# **Response of boron and molybdenum on growth and yield of black gram (*Vigna mungo* L.)**


## **ABSTRACT**

A experiment was conducted in Crop Research Farm in department of agronomy during *Zaid* season of 2023 on Black gram crop. The treatment consisted of 3 levels of Boron (3000,4000,5000 ppm/ha) and Molybdenum (600,700,800 ppm/ha) as foliar spray and control. The experiment was lay out in Randomized Block Design (RBD) with 10 treatments and replicated thrice. Application of Boron (5000ppm/ha) and Molybdenum (800ppm/ha) produced higher Plant height (48.47 cm), more dry weight/plant (9.43 g), maximum number of pods per plant (29.80), number of branches/plant (32.07),number of nodules per plant (6.80),crop growth rate (2.68g/$m^2$/day), number of seeds per pod (7.73), Test weight (40.20 g), Seed yield (1.39t/ha), Stover yield (2.99 t/ha).Treatment combination with Boron (5000ppm/ha) and Molybdenum (800ppm/ha) highest gross return (69500.00INR/ha), net return (43209.90INR/ha) and benefit cost ratio (1.64) when compared to the control (RDF).



**Keywords:** *Boron, Economics, Growth, Molybdenum, Yield*.

## 1. INTRODUCTION:

"Black gram (*Vigna Mungo* L.), is one of the important pulse crops, grown throughout the country belongs to the family Leguminosae. In India cultivated over a wide range of agro - climatic zones of the country" **[1].** "This crop is grown in Kharif and Rabi seasons. The crop is resistant to adverse climatic conditions and improve the soil fertility by fixing atmospheric nitrogen in the soil. It has been reported that the crop produces equivalent to 22.10 kg of N/ha., which has been estimated to be supplement of 59 thousand tonnes of urea annually" **[2].** "The pulse 'Black gram' plays an important role in Indian diet, as it contains vegetable protein and supplement to cereal-based diet. Its seed contains moisture 10.9%, protein 20-25%, fiber 0.9%, fat 1.3%, starch 40- 47%, ash 3.40%, crude fiber 4.2%, calcium 145 (mg/100 g), iron 7.8 (mg/100g), which is almost three times that of cereals and other minerals and vitamins". [3] "Apart from consumption pulses crop cultivation improves soil fertility, the physical structure of soil and also act as nutrition fodder for cattle. The pulse availability per adult per day at present is only 36 which is against the minimum requirement of 50g/adult/day. The recommended dietary allowances (RDA) for adult male and female is 60 g and 55g per day" **[4]**.

"Boron is one of the most important trace elements, which is essential for normal life cycle of the plants" **[5]. "**It influences the absorption of nitrogen, phosphorus, potassium and its deficiency effects the equilibrium of these macronutrients". [5] "It increases the yield and growth of plants by increasing the leaf area expansion, 1000 seed weight, nodule formation, seed yield and biological yield in black gram. It influences the major cellular functions and metabolic activities in plants and required for cell differentiation at all growing tips of plants (meristems) where cell division is active". [6] **[6]** studied "the effect of boron on pulses and concluded that it is important for protein synthesis and improved protein content".

"Molybdenum is an effective micronutrient that plays an important role in improving the crop yield and quality. Molybdenum is one of the most recognized nutrient elements considered to be essential for the growth of plants. As a constituent of nitrate reductase and nitrogenase enzymes, molybdenum directly influences nitrogen assimilation and its fixation in pulse crops. Foliar spray of this micronutrient is more effective and fast-acting than soil application Molybdenum also playing important role in structural interring of cell wall and cell membrane and synthesis of protein as well as nitrogen fixation". **[7]** "Molybdenum is required for the formation of the nitrate reductase enzyme and in the legume, it plays an 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. Thus, the application of B and Mo not only increased the yield but also improved the quality of black gram. It is generally accepted that legumes need more Mo than most of other plants due to its key involvement in the Nitrogen-fixation process". [8] "Molybdenum is required to the Rhizobium bacteria for proper function of nitrogenase enzyme which involved in nitrogen fixation. Again, molybdenum is the cofactor for the enzyme nitrate reductase which involved in nitrogen assimilation" **[7]**.

