

RESPONSE OF CAULIFLOWER (*BRASSICA OLERACEA* L. VAR. *BOTRYTIS*) TO BORON AND MOLYBDENUM APPLICATION

SANTOSH KUMAR, SS SINGH, PRADEEP KUMAR SINGH¹ AND VIVEKA NAND SINGH

N.D. University of Agriculture and Technology, Narendra Nagar, Faizabad - 224 229 (U.P.)

¹Indian Institute of Vegetable Research, Varanasi

Summary

A field experiment was conducted during winter season of the year 2004-05 and 2005-06 to assess the efficacy of various levels of boron and molybdenum as foliar and soil application on growth, yield and economics of cauliflower cv. Snowball K-1. Among the various treatments borax 20 kg/ha + sodium molybdate 2 kg/ha as soil application in combination of recommended dose of NPK @ 120: 60: 60 kg/ha (T₁₂) gave the maximum height of plant, length of leaf, width of leaf, total weight of plant, width of curd, average weight of curd and yield of curd, while foliar application of boron @ 100 ppm + molybdenum @ 50 ppm alongwith recommended dose of NPK @ 120: 60: 60 kg/ha (T₄) gave highest growth and yield among all the foliar application treatments. The maximum net return (Rs.76865.00) and cost benefit ratio (3.15) was obtained under treatment T₄.

सारांश

पत्तागोभी में बोरान एवं मोलिब्डेनम के प्रभाव के अध्ययन के लिये 2004-05 एवं 2005-06 में प्रयोग किया गया। परिणाम से स्पष्ट होता है कि बोरान 20 किग्रा. प्रति हेक्टेयर तथा सोडियम मोलिब्डेड 2 किग्रा. प्रति हेक्टेयर मिट्टी में मिलाकर नत्रजन, फास्फोरस एवं पोटैश की अनुमोदित मात्रा के साथ देने पर पौधे की उपज पत्तियों की लम्बाई, चौड़ाई एवं उपज के लिये लाभकारी पाया गया। इसी तरह बोरान 100 पीपीएम तथा मोलिब्डेनम 50 पीपीएम पर्णिय छिड़काव नत्रजन, फास्फोरस एवं पोटैश की अनुमोदित मात्रा के साथ करने पर सबसे अधिक उपज पाई गयी।

Introduction

Cauliflower (*Brassica oleracea* L. var. *botrytis*) is an important winter vegetable crop grown in India. Its late group variety Pusa Snowball K-1 is highly valued for its medium size, compact and snow-white curd. Cauliflower in general and particularly variety Pusa Snowball K-1 is heavy feeder of nutrients (Welch et al., 1985). In eastern Uttar Pradesh, the maximum soils of Faizabad, Sultanpur, Pratapgarh, Ambedkar Nagar, Azamgarh and other districts are alkaline in nature and characterized by high pH ranging between 7.9-8.5. So, boron and molybdenum become unavailable to the plants due to the high pH. However, for getting higher yield, application of boron alongwith molybdenum is also necessary. But, the information on the use of boron with combination of molybdenum is scanty. Therefore, the present investigations were conducted to study the effect of boron and molybdenum on growth, yield and economics of cauliflower cv. Pusa Snowball K-1.

Materials and Methods

The experiment was conducted at Main Experiment Station (Vegetable Research Farm), Narendra Deva

University of Agriculture and Technology, Narendra Nagar (Kumargang), Faizabad during winter season of 2004-05 and 2005-06. The experiment was laid out in randomized block design and replicated three times. The treatment comprised with foliar application of boron @ 100 ppm and molybdenum @ 50 ppm alone and in combination and two levels of borax @ 10 and 20 kg/ha and sodium molybdate @ 1 and 2 kg/ha alone and in combination as basal application. The control treatment (NPK @ 120: 60: 60 kg/ha) was also laid out. The four week seedlings were transplanted at the spacing of 60 x 45 cm. The entire experimental plot received 120 kg nitrogen, 60 kg phosphorus and 60 kg/ha potassium. Full dose of phosphorus, potash and 1/3rd of nitrogen as common dose, while borax and sodium molybdate were applied as basal dressing on the hills as per treatment and remaining 2/3rd of nitrogen was applied at 30 and 45 days after transplanting as top dressing and earthing was done. Boron was applied in the form of borax and molybdenum through sodium molybdate. Foliar sprays of these micronutrients were given 20 and 35 days after transplanting. The observations related to growth and yield parameters were recorded and analyzed (Panse and Sukhatme, 1985).

