Vegetable Science (2016) 43 (2) : 248-252

Response of cauliflower (*Brassica oleracea* var. *botrytis*) as influenced by organic fertilizers and microbial consortium

Purbashree Hazarika, Deepa Borbora Phookan* and DJ Nath

Received: December 2016 / Accepted: January 2017

Abstract

An investigation was carried out in randomized block design during the periods 2013-2015 to study the performance of cauliflower cv. Pusa Snowball K-1 as influenced by organic inputs and microbial consortium at Experimental Farm, Department of Horticulture, AAI, Jorhat. The trial included three different organic manures each with two levels along the microbial consortium and one treatment with recommended dose of fertilizer. The treatment which received recommended dose of NPK along with FYM (T_1) produced highest curd yield (280.81 qha^{-1}) followed by the treatment which received 5 tha^{-1} Enriched compost along with microbial consortium (T_8) recorded 209.04 qha^{-1}. Among the organic treatments, the same treatment showed the highest values like curd size (103.46 cm^2), leaf number (18.73) and ash content of curd (6.79%). Quality parameters like ascorbic acid (60.13 $mg100g^{-1}$) was highest in treatment receiving 5 t ha^{-1} Enriched compost and consortium (T_8) and leaf ash content (7.28%) in treatment that received 5 t ha^{-1} compost with microbial consortium(T_4). Soil parameters studies revealed that soil pH, soil organic matter content, N, P, K and MBC were found better treatment treated with Enriched compost 5t ha^{-1} and consortium (T_8).

Keywords: Organic, Vermicompost, Enriched Compost, Consortium, Soil parameters

Introduction

Among the vegetables, cauliflower (*Brassica oleracea* L. var. *botrytis*), is one of the important and popular vegetables in the world as well as in India due to its palatability, nutrient content, anti-oxidant and anti-inflammatory properties. To increase the productivity and profitability of vegetable crops, the use of chemical fertilizers, pesticides and other chemical inputs are increasing day by day resulting in economic, environmental and ecological problems which adversely affected the sustainability of agricultural system. Long term use of only chemical fertilizers also has adverse effect on soil physical and biological properties, biodiversity, quality of the produce and human health. Karanatsidis and Berova (2009) reported that organic farming is one of the fastest growing sectors of agriculture worldwide and its goal is to balance systems of soil organisms, plants, animals and humans. According to Zahir *et al* (2004) an ideal organic fertilizer should be capable of giving reasonable yields, increase soil fertility, soil health and quality and sustain productivity. Application of microbial inoculants contributes significantly to the soil surface ecosystem by their organic acid secretions in decomposing soil organic matter, nutrient chelation, fixation and hormonal action. Transformation of nutrients in soil is an enzyme mediated biochemical process facilitated by a group of microorganisms.

Materials and Methods

The present investigation was carried out on cauliflower (*Brassica oleracea* L. var. *botrytis*) cultivar Pusa snowball K-1 in RBD with three replication and eight treatments in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat in the year 2013-2014 and 2014-2015. The experiment on the effect of 8 different treatments consisting of NPK (80:60:60 $kgha^{-1}$) + 10 tha^{-1} FYM (T_1), Rock phosphate + Consortium (T_2), T_2 + Compost 2.5 tha^{-1} (T_3), T_2 + Compost 5 tha^{-1} (T_4), T_2 + Vermicompost 2.5 tha^{-1} (T_5), T_2 + Vermicompost 5 tha^{-1} (T_6), Enriched compost 2.5 tha^{-1} + Consortium (T_7) and Enriched Compost 5 tha^{-1} + Consortium (T_8). The soil of the experimental plot was sandy loam and each size of each experimental plot was 8.1 m^2. Half of urea, full dose of SSP, MOP and borax were applied at the time of basal dose. Consortium was mixed with respective organic nutrients at a ratio of 1:100

Aaasm Agricultural University,
Jorhat-785013, Assam
*Corresponding author, email: deepajorhat111@yahoo.co.in

and mixed properly and water was sprinkled and heaped. The heaps were covered by gunny bags for multiplication of the organisms. After 8-10 days the mixture were applied in the plot as per treatment. Wood ash and banana pseudostem ash were applied along with organic manures irrespective of all the treatments to supplement potash requirement. In the second year same treatment was allotted to the same plot and plots were prepared by hoeing individual plot. Before planting, seedling root dip treatment was done with slurry of microbial consortium and kept for 15 to 20 minutes. Seedlings were then transferred to main field and planted during afternoon by maintaining the spacing 45cm between rows and 45cm between plants. Observations on yield, quality, chemical and biological parameters of soil were recorded as per standard procedures.

