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Effect of Levels of Boron and Molybdenum on Growth and Yield of Blackgram (*Vigna mungo* L.)

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ABSTRACT

Keywords

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A field experiment was conducted at Department of Agronomy, Faculty of Agriculture Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P. during *kharif*2019 on loamy sand soil. The field experiments was conducted to study the Effect of levels of Boron and Molybdenum on Growth and Yield of Blackgram (*Vigna mungo* L.) and their responses. Treatment T9 (R.D.F + 0.3% Solution of Borax +1.5 kg ha-1of Molybdenum) was found best for obtaining the maximum grain yield (19.06 q/ha) and the highest benefit cost ratio was recorded in the treatment T9 (R.D.F + 0.3% Solution of Borax +1.5 kg ha-1of Molybdenum) which was 1.74:1.

Introduction

Black gram (*Vigna mungo* (L.) Hepper) is one of the most important crop grown in India. It is consumed in the form of 'dal' (whole or split, husked and unhusked) or parched. It is chief constituent of 'papad'. It is used as nutritive fodder specially for mulch cattle and also used as green manuring crop. It adds 42 kg N ha'1 in soil. It posses deep root system which binds soil particles and thus, prevent erosion.

Black gram contain about 24 per cent protein, 60 per cent carbohydrate, 10.9 per cent moisture, 1.4 per cent fat, 0.9 per cent fibre, 3.2 per cent minerals and vitamin viz. calcium 154 mg, phosphorus 385mg, iron9.1mg and small amount of vitamin B complex. Black gram has been distributed mainly in tropical to subtropical countries.

It is grown in *kharif, rabi* and summer season in India, Pakistan, Sri Lanka, Burma and some countries of East Asia. In India black gram is very popularly grown in Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra, Uttar Pradesh, West Bengal, Punjab, Haryana, Tamil Nadu and Karnataka.

In India black gram is grown on 2.99 million ha area with total production of 1.59 million tones and productivity of 532 kg ha'1. In Maharashtra, it occupies an area of 3.65 lakh

ha with total production of 2.06 lakh tones and the productivity of299 kg ha'1, while in Marathwada it is grown on an area of 1.47 lakh ha with production of 0.30 lakh tonnes and productivity of282 kg ha'1 (Anonymous, 2015).

Boron plays a key role in a diverse range of plant functions including cell wall formation and stability, maintenance of structural and functional integrity of biological membranes, movement of sugar or energy in to growing parts of plants and pollination and seed sets. Adequate B is also required for effective nitrogen fixation and nodulation in legume crops.

Molybdenum is one of the most recognized nutrient elements considered to be essential for the growth of plant also playing important role in structural interring of cell wall and cell membrane and synthesis of protein a well as nitrogen fixation. Legume it plays and additional role in symbiotic nitrogen fixation. The nitrogen fixing enzyme, nitrogenase is compound of molybdenum. Without adequate quantities of this element, nitrogen fixation can't occur.

Materials and Methods

This experiment was carried out during *kharif* 2019 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, UP, which is located at 25.28oN latitude, 81.54oE longitude and 98 m altitude above the mean sea level. This area situated on the right side of the river Yamuna by the side of Prayagraj, Rewa Road about 5 km away from Prayagraj, city. The climate of this region is typically sub-tropical and semi-arid with monsoon commencing by the third week of June and with drawing by end of September. The temperature reached up to 48oC and in winter it goes down to as low as 2-3oC. During the summer hot scorching winds known as *"Loo"* and frost during winter months are common features. Experimental mechanical analysis of the soil was sand 59.50 (%), silt 24.10 (%), clay 16.40 (%) and textural class silt loam, while chemical analysis of soil was available nitrogen (242 kg/ha), available phosphorus (24.50 kg/ha), available potassium(95.00 kg/ha), organic carbon(0.40 %), pH(7.50) and EC(0.19 dS/m).

