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Response of mung crop (*Vigna radiate* L.) to boron application in alluvial soils of Varanasi district

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Abstract
A field study was conducted with mung crop on alluvial soil of Varanasi district during *zaid* season (2015) to investigate the response of mung crop to B application The treatment were T_1 (control), T_2 (1 kg B ha^{-1}+NPK), T_3 (1.5 kg B ha^{-1} +NPK), T_4 (2 kg B ha^{-1}+NPK) T_5 (2.5 kg B ha^{-1} + NPK), T_6 (3 kg B ha^{-1} +NPK). In general, the higher plant height (11.67cm),number of branches (12.00), number of nodules (19.67), number of grain per pod (9.20), of mung were obtained with T_6 treatment followed by T_5> T_4> T_3> T_2> and T_1 control. As evident from results, grain and Stover yield increased significantly with B application. The mean maximum grain weight (5.18q $^{-1}$) and Stover yield (7.86q ha^{-1}) were obtained at higher dose of B (3kg B ha^{-1}). The mung experiment was laid out in randomized block design (RBD) with three replications.

Keywords: mung, boron, alluvial soil

Introduction
Mung bean is botanically recognized as *Vigna radiata* (L.) wilczek and belongs to the family Fabeaceae. Its seed is more palatable, nutritive, digestible and non-flatulent than other pulses grown in country. It contains 24.7% protein, 0.6% fat, 0.9% fiber and 3.7% ash (Potter and Hotchkiss, 1997) [7]. India is the world largest producer as well as consumer of green gram.it produces about 1.5 to 2 million tons of mung annually from about 3 to 4 million ha of area with an average productivity of 500 kg per hectare. Green gram output accounts for about 10 - 12 % of total pulses production in the country. Green gram is grown on a variety of soils from red laterite soil in the south India to black cotton soils in north India and sandy soil in Rajasthan a well-drained loamy to sandy. Loam soil is the best soil for its cultivation. In plant metabolism, Boron is associated with activity of certain enzymes, cell division, carbohydrate transport, and calcium and potassium uptake and protein synthesis. In Indian soil, total B content vary 7 to 630 ppm and available boron ranges from 0.10 ppm in normal soil to 10.00 ppm in saline alkali soils. Less than 5 percent of the total is the usually available to Plants. The availability of boron is most in India soil ranged between traces to 8 mg kg^{-1}soil (Sakal and Singh, 1995) [10]. The critical limit of available B has been found to be 0.53 mgkg^{-1} in soil (Sakal, 1995) [10]. Below which level of boron in soils are noted as deficient and above which as sufficient available boron. Boron deficiency ranges from 49 to 84 per cent in tarai alluvial soil of U.P, red lateritic and Alfisols of west Bengal, Orissa, Meghalya and Madhya Pradesh (Reddy, 2005) [8]. Over all deficient of boron in soils of Uttar Pradesh is more than 26 per cent (Anonymous 2008-09) [3]. Boron deficiency decreases the rate of water absorption and translocation of sugar in plants. The present investigation was undertaken to study the Response of mung crop to Boron application in alluvial soils of Varanasi district.

Materials and Methods
The field experiment was conducted during *Zaid* season of 2015 on research plot of Udai Pratap Autonomous College, Varanasi (U.P.) adjoining the department of Agricultural Chemistry and Soil Science. Varanasi has tropical and sub-tropical climatic situated in eastern part of U.P, India. The precipitation in thin is normally spread over period of three and half month i.e. from the last week of June to the last week of October. The period from November to February is generally cool and dry. The summer season from March to third week of June is hot and dry. The distribution of average annual rainfall as of 96.6mm is 80% from June to September, 57% from October to December, 3.3% from January to February and 3% from March to May. The soils of Varanasi formed on alluvial, deposited by river Ganga have predominance of illite, quartz, feldspars and illite minerals are partly inherited from micas which are predominant in the sand and silt fractions. The initial chemical properties of experimental soil is (pH - 7.61), low organic carbon content (0.49%), available nitrogen

(280.60 kg ha^{-1}), available phosphorus (17.50 kg ha-1), available potassium (293.00 kg ha^{-1}), low CEC (0.49 c moles p+ kg^{-1} soil) available sulphur (13.45 kg ha^{-1}) and available boron (0.48 mg kg^{-1}). The treatment details of the experiment is T_1 (Control), T_2 (1 kg B ha^{-1}+ NPK (RDF)), T_3 (1.5 kg B ha^{-1}+ NPK (RDF)), T_4 (2 kg B ha^{-1}+ NPK (RDF)), T_5 (2.5 kg B ha^{-1}+ NPK (RDF)) and T_6 (3 kg B ha^{-1}+ NPK (RDF)). Field was prepared by loamy or slit lome soils, after 3-4 cross ploughing followed by harrowing and planking give enough desirable field condition for its cultivation. After showing the fieldis divided into a number of slopping segments (beds) of reasonable size to help retention of rain water into the soil for optimum moisture contents these slopping beds also help to drain out the excessive water due to heavy Rains. Mung seed of cultivar Virat was sowing at spacing of 22.5×7 cm. Recommended dose of NPK were applied in all plots except control through urea, single super phosphate (SSP) and muriate of potash (MOP), respectively full dose of Nitrogen, Phosphorus and potash were applied as a basal dressing and Boron was applied as per treatment at time of sowing through Borax. The data collected from field and laboratory were analysed statistically using standard procedure of randomized block design (RBD).Critical difference (C.D.) and standard error of mean (S.E.m.) were calculated to determine the significance among treatments mean.

