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ORIGINAL RESEARCH ARTICLE



Effect of variety and nutrient sources on growth and yield of broccoli in southern belt of Bangladesh

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ABSTRACT

Ongoing use of synthetic fertilizers affects soil structure. Organic manures can serve as an alternative to synthetic fertilizers. The study evaluated performance of five different types of nutrient sources (T_0 =control, T_1 = Urea @ 250 kg/ha, TSP @ 150 kg/ha, MoP @ 200 kg/ha, T_2 = Cowdung @ 25 t/ha, T_3 = Vermi compost @ 5 t/ha, T_4 = fermented plant juice @ 500 ml/ha and T_5 =Liquid fertilizer (Flora: consists of 20% nitrobenzene) @ 200 ml/ha) on growth and yield of broccoli, cvs. " V_1 =Known You" and " V_2 =Early Green". Yield and yield contributing parameters such as plant height, number of leaves per plant, leaves fresh weight, length of stem, stem diameter, stem fresh weight, days taken for primary curd initiation, curd diameter, fresh weight of primary curd, no. of secondary curd per plant, fresh weight of secondary curd and yield per plot as well as hectare were measured in this experiment. In case of variety, the highest yield/plot 5.83kg and yield/ha 20.23 tons were recorded from "Early green". Considering the nutrient factor, the highest curd weight (290.4g) per plant and yield/plot (5.01kg) were found in fermented plant juice nutrient sources. The highest benefit cost ratio BCR (3.21:1) was found in V_2T_4 , among all other treatment combinations in respect of net return (Tk. 228934.97/ha) through the use of fermented plant juice. Therefore, it can be concluded that fermented plant juice @ 500 ml/ha can be used to improve vegetative growth, and yield quality and quantity, and the broccoli cv. "Early Green" appears to be the best of the cultivars tested.

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INTRODUCTION

The name broccoli comes from Italian word, and is derived from the Latin word 'brachium', which means arm/branch (Gómez-Campo, 1999). Broccoli (*Brassica oleracea* var. *italica*) is one of the non-traditional crop and several other cruciferous vegetables i.e. cabbage, cauliflower, kohlrabi, and brussels sprouts all originate from the wild type of *Brassica oleracea*, which grew along the Mediterranean coasts several hundred years BC. Although originated from temperate region, its distribution has been extended to the subtropical and tropical countries including

Bangladesh. Broccoli is fairly rich in vitamin A, ascorbic acid and contains appreciable amounts of calcium, phosphorus, thiamin, riboflavin, niacin and iron (Thompson and Kelly, 1988, Lincoln, 1987). Watt (1963) reported that broccoli is more nutritious than any other cole crop such as cabbage, cauliflower and kohlrabi. The cancer-fighting properties of broccoli are not new and previous studies have related these benefits to the high levels of active phytochemicals called glucosinolates (Zhao *et al.*, 2007). Eating more than one serving of broccoli a week reduces the risk of prostate cancer by up to 45 percent. Thus broccoli can play a vital role in improving the nutritional status of the people

of Bangladesh. Broccoli is environmentally better adapted than cauliflower and reported to withstand comparatively higher temperature than cauliflower (Rashid, 1976). Its preference to the consumers is increasing day by day.

In recent times, consumers are demanding higher quality and safer food and highly interested in organic products. In respect to food safety, organic products have been verified with no or fewer pesticide residues, compared to conventional products (Baker *et al.*, 2002). The difference in nutritional value between organic and conventional vegetables varied. The cultivation of broccoli requires an ample supply of plant nutrient. The requirement of these plants nutrients can be provided by applying inorganic fertilizer or organic manure or both. Broccoli responds greatly to major essential elements like N, P, and K in respect of its growth and yield (Mital *et al.*, 1975; Singh *et al.*, 1976; Thompson and Kelly, 1988) and storage life. Organic manures such as cattle manure and poultry manure improve the soil structure, aeration, slow release nutrient which support root development leading to higher yield and better quality of broccoli plant. Organic manure plays a direct role in plant growth as a source of all necessary macro and micronutrients in available forms during mineralization, improving the physical and physiological properties of soils.

