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Effect of Different Levels of Boron on the Morphological Traits, Yield and Yield Components of Black Gram (*Vigna mungo*)

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ABSTRACT

Background: In India, black gram (*Vigna mungo*) is an important pulse crop that makes up an important proportion of the population's protein intake. However, low soil fertility specifically, deficiency in macronutrients and micronutrients like boron often limits its output. Foliar treatment of micronutrients, especially boron, has demonstrated potential to increase crop growth and production qualities. A field experiment was conducted to determine the impact of foliar boron application in combination with the recommended dose of fertilizer (RDF) on black gram growth and production.

Methods: The experiment was conducted at the crop research centre (CRC), SGT University, Kaliawas, Gurugram, Haryana, in the summer of 2024. Seven treatments were replicated three times in this randomized block design (RBD) experiment. The experimental plot's soil had a sandy loam texture, slightly alkaline nature and low levels of available nitrogen, phosphorus, potassium, sulphur and micronutrients. Because of its consistent performance across all evaluated parameters, treatment combination T_5 which included RDF +2% boron foliar application (F.A.) @30 and 45 days after sowing, showed significant result among all treatments.

Result: Treatment combination T_5 (RDF + foliar application of 2% boron at 30 and 45 DAS) recorded superior result for various growth and yield attributes like plant height (36.20 cm), number of branches per plant (28.12), number of trifoliate leaves per plant (36.86), number of pods per plant (18.00), number of grains per pod (8.20), test weight (42.22g), grain yield (12.54 q ha^{-1}) and biological yield (32.36 q ha^{-1}).

Key words: Black gram, Boron, Foliar application, Growth, Pod yield, Pulse.

INTRODUCTION

Pulses are a from nature because of their special ability as efficient source of protein in a typical Indian diet. Pulses hold an important position in Indian agriculture. (Ghosh *et al.,* 2022). Black gram, native to Indian subcontinent, found a remarkable resemblance to *Vigna radiata* (Reddemma *et al.,* 2024). India is the world's leading producer of black gram; however, numerous tropical and subtropical countries in Asia, Africa and Central America also contribute to black gram production (Rajput *et al.,* 2021). The total black gram cultivation area in India is 4.8 million ha. Madhya Pradesh ranked 1st position in India in area and production (37% and 32%, respectively) followed by Andhra Pradesh (8% and 13%, respectively). In India, the total production of black gram is 2.73 million tons, while the productivity is 5.64 quintal ha^{-1}.

Boron (B) is an important non-metallic micronutrient that is crucial for maintaining structure of cell walls, cell division, membrane stability, nitrogen uptake, sugar translocation, K+ transport, protein and sucrose synthesis, phenol, carbohydrate, nucleic acid and IAA metabolism. It has been found that the available boron in Indian soils ranges from 0.04 to 7.40 mg kg^{-1}, while the total boron concentration varies between 3.80 and 630 mg kg^{-1} (Kumar *et al.,* 2020). Boron deficiency is more common in low organic matter concentration. Boron is kept in soils through adsorption in minerals and humic particles and the formation of insoluble precipitates. It was reported that 33% of Indian soils may be deficient in Boron. Reproductive growth is reportedly limited by boron deficit. (Jasper *et al.,* 2022). Since many crops' roots (such pulses) may reach beyond the surface layer to obtain some nutrients from subsurface layer, knowledge on depth-wise distribution of soil's accessible boron is desirable. Because boron is a less mobile nutrient in plants, deficiency symptom of boron initially appears on the tips of stems, young leaves, flowers and buds. The symptoms of boron deficiency in plants also include dieback of tips of the shoots, downward cupping of the leaves and dark green, leathery leaves.

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Boron's significance in plant physiology stems from its involvement in several fundamental processes. It is indispensable for maintaining the structural integrity of cell walls by facilitating the cross-linking of pectic polysaccharides, which contribute to cell wall strength and flexibility (Marschner, 1995). This structural role is particularly important during periods of rapid cell division and elongation, such as in growing shoots and roots. Further more, boron aids in the transport of sugars by forming sugar-borate complexes, which are essential for energy distribution and supporting metabolic demands during growth (Brown *et al.,* 2002).