Results and Discussion

It is evident from the results of present study that application of Boron at different levels with 100 % recommended dose of Nitrogen, Phosphorus and Potassium fertilizer increased the growth of crop (plant height, number of leaves and number of branches) as compared to control (without Boron). Growth attributes at different time interval (30, 45 and 60 days after sowing) significantly increased due to soil applied Boron through fertilizer.

Growth attributes

The parameters plant height, number of branches per plant, leaf number, and nodule number were recorded at three stages, viz., 30, 45 and 90 days after sowing (DAS) except number of branches and number of nodules which was recorded only at 30 DAS; a stage having maximum nodulation. Application of Boron significantly increase the plant height of mung as compared to control. The mean maximum plant height (11.67 cm) was obtained at 3 kg B ha^{-1} + NPK application. These results confirmily with those which reported by Kushwaha *et al*. 2009.They reported that application of boron up to 3kg ha^{-1} gave higher response whereas at higher dose it have toxic effect and deteriorates the growth. (Nadim *et al*. 2012) [6] also reported that application of B @ 2kg per ha^{-1} produced higher crop growth rate (23.58 gm m^{-2} day^{-1}) and net assimilation rate (2.82 mg $m^{-2}day^{-1}$). Similar achievement have also been reported by (Khan *et al.* 2011) [4] and (Mete *et al.* 2005) [5]. The maximum number of branches were recorded at 3 kg B ha^{-1} (12.00) and minimum was in the control (9.27). Number of branches significantly higher in T_6 (12.00), followed by T_5 (11.67), T_4(10.93), T_3(10.80), T_2(10.33), and T_1(9.27). It is clear from the result that application of B significantly increased the number of branches $plant^{-1}$ as compared to without B (control).Treatment T_6 (12.00) was found to be significantly superior over other treatment. Similar results were also reported by Tahir *et al.* (2009). Application of B significantly increased the number of nodules as compared to control (without B). The maximum number of nodules plant $^{-1}$ were recorded in case of treatment T_6 (19.67) followed by T_5 (19.00), T_4 (18.67), T_3 (18.00), T_2 (17.67) and T_1 (16.00). Application of 3kg Bha^{-1} was found significantly superior over all the treatment. Increased growth rate and root development at higher amount of B application may be responsible for higher nodules.

Table 1

Treatment	Plant height			No. of branches	No. of root nodule	Grain per pod	Grain yield	Stover yield
	30 DAS	45 DAS	90 DAS	30 DAS	30 DAS	After Harvesting	(q ha-1)	(q ha-1)
Control	9.23	9.57	10	9.27	16	6.53	0.64	1.17
1 kg B ha^{-1}+NPK (RDF)	9.7	9.97	10.33	10.33	17.67	7.8	0.94	2.12
1.5 kg B ha^{-1}+ NPK (RDF)	10	10.23	10.77	10.8	18	8	0.94	2.45
2 kg B ha^{-1}+ NPK (RDF)	10.43	10.5	11.03	10.93	18.67	8.67	2.72	4.69
2.5 kg B ha^{-1}+ NPK (RDF)	10.7	10.8	11.3	11.67	19	8.87	3.7	6.69
3 kg B ha^{-1}+ NPK (RDF)	10.97	11.13	11.67	12	19.67	9.2	5.18	7.86
SEm ±	0.02	0.03	0.04	0.99	0.89	0.53	0.85	1.16
CD (0.05)	0.06	0.11	0.12	3.18	2.8	1.68	2.68	3.65

Yield attributes

The effect of different levels of boron nutrition on grain and stover yield was found statistically significant. The mean maximum grain weight (5.18qha^{-1}) and Stover yield (7.86qha^{-1}) were obtained at higher dose of B (3kg Bha^{-1}). The increase in yield may be because of photosynthetic activity of the plant due to boron application. Spectacular response of gram and groundnuts, sunflower and lentil to soil application of 1.0 to 2.0 kg B ha^{-1} has also been observed by (Singh *et al*. 2005) [11] and Shekhawat and Shivay (2008), respectively. Effectiveness of B application @2$kgha^{-1}$ on the growth and yield of rice crop have also been reported by Ali *et al*. 2009 [2], Ali *et al.* 2011 [1], Rehman *et al*. 2012 [9] and Nadim *et al*. 2012 [6].

Conclusion

It is concluded from the present study that the application of B maintained higher availability of B throughout the crop without having significant effect on available nutrients in soil. Application of boron significantly increased the overall performance of mung such as plant height, number of branches, nodules, grain, Stover yield.

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