However, farmers are now showing interest in organic farming because of, they are more aware about the residual effect of chemical substances used in the crops field and environmental degradation. Organic manure can serve as alternative practice to mineral fertilizers for improving soil structure and microbial biomass (Gupta *et al.*, 2015). Organic manures like cowdung, poultry litter, mustard oil cake (MOC), Vermicompost, fermented plant juice (FPJ) and compost when applied, help to improve the soil texture, structure, color, aeration, water holding capacity and microbial activity of soil (Dauda *et al.*, 2008). The application of both organic and inorganic fertilizer combined, can increase the yield as well as keep the environmental sound (Hsieh *et al.*, 1996). Therefore, utilization of locally produced manures for vegetable production operations may increase crop yields with less use of chemical fertilizers. Considering the above mentioned facts, the present research was aimed to assess the effect of different sources of plant nutrients on the growth and yield of broccoli as well as relative cost and return in broccoli production with different sources of plant nutrients.

MATERIALS AND METHODS

The study was conducted under field conditions during the winter season of 2017 taking broccoli cv. Early green (V_1) and Known you (V_2) collected from Advanced Chemical Industry Seed Company Limited with five types of nutrients sources viz., T_0 = Control (No or zero fertilizer applied), T_2 = N: P: K- 250:150:200 kg/ha, T_3 = Vermi compost - 5 t/ha, T_4 = Fermented Plant Juice (FPJ)-500 ml/ha and T_5 = Liquid fertilizer - 200 ml/ha (Flora: consists of 20% nitrobenzene). Hence, Gypsum =120 kg/ha, Zinc oxide =10 kg/ha, Boric acid= 4 kg/ha were applied in the experiment filed for all treatments. The

experiment was laid out in randomized complete block design (RCBD) with three replications. One-month seedlings were transplanted in the field at a spacing of 60 cm (row) by 40 cm (plant) on raised beds. The unit plot size was 3m × 3m. Seedlings were watered after transplanting. The transplanted seedlings were kept shade with pieces of banana leaf sheaths during the day time to protect those from the scorching sunshine. At night those were kept open to receive dew. Shading and watering were continued for 3 days until the seedlings were established. A number of seedlings were planted at the same time in the border of the experimental plot for gap filling. Weeding, irrigation, crop management and harvesting were done manually. The fermented plant juice were applied when the seedling age became of 25 days were DAT. It was applied 3 times keeping 7 days interval and sprayed the evening. Thus the application of FPJ was completed before the harvesting of curd from the plot. The curds were harvested in compact condition before the flower buds opened (Thompson and Kelly, 1988). Five plants were selected randomly for data collection in each plot and labeled. All broccoli heads of each plot were harvested at marketable stage. The collected data for various growth and yield contributing characters were statistically analyzed using the MSTAT-C program. The mean for all the calculated and the analysis of variances (ANOVA) for each of the characters under study was done by F (variance ratio) test. The treatment means were separated by Least Significant Difference (LSD) at 5% level of significance (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Plant height

The results revealed that variance in different nutrient doses had significant influence on plant height in different growth stages. Results indicated that variety "Known You" showed the highest plant height (36.41, 51.41 and 64.17 cm at 45, 60 DAT and at harvest respectively) and "Early Green" gave the lowest plant height (34.75, 44.80 and 62.06 cm at 45, 60 DAT and at harvest respectively) at all the growth stages (Figure 1). Highest plant height (15.35, 50.98 and 65.46 cm at 45, 60 DAT and at harvest respectively) was found from T_4 (Fermented plant juice) which was statistically similar, to that of T_1 (Recommended fertilizer dose). On the other hand, the lowest plant height (13.01, 42.12 and 57.67 cm at 45, 60 DAT and at harvest, respectively) was observed from T_0 (Control) which was significantly different from all other treatments (Figure 2). In combined effect, the highest plant height (15.46, 54.15 and 67.22 cm at 45, 60 DAT and at harvest, respectively) which was statistically similar to V_1T_1 at the time of harvest while the lowest plant height (13.03, 43.29 and 56.65 cm at 45, 60 DAT and at harvest respectively) was achieved by V_1T_0 . Similar results also found by Singh *et al.* (2000).

