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RESEARCH PAPER

Influence of various organic manures on growth, yield and economics of sprouting broccoli (*Brassica oleracea* L. var. *italica*) cultivar Green Head

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Abstract : A field experiment was designed and conducted during *Rabi* season of 2020-21 at Horticulture Research Block, Department of Horticulture, School of Agriculture Sciences, SGRRU, Dehradun, Uttarakhand to investigate the "Influence of various organic manures on growth, yield and economics of sprouting broccoli [*Brassica oleracea* (L.) var. *italica*] cultivar Green Head". The experiment was laid out in Randomized Block Design with three replications and nine treatments. The treatments comprised following levels of different organic manures with different concentrations *viz*. T_1 (control), T_2 (FYM@ 10t/ha), T_3 (Vermicompost @ 5t/ha), T_4 (cow urine @50%), T_5 (FYM @5 t/ha + Vermicompost @ 2.5 t/ha) T_6 (FYM @5 t/ha + cow urine @25%), T_7 (Vermicompost @ 2.5 t/ha + Cow urine @ 25 %), T_8 (FYM@ 10 t/ha + Vermicompost @ 5t/ha + Cow urine @50 %) and T_9 (FYM@ 5 t/ha + Vermivompost @ 2.5 t/ha + Cow urine @ 25%). The sowing of sprouting broccoli cultivar "Green Head" was done on 11/01/2021 and final harvest done at 14/04/2021. Observations on various growths, yield attributes and economics were recorded. The results revealed that treatment T_9 (FYM@ 5 t/ha + VC@ 2.5 t/ha + Cow urine@ 25%) was found to be most effective in terms of plant height (42.15cm), number of leaves (19.20cm), stalk girth (16.60cm), stalk length (13.73cm), days taken to head initiation (79.87days), total head weight (391.35g) and net return (Rs. 93,9194) whereas maximum B: C ratio (1:23.80) was recorded in T_7 (Vermicompost@ 2.5 t/ha + Cow urine @ 25 %).

Key Words : Organic manure, Vermicompost, Cow urine, FYM, Head initiation

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INTRODUCTION

Sprouting broccoli (*Brassica oleracea* var. *italica* L.) is also known as *harigobhi* in Hindi and it belongs to family Cruciferae. The name broccoli has been derived from Italian word 'brocco' means shoot and the word sprouting broccoli refers to development of young flower bud which has been used as vegetable. Morphologically, sprouting broccoli resembles cauliflower except

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secondary heads which develop in the axil of leaves and may contribute upto 50 per cent of total yield. It has 3 types *viz.*, green, white and purple, out of which green type is highly nutritious. In the world market about 40 per cent is marketed as fresh and remaining 60 per cent as frozen. (Thamburaj and Singh, 2011). Sprouting broccoli has proved an important crop under protected cultivation during off season around metropolitans and tourist places. Broccoli has good organoleptic properties and is a very delicious vegetable. It contains high protein (3.3%), vitamin C (137 mg/100g), vitamin A (3500 IU), vitamin B_2 (0.12 mg/100g), Iron (205 mg/100g) and Calcium (0.80 mg/100g). Cancer Research Centre of USA indicated that broccoli has several anti-cancer ogenic properties due to the presence of sulforaphane (Damato *et al*., 1994). Sprouting 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 use of chemical fertilizers alone can supply only one or two nutrient elements to the crop. Different kind of organic manures such as FYM, vermicomposts, cow urine have been used in crops but the amount and availability of nutrients in organic material vary widely, which makes interpretation of the value of nutrient supplied. It also improves soil physical and chemical properties as well as leading to sustainable agriculture (Chaterjee *et al*., 2005). Bulk density, water holding capacity, humic substances, microbial activities and hormone concentration in optimum range also obtained by application of FYM and vermicompost (Sharma and Garg, 2017; Swami and Bazaya, 2010). Many farmers are reviewing age old practices of applying cow dung, cow urine and their products in the form of manures and pesticides. Majority of farmers in India are small farmers and about 70% of the population engaged in agriculture. (Anonymous, 2011). Cow urine has been described as a liquid with innumerable therapeutic values, capable of curing several incurable diseases in plants. It has been considered that cow urine is very useful in agricultural operations as a bio fertilizer and bio pesticide. FYM, vermicompost and cow urine is rich source of macro, micronutrients and has disinfectant and prophylactic properties thus, purify the atmosphere and improve soil fertility (Pathak and Ram, 2013). Therefore, effect of organic manure on growth, yield attributes and economics of sprouting broccoli can be enhanced to a great extent by application of FYM, vermicompost and cow urine.