Results and Discussion

Effect of boron and molybdenum on growth attributes:

The results revealed that the growth characters were not significantly influenced by boron and molybdenum except total weight of plant during 2004-05 and 2005-06 (Table-1). The maximum height of plant, length and width of leaf and total weight of plant were found with the soil application of borax @ 20kg/ha + sodium molybdate @ 2kg/ha alongwith 120: 60: 60 kg/ha. However, combine foliar application of boron @ 100 ppm and molybdenum 50ppm alongwith NPK 120: 60: 60 kg/ha also markedly increased the growth of plants. Minimum values of growth parameters were recorded under control treatment (120: 60: 60 kg/ha alone). The increase in growth characters might be due to particular function of boron, which resulted into the precipitation of excess cation, buffer action, maintenance of conducting tissues, which ultimately helped in absorption of nitrogen, however, molybdenum activates physiological process by stimulating factor in the metabolism and growth of the plant. The finding is in accordance with the study carried out by the Ghosh and Hasan (1997) and Maurya *et al.* (1992) in cauliflower.

Effect of boron and molybdenum on yield and yield attributes:

Data portrayed in Table-2 indicated that significant response of boron and molybdenum as

various application methods towards increasing the width of curd, average weight of curd with or without guard leaves and yield of curd increases significantly with application of boron and molybdenum during both the years. Maximum width of curd (18.33 cm), average weight of curd with guard leaves (922.3 g), average weight of curd without guard leaves (645.6 g) and curd yield (285.82 q/ha) was recorded with the application of borax 20 kg + sodium molybdate 2 kg/ha alongwith recommended dose of NPK 120: 60: 60 kg/ha (T₁₂). However, among the foliar application treatments maximum values with respect to yield attributes and yield was recorded with the use of boron 100 ppm + molybdenum 50 ppm alongwith recommended dose of NPK 120: 60: 60 kg/ha (T₄) and it was significantly superior over control during experimentation. This increase might be due to combined effect of boron and molybdenum. Boron plays role in enhancing the translocation of carbohydrates from site of synthesis to reproductive tissues in the curd while molybdenum stimulate the photosynthesis and increase the metabolic process. Such significant response of boron and molybdenum has also been reported by Kotur (1998), Farag *et al.* (1994), Singh (2003) and Chattopadhyay and Mukhopadhyay (2003) in cauliflower.

Effect of boron and molybdenum on economics: The acceptance of any agricultural recommendation will mainly depend upon its benefit cost ratio and

Table 1. Effect of boron and molybdenum on growth parameters of cauliflower cv. Snowball K-1.

Treatments	No. of leaves/plant		Leaf Length (cm)		Leaf Width (cm)		Total plant weight (kg)	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
T ₁ Control (120:60:60 kg/ha NPK)	16.00	17.00	45.10	49.10	15.90	18.00	1.62	1.64
T ₂ Boron @ 100 ppm	16.10	16.50	48.70	48.00	18.20	17.90	1.67	1.63
T ₃ Molybdenum @ 50 ppm	17.00	15.80	49.30	46.80	18.30	16.59	1.69	1.60
T ₄ Boron 100 ppm + Molybdenum 50 ppm	19.40	21.40	50.00	51.80	19.20	20.50	1.80	1.84
T ₅ Borax 10 kg/ha	16.00	16.50	48.60	49.60	18.00	17.80	1.64	1.66
T ₆ Borax 20 kg/ha	17.90	16.30	49.90	45.00	18.74	18.00	1.68	1.65
T ₇ Sodium Molybdate 1 kg/ha	17.70	16.70	49.60	49.00	18.64	17.99	1.65	1.62
T ₈ Sodium Molybdate 2 kg/ha	20.30	19.60	50.50	50.00	19.64	18.64	1.72	1.68
T ₉ Borax 10 kg/ha + Sodium molybdate 1 kg/ha	21.10	20.20	50.70	50.50	19.89	18.51	1.76	1.70
T ₁₀ Borax 10 kg/ha + Sodium molybdate 2 kg/ha	20.10	19.80	50.10	50.00	19.31	19.00	1.72	1.70
T ₁₁ Borax 20 kg/ha + Sodium molybdate 1kg/ha	20.90	20.60	50.70	51.50	19.79	20.00	1.74	1.75
T ₁₂ Borax 20 kg/ha + Sodium molybdate 2kg/ha	21.80	21.50	51.90	52.00	19.98	20.51	1.86	1.88
SEm ±	1.60	1.52	1.48	2.05	0.786	0.811	0.05	0.05
CD at 5%	NS	NS	NS	NS	NS	NS	0.16	0.16