Results and Discussion

Highest plant height of 62.39 cm, 21.05 number of leaves, 64.67 cm plant spread and 908.77 cm^2 leaf area were recorded in T_1 {RDF (80:60:60kg NPK + 10t FYM ha^{-1})} which was followed by 59.76cm, 18.73 cm, 61.22 cm and 835.43 cm^2 in T_8 (Enriched compost 5 tha^{-1} + Consortium), respectively (Table 1). Recommended dose of fertilizer recorded the higher value of growth parameters due to the quick and readily availability of major nutrients like nitrogen, phosphorus and potassium to the plants at earlier stages of plant growth. These results were supported by the report of Sharma et al. (2005) in tomato. The higher concentration of nitrogen has the tendency to increase cell number and cell size with overall increase in growth characters. Similar type of result was reported by Thakur et al. (2010). The possible reason for better growth characters under organic sources might be attributed to the added organic nutrient which would have improved the physical, chemical and biological properties of soil which helps in better nutrient absorption and utilization by plant resulting better plant growth. This might be attributed to certain growth promoting substances secreted by the biofertilizers which in turn might have led to better root development, better transportation of water, uptake and deposition of nutrients. These findings are in conformity with Singh et al. (2011) in French bean, Merentola *et al.* (2012) in cabbage, Singh et al. (2013) in tomato and Vimera *et al.* (2012) in king chilli.

Table 2 represented the yield attributing parameters of cauliflower, where inorganic treatment showed the highest curd size (133.42 cm^2) and yield (280.81 q/ha) . This could be due to the rapid availability and utilization of nitrogen for various internal processes in the plant. Irrespective of the types of nutrient sources in all cases, the treatments receiving Enriched compost 5t ha^{-1} with Consortium recorded yield of 209.04 kgha^{-1} and 103.46 cm^2 curd size in T_8 (Enriched compost 5t ha^{-1} + Consortium) which was highest among the organic treatments. Increase in the yield is due to the supply of additional nutrient through organics as well as improvement in the physical and biological properties of soil. The increase is also might be due to fact that these nutrients are being important constituents of nucleotides, proteins, chlorophyll and enzymes, involve in various metabolic process which have direct impact on vegetative and reproductive phase of the plants. The increase in curd size is might be due to the better plant stand and direct contribution of organic inputs with consortium in improving the fertility condition of the soil because of bacterial activities. It is seemed that organic manure need more time for nutrients to be available for plant absorption. However, the beneficial effect of organic manure on yield may be due to an increase in organic matter rate caused by the generation of carbon dioxide during compost decomposition (Wilkinson 1979) and improvement of the soil physical conditions, which encouraged the plant to have a good root development by improving the aeration of the soil (Arisha et al. 2003). The increase in yield and yield components due to the application of microbial consortium can be attributed to the release of bioactive substances having similar effect as that of growth regulators besides enhancement of nutrient absorption.

It is evident from the present study that the maximum value of curd compactness (78.85) was recorded in T_4

Table 1: Effect of organic manures and consortium on plant growth characters of cauliflower

Treatments	Plant height (cm)	Leaf number	Plant spread (cm)	Leaf Area (cm^2)
T1: RDF (80:60:60 kgha^{-1} NPK + FYM 10 tha^{-1})	62.39	21.05	64.67	908.77
T2: Rock phosphate + Consortium	52.08	12.18	50.77	578.77
T3: T2 + Compost (2.5 tha^{-1})	53.64	17.97	56.37	717.53
T4: T2 + Compost (5 tha^{-1})	57.13	17.08	57.83	649.37
T5: T2 + Vermicompost (2.5 tha^{-1})	57.73	18.07	56.23	631.18
T6: T2 + Vermicompost (5 tha^{-1})	58.77	17.87	57.33	655.17
T7: Enriched compost (2.5 tha^{-1} + Consortium	57.99	17.58	59.23	797.88
T8: Enriched Compost (5 tha^{-1}) + Consortium	59.76	18.73	61.22	835.43
CD (5%)	2.86	1.92	2.91	145.12