## 2. MATERIALS AND METHODS:

"This experiment was conducted during the *Zaid* season of 2022 at the Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, (U.P., India), which is located at 250 28' 42" N latitude, 810 50' 56" E longitude, and 98 m altitude above mean sea level. This area is located on the right bank of the Yamuna River, along the Prayagraj, Rewa Road, about 5 km from Prayagraj city. Organic carbon (0.87%), accessible nitrogen (225 kg/ha), phosphorus (41.8 kg/ha), and potassium (261.2 kg/ha) are the most abundant elements. The region has a semi-arid subtropical climate". [9] One hand weeding was performed 15 days following sowing to prevent crop-weed competition. Two irrigations were administered at 6 and 17 days after sowing. The growth characteristics observations were recorded using conventional technique at 15-day intervals and displayed at 60 DAS. "Yield metrics were measured on harvest day, May 20$^{th}$, 2023. All of the parameters were recorded and statistically analysed using appropriate analysis of variance techniques" as described by **[9].**

## 3. RESULT AND DISSCUSSION:

### 3.1 Growth parameters

#### 3.1.1 Plant height (cm)

At 60 days after sowing (DAS), treatment with Boron at 5000 ppm + Molybdenum at 800 ppm recorded significantly highest plant height (48.47 cm). However, treatment with Boron at 5000 ppm + Molybdenum at 700 ppm was statistically at par with the treatment Boron at 5000 ppm + Molybdenum at 800 ppm. "Molybdenum is conceivably due to its vital role in the regulation and activation of enzyme systems especially nitrogenase and nitrate reductase that supply necessary energy required for nodulating bacteria to fix atmospheric nitrogen. Further, it improves the availability of nutrients and their utilization by black gram and possibly promotes crop growth". **[10].** Molybdenum application increased the number of nodules and the nitrogenase activity in black gram plants and increased the growth and yield of black gram plants. The positive effects of molybdenum application were more pronounced in soils that were low in molybdenum **[11].**

**3.1.2 Numbers of branches/plant**

At 60 DAS, treatment with Boron at 5000 ppm + Molybdenum at 800 ppm recorded significantly highest number of branches per plant (37.07). However, treatments with Boron at 5000 ppm + Molybdenum at 700 ppm and Boron at 4000 ppm + Molybdenum at 800 ppm were statistically at par with the treatment Boron at 5000 ppm + Molybdenum at 800 ppm. **[12][13]**, who reported “the increase in Black gram with supplementation of these three micronutrients. 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 the study conducted in a greenhouse using a factorial experiment with three levels of each micronutrient: control, low and high. The results showed that all three micronutrients had positive effects on the growth, nodulation and nitrogen fixation of black gram. The highest levels of growth, nodulation and nitrogen fixation were observed in plants that were treated with the high levels of boron, molybdenum and nickel **[14]**.

**3.1.3 Plant dry Weight (g/plant)**

At 60 DAS, treatment with Boron at 5000 ppm + Molybdenum at 800 ppm recorded highest plant dry weight (9.43 g). However, treatment with Boron at 5000 ppm + Molybdenum at 700 ppm was statistically at par with the treatment Boron at 5000 ppm + Molybdenum at 800 ppm. This might be due to increased availability of nitrogen due to biological nitrogen fixation that induces plant growth to produce huge biomass yield. The present outcome are in conformity with the findings of **[15].**

**3.1.4 Number of nodules/plant**

At 60 DAS, treatment with Boron at 5000 ppm + Molybdenum at 800 ppm recorded significantly highest Number of nodules/plant (6.80). However, treatments with Boron at 5000 ppm + Molybdenum at 700 ppm and Boron at 4000 ppm + Molybdenum at 800 ppm were statistically at par with the treatment Boron at 5000 ppm + Molybdenum at 800 ppm. “The increase in growth attributes due to molybdenum might be due to that it is a structural component of nitrogenase and the enzyme actively involved in nitrogen fixation by root nodule bacteria of leguminous crops”. **[16].**

The resulted data for growth parameters is shown in (Table 1).

