Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 7 [1] December : 75-79

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.876
Universal Impact Factor 0.9804
NAAS Rating 4.95

ORIGINAL ARTICLE **OPEN ACCESS**

Effect of different doses of NPK and boron application on yield and yield's components of broccoli (*Brassica oleracea* L. *Var. italica)* western (U.P.) India

Trilok Chand* and Manoj Kumar Singh
Department of Horticulture,
SVP University of Agriculture and Technology, Meerut, Uttar Pradesh (250110), India

ABSTRACT
The present investigation was carried out to study the *"Effect of different doses of NPK and boron application on yield and yield components of broccoli (Brassica oleracea L. var. italica)"* under irrigated agro-ecosystem of western Uttar Pradesh during Rabi season 2010-11 with seven different treatments including control were used in Randomized Block Design (RBD). The results revealed significant effect on yield and yield components of broccoli for different treatments. Application of 120 kg N+60 kg P_2O_5+40 kg K_2O+15 kg B ha^{-1} gave Minimum days commencement of curd (56.48 days), and all other observation gave the maximum curd diameter (13.69 cm), length of curd (16.33 cm), weight of curd $plant^{-1}$ (286.89 g), weight of sprout $plant^{-1}$(126.89 g), weight of curd and sprout $plant^{-1}$ (0.390 Kg) and total yield Curd + sprout (148.51 qha^{-1}) was recorded with the application of 120 kg N+60 kg P_2O_5+40 kg K_2O+15 kg B ha^{-1}' maximum days commencement of curd and all other observation minimum under control treatment.
Key words: NPK, Boron, yield, yield s' components and Broccoli.

Received 16.08.2017 Revised 21.09.2017 Accepted 19.11. 2017

INTRODUCTION

Broccoli (*Brassica oleracea* L. var. *italica*) is a member of the Brassicaceae family as a wild form of this family, which found along the Mediterranean region [5-7]. Broccoli is an Italian vegetable, native to the Mediterranean region, cultivated in Italy in ancient roman times and about 1720 in England. On the other hand, the USA it first appeared in 1806, but it was commercially cultivated of broccoli was started around 1923 [7]. In Jordan, broccoli is cultivated on a limited area [3].However, due to increase in its popularity; there is a trend to increase cultivation by farmers as well as consumption by consumers. Broccoli is an important vegetable crop and has high nutritional and good commercial value [22]. It is low in sodium food, fat free and calories, high in vitamin C and good source of vitamin A,B_1, vitamin B_2 and calcium [7]. It has 130 times more vitamin A content than cauliflower and 22 times than cabbage [20, 21].The consumption of broccoli in daily diet, it minimizes the incidence of various types of cancer disease in human beings. It has some cancer fighting substances like Phytochemicals, ß- Carotenes, Indoles and isothiocynates. It also contains sulforaphane; it checks the growth of tumors and reduces the risk of cancer. In Indian scenario, broccoli is mainly grown in hilly area of Himachal Pradesh, Uttrakhand, Jammu and Kashmir, Tamil Nadu and Northern plains. Recently, in western Uttar Pradesh it is gaining popularity due to increasing awareness of nutritional security and quality produce as well as reasonable that most of districts comes in the national capital region (NCR) and well connected with national capital Delhi as fresh supply is concerned. The area is negligible under broccoli cultivation in India. The area under the vegetable cultivation is 9205.20 thousand hectares and there production 162186.60 thousand metric tons. The productivity of vegetable is about 17.80 metric tons per hectare [3]. Micro nutrients are essential as macro nutrients because important growth processes depend on them [2].For example, boron is essential for plant growth and development as translocation of sugar and quality production depend on boron [21]. However, the boron deficiency in soil caused by removal of boron by crops is not fully replenished by fertilizer applications. In contrast, high concentration and unbalance ratios of both macro and micro nutrients lead to undesirable plant growth and development [9]. As reported by Ouda *et al.*,[13] that plant growth is severely depressed by boron deficiency, but high concentration of boron also

reduces quality of crop [12, 11, 14, 16].It was found that balance fertilization of macro and micro nutrients is essential for the production of high yield and quality products [19, 2], while foliar application of micronutrients to plant is the most effective and safest way [1, 10].However, little information is available to show the effects of macro and micro nutrients on growth and yield parameters of crop [11, 12]. Although, broccoli is a high value vegetable crop of the world, but there is lack of research, particularly under field condition, to show the effects of nitrogen, phosphorus, potassium and boron on broccoli. Therefore, the current experiment was conducted to study the Effect of different doses of NPK and boron on yield and yield's components of broccoli (*Brassica oleracea* L.var.*italica.*)

