Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(6): 2065-2067
Received: 06-09-2017
Accepted: 07-10-2017

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Impact of bio-fertilizers and zinc on biochemical parameters of sprouting broccoli (*Brassica oleracea* var. *italica* L. Plenck) under Lucknow conditions

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Abstract
The field experiment was conducted at Horticultural Research Farm of the Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University (A Central University), Vidya-Vihar, Raebareli Road, Lucknow - 226025 (U.P.), India during Rabi season of 2016-17. The experiment comprised of 16 treatment combinations with four levels of each bio-fertilizers (Control, *Azotobacter*, PSB and *Azotobacter*+ PSB) and Zinc (Control, 10, 20 and 30 kg/ha) in randomized block design with three replications. The application of *Azotobacter* +PSB resulted in the maximum and significantly more values of quality attributes viz., TSS (12.28^{0}Brix), Ascorbic Acid (84.01 mg/100g), Total sugars (3.86%), Reducing sugar (2.90 %) and Non-reducing sugar (0.87%) as compared to control. Similarly, the application of 30 kg zinc/ha resulted in the maximum and significantly more values of quality attributes viz. TSS (12.72^{0}Brix), Ascorbic Acid (87.31 mg/100 g), Total sugars (3.44%), Reducing sugar (2.66 %) and Non-reducing sugar (0.75 %). It is recommended for quality attributes of sprouting broccoli under Lucknow conditions.

Keywords: Broccoli, Zinc, *Azotobacter*, Quality, TSS and Total sugars.

Introduction
Sprouting broccoli (*Brassica oleracea* var. *italica* L. Plenck) is one of the most nutritious vegetable amongst the cole crops grown for its tender curds. It belongs to the family *Cruciferae* (Brassicaceae). It is a winter season rare vegetable in India, commonly known as Harigobhi. Morphologically, sprouting broccoli resembles cauliflower except secondary heads which develops in the axils of leaves and may contribute up to 50 per cent of the total yield. Broccoli is available in three different colours viz., green, yellow and purple, out of which green colour type is generally preferred. The name '*broccoli'* refers to the young shoots which develop in spring on same species of the genus *Brassica* ('brocco' is Italian world for a shoot. It is a source of valuable nutrients Vitamin A (130 times more Vitamin A contents than cauliflower and 22 times more than cabbage), thiamine, riboflavin, niacin, vitamin C and minerals like Ca, P, K and Fe. *Brassica* vegetables possess both antioxidant and anticarcinogenic properties **(**Cartea *et al.* 2008**)** [2]. Sprouting broccoli contains indole-3-carbinol, which helps to fight breast and lung cancer. Its sprouts are rich source of glucosinolate, particularly glucoraphanin, the substance associated with reducing of cancer **(**Maurya *et al.* 2008**)** [7]. Consumption of 150 gm. of broccoli helps in fulfilling the requirement of adult's for vitamins E, A, B^1 and C and enhances the immune system (Michaud *et al.* 2002) [8]. Consumption of broccoli has been steadily increased due to its health promoting properties and conscious of human towards health.

Bio-fertilizers include a range of nitrogen fixers, viz., Rhizobium, *Azotobacter*, *Azospirillium*, Blue Green Algae and Azolla. Out of these the importance of *Azotobacter* and *Azospirillium* has been well recognized for vegetable crops and there are several reports that showed the role of nitrogen fixing through *Azotobacter* and *Azospirillium.* These bio-fertilizers are organic in origin and thus are absolutely safe, therefore, it is essential to adopt a strategy of integrated nutrient management using combination of chemical fertilizers, organic manures and bio-fertilizers so as to minimize the cost of production and to maintain biological productivity of soils, particularly because the farmers are reluctant to adopt recommended fertilizer doses due to the high cost and risk of crop failure on account of aberrant weather condition. Phosphate solubilizing bio-fertilizer native in soil and applied in inorganic fertilizers becomes mostly unavailable to crops because of its low levels of mobility and solubility and its tendency to become fixed in the soil. The PSB are life forms that can help in improving the phosphate uptake of plants in various ways. PSB also has the potential to enable the utilization of India's

