RESEARCH ARTICLE

IMPACT OF INTEGRATED NUTRIENT MANAGEMENT ON YIELD AND QUALITY OF BROCCOLI (*BRASSICA OLERACEA* L. VAR. *ITALIC* PLENCK) CV. KTS-1

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Abstract: Present investigation was undertaken to study the effect of INM on yield and quality of broccoli cv. 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 Farm of university, during Rabi season of 2014-15. For the experiment, thirteen treatment combinations viz. T_0 (Control), T_1 (NPK:150 :100 :100 Kg/ha), T_2 [(Neem cake (2.5 t/ha) + Vermicompost (5 t/ha) + Azotobacter (2 kg/ha)], T_3 [Neem cake (1.5 t/ ha) + 75% recommended dose of NPK], T_4 [Neem cake (2.5 t/ha) + 50% recommended dose of NPK], T_5 [Vermicompost (2.5 t/ha) + 75% recommended dose of NPK], T_6 [Vermicompost (5 t/ha) + 50% recommended dose of NPK], T_7 [Azotobacter (2 kg/ha) + 75% recommended dose of N + full dose of P and K through inorganic fertilizer], T_8 [Azotobacter (2kg/ha) + 50% recommended dose of N + full dose of P and K through inorganic fertilizer], T_9 [Neem cake (1.5 t/ha) + Vermicompost (2.5 t/ha) + 75% recommended dose of NPK through inorganic fertilizer], T_{10} [Neem cake (2.5 t/ha) +Vermicompost (5 t/ha) + 50% recommended dose of NPK through inorganic fertilizer], T_{11} [Neem cake (1.5 t/ha) + Vermicompost (2.5 t/ha) + Azotobacter (2 kg/ha) + 75% recommended dose of NPK through inorganic fertilizer] and T_{12} [Neem cake (2.5 t/ha) + Vermicompost (5 t/ha) + Azotobacter (2 kg/ha) + 50% recommended dose of NPK through inorganic fertilizer] were used. Treatment T_{11} (Neem cake 1.5 t/ha + Vermicompost 2.5 t/ha + Azotobacter 2 kg/ha + 75% recommended dose of NPK through inorganic fertilizer) was found best in terms of maximum curd weight/plant (438 g), curd weight/plot (3.94 kg), curd yield (219.06 q/ha), T.S.S. (10.15 ^{0}B), vitamin C content (82.91 (mg/100g), acidity (0.49), total sugar content (3.16 g), reducing sugar content (2.75g), non reducing sugar (0.43).

Keywords: Broccoli; Inorganic fertilizer; Vermicompost; Neem cake; Azotobacter; Yield; Quality

INTRODUCTION

Broccoli (*Brassica oleracea* L. var. *italica* Plenck 2n=x=18), which is originated from the Mediterranean region commonly known as *Hari gobhi* in Hindi and a member of Cole group, belongs to the family Brassicaceae or Cruciferae (mustard family). Broccoli is an Italian vegetable which is cultivated in Italy in ancient roman times. Commercial cultivation of broccoli was started around 1923 (Decoteau, 2000). Watt (1983) 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 reported to with stand comparatively at higher temperature than cauliflower (Rashid, 1976). Brassica vegetables possess both antioxidant and anticarcinogenic properties (Cartea *et al.*, 2008) 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, 2008) 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*., 2011). Broccoli contains indole-3-carbinol which helps to fight breast and lung cancer (Anon. 2006). It is used as curries, soups and pickles and also eaten as a salad and cooked as a single or mixed vegetable with potato (Thamburaj and Singh, 2001). 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 is a practical alternative, which holds great promise not only for securing high productivity but also against deterioration of soil environment. Many countries have already introduced the organic production system with specific logo to provide individuality to the organic products in commercial trade (Sharma, 2011). Organic manures not only balance the nutrient supply but also improve the physical and chemical properties of soil (Nair and Peter 1990). Chemical fertilizer nitrogen, phosphorus and potassium are essential macronutrients, which have great significance in plant growth and development and in the formation of starch thus require in large quantity (Choudhary *et al.*, 2012; katyayan, 2001). Taking into consideration the above facts, an experiment entitled "Impact of integrated nutrient management on yield and quality of broccoli (*Brassica oleracea* L. var. *italic* Plenck) cv. KTS-1" was planned with

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the objective to study the effect of INM on yield and quality of broccoli.

MATERIAL AND METHOD

The present study was conducted at research farm of Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow during 2014-2015. The experiment was conducted during Rabi season under Randomized Block Design with three replications. Geographically Lucknow is situated at $26^0$50' N latitude, $80^0$52' E longitude and altitude of 111 meter above mean sea level (MSL).

