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RESEARCH PAPER

Effect of foliar application of boron, urea and GA_3 on various vegetative growth parameters of broccoli (*Brassica oleracea* var. *Italica*)

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Abstract : Broccoli (*Brassica oleracea* var *italica*) is an important cole crop belonging to Crucifer family. Being native to Mediterranean region, its cultivation started in Italy in ancient roman times. It is gaining fast popularity during the last few years among the consumers particularly in and around bigger cities owing to the increased awareness about the nutritional properties as well as palatability. For better yield, application of nutrients and phyto hormones is an important consideration. Various doses of foliar application of boron, urea and GA_3 may affect the proper growth and development of broccoli. Accordingly the objective here was to study the effect of boron, urea and GA_3 on various vegetative growth parameters of broccoli. The experimental design was Randomized Block Design, with three replication and sixteen treatments, under field conditions in the year 2013-14 and 2014-15. The foliar spray of various combination of nutrient and phyto hormones was done twice at 20 days and 40 days after transplanting and status regarding plant height, number of leaves, leaf length, leaf width, stalk length and plant spread were recorded thrice at 20, 40 and 60 days after transplanting. The result shows that in general the significant increases in various vegetative parameters were noticed upto the combination of urea @ 1.0% and GA_3 @ 50 ppm. However, the combination of urea @ 1.5% and GA_3 75 ppm had recorded with the maximum value. Thus, the urea @ 1.0% and GA_3 @ 50 ppm may be safely utilized for the better vegetative growth and development.

Key Words : Broccoli, Foliar spray, Vegetative growth

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INTRODUCTION

Broccoli (*Brassica oleracea* var *italica)* is an important vegetable crop, of Brassicaceae family. It is an Italian vegetable native to Mediterranean region. It is one of the most nutritious cole crops and is laden with vitamin A (130 times and 22 times higher than cauliflower and cabbage, respectively), thiamine, riboflavin, niacin, vitamin C and minerals like Ca, P, K and Fe (Sanwal *et*

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al., 2005). Broccoli has received much attention due to its high content of health-promoting substances, especially the group of antioxidants called glucosinolates. Many glucosinolates protect against cancer development. In addition to this, flavonoids in broccoli are known to prevent development of cancer and infection against HIV virus, high chlorophyll content of broccoli may prevent cancer and protect DNA, while carotenoids may lower the risk of cancer and cardiovascular disease (e.g. Seljåsen , 2002). For these reasons the cultivation and consumption of broccoli started to spread.

Broccoli has a high nutritional requirement. Among macro nutrients, nitrogen is critical for fresh weight yield. It is needed for intensive leaf production. The edible portion of broccoli *i.e.* its green inflorescence is rich in chlorophyll and nitrogen is important for increasing the chlorophyll content. Nitrogen is also important for synthesis of protein, flavonoids, glucosinolates and vitamins. Among the micro nutrients, broccoli has high boron requirement. It is needed for protein synthesis, development of cell walls, carbohydrate metabolism, sugar translocation, hormone regulation, pollen grain germination and pollen tube growth, fruit set, and seed development. The basic role of boron lies in stabilizing certain constituent of cell wall and plasma membrane and enhances membrane permeability etc. A deficiency of boron may cause internal discolouration and cracking of the stem at the base of the head.

Similarly, the role of plant growth regulators in various physiological and biochemical processes in plants to influence growth and yield of a cole crop vegetables is also well known (Arora *et al.,* 1989). Gibberellin (GA_3) can promote vegetative to floral transition, helps in floral development and is a candidate for providing the early developmental cues that shape the curd morphology in broccoli. The interest in foliar fertilizers arose due to the multiple advantages, such as rapid and efficient response of the plant, less requirement of fertilizer and independence on soil fertility (Yildrim *et al.,* 2007). It is also recognized that supplementary foliar fertilization during crop growth can improve the mineral status of plants and increase the crop yield (Kolota and Osinka, 2001). However, to my knowledge, scanty information is available on the effect of foliar application of boron, urea and GA_3 in different concentrations on the vegetative parameters of broccoli.

Therefore, the present aims to evaluate the effect of foliar application of boron, urea and GA_3 in three different combinations upon the various vegetative parameters of broccoli.

