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Effect of Different Sources of Organic Manures on Growth and Yield of Broccoli

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ABSTRACT

Indiscriminate use of chemical fertilizers is a common practice which is hazardous both for soil health and the environment. It has been more than three decades that the global agriculture has been depicted towards organic agriculture owing to sustainability and reduced environmental effects. An experiment was conducted in Randomized Complete Block Design (RCBD) with three replications to study the effect of different sources of organic nutrients on growth and yield of broccoli. The experiment consisted of five different sources of manures; control (no manure), cowdung (25 t/ha), *Trichoderma* compost (10 t/ha), vermicompost (12 t/ha) and poultry litter (14 t/ha) along with two cultivars of broccoli; 'Imperial' and 'Premium Crop'. Different sources of manures and cultivars had significant influence on plant height, height up to curd, number of leaves per plant, length of leaf, breadth of leaf, plant canopy, diameter of curd, diameter of stem, weight of primary curd, number of secondary curds, weight of secondary curd, yield per plant, yield per unit plot and yield per hectare. The maximum yield (17.32 t/ha) was obtained from vermicompost followed by poultry litter in 'Premium Crop' (15.68 t/ha) cultivar. The minimum yield (6.62 t/ha) was recorded by no manure in 'Imperial'. Control treatment showed the lowest values for all the parameters studied. Combination of vermicompost and 'Premium Crop' cultivar was found the best among all other treatment combinations, including in respect of net return (Tk. 234099/ha) and BCR (3.08).

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INTRODUCTION

Broccoli (*Brassica oleracea* L.var. italica) belongs to the family Brassicaceae. It is a fast-growing crop and requires high nitrogen input. It is one of the most important crops as it is highly nutritious vegetable with abundant vitamins and minerals such as vitamin A and C, carotenoids, fiber, calcium, and folic acid (Paradis, et.al., 1995; Michaud et al., 2002). Broccoli and other brassica vegetables have high content of glucosinolates which has cancer-fighting properties. Broccoli buds are rich source of minerals especially K, S, P, Mg and micro-elements (Zhao et al., 2007). The sustainability of conventional agriculture in Bangladesh is under threat from the continuous degradation of land and water resources, as well as declining yield due to indiscriminate use of agro-chemicals. Excessive use of chemical fertilizers causes unforeseen environmental impacts and sensitivity to pests and diseases through the oversupply of nitrogen (Chen, 2006). Environmental impacts of excessive applications of chemical fertilizers in Bangladesh have been reported (Muhibbullah et al., 2005). Application of chemical fertilizers alone can supply only one or two nutrient elements to the crop. On the other hand, supplying only organic inputs can improve soil physical and biological environment, water-holding capacity, high cation exchange capacity and low bulk density and foster diverse population of beneficial soil microorganisms (Bulluck et al., 2002). Organic fertilizers contain macro and micro-nutrients, vitamins, growth-promoting factors indole 3-acetic acid (IAA), gibberellic acid (GA), and beneficial microorganisms (Natarajan et al., 2007) and they increase production in ways similar to inorganic fertilizers (Tonfacks et al., 2009).

However, in the modern days, when agriculture is motivated not only for production, but also accounts for the sustainability of all the resources including soil for the generations to come. The use of chemical fertilizers has been many-a-times reported for degrading soil and water resources. Moreover, organic farming is both a philosophy and a system of agriculture (Chowdhury, 2004), which avoids or largely excludes the use of synthetically produced fertilizers, pesticides and to the maximum extent possible relies upon crop rotations, crop residues, animal manures, legumes, green manures, off farm organic wastes, mineral bearing rocks and bio-fertilizers to maintain soil productivity and to supply plant nutrients and biological means to control insects, weeds and other pests. Thus, this experiment was carried out in order to study the effect of various sources of plant nutrients on growth, development and yield of broccoli and to compare the nutrient value of various sources of organic manure used in production of broccoli.

