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EFFECTS OF BORON AND SULPHUR ON THE GROWTH AND YIELD OF ONION

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ABSTRACT

An experiment was conducted at the Horticulture Farm, Hajee Mohammed Danesh Science and Technology University, Dinajpur from November 2006 to April 2007 to know the effect of boron and sulphur on the growth and yield of onion cv. Taherpuri. The treatment consisted of four levels of each boron (0, 0.5,1 and 2 kg/ha) and sulphur (0, 15, 30 and 60 kg/ha). There was a significant influence of boron and sulphur on yield and yield attributes of onion. Boron @ 1 kg/ha gave the highest yield of bulb (13.19 t/ha) and sulphur @ 30 kg/ha produced the highest yield (12.24 t/ha). However, a combined application of boron and sulphur produced higher yield than boron and sulphur alone. Boron @ 1 kg/ha together with sulphur @ 30 kg/ha produced maximum yield of bulb (15.38 t/ha).

***Key Words**: Boron, sulphur, growth, yield, onion*

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important spice crops grown all over Bangladesh. It belongs to the family Alliaceae. The dietary habit of Bangladeshi people is very much tied up with onion and an average consumption of 25 g per day per person is considered essential (HRDP, 1995). Among the spice crops, it ranks first both in area (86,235 ha) and production (5,89,00 MT) with the average yield of only 6.83 t/ha. The average yield of onion is 17.45 t/ha in the world (FAO, 2004). There is an acute shortage of onion in relation to its requirement. Local production of onion is insufficient which meets only 14% of the total requirement of Bangladesh (Ali and Haq, 1994). Due to inadequacy of land, it is not possible to raise the production of crop horizontally. The high demand of onion can only be met up by increasing it's per hectare yield. This can be done by various ways, of which, the most important ones are judicious application of fertilizers and introduction of high yielding varieties. Boron is a micronutrient requiring for plant growth relatively to a smaller amount. Many authors (Bhonde *et al*., 1995; Singh and Tiwari, 1995; Mishra *et al*., 1990; Baghel and Sarnaik, 1988) reported that the growth characteristics of onion are markedly influenced by micronutrients. Chattopadhyay and Mukhopadhyay (2004) also observed that the highest bulb production (28.01 t/ha) was recorded from spraying of 1.12 kg B/ha. Onion is a bulbous herb having distinctive and pungent odor due to a sulphurous volatile oil knows as allyl propyl disulphide ($C_6H_{12}S_2$). Paterson (1979) showed that sulphur increased bulb size, hastened maturity, increased the sulphur content (pungency) of the bulbs. Nasreen and Huq (2005) reported that sulphur levels up to 45 kg/ha increased the S uptake throughout the season and also produce the highest bulb yield. In addition to N, P and K, sulphur has been found to be very beneficial for onion (Balasubramonian *et al*., 1979). In Bangladesh, particularly in northern region very limited works have been carried out regarding the use of different levels of boron and sulphur other than NPK fertilizers. Therefore, the present study was undertaken to investigate the effects of boron and sulphur on the growth and yield of onion cv. Taherpuri.

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MATERIALS AND METHODS

The experiment was conducted at the Horticulture Farm, Hajee Mohammed Danesh Science and Technology University, Dinajpur since November 2006 to April 2007. The objective of the study was to evaluate the effects of boron and sulphur on the growth and yield of onion cv. Taherpuri. This two-factor experiment consisted of four levels of boron (0, 0.5, 1 and 2 kg/ha) and four levels of sulphur (0, 15, 30 and 60 kg S/ha). The experiment was laid out in Randomized Complete Block Design (RCBD) with sixteen treatment combination replicated three times. Observations were made on plant height and number of leaves per plant at and 60 DAT, and fresh weight of leaves per plant, dry weight of leaves per plant, fresh weight of roots per plant, dry weight of roots per plant, fresh weight of bulbs, bulb diameter and yield of bulb. The collected data were statistically analyzed and the significance of the treatment means was evaluated by DMRT (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Plant height: Plant height was measured at 60 days after transplanting (maximum vegetative growth stage). Different doses of boron and sulphur had significant influence on plant height but combined effects of boron and sulphur had no significant variation. Table 1 showed that application of 1 kg boron / ha produced the tallest plants (48.48 cm) at 60 DAT. Application of 60 kg sulphur /ha produced the tallest plants (47.83 cm) which was statistically similar to 30 kg sulphur /ha. The smallest plant (45.49 cm) was produced by the control. The tallest plant (50.17 cm) was obtained from 1 kg B and 30 kg S/ha but the interaction effect of boron and sulphur was insignificant (Table 2).

