ISSN: 2347-4688, Vol. 5, No.(3) 2017, Pg. 366- 370

Current Agriculture Research Journal

www.agriculturejournal.org

Study the Manifestation of Growth and Yield Attributes of Broccoli through Application of Boron, Molybdenum, Zinc and their Combination Treatments in Teraiagro-Ecological Region of West Bengal.

RIMAN SAHA CHOWDHURY* and SUBHAMOY SIKDER

Department of Vegetable and Spice Crops, Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari, Coochbehar-736165, West Bengal, India.

Abstract

Broccoli (*Brassica oleracea*L.) is an important winter vegetable under the cole groups, which has great market potential in India and Gulf countries. The climatic condition of Terai region of West Bengal is highly suitable for broccoli cultivation that argued for the possibility of getting more net profit of the farmers from cultivation of this high valued crop. But due to the micronutrient deficiency in the soil of terai region, broccoli not gives good return for this reason the experiment was done to give a recommendation to the farmers for better yield. The present experiment was carried out to examine the effect of boron, zinc and molybdenum on broccoli (cv-green magic) with sole doses of these three micronutrients were fixed 0.3% for borax, 0.5% and 1.0% zinc sulphate as per and 0.03% and 0.05% per ammonium molybdate solutions as sole as well as their combined treatments on the yield and growth parameters of the broccoli. Among the sole treatments, application of zinc showed significantly higher effect on leaves per plants, leaf area, total chlorophyll content of the leaf and ascorbic acid content in the head. Significantly higher plant height showed by the treatments 0.03% Mo+1%Zn (59.10cm) and 0.05% Mo+1% Zn (59.05cm), respectively. Irrespective of the treatments Zn had significantly positive influence in increasing the number of leaves per plant, especially at 0.5% dose. Significantly highest ascorbic acid was recorded at i.e., 61.54mg/ 100g of fresh head weight along with this significantly highest leaf area were recorded at combination treatment of 0.3%, 0.03% Mo and 0.5% Zn (454.35 cm2) and sole treatment of 0.5% Zn (452.33 cm2). Combination of 0.3% borax, 0.03% ammonium molybdate and 0.5% zinc sulphate were recorded to be best for most of the traits.

Article History

Received: 12 July 2017
Accepted: 17 August 2017

Keywords:

Boron, Zinc, Molybdenum and Broccoli.

CONTACT Riman saha Chowdhury riman.saha03@gmail.com Department of Vegetable and Spice Crops, Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari, Coochbehar-736165, West Bengal, India.

To link to this Article: http://dx.doi.org/10.12944/CARJ.5.3.16

Introduction

Broccoli (*Brassica oleracea*L.) is an important crop under the cole group of vegetable crops. Broccoli is supposed to be the first of the Cole crops evolved from the wild species of cabbage or kale1.Tender knob and processed products like soup, vegetable curry preparation and others makes it popular throughout the region of Terai zone. It is a rich source of vitamin C, E, B_1, carotenoids, phenolic[2] and possesses anticancer properties due to presence of high amount of indole-3-carbinol[3]. Due to its very high nutritional property the demand is increasing rapidly with the increasing health conciseness among the consumers. The climatic condition of Terai region of West Bengal is highly suitable for broccoli cultivation that argued for the possibility of getting more net profit of the farmers from cultivation of this high valued crop. But, high acidic soil condition in this region is becoming major constrain[4] as it leads to greater extent of micronutrient deficiency viz., boron and molybdenum[5] that ultimately is major hindrance in full exploitation of the economical traits which aggravating the return than the expected. Present experiment was designed to Study the manifestation of growth and yield attributes of Broccoli through application of boron, molybdenum, zinc as well as to optimis e sole and combined doses of micronutrients for better exploitation of the economic traits.

