ 5 t/ha + vermicompost @ 2 t/ha	193.80	155040.00	48425.00	106615.00	2.20
T_7	$^1/_2$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha	204.16	163328.00	41425.00	121903.00	2.94
T_8	$^1/_2$ N:P:K + vermicompost @ 2 t/ha + poultry manures @ 2 t/ha	170.63	136504.00	46425.00	90079.00	1.94
T_9	$^1/_2$ N:P:K + *Azospirillum*	149.42	119536.00	33927.00	85609.00	2.52
T_{10}	$^1/_2$ N:P:K + FYM @ 10 t/ha + *Azospirillum*	218.95	175160.00	43927.00	121233.00	2.99
T_{11}	$^1/_2$ N:P:K + vermicompost @ 4 t/ha + *Azospirillum*	181.47	145176.00	53927.00	91249.00	1.69
T_{12}	$^1/_2$ N:P:K + poultry manure @ 4 t/ha + *Azospirillum*	184.93	147944.00	39927.00	108017.00	2.70
T_{13}	$^1/_2$ N:P:K + FYM @ 5 t/ha + vermicompost @ 2 t/ha+ *Azospirillum*	245.58	196464.00	48927.00	147537.00	3.01
T_{14}	$^1/_2$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha + *Azospirillum*	252.48	201984.00	41927.00	160057.00	3.82
T_{15}	$^1/_2$ N:P:K + vermicompost @ 2 t/ha + poultry manurre @ 2 t/ha + *Azospirillum*	189.36	151488.00	46927.00	104561.00	2.23

ers application significantly increased the yield in broccoli over inorganic fertilizers alone and also over control [14]. Similar findings were also reported in pea [16] and also in cowpea [17]. It has also been reported that the inoculation with *Azospirillum* + 75% N along with P and K produced maximum fruit yield in chilli [18]. The increase in the yield is also due to the supply of additional nutrient through organics as well as inorganic resulting in an improvement in the physical and biological properties of soil in broccoli [19]. 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. These results are in accordance with the findings reported earlier in broccoli [20] and in Chinese cabbage [21]. The lowest curd yield (146.95 q/ha) was noticed in treatment T_2 ($^1/_2$ N:P:K), however, was just at par with T_4 ($^1/_2$ N:P:K + Vermicompost @ 4 t/ha) and T_5 ($^1/_2$ N:P:K + poultry manure @ 4 t/ha) having curd yield of 153.85 q/ha and 156.82 q/ha, respectively.

The maximum dry matter content in curd (13.24%) was noted in treatment T_2($^1/_2$ N:P:K). It might be due to the release of sufficient quantity of nutrient by the process of mineralization at a constant level that in turn gave higher dry matter. The lowest dry matter (10.04%) was obtained in treatment T_{10} ($^1/_2$ N:P:K + FYM @ 10 t/ha + *Azospirillum*). Similar results were also noted in broccoli [14]. The regarding vitamin C content indicated that the ascorbic acid content in curd (Table 3) decreased significantly with application of higher nutrients. The highest ascorbic acid content (63.12 mg) in curd was obtained with the treatment T_{14} ($^1/_2$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha + *Azospirillum*) followed by T_{13} ($^1/_2$ N:P:K + FYM @ 5 t/ha + vermicompost 2 t/ha + *Azospirillum*) producing (54.76) milligram of ascorbic acid per 100 g of juice. The lowest (34.19 mg) ascorbic acid was recorded with the treatment $^1/_2$ N:P:K (T_2). These findings are in close agreement with those earlier reported in cauliflower [11], in cabbage [22], and in cauliflower [23]. Reduction in vitamin C at higher nutrient level is due to the more vegetative growth which provides larger area for the photosynthesis and transpiration resulting thereby in upward movement of water from root zones to the upper part of the plants and decrease in the vitamin C content. It might be also due to the fact that the chemical fertilizers reduce the content compared to the organics by dilution effects. There is a general observation that organically managed crop have usually higher vitamin C than the conventional fertilized crop because when a plant is exposed with more nitrogen, it increases protein production and reduces carbohydrates synthesis. Since vitamin C is synthesized from carbohydrates, its levels are also reduced. In case of organically managed soil, plants are generally exposed with comparatively lower amount of nitrogen and several plant nutrients are released slowly over time. Therefore, organic crop would be expected to maintain higher vitamin C and carbohydrates and less protein in broccoli [24]. Furthermore, soil micro-organism affects soil dynamics and plant metabolisms and utimately results in differences in plant composition and nutritional quality [24, 25].

The adoption of any technology in modern agriculture can only be feasible and acceptable to farmers if it is economically viable. In the present investigation the highest cost of cultivation (Rs 53927.00 ha^{-1}) was worked out under the treatment $^1/_2$ N:P:K + Vermicompost @ 4 t/ha + *Azospirillum*. Maximum gross income (Rs 201984.00 ha^{-1}) as well as the net return (160057.00 ha^{-1}) was obtained from the treatment T_{14} ($^1/_2$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha + *Azospirillum*) followed by the treatment T_{13} ($^1/_2$ N:P:K + FYM @ 5 t/ha + vermicompost @ 2 t/ha + *Azospirillum*) and T_1 (recommended dose of N:P:K) respectively. However, the maximum benefit cost ratio (4.31) were recorded when cauliflower crop was grown by applying the recommended dose of N:P:K followed by the treatment T_{14}($^1/_2$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha + *Azospirillum*) having the B : C ratio of 3.82. This might be due to the higher cost of cultivation involved with the treatment T_{14}($^1/_2$ N:P:K + FYM @ 5 t/ha + poultry manure @ 2 t/ha + *Azospirillum*). The least benefit cost ratio was noted in treatment T_4 ($^1/_2$ N:P:K + Vermicompost @ 4 t/ha) where cost of cultivation incurred was high and the net return was relatively less (Table 4).

Thus it can be said that the application of $^1/_2$ recommended dose of NPK along with FYM @ 5 t/ha + poultry manure or vermicompost @ 2 t/ha as well as seedling inoculation with *Azospirillum* would be the most effective treatment combination for getting higher yield and maximum net return from the cauliflower cultivation.

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