MATERIAL AND METHODS

The experiment was conducted under field conditions during the winter season of 2020-21 at Horticulture Research Block, Department of Horticulture, School of Agricultural Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, India. The Experiment was laid out in Randomized Block Design (RBD) with three replications. Each replication contained with nine treatments of organic manure *viz*. T_1 (control), T_2 (FYM - 10t/ha), T_3 (Vermicompost - 5t/ha), T_4 (Cow urine - 50%), T_5 (FYM + Vermicompost - 5t/ha + 2.5t/ha), T_6 (FYM + Cow urine - 5t/ha + 25%) T_7 (Vermicompost + Cow urine - 2.5t/ha + 25%), T_8 (FYM + Vermicompost + Cow urine - 10t/ha + 5t/ha + 50%), T_9 (FYM+ Vermicompost + Cow urine - 5t/ha + 2.5t/ha +25%). The soil of experimental site is classified as 'sandy loam' with characteristics as deep, well drained, coarse loamy cover over fragmental soils and of medium fertility. The sprouting broccoli cultivar "Green Head" was taken for research purpose. One-month seedlings were transplanted in the field at a spacing of 45cm x 45 cm on raised beds. The unit plot size was 5m x 4m. Seedlings were watered after transplanting. The total amount of organic manures *i.e.* FYM, vermicompost and cow urine was applied during final land preparation as per the treatment. Weeding, irrigation, crop management and harvesting were done manually. The data pertaining to following characters were recorded from five plants which were selected randomly from each replication plot and labeled except yield of heads which was recorded

Table A: Treatment details

Number of Treatment	Combinations	Concentration
T_1	Control	-
T_2	Farmyard Manure	10t/ha
T_3	Vermicompost	5t/ha
T_4	Cow urine	50%
T_5	FYM+ Vermicompost	5t/ha + 2.5t/ha
T_6	FYM+ Cow urine	5t/ha + 25%
T_7	Vermicompost + Cow urine	2.5t/ha+25%
T_8	FYM+ Vermicompost + Cow urine	10t/ha +5t/ha+50%
T_9	FYM+ Vermicompost + Cow urine	5t/ha +2.5t/ha+25%

plot wise. Plant height, number of leaves, stalk girth, stalk length, were measured 40, 60 days after transplanting (DAT) and at final harvest stage. Data on yield components *viz.* days required for 50% head initiations, total head weight were also recorded. The economics of sprouting broccoli crop was calculated as per the fundamental marketable stage. The obtained data were statistically analyzed with using standard statistical method as suggested by Gomez and Gomez (1996).

RESULTS AND DISCUSSION

The results on various growth and yield characters like plant height, number of leaves, stalk girth, stalk length, days for head initiations, 50% head initiation, head maturity and total head weight were significantly influenced by different organic manures as compared to control during the course interpretations. The data presented in Table 1, 2 and 3 were showed that the significant improvement was noticed when applied

Table 1: Effect of organic manures on growth attributes of sprouting broccoli at different harvest intervals

Treatments	Plant height (cm)				Number of leaves				Stalk girth (cm)				Stalk length (cm)			
	40 DAT	60 DAT	At final harvest	Mean	40 DAT	60 DAT	At final harvest	Mean	40 DAT	60 DAT	At final harvest	Mean	40 DAT	60 DAT	At final harvest	Mean
T_1	15.95	28.04	38.02	27.34	9.12	14.86	19.50	14.49	6.45	13.06	16.10	11.87	5.24	10.80	14.80	10.20
T_2	19.02	30.12	40.87	21.00	10.58	19.68	21.16	17.14	8.90	15.40	19.20	14.50	7.00	12.43	17.09	12.17
T_3	18.44	29.02	39.76	29.07	10.02	18.66	20.78	16.49	7.89	13.56	18.02	13.22	6.88	11.95	16.96	11.93
T_4	16.74	28.89	38.09	27.91	9.84	18.12	19.90	15.95	7.09	13.04	16.45	12.19	6.40	11.20	16.23	11.28
T_5	21.03	33.45	41.66	32.05	12.14	20.94	23.03	18.70	10.04	16.82	20.60	15.82	8.18	13.15	18.87	13.40
T_6	18.94	30.01	40.03	29.66	10.36	19.20	21.08	16.88	8.82	15.25	18.95	14.34	6.90	12.02	17.01	11.98
T_7	19.24	32.01	41.08	30.78	11.14	19.86	21.92	17.64	9.02	15.70	19.50	14.76	7.14	12.65	17.82	12.54
T_8	20.75	32.52	41.65	31.64	11.20	20.12	22.90	18.73	9.26	16.02	20.04	15.11	7.64	12.82	18.01	12.82
T_9	21.16	34.48	42.15	32.59	13.06	21.30	23.24	19.20	10.95	17.20	21.65	16.60	8.30	13.87	19.02	13.73
C.D.(P=0.05)			1.04				1.05				0.55				0.54	
S.E. ±			0.35				0.35				0.18				0.18	
SE(d) ±			0.49				0.49				0.26				0.25	
C.V.			1.98				3.49				2.22				2.53	