MATERIALS AND METHODS

A field experiment was conducted during summer 2024 at the crop research centre (CRC) farm of Kaliawash, SGT University, Gurugram, Haryana, located at 28.48′ North latitude and 76.89′ East longitude and at an altitude of 217 meters above mean sea level. The crop research centre is located in the north-western zone of Haryana. Soil samples were collected randomly from different treatments of the experimental field at a depth of 0-15 cm to determine the physiochemical properties of soil. A representative composite sample was then analyzed to assess the physio-chemical properties of the soil using standard methods. The analytical results revealed that the soil of experimental field was sandy loam in texture, slightly alkaline in chemical reaction, had low available nitrogen and medium available phosphorus, potassium, sulfur and deficient micronutrients. The experiment was laid out with seven treatments, *viz.* Control T_1: Recommended dose of fertilizer N:P:K (20: 40: 40 kg ha^{-1}), T_2: RDF + foliar application boron 0.5% @ 30 and 45 DAS, T_3: RDF + foliar application boron 1% @ 30 and 45 DAS, T_4: RDF + foliar application of boron 1.5% @ 30 and 45 DAS, T_5: RDF + foliar application of boron 2% @ 30 and 45 DAS, T_6: RDF + foliar application of boron 2.5% @30 and 45 DAS, T_7: RDF + foliar application of boron 3% @ 30 and 45 DAS, in randomized block design with three replication. Black gram variety (T-9) with plant geometry (30 cm × 25 cm) was sown in mid-April 2024. The data on growth parameters like plant height, number of branches, number of trifoliate leaves, number of pods and number of nodules were recorded from 5 randomly selected plants. Harvested plant samples were sun-dried for 4-5 days and biological yield was recorded threshing was done manually and the grain weight was subtracted from biological yield to get straw yield and calculation economics.

RESULTS AND DISCUSSION

The data related to different growth and yield parameters such as plant height, number of branches, number of trifoliate leaves $plant^{-1}$, number of nodules $plant^{-1}$, number of pod $plant^{-1}$, number of grains pod^{-1}, test weight, biological yield and yield (q ha^{-1}) as influenced by the application of Borax as source of Boron with certain treatments are explained below.

Plant height

Foliar treatments applied in combination significantly increased the plant height of Black gram, as shown in Table 1. The highest plant height was recorded as 19.52 cm at branching stage under treatment combination T_5 which was found to be statistically at par with treatments T_6 and T_3 and significantly superior to other treatments. Again, maximum plant height was 36.20 cm at harvest under treatment combination T_5 which was found to be statistically at par with treatments T_4 and T_3 whereas it was found to be significantly superior to all other treatments. Treatment T_1 (RDF) recorded the lowest plant height of 13.20 cm and 20.86 cm at branching and at harvest stage. Similar finding was reported by Singh *et al.* (2017) and Erol (2024).

Number of branches $plant^{-1}$

Data on number of branches per plant as influenced by boron recorded at two growth phases like branching stage and at harvest (Table 1). At branching stage, maximum number of branches per plant (11.16) was recorded under the treatment combination T_5 which was statistically par with treatments T_6 and T_4 and significantly superior to other treatments. At harvest, maximum number of branches per plant was 28.12 under the treatment combination T_5. Further, treatment T_5 was followed by T_4 and T_3 regarding number of branches per plant. T_5: RDF + foliar application of 2% boron @ 30 and 45 DAS, respectively. The minimum number of branches per plant was 9.36 at branching stage and 16.66 at harvest stage was observed in treatment T_1 (RDF). A similar result was found by Naznin *et al.* (2020).