Planting materials and treatment combinations

The seeds of broccoli were collected from IARI, Regional Research Station Kattrain Kullu Valley (H.P). Broccoli seeds KTS-1 were sown on nursery beds of Horticultural Research Farm, Babasaheb Bhimrao Ambedkar University, Lucknow, by broadcasting method on Oct. 1, 2014. 35 Days after sowing, seedling were ready for transplanting. These healthy seedling uniform shape and size were selected and transplanted in well prepared field. All the agronomic package of practices was taken to grow a healthy crop in each replication. In each replication, randomly fine plants were selected for taking observation. The experimental materials included thirteen treatment combinations viz. T_0 (Control), T_1 (NPK:150 :100 :100 Kg/ha), T_2 [(Neem cake (2.5 t/ha) + Vermicompost (5 t/ha) + Azotobacter (2 kg/ha)], T_3 [Neem cake (1.5 t/ ha) + 75% recommended dose of NPK], T_4 [Neem cake (2.5 t/ha) + 50% recommended dose of NPK], T_5 [Vermicompost (2.5 t/ha) + 75% recommended dose of NPK], T_6 [Vermicompost (5 t/ha) + 50% recommended dose of NPK], T_7 [Azotobacter (2 kg/ha) + 75% recommended dose of N + full dose of P and K through inorganic fertilizer], T_8 [Azotobacter (2kg/ha) + 50% recommended dose of N + full dose of P and K through inorganic fertilizer], T_9 [Neem cake (1.5 t/ha) + Vermicompost (2.5 t/ha) + 75% recommended dose of NPK through inorganic fertilizer], T_{10} [Neem cake (2.5 t/ha) + Vermicompost (5 t/ha) + 50% recommended dose of NPK through inorganic fertilizer], T_{11} **[**Neem cake (1.5 t/ha) + Vermicompost (2.5 t/ha) + Azotobacter (2 kg/ha) + 75% recommended dose of NPK through inorganic fertilizer] and T_{12} [Neem cake (2.5 t/ha) + Vermicompost (5 t/ha) + Azotobacter (2 kg/ha) + 50% recommended dose of NPK through inorganic fertilizer].

Study parameters

Different 9 parameters of yield and quality were observed. Physical parameters like curd weight (g), yield of curd per plot (kg), and yield (q/ha) were measured. Biochemical parameters viz. T.S.S. (^{0} Brix), titratable acidity (%), ascorbic acid (mg/100g), total sugar (%), reducing sugar (%) and non reducing sugar (%) were estimated by method of Ranganna (1999).

Statistical analysis

All the observed parameters were laid down for analysis of variance by using RBD design. Three replications were taken to observations of parameters. Statistical analysis was carried out in OPSTAT software version 1.0 for windows.

RESULT AND DISCUSSION

Yield parameters

Data from Table-1 revealed that the differences with respect to the yield and quality were significant among different treatment combinations. Treatment T_{11} **(**Neem cake (1.5 t/ha) + Vermicompost (2.5 t/ha) + Azotobacter (2 kg/ha) + 75% recommended dose of NPK through inorganic fertilizer) observed best in terms of the maximum curd weight/plant (438 g). Curd of treatment T_{11} had highest weight/plot (3.94 kg) and maximum curd yield (219.06 q/ha) among all treatments. These results are similar to the work of Sharma et al. (2012) reported that the application of recommended dose of nitrogen, phosphorous and potassium in combination with azotobacter and phosphorous solubilizing bacteria in cauliflower registered higher marketable curd yield (9%) over the recommended dose of nitrogen, phosphorous and potassium. Singh and Pandey (2010) studied the effect of integrated nutrient management was study on yield and nutrients uptake of cabbage crop on sandy loam soil. The head yield of cabbage crop has increased significantly with application of recommended doses of inorganic fertilizer (NPK) in combination of organic fertilizer along with bio-fertilizer over the control

Quality parameters

Maximum T.S.S. (10.15^0B), titratable acidity (0.49%) and vitamin C (82.11mg/100g) were recorded in treatment T_{11} (Neem cake (1.5 t/ha) + Vermicompost (2.5 t/ha) + Azotobacter (2 kg/ha) + 75% recommended dose of NPK through inorganic fertilizer).

Similarly, highest total sugar (3.16%) reducing sugar (2.75%) and minimum non reducing sugar (0.43%) were found in treatment T_{11} whereas minimum concentration of sugars was recorded in T_0 (control). These result corroborated with the findings of Bambal et al., (1998) in cauliflower, Upadhyay et al. (2012) in cabbage, Qureshi et al. (2014) in kale.

Table 1. Impact of integrated nutrient management on yield and quality of broccoli (*Brassica oleracea* L. var. *italic* Plenck) cv. KTS-1