Table 2 : Effect of organic manures on days taken to head initiation, 50% head initiation, head maturity and total head weight of sprouting broccoli

Treatments	Number of days taken for			Total head weight (g)
	Head initiation	50% head initiation	Head maturity	
T_1	52.38	60.62	68.66	230.20
T_2	64.32	72.24	82	303.60
T_3	60.14	68	78.24	250.92
T_4	58.58	66.33	75.33	248.28
T_5	66.24	75.2	86.33	363.84
T_6	63.62	71.25	81.26	294.80
T_7	64.44	73.12	84	330.24
T_8	65.24	74.06	84.32	355.20
T_9	73.28	78.32	88.02	383.27
C.D. (P=0.05)		1.609		0.34
S.E. ±		0.532		0.11
SE (d)		0.753		0.16
C.V. (%)		1.286		0.06

Table 3 : Effect of different organic manures on net return and B: C ratio of sprouting broccoli

Treatments	Net return (Rs. ha^{-1})	B:C ratio
T_1	4,30,440	1 : 17.68
T_2	8,30,790	1 : 20.90
T_3	7,06,644	1 : 19.97
T_4	5,49,914	1 : 20.92
T_5	8,69,240	1 : 17.92
T_6	7,51,864	1 : 18.22
T_7	8,45,444	1 : 23.80
T_8	8,54,074	1 : 17.02
T_9	9,38,194	1 : 18.62

different combinations of organic manures on sprouting broccoli economics as compared to control. The findings of the present interpretations were recorded and are thoroughly discussed below:

Plant height :

The observation of plant height, recorded at 40, 60 DAT and at Final harvest was presented in Table 1 revealed significant differences among the treatments. At 40days after transplanting, the maximum plant height was recorded in treatment T_9 (21.16cm) which was at par with T_5 (21.03cm) and T_8 (20.75cm). However, minimum plant height (15.95cm) was recorded under control (T_1). In case of 60 DAT, In case of 60 days after transplanting the maximum plants height was obtained in treatments T_9 (34.48cm), which was at par with treatment T_5 (33.45cm) and T_8 (32.52cm). The significant difference was recorded with treatment T_7 (32.01cm), T_4 (28.89cm), T_3 (29.02cm), T_2 (30.12 cm) and T_6 (30.01 cm). The minimum plant height (28.04cm) was recorded under treatment T_1. At final harvest, the plant height was maximum in T_9 (42.15cm) which was comparable with T_5 (41.66cm) and T_8 (41.65cm). However, significant difference was observed with treatment T_7 (41.08cm), T_4 (38.09cm), T_3 (39.76cm), T_2 (40.87cm) and T_6 (40.03cm) while, minimum plant height was obtained in the treatment T_1 (38.02cm). Plant height increased with different organic manure application is due to the soil fertility, productivity and continuous nutrient supply throughout the growing period. Similar, results were obtained by Maurya *et al.* (2008), Chatto *et al.* (2011) and Chetri *et al.* (2012).

