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Growth and Yield Response of Mungbean as Influenced by Sulphur and Boron Application

Sri Laxmi[1*], Ruby Patel[2], Sonam Singh[1], Babulal Choudhary[1], Rajendra Gadhwal[1], R. Meena[2] and Y. V. Singh[1]

[1]*Department of Soil Science & Agricultural Chemistry, Banaras Hindu University, Varanasi-221005, India*
[2]*Department of Agricultural chemistry & Soil Science, Bidhan Chandra Krishi Viswavidyalaya Mohanpur, West Bengal, India*

**Corresponding author*

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A B S T R A C T

A pot experiment was conducted at Dept of soil Science and Agricultural Chemistry, Banaras Hindu University during the period from July 2017 to October 2017 to investigate the effect of sulphur (0,10, 20 and 30 kg ha^{-1}) and three levels of boron (0,1 and 2 kg ha^{-1}) on growth and yield of mungbean as test crop. The experiment was laid out in factorial CRD with 12 treatments having three replications The results indicated that the crop responded significantly to sulphur and boron in respect of growth and yield such as plant height, number of branches $plant^{-1}$, pods $plant^{-1}$, podlength, number of seeds pod-1, test weight, seed yield, straw yield. In the combination of sulphur and boron, all the parameters were significant by influence. Maximum seed yield was recorded in treatment combination of 30 kg S ha^{-1} and 2 kg B ha^{-1}.

Introduction

The growth of agriculture in India over last few decades has helped the country in achieving food security at national level. The next big challenge faced by the country in particular is to sustain this growth and achieve nutritional security as well. Producing sustainably is therefore becoming central in agriculture and food systems. Legume crops could play an important role in this context by delivering multiple services in line with sustainability principles. Green gramis one of the most important legume crops grown in India.

Besides being a rich source of protein, they also maintain soil fertility through biological nitrogen fixation in soil and thus play a vital role in maintaining sustainability.In spite of having the largest area under mungbean in the country its productivity is not satisfactory which yet to see a major breakthrough low productivity of mungbean is due to abiotic and biotic factors. Amongst them, imbalance use of fertilizers is one of the most important factors. Sulphur is an essential plant nutrient for higher pulse production and has been recognized as fourth major essential plant nutrient because of its widespread deficiency in many crops (Singh 2001).

Its deficiency is posing threats in achieving potential yield of pulses and other crops not only in marginal lands but also in fertile soils (Pasricha and Aulakh 1996: Singh *et al.*, 1998).It is an integral part of sulphur containing amino acids cystine, cystein and methionine. Besides this it involves in various metabolic and enzymatic process including photosynthesis, respiration and legume rhizobium symbiotic nitrogen fixation (Rao *et al.*, 2001).

The micronutrient especially Boron plays an important role in plant nutrition and recognized as major yield limiting factor in pulses (Ali *et al.*, 2004). It helps in chlorophyll synthesis as well as involved in carbohydrates metabolism. The most important role of boron is to activate the germination of pollen, accelerates the growth of pollen tube and increases the number of flowers and fruits formation.So, there is an ample scope of increasing the yield of mungbean per unit area by using balanced fertilization including sulphur and boron. Therefore, the experiment was conducted to study the optimum doses of sulphur and boron on growth and yield of mungbean.

Materials and Methods

The experiment was conducted at the Dept of soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University Varanasi, UttarPradesh, India during the period from July 2017 to October 2017 (Kharif). Mungbean variety HUM-16 was used as a test crop. The experimental soil developed on Gangetic alluvial have predominance of illite, quartz and feldspar minerals under Inceptisol soil order.

The experimental site is located at25.18, North latitude and 80.36, East latitude and at an altitude of 80.71 m above mean sea level in the Gangetic plain of Eastern Uttar Pradesh. The experiment was laid out in a factorial CRD consisting of 12 treatment combinations replicated thrice with four levels of sulfur (0,10, 20 and 30 kg ha-1) and three levels of boron (0,1 and 2 kg ha-1) viz., T1-(S0B0) Control, T2- (S1B0) 10 kg S ha-1 + 0 kg B ha-1,T3- (S2B0) 20 kg S ha-1 + 0 kg B ha-1,T4- (S3B0) 30 kgS ha-1 + 0 kg B ha-1, T5- (S0B1) 0 kg S ha-1 +1 kg Bha-1, T6-(S0B2) 0 kg S ha-1 + 2 kg B ha-1, T7 – (S3B1)30 kg S ha-1 + 1.0 kg B ha-1, T8-(S3B2) 30 kg S ha-1 +2.0 kg B ha-1, T9-(S1B1) 10 kg S ha-1 + 1.0 kg B ha-1,T10-(S1B2) 10 kg S ha-1 + 2 kg B ha-1 , T11-(S2B1) 20kg S ha-1 + 1 kg B ha-1 and T12-(S2B2) 20 kg S ha-1+ 2 kg B ha-1.

