Plant Archives Vol. 26, Supplement 1, 2026 pp. 1630-1634 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.supplement-1.219

RESPONSE OF COWPEA YIELD COMPONENTS AND SOIL CHEMICAL PROPERTIES TO BORON AND MOLYBDENUM APPLICATION

Rahul Kumawat[1], Satyavir Singh[1], Awanish Kumar[1*], Ashish Kumar Tiwari[2], Jay Narayan Tiwari[3], Sankar Lal Yadav[1], Manish Yadav[1] and Rahul Rabiya[1]

[1]Department of Soil Science and Agriculture Chemistry, Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Utter-Pradesh, India
[2]Department of Agronomy, Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Utter-Pradesh, India
[3]Department of Horticulture, Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Utter-Pradesh, India
*Corresponding author E-mail: awanishiasbu@gmail.com
(Date of Receiving : 26-09-2025; Date of Acceptance : 05-12-2025)

ABSTRACT

A field experiment was conducted during Kharif 2024 at Karguanji research farm, department of soil science and agriculture chemistry, Bundelkhand University, Jhansi (Utter Pradesh). The soil texture of experimental site was loamy sand, with a pH of 8.1, low organic carbon (0.58%), available Nitrogen (208.14 kg/ha), available phosphorus (12.57 kg/ha), available potassium (232.14 kg/ha) and EC (0.29 d Sm^{-1}). The experiment was laid out in randomized block design with nine treatments to evaluate the performance of Boron and Molybdenum on Growth parameters, Yield Attributes, Yield and Soil properties by Cowpea. The treatments consist of foliar application of boron (0%, 0.2%, 0.4%) and molybdenum (0%, 0.4%, 0.8%). The results reveled that maximum plant height was recorded significantly higher *viz.* 72.28cm, maximum number of branches/plant (9.61), maximum number of root nodules/plant (36.50), maximum number of leaves/plant (27.09), maximum number of pods/pant (34.70), length of pod (36.96), number of seeds/pod (18.09), 100 seeds weight (15.94), pod yield/ plant (232.12 g) and yield t/ha (34.46 t) were recorded with foliar application of boron 0.4% + molybdenum 0.8% as compared to other treatments.
Keywords **:** Boron, Molybdenum, Cowpea, Available nutrients, Pod yield.

Introduction

Cowpea (*Vigna unguiculata*), often called lobia, is an annual legume from tropical and subtropical regions. It is a key multipurpose legume that is widely grown in the arid and semiarid tropical regions of India. It is a warm-weather crop that is well suited to the drier parts of the tropics and resistant to drought. Protein from cowpea is not a good source for men. Cowpea is most likely indigenous to the middle of Africa. The dry weight of cowpea grain is made up of 23. 4% protein, 1.8% fats, and 60.3% carbohydrates, and it is a great source of calcium and iron. The majority of the world's land area about 90% is in Africa, where it is mostly cultivated. Cowpea is cultivated on 3.9 million hectares in India, primarily in the western, central, and peninsular areas (Bute and Thaokar *et al*., 2019). Although it can be cultivated as a rabi, spring, or summer crop in some regions of the nation, it is typically planted as a *kharif* crop. The crop is renowned for its quick growth and dropping leaves, which at first inhibit the growth of weeds. At first, rapid growth promotes widespread root formation. Early crop establishment during a drought-like condition. Additionally, it grows effectively in poor soils with more than 85% sand, less than 0.2% organic matter, and low phosphorus levels. It also has the helpful capacity to fix atmospheric nitrogen through its root nodules. Additionally, it is a well-known cover crop and has a great resistance to soil erosion from rainfall (Bute *et al*., 2019).