abundant rock phosphate deposits, much of which is not enriched a significant role in solubilizing insoluble phosphate **(**Ghosh, 2004**)** [5]. The beneficial role of bio-fertilizers in improving soil physical, chemical, and biological role is well known, which in turn helps in better nutrient absorption by plants and resulting high yield **(**Prabu *et al.* 2002**)** [10]. Hence, the present investigation have been planned to study of "Impact of bio-fertilizers and zinc on biochemical parameters of sprouting broccoli (*Brassica oleracea* var. *italica* L. Plenck) under Lucknow conditions".

Materials and methods

The present investigation entitled "Impact of bio-fertilizers and zinc on biochemical parameters of sprouting broccoli (*Brassica oleracea var. italica* L. *Plenck*) under Lucknow conditions was carried out at the Horticulture Research Farm-I of the Department of Applied Plant Sciences (Horticulture), Babasaheb Bhimrao Ambedkar University, (A central university), Vidya-Vihar Rae Bareli Road, Lucknow- 226025 (U.P.) India, during Rabi season of 2016-17. The seed of broccoli collected from Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Solan (H.P.). Broccoli seeds Palam Samridhi were sown in the nursery beds. The experiment was laid out in Randomized Block Design (RBD) with three replication and experiment comprised of 16 treatment combinations with four levels of each bio-fertilizers (Control, *Azotobacter*, PSB, *Azotobacter*+ PSB) and Zinc (Control, 10, 20 and 30 kg/ha). Zinc Sulphate ($ZnSo_4$) was applied at the time of transplanting. Before sowing the seed were treated with Azotobactor and PSB inoculums, which was added with 5 g jiggery in 50 ml of boiled water and made in to a sticky paste. The seed were treats for half an hour and then dried in shade for 30 minutes and then sown the experimental plot immediately. These healthy seedling uniform shape and size were selected and transplanting in well prepared field. Five plants were randomly selected and tagged before flowering from each line to record the data on the following attributes. The observations were recorded on total soluble solids (^{0}Brix) was measured with the help of an Erma hand refractometer and were corrected using standard reference table and express in terms of (^{0}Brix) at 20^0, ascorbic acid (mg/100g) Ascorbic acid content was determined by diluting the known volume of juice with 3% meta-phosphoric acid and titrating with 2,6-dichlorophenol-indo-phenol solution with **(**AOAC,1960**) [1]**, till the faint pink colour was obtained, reducing sugar (%), non reducing sugar (%) and total sugars (%) were determined by titrating the sample against Fehlings solution using methylene blue as an indicator. All the parameters were collected from five randomly selected plants of each treatment. Least significant difference at 5% level was used for finding the significant differences among the treatment means. The data obtained from selected plants were subjected to analysis of variance Panse and Sukhamate (1961**)** [9].