Number of leaves :

The number of leaves per plant counted at different stages of crops growth showed significant as presented in Table 1 revealed significant differences among the treatments. At 40 days after transplanting, the highest no. of leaves of sprouting broccoli was recorded in treatment T_9 (13.06cm) and it was at par with T_5 (12.14cm) and T_8 (11.20cm) however, significant differences were observed with treatment T_7 (11.14cm), T_4 (9.84), T_3 (10.02cm), T_6 (10.36cm) and T_2 (10.58cm). The minimum number of leaves (9.12cm) was recorded under the treatment T_1. In case of 60 days after transplanting, the maximum number of leaves was obtained in treatments T_9 (21.30cm), which were at par with the treatments T_5 (20.94cm) and T_8 (20.12cm). The significant difference was observed with treatment T_7 (19.86cm), T_4 (18.12cm), T_3 (18.66cm), T_6 (19.20cm) and T_2 (19.68cm). The minimum number of leaves (14.86cm) was recorded under the treatment T_1. At harvest days after transplanting, the number of leaves was maximum in T_9 (23.24cm) which was comparable

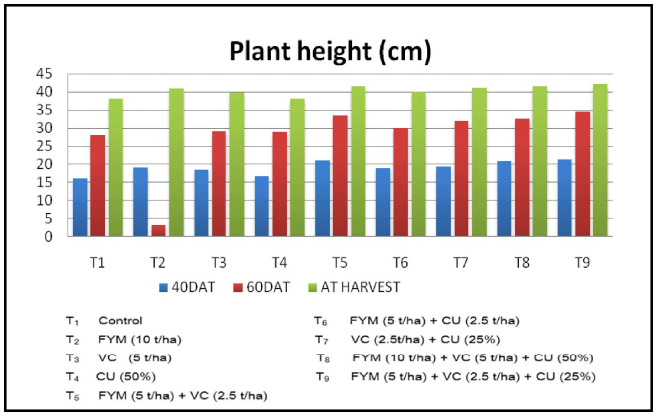

Fig.1: Plant height (cm) as influenced by organic manure at different harvesting interval in sprouting broccoli

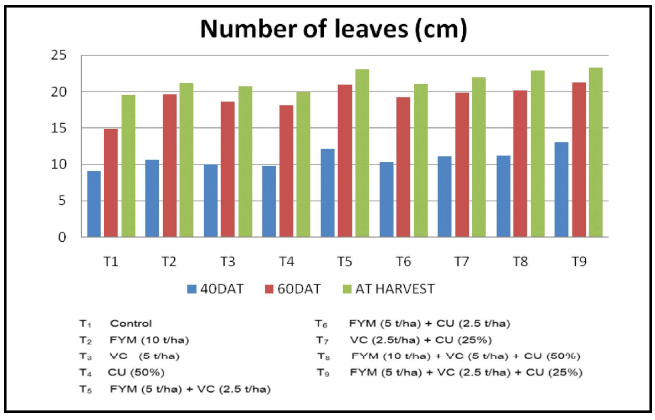

Fig. 2: Number of leaves (cm) as influenced by organic manure at different harvesting interval in sprouting broccoli

with T_5 (23.03cm) and T_8 (22.90cm) however, significant difference was observed with treatment T_7 (21.92cm), T_4 (19.90cm), T_3 (20.78), T_6 (21.08cm) and T_2 (21.16cm) while, minimum number of leaves was obtained in the treatment T_1 (19.50cm). This variation might be due to the balanced supply of nutrients including micronutrients and could be due to the soil water holding capacity. The findings were confirmed with Shiyam *et al.,* (2010), Wani *et al.,* (2011) and Chetri *et al.,* (2012).

Stalk girth :

Stalk girth at 40 days after transplanting the highest value of stalk girth of sprouting broccoli was recorded in treatment T_9 (10.95cm) and the lowest value (6.45cm) of girth of main stem was recorded under the treatment T_1 (control). In case of 60 days after transplanting, the maximum stalk girth was obtained in treatments T_9 (17.20), which were at par with the treatments T_5 (16.82cm) and T_8 (16.02cm). The significant difference was observed with treatment T_8 (15.70cm), T_4 (13.04cm), T_3 (13.56cm), T_6 (15.25cm) and T_2 (15.40cm). The minimum girth of main stem (13.06cm) was recorded under the treatment T_1. At harvest days after transplanting, the girth of main stem was maximum in T_9 (21.65cm) which was comparable with T_5 (20.60cm) and T_8 (20.04cm) however, significant difference was observed with treatment T_7 (19.50cm), T_4 (16.45cm), T_3 (18.02cm), T_6 (18.95cm) and T_2 (19.20cm) while, minimum girth of main stem was obtained in the treatment T_1 (16.10cm). Similar findings were obtained by Kumar *et al.* (2017).