Number of leaves per plant: The leaf production ability of the plant was greatly influenced by application of boron and sulphur. The number of leaves per plant measured at 60 DAT was the highest (6.485) from 1 kg B/ha and the lowest number of leaves per plant (6.183) was found from the control. Application of sulphur up to 30 kg/ha resulted in a gradual increase in the number of leaves per plant (Table 1). The maximum number of leaves per plant (6.767) was recorded in the combination of 1 kg B and 30 kg S/ha at 60 DAT, which was statistically insignificant.

Fresh weight of leaves per plant: Different doses of boron and sulphur had significant effect on the fresh weight of leaves per plant. The highest fresh weight of leaves per plant (11.878 g) was found in 1kg B/ha and the lowest fresh weight of leaves per plant (9.28 g) was obtained from the control. Sulphur @ 30 kg/ha produced the highest fresh weight of leaves per Plant (11.252 g) and the lowest fresh weight of leaves per plant (10.41g) from the control (Table 1) In combination of 1kg boron and 30kg sulphur/ha gave the maximum fresh weight of leaves per plant (12.697g), while the minimum fresh weight of leaves per plant (8.601g) was recorded from the control (Table 2). From the above result, it was clear that the fresh weight of leaves per plant was not the highest with treatment containing the highest doses of boron and sulphur.

Dry weight of leaves per plant: It was observed that boron @ 1 kg/ha and sulphur @ 30 kg/ha produced the highest dry weight of leaves per plant of 1.569 g and 1.587 g, respectively, while control gave the lowest dry weight of leaves per plant (1.251 g). Data in Table 2 indicate that the combined effect of boron and sulphur were significant. Application of boron @ 1kg/ha with

sulphur @ 30 kg/ha gave the maximum dry weight of leaves per plant (2.019 g) and the control gave the minimum dry weight of leaves per plant (1.097 g) (Table 1).

Fresh weight of roots per plant: The highest fresh weight of roots per plant (0.404 g) was obtained from 1kg/ha. sulphur @ 30 kg/ha produced the highest fresh weight of roots per plant (0.409 g) which was statistically similar to 60 kg/ha (Table 1). The combination due to different levels of boron and sulphur had statistically significant effect on fresh weight of roots per plant. It was evident from the results shown in Table 2 that the treatment combination of 1 kg boron and 30 kg sulphur/ha gave the maximum fresh weight of leaves per plant (0.514 g), and the minimum fresh weight of roots per plant (0.306 g) was recorded in the control.

Dry weight of roots per plant: The highest dry weight of roots per plant (0.093 g) was observed in 1kg boron/ha. In case of sulphur, the maximum dry weight of roots per plant (0.094 g) was recorded from 30 kg sulphur/ha, while control gave the minimum dry weight of roots per plant (Table 1). Boron @ 1kg/ha with 30 kg sulphur/ha produced the highest dry weight of roots per plant (0.073 g) recorded from the control (Table 2).