Results and discussion

Effect of bio-fertilizers on biochemical (quality) parameters

The data revealed that the TSS content in curd significantly influenced by different bio-fertilizers Table 1. The maximum TSS content (12.28) was recorded under B_3 treatment followed by B_2 that was superior over B_1 and control. However minimum TSS contains (9.56) was recorded under the treatment B_0. The mean increase in TSS under B_2 (PSB application) was 8.58 per cent more over control (B_0). The data in revealed that the vitamin content in curd significantly influenced by different bio-fertilizers. The maximum vitamin C content (84.01 (mg/100 g) was recorded under B_3 treatment followed by B_2 that was superior over B_1 and control. However minimum vitamin C contain (66.69 (mg/100 g) was recorded under the treatment B_0. The mean increase in vitamin C content under B_2 (PSB) was 16.52 per cent more over control (B_0). The data revealed that the total sugars content in curd significantly influenced by different bio-fertilizers. The maximum total sugar content (3.86) was recorded under B_3 treatment (*Azotobacter* +PSB). However minimum total sugars contains (2.55) was recorded under the treatment B_0. The mean increase in total sugars under B_2 (PSB application) was 17.65 per cent more over control (B_0). The data revealed that the reducing sugar content in head significantly influenced by different bio-fertilizers. The maximum reducing sugar content (2.90) was recorded under B_3 treatment (*Azotobacter* +PSB). However minimum reducing sugar contains (1.79) was recorded under the treatment B_0. The mean increase in reducing sugar under B_2 (PSB application) was 49.16 per cent more over control i.e. B_0. The data revealed that the non-reducing sugar content in head significantly influenced by different bio-fertilizers. The maximum non-reducing sugar content (0.87) was recorded under B_3 treatment (*Azotobacter* +PSB). However minimum reducing sugar contains (0.40) was recorded under the treatment B_0. The mean increase in non-reducing sugar under B_2 (PSB application) was 95.00 per cent more over control i.e. B_0. Application of *Azotobacter* had significant effect on nitrogen content, protein content and ascorbic acid content because these bio-fertilizers add nitrogen to the soil and indirectly received by plant over control. Ascorbic acid content also increased by the use of bio-fertilizers because they added nitrogen to the soil and consequently for use by the plant resulting in vigours growth. Nitrogen imparted deep green colour of foliage which increase the photosynthetic activity of plant. So there was greater accumulation of food material i.e. carbohydrates in head due to this there was more synthesis of ascorbic acid. The combined inoculation with *Azotobacter* + PSB was more beneficial in enhancing all the above parameters due to increased solubility of phosphorus and higher nitrogen fixation, leading to increased availability of nitrogen and phosphorus. The greater uptake of nutrient and phosphorus might be due to increased content of these nutrients in curd. These results corroborate the findings of Gained and Gaur (1991) [4] and Kalyani *et al*. (1992) [6].

Effect of zinc on quality parameters

Application of different levels of zinc also affected the TSS content in curd significantly Table 1. The maximum TSS content in head (12.72^0Brix) was recorded with 30 kg Zn/ha. Application of 20 kg Zn/ ha registered and increases in TSS content over control and 10 kg Zn/ha was 32.19 and 15.28 per cent respectively. Application of different levels of zinc also affected the vitamin C content in curd significantly up to 20 kg Zn/ha. The maximum vitamin C content in curd (87.31mg/100 g)) was recorded with 30 kg Zn/ha. The per cent increase in Vitamin C over with application of 20 kg Zn/ ha over control 10 kg Zn/ha was 23.69 and 10.31 respectively. Application of different levels of zinc also affected the total sugars content in curd significantly. The maximum total sugars content in curd (3.44%) was recorded with 30 kg Zn/ha. Application of 20 kg Zn/ha registered and increase in total sugar content over control and 10 kg Zn/ha was 16.67 and 2.27 per cent respectively. Application of different levels

of zinc also affected the reducing sugar content in head significantly. The maximum reducing sugar content in head (2.66%) was recorded with 30 kg Zn/ha. Application of 20 kg Zn/ha registered and increase in total sugar content over control and 10 kg Zn/ha was 23.74 and 7.93 per cent respectively. Application of different levels of zinc also affected the non-reducing sugar content in head significantly. The maximum reducing sugar content in head (0.75%) was recorded with 30 kg Zn/ ha. Application of 20 kg Zn/ha registered and increase in total sugars content over control and 10 kg Zn/ ha was 23.63 and 7.94 per cent respectively. The beneficial role of zinc in increasing CEC of roots helped in increasing absorption of nutrient from the soil. Further, the beneficial role of Zn in chlorophyll formation, regulating auxin concentration and its stimulatory effect on most of the physiological and metabolic process of plant, might have helped plants in absorption of greater amount of nutrients from the soil. Thus, the favourable effect of zinc on photosynthesis and metabolic processes augmented the production of photosynthesis and their translocation to different plant parts, which ultimately increased the concentration of nutrients in the plant. Similar results were also reported by Yadav *et al*. (1999) [11] and Chhippa *et al*. (2005) [3].