Cowpea is a popular summer vegetable valued for its protein, energy, and minerals. Due to its short duration, soil-enriching habit, and greater profitability, which are gradually replacing traditional summer vegetables like okra and cucurbits, the crop is becoming more popular among vegetable producers (Ranjit Chatterjee *et al*., 2017). As boron is essential for the healthy growth of reproductive organs, legume crops need more of it than most field crops. By causing reproductive tissue malformation that affects pollen germination, its deficiency causes plant sterility, which increases flower fall and decreases fruit set (Subasinghe *et al*., 2003). The nitrogen input may once more be hampered by a lack of boron since it makes the crop require more boron (Prasad *et al*., 1998). For the proper operation of nitrogenase enzyme, which is involved in nitrogen fixation, Rhizobium bacteria need molybdenum. Again, molybdenum serves as the cofactor for the enzyme nitrate reductase, which is responsible for nitrogen absorption. The use of molybdenum in soils lacking this element promoted nitrogen fixation and nodule development (Ranjit Chatterjee *et al*., 2017). Nitrogen availability in soil is heavily influenced by boron and molybdenum, which primarily affect nitrogen fixation and metabolism in plants. While molybdenum plays a vital role in phosphorus solubilization, boron may increase phosphorus uptake (Kousar Tasleem Shaik *et al*., 2021).

Materials and Methods

The field experiment was conducted at the organic research farm karguanji, Bundelkhand University, Jhansi (Utter Pradesh) during Kharif season (August to November) of 2024-25. The site is located at 750 47' East longitudes, 260 51' North latitudes and at altitude of 390 m above mean sea level in Jhansi Utter Pradesh. The soil was loamy red in texture and slightly basic in nature (pH 8.1). The experiment was laid out in randomized block design with three replications and nine treatments. Treatments consists different levels of boron (0%, 0.2% and 0.4%) and different levels of molybdenum (0%, 0.4% and 0.8%) foliar spray at 15, 45 and 75 DAS. The treatment combinations are given in table 1. The sourceof boron is borex/suhaga ($Na_2B_4O_5(OH)_4.8H_2O$) and molybdenum is sodium molybdate ($Na_2MoO_4.2H_2O$).The cowpea seeds of the variety KASHI UNNATI were planted during 1st week of august in 1.8m X 2.25m plots with spacing of 15cm within and 45cm between rows. The crop was raised adopting standard cultural practices and the observations were recorded on five randomly selected plants from each plot on different growth parameters, yield attributes, yields and soil properties. The soil parameters namely soil pH, organic carbon, available nitrogen, phosphorus and potassium as well as electrical conductivity status of soil was estimated by standard analytical methods (Jackson, 1973, Olsen et al., 1954 and Asija, 1956). The experimental data on observations were statistically analyzed by adopting the procedure of Panse and Sukhatme. The critical difference was calculated at five per cent probability level to draw statistical calculations.

Table 1: Treatments with their symbol

Symbols	Treatments
T_1	FYM + B_0 (0%) + M_0 (0%)
T_2	FYM + B_0 (0%) + M_1 (0.4%)
T_3	FYM + B_0 (0%) + M_2 (0.8%)
T_4	FYM + B_1 (0.2%) + M_0 (0%)
T_5	FYM + B_1 (0.2%) + M_1 (0.4%)
T_6	FYM + B_1 (0.2%) + M_2 (0.8%)
T_7	FYM + B_2 (0.4%) + M_0 (0%)
T_8	FYM + B_2 (0.4%) + M_1 (0.4%)
T_9	FYM + B_2 (0.4%) + M_2 (0.8%)

FYM – farm yard manure, B – boron, M –molybdenum

Results and Discussion

Effect of boron and molybdenum application on growth parameters

At all phases of cowpea development, foliar treatment of varying doses of boron and molybdenum resulted in significant changes in growth characteristics. All growth parameters, including plant height, number of branches in plant^{-1}, number of nodules in plant^{-1}, and number of leaves in plant^{-1}, were considerably higher than those in the control treatment (T_1). With the use of treatment T_9, the highest values of plant height (31.76, 69.91, and 72.28 cm), number of branches plant^{-1} (5.51, 8.05, and 9.61), number of nodules plant^{-1} (36.50, 20.63, and 16.80), and number of leaves plant^{-1} (15.24, 27.09, and 24.27) were found at 30, 60, and 90 DAS. The information provided in table 2.