(Compost 5 tha^{-1} + Consortium). The comparative higher level of curd compactness might be due to action of specific soil nutrients which might be made more readily available into the soil for plant absorption as a result of organic manures with consortium which in term might activate specific enzymes for the synthesis of these compounds. It is therefore, certain specific nutrients in soil play a vital role in determining these quality parameters. Similar finding was reported by Sable and Bhamare (2007) in cauliflower. The least unmarketable curd was observed in T_1 {RDF (80:60:60 kg NPK + 10 t FYM ha^{-1})} of 7.92% followed by T_8 (Enriched compost 5t ha^{-1} + Consortium) of 8.58%. This might be due to the readily availability and uptake of major nutrients and micro nutrients by the plants.

Ash content represented the total amount of non-combustible substances i.e. minerals present in the plant product (Table 3). In the present study ash content of 7.28% and 6.79% was found highest in T_4 (T_2 + Compost 5 tha^{-1}) and T_8 (Enriched compost 5 tha^{-1} + Consortium) for leaf and curd respectively. This might be due to the increase in quality parameters, because soil that has been managed organically has more microorganisms, which produce many compound that influence the plant to absorb more micro nutrients from soil. In the present study highest ascorbic acid content (60.13 mg100g^{-1}) was recorded in T_8 (Enriched compost 5 tha^{-1} + Consortium) .The finding was in close agreement with those earlier reported by Sable and Bhamare (2007) in cauliflower. There is a general observation that the organically managed crops have usually higher vitamin C than the conventionally 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 as reported by Bahadur et al. (2003) in broccoli

Results on soil analysis (Table 4) at harvest showed significant variation among treatments in respect of soil pH, organic carbon content, available nitrogen, phosphorus and potassium. Organic carbon of soil acts as a sink and source of nutrients for microbial population, which regulates the availability of different nutrients through microbial transformation. The net increase in organic carbon was much higher with organic manures in combination with microbial consortium. It is probably due to application of organic inputs and their releasing behaviour of different acids. However, before experimentation organic carbon and soil pH of 0.62% and 4.60 were found respectively. There was significant increase in soil pH (5.69) and organic carbon (0.92%) when Enriched compost 5t ha^{-1} was applied in combination with Consortium (T_8). This might be due

Table 2: Effect of organic manures and consortium on yield contributing characters of cauliflower

Treatments	Curd size	Curd compactness	Unmarketable curd (%)	Yield/ha(q)	B:C
T1: RDF (80:60:60 $kgha^{-1}$ NPK + FYM 10 tha^{-1})	133.42	49.13	7.92	280.81	2.93
T2: Rock phosphate + Consortium	67.70	57.93	14.58	69.42	0.45
T3: T2 + Compost (2.5 tha^{-1})	85.13	68.99	13.75	129.13	1.71
T4: T2 + Compost (5 tha^{-1})	92.50	78.85	12.92	136.94	1.43
T5: T2 + Vermicompost (2.5 tha^{-1})	89.78	58.36	11.25	173.73	2.08
T6: T2 + Vermicompost (5 tha^{-1})	102.83	54.38	8.90	186.32	1.53
T7: Enriched compost (2.5 tha^{-1} + Consortium	91.00	76.31	9.75	191.77	2.61
T8: Enriched Compost (5 tha^{-1}) + Consortium	103.46	71.17	8.58	209.04	1.81
CD (5%)	13.79	19.70	1.78	24.81	

Table 3: Effect of organic manures and consortium on quality characters of cauliflower

Treatments	Ascorbic acid (mg 100g^{-1})	Total mineral content of leaf (mg)	Total mineral content of curd (mg)
T1: RDF (80:60:60 $kgha^{-1}$ NPK + FYM 10 tha^{-1})	37.19	5.08	6.33
T2: Rock phosphate + Consortium	37.29	4.48	5.68
T3: T2 + Compost (2.5 tha^{-1})	43.28	5.10	6.05
T4: T2 + Compost (5 tha^{-1})	47.58	7.28	6.25
T5: T2 + Vermicompost (2.5 tha^{-1})	50.65	5.12	6.17
T6: T2 + Vermicompost (5 tha^{-1})	56.69	5.38	6.61
T7: Enriched compost (2.5 tha^{-1} + Consortium	59.99	5.15	6.33
T8: Enriched Compost (5 tha^{-1}) + Consortium	60.13	6.10	6.79
CD (5%)	3.13	0.25	0.03

