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RESPONSE OF JUMBOO GRASS (SWEET CLOVER X SORGHUM) TO BORON AND MOLYBDENUM APPLICATION IN SANDY SOIL

S. M. KABIR and R. MANDAL
Department of Soil, Water and Environment, University of Dhaka, Dhaka-1000, Bangladesh.

The response of most common fodder plant jumboo grass (sweet clover x sorghum) to boron and molybdenum application was studied in sandy soil of char land collected from the bank of the river Meghna under the pot experiment. Boron was applied as borax @ 0, 2.5, 4.0, 6.0, 8.0 and 10.0 kg/ha and molybdenum was applied as ammonium molybdate @ 0, 0.25, 0.50, 1.00, 2.00 and 4.00 kg/ha. Significant (P=0.05) increasing response in growth and nutrient contents of jumboo grass has been recorded with boron and molybdenum treatment of jumboo grass has been recorded with boron and molybdenum treatments. However, molybdenum reacted on the other way round at the higher levels. The total dry matters as well as protein content of the grass have been found to be increased significantly (P=0.05) due to treatments of both boron and molybdenum. The higher rate of boron @ 8.00 kg/ha and the lower rate of molybdenum @ 0.25 kg/ha have been found to produce bettter yields and protein contents of the grass reflecting the deficiency of boron and molybdenum in the sandy soil. The height of the plant also increased significantly due to boron and molybdenum application. The order of yield and protein content responded to boron treatments was found as 0<2.5 <4.0 <6.0 <8.0 >10.0 kg/ha and to that of molybdenum treatments as 0< 0.25 > 0.50 > 1.00 > 2.00 > 4.00 kg/ha. Uptakes of NPK also increased significantly in shoot and root of the grass due to boron and molybdenum application.

Keywords : Jumboo grass (sweet clover x sorghum); boron, molybdenum; sandy soil.

Introduction

Now a days with the increasing need of food production for human being, the demand for growing fodder plants for domestic livestock is also a great question to solve. In Bangladesh mainly the hay from paddy is used to feed cows. Secondly, grass, which grows in fallow lands, is insufficient and very small in quantity. As grasses are not produced as cash crops, the feedings of domestic animals are fully dependent on hays and by-products of oil seeds. Grasses can be grown profoundly near the river bank for a short period of time. The higher content of protein in the grass obviously can improve the health condition of livestock resulting an increased production of milk. Jumboo grass has been reported to be a most successful one among the fodder crops. Boron has a marked effect on plants from the standpoint of the plant nutrition. Of the known essential micronutrients, boron deficiency in plants is also most widespread. Soil pH is one of the most important factor affecting boron uptake by plants. Jones and Scarseth[1] reported that boron could be applied in large amounts on alkaline or limed soil without causing any injury or toxic effect than when added to acid soils.

Studies by Peterson and Newman[2] and Gupta and MacLeod[3] have shown that a negative relationship between soil pH and plant boron occurs when soil pH levels are higher than 6.5. Since the soils absorb boron and plants obtain its boron from the soil solution, the greater ability of the soil to adsorb boron results the lower content of boron in the plant. Sakal *et al*[4]. reported that black gram and chickpea responded well to boron in the boron deficient calcareous soil in north Bihar. Sinha *et al*[5]. also observed that added boron increased markedly the yield of both the kharif and robi crops. As a fact, to get the benefit of applied N, P and K on the growth and yield of the plants, the necessity of using balanced amount of micronutrient is highly needed[6]. Molybdenum being an vital micronutrient takes part in the symbiotic nitrogen fixation and is an essential integral component of the nitrogen fixing enzyme, "Nitrogenase". Gupta and Debas[7] reported that both total and available Mo had significant and positive relationships with pH and EC. The present experiment has been conducted to investigate the influence of boron and molybdenum on the dry matter production and nutrients content of jumboo grass grown on the river side of Bangalesh.

Materials and Methods

A pot experiment in the greenhouse was conducted during Kharif season 2001 in the Department of Soil, Water and Environment, Dhaka University. Some physicochemical characteristics of the char land soil collected from the bank of the river Meghna are determined. The texture was sand, pH 8.3 (1: 2.5 water), TDS 60 ppm (1: 2.5 water), total N[8] (0.09%) organic carbon[7] 0.13%, available phosphorous[10] 0.68 ppm, available potassium[11] 6.2 ppm, available boron[12] (hot water extract) 0.2 ppm and available molybdenum[13] (ammonium oxalate extractants pH 3.3) 0.06 ppm.