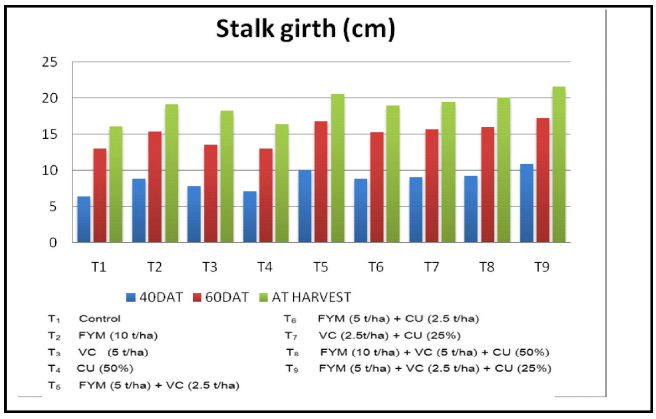

Fig. 3: Stalk girth (cm) as influenced by organic manure at different harvesting interval in sprouting broccoli

Stalk length :

The observation of stalk length was recorded at 40 DAT, 60 DAT and at final harvest and the results shows significant differences between the treatments. At 40 days after transplanting, the highest value of stalk length of sprouting broccoli was recorded in treatment T_9 (8.30cm) and the lowest value (5.24cm) of stalk length was recorded under the treatment T_1 (control). In case of 60 days after transplanting, the maximum stalk length was obtained in treatments T_9 (13.87cm), which were at par with the treatments T_5 (13.15cm) and T_8 (12.82cm). The significant difference was observed with treatment T_7 (12.65cm), T_4 (11.20cm), T_3 (11.95cm), T_6 (12.02cm) and T_2 (12.43cm). The minimum stalk length (10.80cm) was recorded under the treatment T_1. At harvest days after transplanting, the stalk length was maximum in T_9 (14.56cm) which was comparable with T_5 (18.87cm) and T_8 (18.01cm) however, significant difference was observed with treatment T_7 (17.82cm), T_4 (16.23cm), T_3 (16.96cm), T_6 (17.01cm) and T_2 (17.09cm) while, minimum stalk length was obtained in the treatment T_1 (16.10cm). This may due to the better nutritional environment of the root zone for the growth and development of plant. Similar results are found by Warn *et al.* (2011) and Choudhary *et al.* (2012).

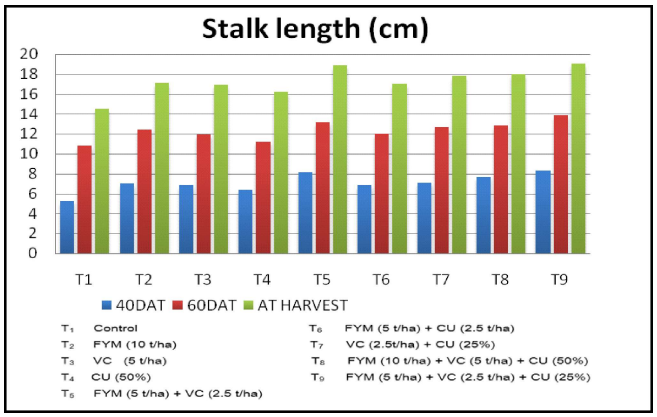

Fig. 4 : Stalk length (cm) as influenced by organic manure at different harvesting interval in sprouting broccoli

Days for head initiation, 50% head initiation and head maturity :

Different levels of organic manure treatments were found significant for the days, required for first head initiation and 50% head initiation. The treatment T_1 was significantly superior over rest of the treatment in respect of days for head initiation and 50% head initiation with minimum 52.38 and 60.62 days, respectively. The treatment T_1 was at par with treatment T_4 (58.58 days) and T_6 (63.62 days). The treatment T_1 has initiated heads at 52.38 days after transplanting and 50 % head initiated

at 60.62 days, while treatment T_4 and T_6 initiated first heads at 58.58 and 63.62 days, respectively whereas 50% head was initiated at 60.62 and 66.33 days, respectively. The days required for first head initiation and 50% curd initiation in treatment T_9 was 78.32 and 75.2 days respectively, which was required maximum days as compared to other treatments. The days required for maturity were significantly influenced by the organic manure at different levels. The treatment T_1 (52.38 days) gave early maturity on an average 68.66 days from transplanting, which was significantly superior over other treatments and at par with treatment T_4 (58.58 days), T_6 (63.62 days) and T_3 (60.14 days) with T_4 (75.33 days), T_6 (81.26 days) and T_3 (78.24 days), respectively. The maximum number of 88.02 days was required after transplanting for maturity of head as compared to other treatments, in treatment T_9.This was due to the different macro and micro nutrients present in organic manure plays a significant role in enhancing head emergence and maturity of sprouting broccoli. Similar findings have also been recorded by Warn *et al.* (2011).