Number of trifoliate leaves $plant^{-1}$

The data regarding the number of trifoliate leaves per plant, as affected by the treatments, recorded at two growth stages, are presented in Table 1. The highest number of trifoliate leaves per plant was recorded as 17.66 at branching stage which was found to be statistically at par with treatments T_3 and T_4 and at harvest the maximum number of trifoliate leaves per plant was recorded in T_5: RDF + foliar application of 2% boron at 30 and 45 DAS, is 36.86 this was followed by treatment T_4 and T_3. The lowest number of trifoliate leaves per plant 12.46 at branching and 18.60 at harvest stage was recorded with treatment T_1 (RDF). A similar result was found by Meena *et al.* (2016).

Nodulation

The data on number of nodules per plant at flowering stage are presented in Table 1. The maximum number of nodules per plant was obtained under treatment T_5: RDF + foliar application (F.A.) of 2% boron at 30 and 45 DAS, which was 17.32 and found to be statistically at par with treatments T_4 and T_3 and significantly superior to rest of the treatments. The minimum number of nodules per plant was obtained under treatment T_1 (RDF), which was 10.60. A similar report was found by Mishra *et al.* (2018) and Muddana *et al.* (2025).

Table 1: Effect of treatments application on growth attributes of black gram.

Treatments	Plant height (cm)		Number of branches (plant^{-1})		Number of trifoliate leaves (plant^{-1})		Number of nodules (plant^{-1})
	At branching	At harvest	At branching	At harvest	At branching	At harvest	45 DAS
T_1- RDF NPK (20:40:40)	13.20	20.86	9.36	16.66	12.46	18.60	10.60
T_2- RDF+(FA) B @0.5% at 30 and 45 DAS	15.60	27.92	9.75	17.52	15.20	27.20	13.32
T_3- RDF+(FA) B @1% at 30 and 45 DAS	17.66	30.74	9.86	18.02	16.86	29.00	16.40
T_4- RDF+(FA) B @1.5% at 30 and 45 DAS	17.46	33.72	10.18	21.40	16.72	31.18	16.46
T_5- RDF+(FA) B @2% at 30 and 45 DAS	19.52	36.20	11.16	28.12	17.66	36.86	17.32
T_6- RDF+(FA) B @2.5% at 30 and 45 DAS	18.40	30.32	10.22	18.00	15.48	28.28	15.52
T_7- RDF+(FA) B @3% at 30 and 45 DAS	13.26	20.90	9.40	16.70	12.50	18.74	10.67
SEm±	0.64	0.96	0.34	0.64	0.56	0.90	0.44
CD (5%)	1.97	2.98	1.05	2.02	1.74	2.78	1.37

. RDF- Recommended dose of fertilizer; . FA- Foliar application; . B- Boron.

Number of pods plant^{-1}

Data on number of pods per plant of black gram, as influenced by various treatments, are presented in Table 2. All the treatments significantly increased the number of pods per plant compared to T_1 (RDF). Treatment T_5: RDF + foliar application (F.A.) of 2% boron at 30 and 45 DAS resulted in maximum number of pods per plant at harvest 18.00, which was followed by treatments T_4 and T_6 and these treatments are significantly at par to each other which produced 15.80 and 15.20 pods per plant, respectively. A similar result was found by Mondal *et al.* (2024).

Number of grains pod^{-1}

The quantity of grains per pod at harvest stage was substantially impacted by the treatments, as shown in Table 2. Treatment T_5: RDF + foliar application (F.A.) of 2% boron at 30 and 45 DAS had maximum number of grains per pod (8.20), whereas treatment T_1 (RDF) had the lowest number of grains per pod (5.22). Similar was reported by finding Banerjee *et al.* (2023).

Test weight

The data test weight presented in Table 1 revealed that the highest test weight (42.22 g) was recorded with T_5: RDF + foliar application (F.A.) of 2% boron at 30 and 45 DAS, which was superior to all other treatments. However, this treatment is followed by T_2 (37.12 g), which is at par to T_3 (37.00 g). A similar result was also reported by Mondal *et al.* (2024).