MATERIALS AND METHODS

The study was conducted under field conditions in the experimental field of the Department of Horticulture, Patuakhali Science and Technology University (PSTU) during winter season from October 2022 to March 2023 on broccoli cv. Imperial (V_1) and Premium Crop (V_2) obtained from local seed market with five treatments viz. Control (M_0); (No organic manure), Cowdung (M_1); (25 t/ha), *Trichoderma* compost (M_2); (10 t/ha), Vermicompost (M_3); (12 t/ha), Poultry litter (M_4); (14 t/ha). The following doses of manures and fertilizers i.e. cowdung: N:P:K-15000:115:30:100 (kg/ha) were recommended for broccoli production by Rashid (1993). The above doses of manures and fertilizers were converted into manures as per treatment of the experiment so that almost same amount of N is supplied by each type of manure. After conversion the dose of each manure and their % nutrient content used in the experiment was as follows, Cowdung (N:P:K:S-1:1.6:0.2:0.3), *Trichoderma* compost (N:P:K:S-1.2:0.61:0.77:0.24), Poultry litter (N:P:K:S-1.6:1.5:0.85:0.4) and Vermicompost (N:P:K:S-2.16:1.44:2.55:0.8) (Source: Fertilizer Recommendation Guide, BARC, 1997).The experiment was laid out in randomized complete block design (RCBD) and the treatments were replicated three times. The broccoli seeds were sown in nursery bed and raised the seedlings. After one month, the seedlings were transplanted in the main field at a spacing of 60 cm (row) by 40 cm (plant) on beds. Planting

was done in the afternoon to avoid transplanting shock. Seedlings were watered after transplanting. Banana leaves were used around seedlings as mulch. Weeding, irrigation, crop management and harvesting were done manually. The curds were harvested in compact condition before the flower buds opened (Thompson and Kelly, 1988). Five plants were randomly selected for data collection from each plot and labelled and the following data were recorded: plant height, leaf number per plant. All broccoli curds of each plot were harvested at marketable stage and the following variables were measured: weight of primary curd and secondary curd, no. of secondary curd, fresh weight and dry weight of curd, yield (g/plant) and yield (t/ha). The data obtained from the characters were statistically analyzed to find out the variation resulting from experimental treatments following F variance test. The differences between treatments were adjusted by Duncan‟s Multiple Range Test (DMRT) (Gomez and Gomez, 1984). Cost and return analysis were done following the procedure of Alam et al. (1989).

RESULTS AND DISCUSSION

The soil analysis before the planting and after the harvesting of broccoli indicated the soil organic matter content was 1.15% and 1.26%, respectively. During planting, the soil pH was 6.64 and the electrical conductivity (EC) was 1.58 (dS/m). The results revealed that variance in different nutrient doses had significant influence on plant height in different growth stages of two cultivars of broccoli. In combined effect, the highest plant height (50.3, 62.8 and 65.3 cm at 45, 60 and 75 DAT, respectively) was found in 'Premium Crop' cultivar with vermicompost while the lowest plant height (37.8, 53.1 and 53.6 cm at 45, 60 and 75 DAT, respectively) was recorded from the cultivar 'Imperial' with no organic manure (Table 1). Similar results also found by Singh et al. (2000). Thompson and Kelly (1988) reported that the rate of release of nitrogen from the manure is higher in vermicompost than other sources of manures which ultimately were reflected in higher plant growth. Height up to curd from ground level was highest (31.5 cm) in M_3V_2 treatment combination followed by M_4V_2 (31.4 cm) and M_2V_2 (31.3 cm) treatment combinations respectively and the lowest (26.6 cm) was found from M_0V_1 treatment combination.