Boron deficiency had previously been shown to cause pollen tube growth inhibition during flowering, resulting in pollen sterility, flower abortion, and inadequate pod formation (Tariq and Mott, 2007). Boron is not particularly mobile and cannot be readily transferred to reproductive organs, but it is essential that the plant receives a steady supply throughout the blooming phase. To promote efficient nodulation and nitrogen fixation in legumes, enough boron is also necessary (Noor and Hossain, 2007). The essential trace element molybdenum is necessary for the activity and production of molybdoenzymes, such as nitrogenase, the nitrogen-fixing enzyme that plays the main regulatory role in initiating nodulation and maintaining nitrogen fixation in legumes and nitratereductase, the nitrogen assimilation enzyme (Franco and Munns, 1981).Cowpea var. Bombay was responded differently by increasing nodulation with increase the level of molybdenum and with increasing boron concentration up to 4ppm the Bombay var. recorded maximum crop growth (Subasinghe *et al.,* 2003).

Table 2: Effect of boron and molybdenum application on growth parameters by cowpea

Symbol	Plant height (cm)			Number of branches plant^{-1}			Number of nodules plant^{-1}			No. of leaves plant^{-1}		
	30 days	60 days	90 days	30 days	60 days	90 days	30 days	60 days	90 days	30 days	60 days	90 days
T1	26.22	62.10	64.10	3.13	5.30	6.86	25.26	9.78	9.10	9.42	21.61	19.10
T2	27.35	63.27	65.38	3.36	5.46	6.53	28.53	12.81	10.63	9.92	21.83	19.37
T3	27.50	63.67	65.79	3.60	6.07	7.15	29.31	13.67	11.20	10.24	22.00	20.09
T4	28.58	64.31	66.47	3.68	6.14	7.47	30.24	13.84	11.83	11.12	22.71	20.80
T5	31.19	67.98	70.48	3.77	7.60	8.50	32.14	17.56	12.46	13.27	24.43	21.58
T6	30.03	66.35	68.45	4.43	7.25	8.97	35.90	18.83	12.73	13.54	24.91	22.28
T7	29.30	65.19	65.89	3.74	6.66	8.06	32.10	17.20	12.32	12.43	23.03	21.20
T8	29.61	67.23	69.37	4.08	7.11	8.80	36.11	19.27	16.64	14.67	25.23	22.50
T9	31.76	69.91	72.28	5.51	8.05	9.61	36.50	20.63	16.80	15.24	27.09	24.27
S.Em(±)	**0.60**	**0.68**	**0.78**	**0.15**	**0.05**	**0.19**	**0.07**	**0.07**	**0.07**	**0.13**	**0.07**	**0.08**
CD (P=0.05)	**1.81**	**1.45**	**1.65**	**0.45**	**0.15**	**0.58**	**0.21**	**0.22**	**0.20**	**0.40**	**0.22**	**0.25**

Effect of boron and molybdenum application on yield attributes and yields

The yield qualities and yields of cowpea were significantly affected by the foliar application of boron and molybdenum (table 3). The yield characteristics recorded the maximum number of pods plant^{-1} (34.70), length of pod (36.96 cm), number of seeds pod^{-1} (18.09), test weight (15.94 g), and yield attributes, while in yields, the treatment T_9 produced the highest pod yield plant^{-1} (232.12 g) and pod yield ha^{-1} (34.46 t), which were both considerably higher than the control treatment T_1. Compared to the T_1 treatment (control), the treatment T_9 achieved 36% more pods per plant^{-1}, 23% longer pod length, 46% more seeds per pod^{-1}, 20% higher test weight, and 58% higher pod yield per plant^{-1}& pod yield ha^{-1}.

