

## Boron and Molybdenum Nutrition in Garlic (*Allium sativum* L.) for Yield and Quality under Terai Region of West Bengal

PARTHA SAHA<sup>1</sup>, N. R. DAS<sup>2</sup> AND PARTHA CHOUDHURI

*Department of Vegetable and Spice Crops, Uttar Banga Krishi Viswavidyalaya  
 Pundibari 736165, India*

<sup>1</sup>*Division of Vegetable Science, IARI, Pusa, New Delhi 110012, India*

<sup>2</sup>*Division of Environmental Sciences, IARI, Pusa, New Delhi 110012, India*

*E-mail : hortparth@yahoo.com*

### Abstract

A field trial was conducted during *rabi* season of 2004-2005 to standardize the soil application of boron (0, 0.75, 1.5 and 2 kg/ha) and molybdenum (0, 0.25, 0.5 and 1 kg/ha) for getting high yield with better quality of garlic. Significant response of boron and molybdenum was obtained with respect to growth, yield and quality characters like total soluble solid (TSS) of garlic over the control. Application of boron at 1.5 kg/hectare gave highest yield (10.74 tonnes/ha) with maximum TSS (34.72%). However, application of molybdenum was less pronounced as compared to boron. The maximum yield (9.60 tonnes/ha) along with highest TSS (32.96%) were obtained with the application of 0.5 kg molybdenum/hectare. Plants under combined application of 1.5 kg boron and 0.5 kg molybdenum/hectare gave the maximum yield (11.17 tonnes/ha) along with maximum TSS (36.25%) which was 72.69 and 36.22% higher over control.

**Key words :** Garlic, Boron, Molybdenum, Yield, Quality.

Garlic (*Allium sativum* L.) is an important bulbous vegetable crop in India fetching lucrative higher exchange. In India it is mostly grown in Madhya Pradesh, Gujrat, Rajasthan, Maharashtra, Uttar Pradesh, Orissa and West Bengal. The productivity of India is low (4.7 t/ha) as compared to the leading countries like Egypt, USA, China and Korea (Sharengi et al. 2003). West Bengal is meager in garlic production and it is not produced commercially in terai region of the state probably due to acidic soil, high rainfall and other climatic condition. Mukhopadhyaya and Chattopadhyay (1999) reported that leaching of nutrients due to heavy rainfall is a great problem and the soil is mostly deficient in micronutrient like boron and molybdenum. Among several factors affecting the productivity of the crop, nutrition plays an important role (Sharma 2003). Though the balanced dose of macronutrients with other cultural practices are indispensable to fetch the maximum productivity but role of Micronutrient in increasing the yield, quality and overcoming the physiological disorders is equally important (Sindhu and Tiwari 1993). Till now no work have been under taken for standardization of micronutrients for the successful production of garlic. Hence the present study was made to

find out the optimum requirement boron and molybdenum in this region for getting higher yield with better quality of garlic.

### Methods

The experiment was conducted at the instructional farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal during *rabi* season of 2004-2005. The soil was well drained sandy loam having pH 5.13, organic carbon 0.94% and available N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O, B, Mo were 210.25 kg/ha, 18.25 kg/ha, 110.36 kg/ha, 0.36 ppm and 0.12 ppm respectively. The experiment comprised of soil application of boron in the form of borax (10.6% boron) at 0 (B<sub>0</sub>), 0.75 (B<sub>1</sub>), 1.5 (B<sub>2</sub>) and 2 (B<sub>3</sub>) kg/ha, and molybdenum in the form of sodium molybdate (9.2% molybdenum) at 0 (M<sub>0</sub>), 0.25 (M<sub>1</sub>), 0.5 (M<sub>2</sub>) and 1 (M<sub>3</sub>) kg/ha. Thus 16 treatment combinations were laid out in factorial randomized block design with three replications. Garlic (cv Jalpaiguri Local) seedlings were transplanted in 1.0 m × 0.6 m plot. The crops received a uniform dose of FYM at 25 tonnes/ha and fertilizers at 100 kg N, 50 kg P<sub>2</sub>O<sub>5</sub> and 50 kg K<sub>2</sub>O/hectare. Recommended cultural and plant protection measures were followed equally

**Table 1.** Effect of boron on yield and quality of garlic

Levels of boron	Plant height (cm)	No. of leaves per plant	Neck diameter (cm)	Bulb diameter (cm)	Yield (tonnes/ha)	TSS (%)
B <sub>0</sub>	49.53	9.57	1.07	2.69	8.61	31.21
B <sub>1</sub>	50.71	10.72	1.13	3.2	9.53	32.82
B <sub>2</sub>	53.86	11.05	1.19	3.48	10.74	34.72
B <sub>3</sub>	49.63	9.86	1.04	2.49	8.11	31.57
CD at 5%	0.75	0.45	0.03	0.08	0.15	0.62

in all the plots as and when required. The observations were recorded on 10 randomly selected plants from each plot on different growth, yield and quality characters. The data were analyzed statistically as suggested by Panse and Sukhatme (2002).