Table 2. Effect of boron and molybdenum on yield and yield attributes of cauliflower cv. Snowball K-1

Treatments	Width of curd (cm)		Average weight of curd with gourd leaves (Kg)		Average weight of curd without gourd leaves (Kg)		Yield (q/ha)	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
T ₁ Control (120:60:60 kg/ha NPK)	14.67	16.62	670.06	803.60	510.30	643.30	245.19	267.87
T ₂ Boron @ 100 ppm	17.17	16.00	802.00	789.90	561.40	549.30	267.86	263.33
T ₃ Molybdenum @ 50 ppm	17.25	15.90	805.60	699.90	563.90	458.20	269.09	233.33
T ₄ Boron 100 ppm + Molybdenum 50 ppm	17.58	18.50	822.00	893.60	575.80	645.40	280.80	297.87
T ₅ Borax 10 kg/ha	16.92	17.25	800.00	803.30	560.00	563.30	267.19	267.78
T ₆ Borax 20 kg/ha	17.75	17.08	822.60	783.30	575.40	536.10	274.19	261.11
T ₇ Sodium Molybdate 1 kg/ha	17.42	17.00	819.00	800.00	537.30	518.30	273.54	266.67
T ₈ Sodium Molybdate 2 kg/ha	17.67	17.58	850.00	819.90	595.00	564.90	280.89	273.33
T ₉ Borax 10 kg/ha + Sodium molybdate 1 kg/ha	17.92	17.90	879.00	826.60	615.00	562.60	283.90	275.55
T ₁₀ Borax 10 kg/ha + Sodium molybdate 2kg/ha	17.67	17.29	841.00	806.60	588.00	553.60	276.35	268.89
T ₁₁ Borax 20 kg/ha + Sodium molybdate 1kg/ha	17.75	18.00	875.00	880.00	600.00	603.60	283.69	284.44
T ₁₂ Borax 20 kg/ha + Sodium molybdate 2kg/ha	18.33	18.60	922.30	926.60	645.60	649.90	285.82	308.89
SEm ±	0.54	0.52	22.70	36.11	17.20	21.17	6.72	7.21
CD at 5%	1.60	1.53	66.50	105.92	50.50	62.09	19.82	22.40

Table 3. Effect of boron and molybdenum on gross income, net return and cost benefit ratio of cauliflower cv. Snowball K-1

Treatments	Gross income (Rs./ha)	Cost of cultivation (Rs./ha)	Net return (Rs./ha)	Cost Benefit ratio
T ₁ Control (120:60:60 kg/ha NPK)	89729	23680	66049	2.78
T ₂ Boron @ 100 ppm	92960	24200	68760	2.84
T ₃ Molybdenum @ 50 ppm	87923	24182	63741	2.64
T ₄ Boron 100 ppm + Molybdenum 50 ppm	101267	24402	76865	3.15
T ₅ Borax 10 kg/ha	93621	24680	68941	2.79
T ₆ Borax 20 kg/ha	93779	25680	68099	2.65
T ₇ Sodium Molybdate 1kg/ha	94538	25280	69258	2.74
T ₈ Sodium Molybdate 2kg/ha	96988	26880	70108	2.61
T ₉ Borax 10 kg/ha + Sodium molybdate 1 kg/ha	97905	26280	71625	2.73
T ₁₀ Borax 10 kg/ha + Sodium molybdate 2kg/ha	95417	27880	67537	2.42
T ₁₁ Borax 20 kg/ha + Sodium molybdate 1kg/ha	99424	27220	72204	2.65
T ₁₂ Borax 20 kg/ha + Sodium molybdate 2kg/ha	104072	28880	75192	2.60

Note- Selling rate Rs. 350/q

recommendation pertaining to specific crop management will not be adopted by any farmers unless treatments are not economically viable. The economics of the cauliflower production affected by different methods of application and concentrations of boron and molybdenum have been presented in Table-3. This was calculated by average data of curd yield of both the years. The maximum net return (Rs. 76865.00) and

cost: benefit ratio (3.15) was recorded with the foliar application of boron @ 100 ppm + molybdenum @ 50 ppm alongwith recommended dose of NPK 120: 60: 60 kg/ha, however, soil application of borax 20 kg + sodium molybdate 2 kg/ha alongwith recommended dose of NPK 120: 60: 60 kg/ha (T₁₂) have net return (Rs. 75192.00) and cost: benefit ratio (2.60). So, the commercial use of foliar application of

boron @ 100 ppm + molybdenum @ 50 ppm alongwith recommended dose of NPK 120: 60: 60 kg/ha is more remunerative and advantageous than other treatments.

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