Each earthen pot was filled up with 10 kg of soil and was taken under 50% maximum water holding capacity (MWHC) throughout the experimental period, adjusting by weighing the loss of water in every 2 days of intervals. Any contamination from the pot was prevented by using a polyethylene sheet. Boron was applied as borax @ 0, 2.5, 4.0, 6.0, 8.0 and 10.0 kg/ha and molybdenum as ammonium molybdate @ 0, 0.25, 0.50, 1.00, 2.00 and 4.00 kg/ha. A basal dose (kg/ha) was adjusted as $N_{100}P_{20}$ K_{50}. All these fertilizers were applied as liquid form in the soil. Three replications have been taken for each treatment. 20 seeds of jumboo grass were sown and thinned to 12 after germination in each pot. The experiment was arranged following a randomized block design. Height of the grass was recorded at 15, 21, 30, 37 and 45 days after sowing of seeds. Grasses were harvested after 45 days of growth and the fresh and oven dry (65°C) weights were recorded. Plant samples were digested with H_2SO_4 and N, P and K contents were determined by Kjeldahl distillation[14], calorimetrically[14] and flame photo metrically[14] respectively. Multiplying N content with 6.25 protein content was computed.

Results and discussions

Height : Jumboo grass responded significantly under the treatment of boron along with the basal dose of N_{100} P_{20} and K_{50} fertilizers (Table 1). Compared to the control where only the basal dose (NPK) was given, a significant (P=0.05) positive increase in height of the plant was found up to 8 kg B/ ha. But the dose @ 10 kg/ha caused a decrease in the height of the jumboo grass. This might be due to the excess or toxic effect of applied boron on the jumboo grass. The trend of producing taller grasses due to added boron is a follows :

0 (control) > 1.25 > 2.50 > 4.00 > 6.00 > 8.00 < 10.00 kg/ha.

The highest heights of grass have been recorded in plants treated with 8 kg B/ha (17.0, 29.4, 36.7, 37.8 and 44.8 cm) followed by 6 kg B/ha (13.4, 25.5, 29.3, 29.3 and 35.3 cm) at the growth stage of 15, 21, 30, 37 and 45 days, respectively. The heights of the grass were found to be 105.5% and 61.9% higher than that of control when the soil was amended with 8.00 and 6.0 kg B/ ha, respectively, after 45 days of growth.

The effect of molybdenum on the growth of jumboo grass has been found to be very distinct throughout the experiment. Significantly better perfomance of growth of the grass has been found in the pot where 0.25 kg Mo/ha was applied along with the basal dose of N_{100} P_{20} and K_{50}. There after the consequent decreasing performance was recorded with the increasing dose of molybdenum. The trend of producing taller grasses under the molybdenum treatments is as follows : 0(control) >0.25 <0.50 <1.00 <2.00 <4.00 kg Mo/ha. The tallest grass was recorded under the treatment of 0.25 kg Mo/ ha (37.6 cm) followed by 0.50 kg Mo/ha (34.2 cm). The heights of the grass under 0.25 and 0.50 kg Mo/ha have been found to be 72.5% and 56.8% higher than the control, respectively, at harvest.

Yield : The total yield of jumboo grass has been found to be significantly increased by the treatments of boron and molybdenum (Table 2). 8 kg/ha of boron exerted the best effect on fresh weights of shoot (4.53 g/pot) and of root (1.43 g/pot). This was followed by 6 kg B/ha yielding 4.00 g shoot/pot and 0.99 g root/pot, respectively. The dry matter yield of shoot and root were recorded to 1.37 and 1.15 g/pot respectively under the treatment of 8 kg/B/ha. 6 kg B/ha produced the next higher yields of shoot and root amounting 1.12 and 0.80 g/pot, respectively. Result showed about 164% increase in yield of shoot occurred under the treatment of 8 kg B/ha than the control. However, a decrease in amount of applied boron from 8 to 6 kg/ha resulted only about an increase of 115%. This result strongly suggested that the soil of the river bank of Meghna responded significantly to the applied boron and stimulated to increased the total quantity of fresh and dry matter of the shoot and root of the jumboo grass. Sinha *et al.*[6] showed tha the application of boron significantly incrased the yield of maize, onion, yam bean and sweet potato grown in the calcareous soil.Along with the normal dose of N_{100} P_{20} K_{50}, application of boron @ 8 kg/ha has been found to be promotive for yield of jumboo grass. However, any boron beyond 8 kg/ha has been shown to be toxic for the grass concerned.