		Characters								
S. No.	**Treatments**	**Curd Weight (g)**	**Yield of curd per plot (kg)**	**Yield (q/ha)**	**Acidity (%)**	**T.S.S. ^{0}brix**	**Vitamin C (mg/100g)**	**Total sugar (%)**	**Reducing sugar (%)**	**Non reducing sugar (%)**
1.	T_0	163.16	1.46	81.473	0.28	7.13	68.45	1.92	1.71	0.21
2.	T_1	423.81	3.81	211.65	0.43	9.00	76.38	2.75	2.50	0.35
3.	T_2	230.13	2.06	114.80	0.30	7.15	71.66	2.36	1.83	0.23
4.	T_3	260.16	2.35	129.99	0.34	7.45	70.99	2.48	2.00	0.25
5.	T4	240.32	2.16	119.99	0.32	7.33	72.17	2.10	1.87	0.23
6.	T5	283.47	2.54	141.47	0.39	7.42	73.53	2.67	2.37	0.30
7.	T6	294.46	2.64	147.03	0.37	7.53	74.51	2.47	2.20	0.27
8.	T7	342.06	3.07	170.91	0.42	8.63	76.22	2.77	2.44	0.33
9.	T8	304.32	2.73	151.84	0.39	8.40	76.61	2.72	2.41	0.31
10.	T9	411.97	3.73	207.58	0.45	9.58	81.40	3.06	2.67	0.38
11.	T10	389.97	3.50	194.80	0.44	9.26	78.07	2.98	2.62	0.36
12	T11	438.71	3.94	219.06	0.49	10.15	82.91	3.16	2.75	0.43
13	T12	373.47	3.36	186.65	0.47	9.82	82.11	3.12	2.72	0.39
CD at 5%		22.20	0.20	11.22	0.03	0.73	1.82	0.16	0.04	0.02

CONCLUSION

On the basis of present investigation it can be concluded that the application of T_{11} (Neem cake 1.5 t/ha + Vermicompost 2.5 t/ha + Azotobacter 2 kg/ha + 75% recommended dose of NPK through inorganic fertilizer) followed by T_1 in (NPK: 150:100:100 kg/ha recommended dose nutrients through inorganic fertilizers) proved best for higher curd yield and maximum retention of quality attributes. It can be recommended for higher production of broccoli under Lucknow (Uttar Pradesh) conditions.

REFERENCES

Aires, A. Rosa, E. and Carvalho, R. (2006). Effect of nitrogen and sulphur fertilization on glucosinolates in the leaves and roots of broccoli sprouts. (*Brassica oleracea* var. *italica*). *J. Sci. Food Agric.* 86: 1512-16.

Anon, (2006). Cabbage, kale, broccoli, sprouts in: *you want to live forever. Times of India. New* Delhi. December 3: 9.

Cartea, M. E. Pablo Velasco, S. O. and Guillermo Padilla, A. H. (2008). Seasonal variation inglucosinolate content in *brassica oleracea* crops grown in northwestern Spain. *photochemistry*, 69: 403–410.

Choudhary, S. Choudhary, A. K. and Jat, N. K. (2012). Effect of organic and inorganic sources of nutrients on growth, yield and quality of sprouting broccoli cv. CBH-1. *Indian Journal of Horticulture 69(4): 550-554.*

Decoteau, D. R. (2000). Vegetable crops. Upper rever company. New Jersey, U.S.A

Katyayan, A. (2001). Fundamental of agriculture vol-I. 266-268. K*ushal publication and distributers Varanasi.*

Kumar, M. Das, B. Prasad, K. K. and Kumar, P. (2011). Effect of integrated nutrient management on quality of broccoli (*Brassica oleraciavar* var *Italica*) cv. fiesta under Jharkhand conditions. *The Asian Journal of Horticulture.* 6: 388-392.

Mc carty and Mark, F. (2008). 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.* 70: 170–181.

Nair, M. and Peter, K.V. (1990). Organic, inorganic fertilizers and their combinations on yield and storage life of hot chilli. *Veg. Sci*. 17: 7-10.

Qureshi, F. Wani, J. A. Bashir, U. Malik, M. A. and Mir, S. A. (2014). Response of farmyard manure and inorganic nitrogen on vegetative growth, leaf yield and quality of kale (Brassica oleracea var. acephala) in temperate region of Kashmir Valley. *International Quarterly Journal of Biology & Life Sciences*. 2(3):786-791.

Ranganna, S. (1999). Handbook of Analysis and Quality control for Fruit and Vegetable Products. 3rd edition. Tata McGraw- Hills Education, New Delhi, India.

Rashid, M.M. (1976). Vegetable of Bangladesh (In Bengali). First edition. *Bangla academy, dhaka.* 283

Sharma, J. P. (2011). Organic vegetables: production and protection technology in: quality seed production of vegetable crops. vol. 1 (Ed. J. P. Sharma). *Kalyani Publishers, New Delhi*, 123-143.

Sharma, J. P. Rattan, P. and Kumar, S. (2012). Response of vegetable crops to use of integrated nutrient management practices. S*abb Journal of Food and Agriculture Science.* 2(1). 15-19.

Singh, P. K. and Pandey, M. (2010). Study the effect of integrated nutrient management on yield and nutrient uptake in cabbage. *Indian Journal of Hill Farming*. 23(2):39-41.

Thamburaj, S. and Singh, N. (2001). Vegetables, tuber crops and spices. *Directorate of Information and Publications of Agriculture, ICAR, New Delhi.* 137.

Upadhyay, A. K. Bahadur, A. and Singh, J. (2012). Effect of organic manures and biofertilizers on yield, dry matter partitioning and quality traits of cabbage (Brassica oleracea var. capitata). *Indian Journal of Agricultural Sciences*, 82 (1): 31-34.

Watt, B. K. (1983). Nutritive Value of Fruits and Vegetables. *USAID, Hand Book. An Avi Book Published by Van Nostrand Reinhold, New York.* 369. 414.