Table 4: Effect of organic manures and consortium on soil parameters

Treatments	Soil pH	Organic carbon (%)	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
T1: RDF (80:60:60 $kgha^{-1}$ NPK + FYM 10 tha^{-1})	4.75	0.66	261.44	44.25	133.10
T2: Rock phosphate + Consortium	5.24	0.78	265.97	42.35	121.62
T3: T2 + Compost (2.5 tha^{-1})	5.33	0.85	267.55	52.41	127.38
T4: T2 + Compost (5 tha^{-1})	5.44	0.90	273.17	54.35	130.59
T5: T2 + Vermicompost (2.5 tha^{-1})	5.40	0.79	272.50	56.46	137.02
T6: T2 + Vermicompost (5 tha^{-1})	5.38	0.82	277.95	60.87	141.11
T7: Enriched compost (2.5 tha^{-1} + Consortium	5.53	0.88	275.18	62.70	141.38
T8: Enriched Compost (5 tha^{-1}) + Consortium	5.69	0.92	285.89	66.35	146.34
CD (5%)	0.12	0.02	0.95	0.91	1.06

to increase in microbial activities in the root zone which decomposes organic manures and also fix unavailable form of mineral nutrient into available forms in soil thereby substantiates crop requirement and improve organic carbon level and stabilize soil pH. Similar result was also reported by Tekasangla et al. (2015) in cauliflower.

The highest available nitrogen of 285.89 $kgha^{-1}$ was recorded under treatment with Enriched compost 5t ha^{-1} + Consortium (T_8). Organically managed soil exhibited great of biological activity of inoculated microorganism as well as their potential nitrogen fixation (Melero et al. 2006). The lowest nitrogen content of 261.44 $kgha^{-1}$ was recorded in T_1 {RDF (80:60:60kg NPK + 10t FYM ha^{-1})}. This might be due to leaching and other losses with chemical fertilizers as compared to organic manures (Umlong 2010). The increased available phosphorus in T_8 might be attributed to the improvement of soil condition due to the application of compost and the phosphate Solubilizing and mineralizing ability of the micro organisms from the soluble form of phosphorus sources (Tao et al. 2008). Microbial culture plays a vital role in the release of phosphorus both from native and applied phosphorus sources due to production of phosphate solubilising enzymes. It is established that application of PSB along the rock phosphate significantly increased the available phosphorus status in soil which could be attributed to the production of organic acids.

In case of residual potassium, treatment receiving Enriched compost 5 tha^{-1} with consortium showed higher phosphorus content of (146.34 $kgha^{-1}$) than the other treatments including T_1 {RDF (80:60:60 kg NPK + 10 t FYM ha^{-1})}. This might be due to release of potassium from these organic amendments and also due to solubilisation of mineral based potassium or native potassium. Besides, it could be also due to prevention of leaching loss due to retention of more potassium by organic components while inorganic fertilizers could have released potassium at a faster rate. These results were similar to the findings reported by Umlong (2010). From this study considering yield, quality and B:C it is concluded that among the different treatments, enriched compost 2.5 tha^{-1} was applied in combination with Consortium (T_7) enhanced productivity of cauliflower as well as improved the soil health.