MATERIALS AND METHODS

An experiment was conducted at Horticultural Research Centre, of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh (28°40′07″N to 29°28′11″N, 77°28′14″E to 77° 44 18″E) during 2010-11.The climate of the area is semi-arid, with an average annual rainfall of 665 mm 75–80% of which is received during July to September), minimum temperature of 4^0C in January, maximum temperature of 41–45^0C in June and relative humidity of 67–83% during the year. The soil of the experimental plot was sandy and low to medium in organic matter content. Soil with a bulk density of 1.48 Mg m^{-3}, pH =7.81, Organic carbon.=0.42% g, Available N =153.49 kg ha^{-1},Available P =29.98 kg ha^{-1}, and Available K =144.60 kg ha^{-1}. Ground water pumping was the predominant method of irrigation in Western UP.

The present experiment entitled *"Effect of different doses of NPK and boron application on yield and yield s'components of broccoli (Brassica oleracea L.var.italica.)"* was formulated in Randomized Block design (RBD) with three replications. The experiment was consisted of seven treatments with different doses of fertilizer combinations and boron applications in combinations and alone. The details of applied treatment were T_1-100 kg N+ 40 kg P_2O_5+20 kg K_2O ha^{-1}, T_2- 120 kg N+60 kg P_2O_5+40 kg K_2O ha^{-1},T_3-140 kg N +80 kg P_2O_5+60 kg K_2O ha^{-1},T_4-100 kg N+40 kg P_2O_5+20 kg K_2O+10 kg B ha^{-1},T_5-120 kg N+60 kg P_2O_5+40 kg K_2O+15 kg B ha^{-1},T_6-140 kg N +80 kg P_2O_5+60 kg K_2O+20 kg B ha^{-1},T_7- control (No fertilizer application). In present investigation, a Takki hybrid variety of broccoli was taken. The seeds of broccoli were sown in 3rd week of September in well prepared nursery beds. Thereafter, 30 days old seedlings of broccoli were transplanted in well prepared experimental field in classified plots at a 50x50 cm (plant to plant x Row to Row) distance. At the time of transplanting, half dose of nitrogen, full dose of phosphorus and potash were applied in experimental plots and thoroughly mixed in soil. Remaining half dose of nitrogen was applied after one month of transplanted crop. All the crop management practices were adopted during cropping season. The plant protection measures were also used to control of pest and diseases infestation. To find out the effect of treatments application on the three selected plants from each plot to obtain the field data according to observations on yield and yield components during the cropping periods for research purposes. The field data were analyzed statistically as suggested by Gomez and Gomez [8].

RESULTS AND DISCUSSION

The significant results on yield and yield attributing parameters were noticed with each increasing dose of NPK and boron up to a level of 120 kg N+60 kg P_2O_5+40 kg K_2O+15 kg boron ha^{-1} (Table- 1) as compared to control, therefore markedly declined in terms of days taken to curd formation, diameter and length of curd, weight of curd $plant^{-1}$, number of sprout and weight of sprout $plant^{-1}$, weight of curd and sprout $plant^{-1}$, yield of curd and sprouts (qha^{-1}).Minimum (56.48 days) taken to curd formation under T_5-120 kg N+60 kg P_2O_5+40 kg K_2O+15 kg boron ha^{-1},and maximum(63.11days) taken under control treatment. Similar results were obtained in terms of diameter of curd and length of curd. Maximum diameter (13.69 cm) and length (16.33 cm) of curd were recorded at T_5-120 kg N +60 kg P_2O_5+40 kg K_2O+15kg boron ha^{-1} and minimum (9.44 cm) and (10.87 cm) were obtained in control treatment. The minimum days taken to curd formation and size of curd is directly associated for higher yield of broccoli. The minimum days taken to curd formation and size of curd is directly associated for higher yield of broccoli. It is due to proper utilization of carbohydrates doses which is formed by protein synthesis through the nitrogen application. Phosphorus is responsible for root development and early maturity due to recovery of reactions. In other hand, potassium also give a significant role in many functions like carbohydrate metabolism and enzyme activation in plant body and boron act as proper translocation of sugars, starch and nitrogen compound in plant body. These findings are in close conformity with the earlier results obtained by [4] and [17]. The maximum weight (286.89 g) of curd $plant^{-1}$was also found in treatment T_5-120 kg N+ 60 kg P_2O_5 +40 kg K_2O+15 kg boron ha^{-1},and minimum curd weight (142.65 g) was recorded in the unfertilized plot. Similarly, the number of sprouts and weight of sprouts $plant^{-1}$ were recorded significantly higher by using various doges of NPK and boron combinations.