These findings are consistent with those of Subasinghe*et al.* (2003). The study looked at the impact of boron supplementation at 4 weeks after planting, which coincides with the start of the reproductive stage, which may have an impact on flowering and pod establishment, as well as an increase in the total pod yield, number of pods per plant. Since boron is a trace element and the margin between deficiency and toxicity in the soil-plant system is narrow, one spray at the start of the reproductive stage is enough to produce the best blooms and pod yields. Without molybdenum in the soil, the plant molybdoenzymes can be broken down, significantly impairing the nitrogen fixation carried out by soil bacteria (Kaiser *et al.*, 2005). Cowpea var. Bombay was responded differently by increasing the level of molybdenum and boron concentration recorded maximum crop yield (Subasinghe *et al.*, 2003). Workers such as Schon and Blevins (1990), Bolanos *et al.* (1996) and Nahardani *et al.* (2013) also highlighted beneficial effect of boron on yield of legume crops.

Table 3 : Effect of boron and molybdenum application on yield attributes & yields by cowpea

Symbol	Yield attributes				Yield of cowpea	
	No. of pods plant^{-1}	Length of pod(cm)	No. of seeds pod^{-1}	Test weight (g)	Pod yield plant^{-1} in g	Pod yield ha^{-1} in t
T1	25.52	30.09	12.35	13.29	147.24	21.86
T2	28.28	30.93	13.24	13.37	157.18	23.33
T3	27.22	31.40	13.97	13.93	170.52	25.32
T4	27.70	33.58	14.52	14.03	183.04	27.18
T5	33.32	35.15	15.27	14.44	195.15	28.97
T6	30.08	35.35	15.38	14.54	191.64	28.44
T7	29.97	34.11	14.82	14.04	202.76	30.10
T8	31.21	36.43	16.01	15.52	214.24	31.81
T9	34.70	36.96	18.09	15.94	232.12	34.46
S.Em(±)	**0.08**	**0.18**	**0.05**	**0.06**	**1.35**	**0.20**
CD (P=0.05)	**0.25**	**0.57**	**0.15**	**0.19**	**4.04**	**0.60**

Effect of boron and molybdenum application on soil properties

Following the harvest of cowpea plants, the micronutrient treatments significantly impacted the availability of key soil nutrients, as shown in Table 4. The application of treatment T9 recorded considerably higher available nitrogen (207.27 kg ha^{-1}), available potassium (231.79 kg ha^{-1}), available phosphorus (12.24 kg ha^{-1}), organic carbon (0.59%) and Ec(0.27dsm^{-1}) when compared to treatment T_1 (control).

The findings demonstrated that spraying boron and molybdenum on the foliage during the growth stages had a significant impact on the availability of key nutrients in the soil. The presence of a favourable soil environment and key macro and micronutrients may have encouraged the nodule bacteria to fix nitrogen and increased the availability of nitrogen, phosphorus, and potassium in the soil. Applying boron and molybdenum in the growing methods resulted in higher nitrogen and phosphorus concentrations in the soil, as reported by Srivastava and Varma (1995).

Table 4 : Effect of boron and molybdenum application on soil properties by cowpea

	Soil properties				
Symbol	**Available N**	**Available P**	**Available K**	**Organic carbon (%)**	**EC (dSm^{-1})**
T1	159.44	6.33	170.44	0.44	0.18
T2	165.12	7.23	180.46	0.46	0.19
T3	169.00	7.67	210.36	0.49	0.20
T4	174.62	8.54	217.63	0.50	0.21
T5	180.45	9.34	221.98	0.52	0.21
T6	182.79	9.23	224.46	0.53	0.22
T7	185.11	10.69	228.52	0.55	0.25
T8	196.51	11.92	230.07	0.57	0.26
T9	207.27	12.24	231.79	0.59	0.27
S. Em (±)	**0.48**	**0.08**	**0.86**	**0.01**	**0.01**
CD (P=0.05)	**1.44**	**0.24**	**2.58**	**0.02**	**0.02**

Conclusion

The application of boron 0.4% and molybdenum 0.8% at 15, 45, and 75 days after cowpea sowing can improve the experimental results, which include growth parameters (such as plant height, number of branches $plant^{-1}$, number of nodules $plant^{-1}$, and number of leaves $plant^{-1}$), yield attributes (such as number of pods $plant^{-1}$, length of pod, number of seeds pod^{-1} and test weight), and yields (pod yield $plant^{-1}$ and pod yield ha^{-1}). The use of molybdenum and boron had a considerable impact on the soil's characteristics.

