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Short Communication

Effect of foliar application of ammonium molybdate and zinc sulphate on vegetative growth in sprouting broccoli cv. Pusa KTS-1 under Varanasi region

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Broccoli (*Brassica oleracea* var. italica L.) is an exotic and under exploited winter season vegetable crop. And it is quietly rich in vitamin carotene, ascorbic acid, thiamin, riboflavin, niacin and iron (Thomson and Kelly, 1985; Rahman, 1988). Broccoli is also rich source of glucosinolates the precursor of the chemo protective isothiocynate (sulphoraphase), a compound associated with reducing the risk of cancer. It requires good amount of macro and micro nutrients to perform the various physiological and biochemical process in plants to influence growth and yield of crop. Rather than essentiality of macronutrients, micronutrients like molybdenum and zinc are also essential for plant growth and metabolism. Molybdenum (Mo) is an essential micronutrient for plant growth and development because it is directly related to metabolic function of nitrogen through nitrate fixation in legume nodules. It also works as an enzyme activator, a constituent of many enzymes and a carrier of phosphorus in the plant (Marschner, 1995, Mengel and Kirkby, 1987 Allison, Fower and Allen, 2001). Molybdenum also participates as a co-factor of nitrogenase responsible for biological nitrogen fixation as the deficiency of this element causes a reduction of nodulation and nitrogen fixation (Bambara and Ndakidemi, 2010).

The field experiment was conducted at Vegetable Research Farm of Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The soil of the experimental field was Gangetic alluvial having sandy clay loam texture with pH 7.41. The experiment was laid out in Randomized Block Design with two treatments *viz*., ammonium molybdate and zinc sulphate ($ZnSo_4$) with three concentrations (0.15, 0.30, and 0.45 %) of each along with control was replicated thrice during the years, 2010-2011 and 2011-2012 in winter season. Planting was done at 50 cm × 40 cm spacing in plot size of 3m × 2 m. A constant dose of P_2O_5 (90kg/ha) in the form of SSP and K_2O (110 kg/ha) in the form of MOP, along with other standard agronomic practices of crop production and protection were followed. Micronutrients were applied in the form of foliar spray at 25, 45 and 65 days after transplanting to runoff stage. The observations were recorded on five randomly selected plants from each plot. Observations on various yield parameters were taken carefully and analyzed statistically.

An increasing trend was found with the application of ammonium molybdate and zinc sulphate in vegetative growth attributes of broccoli. The most effective treatment was zinc sulphate @ 0.45%, helpful in influencing the vegetative growth. However applying of ammonium molybdate at 0.3% concentration also gave the higher values of all vegetative attributes, in both seasons *viz*., plant height (64.27 cm), plant spread (56.40 cm), number of leaves/plant (25.05) leaf length (37.37 cm), leaf width (20.39 cm), stalk length (17.39cm), fresh plant weight (1583.22 g) and root length (15.50 cm) comparatively to control. These results may suggest that the role of Mo as a plant nutrient is related to its function as a metal component of some enzymes that catalyze nitrogen function, nitrate assimilation and reduction Kotur, (1995) reported that foliar application of molybdenum @ 0.2% significantly increased the vegetative growth *viz*., leaf width, leaf length and plant height in cauliflower. Saha *et al*. (2010) also found the same findings and reported that molybdenum had significant effect on stem length, leaf width and maturity days of central head. Kotur, (1997) found significant improvement in leaf width with application

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Table 1: Effect of foliar application of ammonium molybdate and zinc sulphate in vegetative growth of broccoli (mean data of two years)

Treatments	Plant Height (cm)	Plant Spread (cm)	Number of Leaves/plant	Leaf Length (cm)	Leaf Width (cm)	Stalk Length (cm)	Fresh Plant Weight (g)	Root Length (cm)
Ammonium molybdate@ 0.15 %	61.57	54.21	23.46	34.59	18.29	16.37	1423.16	13.47
Ammonium molybdate@ 0.30 %	64.27	56.40	25.05	37.37	20.39	17.39	1583.22	15.50
Ammonium molybdate@ 0.45 %	63.19	56.13	21.73	36.29	19.95	16.17	1371.03	13.56
Zinc sulphate@0.15%	63.24	56.23	23.09	37.77	19.30	17.71	1506.95	13.39
Zinc sulphate@0.30%	65.11	57.23	22.20	38.17	19.40	16.61	1693.49	14.66
Zinc sulphate@0.45%	66.18	58.14	23.54	39.58	21.25	18.38	1881.58	16.43
Control	51.71	49.60	19.24	28.94	15.38	14.50	897.645	11.32
SEm± at 5%	0.75	0.64	0.98	0.98	0.68	0.58	1.03	0.57
CD (P=0.05)	2.17	1.82	2.81	2.81	1.95	1.66	2.96	1.63

of molybdenum in cauliflower. Single spraying of molybdenum was found better in terms of stem diameter. Similar result was also reported by Prasad and Yadav (2003).

Applying of zinc sulphate @ 0.45% proved as best treatment as any other of the treatments for all the vegetative attributes in both the seasons. Vegetative attributes *viz*., plant height (66.18 cm), plant spread (58.14 cm), number of leaves/plant (23.54) leaf length (39.58 cm), leaf width (21.25 cm), stalk length (18.38cm), fresh plant weight (1881.58g) and root length (16.43 cm) recorded their highest values with zinc sulphate @ 0.45%. In this regard, Mallick and Muthukrishnan (1979) explained that presence of zinc activates the synthesis of tryptophan, the precursor of IAA and it is responsible to stimulate plant growth. Sarma *et al.* (2003) also reported that root length and root spread were influenced by the application of micronutrients, particularly zinc sulphate 0.5% on cabbage. Same findings were recorded by Kanujia *et al*. (2006) in cabbage they obtained that the foliar application of Zn @ 100 ppm gave maximum plant height during both the seasons. These findings showed that zinc sulphate @ 0.45% was found as best treatment to enhance the vegetative growth of broccoli. However applying of ammonium molybdate at 0.3% concentration also produced the higher values of vegetative characteristics of broccoli.

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