International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(4): 2115-2118

Received: 04-05-2019
Accepted: 06-06-2019

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Effect of integrated nutrient management on growth, economics and yield attributes of broccoli (*Brassica oleracea* L. var. *italica* Plenck) cv. Pusa broccoli KTS-1 under Dehradun condition of Uttarakhand

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Abstract
Present investigation was undertaken to study the response of integrated nutrient management on growth, yield and economics of broccoli cv. Pusa Broccoli KTS-1. For this, a field experiment was carried out in Randomized Block Design with three replications. The experiment was conducted at the Horticulture Research Block of Shri Guru Ram Rai School of Agricultural Sciences, during rabi season of 2017-18. For the experiment, nine treatment combinations are taken viz. Full dose of NPK through chemical fertilizer (T_1), FYM@ 25t/ha (T_2), FYM @15t/ha + half NPK through fertilizer (T_3), Neem Cake @5q/ha (T_4), Neem Cake @ 2.5q/ha + half NPK through fertilizer (T_5), Vermicompost @5t/ha (T_6), Vermicompost @2.5t/ha + half NPK through fertilizer (T_7), Poultry manure @ 5t/ha (T_8), Poultry manure @ 2.5t/ha + half NPK through fertilizer (T_9). The cultivar Pusa Broccoli KTS-1 of broccoli was transplanted at a spacing of 50cm x 50cm. Results indicate that the treatment combination of Vermicompost @2.5t/ha + half NPK through fertilizer (T_7) recorded maximum head length (14.88 cm), head width (13.68cm), gross head weight (368.22 g), net head weight (296.85g), yield per plot (13.26kg), net yield (164.66 q/ha) and benefit:cost ratio (3.98) followed by treatment T_9 (Poultry manure @ 2.5t/ha + half NPK through fertilizer) and (T_1) Full dose of NPK through chemical fertilizer.

Keywords: Integrated nutrient management, vermicompost, poultry manure, net yield, benefit: cost ratio

Introduction
Broccoli (*Brassica oleracea* L. var. *italica* Plenck) is originated from the Mediterranean region and commonly known as *Hari gobhi* in Hindi. It is a member of Cole crops group, belongs to the family Brassicaceae. Broccoli is an Italian vegetable which is cultivated in Italy in ancient roman times. Commercial cultivation of broccoli was started around 1923 (Decoteau, 2007). Watt (1998) reported that broccoli is more nutritious than any other cole crops such as cabbage, cauliflower and kohlrabi. On the other hand, broccoli is environmentally better adapted than cauliflower and it can also with stand comparatively higher temperature than cauliflower (Rashid, 2012). Brassica vegetables possess both antioxidant and anticarcinogenic properties (Cartea *et al.*, 2008) [3] and it is well known that dietary intake of food containing antioxidants provides effective support for the body's defensive systems and may prevent some diseases (Mc Carty, 2011). Broccoli is one of the most nutritious cole crops and contains vitamin A (130 times and 22 times higher than cauliflower and cabbage, respectively), thiamin, riboflavin, niacin, vitamin C and minerals like Ca, P, K and Fe (Kumar *et al.*, 2016). Broccoli contains indole-3-carbinol which helps to fight against breast and lung cancer (Anon. 2015). It is used as curries, soups, pickles and also eaten as a salad or may cooked as a single or mixed vegetable with potato (Thamburaj and Singh, 2001) [10]. Broccoli is a cool-loving crop and very sensitive to high temperature which cause the heads to be distorted, making it a high-risk crop. Integrated nutrient management (INM) consists of improvement and maintenance of soil fertility for sustainable crop productivity through optimization of all available organic, inorganic and biotic resources in an integrated manner, appropriate to each cropping system and farming situations with its ecological, social and economic ramifications (Agarwal, 2002) [1]. Several factors have been found to influence growth and yield of high value crops like vegetables, which ensure high and quick returns per unit area and time.