Conclusion

On the basis of the results obtained in the present investigation, it may be concluded that application of different bio-fertilizers and zinc levels enhanced the quality of sprouting broccoli as comparison to control. Application of 30 kg Zn SO4 and inoculation with *Azotobacter* +PSB may be considered as best treatment in terms of quality in broccoli curd. It is recommended for higher production of sprouting broccoli under Lucknow conditions.

Table 1: Impact of bio-fertilizers and zinc on biochemical parameters of broccoli

Treatment	Total soluble solids (TSS) ^{0}Brix	Vitamin C (mg/100g)	Total sugars (%)	Reducing sugar (%)	Non-reducing sugar (%)
Bio-fertilizers					
Control	9.56	66.69	2.55	1.79	0.40
Azotobactor	11.00	75.04	2.96	2.00	0.56
PSB	10.38	77.71	3.00	2.67	0.78
Azotobacter+PSB	12.28	84.01	3.86	2.90	0.87
SEm±	0.27	2.08	0.08	0.07	0.02
CD(P=0.05	0.79	6.00	0.24	0.20	0.06
Zinc Sulphate ($ZnSo_4$)					
Control	8.79	64.36	2.70	1.98	0.55
10Kg/ha	10.08	72.17	3.08	2.27	0.63
20Kg/ha	11.62	79.61	3.15	2.45	0.68
30Kg/ha	12.72	87.31	3.44	2.66	0.75
SEm±	0.27	2.08	0.08	0.07	0.02
CD(P=0.05)	0.79	6.00	0.24	0.20	0.06

References

1. AOAC. Official methods of analysis, 18 Edn. Association of Official Agricultural Chemists, Washington. 1960.
2. Cartea ME, Pablo velesco SO, Guillermo padilla AH. Seasonal variation in glucosinolate content in brassica oleracea crops grown in north western Spain. Photochemistry. 2008; 69:4-3-410.
3. Chhippa BG, Effect of different levels of sulphur and zinc on growth and yield of cauliflower (*Brassica oleracea* var. *botrytis* L.). M.Sc. (Ag.) Thesis, S.K.N. College of Agriculture, Jobner, RAU, Bikaner. 2005.
4. Gained S, Gaur AC. Thermo tolerant phosphate solubilizing micro- organism and their interaction with mungbean. Plant and Soil, 1991; 133:141-149.
5. Ghosh N, Promoting Biofertilizers in Indian Agriculture. Economic and political weekly. 2004; 39(52):5617-5625.
6. Kalyani DP, Ravi Sankar C, Pillai RN, Prasad MD. Studies on the effect of nitrogen and *Azospirillium* on dry matter and nutrient uptake of cauliflower. Vegetable Science 1992; 19(2):147-151.
7. Maurya AK, Singh MP, Srivastva, BK, Singh YV, Singh DK, Singh S *et al.* Effect of organic manures and inorganic fertilizers on growth characters, yield and economics of sprouting broccoli cv. Fiesta. Indian Journal of Horticulture. 2008; 65 (1): 116-118.
8. Michaud DS, Pieti nen p, Taylor PRM, Virtanen, Viratomo J Albanes D. Intates of fruits and vegetables, carotenoids and Vitamin A, E, C in relation to the risk of bladder cancer in the ATBC cohort study. International Journal of cancer. 2002; 87:960-965.
9. Panse VG, Sukhatme PV. Statistical Methods for Agriculture Workers. II ed. ICAR New Delhi. 1961.
10. Prabu T, Narwadkar PR, Sajindranth AK Rathod NG. Integated nutrient management in Coriander. South Indian Hort. 2002; 50:680-84.
11. Yadav PVS, Singh NK, Tikkoo A. Effect of zinc and boron application on yield of tomato (*Lycopersicon esculentum* Mill). Haryana Journal of Horticultural Sciences. 1999; 28(3&4):241-243.