

Effect of organic amendments for sustainable production of Broccoli(*Brassica oleracea* var. *italica*)

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Abstract

A field experiment entitled “Effect of organic amendments for sustainable production of Broccoli(*Brassicaoleracea* var. *italica*)was conducted at Horticulture Research Station, Mondouri, Bidhan Chandra KrishiViswavidyalaya, ,Nadia, West Bengal from November 2017 to February 2018.The design of experiment was Randomized Block Design(RBD) and with 3 replications. The variety used was Sadhana (F1 hybrid).From the experimental result,it was observed that application of the recommended dose of fertilizers recorded higher values for both the vegetative growth parameters like plant height(44.07cm),plant spread(68.60cm),stem girth(19.49mm)etc. and reproductive parameters like curd diameter(10.42cm),curd weight(153g) and yield(17.32t/ha).The treatment T3(Vermicompost+Azotobacter+PSB) was found next best treatment after T1(recommended dose of fertilizers).But as per economics and sustainability was concerned,T3 recorded the maximum values like B:C ratio(3.50) and net return(Rs 235150) followed by T4(Neemcake+Azotobacter+PSB) with B:C ratio(3.18) and net return (Rs 189650).From the experiment,it may be concluded that application of vermicompost+azotobacter+PSB may be viable and sustainable for cultivation of broccoli for new alluvial plains of West Bengal.

Keywords- biofertilizers,broccoli,growth,organic,yield,

Introduction

Sprouting Broccoli (*Brassica oleracea* L. var. *italica* Plenck) is an unconventional and exotic vegetable which belongs to the Brassicaceae family or cole crops family. Broccoli has gained immense popularity in the last few years in India. Broccoli has a great importance, enormous nutritional and medicinal values attributed to being rich in vitamins, minerals, number of antioxidants which decrease the formation of cancer (Goncalves *et al.*, 2011). The 3,3'-diindolylmethane found in broccoli is a potent modulator of the innate immune response system with anti-viral, anti-bacterial and anti-cancer properties. Broccoli is also an excellent source of indole-3-carbinol and sulforaphane, the compounds which boost the DNA repair in cells and block the growth of cancer cells (Das *et al.*, 2013). India produced 8.57 million tonnes of broccoli and cauliflower altogether from an area of 0.43 million hectares with an average productivity of 19.76 tonnes/ha (National Horticulture Board Database, 2014). Organic means of agriculture is a method used to carry out a healthy relation among soil characteristics, products quality and environmental aspects. In last two decades people are seriously considering the environmental and health aspect for which the demand of organic agricultural produces are increasing day by day (Yadav *et al.*, 2010). Organic Farming is nutritionally superior with good taste, lusture, keeping qualities (Chatterjee *et al.*, 2005). Improvement in yield and quality attributes of broccoli have been documented by several researchers who found that application of organic inputs had promotive effect on all growth parameters including the growth, yield in broccoli (Singh *et al.*, 2005; Howladar *et al.*, 2013; Hashem and Abd-Elrahman (2016). Farmers of Gangetic plains in West Bengal are switching over to broccoli cultivation in small space. So keeping all these facts in mind, the present investigation was framed to assess the "Effect of organic amendments for sustainable production of Broccoli (*Brassica oleracea* var. *italica*) with the following objectives:

1. To study the effect of organic inputs on growth, yield and biochemical parameters of broccoli.
2. To work out the economics of broccoli cultivation.

Materials and Methods:

The present experiment entitled “Effect of organic amendments for sustainable production of Broccoli(*Brassicaoleracea* var. *italica*)cv. Sadhana (F1 hybrid) was conducted in humid sub-tropical region of West Bengal(Horticultural Research Station, Mondouri, Nadia) during the period between November ,2017 to February,2018.The farm is situated very close to the tropic of cancer having approximately 23.5⁰C North latitude and 80⁰ East longitude. The altitude of the place is about 9.75m above the Mean Sea Level.The design of experiment was Randomized Block Design(RBD) with seven treatments and three replications.The treatments were T1(recommended dose of fertilizers),T2(Farm Yard Manure+Azotobacter+PSB),T3(Vermicompost+Azotobacter+PSB),T4(NeemCake+Azotobacter+PSB),T5(Mustard Cake+Azotobacter+PSB),T6(Poultry Manure+Azotobacter+PSB) and T7(Biofertilizer) which are applied at the rate 150:60:80kg/ha,20t/ha,5t/ha,0.5t/ha,2t/ha and 2.5kg/ha each respectively.Seedlings of five weeks old and of uniform size, well developed and healthy were transplanted in the field on 10th November 2017 at a spacing of 60 cm x30 cm .Seeds of broccoli were sown in plug-trays with the media of coco-peat.After sowing, plug trays were lightly irrigated and kept in proper substratum for germination.The healthy transplanted seedlings were raised in a plot size 5.4m² with a spacing of 60x30cm.The crop was raised using all the recommended cultural practices.Five plants in each treatment and in each replication were selected randomly, numbered, tagged properly for detailed studies at 60 days after transplanting for recording of growth and yield parameters.The following observations were recorded while performing the experiment i.e. plant height,plantspread,girth of the plant,number of leaves per plant,rootweight,root volume and yield parameters are days to head initiation,diameter of primary head,weight of primary head,yield per plot,yield per hectare.Data collected from the field experiment was subjected to statistical analysis appropriate to the design(Gomez and Gomez,1984).The significance of the different sources of variation was tested by Fisher and Snedecor’s ‘F’ test with probability at 0.05% for the determination of least significance at 5% level of significance; the statistical tables formulated by Fisher and Yates,(1979) were consulted.Economics of broccoli production by use of various sources of organic nutrients was worked out by considering the present price of inputs and produce net returns and benefit cost ratios were worked out for each nutrient treatment by adopting the following formulae.

$$\text{Net return (Rs. ha}^{-1}\text{)} = \text{Gross returns (Rs. ha}^{-1}\text{)} - \text{Cost of cultivation (Rs. ha}^{-1}\text{)}$$

$$\text{Benefit: Cost ratio} = \frac{\text{Net return}}{\text{Cost of cultivation}}$$

Results and Discussion:

Growth and yield attributes

The plants treated with recommended dose of fertilizer T1(150:60:80kg/ha) obtained the maximum plant height(44.07cm).Among the organic inputs,the maximum plant height was recorded in T3(Vermicompost+Azotobacter+PSB)(42.83cm) followed by T4(Neemcake+Azotobacter+PSB)(40.27cm).In this experiment the maximum plant height was observed in recommended dose of fertilizers because nutrients availability was high and as nitrogen is a component of chlorophyll and therefore essential for photosynthesis enhanced the plant growth.Similar trend in plant height has been observed from the findings of Girietal (2013) investigated increase in plant height with increased application of N rate. Similar positive response of nitrogen fertilization in plant height of broccoli was also observed by El-Shikhaetal (2007).The maximum plant spread(68.60cm) was observed in T1. Among the organic inputs the maximum plant spread of 53.83cm was recorded in treatment T3 followed by treatment T4(48.23cm).In this experiment the maximum plant spread was observed in recommended dose of fertilizers because nitrogen being constituent of protoplasm is helpful to encourage vegetative growth as a result it helped to improve spread of plant and among the organic inputs vermicompost recorded maximum plant spread because vermicompost was found more effective due to better aeration and water holding capacity.Similar trend in plant height has been observed from the findings of Katiyaret al.,(2011) reported an increase in plant spread of 68.54 cm with the application of 90 kg N/ha.the maximum number of leaves per plant (15.57cm) was observed in T1.Among the organic inputs the maximum number of leaves per plant of 14.40cm was recorded in treatment T3 followed by treatment T4(13.03cm).In this experiment the maximum number of leaves was observed in recommended dose of fertilizers because it might be due to the nitrogen synthesizes proteins and formed the carbohydrates in crop plant; it favoured number of leaves.Similar trend in maximum number of leaves per plant was observed by Singh et al.,(2006).It was found that minimum number of days to curd initiation was observed in T1(47.33).Among the organic inputs, the minimum number of days to curd initiation was observed in T3(48.00) followed by T4 (49.33).The minimum number of days to curd initiation was observed in recommended dose of fertilizers because inorganic compounds releases the nutrients very quickly and is readily available to the plants whereas comparatively longer duration was required for organic manures because organic manures are slow release nutrients all over the growth season.Similar findings was observed by Oudaet al.,(2008).The maximum curd diameter(10.42 cm) was observed in T1. Among the organic inputsthe maximum curd diameter of 9.76cm was recorded in treatment T3 followed by treatment T4(9.73cm).Among the organic inputs the application of vermicompost was found more effective due to