Number of leaves per plant

A good foliage status indicates vigor condition of plants. Vigor plant provides higher growth, development and productivity of plants. The variety "Known You" showed the highest number of

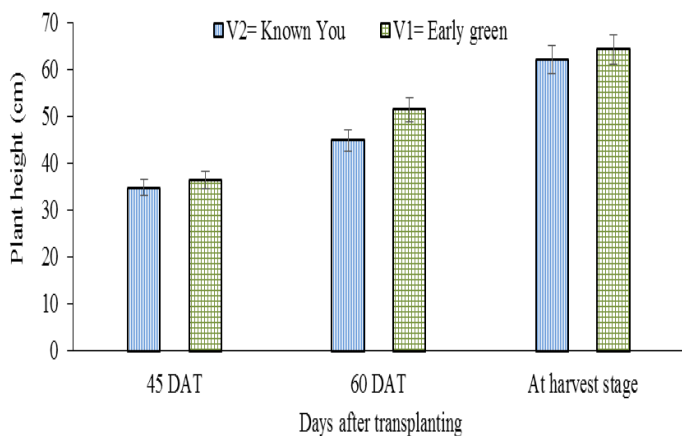


Figure 1. Effect of variety on plant height (cm) of broccoli at different days after transplanting. LSD represents at 5% level of probability.

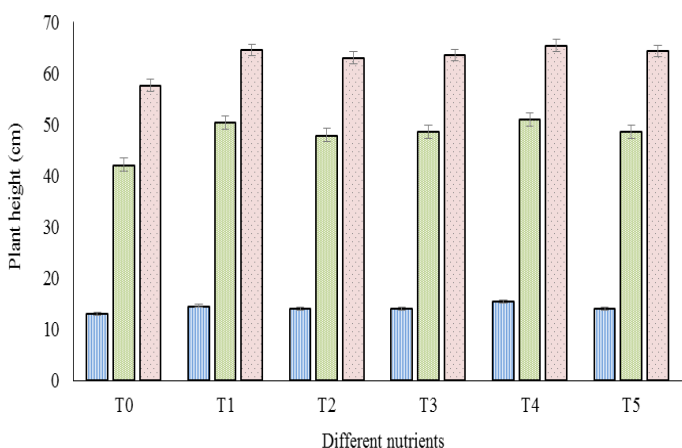


Figure 2. Effect of different sources of nutrients on plant height (cm) of broccoli. (LSD represents at 5% level of probability, T₀= No fertilizer, T₁=Recommended fertilizer dose, T₂= Cow dung, T₃= Vermicompost, T₄= Fermented plant juice, T₅= Liquid fertilizer).

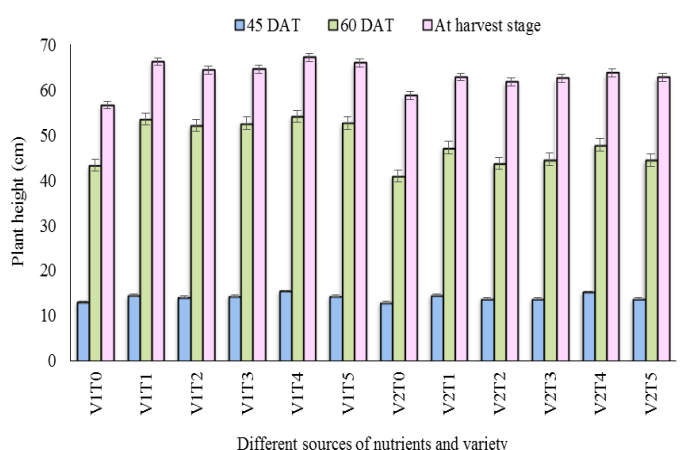


Figure 3. Combined effect of different sources of nutrients and variety on plant height of broccoli. LSD represents at 5% level of probability.

V₁T₀= Known You with no fertilizer V₁T₁= Known You with recommended fertilizer dose; V₁T₂= Known You with cow dung V₁T₃= Known You with vermicompost; V₁T₄= Known You with FPJV V₁T₅= Known You with liquid fertilizer; V₂T₀=Early Green with no fertilizer V₂T₁= Early Green with recommended fertilizer dose; V₂T₂= Early Green with cow dung V₂T₃= Early Green with vermicompost; V₂T₄=Early Green with FPJV V₂T₅= Early Green with liquid fertilizer.

leaves (14.29) which was statically similar to the “Early Green” and number of leaves (14.02). The highest number of leaves (15.35) was found from fermented plant juice while the lowest number of leaves was found in the control. It was observed that the highest number of leaves (15.46) was found in V₁T₄ which was statistically similar to that of V₂T₄. On the other hand the lowest number of leaves (12.98) was achieved by V₂T₀ which was statistically different from all other treatments at the time of growth (Table 3).