Bulb diameter: The diameter of bulbs was significantly increased by the application of boron and sulphur. One kg B/ha produced the highest (3.591 cm) diameter of bulbs and the minimum diameter (2.938 cm) was observed in control. Single application of sulphur at 30 kg/ha showed the largest diameter (3.582 cm) and the lowest diameter (3.007 cm) was obtained from the control (Table 1). The combined effects of boron and sulphur were also significant. One kg boron and 30 kg S/ha produced the highest bulb diameter (4.32 cm), where as control plant produced bulbs only with 2.613 cm diameter (Table 2). This results dictated that the highest diameter of bulb was not obtained from the highest doses of boron and sulphur, which probably caused by barrier effect of excess boron and sulphur during the growth of the plant.

Table 1. Main effect of boron and sulphur on growth and yield components of onion

Treatments	Plant height (cm)	Number of leaves/ plant	Fresh weight of leaves/plant (g)	Dry weight of leaves/ plant (g)	Fresh weight of roots/plant (g)	Dry weight of roots/plant (g)	Bulb diameter (cm)	Fresh weight of bulb/plant (g)	Yield of bulb (t/ha)
Boron (kg/ha)									
0 (B_0)	44.52c	6.183	9.280d	1.233c	0.342c	0.078b	2.938c	18.60d	8.49d
0.5 (B_1)	47.12b	6.342	10.654c	1.417b	0.357bc	0.082b	3.233b	21.35c	10.44c
1 (B_2)	48.48a	6.458	11.878a	1.569a	0.404a	0.093a	3.591a	23.20a	13.19a
2 (B_3)	46.78b	6.217	11.367b	1.411b	0.370b	0.085ab	3.259b	22.35b	11.96b
CV (%)	3.12	4.36	0.52	4.82	10.09	3.70	1.23	3.21	2.28
Level of significance	**	NS	**	**	**	**	**	**	**
Sulphur(kg/ha)									
0 (S_0)	45.49b	6.125b	10.416d	1.251c	0.321c	0.077b	3.007d	20.66b	9.94d
15 (S_1)	45.92b	6.217ab	10.631c	1.373b	0.354b	0.085b	3.178c	20.95b	10.54c
30 (S_2)	47.66a	6.433a	11.252a	1.587a	0.409a	0.094a	3.582a	22.15a	12.24a
60 (S_3)	47.83a	6.425a	10.881b	1.420b	0.389a	0.084b	3.255b	21.74a	11.37b
CV (%)	3.12	4.36	0.52	4.82	10.09	3.70	1.23	3.21	2.28
Level of significance	**	*	**	**	**	**	**	**	**

Figures in a column having common letter(s) do not differ significantly, *= Significant at 5% level, **= Significant at 1% level, NS = Not significant, Data represent the mean of three replications

Table 2. Combined effects of boron and sulphur on growth and yield components of onion