Application of molybdenum influenced the production of the fresh and dry matter yields of jumboo grass significantly. Highest amounts of fresh and dry matter yield of the shoot of jumboo grass were recorded as 5.30 and 1.42 g/pot and those of root as 1.34 and 1.01 g/pot, respectively under the treatment of 0.25 kg Mo/ha. Singh *et al.*[15] observed an increse in the root yield of pea and soybean with an increase in level of Mo. The further increase of the dose of molybdenum did not show any increment in the yield of the grass. Similar effect was observed by Khirwar and Singh[16]. They revealed that addition of Mo @ 1 ppm significantly increased the grain and straw yields of lentil but tended to decrease it with 2 ppm. IOC of shoot (173%) and root (106%) have been found with the addition of a little amount of molybdenum (0.25 kg Mo/ha). The additional increase in the dose of molybdenum showed a negative effect on yield of the grass.

The growth of grass was significanly modified by the application of boron and molybdenum. The need of high amount of boron (8 kg/ha) and the low amount of molybdenum (0.25 kg/ha) in this char land soil for the optimum growth and yield of the grass have showed the normal characteristics of less availability of boron and moderate availability of molybdenum.

Protein content : The content of protein in the grass increased significantly due to application of boron and molybdenum and followed the same pattern as the dry matter yields (Table 2). Almost same contents of protein in the shoot (118.2 and 118.9 mg/pot) have been found due to the treatment of 8 kg B/ha and 0.25 kg Mo/ha, respectively. However, molybdenum at the rate of 0.25 kg/ha showed relatively higher protein content in the root (52.4 mg/pot) than that of 8 kg/ha boron (48.2 mg/pot). Increase in protein content over control in the shoot and root of the grass receiving 8 kg B/ha were 122 and 91% respectively. In contrast 0.25 kg Mo/ha yielded about 123 and 122% more protein than the control in the shoot and root respectively. A significant increase in yield of protein was observed due to application of boron from 1.25 kg/ha to 8kg/ha. Contrary to this, a sharp decline in protein content occurred due to inccrease in dose of molybdenum after 0.25 kg/ha i.e. from 0.5 kg to 4.0 kg Mo/ha. These results agreed favorably well with the findings of Singh *et al.*[17], who reported that Mo @ 1 or 2 kg/ha increased the protein content in cowpea by 0.31 and 0.83 percent, respectively.

N, P and K uptake : Significant (P=0.05) increase in the N, P and K uptake under the treatments of both boron and molybdenum by jumboo grass have been observed (Table 3). The best treatment of boron for NPK uptake was found to be @ 8 kg/ha. Uptake of nutrients in the grass shoot and root were calculated to be 18.91 and 7.71 mg/pot for N, 5.89 and 3.34 mg/pot for P and 24.93 and 12.54 mg/pot for K, respectively.

Table 1. Effect of boron and molybdenum on the height (cm) of jumboo grass at different growth intervals grown on the char land of the river Meghna.

Treatment kg/ha	Plant height				
	15 days	**21 days**	**30 days**	**37 days**	**45 days**
Control	8.6	15.7	19.2	20.0	21.8
Boron					
2	12.3	25.3	24.9	25.3	29.6
4	12.4	25.9	29.6	28.8	33.6
6	13.4	25.5	29.3	29.3	35.3
8	17.0	29.4	36.7	44.8	44.8
10	16.6	28.2	29.6	40.3	40.3
L.S.D. at 5% level	**0.8**	**1.1**	**1.1**	**1.2**	**1.6**
Molybdenum					
0.25	16.5	28.5	31.3	33.0	37.6
0.50	12.9	24.3	28.3	29.0	32.0
1	12.2	26.0	28.3	29.0	32.0
2	10.4	21.9	23.6	24.1	26.0
4.	8.0	11.7	20.5	23.2	25.4
L.S.D. at 5% Level	**1.1**	**1.7**	**1.2**	**1.2**	**1.2**

Table 2. Effect of boron and molybdenum on the yield (g/pot) and protein content (mg/pot) of jumboo grass grown on the sandy soil of the char land of the river Meghna.