## Results and Discussion

### *Effect of Boron*

Application of boron at different levels progressively increased the plant height. Maximum plant height (53.86 cm) along with maximum number of leaves (11.05) were recorded with the application of 1.5 kg boron/ha (Table 1). Significant increase in plant height and leaf number was due to the reason that boron influence cell division, cell elongation and meristematic activity of plants. Soil application of boron showed significant effect on neck diameter with maximum (1.19 cm) under 1.5 kg boron/ha. Sharangi et al. (2003) found increased plant height, number of leaves with the application of boron. Considering the different concentration of boron, 1.5 kg boron/ha was found to give higher yield (10.74 tonnes/ha) and TSS (34.72%) where as highest dose drastically reduced the yield and other characters. Improvement in the growth and yield might be due to enhanced enzymatic activity and increased photosynthetic activity and greater translocation rate under influence of boron where as excess dose of boron caused toxicity to plants. Selvaraj et al. (2002) also reported increase in bulb yield with boron application in garlic. The contribution of boron for quality traits like TSS might be owing to its role in hydrolysis of complex polysaccharides into simple sugars, synthesis of metabolites and translocation of photosynthesis to sink. Srivastava et al. (2005) found increased TSS with the application of boron.

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### *Effect of Molybdenum*

Although a significant difference on plant height, number of leaves were recorded between control and application of molybdenum, but failed to show significant variation of TSS (Table 2). Maximum plant height (52.96 cm), leaf number (10.74), neck diameter (1.18 cm), bulb diameter (3.10 cm) were recorded with the application of 0.5 kg molybdenum/ha. The bulb production increased from 8.6 tonnes/ha under control to 9.60 tonnes/ha with 0.5 kg molybdenum/ha. Improvement on growth and yield of garlic was due to enhanced enzymatic activity, greater chlorophyll synthesis and higher rate of protein synthesis. The

**Table 2.** Effect of molybdenum on yield and quality of garlic.

Levels of molybdenum	Plant height (cm)	No. of leaves per plant	Neck diameter (cm)	Bulb diameter (cm)	Yield (tonnes/ha)	TSS (%)
M <sub>0</sub>	49.35	9.96	1.08	2.94	8.6	32.26
M <sub>1</sub>	51.88	10.38	1.11	2.93	9.31	32.83
M <sub>2</sub>	52.96	10.74	1.18	3.10	9.60	32.96
M <sub>3</sub>	49.53	10.13	1.07	2.88	9.48	32.27
CD at 5%	0.75	0.45	0.03	0.08	0.15	NS

**Table 3.** Effect of interaction of boron and molybdenum on yield and quality of garlic.

Interaction levels of boron and molybdenum	Plant height (cm)	No. of leaves per plant	Neck diameter (cm)	Bulb diameter (cm)	Yield (tonnes/ha)	TSS (%)
B <sub>0</sub> M <sub>0</sub>	48.50	9.13	1.02	2.34	8.12	31.13
B <sub>0</sub> M <sub>1</sub>	50.42	9.72	1.08	2.67	8.64	31.26
B <sub>0</sub> M <sub>2</sub>	51.46	9.89	1.14	2.91	8.92	31.42
B <sub>0</sub> M <sub>3</sub>	47.76	9.56	1.06	2.84	8.76	31.06
B <sub>1</sub> M <sub>0</sub>	48.48	10.42	1.12	2.93	8.43	32.41
B <sub>1</sub> M <sub>1</sub>	50.12	10.68	1.15	2.26	9.46	32.96
B <sub>1</sub> M <sub>2</sub>	52.48	11.02	1.19	3.32	10.11	33.02
B <sub>1</sub> M <sub>3</sub>	51.76	10.76	1.07	3.31	10.12	32.91
B <sub>2</sub> M <sub>0</sub>	50.18	10.43	1.14	3.18	9.79	33.42
B <sub>2</sub> M <sub>1</sub>	54.76	10.97	1.21	3.63	10.98	35.11
B <sub>2</sub> M <sub>2</sub>	58.10	11.63	1.26	3.98	11.17	36.25
B <sub>2</sub> M <sub>3</sub>	52.42	11.18	1.17	3.14	11.05	34.12
B <sub>3</sub> M <sub>0</sub>	50.26	9.87	1.06	3.32	8.07	32.11
B <sub>3</sub> M <sub>1</sub>	52.25	10.16	1.02	2.19	8.16	32.02
B <sub>3</sub> M <sub>2</sub>	49.82	10.42	1.13	2.21	8.22	31.15
B <sub>3</sub> M <sub>3</sub>	46.20	9.02	0.98	2.24	8.02	31.02
CD at 5%	1.50	NS	NS	0.16	0.30	1.24

increase in size of the bulb might be due to greater translocation of food from leaves to bulbs under influence of molybdenum. Rumple (1971) and Tanaka et al. (1970) also noted similar result with molybdenum application on growth and yield on onion.

#### *Effect of Interaction of Boron and Molybdenum*

Plant height was maximum (58.10 cm) with combined application of 1.5 kg boron and 0.5 kg molybdenum/ha (Table 3). No significant difference was observed on number of leaves and neck diameter due to interaction between different levels of boron and molybdenum. An average bulb diameter (3.98 cm) was recorded in plants which received 1.5 kg boron and 0.5 kg molybdenum/ha. An appreciable variation on the yield was recorded from 31.13 to 36.25 tonnes/ha which was 72.69% higher over control. Mukhopadhyay and Chattopadhyay (1999), Sharma et al. (1988) also noted similar results with combined application of boron and molybdenum on growth and yield of onion. The TSS was significantly increased with maximum (36.25%) with the application of 1.5 kg boron and 0.5 kg molybdenum/ha which was 36.22% higher over control.

Thus, the results of the experiments indicated a significant response of boron and molybdenum with

respect to growth, yield and quality characteristics of garlic. Excess doses of boron and molybdenum were found to be uneconomical but also have detrimental effect. Hence, the combined application of boron at 1.5 kg/ha along with 0.5 kg molybdenum/ha may be recommended as the optimum level for improving yield and quality of garlic under soils of terai region of West Bengal

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