Treatment combinations	Plant height (cm)	Number of leaves per plant	Fresh weight of leaves/plant (g)	Dry weight of leaves plant(g)	Fresh weight of roots/plant (g)	Dry weight of roots/plant (g)	Bulb diameter (cm)	Fresh weight of bulb/plant (g)	Yield of bulb (t/ha)
$B_0 \times S_0$	43.07	5.933	8.601j	1.097f	0.306f	0.073c	2.613j	18.17gh	7.20h
$B_0 \times S_1$	44.17	6.067	8.880i	1.227e	0.317f	0.077bc	2.767i	17.66h	8.31g
$B_0 \times S_2$	45.53	6.400	9.830h	1.330cde	0.370cde	0.082bc	3.220ef	19.33fg	9.27f
$B_0 \times S_3$	45.30	6.333	9.810h	1.280de	0.374cde	0.081bc	3.150fg	19.23fg	9.20f
$B_1 \times S_0$	46.80	6.300	10.280g	1.253e	0.307f	0.078bc	3.033h	20.21ef	9.35ef
$B_1 \times S_1$	47.27	6.300	10.623f	1.437bc	0.330ef	0.082bc	3.317cd	20.80de	9.75e
$B_1 \times S_2$	46.47	6.267	10.983e	1.483b	0.370cde	0.087bc	3.433b	21.85bcd	11.49d
$B_1 \times S_3$	47.93	6.500	10.730f	1.493b	0.420b	0.082bc	3.150fg	22.57bc	11.18d
$B_2 \times S_0$	47.43	6.267	11.410c	1.327cde	0.323f	0.075bc	3.277de	22.86b	12.15c
$B_2 \times S_1$	47.40	6.433	11.640b	1.410bcd	0.397bc	0.094b	3.400b	23.02b	12.60b
$B_2 \times S_2$	50.17	6.767	12.697a	2.019a	0.514a	0.113a	4.320a	24.53a	15.38a
$B_2 \times S_3$	48.93	6.367	11.767b	1.520b	0.383bcd	0.089bc	3.367bc	22.37bc	12.62b
$B_3 \times S_0$	44.67	6.000	11.373c	1.326cde	0.347def	0.082bc	3.103gh	21.41cd	11.04d
$B_3 \times S_1$	44.83	6.067	11.380c	1.417bc	0.373cde	0.085bc	3.227ef	22.33bc	11.49d
$B_3 \times S_2$	48.47	6.300	11.497c	1.517b	0.380bcd	0.093b	3.353bcd	22.89b	12.84b
$B_3 \times S_3$	49.13	6.500	11.217d	1.387bcd	0.380bcd	0.082bc	3.353 bcd	22.78b	12.47bc
CV (%)	3.12	4.36	0.52	4.82	10.09	3.70	1.23	3.21	2.28
Level of significance	NS	*	**	**	**	**	**	*	**

Figures in a column having common letter (s) do not differ significantly, but figures bearing dissimilar letter(s) differ significantly at 5% level of significance, * = Significant at 5% level, ** = Significant at 1% level, NS =Not significant, Data represent the mean of three replications

Fresh weight of bulb per plant: Application of boron and sulphur had marked influence on the fresh weight of bulb per plant. Individual bulb fresh weight was maximum (23.2 g) in the treatment B_2 (1 kg boron/ha) that was statistically different from B_3, B_1 and B_0. The minimum fresh weight of bulb (18.6 g) was recorded from the control. The main effect of sulphur at 30 kg /ha showed that it produced the heaviest bulb (22.15 g), which was closely followed by 60 kg S/ha. The smallest bulb (20.66 g) was produced in the control followed by 15 kg S/ha (Table 1). Ahmed *et al*. (1988) reported that the weight and size of bulb were significantly improved up to 24 kg S/ha. Combined effect of 1 kg B and 30 kg S/ha produced large bulb (24.53 g) and the smallest (17.66 g) was found from the treatment combination of B_0S_1 (0 kg B and 15 kg S/ha), followed by the control (Table 2).

Yield of bulb: The highest yield (13.19 t/ha) was obtained from 1 kg boron /ha, while the lowest yield (8.49 t/ha) was recorded from the control. The yield of bulb was also influenced by the application of sulphur, resulting a significant increase in yield up to 30 kg sulphur per hectare. Application of 30 kg S/ha gave the highest yield (12.24 t/ha) and the lowest yield (9.94 t/ha) was obtained from control (Table 1). It was evident that, the proper or balance doses of fertilization helped better growth and yield of onion. From the combined effects of boron and sulphur, it was noticed that some combination of boron and sulphur produced higher yield than boron or sulphur alone. Boron at 1 kg/ha with 30 kg sulphur/ha produced the maximum (15.38 t/ha) yield of bulb, while the lowest yield of bulb (7.2 t/ha) was obtained from the control (Table 2). This result revealed that the combination of the highest level of boron (2 kg/ha) and sulphur (60 kg/ha), however, reduced the yield. It was not unlikely that the excessive amount of fertilizers caused a delayed bulb development leading to reduced yield. Moreover, the fertilizer use depends on soil condition, pungency and other internal characteristics of the crops.

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