Fresh weight of leaf

The variety “Known You” showed highest leaf weight (625.92 g) at all growth stages and “Early Green” gave lowest leaf weight (505.72 g) at their growth stages. Momentous variation was also found among the nutrients in respect of fresh weight of leaf at their growth stages. The results exposed that the highest fresh leaf weight was found from T₄ (580.0 g) treatment which was identical to T₁ (579.5 g) and followed by T₅ and T₃. On the other hand, the lowest leaf weight was observed from T₀ (515.2 g) which was significantly poles apart from all other treatments combinations. In combined effect, the highest fresh leaf weight was achieved from the treatment combination of V₁T₄ (656.90 g) which was statistically poles apart from all other treatments followed by V₁T₁ (653.8 g) and V₁T₅ (647.0 g). Simultaneously significantly different results performed by V₁T₀ (524.3 g) which was apart from others combinations (Table 3). Nonnecke *et al.* (2002) found that using mineral fertilizer (N, P, K) increasing broccoli vegetative growth, yield and quality.

Length of stem

A statistically significant difference was found on varieties in respect of length of stem presentation. Results indicated that the variety V₁ (9.32 cm) showed the highest stem height at harvest stage and V₂ (8.48 cm) gave the lowest plant height at harvest stage. The highest stem height was found from fermented plant juice nutrient source while the lowest stem height (8.15 cm) was observed from control. The highest stem length was achieved from the treatment combination of V₁T₄ (9.61cm) which was statistically similar to V₁T₁, V₁T₅ and V₁T₃ at the time of harvest. The lowest stem length was achieved by V₂T₀ (8.05 cm). Similar results were also found by Singh *et al.* (2000) reported a linear increased in plant height was observed with increasing N and K rates. K improved the development of roots and the utilization of N.

Diameter of stem

Variety Known You showed the highest stem diameter (3.75 cm) at the harvest stage and Early Green shown the lowest (3.66 cm) at harvest stage. Fermented plant juice treated plant gave the highest stem diameter (3.98 cm) and control plant resulted the lowest stem diameter (3.28 cm). Combined Known You variety and Fermented plant juice nutrient source gave the highest stem diameter (4.14 cm) which was statistically similar to V₁T₁, V₁T₅, V₂T₄ and V₂T₁ at the time of harvest. The lowest stem diameter was achieved by V₂T₀ (3.26 cm) (Table 3).

Table 1. Effect of variety on number of leaves per plant, fresh weight of leaves, stem length, stem diameter and stem weight of broccoli.

Variety	Number of leaves/ plant	Fresh weight leaves (g)	Stem length (cm)	Stem diameter (cm)	Stem weight (g)
Known You (V1)	14.30	625.92 a	9.32 a	3.75	63.00 a
Early Green (V2)	14.02	505.73 b	8.48 b	3.66	60.06 b
LSD _{0.05}	0.21	3.472	0.52	0.12	1.26
Level of significance	NS	**	**	NS	**
CV (%)	10.51	9.53	8.42	6.29	7.63

In a column figures having similar and no letter(s) do not differed significantly at 5% level whereas figures with dissimilar letter(s) differed significantly as per DMRT at same level; **= 1% level of probability, NS= Non-significant, CV=Coefficient of variation

Table 2. Effect of nutrient sources on number of leaves, fresh weight of leaves, stem length, stem diameter and stem weight of broccoli.