Material and Methods

The field experiments were carried out at Horticultural Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, situated at 26° 40' N latitude and 89° 38' E longitudes with average altitude of 43 m above the mean sea level (MSL) and soil pH 5.5-6.5 during autumn-winter season. In this experiment three important micronutrients *viz*., boron, molybdenum and zinc along with their combinations were applied through foliar spray at 30 and 45 days after transplanting on locally popular cultivar "Green Magic" of broccoli. Rapid uptake of nutrients applied to crop foliage ensures a fast response within the plant as micronutrients directly enter the metabolic processes. Foliar applications of micronutrients are most completely available to the plant, because they are not either fixed or diluted in some large volumes of soil6. The sole doses of these three micronutrients were fixed 0.3% for borax as per[7] 0.5% and 1.0% zinc sulphate as per[8] and 0.03% and 0.05% per ammonium molybdate solutions as per[7] and their different treatment combinations. Thus three sole treatments as well as fourteen different combinations along with their control were laid out in randomized block design with 3 replications with a spacing of 45 x 45 cm in plot sized of 2.5 m x 2 m. Common cultural practices were used for the broccoli production such as irrigation, fertilization etc, according to recommended practices for broccoli in the commercial fields along with basal recommended dose of N, P2O5, K2O (120 kg, 60 kg andm60 kg/ ha, respectively) were followed. Observations were recorded on ten randomly selected plants from each plot. Data were recorded on five morphological traits *viz.* plant height (cm), leaves per plant, days to head maturity, head weight (g) and leaf area along with two bio-chemical traits viz. total chlorophyll content of leaf (mg/ 100g) and ascorbic acid of head (mg/g). Total chlorophyll content was estimated as per[9] and ascorbic acid was estimated as per[10]. Collected data were analysed statistically by using SPSS 22.0.

Result

Obtained expression of the traits under the experiment in the analysed table form depicted the role micronutrients (boron, molybdenum and zinc) in governing the manifestation of the traits. Among the micronutrients, zinc showed significantly higher performance for leaves per plant (16.15), leaf area (452.33 sq. cm), total chlorophyll of leaves (9.88 mg/100g) and ascorbic acid (58.18 mg/100g). Application of 0.3% boron resulted in early head maturity (64.40 days) followed by combined treatments of 0.3% B + 0% Mo + 0.5% Zn (64.55 days), 0.3% B + 0.05% Mo + 0.5% Zn (64.95 days), respectively. Although we failed to trap any significant sole nutrient effect on enhancing the head weight, where as significant effect was recorded regarding the for plant height irrespective of treatments (sole as well and combined treatments of micronutrients). Considering the overall performance, significantly higher plant height showed by the treatments 0.03% Mo+1%Zn (59.10cm) and 0.05% Mo + 1% Zn (59.05cm), respectively. Sole application of Zn indicated significantly positive influence in increasing the number of leaves per plant i.e., 16.15 at 0.5% and 15.25 at 1.0% solutions, respectively. Although, treatments of 0.3% B + 0.05% Mo + 0.5% Zn and 0% B + 0.03% Mo + 0.5% Zn were remarkably increased the number of leaves per plant i.e., 16.30 and 16.25 respectively. Greater extent of significant

differentiate response were recorded in case of head weight throughout the treatments. Significant positive values were recorded for chlorophyll content of leaves, especially sole treatments of 0.3% B, 0.05% Mo and 0.5% Zn or as their combinations. Significantly highest ascorbic acid was recorded at i.e., 61.54mg/ 100g of fresh head weight at 0.3% B + 0.03% Mo+ 0.5Zn. Whereas, significantly highest leaf area i.e., 454.35 cm2 was recorded at combination treatment of 0.3% B, 0.03% Mo and 0.5% Zn and sole treatment of 0.5% Zn i.e., 452.33 cm^2.

Discussion

Data obtained from the field clearly indicated that there was significant effect of the micro-nutrients as sole as well as their combined treatments on the yield and growth parameters of the broccoli which justified the application of micronutrients at optimum level along with the macronutrients to promote better growth and yield in this region to fetch higher net return by the farmers. These phenomena might be due to beneficial effects of applying foliar plant nutrients particularly nitrogen, zinc, boron, iron and manganese and its sources play a key role in improving the productivity and quality of crop due their involvement in various enzymes and other physiologically active molecule[11]. Lahijie and Khosa et al. were reported that micronutrients play vital roles in the growth and development of plants, due to their stimulatory and catalytic effects on metabolic processes and ultimately on flower yield and quality[12,13].