### 3.2 Yield parameters

#### 3.2.1 Number of pods/plant

Treatment with Boron at 5000 ppm + Molybdenum at 800 ppm recorded significantly highest Number of pods per plant (29.80). However, treatment Boron at 5000 ppm + Molybdenum at 700 ppm was statistically at par with the treatment Boron at 5000 ppm + Molybdenum at 800 ppm.

#### 3.2.2 Number of seeds/pod

Treatment with Boron at 5000 ppm + Molybdenum at 800 ppm recorded significantly highest Number of seeds per pods (7.73). However, treatment Boron at 5000 ppm + Molybdenum at 700 ppm was statistically at par with the treatment Boron at 5000 ppm + Molybdenum at 800 ppm. 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 **[14].**

#### 3.2.3 Seed yield (t/ha)

Treatment with Boron at 5000 ppm + Molybdenum at 800 ppm recorded the highest seed yield (1.39 t/ha). However, treatments with Boron at 4000 ppm + Molybdenum at 700 ppm, Boron at 4000 ppm + Molybdenum at 800 ppm and Boron at 5000 ppm + Molybdenum at 700 ppm were statistically at par with the treatment Boron at 5000 ppm + Molybdenum at 800 ppm. The essential role of 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 **[17].**

#### 3.2.4 Stover yield (t/ha)

Treatment with Boron at 5000 ppm + Molybdenum at 800 ppm recorded the highest Stover yield (2.99 t/ha). However, treatments with Boron at 4000 ppm + Molybdenum at 700 ppm, Boron at 4000 ppm + Molybdenum at 800 ppm and Boron at 5000 ppm + Molybdenum at 700 ppm were statistically at par with the treatment Boron at 5000 ppm + Molybdenum at 800 ppm. Straw yield is directly related to vegetative growth (plant height and number of branches) which was increased by soil application of S and Mo and seed inoculation with

Rhizobium. These results were confirmed by the findings of **[18]** in chickpea and **[19]** in black gram crop.

The resulted data for yield parameters is shown in (Table 2).

**Economics:**

The result showed that (Table 3) the maximum gross return (69500.00 INR/ha), net return (43209.90 INR/ha) and B:C ratio (1.64) was recorded in Boron at 5000 ppm + Molybdenum at 800 ppm as compared to other treatments.

## 4. CONCLUSION:

It is concluded that hybrid Boron at 5000 ppm + Molybdenum at 800 ppm was found to be best for obtaining maximum grain yield. It also fetched the maximum gross return, net return and B:C ratio.

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**Table 1. Effect of Boron and molybdenum on Growth parameters of Black gram.**

| S. No. | Treatments | Growth parameters | | | |
|---|---|---|---|---|---|
| | | Plant height (cm) | Branches/plant | Dry weight (g) | Nodules/plant |
| 1. | Boron at 3000 ppm + Molybdenum at 600 ppm. | 45.20 | 33.73 | 5.05 | 4.73 |
| 2. | Boron at 3000 ppm + Molybdenum at 700 ppm. | 45.50 | 34.00 | 6.40 | 4.80 |
| 3. | Boron at 3000 ppm + Molybdenum at 800 ppm. | 45.60 | 34.13 | 6.90 | 4.93 |
| 4. | Boron at 4000 ppm + Molybdenum at 600 ppm. | 45.70 | 34.21 | 8.17 | 5.80 |
| 5. | Boron at 4000 ppm + Molybdenum at 700 ppm. | 46.40 | 34.93 | 9.21 | 5.93 |
| 6. | Boron at 4000 ppm + Molybdenum at 800 ppm. | 46.91 | 35.53 | 9.23 | 6.13 |
| 7. | Boron at 5000 ppm + Molybdenum at 600 ppm. | 45.80 | 34.40 | 7.73 | 5.87 |
| 8. | Boron at 5000 ppm + Molybdenum at 700 ppm. | 47.87 | 36.27 | 9.23 | 6.33 |
| 9. | Boron at 5000 ppm + Molybdenum at 800 ppm. | 48.47 | 37.07 | 9.43 | 6.80 |
| 10. | Control (Farmer Practice) 25:50:25 NPK kg/ha | 43.43 | 31.98 | 4.13 | 3.00 |
| | F-test | S | S | S | S |
| | SEm± | 0.39 | 0.53 | 0.43 | 0.25 |
| | CD (p=0.05) | 1.15 | 1.59 | 1.26 | 0.75 |