Biological yield

The data in Table 2 indicated that various treatments significantly influenced biological yield. The maximum biological yield (32.36 q ha^{-1}) was concluded with treatment T_5: RDF + foliar application (F.A.) of 2% boron at 30 and 45 DAS, which was found to be statistically at par with treatments T_4 and T_3 and significantly superior to other treatments. The lowest biological yield (24.05 q ha^{-1}) was recorded in treatment T_7 (RDF + foliar application (F.A.) of 3% boron at 30 and 45 DAS). A similar result was found by Jyothika *et al.* (2023).

Grain yield

The study observed a variation in yield ranging from 10.02 q ha^{-1} to 12.54 q ha^{-1}, indicating a 25.14%, 19.50% and 15.56% increase in yield treatment T_5, T_4 and T_3 respectively increase in yield and these are significant and at par with each other and the lowest yield is recorded in treatment T_7. The treatment T_5-RDF + (FA) B@2% at 30 and 45 DAS recorded the highest yield. The application of boron at an optimal concentration @2% B significantly enhanced yield, while the excessive application @ 3% B resulted in a decline in yield due to toxicity of Boron in soil. A similar result was found by Mishra *et al.* (2018).

Effect of treatments on the economics of black gram

The effect of application of boron on the economics of black gram is described in Table 2. Maximum gross returns

Table 2: Effect of treatments on yield parameters.

Treatments	Number of pods/plant	Number of grains/pod	Test weight (g)	Biological yield (q/ha)	Yield (q/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B: C
T_1- RDFNPK (20:40:40)	10.86	5.22	36.66	24.98	10.09	42811	75924	33112	1.74
T_2- RDF+(FA) B @0.5% at 30 and 45 DAS	13.86	6.82	37.12	26.40	10.92	42881	80808	37926	1.88
T_3- RDF+(FA) B @1% at 30 and 45 DAS	14.52	7.22	37.00	31.27	11.58	42951	85692	42740	2.00
T_4- RDF+(FA) B @1.5% at 30 and 45 DAS	15.80	7.00	36.42	31.51	11.97	43022	88578	45555	2.06
T_5- RDF+(FA) B @2% at 30 and 45 DAS	18.00	8.20	42.22	32.36	12.54	43092	92796	49703	2.15
T_6- RDF+(FA) B @2.5% at 30 and 45 DAS	15.20	6.80	35.54	25.23	10.26	43162	74666	31503	1.76
T_7- RDF+(FA) B @3% at 30 and 45 DAS	10.90	5.15	35.96	24.05	10.02	43232	72520	29287	1.72
SEm±	0.57	0.22	1.20	1.72	0.43				
CD (5%)	1.77	0.67	3.73	5.35	1.32				

· RDF- Recommended dose of fertilizer; · FA- Foliar application; · B- Boron.

(Rs.92,796 ha^{-1}), net returns (Rs.49,703 ha^{-1}) and B: C ratio (2.15) were recorded in treatment T_5: RDF + foliar application (F.A.) of 2% boron at 30 and 45 DAS. With a greater magnitude of yield enhancement, the marginal increase in production costs related to other treatments resulted in better yields, gross returns, net returns and benefit-cost ratios.

CONCLUSION

The experimental findings indicate that the treatment T_5 with recommended dose of fertilizers (RDF) combined with foliar application of 2% boron at 30 and 45 days after sowing (DAS) was the most effective in enhancing the growth, yield and economic returns of black gram (*Vigna mungo* L.). The application of RDF along with foliar application of 2% boron at these critical growth stages resulted in significantly higher yield. Based on the results of this study, it is recommended that black gram cultivation with RDF and foliar application of 2% boron at 30 and 45 DAS to optimize yield potential and economic profitability.

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Disclaimer

The views and opinions expressed in this research paper are those of author and do not necessarily reflect the official policy or position of any affiliated institutions, organizations, or funding agencies. The authors are solely responsible for the content and accuracy of data and analysis presented herein. Any error or omission is the responsibility of author.

Informed consent

All participants voluntarily took part in this study after receiving detailed information about its purpose and procedures. Written consent was obtained and confidentiality was assured. Participants were free to withdraw at any time. The study adhered to ethical guidelines approved by the appropriate institutional ethics committee.

Conflict of interest

The authors declare no conflict of interest. The research was conducted independently and no financial or personal relationships influenced the outcome or interpretation of findings.