Among the sole treatments, application of zinc showed significantly higher effect on leaves per plants, leaf area, total chlorophyll content of the leaf and ascorbic acid content in the head. Where as sole application of boron was highly associated with head maturity. In our experiment we failed to trap any sole effect of molybdenum on mentioned parameters might be due to doses was not fitted well to express high level of physico-chemical responses that contradicted the earlier finding[7, 14].

However, sole as well as combined treatments of three micronutrients together depicted a very

Table: Different quantitative characters of plant along with treatment effects

Treatment	Plant Height (cm)	Leaves/ Plant	Days to Head Maturity	Head Weight (g)	Total Chloro-phyll of Leaf (mg/100g)	Ascorbic Acid (mg/100g)	Leaf Area (cm^2)
$B_0M_0Zn_0$	57.55 ^{ab}	13.85 ^{fg}	70.25 $^{b-d}$	350.28 ^{m}	6.48 ^{c}	48.32 ^{gh}	312.82 ^{i}
$B_0M_0Z_{0.5}$	58.25 ^{ab}	16.15 ^{a}	70.25 $^{b-d}$	502.15 ^{e}	9.88 ^{a}	58.18 ^{b}	452.33 ^{a}
$B_0M_0Z_{1.0}$	57.85 ^{ab}	15.25 ^{cd}	70.95 $^{a-c}$	412.23 ^{i}	7.64 ^{b}	52.23 ^{de}	328.24 ^{h}
$B_0M^{0.03}Z_0$	58.10 ^{ab}	13.65 ^{fg}	69.05 ^{de}	352.71 ^{m}	6.17 ^{c}	46.17 ^{h}	298.91 ^{j}
$B0M0.03Z_{0.5}$	58.45 ^{ab}	16.25 ^{a}	71.05 ^{ab}	518.22 ^{d}	9.78 ^{a}	59.61 ^{ab}	412.12 ^{c}
B0M0.03Z1.0	59.10 ^{a}	14.85 ^{de}	69.35 $^{c-e}$	401.72 ^{j}	7.84 ^{b}	55.23 ^{c}	345.87 ^{g}
B0M0.05Z0	57.95 ^{ab}	14.05 ^{f}	69.25 $^{c-e}$	348.54 ^{m}	6.42 ^{c}	48.11 ^{gh}	317.61 ^{i}
B0M0.05Z0.5	56.25 ^{b}	16.15 ^{a}	69.15 ^{de}	485.95 ^{f}	10.11 ^{a}	58.85 ^{b}	444.57 ^{b}
B0M0.05Z1.0	59.05 ^{a}	15.65 ^{bc}	71.95 ^{a}	398.65 ^{j}	6.54 ^{c}	50.43 $^{e-g}$	361.55 ^{e}
B0.3M0Z0	58.45 ^{ab}	13.55 ^{g}	64.40 ^{i}	372.65 ^{l}	6.55 ^{c}	50.27 $^{e-g}$	329.73 ^{h}
B0.3M0Z0.5	58.37 ^{ab}	15.95 ^{ab}	64.55 ^{hi}	612.85 ^{b}	10.33 ^{a}	60.17 ^{ab}	412.34 c
B0.3M0Z1.0	58.25 ^{ab}	15.05 ^{de}	67.15 ^{fg}	442.13 ^{g}	8.11 ^{b}	52.72 ^{de}	317.89 ^{i}
B0.3M0.03Z0	57.65 ^{ab}	13.80 ^{fg}	68.15 ^{ef}	385.82 ^{k}	6.63 ^{c}	51.25 ^{ef}	331.92 ^{h}
B0.3M0.03Z0.5	57.90 ^{ab}	15.85 ^{ab}	65.05 ^{hi}	625.33 ^{a}	10.23 ^{a}	61.54 ^{a}	454.35 ^{a}
B0.3M0.03Z1.0	58.10 ^{ab}	14.95 ^{de}	66.24 ^{gh}	428.55 ^{h}	8.17 ^{b}	49.17 ^{fg}	332.86 ^{h}
B0.3M0.05Z0	58.35 ^{ab}	14.10 ^{f}	69.15 ^{de}	401.11 ^{j}	6.75 ^{c}	54.35 ^{cd}	298.21 ^{j}
B0.3M0.05Z0.5	57.15 ^{ab}	16.30 ^{a}	64.95 ^{hi}	602.82 ^{c}	10.44 ^{a}	59.47 ^{ab}	399.89 ^{d}
B0.3M0.05Z1.0	57.40 ^{ab}	14.65 ^{e}	68.45 ^{ef}	431.92 ^{h}	7.93 ^{b}	55.25 ^{c}	351.54 ^{f}