Treatment	Number of leaves/ plant	Fresh weight leaves(g)/Plant	Stem length (cm)	Stem diameter (cm)	Fresh stem weight (g)
T ₀	13.01 c	515.2 c	8.15 c	3.28 c	48.05 e
T ₁	14.51 ab	579.5 a	9.17 a	3.82 ab	65.12 b
T ₂	13.99 bc	568.6 b	8.89 b	3.69 b	61.19 d
T ₃	14.04 bc	573.4 ab	8.99 b	3.70 b	62.97 c
T ₄	15.35 a	580.0 a	9.19 a	3.98 a	66.89 a
T ₅	14.06 bc	578.2 ab	9.02 b	3.78 ab	64.96 b
LSD _{0.05}	1.00	9.52	0.13	0.23	1.20
Level of significance	*	**	**	**	**
CV (%)	10.51	9.53	8.42	6.29	7.63

In a column figures having similar and no letter(s) do not differed significantly at 5% level whereas figures with dissimilar letter(s) differed significantly as per LSD at same level; * = 5% level of probability, ** = 1% level of probability, CV= Coefficient of variation; T₀= No fertilizer; T₁=Recommended fertilizer dose; T₂= Cow dung; T₃= Vermicompost; T₄= Fermented plant juice; T₅= Liquid fertilizer.

Table 3. Combined effects of nutrient sources and varieties on number of leaves, fresh weight of leaves, stem length, stem diameter and stem weight of broccoli.

Combined effect of different sources of nutrients X Varieties	Number of leaves/plant	Fresh weight leaves (g)	Stem length (cm)	Stem diameter (cm)	Fresh stem weight (g)
V ₁ T ₀	13.03 c	524.3 d	8.25	3.31	48.49 f
V ₁ T ₁	14.47 a-c	653.8 ab	9.59	3.85	66.43 b
V ₁ T ₂	14.20 a-c	633.0 c	9.35	3.69	61.51 e
V ₁ T ₃	14.30 a-c	640.5 bc	9.55	3.70	64.46 c
V ₁ T ₄	15.46 a	656.9 a	9.61	4.14	69.60 a
V ₁ T ₅	14.33 a-c	647.0 ab	9.58	3.83	67.53 b
V ₂ T ₀	12.98 c	506.1 e	8.05	3.26	47.62 f
V ₂ T ₁	14.55 a-c	505.2 e	8.75	3.78	63.81 cd
V ₂ T ₂	13.79 bc	504.1 e	8.44	3.69	60.88 e
V ₂ T ₃	13.78 bc	506.3 e	8.43	3.71	61.49 e
V ₂ T ₄	15.24 ab	509.5 e	8.77	3.81	64.19 c
V ₂ T ₅	13.79 bc	503.2 e	8.47	3.74	62.38 de
LSD _{0.05}	1.42	13.23	0.18	0.33	1.69
Level of significance	**	**	NS	NS	**
CV (%)	10.51	9.53	8.42	6.29	7.63

In a column figures having similar and no letter(s) do not differed significantly at 5% level whereas figures with dissimilar letter(s) differed significantly as per LSD at same level; **= 1% level of probability, NS= Non-significant, CV= Coefficient of variation.

Table 4. Effect of variety on days taken to primary curd initiation, head height, head diameter, primary curd weight /plant of broccoli.

Varieties	Days taken to Primary curd initiation	Head diameter (cm)	Primary curd wt. (g) /plant	Number of secondary curd/plant	Fresh wt. of secondary curd /plant (g)	Total yield/ plot (kg)
V ₁	70.27 a	16.52	281.24 a	0.000 b	0.000 b	3.38 b
V ₂	55.13 b	15.32	258.30 b	20.908 a	227.137 a	5.83 a
LSD _{0.05}	1.85	2.37	6.35	11.98	11.59	1.24
Level of significance	**	NS	**	**	**	**
CV (%)	7.76	11.63	7.39	11.16	9.57	9.57

In a column figures having similar and no letter(s) do not differed significantly at 5% level whereas figures with dissimilar letter(s) differed significantly as per DMRT at same level; ** = 1% level of probability and NS = Non-significant, CV = Coefficient of variation.

Table 5. Effect of nutrient sources on days taken to primary curd initiation, head height, head diameter, primary curd weight /plant of broccoli.