REFERENCES

Banerjee, P., Kumari, V.V. and Nath, R. (2023). Response of autumn sown black gram as influenced by cobalt, potassium and boron nutrition under Indian subtropics. *Journal of Plant Nutrition*. **46(19):** 4573-4593.

Brown, P.H., Bellaloui, N., Wimmer, M.A., Bassil, E.S., Ruiz, J., Hu, H. and Römheld, V. (2002). Boron in plant biology. *Plant Biology*. **4(2):** 205-223. https://doi.org/10.1055/s-2002-25740.

Erol, O. (2024). Effect of foliar boron and proline applications on physiological and biochemical properties in soybean (*Glycine max* L.). *Legume Research*. **47(12):** 2059-2067. doi: 10.18805/LRF-812.

Ghosh, K., Swaroop, N., Thomas, T. and Ravindra, J. (2022). Soil physico-chemical properties (*Vigna mungo* L.) cultivation in an inceptisol of Prayagraj, Uttar Pradesh, India. *International Journal of Plant and Soil Science*. **34(22):** 1172-1182.

Jasper, M.V. and Singh, S. (2022). Effect of spacing and boron levels on growth and yield of black gram (*Vigna mungo* L.). *International Journal of Plant and Soil Science*. **34(22):** 310-316.

Jyothika, V., Dawson, J. and Krishna, C.V. (2023). Response of boron and biofertilizers on growth and yield of summer blackgram (*Vigna mungo* L.). *International Journal Environment Climate Change*. **13(4):** 148-155.

Kumar, R., Kumari, S., Shambhabhi, S. and Priyadarshi, R. (2020). Relative change in yields and nutrient uptake of black gram under different doses and sources of boron. *International Research Journal of Pure and Applied Chemistry*. **21(4):** 17-22.

Marschner, H. (1995). Mineral Nutrition of Higher Plants (2nd ed.). Academic Press.

Meena, D., Bhushan, C., Shukla, A., Chaudhary, S., Semwal, M.P., and Kumar, K. (2016). Effect of foliar application of nutrients on growth parameter, nutrient content and uptake of Urdbean [*Vigna munga* (L.*) Hepper*]. *Ecology Environment and Conservation*. **22(4):** 2101-2106.

Mishra, U.S., Sharma, D. and Raghubanshi, B.P.S. (2018). Effect of zinc and boron on yield, nutrient content and quality of black gram (*Vigna mungo* L.). *Research on Crops*. **19(1):** 34-37.

Mondal, S., Singh, K. and Dawson, J. (2024). Effect of zinc and boron on growth and yield of black gram (*Vigna mungo* L.). *International Journal of Research in Agronomy*. **7(5):** 369-371.

Muddana, S.C.S. and Sanjay-Swami. (2025). Interactive effect of phosphorus and boron on their temporal soil availability under black gram [*Vigna mungo* (L.) Hepper] cultivation and nodulation in acid inceptisol. *Legume Research*. **48(3):** 444-449. doi: 10.18805/LR-4877.

Naznin, F., Hossain, M.A., Khan, M.A., Islam, M.A. and Rahman, A.K.M.H. (2020). Effect of boron on growth, yield and nutrient accumulation in black gram. *The Agriculturists*. **18(2):** 34-43.

Reddemma, K.E.M.P.I.L.I., Reddy, M.S. and Tej, M.K. (2024). Performance of rabi blackgram (*Vigna mungo* L.) under different sowing windows. *Journal of Experimental Agriculture International*. **46(6):** 30-44.

Rajput, D., Kumar, M., Kumar, S. and Yadav, R. (2021). Effect of micronutrient application on nodulation and quality parameters of urd bean (*Vigna mungo* L.). *Journal of Plant Development Sciences*. **13(1):** 41-44.

Singh, S.P. (2017). Effect of micronutrients on nodulation, growth, yield and nutrient uptake in black gram (*Vigna mungo* L.). *Annals of Plant and Soil Research*. **19(1):** 66-70.