Means followed by the same letters are not significant at 0.05 percent level according to Duncan's test.

complex trend of effect. There was no huge significant variance throughout the treatments regarding the plant height. Significantly higher plant height showed by the treatments 0.03% Mo+1%Zn and 0.05% Mo + 1% Zn. Irrespective of the treatments Zn had significantly positive influence in increasing the number of leaves per plant, especially at 0.5% dose. Similar findings in case both of these two traits were reported by Kanti et.al. in cauliflower[15]. Analysed data clearly indicated that borax predominately influenced the head maturity and significantly reduced days required to obtain marketable output. Similar result obtained in case of 0.5% Zn along with combination treatment of 0.3% B + 0% Mo + 0.5% Zn. A very complicated association between the different treatment combinations were recorded in case of head weight that suggested the complex combinations of nutritional effect in up and or down regulation of enzymatic activity influence the head size and weight. However, B0.3% B + 0.03 Mo + 0.5% Zn showed significantly highest value for head weight. This finding was supported by the earlier works in cauliflower[16], cabbage[17], sweet potato[18] and broccoli[7]. Obtained data on chlorophyll content of leaves clearly indicated the significantly positive effect of all these three micronutrients, especially 0.3% B, 0.05% Mo and 0.5% Zn as sole treatment or as their combinations. Significantly highest ascorbic acid obtained at 0.3% B + 0.03% Mo+ 0.5Zn solution. Both the findings in case of chlorophyll content of leaf and ascorbic acid content were supported by the findings of Thapa *et. al.*[19]. Whereas, significantly highest leaf area were recorded at combination treatment of 0.3% B, 0.03% Mo and 0.5% Zn and sole treatment of 0.5% Zn. Throughout the data dominance of zinc in determining the leaf are might be due to its association in synthesis of tryptophan, stimulate the leaf growth of plant by active physiological process and there by increased leaf area[8].

Conclusion

However, it may be concluded from the above discussion that sole treatment of 0.05% zinc sulphate and combination of 0.3% borax, 0.03% ammonium molybdate and 0.5% zinc sulphate were recorded to be best for most of the traits.

Acknowledgement

We wish to acknowledge Department of Vegetable and Spice Crops, UttarBanga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, for providing necessary facilities to carry out this study.