Varieties	Days taken to Primary curd initiation	Head diameter (cm)	Primary curd wt. (g) /plant	Number of secondary curd/plant	Fresh wt. of secondary curd /plant (g)	Total yield/ plot (kg)
T ₀	66.80 a	13.57 d	179.6 d	8.27 c	79.00 c	947.6 c
T ₁	60.53 d	17.07 a	288.8 b	11.88 a	123.9 ab	1487 ab
T ₂	64.04 b	15.54 c	285.9 c	10.41 a-c	110.7 b	1329 b
T ₃	63.45 bc	15.85 bc	286.9 c	9.22 bc	119.2 ab	1431 ab
T ₄	60.29 d	17.19 a	290.4 a	12.09 a	127.5 a	1530 a
T ₅	61.06 cd	16.28 b	287.1 c	10.86 ab	121.0 ab	1453 ab
LSD _{0.05}	2.73	0.49	1.27	2.15	13.01	156.1
Level of significance	**	**	**	**	**	**
CV (%)	7.76	11.63	7.39	11.16	9.57	9.57

In a column figures having similar and no letter(s) do not differed significantly at 5% level whereas figures with dissimilar letter(s) differed significantly as per LSD at same level; ** = 1% level of probability, CV = Coefficient of variation; T₀ = No fertilizer; T₁ = Recommended fertilizer dose; T₂ = Cow dung; T₃ = Vermicompost; T₄ = Fermented plant juice; T₅ = Liquid fertilizer.

Fresh weight of stem

The results indicated that variety V₁ (63.00 g) showed highest stem weight at harvest stage and V₂ (60.06 g) shown the lowest stem weight at the harvest stage. It was observed that the highest fresh stem weight was achieved from the treatment combination of V₁T₄ (69.60 g) which was statistically poles apart from all other treatments followed by V₁T₅ (67.53 g) and V₁T₁ (66.43 g). On the other hand the lowest results achieved from V₂T₀ (47.62 g), followed by V₁T₀ (Table 3). A similar experiment was conducted Farooque and Islam (1989) showed in an experiment that application of cowdung, oil cake, urea, triple superphosphate and muriate of potash combined gave better growth and maximum yield of cabbage.

Days taken to primary curd initiation

The results indicated that variety V₁ (70.265) were taken maximum days for primary curd initiation and minimum days were taken by V₂ (55.126) for their primary curd initiation. Due to the nutritional effect, maximum days were taken by T₀ (66.80) and then T₂ (64.04) treatments for their primary curd initiation. On the other hand the lowest days were taken by T₄ (60.29) closely followed by T₁ (60.53) for their primary curd initiation. It was pragmatic that the maximum days taken for primary curd initiation V₁T₀ (74.45) closely followed by V₁T₂ (73.01). The lowest days were taken by V₂T₄ (53.57) closely followed by treatments V₂T₁, V₂T₅, and V₂T₃ for their primary curd initiation (Table 6).

Head diameter of primary curd

A significant variation was also found in terms of varietal performance. The variety V₁ (16.51 cm) showed the highest head diameter at the harvest stage and V₂ (15.318 cm) shown the lowest head diameter at the harvest stage. Fermented plant juice treated plant gave the highest head diameter (17.19 cm) but the lowest head diameter (13.57 cm) was observed in T₀ which was significantly different from all other treatments (Table 6). From the similar experiment of Roy (1981) reported an increased curd diameter from 15.1-20.2 cm and yields from 1083-2614 kg/ha by increasing the levels of N from 60-200 kg/ha in a period of 3 years with cv. Dania.

Primary curd weight per plant

Results indicated that variety V₁ (281.24 g) showed highest curd weight at the time of harvest stage and V₂ (258.30 g) gave the lowest curd weight at their harvest stage. The weight of curd was the maximum in T₄ (290.4 g/plant) treatment while T₁ (288.8 g/plant) was better than those of other treatments. But due to the nutrient effects T₀ (179.6 g/plant) shown the lowest in relation to others. It was matter-of-fact that the maximum primary curd exposed V₁T₄ (303.1 g/plant) followed by V₁T₁ (300.3 g/plant). moderate result was shown by the treatment combination of V₂T₄ (277.7 g/plant) which were statistically similar to V₂T₁ (277.3 g/plant). But the lowest results were found from the treatment combination of V₂T₀ (166.5 g/plant) at the harvest stage (Table 6).