It is an established fact that continuous sole and imbalanced use of chemical fertilizers leads to deterioration of soil health and ecological balance in conjunction with decrease in nutrient uptake efficiency of the applied nutrients. Therefore, there is an urgent need to adopt an integrated nutrient supply and management system for promoting efficient and balanced use of plant nutrients. While the main emphasis was given on increasing the proper and balanced use of mineral fertilizers, the role of organic manure, biofertilizers, green manuring and recycling of organic wastes etc. should be considered supplementary and not substitutable. Being a highly remunerative crop, there was an essential need for standardization of integrated nutrient management packages consisting locally available organic sources integrated with chemical fertilizers. Keeping this in regard, the present research was carried out with the objectives to study the response of integrated application of inorganic and organic manures on growth, yield, economics and yield attributes of broccoli cv. Pusa Broccoli KTS-1.

Materials and Methods

A field experiment was conducted during the summer season of 2017 and 2018 at Research Block of Department of Horticulture, SGRR School of Agricultural Sciences, Dehradun, Uttarakhand (29º58' N, 77º34' E). The present investigation was undertaken to ascertain the response of integrated management of nitrogen, phosphorus and potassic fertilizers through organic manures in broccoli during the rabi season of 2017-18. The broccoli cultivar used in this experiment is Pusa Broccoli KTS-1, which is an early maturity variety, which takes around 90 days for 1st harvesting from transplanting, with the plant height being around 60cm and average head weight being 350-450gm.The experiment was conducted in RBD design with 3 replications. The experiment was laid in plots of size 3 m x 3 m with a spacing of 50 cm in between rows and 50 cm in between plants. Fertilizers were provided at a dose of 200 kg nitrogen, 50 kg phosphorus and 100 kg potash per hectare. The sources of fertilizers (both organic and inorganic) used were the basis of formation of different treatment combinations. The details of the treatment are as follows; T_1: Full dose of NPK through chemical fertilizer, T_2: FYM@ 25t/ha, T_3: FYM @15t/ha + half NPK through fertilizer, T_4: Neem Cake @5q/ha, T_5: Neem Cake @ 2.5q/ha + half NPK through fertilizer, T_6: Vermicompost @5t/ha, T_7: Vermicompost @2.5t/ha + half NPK through fertilizer, T_8: Poultry manure @ 5t/ha, T_9: Poultry manure @ 2.5t/ha + half NPK through fertilizer. The observations were recorded on different yield and yield attributing characters like head length, head width, gross head weight, net head weight, yield etc. The B: C ratio was calculated taking into considerations of the costs incurred and income generated. The statistical formulas were used for compilation of data and drawing of conclusion.

Results and Discussion

Although chemical fertilizers contribute a lot in fulfilling the nutrient requirement of broccoli, which is an exhaustive crop, but their regular, excessive and unbalanced use may lead to deterioration of soil health and ultimately poor crop yields. Consequently, there is stagnation or plateau in crop yield and this poses challenge to environment and food safety. From the present experiment, it was observed that the head length and head width were markedly influenced by different treatments. The data shown in table 2 revealed that the broccoli head length is significantly at par in the treatment containing 2.5 tonnes/ha of vermicompost + half NPK through fertilizer was on par with all other treatments except T_4 and T_6. The maximum head width was recorded in treatment T_7 (13.68 cm) followed by T_9 (13.32 cm) and T_5 (13.18 cm). The lowest head diameter was observed in T_4 where neem cake @ 5q/ha was applied. The data regarding effect of integrated nutrient management on head weight is presented in Table 1. A perusal of data indicated that weight of head per plant showed significant variation among the treatments. The data revealed that the lowest gross head weight of 280.58g in broccoli was recorded in T_4 treatment, which were consisting of neem cake only @5q/ha. It was observed that in broccoli maximum gross head weight was obtained in treatment T_1 (367.58g) with full dose of NPK through fertilizers which was at par with T_3, T_5, T_7 and T_9. The lowest net head weight of 222.30 g in broccoli was found in T_4 plots again and maximum net head weight was obtained in treatment T_7 (296.88 g) with Vermicompost @2.5 T/ha + half NPK through fertilizers which was at par with T_1(279.52 g) with (Full dose of NPK through chemical fertilizer), T_3(269.43 g) with (FYM @ 10t/ha+half NPK through fertilizer), T_5 (267.32 g) with (Neem Cake @ 2.5q/ha+half NPK through fertilizer) and T_9 (277.14 g) (Poultry manure @2.5t/ha+half NPK through fertilizer).The increase in net head weight might be due to the more photosynthesis from a larger area of the leaves and the translocation of photosynthates to the sink which is ultimately the head. The increase in the net head weight at this level might also be due to the increase in the leaf weight and also due to higher values of head length and head width also cited by Sharma *et al.,* (2008) [9].

