Effect of different levels of boron and molybdenum on growth and yield of mung bean [*Vigna radiata* (L.) Wilczek (cv. *Baisakhi Mung*)] in Red and Laterite Zone of West Bengal

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ABSTRACT

A field experiment was conducted during 1999 and 2000 kharif (rainy) season in a sandy loam soil (mixed hyperthermic paleudalfs) at Jhargram, Paschim Medinipur in the Red and Laterite zone of West Bengal to investigate the effect of four levels of boron and three levels of molybdenum on growth and yield of Mung Bean [Vigna radiata (L.) Wilczek (cv. Baisakhi Mung)]. Boron, molybdenum and their combined application significantly improved all the growth and yield attributing characters of Mungbean. The synergistic influence of these two micronutrients helped augmenting growth and yield of the crop.

Key words:, Boron, growth and yield, molybdenum, mungbean, red and laterite zone

Pulses constitute an integral part of Indian diet and an important source of protein for a vast majority of Indian population. With very low level of national productivity (544 kg ha^{-1}), there is wide gap between the per capita availability of pulses in the country (35 g) and the standard set by the WHO (985 g). In West Bengal total pulse crop occupy only 0.42 M ha or 11.76% of the gross cropped area, producing only 0.26 M t of pulses (Jeswani and Baldev, 1997) annually. Rice is the main crop of red and laterite zone of West Bengal and Mungbean is cultivated as rainfed crop in the marginal lands during *kharif* (wet rainy) season. Due to different biotic and abiotic stresses yield of pulses in the state is very poor. The upland soils of the zone are mostly light textured and porous; acidic in reaction; poor in organic matter, available nitrogen, phosphorus, potassium, bases and micronutrients. In plant metabolism, Boron is associated with activity of certain enzymes, cell division, carbohydrate transport, and calcium and potassium uptake and protein synthesis. High amounts of iron and aluminum in acid soils favour formation of complexes with boron and results in its higher deficiency in acid soil (Singh, 2006).This highlights the urgency of applying B fertilizers in such soils to check further deterioration of agricultural production (Jana and Nayak, 2006). Molybdenum, being a constituent of nitrate reductase and nitrogenase enzymes, is associated with ammonia reduction and nitrogen fixation and its deficiency adversely affects growth and yield of Mungbean (Paricha *et al*., 1978; Velu and Savithri, 1983). Molybdenum oxyanion has strong adsorption binding, but the strength of this binding decrease as the pH ofsoil increases. Thus molybdenum becomes deficient in lower pH and available at higher soil pH. Soil acidity limit nitrogen fixation and to survive, multiply and nodulate legume plants, *Rhizobia,* in addition to phosphorus, potassium, calcium, sulphur and traces of zinc, cobalt, manganese and iron , also need molybdenum and boron, (Smith, 1982; Sprent and Minchin, 1983). Their deficiency adversely affects growth and yield of Mungbean (Howeler *et al*., 1978). Proper management of these micronutrients in acid soils is found to be extremely important in sustaining higher crop yields (Singh, 2001; Bhupalraj *et al*., 2005; Singh, 2006).The present investigation was undertaken to study the effect of boron and molybdenum on growth and yield of Mungbean (cv. Pusa Baisakhi) in a lateritic soil of West Bengal.