The combined effect of different sources of manures and cultivars were significantly influenced on the number of leaves per plant, length of leaf, breadth of leaf, plant canopy, curd diameter and length of stem. The highest number of leaves (20.6) was recorded from the cultivar Premium Crop with vermicompost treatment which was followed by the same variety treated with *Trichoderma* (19.8) while the lowest number of leaves per plant (16.2) was found from the Imperial cultivar with no organic nutrient source (Table 2). The longest leaf (52.5 cm) was found from the plants in treatment combination M_3V_2. On the other hand, the shortest leaf (37.6 cm) was obtained from M_0V_1 treatment. It was observed that the breadth of leaf was the highest (22.1 cm) in the plant having a treatment combination of M_3V_2 and the lowest (17.8 cm) leaf breadth was recorded from the treatment combination M_0V_1. In this study, organic manure increased the activity of microorganisms which ultimately made more availability and absorption of essential plant nutrients resulting increased leaf and plant morphology. The maximum canopy (87.8 cm) was obtained from the treatment combination M_3V_2 which was statistically identical to the combination M_4V_2 (87.2 cm) whereas the lowest canopy (59.4 cm) was obtained from the combination M_0V_1. The maximum length of stem (5.3 cm) was obtained from the treatment combination M_3V_2 followed by M_2V_2 (4.8 cm) and M_4V_2 (4.8 cm). However, the lowest length of stem (3 cm) was obtained from the treatment combination M_0V_1. The maximum diameter of curd (17.8 cm) was obtained from the treatment combination M_3V_2 and it was statistically identical to the combination M_2V_2 (17.2 cm). However, the lowest diameter of curd (12.1 cm) was obtained from the treatment combination M_0V_1 (Table 2). Steffen *et al.* (1994) observed the effect of organic matter (spent mushroom compost at 64 t/ha + rotten cattle manure at 57 t/ha) on the growth and yield of broccoli. They concluded that broccoli yield and curd diameter were greater in the amended treatment.

Table 1. Combined effect of different sources of manures and cultivars on height of broccoli at different days after transplanting (DAT**)**

Sources of manures X cultivars	Plant height (cm) at DAT			Height up to curd from ground level (cm)
	45	60	75	
M_OV_1	37.8e	53.1c	53.6c	26.6c
M_0V_2	39.7de	59.0abc	59.8abc	29.2abc
M_1V_1	40.8de	55.4bc	57.4bc	28.8bc
M_1V_2	45.5abc	60.5ab	63.2ab	31.0b
M_2V_1	44bcd	56.4abc	58. 4abc	28.9bc
M_2V_2	46.2abc	61.2ab	64.2ab	31.3ab
M_3V_1	49.2a	61.8ab	64.5ab	31.0b
M_3V_2	50.3a	62.8a	65.3a	31.5a
M_4V_1	42.8cde	58.1abc	61.1ab	29.4abc
M_4V_2	48.5ab	62.3a	64.6ab	31.4ab
LSD **(**0.05**)**	4.12	5.96	6.76	2.66
CV (%)	5.38	5.91	6.44	5.15

M_0 = No manure; M_1 = Cowdung; M_2 = *Trichoderma* compost; M_3= Vermicompost; M_4 =Poultry litter; V_1= Imperial and V_2= Premium Crop; Mean in the column followed by different letters differed significantly by DMRT at 5% level of significance

Table 2. Combined effect of different sources of manures and cultivars on growth parameters of Broccoli

Sources of manures × cultivars	No. of leaf/ plant	Length of leaf (cm)	Breadth of leaf (cm)	Plant canopy (cm)	Diameter of curd (cm)	Length of stem (cm)
M_0V_1	16.2f	37.6c	17.8e	59.4d	12.1d	3e
M_0V_2	17.3def	38.7bc	18.3de	67.6cd	12.4d	3.9cd
M_1V_1	17.0ef	41.2bc	19.1cde	61.5d	14.6c	4.2bcd
M_1V_2	17.9cdef	46.5ab	19.8bcd	74.6bc	15.2bc	4.4abcd
M_2V_1	18.0cdef	41.3bc	20.5abc	80.9ab	15.1c	3.8de
M_2V_2	19.8ab	45.4abc	21.0ab	86.6a	17.2a	4.8ab
M_3V_1	18.6bcd	44.2abc	20.9ab	82.0ab	15.9bc	4.3bcd
M_3V_2	20.6a	52.5a	22.1a	87.8a	17.8a	5.3a
M_4V_1	18.3bcde	41.2bc	18.7de	82.2ab	15.5bc	4.6abc
M_4V_2	19.0abc	42.3bc	19.3cde	87.2a	16.7ab	4.8ab
LSD **(**0.05**)**	1.43	6.86	1.43	9.56	1.44	0.63
CV (%)	4.62	9.32	4.28	7.20	5.54	8.35

M_O = No manure; M_1 = Cowdung; M_2 = *Trichoderma* compost; M_3 = Vermicompost; M_4 = Poultry litter; V_1 = Imperial and V_2 = Premium Crop; Mean in the column followed by different letters differed significantly by DMRT at 5% level of significance