Each treatment received an equal amount of nitrogen, phosphorus and potassium except control applied basally through urea, di-ammonium phosphate and muriate of potash, respectively. Sulphur was applied in the form of gypsum and boron was applied in the form of borax. Seeds were sown in each polythene lined 10 kg earther pot.

Data on plant height and number of branches per plant, SPAD value, no. of pods per plant, no. of seeds per pod test weight, seed yield and straw yield were recorded from each pot. The data were statistically analysed by standard method (Panse and Sukhatme1967).

Results and Discussion

Plant height was significantly influenced due to the increasing levels of Sulphur and its combination with boron at 15 and 45 days after sowing. The highest plant height (20.967) at 15 DAS was associated with Sulphur @ 30kg/ha (S3) closely followed by Sulphur @ 20kg/ha (S2). However, both were significantly superior to other treatments and control in respect of plant height. Effect of boron on plant height can also be understood from the table 4.3. Its effect at 15 DAS was found significant, highest in B1 (21.425) followed by B0 (21.342).

At 30 DAS boron effect on plant height is non-significant whereas at 45 DAS its effect is again found significant, maximum in B0 (42.158) and minimum in B2 (41.150). The interaction effect between Sulphur and boron in respect of plant height was found significant at 15, 30 and 45 DAS. Plant height at 30 kg S/ha was significantly higher over lower doses of Sulphur (Table 4.3). It might be due to favourable effect of Sulphur on root growth and development which increased the uptake of nutrients resulted in increased plant height. The increase in plant height of mungbean due to Sulphur application has also been reported by Shivran *et al.,* (1996) Ramamorthy *et al.,* (1997). Srinivasan and Sankaran (2001), Singh *et al.,* (2004) and Singh *et al.,* (2005). As the crop matures there is increase in no. of branches however initially no. of branches increases rapidly but 30 DAS there is gradual increase in no. of branches/plant. No. of branches at 45 DAS was found maximum in S2 (5.50) which is at par with S3 (5.389).

Number of branches increases with increasing Sulphur levels, it might be due to role of Sulphur in regulating metabolic and enzymatic process in plants as stated by Rao *et al.,* (2001). Similar results have also been reported by Bhadoria (1997), Sharma *et al.,* (2003) and Singh *et al.,* (2003). Sulphur @ 30 kg/ha (S3) resulted in significant increase in Seed yield (12.171 g/pot) closely followed by Sulphur @ 10 kg/ha (11.471 g/pot). However, both brought about significant improvement in Seed yield when compared to other levels of Sulphur and control.

Table.1 Effect of Sulphur and boron levels on plant height at different stage of Mungbean

Treatments	**Plant height (cm)**		
	15DAS	**30DAS**	**45DAS**
Sulphur levels(Kg/ha)			
S0	20.389	30.489	40.733
S1	20.589	30.656	41.30
S2	20.600	32.144	43.200
S3	20.967	30.622	41.389
Sem (±)	0.059	0.405	0.273
CD (P=0.05)	0.173	1.190	0.801
Boron levels (Kg/ha)			
B0	21.342	29.500	42.158
B1	21.425	29.767	41.675
B2	20.642	29.400	41.150
Sem (±)	0.051	0.351	0.236
CD (P=0.05)	0.149	NS	0.694

Table.2 Interaction effect of Sulphur and boron levels on plant height (cm) at different stages of Mungbean

S x B	Plant height (15DAS)			Plant height (30DAS)			Plant height (45DAS)		
	B0	B1	B2	B0	B1	B2	B0	B1	B2
S0	20.133	20.200	20.067	29.500	29.76	29.400	40.067	40.167	40.367
S1	20.333	20.367	20.400	31.000	30.83	30.760	40.633	40.700	40.700
S2	20.700	21.067	21.433	30.967	30.100	31.000	41.500	41.430	42.033
S3	21.500	23.33	24.100	32.8	32.600	33.000	43.367	44.500	44.467
Sem (±)	0.102			0.702			24.1		
CD(P=0.05)	0.299			2.061			1.387		

