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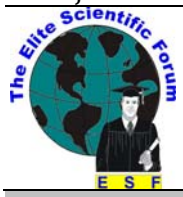


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**RESEARCH ARTICLE**

# Effect of Molybdenum on Yield and Quality of Black Gram (*Vigna mungo* L.)

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**ABSTRACT**

Molybdenum (Mo) is an effective micronutrient that plays an important role in improving the crop yield and quality. A field trial was conducted to evaluate the effect of Mo on yield and quality of black gram (*Vigna mungo* L.) (mash) at Agronomic Research Area, University of Agriculture, Faisalabad, Pakistan during spring 2012. Seed treatment with Mo (Sodium molybedate as source) at 0 (control), 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6 g $kg^{-1}$ of seed was applied. The experiment was laid out in randomized complete block design (RCBD) with three replications. The crop (mash Arooj 2010) was sown in 30 cm apart rows maintaining plant to plant distance of 10 cm with net plot size of 1.5 m x 5 m. Data on yield and quality attributes was recorded by using standard procedures. The data collected were statistically analyzed using Fisher's analysis of variance technique and the treatment's means were compared by using least significant difference test at 5% level of probability. Plant height at maturity (55.30 cm), number of nodules per plant (11.17), number of pod bearing branches (13.43), number of pods per plant (27.70), protein content (24.53%), carbohydrate content (59.53%), number of seeds per pod (10.00), pod length (6.98 cm), 1000 seed weight (40.18 g), seed yield (1049.2 kg $ha^{-1}$), biological yield (6480 kg $ha^{-1}$) and harvest index (16.67 %) were significantly higher over control in treatment (T9) where seed was treated with 4 g Mo $kg^{-1}$ of seed. The results of this study highlighted the role of Mo as seed treatment for improving the yield and quality in mashbean. It is recommended that seeds of mash bean crop may be treated with Mo to get better quality and high yield of crop under agro-ecological conditions of Faisalabad and similar areas.

## INTRODUCTION

Black gram commonly known as mashbean (*Vigna mungo* L.) is one of the most important pulse crop grown in Pakistan. It covers an area of 24.5 thousand hectare with 10.9 thousand tons of grain production having an average yield of 200 kg $ha^{-1}$ (Anonymous, 2012). It fetches premium over other pulses of the country due to being palatable, highly nutritive and easily digestible. It has wider adaptability under varying climatic conditions. It can fit in any crop rotation easily and can be grown twice a year in both spring and autumn seasons. It is used for preparation of curries and papad. Its straw is used as cattle feed and green pods are used as vegetable. It is also boiled and eaten whole or after splitting as dhal. 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/100 g), small amount of vitamin $B_1$ 0.52-0.66 (mg/100 g), vitamin $B_2$ 0.29-0.22 (mg/100 g), vitamin A 300 (IU), vitamin C 5 (mg/100 g) and niacin 2.0 (mg/100 g) (Anonymous, 2006). It is also used for treatment of diseases like diabetes, sexual dysfunction, nervous disorders, hair disease, digestive system disorders and rheumatic afflictions. Despite of all the above characteristics, it is a good substitute for animal protein. The use of nitrogenous fertilizers is limited because of high cost, poor economic condition of the farmers and non-availability of the fertilizers at proper time. So it is necessary that the use of leguminous crops should be included in our cropping system because they have the ability to enrich nitrogen in our soils to fix nitrogen from the air for improving soil productivity (Yakubu et al., 2008).

Micronutrient application through seed treatments improves the stand establishment, advances phonological

events, and increases yield and micronutrient grain contents in most cases (Farooq et al., 2012). The total amount of biological nitrogen fixed in various leguminous crops were increased when molybdenum was applied which eventually led towards better yield harvest index in leguminous crops (Yakubu et al., 2010). Molybdenum increased plant height, number of branches and pods per plant, number of seeds per plant and seed yield in lentil (Togay et al., 2008). It was found that molybdenum enhanced growth parameters, pods and seed yield in groundnut chickpea (Tripathy et al., 1999; Khanal et al., 2005; Niranjana et al., 2005). Seed priming is a simple, low cost and effective approach for enhancement of seed germination, early seedling growth and yield under stressed and on stressed conditions. Seed priming is a form of seed preparation in which seeds are pre-soaked before planting (Ahmad et al., 2012). Further, germination and seedling vigor has been reported to be enhanced by priming with polyamines in tomato cultivars (Afzal et al., 2009). Priming also reduced the incidence of stem and root diseases, and increased nodulation (Musa et al., 2001).