Number of secondary curds per plant

Combined effect of varieties and nutrients on secondary curd formation per plant was found significant. It was practical that the highest number of secondary curd was found V₂T₄ (24.17) at the production to final harvest stage followed by V₂T₁ (23.75) and V₂T₅ (21.73). On the other hand results also indicated that the lowest number of secondary curd produced by V₂T₀(16.54) which were poles apart from other treatments. Simultaneously there was no secondary curd achieved of their any stage of life from the treatments of V₁T₀,V₁T₁, V₁T₂, V₁T₃, V₁T₄ and V₁T₅ due to their varietal effect which were also influenced by nutrients' (Table 6).

Fresh weight of secondary curd per plant

The result indicates that variety V₁ (0.00) showing no secondary curd from beginning to its harvest stage. But due to varietal effect V₂ (227.14 g/plant) exposed the fresh weight of secondary curd found in its total harvest stage. The maximum fresh weight of secondary curd was found from T₄(127.5 g/plant) which was followed by treatment T₁ (123.9 g/plant), T₅(121.0g/plant), andT₃ (119.2 g/plant). The lowest secondary curd production was shown by T₀ (79.0 g/plant). The highest weight of secondary curd was found V₂T₄ (255.0 g/plant) at the production to harvest final harvest stage followed by V₂T₁ (247.8 g/plant) and V₂T₅ (242.1 g/plant). Simultaneously there was no secondary curd weight achieved of their any stage of life from the treatments of V₁T₀,V₁T₁ and V₁T₂.

Total yield per plot

A significant variation was found on total yield/plot is respect of variety, nutrient sources and their combined effect. Known You showed the minimum curd weight (3.38 kg/plot) at harvest stages and Early Green gave utmost curd weight through primary and secondary (5.83 kg/plot) at their harvest stages. Fermented plant juice gave the uppermost fresh curd weight (5.01 kg/plot) and the minimum curd weight was observed from the treatment

combination of T₀ (3.10 kg/plot) which were significantly poles apart from all other treatments combinations. In the experiment it was observed that the uppermost fresh curd weight was achieved from the treatment combination of V₂T₄(6.39 kg/plot). The lower most total curd weight produced by the treatment combination of V₁T₀ (2.31 kg/plot) in presence of combined effect of variety and nutrient (Table 6). 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.

Cost and return analysis

Materials, non-materials and overhead cost were recorded for all the treatments of unit plot and calculated on per hectare basis. The price of broccoli at the local market rate was considered. The total cost of production ranged between Tk. 103580 to Tk. 133580per hectare among the different treatment combinations. The variation was due to different cost of broccoli cultivar and different sources of nutrients. The highest cost of production Tk. 96530 per hectare was recorded in the treatment combinations of vermicompost with "Known You" or "Early Green" cultivar; while the lowest cost of production TK. 66530 per hectare was recorded in the combination of no fertilizer with "Known You" or "Early Green" cultivar. The sale of harvested broccoli was @ Tk. 15,000 per ton. Among the different combinations, fermented plant juice with "Early Green" cultivar gave the highest net return (Tk. 228930 per hectare) while the lowest net return Tk. (16860 per hectare) was obtained from the treatment combination of no fertilizer with "Known You" cultivar. The benefit cost ratio (BCR) was found the highest (3.21) in the treatment combination V₁T₄ (Fermented plant juice with "Early Green" cultivar). On the other hand, the lowest BCR (1.16) was recorded from V₁T₀ (no fertilizer with "Known You") cultivar.

Table 6. Combined effects of nutrient sources and varieties on days taken to primary curd initiation, head height, head diameter, primary curd weight /plant of broccoli.