better aeration and water holding capacity, which might have increased the nutrient use efficiency and availability of major nutrients due to favourable soil conditions. Similar trend was observed by Velmurugan *et al.* (2008) who reported that curd length (15.66 cm) and curd diameter (17.21 cm) was highest at the combined application of vermicompost along with panchagavya (T8). The maximum curd weight (153g) was observed in T1. Among the organic inputs the maximum curd weight of 97.67g was recorded in treatment T3 followed by treatment T4 (95g). The maximum curd weight was observed in recommended dose of fertilizers because it might be due to the nitrogen synthesizes proteins and formed the carbohydrates in crop plant; it favoured curd weight. Maximum curd weight was observed by findings are in confirmative with study conducted by Devet *et al.* (2012). The maximum yield (17.32 t/ha) was observed in T1. Among the organic inputs the maximum yield of 12.09t/ha was recorded in treatment T3 followed by treatment T4 (9.97t/ha). It might be due to the nitrogen synthesizes proteins and formed the carbohydrates in crop plant; it favored to yield. This was because of good growth in wider spacing, interception of light and less competition for moisture and nutrients that increased photosynthesis and accumulation of photosynthetes in main head. Feller and Fink (2005) recorded highest marketable yield with increase in nitrogen application. Nurhidayati N, (2017) found that with the application of 5t/ha of vermicompost gives an yield of 15 t/ha.

Economics of production:

Higher money value and less cost of cultivation are desirable traits for getting higher returns. Hence economics of the treatments was worked out. The benefit cost ratio was found promising with the organic amendments. The maximum benefit:cost ratio was obtained in vermicompost treatment T3 (3.50) followed by neem cake treatment T4 (3.18). However with the RDF T1 the value obtained was 2.50.

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Effect of different nutrient source on growth parameters of broccoli

Treatments	Plant height(cm)	Plant spread(cm)	Leaf no./plant	Stem girth(mm)	Root weight(g)	Root volume(cm ³)
T1	44.07	68.60	15.57	19.49	54.63	44.00
T2	33.40	40.30	12.36	15.13	18.60	11.00
T3	42.83	53.83	14.40	19.35	26.73	23.33
T4	40.27	48.23	13.03	18.71	24.47	21.66
T5	34.97	43.30	12.83	16.54	24.40	14.67
T6	32.77	40.80	12.80	15.90	22.97	18.00
T7	20.83	30.43	8.33	13.30	11.07	6.33
SEm (±)	3.76	2.68	0.49	0.61	0.54	0.98
CD at 5%	11.71	8.36	1.55	1.91	1.67	3.08

Effect of different nutrient sources on yield parameters of broccoli

Treatments	Days to curd initiation	Curd diameter(cm)	Curd weight(g)	Yield(tonnes/ha)
T1	47.33	10.42	153	17.32
T2	52.33	7.60	87.67	5.59
T3	48.00	9.76	97.67	12.09
T4	49.33	9.73	95	9.97
T5	51.00	8.59	94	7.00
T6	50.67	8.76	94.67	8.74
T7	55.67	6.82	54.23	4.09
SEm (±)	0.75	0.37	1.94	0.96
C.D at 5%	2.33	1.15	6.05	2.98

Economics of production of broccoli with different nutrient sources

Treatments	Yield (t/ha)	Gross income (Rs)	Treatment Cost (Rs.)			Net return (Rs)	Benefit :Cost ratio
			Fixed cost	Variable cost	Total cost		
T1	17.32	173200.00	41600	7782	49382	123818	2.50
T2	5.59	139750	41600	20500	62100	77650	1.25
T3	12.09	302250	41600	25500	67100	235150	3.50
T4	9.97	249250	41600	18000	59600	189650	3.18
T5	7	175000	41600	20500	62100	112900	1.81
T6	8.74	218500	41600	14500	56100	162400	2.89
T7	4.09	102250	41600	500	42100	60150	1.42