Table.3 Effect of Sulphur and boron levels on no. of branches/plant at different stages of mungbean

Treatments	No. of branches/plant		
	15DAS	30DAS	45DAS
Sulphur levels(Kg/ha)			
S0	1.000	4.056	5.056
S1	1.056	4.111	5.167
S2	1.278	4.333	5.500
S3	1.000	4.222	5.389
Sem (±)	0.062	0.111	0.096
CD (P=0.05)	0.182	NS	0.283
Boron levels (Kg/ha)			
B0	1.125	4.208	5.458
B1	1.125	4.208	5.250
B2	1.000	4.125	5.125
Sem (±)	0.054	0.096	0.083
CD (P=0.05)	NS	NS	0.245

Table.4 Interaction effect of Sulphur and boron levels on no. of branches/plant at different stages of Mung bean

S x B	No. of branches/plant (15DAS)			No. of branches/plant (30DAS)			No. of branches/plant (45DAS)		
	B0	B1	B2	B0	B1	B2	B0	B1	B2
S0	1.000	1.000	1.000	4.000	4.000	4.000	5.000	5.000	5.000
S1	1.000	1.000	1.000	4.000	4.000	4.167	5.000	5.000	5.833
S2	1.000	1.000	1.000	4.167	4.167	4.333	5.167	5.000	5.333
S3	1.167	1.33	1.500	4.333	4.333	4.677	5.500	5.500	6.000
Sem (±)	0.108			0.192			0.167		
CD(P=0.05)	NS			NS			0.489		

Table.5 Effect of Sulphur and boron levels on Seed and straw yield of mungbean

Treatments	Seed Yield (g/pot)	Straw yield(g/pot)
Sulphur levels(Kg/ha)		
S0	10.865	6.580
S1	11.471	6.616
S2	11.280	7.414
S3	12.171	6.770
Sem (±)	0.206	0.057
CD (P=0.05)	0.604	0.166
Boron levels (Kg/ha)		
B0	11.289	6.933
B1	11.583	6.928
B2	11.428	6.673
Sem (±)	0.178	0.049
CD (P=0.05)	NS	0.144

Table.6 Interaction effect of Sulphur and boron levels on seed and straw yield of mungbean

S x B	Seed yield(g/pot)			Straw Yield (g/pot)		
	B0	**B1**	**B2**	**B0**	**B1**	**B2**
S0	10.513	10.533	10.767	6.496	6.410	6.467
S1	11.100	11.193	11.403	6.626	6.716	6.730
S2	11.100	11.776	11.683	6.616	6.686	6.893
S3	12.160	12.440	12.960	6.970	7.536	7.990
Sem (±)	0.356			0.098		
CD(P=0.05)	1.046			0.288		

It is apparent from the data that maximum straw yield was registered under S2 (7.414 g/pot) which was significantly superior to the straw yield obtained under S3 (6.77 g/pot). Higher straw yield per pot with increased levels of Sulphur seem to be supported by number of branches per plant (Table 4.5) and plant height (Table 4.3) which is also increased with increasing rates of Sulphur upto almost same level.

The interaction effect of Sulphur and boron levels was found significant for straw yield. The possible reasons for increase in seed and straw yield due to Sulphur application at higher rate are in accordance to those of Joseph *et al.*, (1995), Bhadoria *et al.*, (1997),Singh *et al.*, (1998), Chanda *et al.*, (2002), Sharma *et al.*, (2003) Singh *et al.*, (2005) and Ali (2010).

All these research workers observed significant increase in seed and or straw yields with increased application of Sulphur from 20 to 40 kg/ha. However, in current research it is found that application of 30 kg S/ha recorded maximum Seed yield followed by 20 kg S/ha and they were significantly superior to 0, 10 kg/ha but remained at par among each other. Combined application of Sulphur and boron were significantly increase the Seed and straw yield of mungbean as the combinations significantly increase the plant height (45 DAS), number of branches/plant

(45 DAS), number of pods/plant and number of seeds/pod. It may be explained that the 30 kg S/ha and 2 kg B/ha had beneficial effect on it by improving metabolic enzymatic process in the plant and encourages vegetative growth of plant (formation and enlargement of leaves, increase internodes and ancillary buds). Thus increased growth characters attributed to registered highest Seed and straw yield at same combination of Sulphur and boron.

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