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Effect of levels of boron and molybdenum on economics of Blackgram (*Vigna mungo* L.) cultivation

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Abstract
A field experiment was conducted to determine the effect of levels of Boron and Molybdenum on Economics of Blackgram cultivation. The experiment was laid out in Randomized Block Design, with 12 treatments, each replicated thrice, in the *kharif* 2019 with the different levels of Boron (0.1%,0.2%,0.3% of Borax solution) and Molybdenum(0.5,1.0,1.5 Mo Kg/ha) respectively at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). Application of Boron and Molybdenum significantly influenced the economics of Blackgram. Addition of 0.3% solution of Borax +1.5kg Mo/ha recorded the maximum Gross realization (Rs. 56100) was observed with the treatment T_9 (R.D.F + 0.3% Solution of Borax +1.5 kg $ha^{-1}$of Molybdenum) Maximum net returns (Rs27783) were also recorded with the same treatment. The highest benefit cost ratio was recorded as (1.73:1) with above said treatment.

Keywords: Blackgram, *kharif*, boron, molybdenum, growth, yield attributes

Introduction
Blackgram belongs to family Leguminoseae. Blackgram (*Vigna mungo* L.) is the important pulse crop of India cultivated over a wide range of agro - climatic zones of the country. This crop is grown in *Kharif* and Rabi seasons, however, maximum area is under *Kharif* cultivation where intercropping with sorghum, pearl millet, maize, cotton, castor, pigeonpea is very popular.

Blackgram also occupies about more than 4.50 million ha area in the country producing 2.83 million tonnes. The major blackgram growing states of the country are Maharashtra, Uttar Pradesh, Andhara Pradesh, Madhya Pradesh and Tamil Nadu.

The total area under the crop has increased progressively from 1.84 million ha in 1965 - 66 to 4.50 million ha in 2016 - 17. Similarly, the production has increased from 0.55 million tonnes to 2.83 million tonnes during the same period. In the state of Maharashtra this crop is grown on 0.48 million ha area with the production of 0.18 million tonnes and the average productivity of the state is 365kg ha^{-1}. Blackgram is the important pulse crop of Vidarbha region of Maharashtra covering 0.10 million ha with the production of 0.04 million tones registering the productivity of 387 kg ha^{-1}(AICRP)

Micronutrients are essential elements that are used by plants in small quantities to orchestrate a range of physiological functions. Application of micronutrients increase the yield and quality of agricultural products.

Boron (B) is one of the most important trace elements, which is essential for normal life cycle of the plants. It influences the absorption of nitrogen, phosphorus, potassium and its deficiency affects the equilibrium of these macronutrients. Boron plays a key role in sugar translocation, nodulation, nitrogen fixation, protein synthesis, sucrose synthesis, cell wall composition, membrane stability, K+ transport, viability of pollen, pollen germination and pollen tube growth and pollination and seed set. Boron deficiency commonly results in empty pollen grains, poor pollen vitality and a reduced number of flowers per plant besides stunted root growth as shown in the soybean and canola.

Studies on molybdenum application to crop revealed that, cereals and legumes showed a higher response compared to other crops. It is important for good foliage growth, nitrogen fixation and nitrogen assimilation as a constituent of nitrogenous and nitrate reductive and

inhibiting acid phosphates. It retranslocate freely from roots, stem and leaves. Khan and Prakash (2014) [7] application of molybdenum up to 1.0 kg ha^{-1} significantly increased growth characters, number and dry weight of root nodules, seed and Stover yield, nutrient uptake, gross and net returns and benefit: cost ratio.

