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Short communication

Effect of different organic nutrient levels on growth, yield and quality in cauliflower

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ABSTRACT

A field experiment was conducted during two *Rabi* seasons at Organic Experimental Block of IIHR farm, Hessaraghatta, Bengaluru to study the effect of different levels of organic manures and conventional practices on growth, yield and quality of cauliflower. The trial included five levels of organic manure nutrient and two inorganic nutrient supplies. The treatment which received recommended dose of farm yard manure along with recommended NPK produced the highest mean curd yield (21.23 t/ha) followed by the treatments, which received 100 and 75 per cent recommended dosage of nitrogen (RDN) through organics (19.36 and 18.42 t/ha). The same treatment also recorded higher values for growth and yield parameters like number of leaves, leaf area, leaf area index, curd diameter and curd weight. Quality parameters in terms of total antioxidant capacity, radical scavenging ability, total flavonoids and vitamin C were better with integrated nutrient management as compared to chemical fertilizers only.

Key words: Antioxidants, cauliflower, organic nutrients, yield.

The principles of organic agriculture include replenishing and maintaining long-term fertility by providing optimal conditions for biological activity; producing viable quantities of high quality, nutritious food and feed; reducing the use of fossil fuels in agriculture and pollution. It is based on minimizing the use of external inputs through use of on-farm resources efficiently compared to industrial agriculture. Thus, the use of synthetic fertilizers and pesticides is avoided (Ramesh *et al.*, 7). Although, as yet infancy, Organic farming is becoming important in the agriculture sector of India, as it can protect damaging impacts on environment, human and animal health, soil and water resources. In India, certified organic farming has increased from 42,000 ha in 2003-04 to 1.18 m ha in 2009 (Willer and Kilcher, 14). Though organic farming, especially of vegetables are known to fetch high prices owing to better quality, the question being raised is sustainability of the productivity in the context of already low productivity prevalent even under chemical systems. Organic agriculture if practiced appropriately is likely to sustain good productivity, simultaneously maintaining the quality of the produce harvested without deterioration of soil health thereby enhancing the sustainability of entire ecosystem as such (Choudhury *et al.*, 1; Thilagam *et al*., 11). Cauliflower is one of the important vegetable crop of India grown in 3.48 lakh ha land with the production and productivity of 6,569 MT and 18.9 t/ha, respectively (NHB, 6). However, the endeavor of many organic researchers in India is to develop experimental evidence and workout economic feasibility of organic cultivation of horticulture crops including vegetables. In this direction an experiment was conducted.

The field trials on organic cauliflower were carried out at Indian Institute of Horticultural Research, Bengaluru during *rabi* seasons (October to December) for two years. The soil of experiment site was well drained sandy loam with pH 7.29 and EC 0.22 dS/m. The initial organic carbon content of soil was 0.56% and available N, P_2O_5 and K_2O were 290.0, 52.0 and 307 kg/ha, respectively. The experiment was carried out in a Randomized Block Design with four replications. Organic and inorganic plots were having similar soil properties and were situated five metre apart from each other and separated by a *Glyricidia* spp. live hedge to protect from possible spray drift to organic treatments. The experiment constituted seven treatments, *viz*., T_1: 25%, T_2: 50%, T_3: 75%, T_4: 100% of recommended dose of nitrogen equivalent of farm yard manure (FYM) application in addition to recommended dose of 25 t/ha FYM, T_5: only recommended FYM @ 25 t/ha, T_6: Conventional practice (recommended FYM @ 25 t/ha + recommended N P K fertilizers), and T_7: only recommended N P K fertilizers. The treatments under organic cultivation received well decomposed FYM as source of nutrients prior to sowing. Quantity of FYM required for different treatments was calculated based on dry weight and total nitrogen content of manure used. The recommended dosage of N:P:K is 125:100:125 kg