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MATERIALS AND METHODS

The investigation was undertaken during 1999 and 2000 *kharif* (rainy) seasons in the university's research farm attached to the Regional Research station for the Red and Laterite zone at Jhargram, Paschim Medinipur, West Bengal. Jhargram has a tropical sub humid climate and receives between 1300-1500 mm rainfalls annually. The investigation was carried out in a sandy loam soil having 13% clay, 16% silt and 71% sand. It belonged to mixed hyperthermic family of paleudalfs. It had acidic soil reaction (pH-4.9), low organic carbon content (0.49%), low available phosphorus (8.43 kg Olsen's P ha^{-1}), medium available potassium (104.0 kg K_2O ha^{-1}) and low CEC (9.40 c moles p^+ kg^{-1} soil). Farm yard manure at 5.0 t ha^{-1} was applied during land preparation. Fertilizer N and P_2O_5 at 20 and 40 kg ha^{-1}, were applied through urea and single super phosphate, respectively, as basal dressing during final land preparation. Seeds of Mungbean cv Pusa Baisakhi were treated with suitable strain of *Rhizobium* and sown at (30 cm x 15 cm) spacing in (4 m x 3 m) plots. The experiment was laid out in a 4 x 3 Factorial Randomized Complete Block Design (RBD) with 4 levels of boron viz., (i) 0% B (B_0), (ii)0.1% solution of borax (B_1), (iii) 0.2% solution of borax (B_2) and (iv) 0.3% solution of borax (B_3); and 3 levels of Molybdenum viz., (a) 0% solution of ammonium molybdate (MO_0), (b) 0.03% solution of ammonium molybdate (MO_1) and (c) 0.05% solution of ammonium molybdate (MO_2), in all possible combinations. Boron and molybdenum solutions were sprayed on the plants twice- during vegetative and during flowering stages. Other intercultural operations were followed as and when necessary. The crop was grown to maturity and observations on plant height, number of clusters, number of pods, number of seeds per pod, pod length and seed yield were recorded. The data generated were analyzed following standard statistical procedures.

RESULTS AND DISCUSSION

Two years' mean data for different attributes are presented in table 1 and 2. Statistical analyses of the data revealed significant effect of B, Mo and their interaction on different growth and yield attributes of Mungbean in the experimental soil.

Plant height at harvest: Application of B and/or Mo had significant influence on plant height at harvest (table1). Irrespective of boron levels, plants were tallest with spraying of 0.05% ammonium molybdate (Mo_2) solution. Similarly, irrespective of molybdenum application, spraying of 0.2% solution of borax produced the tallest plants. While the plants were shortest under control treatment (B_0Mo_0), the tallest plants were observed under B_2Mo_2 treatment. Application B and/or Mo resulted in better *Rhizobial* growth, more N fixation and in better crop growth (Singh, 1993).

Number of cluster per plant: Application of B, Mo and their interaction significantly influenced the number of cluster of pods in mungbean. While B_0Mo_0 treatment (control) produced only 3.7 clusters per plant, application of 0.2% solution of borax (B_2) and 0.05% solution of ammonium molybdate (MO_2), resulted in the highest number of clusters (6.0). The corresponding increase in the number of cluster due to application of B and Mo was to the tune of 62.2%.

Number of pods per plant: Boron, molybdenum and their combined application had significant positive influence on this yield attributing character of the crop. Under control treatment (B_0Mo_0) the number of pods per plant was only 9.4 which increased to 14.8, an increase to the tune of 57.5% with combined application of 0.05% solution of ammonium molybdate and 0.2% solution of borax (B_2Mo_2).

Number of seeds per pod: Boron, molybdenum and their combined application significantly positively influenced this yield attributing character of the crop. Under control treatment (B_0Mo_0) the number of seeds per pod was only 8.6 which increased to 13.3 with combined application of 0.05% solution of ammonium molybdate and 0.2% solution of borax (B_2Mo_2). The corresponding increase in the number of seeds due to combined application of B and Mo over control was to the tune of 54.6%.

Length of pods: Spray application of B, Mo and their combination significantly positively influenced the length of pods in mungbean. While under control treatment (B_0Mo_0) the average length of the pods was only 7.06 cm, with combined application of 0.05% solution of ammonium molybdate and 0.2% solution of borax (B_2Mo_2) the mean pod length increased to 7.81 cm. The corresponding increase was to the tune of 10.6%.