Materials and Methods

The experiment was carried out during *Kharif* season of 2019 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P). The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.2), low in organic carbon (0.58%), medium in available N (238 Kg/ha), high in available P (32.10 Kg/ha) and low in available K (189 Kg/ha). The treatment consisted of T1:R.D.F+0.1% solution of borax at 15, 30, 45DAS + 0.5 kg ha^{-1}of Molybdenum,T2: R.D.F + 0.1% solution of Borax+ 1kg ha-1of Molybdenum, T3: R.D.F + 0.1% solution of Borax, 1.5kg ha^{-1} of Molybdenum, T4:R.D.F + 0.2% solution of Borax +0.5 kg ha^{-1} of Molybdenum, T5: R.D.F + 0.2% solution of Borax +1.0 kg ha^{-1} of Molybdenum, T6:R.D.F + 0.2% solution of Borax + 1.5 kg ha^{-1} of Molybdenum, T7:R.D.F + 0.3% solution of Borax +0.5 kg ha^{-1} of Molybdenum, T8:R.D.F + 0.3% solution of Borax +1.0 kg ha^{-1} of Molybdenum and T9:R.D.F + 0.3% solution of Borax +1.5 kg ha^{-1} of Molybdenum. There are 9 treatments each replicated thrice. The experiment was laid out in Randomized Block Design. It was sown on 25th July 2019 with seed rate Kg/ha at spacing 30cm x 10cm. Recommended doses of nitrogen, phosphorus and potassium were applied.

Results and Discussions

Economics of all treatments were calculated according to expenditure incurred from the land preparation till harvesting of the crop. Gross return, net return, cost of cultivation were calculated and are presented in the Tables no.1.

The maximum Gross realization (Rs. 56100) was observed with the treatment T_9 (R.D.F + 0.3% Solution of Borax +1.5 kg ha^{-1}of Molybdenum) Maximum net returns (Rs27783) were also recorded with the same treatment. The highest benefit cost ratio was recorded as (1:1.73) with above said treatment Khan *et al*. (2014) [7] revealed that the application of molybdenum up to 1.0 kg ha $^{-1}$ significantly increased the number and dry weight of nodules plant $^{-1}$, uptake of nitrogen, zinc, molybdenum in urdbean and increases gross and monetary return and benefit: cost ratio. Karpagam and Rajesh (2014) [6] reported that with increasing levels of Mo, the pod yield, seed yield and haulm yield also increases and the highest benefit : cost ratio of 2.79 was recorded with soil application of Mo @ 1000 g ha $^{-1}$ as sodium molybdate. Rathi *et al.* (2009) found that application *rhizobium* along S @ 4kg ha^{-1} B @ 0.6 kgha^{-1}and Mo @ 0.1kg ha^{-1}significantly increased the yield and economics of Blacgram. Quddus *et al.* (2011) observed that the combined application Zn 1.5 kg ha^{-1}B 1.0 kgha^{-1}produced significantly higher yield (3058 kg ha^{-1}) and economics of Mungbean over single application of both nutrients.

Table 1: Effect of levels of boron and molybdenum on economics of blackgram

Treatment combinations	Cost of Cultivation	Yield		Sale rate		Gross return (ha^{-1})	Net Return (ha^{-1})	B:C ratio
		Grain (kg/ha)	Stover (kg/ha)	Grains (kg/ha)	Stover (kg/ha)			
T_1R.D.F+ 0.1% of Borax + 0.5kg/ha of Molybdenum	36,982	651	1441	39060	7205	46265	9284	1.2:1
T_2- R.D.F+ 0.1% of Borax+1.0kg/ha	37,682	764	1668	45840	8340	54180	16498	1.45:1
T_3-R.D.F+0.1% of Borax+ 1.5kg/ha of Molybdenum	37,982	847	1799	50820	8995	59815	21833	1.15:1
T_4-R.D.F+0.2% of Borax+0.5kg/ha of Molybdenum	37,382	908	1576	54480	7880	62360	24978	1.60:1
T_5R.D.F+0.2% of Borax+1.0kg/ha of Molybdenum	37,682	858	1793	51480	8965	60445	22765	1.16:1
T_6-R.D.F+0.2% of Borax+1.5kg/ha of Molybdenum	37,782	908	1876	54480	9380	63860	26478	1.70:1
T_7-R.D.F+0.3% of Borax+0.5kg/ha of Molybdenum	37,182	802	1723	48120	8615	56735	19555	1.52:1
T_8-R.D.F+0.3% of Borax+1.0kg/ha of Molybdenum	37,482	883	1821	52980	9105	62085	24603	1.65:1
T_9- R.D.F+0.3% of Borax+1.5kg/ha of Molybdenum	37,847	935	1906	56100	9530	65630	27783	1.73:1

Conclusion

It may be concluded that the treatment T9 (R.D.F + 0.3% Solution of Borax +1.5 kgha-1 of 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 +1.5kg ha-1 of Molybdenum) which was (1.73:1).

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