In yield attributes of Broccoli, significant variations were found for different organic nutrients and two cultivars. The highest number of secondary curd (7.5) was found from vermicompost in Premium crop cultivar (M_3V_2) where the minimum number of secondary card (5.2) was recorded from no manure in Imperial cultivar (M_0V_1). The maximum weight of primary curd (246.7 g) per plant was recorded from M_3V_2 whereas the lowest primary curd weight (133.7 g) was measured from M_0V_1 treatment combination. The interaction effect of different sources of manures and cultivars were highly significant for secondary curd weight. The highest secondary curd weight (205.8 g) was recorded from the Premium Crop cultivar with vermicompost (M_3V_2) which was followed by the same cultivar with *Trichoderma* (193.7 g). The lowest secondary curd weight (84.2 g) was measured from Imperial cultivar with no manure application (M_0V_1) (Table 3).

The highest yield per plant (441.1 g) was recorded from vermicompost applied plot plant with Premium Crop variety (M_3V_2) followed by poultry litter manure (420.2 g) whereas the lowest (218.2 g) yield per plant was recorded from Imperial cultivar (M_4V_2) with no manure application (M_0V_1). The highest yield per plot (8.1 kg) and yield per hectare (17.32 tonnes) were obtained from the Premium Crop along with vermicompost treatment (M_3V_2) followed by poultry litter manure (7.74 kg and 15.68 t/ha). The lowest yield (4.1 kg/plot and 6.62 t/ha) were recorded from the cultivar Imperial with no organic manure application (M_0V_1) (Table 3). It was possible that organic manures provided good soil condition for growth as well as supplied sufficient plant nutrients that helped the production of highest yield per plant. Sharma *et al.* (2000) a field experiment was conducted to evaluate the effects of N (60, 120, 180 and 240 kg/ha) and P (60, 120 and 18 kg/ha) on the growth and seed yield of Broccoli cv. Green Curd and observed. In general, all parameters significantly improved with increasing concentrations of N and P.

Table 3. Combined effect of sources of manures and cultivars on yield attributes of broccoli

Sources of manures × cultivars	No. of secondary curd	Weight of primary curd (g)	Weight of Secondary curd (g)	Yield/plant (g)	Yield/plot (kg)	Yield (t/ha)
M_0V_1	5.2c	133.7d	84.2d	218.2c	4.1d	6.62f
M_0V_2	5.7bc	145.4d	88.9d	233.9c	4.22cd	7.08f
M_1V_1	5.4c	136.9d	113.2c	252.2c	4.52bcd	10.42e
M_1V_2	5.9bc	175.1c	113.8c	252.8c	5.18bcd	11.08e
M_2V_1	5.9bc	136.1d	110.9c	242.9c	4.40bcd	12.35de
M_2V_2	6.5ab	218.6b	193.7.6a	415.8a	7.62a	13.10c
M_3V_1	6.0bc	182.1c	128.2c	329.9b	6.04abc	15.28b
M_3V_2	7.5a	246.7a	205.8a	441.1a	8.1a	17.32a
M_4V_1	6.6ab	186.1c	164.3b	348.1b	6.10abc	13.92cd
M_4V_2	7.3a	223.7b	152.6b	420.2a	7.74a	15.68b
LSD (0.05)	0.94	19.11	16.36	62.33	1.74	0.78
CV (%)	8.98	6.31	7.08	11.68	10.15	12.56

M_0 = No manure; M_1 = Cowdung; M_2 = *Trichoderma* compost; M_3 = Vermicompost; M_4 = Poultry litter; V_1 = Imperial and V_2 = Premium Crop; Mean in the column followed by different letters differed significantly by DMRT at 5% level of significance

Positive response of vermicompost in different growth parameters of broccoli is due to fact that it increases the microbial population and also provides the source of energy to sustain them and remain active (Ghimire et al., 2013). It increases the plant growth and yield by providing nutrients in the available form as compared to other organic manures and conventional inorganic fertilizers. Vermicompost retains nutrients for long time while the conventional compost fails to deliver the required amount of macro and micronutrient including the vital NPK to plants in shorter time. Euras (2009) reported that the vermicompost is proving to be highly nutritive organic fertilizer and more powerful growth promoter over the conventional composts. The Vermicomposting accelerates the rate of decomposition of the organic matter, alters the physical and chemical properties of the material, and lowers the C: N ratio, leading to a rapid humification process in which the unstable organic matter is fully oxidized. Application of vermin-compost to soils increased their microbial biomass and dehydrogenase activity (Albanell et al., 1988). This increase in microbial mass and dehydrogenase activity helps in nitrogen fixation and increase the availability to the crop and boost up the growth and development. Rosen & Bierman (2005) reported it improves soil structure or tilt and increases its water holding capacity.