Seed Yield: Boron, molybdenum and their combined application significantly positively influenced seed yield of the crop. Under control treatment (B_0Mo_0) seed yield was only 407.3 kg ha^{-1}, which increased to 714.3 kg ha^{-1} with application of 0.2% solution of borax (B_2). With application of 0.05% solution of ammonium molybdate (Mo_2) the seed yield increased to 684.1 kg ha^{-1}. The combined application of 0.05% solution of ammonium molybdate and 0.2% solution of borax (B_2Mo_2) resulted in 78.4% (726.7 kg ha^{-1}) increase in seed yield compared to control treatment (B_0Mo_0) (table 2).

The results revealed significant positive influence of both boron and molybdenum and their combined application on all the growth and yield attributing characters of Mungbean under the Red and Laterite Agro climatic Zone of West Bengal. The synergistic influence of these micronutrients helped augmenting nitrogen fixation and thus growth and yield of the crop. Working with different crops other researchers have also reported increased yield of different crops with application of B (Sakal and Singh, 1995; Sharma, 2006; Singh, 2001; Singh, 2006), Mo (Singh, 2006) and micronutrient mixtures containing B and Mo (Kumpawat and Manohar, 1994; Revathy *et al*., 1997; Jayaball *et al*., 1999; Manivannan *et al*., 2001). The result presented in this report clearly brought out the need and the benefit of application of B and Mo for improving pulse production in acidic soils of the state.

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Table 1: Effect of levels of boron and molybdenum on height (cm), number of cluster plant^{-1} and number of pods plant^{-1} of Mungbean (cv *Baisakhi mung*).

Treatment	Plant height (cm)				Number of cluster plant^{-1}				Number of pods plant^{-1}			
	Mo_0	Mo_1	Mo_2	Mean	Mo_0	Mo_1	Mo_2	Mean	Mo_0	Mo_1	Mo_2	Mean
B_o	45.3	45.2	51.7	47.4	3.7	4.0	4.5	3.9	9.4	10.7	10.9	10.3
B_1	45.2	45.7	53.1	48.0	3.6	4.0	4.1	4.1	10.1	11.5	11.0	10.9
B_2	48.9	49.2	52.6	50.2	4.1	4.9	6.0	5.0	11.7	14.2	14.8	13.6
B_3	46.7	45.7	51.0	47.8	3.8	3.7	3.8	3.8	11.6	12.3	12.6	12.2
Mean	46.5	46.9	52.1		3.8	4.1	4.6		10.7	12.1	12.3	
	Mo	**B**	**B x Mo**		**Mo**	**B**	**B x Mo**		**Mo**	**B**	**B x Mo**	
LSD (p=0.05)	**0.11**	**1.21**	**2.09**		**0.22**	**0.25**	**0.44**		**0.38**	**0.44**	**0.76**	

Table 2: Effect of levels of boron and molybdenum on number of seeds pod^{-1}, length of pod (cm) and seed yield (kg ha^{-1}) of Mungbean (cv *Baisakhi mung*).

Treatment	Number of seeds pod^{-1}				Length of pod (cm)				Seed yield (kg ha^{-1})			
	Mo_0	Mo_1	Mo_2	Mean	Mo_0	Mo_1	Mo_2	Mean	Mo_0	Mo_1	Mo_2	Mean
B_o	8.6	9.6	10.5	9.5	7.06	7.54	7.59	7.39	407.3	433.0	599.7	480.0
B_1	9.2	9.7	11.3	10.1	7.54	7.55	7.78	7.62	456.7	581.3	688.0	575.3
B_2	10.2	10.2	13.3	11.2	7.59	7.61	7.81	7.67	707.3	709.0	726.7	714.3
B_3	10.0	9.6	10.4	10.0	7.48	7.56	7.42	7.49	506.0	515.3	722.0	581.1
Mean	9.5	9.7	11.4		7.41	7.56	7.65		519.3	559.7	684.1	
	Mo	**B**	**B x Mo**		**Mo**	**B**	**B x Mo**		**Mo**	**B**	**B x Mo**	
LSD (p=0.05)	**0.30**	**NS**	**0.59**		**0.12**	**0.14**	**0.24**		**16.1**	**18.7**	**32.3**	