It was clearly observed that a wide variation in yield per plot and per hectare can be obtained by altering the different fertilizer levels among the treatments. The head yield per plot and per hectare showed significant difference among all the treatments. The data clearly signifies that a wide variation in total head yield per plot can be obtained by altering the levels of N, P and K among the treatments. Highest yield per plot (13.26 kg) was obtained from T_7 (Vermicompost @2.5 T/ha + half NPK through fertilizers) followed by 12.52 kg in T_1, 12.24 kg in T_9 and 11.70 kg in T_3, which were at par with each other. Lowest yield per plot (7.48 kg) was recorded in plot T_4. It was observed that the various doses of nutrient produced significant variation in total head yield per plot. Highest head yield (164.66 t/ha) per hectare was recorded in T_7 followed by 154.74 t/ha in T_1. The beneficial role of farmyard manure and vermicompost in improving physical, chemical and biological properties of soil, which in turn, help in better nutrient absorption by plants, also resulted in higher values for yield contributing parameters. The study further revealed that various yield parameters (Table 1) have not been significantly influenced when organic manures are not applied (treatment T_1), which signifies the role of organic manures in combination with inorganic fertilizers for enhancing yield parameters in broccoli. Similar results were observed by Bahadur *et al.,* (2013) [2] and Chaterjee *et al.,* (2005) [4] (Fig. 1).

The B: C ratio of different treatment on sprouting broccoli with respect to gross and net returns per hectare and benefit cost ratio have been presented in Table 1. The data presented revealed that highest benefit cost ratio (4.30) were obtained in T_1 (Full dose of NPK through fertilizers), followed by treatment T_7 (4.11). Lowest benefit cost ratio of 2.17 and 2.50 was recorded in treatment T_8 (Poultry manure @ 5t/ha) and T_2 (20 tonnes/ha of FYM) respectively. The present investigation on integrated application of inorganic fertilizers and

vermicompost proved at par yield performance with full dose of NPK whereas, treatments without inorganic manure resulted in significant reduction in growth and yield attributing parameters. Among all the treatments, the application of vermicompost @2.5 t/ha + half NPK through fertilizers in broccoli was found to be the best for obtaining highest yield as well as benefit cost ratio in dehradun condition.

Table 1: Details of treatments

S. No.	Symbol	Treatments
1.	T_1	Full dose of NPK through chemical fertilizer
2.	T_2	FYM @ 25t/ha
3.	T_3	FYM @ 15t/ha+1/2 NPK through fertilizer
4.	T_4	Neem Cake @5q/ha
5.	T_5	Neem Cake @ 2.5q/ha+1/2 NPK through fertilizer
6.	T_6	Vermicompost @5t/ha
7.	T_7	Vermicompost @2.5t/ha+1/2 NPK through fertilizer
8.	T_8	Poultry manure @5t/ha
9.	T_9	Poultry manure @2.5t/ha+1/2 NPK through fertilizer

Table 2: Effect of integrated nutrient management on yield and yield attributes of broccoli cv. Pusa Broccoli KTS-1

Treatments	Head Length (cm)	Head width (cm)	Gross Head wt. (g)	Net Head wt (g)	Net yield (Kg/plot)	Net yield (q/ha)	B:C ratio
T_1: Full dose of NPK through chemical fertilizer	14.60	12.65	367.58	279.52	12.52	154.74	4.30
T_2: FYM @ 20t/ha	13.93	13.17	309.41	239.61	8.42	103.94	2.50
T_3: FYM @ 10t/ha+1/2 NPK through fertilizer	14.03	13.12	350.01	269.43	11.70	144.38	3.73
T_4: Neem Cake @5q/ha	13.17	12.16	280.58	222.30	7.48	92.49	2.67
T_5: Neem Cake @ 2.5q/ha+1/2 NPK through fertilizer	14.02	13.18	323.63	267.32	11.01	135.92	3.90
T_6: Vermicompost @5t/ha	13.07	12.77	296.61	224.96	9.89	122.07	2.57
T_7: Vermicompost @2.5t/ha+1/2 NPK through fertilizer	14.88	13.68	368.22	296.88	13.26	164.66	4.11
T_8: Poultry manure @5t/ha	13.86	12.76	288.98	242.03	7.97	98.41	2.17
T_9: Poultry manure @2.5t/ha+1/2 NPK through fertilizer	14.33	13.32	352.52	277.14	12.24	151.16	3.70
CD @ 5%	1.45	1.41	57.49	43.34	1.80	22.27	