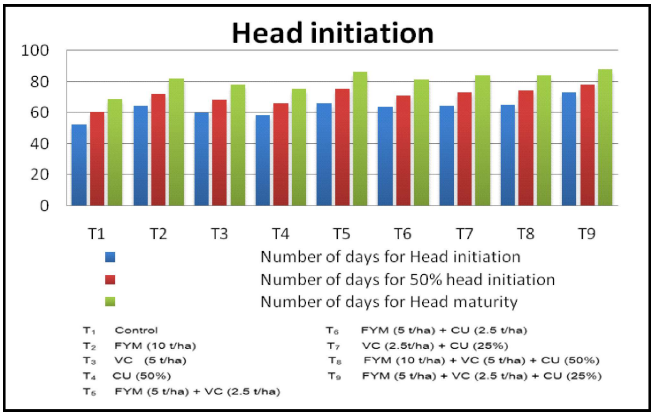

Fig. 5 : Days of head initiation and maturityof sprouting broccoli as influenced by different organic manure treatments

Total head weight :

The total head weight of different treatments differed significantly and range from 230.20 g to 383.27 g. the maximum total head weight was noted in the treatment T_9 (383.27g), which was at par with T_5 (363.84g) and T_8 (355.20g). However significant differences were observed with rest of the treatments. The minimum total head weight (230.20g) was recorded in treatment T_1. This could be due to increase in vegetative growth, more photosynthetic activity and better mobilization of plant nutrients particularly nitrogen and

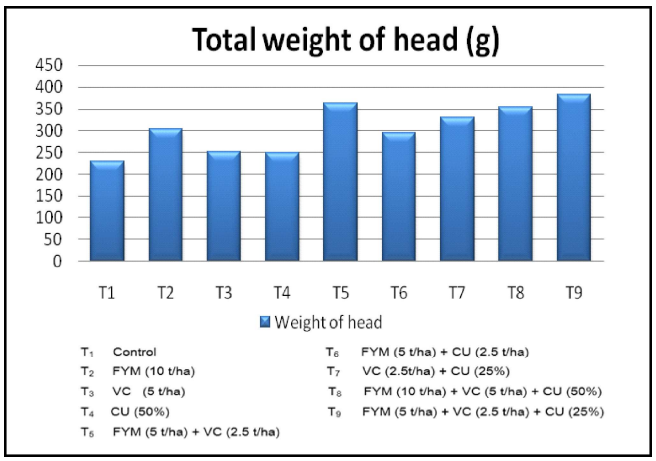

Fig. 6 : Total head weight (g) of sprouting broccoli as influenced by different organic manure treatments

phosphorus during latter stage of plant growth. This result was confirmed the findings of Wani *et al.* (2011) and Choudhary *et al.* (2012).

Economics :

The economics of all the treatments were given in Table 3. The net profit per hectare ranges from Rs.4,28,440 to 9,38,194. The maximum and minimum net profit per hectare was recorded under the treatment T_9 (9,38,194) and T_1 (Rs.4,28,440), respectively. The benefit cost ratio ranged from 1:17.02 to 1:23.80 depending on different treatments. It was found to be highest (1:23.80) under the treatments T_7 and lowest (1:17.02) under the treatment T_8. The increase in B:C ratio might be due to the application of organic sources *viz.*, vermicompost, cow urine which increases the plant height, number of leaves, stalk girth, stalk length, days taken to head initiation, 50% head initiation, head maturity, total head resulted in higher photosynthetic rate in plant leading to enhance the yield.

Conclusion :

On the basis of present research on "Influence of various organic manures on growth, yield attributes and economics of sprouting broccoli" in cultivar Green Head, it can be accomplished that among different organic manures treatments T_9 (FYM@ 5 t/ha + VC@ 2.5 t/ha + Cow urine@ 25%) was found to be most effective for increasing plant height, number of leaves, stalk girth, stalk length, days taken to head initiation, 50% head initiation, head maturity, total head weight and net profit whereas maximum B:C ratio was recorded in T_7 (Vermicompost@ 2.5 t/ha + Cow urine @ 25 %).

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