Fertilizer application: The fertilizers were applied in each plot according to treatment combinations. T1-R.D.F + 0.1% Solution of Borax+ 0.5 kgha-1 of Molybdenum, T2-R.D.F + 0.1% Solution of Borax+ 1.0 kgha-1 of Molybdenum, T3-R.D.F + 0.1% Solution of Borax+ 1.5 kgha-1 of Molybdenum, T4-R.D.F + 0.2% Solution of Borax+ 0.5 kg ha-1of Molybdenum, T5-R.D.F + 0.2% Solution of Borax +1.0 kg ha-1of Molybdenum, T6-R.D.F + 0.2% Solution of Borax + 1.5 kg ha-1of Molybdenum, T7-R.D.F + 0.3% Solution of Borax + 0.5 kg ha-1of Molybdenum, T8-R.D.F + 0.3% Solution of Borax + 1.0 kg ha-1of Molybdenum and T9-R.D.F + 0.3% Solution of Borax +1.5 kg ha-1of Molybdenumwas given in equal quantity to each plot which was calculated on the basis of general recommendation for blackgram as 0 kg, 80 kg, 100 kg ha-1 was supplied.

Results and Discussion

Pre harvest observations

Table 1 and 2presents the results for the growth and yield performance of the Blackgram (*Vigna mungo* L.). Effect of different treatments of Boron and Molybdenum application on pre-harvest observations. The maximum plant height was recorded (59.77cm) was recorded with T9 [R.D.F + 0.3% Solution of Borax +1.5 kg ha-

1of Molybdenum] followed by 59.43cm with T6 [R.D.F + 0.2% Solution of Borax + 1.5 kg ha-1of Molybdenum]. T1 [R.D.F + 0.1% Solution of Borax + 0.5 kgha-1 of Molybdenum] recorded the minimum (55.90 cm), maximum number of branches (5.10) was recorded with T9[R.D.F + 0.3% Solution of Borax +1.5 kg ha-1of Molybdenum] followed by 5.00 with T6[R.D.F + 0.2% Solution of Borax + 1.5 kg ha-1of Molybdenum], higher dry weight was observed in T9[R.D.F + 0.3% Solution of Borax + 1.0 kg ha-1of Molybdenum] was 2.97 and minimum was (1.93) recorded in T1[R.D.F + 0.1% Solution of Borax+ 0.5 kgha- 1 of Molybdenum], maximum Crop Growth Rate (g/m2/day) (3.69) was recorded with T8 [R.D.F + 0.3% Solution of Borax + 1.0 kg ha-1of Molybdenum] followed by 3.28 with T4[R.D.F + 0.2% Solution of Borax+ 0.5 kg ha-1of Molybdenum]. T3[R.D.F + 0.1% Solution of Borax + 1.5 kgha-1 of Molybdenum] recorded the minimum (0.64) and maximum Relative Growth Rate (g/g/day)(0.069) was recorded with T9 [R.D.F + 0.3% Solution of Borax + 1.0 kg ha-1of Molybdenum] followed by 0.062 with T8[R.D.F + 0.3% Solution of Borax + 1.0 kg ha-1of Molybdenum]. T1[R.D.F + 0.1% Solution of Borax+ 0.5 kgha-1 of Molybdenum] recorded the minimum (0.040).

Table.1 Effect of Boron and Molybdenum application on pre harvest observations of Blackgram (*Vigna mungo* L.)

Treat	Plant height (cm)	Number of branches per plant	Number of Nodules	Dry weight (g)	Crop Growth Rate (g/m^2/day)	Relative Growth Rate (g/g/day)
T1R.D.F+ 0.1%ofBorax+0.5kg/ha of Mo	55.9	4.53	7.20	1.93	1.08	**0.040**
T2-R.D.F+ 0.1%of Borax+1.0 Kg/ha of Mo	55.43	4.90	6.80	2.13	0.96	**0.047**
T3-R.D.F+ 0.1% oBorax+1.5kg/ha of Mo	57.57	4.57	7.33	2.18	0.64	**0.049**
T4-R.D.F+0.2%of Borax+0.5kg/ha of Mo	56.77	4.97	7.67	2.21	3.28	**0.052**
T5-R.D.F+0.2%ofBorax+1.0kg/ha of Mo	56.2	4.90	7.55	2.23	2.23	**0.051**
T6-R.D.F+0.2%ofBorax+1.5kg/ha of Mo	59.43	5.00	8.77	2.64	2.39	**0.062**
T7-R.D.F+0.3%ofBorax+0.5kg/ha of Mo	57.47	4.97	8.10	2.17	2.27	**0.050**
T8-R.D.F+0.3%ofBorax+1.0kg/ha of Mo	57.33	4.77	8.43	2.61	3.69	**0.062**
T9- R.D.F+0.3%ofBorax+1.5kg/ha of Mo	59.77	5.10	9.67	2.97	2.17	**0.069**
F- test	S	S	S	S	NS	**S**
S. Ed. (±)	1.076	0.154	0.509	0.278	2.626	**0.008**
C. D. (P = 0.05)	**2.221**	**0.318**	**1.05**	**0.573**	**5.419**	**0.017**