सारांश

पैपरिका के तीन विभिन्न तुड़ाई अवस्था अर्थात् फल बदलाव अवस्था, लाल पके अवस्था तथा कुम्हलाने कि अवस्था में गुणवता घटकों पर प्रभाव के प्रयोग से स्पष्ट हुआ कि ओलियोरेजिन, रंग तथा कैप्सिसीन में फल की अवस्था के साथ वृद्धि पायी गयी तथा बदलाव अवस्था से कम्हलाने की अवस्था तक इन गुणों में वृद्धि होती है। पैपरिका के जैव रसायनिक गुणों पर जीन प्ररूप एवं फसल परिपक्वता का सार्थक प्रभाव पाया गया। प्रजाति सी ए–5 में ओलियोरेजिन की अधिकतम मात्रा (23.13 प्रतिशत) फल के कुम्हलाने की अवस्था में पाया गया। सी ए–38 में एस्कार्बिक अम्ल की उच्च मात्रा (185.07 मि.ग्रा/100 ग्राम) लाल पके अवस्था में प्राप्त हुआ। प्रजाति सी ए–37 जब कुम्हलाने की अवस्था में तुड़ाई की गयी उसमें अधिकतम रंग मूल्य (200.32 ए एस टीए ईकाई) पाया गया। कैप्सिसीन की अधिकतम मात्रा (0.99 प्रतिशत) प्रजाति सी ए–10 में कुम्हलाने की अवस्था तथा न्यूनतम मात्रा प्रजाति सी ए–38 (0.08 प्रतिशत) में बदलाव की अवस्था में पाया गया।

References

Arisha HME, Gad AA and Younes SE (2003) Response of some pepper cultivars to organic and mineral nitrogen fertilizer under sandy soil conditions. Zagazig J Agric Res 30: 1875-1899.

Bahadur A, Singh J and Singh KP (2003) Response of cabbage to organic manure and biofertilizers. Indian J Hort 61(3): 278-279.

Karanatsidis G and Berova M (2009) Effect of organic-N fertilizer on growth and some physiological parameters in pepper plants (*Capsicum annum* L.). Biotechnol Equip 23: 254–257.

Merelo S, Porros JD, Herencia JF and Madegon E (2006) Chemical and biochemical properties in a silty loam soil under conventional and organic management. Soil Tillage Res 90: 162-170

Merentola SP and Singh VB (2012) Effect of integrated nutrient management on growth, yield and quality of cabbage (*Brassica oleraceae* var. *capitata*). J Soils Crops 22(2): 233-239.

Sable PB and Bhamare VK (2007) Effect of biofertilizers (AZB and Azospirillum) alone and in combination with reduces levels of nitrogen on quality of cauliflower cv. Snowball-16. Asian J Hort 2(1): 215-217

Sharma RP, Sharma A and Sharma JK (2005) Productivity, nutrient uptake, soil fertility and economics as affected by chemical fertilizers and farm yard manure in broccoli *(Brassica oleracea* var. *italica)* in an entisol. Indian J Agri Sci 75(9): 576-579.

Singh BK, Pathak KA, Ramakrishna Y, Verma VK and Deka BC (2013) Vermicompost, mulching and irrigation level on growth, yield and TSS of tomato (*Solanum lycopersicum* L.). Indian J Hill Farm 26 (2): 105-110.

Singh BK, Pathak KA, Verma AK, Verma VK and Deka BC (2011) Effects of vermicompost, fertilizer and mulch on plant growth, nodulation and pod yield of French bean (*Phaseolus vulgaris* L.). Veg Crops Res Bull 74: 153-165.

Tao G, Jian S, Cai M and Xie G (2008) Phosphate solubilising and mineralizing abilities of bacterial isolated from soil. Pedosphere 18(4): 515-523.

Tekasangla SP and Singh PK (2015) Integrated nutrient management for quality production of cauliflower in acid alfisol of Nagaland**.** Karnataka J Agril Sci 28(2): (244-247).

Thakur KS, Thakur R, Shukla YR, Mehta DK and Thakur AK (2010) Effect of organic manures and biofertilizers on growth and yield of tomato *(Solanum lycopersicon* L.). J Hill Agri 1(2): 190-192

Umlong RM (2010) Growth, yield and quality of carrot (*Daucas carota* L.) as influenced by organics and lime. MSc (Hort) thesis, Assam Agricultural University, Jorhat.

Vimera K, Kanaujia SP, Singh VB and Singh PK (2012) Effect of integrated nutrient management on growth and yield of king chilli under foothill condition of Nagaland. J Indian Soc Soil Sci 60: 45-49.

Wilkinson SR (1979) Plant nutrient and economic value of animal manures. J Animal Sci 48: 121–133.

Zahir ZA, Arshad M and Frankenberger WT (2004) Plant growth promoting rhizobacteria: applications and perspectives in agriculture. Adv Agron 81: 97-168.