This article was financial support by the University of Babylon, Faculty of Science for Women, for providing the necessary infrastructural facilities during my research This article was financial support by the University of Babylon, Faculty of Science for Women, for providing the necessary infrastructural facilities during my research.

Acknowledgment

This manuscript was financial support by the Institute of Agricultural Sciences, Bundelkhand University, Jhansi for providing the necessary field and laboratory facilities during my master research in Soil Science and Agricultural Chemistry.

References

Bolanos, L., Brewin, N.J., Bonilla, I. (1996). Effects of boron on Rhizobium-legume cell-surface interactions and node development. *Plant Physiol*. **110**, 1249–1256.

Franco, A.A., Munns, D.N., (1981). Response of *Phaseolus vulgaris* L. to molybdenum under acid conditions. *Soil Sci. Soc. Am. J.,* **45**, 1144–1148.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi, India, pp. 111-203.

Kaiser, B.N., Gridley, K.L., Brady, J.N., Phillips, T., Tyerman, S.D., (2005). The role of molybdenum in agricultural plant production. *Ann. Bot.*, **96**, 745–754.

Kousar, T.S. *et al.* (2021). Effect of nitrogen phosphorus potassium boron and zinc on soil health parameters.*The pharma innovation international journal,* Vol.10, Issue 11.

Nahardani, A.A., Sinaki, J.M., Firouzabadi, M.B., Abbaspour, H. (2013). Effects of sowing date and biological fertilizer foliar on yield and yield components of cowpea. *Int. J. Plant Prod.* **4**(11), 2822 2826.

Noor, S.S., Hossain, M.A. (2007). Effects of boron and molybdenum on the yield of chickpea. *J. Agric. Rural Dev.*, **5** (1&2), 17–24.

Olsen, S.R., Cole, C.V., Watanable, F.S. and Dean, L.A. (1954). Estimation of available phosphorus in soils by extraction with sodium bicarbonate. *Circular, United States Department of Agriculture*, p. 932.

Prasad, M., Pillai, A., Faber, G., Field, S., Dowling, T. (1998). Molybdenum response of pigeonpea on ferruginous latosols in Fiji. Int. Chickpea Pigeon Pea Newsletter, **5**, 55–56.

Ranjit, C. and Subhendu, B. (2017). Effect of boron, molybdenum and biofertilizers on growth and yield of cowpea (*Vigna unguiculata* L. Walp.) in acid soil of eastern Himalayan region.*Journal of the Saudi Society of Agricultural Sciences*. **16**, 332–336.

Schon, M.K., Blevins, D.G. (1990). Foliar boron applications increase the final number of branches and pods on branches of field grown soybeans. *Plant Physiol*. **92**, 602–607.

Srivastava, S.N.L., Varma, S.C. (1995). Effect of nitrogen, phosphorus and molybdenum fertilization on growth, nodulation and residual fertility in field pea. *Indian J. Agric. Res*., **19**(3), 131 137.

Subasinghe, S., Dayatilake, G.A., Senaratne, R. (2003). Effect of B, Co and Mo on nodulation, growth and yield of cowpea (*Vigna unguiculata*). *Trop. Agric. Res. Ext*. **6**, 108–112.

Subbiah, B. V. and Asija, G. L. (1956). A rapid procedure for the determination of available nitrogen in soils. *Current Science*, **25**: 259-260.

Tariq, M., Mott, C.J.B. (2007). The significance of boron in plant nutrition and environment– a review. *Agron. J*. **6**(1), 1–10.

Vaibhav, A.B., Ambarish, T., Kevin, A.G., Ashish, S., Amol, N. and Satish, K.J. (2019). Growth & yield of cowpea influenced by foliar application of nutrient. *Journal of Pharmacognosy and Phytochemistry*, **8**(5): 2034-2037.