Combined effect of nutrients×Varieties	Days taken to Primary curd initiation	Head diameter (cm)	Primary curd wt. (g) /plant	Number of secondary curd/plant	Fresh wt. of secondary curd /plant (g)	Total yield/ plot (kg)
V ₁ T ₀	12.28 f	74.45	192.7 f	0.00 e	0.00 e	0.00 f
V ₁ T ₁	14.85 ab	67.44	300.3 b	0.00 e	0.00 e	0.00 f
V ₁ T ₂	13.58 de	73.01	296.8 c	0.00 e	0.00 e	0.00 f
V ₁ T ₃	13.97 cd	72.09	297.1 c	0.00 e	0.00 e	0.00 f
V ₁ T ₄	15.11 a	67.02	303.1 a	0.00 e	0.00 e	0.00 f
V ₁ T ₅	14.18 b-d	67.59	297.4 c	0.00 e	0.00 e	0.00 f
V ₂ T ₀	11.45 g	59.14	166.5 g	16.54 d	158.00 d	1496.00 e
V ₂ T ₁	13.89 cd	53.62	277.3 d	23.75 ab	247.80 ab	2974.00 b
V ₂ T ₂	12.94 ef	55.07	274.9 e	20.82 bc	221.50 c	2658.00 d
V ₂ T ₃	13.42 de	54.82	276.6 de	18.44 cd	238.50 b	2862.00 c
V ₂ T ₄	14.40 a-c	53.57	277.7 d	24.17 a	255.00 a	3059.00 a
V ₂ T ₅	13.42 de	54.54	276.8 de	21.73 ab	242.10 ab	2905.00 c
LSD _{0.05}	0.69	1.85	1.79	3.04	14.59	62.52
Level of significance	**	NS	**	**	**	**
CV (%)	7.76	11.63	7.39	11.16	9.57	9.57

In a column figures having similar and no letter(s) do not differed significantly at 5% level whereas figures with dissimilar letter(s) differed significantly as per LSD at same level; **= 1% level of probability, NS= Non-significant, CV= Coefficient of variation.

Table 7. Cost and return of broccoli due to use of different sources of nutrients and varieties of broccoli.

Treatment	Yield ton/ha	Gross return (000 Tk./ha)	Total cost of production (000 Tk./ha)	Net return (000 Tk./ha)	Benefit cost ratio (BCR)
V ₁ T ₀	8.03	120.45 (1420 \$)	103.58 (1218 \$)	168.66 (199 \$)	1.16
V ₁ T ₁	12.49	187.35 (2204 \$)	115.78 (1362 \$)	715.66 (842 \$)	1.62
V ₁ T ₂	12.42	186.3 (2191 \$)	128.58 (1512 \$)	577.16 (680 \$)	1.45
V ₁ T ₃	12.39	185.85 (2186 \$)	133.58 (1571 \$)	522.66 (615 \$)	1.39
V ₁ T ₄	12.63	189.45 (2228 \$)	103.61 (1254 \$)	858.35 (1010 \$)	1.83
V ₁ T ₅	12.4	186 (2188 \$)	104.23 (1226 \$)	817.67 (962 \$)	1.78
V ₂ T ₀	13.52	202.8 (2385 \$)	103.58 (1218 \$)	992.16 (1168 \$)	1.96
V ₂ T ₁	21.88	328.2 (3861 \$)	115.78 (1362 \$)	2124.16 (2499 \$)	2.83
V ₂ T ₂	20.69	310.35 (3651 \$)	128.58 (1512 \$)	1817.66 (2139 \$)	2.41
V ₂ T ₃	21.46	321.9 (3787 \$)	133.58 (1571 \$)	1883.16(2215 \$)	2.41
V ₂ T ₄	22.17	332.55 (3912 \$)	103.61 (1219 \$)	2289.35 (2693 \$)	3.21
V ₂ T ₅	21.01	315.15 (3707 \$)	108.23 (1273 \$)	2069.17 (2435 \$)	2.91

Conclusion

The result of the experiment revealed that almost all the parameters studied were significantly influenced by different sources of nutrients. More or less, all the characters attained highest values when fermented plant juice had applied. The control gave the lowest value in all the characters studied. Maximum yield (22.83 ton/ha) were obtained by fermented plant juice and the minimum yield (8.03 ton/ha) were found in the control plot. The maximum yield (20.23 ton/ha) were obtained from “Early green” variety. In combined effect of different sources of organic nutrients and cultivars exhibited that, highest yield (20.83 ton/ha) was recorded from the treatment combination of fermented plant juice with “Early green” cultivar (V₁T₄) where the minimum yield (8.03 ton/ha) was found from control with “Known you” (V₁T₀) treatment combination. The application of Fermented plant juice with “Early Green” cultivar was found to be conducive to higher economic return from broccoli and from soil under the field belongs to the Agro-ecological zone of AEZ -13, Ganges Tidal Floodplains.

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