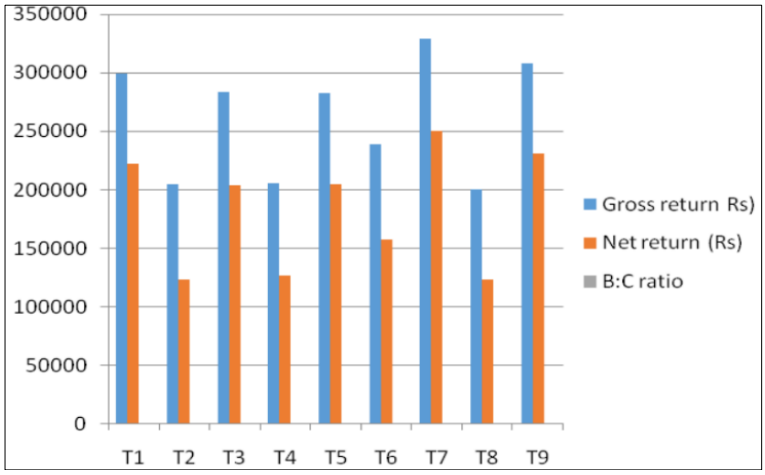

Fig 1: Gross Head wt. – Head weight along with leaves and stalk; Net Head wt. - Head weight excluding leaves & stalk

References

1. Agarwal SK. Role of integrated nutrient management using biological resources for sustainable agriculture, Microbes in Integrated Nutrient Management (Sep15 to Oct 12, 2002), AAREMCCSHAU, Hissar, 2002.
2. Bahadur A, Singh J, Upadhaya AK. Effect of manures and bio fertilizers on growth, yield and quality attributes of broccoli (*Brassica oleracea* L. var. *italica* Plenck.), Vegetable Science. 2013; 30(2):192-194.
3. Cartea ME, Pablo Velasco SO, Guillermo Padilla AH. Seasonal variation in glucosinolate content in *Brassica oleracea* crops grown in northwestern Spain. Photochemistry. 2008; 69:403-410.
4. Chaterjee B, Ghanti P, Thapa U, Tripathy P. Effect of organic nutrition in sprouting broccoli (*Brassica oleracea* L. var. *italica* Plenck.), Vegetable Science. 2005; 32(1):51-54.
5. Decoteau DR. Vegetable crops. Upper rever company. New Jersey, USA, 2000.
6. Kumar Das MB, Prasad KK, Kumar P. Effect of integrated nutrient management on quality of broccoli (*Brassica oleraciavar* var *Italica*) cv. fiesta under Jharkhand conditions. The Asian Journal of Horticulture. 2011; 6:388-392.
7. Mc carty, Mark F. Scavenging of peroxynitrite derived radicals by flavonoids may support endothelial no syntheses activity, contributing to the vascular protection associated with high fruit and vegetable intakes. Medical hypotheses. 2008; 70:170-181.
8. Rashid MM. Vegetable of Bangladesh (In Bengali). First edition. Bangla academy, Dhaka, 1976, 283.
9. Sharma A, Parmar DK, Kumar P, Singh Y, Sharma RP. *Azotobacter* soil amendment integrated with cow manures reduces need for NPK fertilizers in Sprouting

Broccoli, International Journal of Vegetable Science. 2008; 14(3):273-285.
10. Thamburaj S, Singh N. Vegetables, tuber crops and spices. Directorate of Information and Publications of Agriculture, ICAR, New Delhi, 2001, 137.
11. Watt BK. Nutritive Value of Fruits and Vegetables. USAID, Hand Book. An Avi Book Published by Van Nostrand Reinhold, New York. 1983; 369:414.