MATERIAL AND METHODS

The experiment was conducted under filed conditions in the horticultural farm of Birsa Agricultural University, Ranchi, Jharkhand in the year of 2013-14 and 2014-15, on Broccoli variety Fiesta. The experimental site comes under the seventh Agro-Climatic region of country, *i.e.* Eastern plateau and hills which enjoys a sub-tropical climate with summer comparatively cool, heavy rainy season and moderate winters. The soil of the site is sandy loam with acidic pH which ranged between 5.4 to 5.7. Sixteen treatments were arranged in a Randomized Block Design with three replications. The treatments consisted of urea at three different concentrations of 0.5, 0.1 and 1.5 per cent, GA_3 at three different concentrations of 25 ppm, 50 ppm and 75 ppm, B at three different concentration of 1.0 per cent, 1.5 per cent and 2.0 per cent. Different combinations of urea, boron and GA_3 were sprayed twice at 20 and 40 days after transplanting and a control was used with no spray. The randomly selected plants were tagged for observations. Various vegetative features like plant height, number of leaves, leaf length, leaf width, stalk length and plant spread were recorded thrice at 20, 40 and 60 days after transplanting.

The data were subjected to the analysis of variance (ANOVA) to compare the effect of various foliar treatments.

RESULTS AND DISCUSSION

Results are presented in Table 1 and 2. The result shows that there was significant increase in various vegetative parameters *i.e.* plant height, number of leaves, leaf length, leaf width, stalk length and plant spread over the untreated control.

In both the years, the maximum value were recorded with the treatment having combination of urea @ 1.5% and GA_3 @ 75 ppm. However, the treatments having combination of urea @ 1.0% and GA_3 @ 50 ppm and the treatment having urea @ 0.5%, GA_3 @ 50 ppm, B @ 1.5% had done equally good in various vegetative parameters.

This result may be due to the fact that nitrogen in the form of urea increases photosynthetic assimilation and auxin level in plants. The growth promoting activities of nitrogen might be through its effect on rapid meristemetic activities. However, the auxin availability

to plant could have increased the inter-nodal length coupled with more apical dominance which eventually might have been helpful for maximum growth. The other possible reason for increases in growth attributes due to urea may be due to carbohydrate used for growth and development of root system and it makes the plant stouter.

Table 1: Effect on different vegetative parameters of broccoli on treatment with different combinations of urea, boron and GA_3 in the year 2013-14

	Treatments	Plant height	No. Of leaves	Leaf length	leaf width	Stalk length	Plant spread E-W	Plant spread N-S
T_1	Urea (0.5%)	41.64	12.94	30.44	12.30	10.44	60.59	59.24
T_2	Urea (1.0%)	44.08	15.72	34.49	12.38	11.44	55.64	60.67
T_3	Urea (1.5%)	47.06	17.04	32.90	13.36	14.25	63.28	63.45
T_4	GA_3 (25 ppm)	46.00	13.14	36.06	12.27	10.27	55.63	55.15
T_5	GA_3 (50 ppm)	45.22	15.55	39.12	13.02	10.70	58.32	58.66
T_6	GA_3(75 ppm)	43.66	14.67	39.07	12.90	12.50	59.44	60.07
T_7	B as Borax (1.0%)	46.14	12.91	30.60	10.02	10.00	50.49	60.20
T_8	B as Borax (1.5%)	48.51	15.00	31.43	10.39	12.09	55.58	59.15
T_9	B as Borax (2.0%)	44.50	15.71	31.14	11.95	11.91	57.06	58.00
T_{10}	Urea (0.5%) + GA_3 (25 ppm)	52.42	16.16	34.16	11.62	13.15	60.96	64.16
T_{11}	Urea (1.0%) + GA_3 (50 ppm)	56.17	14.17	36.87	15.69	16.33	68.13	68.41
T_{12}	Urea (1.5%) + GA_3 (75 ppm)	58.95	16.89	39.60	15.19	16.70	69.36	69.45
T_{13}	Urea (0.5%) + GA_3 (25 ppm) + B as Borax (1%)	46.15	17.16	34.63	13.54	12.50	60.23	64.88
T_{14}	Urea (0.5%) + GA_3 (50 ppm) + B as Borax (1.5%)	47.02	15.00	38.00	13.86	13.29	61.28	63.68
T_{15}	Urea (0.5%) + GA_3 (75 ppm) + B as Borax (2%)	47.51	15.93	41.48	15.41	15.34	62.99	68.75
T_{16}	Control	39.64	11.99	28.16	9.54	9.26	54.60	59.66
	S.E. ±	3.36	0.82	2.01	0.72	0.72	2.80	3.03
	C.V. %	12.32	9.48	9.97	9.80	10.03	8.15	8.46
	C.D. (P=0.05)	9.69	2.37	5.80	2.08	2.09	8.10	NS