Table.2 Effect of Boron and Molybdenum application on post harvest observations of Blackgram (*Vigna mungo* L.)

Treat	Number of pods per plant	Number Seeds/pod	Test weight (g)	Seed yield (q/ha)	Straw yield (q/ha)	Harvest inde (%)
T1R.D.F+ 0.1%ofBorax+0.5kg/ha of Mo	18.43	5.93	28.83	6.51	14.41	**45.18**
T2-R.D.F+ 0.1%of Borax+1.0 Kg/ha of Mo	22.23	6.63	30.63	7.64	16.68	**45.8**
T3-R.D.F+ 0.1% oBorax+1.5kg/ha of Mo	24.23	7.03	32.03	8.47	17.99	**47.08**
T4-R.D.F+0.2%of Borax+0.5kg/ha of Mo	26.03	7.43	33.13	9.08	18.76	**48.4**
T5-R.D.F+0.2%ofBorax+1.0kg/ha of Mo	25.63	7.33	32.93	8.58	17.93	**49.06**
T6-R.D.F+0.2%ofBorax+1.5kg/ha of Mo	26.83	7.63	33.5	9.08	18.76	**47.85**
T7-R.D.F+0.3%ofBorax+0.5kg/ha of Mo	23.33	6.73	31.13	8.02	17.23	**46.55**
T8-R.D.F+0.3%ofBorax+1.0kg/ha of Mo	26.4	7.53	33.23	8.83	18.21	**48.49**
T9-R.D.F+0.3%ofBorax+1.5kg/ha of Mo	27.03	7.8	33.53	9.35	19.06	**48.4**
F- test	S	S	S	S	S	**S**
S. Ed. (±)	1.155	0.292	0.923	0.483	0.57	**1.114**
C. D. (P = 0.05)	**2.383**	**0.602**	**1.905**	**0.996**	**1.176**	**2.299**

V The increase in plant height by the basal application of B, Mo and Ni might be due to its crucial role as promoter of cell division and act in the induction and development of its meristematic tissues. The results were in conformity with the findings of Devi *et al.*, (2012) and Alam *et al.*, (2017) in soybean and chickpea with B nutrition, Tahir *et al.*,(2014) in blackgram with Mo and Valenciano *et al.*, (2010) in chickpea with B+Mo nutrition. This greater increase in branch number with B, Mo and Ni application in combinations could be attributed to the increase in plant height caused by the three nutrients. These results were in concurrence with the findings of Rahman *et al.*, (2008) Alam *et al.*, (2017) Devi *et al.*, (2012), Malik *et al.*, (2015) and (Shil *et al.*, 2007), who reported the increase in branching with supplementation of these three micronutrients. Alam *et al.*, (2017) reported the highest nodule number with application of 3 kg B ha-1 in chickpea. Awomi *et al.*, (2012) found maximum number of nodules in mungbean with the application of Mo @ 1.5 kg ha-1. Khan *et al.*, (2014) stated that application of nickel up to 10 ppm increased the functional nodules number in chickpea. Similar positive effects of B and Mo on TDM have also been reported by Malik *et al.*, (2015) in mungbean, Karpagam and Rajesh (2014) in blackgram, Zahoor *et al.*, (2013) in soybean and Goutam *et al.,* (2014). The results of present investigation also exposed the same. Mahilane and Singh (2018) reported that application of Mo significantly increased the CGR of blackgram when applied @ 1.0 kg ha-1. Similar observations of increase in CGR in response to B and Mo application were reported by Sritharan *et al.,* (2015) in blackgram and Wasaya *et al.,* (2017) in maize.