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per hectare for cauliflower. In T_6 and T_7 treatment entire amount of P was applied as basal dose and N and K were applied in two equal splits, one as basal and the other as side dress after 30 days of planting. Farm yard manure applied in organic treatments was enriched with bio-fertilizers and bioagents like *Azospirillum*, phosphate solubilizing bacteria (PSB), *Pseudomonas fluorescens* and *Trichoderma harzianum* before field application. Supplemental P was given through PSB treated rock phosphate @ 50 kg/ha/year and neem cake was also added @ 625 kg/ha. Transplanting of cauliflower seedlings (25-days-old) of variety Suhasini was done at the spacing of 50 cm × 30 cm. The crop was irrigated with inline drip system having the discharge rate of 2 lph as and when required to supply irrigation @ 0.7 Epan losses. Organic plant protection was taken up using *T. harzianum*, *Beauveria basiana*, *Verticillium lecani*, neem seed powder extract (4%), neem and pongamia soap (0.7%). For T_6 & T_7, recommended plant protection chemicals were used. The harvesting of the curds started at 70 days and continued up to 75 days after transplanting. The observation on crop growth and yield parameters were recorded at the time of harvesting and statistically analyzed as suggested by Gomez and Gomez (3). For the quality parameter analysis of the cauliflower curds especially related to antioxidant properties, randomized curd samples were taken from selected organic treatments(T_2,T_4 and T_5), *i.e.* medium, higher and minimum quantities of FYM application as well as from inorganic treatments (T_6 and T_7) from the second year crop. The samples were analysed for vitamin C, total phenols and flavonoids, ferric reducing antioxidant potential (FRAP) and diphenyl picryl hydrazide (DPPH) methods (Shivashankara *et al.*, 9).

The experimental results on growth parameters of cauliflower as influenced by different organic and inorganic treatments are presented in Table 1. The treatments tested had significant influence on growth paramet ers such as leaf area and leaf area index while they did not differ significantly for the number of leaves per plant at the time of harvest, during both the years. The treatment T_6 (recommended FYM + N P K fertilizers) recorded significantly higher values for the leaf area (3252 cm^2) than T_1,T_2,T_3 and T_5 during first year, while it remained on par with most of the treatments except T_5 (2136 cm^2) during second year. Within the organic nutrient supply treatments, maximum mean leaf area (2722.5 cm^2) was with T_4, where highest amount of FYM equivalent to 100% of recommended N was applied. Similarly the application of recommended FYM + NPK (T_6) has resulted in significantly higher leaf area index than all other treatments in first year, while it remained on par with T_7 during second year, where the only recommended NPK fertilizer was applied. The leaf area and leaf area index were found to decrease with decrease in amount of FYM given in organic treatments. These observations are in accordance with the findings reported by Choudhury *et al.* (1). The treatments did not affect markedly the number of leaves per plant at the time of harvest. However, the highest mean

Table 1. Effect of different nutrients levels and sources on growth parameters of cauliflower var. Suhasini.

Treatment	No. of leaves/plant			Leaf area (cm^2)			LAI		
	1st year	2nd year	Av.	1st year	2nd year	Av.	1st year	2nd year	Av.
T_1 = (Organic manure equivalent to 25% of RDN)	13.2	13.9	13.55	2284	2667	2475.5	1.27	1.48	1.38
T_2 = (Organic manure equivalent to 50% of RDN)	12.3	14.4	13.35	2323	2790	2556.5	1.29	1.55	1.42
T_3 = (Organic manure equivalent to 50% of RDN)	13.7	15.2	14.45	2347	2786	2566.5	1.30	1.55	1.43
T_4 = (Organic manure equivalent to 100% of RDN)	13.7	14.3	14.00	2559	2886	2722.5	1.42	1.60	1.51
T_5 = (Only recommended FYM @ 25 t/ha)	13.3	13.6	13.45	2091	2136	2114.0	1.25	1.36	1.31
T_6 = Conventional practice (Recommended FYM + NPK fertilizers)	14.3	16.2	15.25	3252	2982	3117.0	1.56	1.80	1.68
T_7 = (Recommended NPK fertilizers alone)	13.7	15.1	14.40	2988	2863	2925.5	1.30	1.66	1.48
$CD_{0.05}$	NS	NS		763.2	788.3		0.12	0.14	

number of leaves per plant (15.25) was recorded with the treatment where recommended fertilizers and FYM were applied (T_6). Velmurugan *et al.* (12) also observed that the application of recommended dose of fertilizers along with FYM recorded the maximum number of leaves, leaf area and leaf area index in cauliflower.

The yield and yield attributing characters like curd weight and curd diameter differed significantly with the treatments tested during both the years of experimentation (Table 2). With respect to curd weight, conventional treatment (T_6) recorded significantly higher curd weight (359 g) than T_1, T_5 and T_7 during the first year, while it remained on par with only T_4, where the 100% of the recommended dose of nitrogen equivalent to FYM was applied. The application of recommended FYM and NPK recorded significantly higher curd diameter during both the years. Among the organic treatments T_4 recorded the higher values for the same in both the years. These results are in corroboration with the findings of Velmurugan *et al.* (12).