The maximum number of sprout (9.37) and weight of sprout (126.89g) plant^{-1} were recorded with a dose of 120 kg N+ 60 kg P_2O_5 + 40 kg K_2O+15 kg boron ha^{-1}. However control gave the minimum number of sprouts and weight of sprout plant^{-1} i.e., 6.22 and 44.86 g, respectively. Maximum weight of curd and weight of sprout plant^{-1} (0.390 kg) was recorded at 120 kg N+ 60 kg P_2O_5+ 40 kg K_2O+ 15 kg boron ha^{-1}, and minimum (0.200 kg) was noticed under control plot. The total yield of curd and sprouts (148.51qha^{-1}) was obtained under the applied doses i.e.120 kg N +60 kg P_2O_5 +40 kg K_2O +15 kg boron ha^{-1} followed by treatments T_4 and T_5, respectively, Table 1. Whereas, minimum total yield of curd and sprout (75.27q) ha^{-1} was recorded under control plot. It might be due to proper utilization of carbohydrates, proteins and accumulation photosynthates and many functions like carbohydrate metabolism and enzyme activation and translocation of sugars and starch by the supply of optimum level of NPK and boron in broccoli. These findings are also confirmed with the earlier workers [16, 19].

The data table -2 revealed that higher cost of cultivation Rs. 49147.08 ha^{-1} was investigated in T_6 (140Kg N + 80Kg P_2O_5 + 60Kg K_2O + 20Kg B ha^{-1}) followed by T_3 (140Kg N + 80Kg P_2O_5 + 60Kg K_2O ha^{-1}) and T_5 (120Kg N+ 60Kg P_2O_5 + 40Kg K_2O + 15Kg Bha^{-1}) with cost Rs. 47947.08 and 47671.63 ha^{-1} respectively. The least cost of cultivation Rs. 43006.00 ha^{-1} was found under the control during the course of study. The table-2 indicated that higher gross income Rs. 148510.00 ha^{-1} , Net return Rs. 100838.37,Cost : Benefit ratio 1:2.11 was recorded under the T_5 (120Kg N + 60Kg P_2O_5 + 40Kg K_2O + 15Kg B ha^{-1}) followed by the T_4 (100Kg N + 40Kg P_2O_5 + 20Kg K_2O + 10Kg Bha^{-1}) and T_6 (140Kg N + 80Kg P_2O_5 + 60Kg K_2O + 20Kg B ha^{-1}) with an amount of Rs. 142550.00 and Rs. 96353.87.00 ha^{-1}, 1:2.09 respectively whereas the lowest gross income Rs. 75270, Net return Rs. 32264.00, Cost : Benefit ratio 1:075 ha^{-1} was found under the control during the course of cultivation.

Table–1: Effect of Different doses of NPK and boron application on yield and yield attributing parameters of broccoli (*Brassica oleracea* L.var. *italica*)

Treatments	Commencement of curd (Days)	Curd diameter (cm)	Length of curd (cm)	Weight of curd plant^{-1} (g)	Number of sprout plant^{-1}	Weight of sprout plant^{-1} (g)	Weight of curd and sprout plant^{-1} (Kg)	Total yield of curd and sprouts (qha^{-1})
T_1 - 100kg N + 20Kg P_2O_5 + 20 Kg K_2O ha^{-1}	61.88	10.48	12.05	149.42	6.40	54.33	0.220	81.43
T_2 - 120Kg N + 60Kg P_2O_5 + 40 Kg K_2O ha^{-1}	60.87	11.09	12.50	183.77	6.77	54.85	0.250	95.44
T_3 - 140 Kg N + 80 Kg P_2O_5 + 60 Kg K_2O ha^{-1}	60.33	11.61	13.00	188.34	6.99	93.42	0.310	118.22
T_4 - 100 Kg N +40 Kg P_2O_5 +20 Kg K_2O +10 Kg B ha^{-1}	59.44	12.29	14.83	247.39	7.77	108.55	0.370	142.55
T_5 - 120 Kg N +60 Kg P_2O_5+40 Kg K_2O+ 15 Kg B ha^{-1}	56.48	13.69	16.33	286.89	9.37	126.89	0.390	148.51
T_6 - 140 Kg N +80 Kg P_2O_5 +60 Kg K_2O +20 kg B ha^{-1}	58.15	11.86	14.00	239.45	7.44	107.24	0.343	133.25
T_7 - Control	63.11	9.44	10.87	142.65	6.22	44.86	0.200	75.27
SE(m)	1.09	0.46	0.70	0.14	0.54	0.09	0.003	0.39
CD at 5%	3.43	1.44	2.20	0.45	1.68	0.31	0.008	1.21