Table 4. Cost and return of broccoli due to use of different sources of nutrients and varieties

Sources of manures × cultivars	Yield (t/ha)	Gross return (Tk/ha)	Total cost of production (Tk./ha)	Net return (Tk/ha)	Benefit cost ratio (BCR)
M_0V_1	6.62	132400	97352.5	35047.5	1.36
M_0V_2	7.08	141600	97352.5	44247.5	1.45
M_1V_1	10.42	208400	118409.4	89990.6	1.76
M_1V_2	11.08	221600	118409.4	103190.6	1.87
M_2V_1	12.35	247000	128645.8	118354.8	1.92
M_2V_2	13.10	262000	128645.8	133354.2	2.03
M_3V_1	15.88	317600	112301.9	205298.1	2.82
M_3V_2	17.32	346400	112301.9	234098.1	3.08
M_4V_1	13.92	278400	103615.3	174.784	2.68
M_4V_2	15.08	301600	103615.3	197984.7	2.91

M_0 = No manure; M_1 = Cowdung; M_2 = *Trichoderma* compost; M_3 = Vermicompost; M_4 = Poultry litter; V_1 = Imperial and V_2 = Premium Crop; Mean in the column followed by different letters differed significantly by DMRT at 5% level of significance

Cost and Return Analysis

The cost and return analysis were done on the basis of total yield, gross income and total expenditure as well as count benefit cost ratio (BCR). Materials, non-materials and overhead cost were recorded for all the treatments of unit plot and calculated on per hectare basis. The total cost of production ranged between Tk. 97352.5 to Tk. 128645.8 per hectare among the different treatment combinations. The variation was due to different cost of broccoli cultivar and different sources of organic nutrients. The highest cost of production Tk. 128645.8 per hectare was recorded in the treatment combinations of vermicompost with “Premium Crop” or “Imperial” cultivar; while the lowest cost of production TK. 97352.5 per hectare was recorded in the combination of no manure with “Premium Crop” or “Imperial” cultivar. The gross return from the different treatment combinations ranged between Tk. 35047.5 and Tk. 234098.1 per hectare. The sale of harvested broccoli was @ Tk. 20,000 per ton. Among the different combinations, vermicompost with “Premium Crop” cultivar gave the highest net return (Tk. 234098.1 per hectare) while the lowest net return (Tk. 35047.5 per hectare) was obtained from the cultivar “Imperial“ with no manure.

The benefit cost ratio (BCR) was found the highest (3.08) in the treatment combination M_3V_2 (Vermicompost with “Premium Crop” cultivar) while the second highest was recorded from M_4V_2 (2.91) combination where poultry litter with “Premium Crop” cultivar were used. On the other hand, the lowest BCR (1.36) was recorded from M_0V_1 (no manure with “Imperial“) cultivar.

CONCLUSION

The experiment showed that the use of vermicompost was better for broccoli growth and development as compared to other organic manures used in the experiment. The use of high cost-chemical fertilizer can be readily substituted by farm-produced organic sources of plant nutrients and thus aid in sustainable and efficient resource use. However, it is important to note the better results of vermicompost as the source of organic manure in broccoli.

COMPETING INTEREST

The authors declare that they have no competing interests.