NS= Non-significant

Table 2 : Effect on different vegetative parameters of broccoli on treatment with different combinations of urea, boron and GA_3 in the year 2014-15

	Treatments	Plant height	No. of leaf	Leaf length	Leaf width	Stalk length	Plant spread (E-W)	Plant spread (N-S)
T_1	Urea (0.5%)	49.16	14.79	33.10	12.99	12.87	69.59	63.28
T_2	Urea (1.0%)	53.80	16.73	38.25	13.41	13.00	71.50	67.16
T_3	Urea (1.5%)	54.81	16.48	39.48	12.40	13.70	68.64	68.37
T_4	GA_3 (25 ppm)	37.55	14.06	32.13	11.36	9.39	63.95	65.78
T_5	GA_3 (50 ppm)	48.73	14.46	37.01	14.17	11.46	64.50	65.27
T_6	GA_3(75 ppm)	47.54	15.00	35.14	14.03	11.95	65.13	66.33
T_7	B as Borax (1.0%)	38.5	13.61	34.07	11.82	9.43	65.20	58.59
T_8	B as Borax (1.5%)	40.67	14.78	33.33	13.59	11.34	65.39	58.44
T_9	B as Borax(2.0%)	51.03	13.87	35.22	13.63	11.30	66.12	63.10
T_{10}	Urea (0.5%) + GA_3 (25 ppm)	45.75	13.04	37.06	14.38	11.13	63.66	59.48
T_{11}	Urea (1.0%) + GA_3 (50 ppm)	50.38	16.75	41.10	16.36	13.46	63.29	60.96
T_{12}	Urea (1.5%) + GA_3 (75 ppm)	52.28	17.67	35.32	14.87	15.87	66.54	63.91
T_{13}	Urea (0.5%) + GA_3 (25 ppm) + B as Borax (1%)	48.81	14.18	38.32	12.56	13.00	65.32	58.24
T_{14}	Urea (0.5%) + GA_3 (50 ppm) + B as Borax (1.5%)	51.84	15.65	42.36	13.20	14.54	68.65	66.38
T_{15}	Urea (0.5%) + GA_3 (75 ppm) + B as Borax(2%)	52.14	15.30	37.15	16.53	14.89	69.69	64.00
T_{16}	Control	42.50	13.42	34.41	8.29	11.00	61.98	53.50
	S.E.±	3.35	0.92	2.10	0.70	0.75	2.71	3.34
	C.V. %	12.12	10.61	9.96	9.03	10.53	7.10	9.23
	C.D. (P=0.05)	9.67	2.65	NS	2.01	2.18	NS	NS

NS=Non-significant

The results are in accordance with the earlier finding of Singal and Saraf (1995); Nkoa *et al*. (2002) and Yildrim *et al*. (2007).

Further findings revealed that the various vegetative parameters were affected positively with the application of GA_3. This increase may be attributed to the increased metabolism of the plants. Paleg (1965) had concluded that the mechanism of gibberellins action in the apex of the responsive plant result in increased protein synthesis, cell division, auxin production and cell expansion. All these in combination have lead to increase in various growth attributes of broccoli. These results are in close proximity of Davis *et al*. (2000). Chao and Lovatt (2006) and Rahman *et al*. (2015). With the increasing concentrations of B, the various vegetative growth parameters get improved. This growth may be attributed to various physiological activities which are directly linked with boron, such as RNA metabolism, sugar transport, hormones development, respirations, cell division, indole acetic acid (IAA) metabolism etc. All these factors in combination had lead to increased vegetative growth of broccoli. Similar results have also been reported by Medhi and Katki (1994) Harris and Mathuma (2015) and Bishnu *et al*. (2014). The enhanced effect upon various vegetative parameters due to urea, GA_3 and boron in combination may be because of the synergistic effect.

Conclusion:

In the present study, it was revealed that various concentrations of urea, B and GA_3 influenced the various vegetative growth parameters of broccoli. The various treatments have positively influenced and significantly improved the characters as compared to control. A combination of urea @ (1.5%) with GA_3 @ 75 ppm had recorded the maximum value, however, the treatment having urea @ 1.0% with GA_3 @ 50 ppm, along with the treatment having urea @ (0.5%) with GA_3 (75) ppm and B@ (2%) had done equally good in various vegetative parameters. We can safely conclude that the treatment having urea @ 1.0% along with GA_3@50 ppm as well as the treatment having urea @ (0.5%) with GA_3 (75) ppm and B @ (2%) has the significant effect upon various vegetative parameters.

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