Treatment kg/ha	Fresh weight		Dry weight				Protein content			
	Shoot	**Root**	**Shoot**	**IOC (%)**	**Root**	**IOC (%)**	**Shoot**	**IOC (%)**	**Root**	**IOC (%)**
Control	1.31	0.62	0.52		0.49		53.3		23.8	
Boron										
2	3.48	0.97	1.02	96	0.76	55	77.8	46	39.0	66
4	3.66	0.76	1.04	100	0.61	25	100.8	89	36.6	56
6	4.00	0.99	1.12	115	0.80	63	102.0	91	35.0	49
8	4.53	1.43	1.37	164	1.15	135	118.2	122	48.2	105
10	4.23	1.35	1.09	110	1.09	104	107.6	102	49.8	111
L.S.D. at 5% level	**0.26**	**0.21**	**0.27**		**0.18**		**1.4**		**2.4**	
Molybdenum										
0.25	5.30	1.34	1.42	173	1.01	106	118.9	123	52.4	122
0.50	3.23	0.73	1.09	110	0.52	6	85.2	60	27.9	19
1	3.04	0.70	0.88	69	0.52	6	81.4	53	26.0	10
2	2.72	0.70	0.72	39	0.46	-6	66.6	25	28.4	21
4.	1.19	0.64	0.64	23	0.44	-10	62.0	16	24.8	5
L.S.D. at 5% Level	**0.66**	**0.28**	**0.20**		**0.14**		**1.4**		**1.6**	

Table 3. Effect of boron and molybdenum uptake of N, P and K nutrients (mg/pot) in jumboo grass grown on sandy soil of the char land of the river Meghna.

Treatment kg/ha	N		P		K	
	Shoot	Root	Shoot	Root	Shoot	Root
Control	8.53	3.77	2.76	1.13	9.46	4.12
Boron						
2	12.44	6.08	3.47	2.05	16.12	6.92
4	16.12	5.86	3.64	1.65	18.00	6.65
6	16.24	5.60	4.37	2.24	20.05	7.28
8	18.91	7.71	5.89	3.34	24.93	12.54
10	17.22	7.96	4.14	2.62	18.84	9.16
L.S.D. at 5% level	**0.70**	**0.54**	**0.58**	**0.44**	**0.84**	**0.49**
Molybdenum						
0.25	19.17	8.38	6.53	3.94	28.83	12.02
0.50	13.50	4.47	4.58	1.92	18.31	5.67
1	13.02	4.16	3.61	1.87	15.14	4.58
2	10.66	4.55	2.66	1.52	14.11	5.79
4.	9.92	3.96	2.18	1.14	11.65	5.10
L.S.D. at 5% Level	**0.68**	**0.60**	**0.82**	**0.48**	**1.04**	**0.42**

However, the variation in nitrogen uptake due to 4 and 6 kg B/ha were not significant both in shoot and root systems of the grass.

Molybdenum @ 0.25 kg/ha showed the significant (P=0.05) increase in the uptakes of N, P and K nutrients in shoot @ 19.17, 6.53 and 28.83 mg/pot and those in root amounted 8.83, 3.9 and 12.02 mg/pot, respectively. Samui and Bhattachariya[18] also reported that application of molybdenum increased the nitrogen content and uptake in the sunflower plant. Increasing rate of Mo from 0.50 to 4.00 kg/ha showed significant decrease in N, P and K uptakes in the shoot and root when compared with those of plants treated with 0.25 kg Mo/ha. The result showed that molybdenum was relatively more stimulative in the accumulation of the higher amounts of N, P and K nutrients in both the shoot and root than those of the boron treated one. The phosphorous uptakes both in the shoot (6.53 mg/pot) and root (3.94 mg/pot) due to 0.25 kg Mo/ha application were found to be almost equal to those of plants treated with 8 kg B/ha. This result suggested that molybdenum has a greater influence on the uptake of phosphorus in the shoot and root of jumboo grass. Potassium accumultion in the shoot and root systems of the grass also showed the similar trend.

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