References

1. Rubatzky, V.E. and Yamaguchi, M. Cole crops, other Brassica and other crucifer vegetables. World Vegetables, 371-417 (1997).
2. Parente, C.P., Reis, L. M.J., Teixeira,L.E., Moreira, M.M., Barros, A.A. and Guido, L.F. Phenolic content and antioxidant activity determination in broccoli and lamb's lettuce. *International Journal Agriculture Biosystem ScienceandEngineering.* ***7***(7):70-73 (2013).
3. Solunke, B.G., Wagh, A.P., Dod, V.N. and Nagre,P.K. Effect of dates of planting andspacing on growth and yield of broccoli. *The Asian Journal of Horticulture.* ***6***(2): 294-296 (2011).
4. Pati, R. andMukhopadhyay, D. Distribution of cationic micronutrients in some acid soils of West Bengal. *Journal of the Indian Society of Soil Science.* ***59***(2): 125-133 (2011).
5. Lal, G. In: Advances in Horticulture.Agro techniques for colecrops,Chadha KL, Kalloo G(eds). Malhotra Publishing House, New Delhi, 5:503-521 (1993).
6. Baloch, M.J., Khan, N. U., Rajput, M. A.,Jatoi, W. A., Gul,S.,Rind, I. H. and Veesar, N. F., Yield related morphological measures of short duration cotton genotypes. *Journal of Animal and Plant Science.* ***24***(4): 1198-1211 (2014).
7. Saha, P., Das,N.R. and Chatterjee, R. Boron and molybdenum nutrition in sprouting broccoli under terai region ofWest Bengal. *The Asian Journal of Horticulture.* ***5***(2): 353-355 (2010).
8. Laskari, C.O., Makwana, A.N. and Meman,M.A.Effect of zinc and iron on growth and yield of cauliflower (Brassica

oleraceaVar. Botrytis Linn) cv.Snowball-16. *The Asian Journal of Horticulture.* ***2***(2):277-279 (2007).

9. Sadasivam, S. and Manickam, A. Biochemical methods. 2nd edition, New Age International (p) Ltd. Publisher, New Delhi. 179–186 (1969).
10. AOAC. Official methods of analysis of the association of official analytical chemists. 15th edition (eds. Helrich, K.), AOAC, Inc., Arlington, Virginia, USA (1990).
11. Alloway. and Brain, J. An Introduction- Micro-nutrient and crop production, Micro-nutrient deficiency in global crop production. Springer Netherlands. 1-39 (2008).
12. Lahijie, M. F. Application of Micronutrients $FeSO_4$ and $ZnSO_4$ on the Growth and Development of Gladiolus Variety "*Oscar". Int. J. Agric. Crop Sci.****4***: 718-720 (2012).
13. Khosa, S.S., Younis, A., Rayit, A., Yasmeen, S. and Riaz, A. Effect of Foliar Application of Macro and Micro Nutrients on Growth and Flowering of Gerbera jamesoniiL. Amer. *Euras. J. Agric.Environ. Sci.* ***11***: 736-757 (2011).
14. Chahal, V.P.S. andChahal,P.P.K.Interaction studies between Rhizobium leguminosarum and Meloidogyne incognita on pea (Pissumsativum L.) growth under different concentrations of molybdenum. *Plant Soil Sci.* ***45***:673-676 (1991).
15. Kant,K., Singh,K.P., Singh,V.K. and Ranjan. A. Effect of boron, zinc and their combinations on the yield ofcauliflower (Brassica oleracea var. Botrytis Linn.) hybridcultivar– Himani. *The Asian Journal OF horticulture.* ***8***(1):238-240 (2013).
16. Choudhary, D, and Mukharjee, S. Effect of boron and zinc concentration on growth and yield of cauliflower cv. Snowball-16. *Haryana. J. Horti. Sci.* ***28***(1-2): 119-120 (1999).
17. Pagodina, T. andIzergina, M.M. The effect of micro fertilizers on the yield and quality of white cabbage. J. VC. Zeb Petrozavods Univ. ***13***(3): 3-7(1965).
18. El-Baky, M.M.H., Ahmed, A.A., El-Nemr, M.A. and Zaki, M.F. Effect of Potassium Fertilizer and Foliar Zinc Application on Yield and Quality of Sweet Potato. *Research Journal of Agriculture and Biological Sciences.* ***6***(4): 386-394 (2010).
19. Thapa. U., Prasad. P.H., and Rai. R. Studies on growth, yield and quality of broccoli (Brassica oleraceaL.var italic Plenck) as influenced by boron and molybdenum. *Journal of Plant Nutrition.* ***39***(2):261–267 (2016).