Table–2: Effect of Different doses of NPK and boron application on yield components of broccoli (*Brassica oleracea* L.var. *italica*)

Treatments	Total cost of Cultivation (Rs.)	Gross income (Rs.)	Net Return (Rs.)	Cost : Benefit ratio
T_1 - 100kg N + 20Kg P_2O_5 + 20 Kg K_2O ha^{-1}	45796.13	81430.00	35633.87	1:0.78
T_2 - 120Kg N + 60Kg P_2O_5 + 40 Kg K_2O ha^{-1}	46871.63	95440.00	48568.37	1:1.04
T_3 - 140 Kg N + 80 Kg P_2O_5 + 60 Kg K_2O ha^{-1}	47947.08	118220.00	70272.92	1:1.47
T_4 - 100 Kg N +40 Kg P_2O_5 +20 Kg K_2O +10 Kg B ha^{-1}	46196.13	142550.00	96353.87	1:2.09
T_5 - 120 Kg N +60 Kg P_2O_5+40 Kg K_2O+ 15 Kg B ha^{-1}	47671.63	148510.00	100838.37	1:2.11
T_6 - 140 Kg N +80 Kg P_2O_5 +60 Kg K_2O +20 kg B ha^{-1}	49147.08	133250.00	84102.92	1:1.71
T_7 - Control	43006.00	75270.00	32264.00	1:0.75

CONCLUSIONS

The effects of nitrogen, phosphorus, potassium and boron on yield and yield attributing parameters of broccoli were investigated. These results indicated that yield and yield attributing parameters of broccoli were significantly related to suitable combinations of nitrogen, phosphorus, potassium and boron. Interestingly, number of curd plant^{-1} and total yield were maximum by combination of N, P, K and boron when plots received N at 120 kg ha^{-1}, P at 60 kg ha^{-1}, K at 40 kg ha^{-1} and boron at 15 kg ha^{-1}. However, yield started to decline from peak when P, K, and boron were kept constant but nitrogen was increased from 120 to 140 kg ha^{-1}. Therefore, to make recommendation and generalization about these combinations of N, P, K, and boron 120, 60, 40 and 15 kg ha^{-1} for highest yield of broccoli under irrigated agro-ecosystem of western Uttar Pradesh. However, cost of fertilizers and water pollutions through high fertilizations should also kept in mind when making recommendations for highest yield through high levels of fertilizations. In general, it can be concluded that compared to control best yield and yield components of broccoli for this experiment were obtained when plots received N_2 @ 120 kg, P_2O_5 @ 60 kg, K_2O @ 40 kg and boron @15 kg ha^{-1}.

ACKNOWLEDGEMENT

The authors are highly grateful to the Hon'ble Vice-Chancellor, Director Research and Head, Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut-250110 for providing the research facility as well as for kind encouragement during entire research period.