Post-harvest observations

Data presented in table 2 showed that treatment T9[R.D.F + 0.3% Solution of Borax +1.5 kg ha-1of Molybdenum] recorded maximum number of pods per plant (27.03), followed by (26.83) in T6[R.D.F + 0.2% Solution of Borax + 1.5 kg ha-1of Molybdenum]. Lower number of pods per plant was found in treatment T1[R.D.F + 0.1% Solution of Borax+ 0.5 kgha-1 of Molybdenum] was (18.43) number of pods per plant. Treatment T9[R.D.F + 0.3% Solution of Borax +1.5 kg ha-1of Molybdenum] recorded maximum seeds per pod (7.80), followed by (7.63) in T6[R.D.F + 0.2% Solution of Borax + 1.5 kg ha-1of Molybdenum] and minimum number of seed per pod was found in treatment T1[R.D.F + 0.1% Solution of Borax+ 0.5 kgha- 1 of Molybdenum] was (5.93) seeds/pod. Treatment T9 [R.D.F + 0.3% Solution of Borax +1.5 kg ha-1of Molybdenum] recorded maximum test weight (33.53), followed by (33.50) inT6[R.D.F + 0.2% Solution of Borax + 1.5 kg ha-1of Molybdenum]. Lowest test weight was found in treatment T1[R.D.F + 0.1% Solution of Borax+ 0.5 kgha-1 of Molybdenum] was 28.83 test weight. Treatment T9[R.D.F + 0.3% Solution of Borax +1.5 kg ha-1of Molybdenum] recorded maximum Seed yield (q/ha) (9.35), followed by (9.08) in T6[R.D.F + 0.2% Solution of Borax + 1.5 kg ha-1of Molybdenum] and minimum. Seed yield (q/ha) was found in treatment T1[R.D.F + 0.1% Solution of Borax+ 0.5 kgha-1 of Molybdenum] was (6.51) Seed yield (q/ha). Treatment T9[R.D.F + 0.3% Solution of Borax +1.5 kg ha-1of Molybdenum] recorded maximum Straw yield (q/ha) (19.06), followed by (18.76) in T6[R.D.F + 0.2% Solution of Borax + 1.5 kg ha-1of Molybdenum]. Lowest Straw yield (q/ha)was found in treatment T1[R.D.F + 0.1% Solution of Borax+ 0.5 kgha-1 of Molybdenum] was 14.41Straw yield (q/ha). Treatment T5 [R.D.F + 0.2% Solution of Borax +1.0 kg ha-1of Molybdenum] recorded maximum harvest index (%) (49.06), followed by (48.49) in T8[R.D.F + 0.3% Solution of Borax + 1.0 kg ha-1of Molybdenum]. Lowest harvest index (%) was found in treatment T1[R.D.F + 0.1% Solution of Borax+ 0.5 kgha-1 of Molybdenum] was (45.18) harvest index (%).These results were in concurrence with the findings of Duyingqiong *et al.,* (2002), Rathi. (2016), Chatterjee *et al.,* (1985) and Bagewadi *et al.,* (2003) who reported the significant increase in pod number per plant in blackgram. The increase in seed number could be due to the increase in pod length caused by the three nutrients. The results of the present investigation were in conformity with the findings of (Alam *et al.,* 2017), Pandey and Gupta, (2012) and Alam and Islam, (2016) who reported these three nutrients increased seed number perpod. The results of present investigations in contrasting with the findings of Alam and Islam, (2016), Ramamoorthy and Sudarshan, (1992) and Monem *et al.,* (2009) who reported B, Mo influenced the 100 seed weight. Working with different crops other researchers have also reported increased yield with application of B (; Rajeev and Dinesh, 2014) and other micronutrients Mo(Kumar *et al.,* 2018; Malik *et al.,* 2015). However the essential role of Borax and molybdenum has been established as a component of several enzymes concerned with carbohydrate and nitrogen metabolism, in addition to its involvement directly or indirectly in regulating the various physiological processes of plants. Similar results were reported by Sharma *et al.,* (2010).

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