**Table 2. Effect of Boron and molybdenum on Yield parameters of Black gram.**

| S. No. | Treatments | Yield parameters | | | |
|---|---|---|---|---|---|
| | | Pods/plant | Seeds/pod | Seed yield (t/ha) | Stover yield (t/ha) |
| 1. | Boron at 3000 ppm + Molybdenum at 600 ppm. | 22.60 | 5.40 | 0.97 | 2.52 |
| 2. | Boron at 3000 ppm + Molybdenum at 700 ppm. | 23.20 | 5.60 | 1.01 | 2.56 |
| 3. | Boron at 3000 ppm + Molybdenum at 800 ppm. | 23.40 | 6.00 | 1.07 | 2.62 |
| 4. | Boron at 4000 ppm + Molybdenum at 600 ppm. | 23.60 | 6.20 | 1.13 | 2.68 |
| 5. | Boron at 4000 ppm + Molybdenum at 700 ppm. | 26.40 | 6.80 | 1.20 | 2.75 |
| 6. | Boron at 4000 ppm + Molybdenum at 800 ppm. | 27.80 | 7.20 | 1.26 | 2.81 |
| 7. | Boron at 5000 ppm + Molybdenum at 600 ppm. | 24.40 | 6.40 | 1.17 | 2.72 |
| 8. | Boron at 5000 ppm + Molybdenum at 700 ppm. | 29.20 | 7.47 | 1.36 | 2.89 |
| 9. | Boron at 5000 ppm + Molybdenum at 800 ppm. | 29.80 | 7.73 | 1.39 | 2.99 |
| 10. | Control (Farmer Practice) 25:50:25 NPK kg/ha | 22.20 | 5.20 | 0.93 | 2.48 |
| | F-test | S | S | S | S |
| | SEm± | 0.28 | 0.11 | 0.07 | 0.08 |
| | CD (p=0.05) | 0.84 | 0.33 | 0.22 | 0.25 |

**Table 3. Effect of Boron and molybdenum on Economics of Black gram.**

| S. No. | Treatments | Economics | | | |
|---|---|---|---|---|---|
| | | Cost of cultivation (INR/ha) | Gross return (INR/ha) | Net return (INR/ha) | B:C ratio |
| 1. | Boron at 3000 ppm + Molybdenum at 600 ppm. | 25935.10 | 48500 | 22564.90 | 0.87 |
| 2. | Boron at 3000 ppm + Molybdenum at 700 ppm. | 25985.10 | 50500 | 24514.90 | 0.94 |
| 3. | Boron at 3000 ppm + Molybdenum at 800 ppm. | 26035.10 | 53500 | 27464.90 | 1.05 |
| 4. | Boron at 4000 ppm + Molybdenum at 600 ppm. | 26062.60 | 56500 | 30437.40 | 1.17 |
| 5. | Boron at 4000 ppm + Molybdenum at 700 ppm. | 26112.60 | 60000 | 33887.40 | 1.30 |
| 6. | Boron at 4000 ppm + Molybdenum at 800 ppm. | 26162.60 | 63000 | 36837.40 | 1.41 |
| 7. | Boron at 5000 ppm + Molybdenum at 600 ppm. | 26190.10 | 58500 | 32309.90 | 1.23 |
| 8. | Boron at 5000 ppm + Molybdenum at 700 ppm. | 26240.10 | 68000 | 41759.90 | 1.59 |
| 9. | Boron at 5000 ppm + Molybdenum at 800 ppm. | 26290.10 | 69500 | 43209.90 | 1.64 |
| 10. | Control (Farmer Practice) 25:50:25 NPK kg/ha | 25252.60 | 46500 | 21247.40 | 0.84 |