REFERENCES

1. Aghtap A.A., Ghanbari, A., Sirousmehr A., Siahsar B., Asgharipour M., Tavssoli, (2011). Effect of irrigation with wastewater and foliar fertilizer application on some forage characteristics of foxtail millet (*Setaria italic).* International Journal of Plant Physiology and Biochemistry. 3 (3):34-42
2. Ali S., Khan A.Z., Mairaj G. Arif, M. Fida M., Bibi, S., (2008). Assessment of different crop nutrient management practices for yield improvement. Australian Journal of Crop Science, 2 (3): 150-157
3. Anonymous, (2006). Annual Report of Plant Production. Plant production division, Ministry of Agriculture, Amman, Jordan
4. Bahadur, A., Singh, J., Singh Anonymous, 2013. Indian Horticulture Data Base, National Horticulture Board, Gurgaon, Haryana, India pp-10
5. Basavarajeshwari C. Patil, R.M. Hosamani, P.S. Ajjappalavar, B.H. Naik, R.P. Smitha and K. C. Ukkund (2008). Effect of foliar application of Micronutrients on growth and yield components of tomato Solenum lycopericon, Karnatka J. Agric. Sci., 21(3): (428- 430).
6. Chan, J.H., (2006).The combined use of chemical and organic fertilizers and/or biofertilizers for growth and soil fertility. International Workshop on Sustained Management of Soil-Rhizosphehere System for Efficient Crop Production and Fertilizer Use.16-20 October,
7. Decoteau, D.R.., (2000). Vegetable Crops. Upper River Company. New Jersey, U.S.A.
8. Gomez, A. and Gomez, A.A., (1996). Statistical Procedure for Agricultural Research. 2 John Willey and Sons Pnc, New York
9. Hall, J.L., (2002). Cellular mechanisms for heavy metal detoxification and tolerance. Journal of Experimental Botany, 53 (366):1-11
10. Haq Nawaz, Muhammad Zubair, and Hafiz, Derawadan., (2012). Interactive effects of nitrogen, phosphorus and zinc on growth and yield of Tomato (*Solanum lycopersicum)*. African Journal of Agricultural Research , **7** (26):3792-3769
11. Islam M., Ali S., Hayat, R. (2009). Effect of integrated application of phosphorus and sulphur on yield and micronutrient uptake by chickpea (*Cicer arietinum* L.). International Journal Agricultural Biology, 11:33-38
12. May, G.M., Pritts, M.P., (1993). Phosphorus, zinc and boron influence yield components in Earliglow strawberry. Journal of American Society of Horticultural Science, 118 (1)**:**43-49
13. Ouda, B.A., Mahadeen, A. Y., (2008). Effect of fertilizers on growth, yield, yield components, quality and certain nutrient contents in broccoli (*Brassica oleracea var. italic).* International Journal Agricultural Biology , 10**:** 627–32
14. Rangkadilok, N., Nicolas M. E., Bennett R. N., Eagling D. R., Premier R.R., Taylor W.J. (2004). The effect of sulfur fertilizer on glucoraphanin levels in broccoli (*Brassica. oleracea* L. var. *italica*) at different growth stages. Journal of Agricultural and Food Chemistry, 52**:** 2632–9
15. Sahah, D.A., Narayan, R. Ahmad, N. Narayan, S., Wani, K. P., (2010). Influence of boron and zinc on growth, yield and quality of Knol-khol cv. Early white Vienna. Indian Journal of Horticulture, 67 (special issue): 323-328
16. Shaheen, A. M., Abdel-Mouty, M.M., Ali A.H., Rizk, F.A., (2007). Natural and chemical phosphorus fertilizers as affected onion plant growth, bulbs yield and its some physical and chemical properties. Australian Journal of Basic Applied Science, 1 (4)**:**519-524
17. Singh, M.K., Malik, S., Kumar, V., Singh, I.P., (2009). Response of foliar feeding of molybdenum and boron on growth and yield of broccoli (*Brassica oleracea* L. var. *Italica*) cv. Aishwarya. Journal of Farming System Research and Development, 15 (1&2): 147-149

18. Supe, V. S., Marbhal, S. K., (2008). Effect of organic manure with graded levels of nitrogen on growth and yield of cabbage (*Brassica oleracea* var. *capitata* L.). Asian Journal of Horticulture, 3 (1): 48-50
19. Swan Z.M., Hafez, S. A., Basyony, A.E. (2001).Effect of phosphorus fertilization and foliar application of chelated zinc and calcium on seed, protein and oil yield and oil properties of cotton. Journal of Agricultural Science, 136**:**191-198
20. Thamburaj, S., Singh, N., (2003). Cole crops: A text book of vegetables, Tuber Crops and Spices, ICAR, New Delhi, *Pp*-136-137
21. Vasconcelos, A. C. F., Nascomento, C. W. A. Fiho, F.C., (2011). Distribution of zinc in maize plants as a function of soil and foliar Zn supply. International Research Journal of Agricultural Science and Soil Science , 1 (1):1-5
22. Yoldas, F., S. Ceylan, B. Yagmur and N. Mordogan, (2008). Effect of nitrogen fertilizer on yield quality and nutrient content in broccoli. Journal of Plant Nutrition, 31**:** 1333–43

Citation of this Article
Trilok Chand and Manoj Kumar Singh· Effect of different doses of NPK and boron application on yield and yield's components of broccoli (*Brassica oleracea* L. *Var. italica)* under western (U.P.) India. Bull. Env. Pharmacol. Life Sci., Vol 7 [1] December : 75-79