REFERENCES

1. Alam, M S, Iqbal, M T, Amin, M S, Gaffer, M A, 1989. Krishitattik Fasaler Utpudan 0 Unnayan (in Bengali). T. M. Jubair Bin Iqubal, Manik Potal, Meghai, Sirajgonj. pp. 231-239.
2. Albanell, E, Plaixats, J, Cabrero, T, 1988. Chemical changes during vermicomposting (*Eiseniafetida*) of sheep manure mixed with cotton industrial wastes. Biology and Fertility of Soils, 6(3): 266-269.
3. Bulluck, LR, Brosius, M, Evanylo, G K, Ristain, J B, 2002. Organic and synthetic fertility amendments influencesoil microbial, physical and chemical properties on organic and conventional farms. Appl. Soil Ecology, 19: 147–160.
4. Chen, J H, 2006. The combined use of chemical and organic fertilizers and/or biofertilizer for crop growth and soilfertility. In Proceedings of the International Workshop on Sustained Management of the Soil-Rhizosphere System for Efficient Crop Production and Fertilizer Use, Bangkok, Thailand.
5. Chowdhury, R, 2004. Effects of chemical fertilizers on the surrounding environment and the alternative to the chemical fertilizers. Ies. Envis News l., 7: 4–5.
6. Euras, A, 2009. Vermi-culture can promote sustainable agriculture and completely replace chemical agriculture: Some experimental evidences by studies on potted and farmed cereal and vegetable crop. Journal of Agriculture and Environmental Science, 5(5): 1-55.
7. Ghimire, S, Shakya, S M, Shrivastava, A, 2013. Sweet pepper production using different nitrogen sources in subtropical climate. Journal of Agriculture and Food Science, 1(1): 6-10.
8. Gomez, K A and Gomez, A A, 1984. Statistical Procedures for agricultural research second edition. A Wiley Inter Science Production, John Whiley & Sons. New York. p.680.

9. Michaud, D S, Pietinen, P, Taylor, P R, Virtanen, M, Virtamo, J, Albanes, D, 2002. Intakes offruits and vegetables, carotenoids and vitamins A, E, C in relation to the risk of bladder cancer inthe ATBC cohort study. British Journal of Cancer, 87: 960-965.
10. Muhibbullah, M, Momotaz, S, Chowdhury, A T, 2005. Use of agrochemical fertilizers and their impact on soil, water and human health in the Khamargao Village of Mymensingh District, Bangladesh. J. Agronomy, 4: 109–115.
11. Natarajan, K, 2007. Panchagavya for plant. In Proceedings of the National Conference, Glory Gomatha, S.V. Veterinary University: Tirupati, India; pp. 72–75.
12. Paradis, C, Castaigne, F, Desrosiers, T, Willemot, C, 1995. Evaluation of vitamin C, β-caroteneand chlorophyll content in broccoli heads and florets during storage in air. Sciences des Aliments,15(2): 113-123.
13. Rashid, M M, 1993. Sabji Biggan. Text Book Division, Bangla Academy, Dhaka, Bangladesh, p. 220.
14. Rosen, C J and Bierman, P M, 2005. Using manure and compost as nutrient source for fruit and vegetable crops. Department of soil, water and climate. University of Minnesota, USA.
15. Sharma, K C, 2000. Influence of integrated nutrient management on yield and economics in broccoli (*Brassica oleracea* L. var. italica) plant under cold temperate conditions. Vegetable Science, 27(1): 62-63.
16. Singh, A K, Akhilesh, S, Singh, A, 2000. Influence of nitrogen and potassium on growth and head yield of broccoli (*Brassica oleracea* L. var. italica) under low hills subtropical condition of H.P. Regional Research Station, Dhaulakua, Sinnour. Himachal Pradesh, India. Vegetable Science, 27(1): 99-100.
17. Steffen, K L, Dann, M S, Fager, K, Fleischer, S J, Harper, J K, 1994. Short term and long-term impact of an initial large-scale SMS soil amendment on vegetable crop productivity and resource use efficiency. Comp. Sci. mil., 2(4): 75-83.
18. Thompson, H C and Kelly, W C, 1988. Vegetables Crops. Fifth edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, India, p. 611.
19. Tonfack, L B, Bernadac, A, Youmbi, E, Mbouapouognigni, V P, Ngueguim, M, Akoa, M, 2009. Impact of organic and inorganic fertilizers on tomato vigor, yield and fruit composition under tropical andosol soil conditions. Fruits, 64: 167–177.
20. Zhao, H, Lin, J, Barton Grossman, H, 2007. Dietary isothio cyanates, GSTM1, GSTT1, NAT2polymorphisms and bladder cancer risk. International Journal of Cancer, 120(10): 2208-2213.