The highest curd yield of 19.76 and 22.69 t/ha have been recorded during two years in T_6 treatment followed by T_4 and T_3 treatments. The curd yields under these treatments were significantly superior as compared to the organic treatments receiving lowest quantity of FYM (T_5) as well as the crop receiving only chemical fertilizers (T_7). The higher curd yield in treatments T_3, T_4, T_6 were due to higher number of leaves and leaf area, which resulted in bigger size of curds due to higher amounts of photosynthates produced and translocated. Similar findings in cauliflower were reported by Wani *et al.* (13). The integrated nutrient management treatment receiving recommended dose of FYM and chemical fertilizers (T_6) was found to be superior to organic treatments with respect to yield components. This is in line with the findings of Scalzo *et al.* (8). Similarly, the application of only chemical fertilizers substantially reduced the curd yield of cauliflower. Kamala *et al.* (4) also reported significant reduction in curd yield with application of chemical fertilizers alone.

Antioxidants quality parameters of cauliflower grown under organic and conventional methods for the second year are presented in Table 3. The application of recommended FYM and NPK has resulted in significantly higher amount of vitamin C and total flavonoids than the samples collected from all other treatments. Among the organic treatments, T_5 has recorded the lowest values for the same. Application of only chemical fertilizer (T_7) resulted in significantly lower value (39.52 mg/100 g) for total phenols than other treatments discussed and the same treatment remained on par with T_5 for recording the lowest value for FRAP (30.12 mg/100 g). As far as the values related to DPPH is concerned the FYM application equivalent to 50% N requirement recorded significantly higher values than other treatments except T_6. Overall results indicated that under conventional practices of integrated nutrient management and organic treatments with higher rate of FYM applications showed better antioxidant capacity compared to cauliflower grown using only chemical fertilizers (T_7). Similar results were reported by Young *et al.* (15), Dangour *et al.* (2), and Sreedevi Shankar *et al*. (10). They did not find any significant differences with respect to total antioxidant capacity and total phenols between organic and conventional methods of cultivation in some of the vegetables. However, Lairon (5) reported higher phenolic antioxidants in organically grown fruits and vegetables in his review. In the present study also

Table 2. Yield parameters of cauliflower as influenced by different organic nutrient levels and sources.

Treatment	Curd wt. (g)			Curd dia. (cm)			Curd yield (t/ha)		
	1st year	2nd year	Av.	1st year	2nd year	Av.	1st year	2nd year	Av.
T_1 = (Organic manure equivalent to 25% of RDN)	293	285	289	13.2	12.9	13.1	16.12	15.66	15.89
T_2 = (Organic manure equivalent to 50% of RDN)	311	301	306	13.2	12.8	13.0	17.11	16.57	16.84
T_3 =(Organic manure equivalent to 50% of RDN)	335	335	335	13.6	13.6	13.6	18.43	18.41	18.42
T_4 =(Organic manure equivalent to 100% of RDN)	338	366	352	14.2	15.3	14.8	18.61	20.11	19.36
T_5 = (Only recommended FYM @ 25 t/ha)	256	275	263	12.8	13.2	13.0	14.10	14.60	14.35
T_6 = Conventional practice (Recommended FYM + NPK fertilizers)	359	413	386	16.4	18.8	17.6	19.76	22.69	21.23
T_7 = (Recommended NPK fertilizers alone)	262	257	260	12.5	12.3	12.4	14.39	14.15	14.27
$CD_{0.05}$	62.4	56.3		1.90	1.97		4.03	4.17	

Table 3. Antioxidant quality (mg/100g) of cauliflower grown under organic and conventional methods.

Treatment	Vit. C	Total phenols	Total flavonoids	FRAP	DPPH
T_2 (Organic manure equivalent to 50% of RDN)	28.32	45.06	4.06	38.2	28.74
T_4 (Organic manure equivalent to 100% of RDN)	27.6	47.08	4.29	35.20	25.48
T_5 (Only recommended FYM @ 25 t/ha)	23.52	45.45	3.68	31.00	24.82
T_6 (Conventional practice : Recommended FYM + NPK fertilizers)	33.98	44.21	4.56	39.04	27.66
T_7 (Recommended NPK fertilizers alone)	27.27	39.52	3.73	30.12	23.88
$CD_{0.05}$	2.26	3.14	0.21	1.89	1.52

higher phenolic contents were noticed in organically grown cauliflower as compared to non organic crop. From this study it is evident that cauliflower grown with integrated nutrient system or organic system produced better yields with higher antioxidant qualities than crop grown with chemical fertilizers only.

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