## MATERIALS AND METHODS

A field experiment to evaluate the effect of Molybdenum as seed treatment on yield and quality of Mashbean was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad, during spring 2012. The experiment was laid out in Randomized Complete Block design (RCBD) having three replications. Crop variety mash Arooj 2010 was used as test crop. The net plot size for each treatment was 1.5m x 5m. The experiment was comprised of following treatments:

$T_1$= No seed treatment (control), $T_2$ = 0.5 g Mo kg $^{-1}$ of seed, $T_3$ = 1.0 g Mo kg $^{-1}$ of seed, $T_4$ = 1.5 g Mo kg $^{-1}$ of seed, $T_5$ = 2.0 g Mo kg $^{-1}$ of seed, $T_6$ = 2.5 g Mo kg $^{-1}$ of seed' $T_7$ = 3.0 g Mo kg $^{-1}$ of seed, $T_8$ = 3.5 g Mo kg $^{-1}$ of seed, $T_9$ = 4.0 g Mo kg $^{-1}$ of seed, $T_{10}$= 4.5 g Mo kg $^{-1}$ of seed, $T_{11}$= 5.0 g Mo kg $^{-1}$ of seed, $T_{12}$= 5.5 g Mo kg $^{-1}$ of seed, and $T_{13}$= 6.0 g Mo kg $^{-1}$ of seed.

The properties of the experimental soil were: pH 7.5, organic matter (OM) 0.96%, available phosphorus (P) 16.7mg/L, available nitrogen (N) 0.052 mg/L, available potassium (K) 234 mg/L, available iron 3 mg/L, saturation 45%, texture loam, SAR 6.4, ESP 7 and EC 1.26 dS/m. At sowing time, fertilizer was applied to the crop @ 57 kg phosphorus ha$^{-1}$and 23 kg nitrogen ha$^{-1}$ in the form of diammonium phosphate and urea, respectively. Crop was sown on well prepared seedbed in lines with single row hand drill using seed rate of 25 kg ha$^{-1}$. The row to row and plant to plant distance was 30cm and 10cm, respectively. All other cultural practices such as hoeing, irrigation, insect pest control were kept normal for all the treatments. The data collected on various parameters was analyzed statistically by using Fisher's analysis of variances techniques and differences among treatment means were compared by using LSD at 5% probability level (Steel et al., 1997).

## RESULTS AND DISCUSSION

Plant height was affected significantly by the application of molybdenum as seed treatment. The maximum plant height (55.30 cm) was recorded in treatment ($T_9$) where seed was treated with 4 g Mo kg$^{-1}$ of seed and minimum plant height (40.83 cm) was recorded in control. Bhuiyan et al. (2008) found that application of molybdenum along with phosphorus significantly increased the plant height of mungbean as compared to control. Number of nodules per plant was significantly affected by molybdenum seed treatment. Maximum number of nodules per plant (11.17) was recorded in treatment ($T_9$) where seed was treated with 4 g Mo kg$^{-1}$ of seed and minimum number of nodules per plant (6.8) was recorded in control. Srinivasan et al. (2007) reported that under all method of application of molybdenum number of nodules per plant of mungbean increased with increasing doses of molybdenum. Number of pods bearing branches per plant was significantly affected by molybdenum seed treatment. Maximum number of pod bearing branches per plant was observed in $T_{13}$; however, this treatment was statistically at par with treatments $T_9$ to $T_{12}$. Number of pods per plant was significantly affected by molybdenum seed treatment. Maximum number of pods per plant (27.70) was recorded in treatment ($T_9$) where seed was treated with 4 g Mo kg$^{-1}$of seed and minimum number of pods per plant (16.30) was recorded in (control). Seed treated with Mo resulted an increase number of pods per plant might be due to efficient utilization of molybdenum resources in the soil. Shill et al. (2007) found that the yield and yield components like number of pods per plant, 1000-seed weight were significantly influenced due to boron and molybdenum fertilization. Carbohydrate content was significantly affected by molybdenum seed treatment. Significantly maximum carbohydrate content (59.53%) was recorded in treatment ($T_9$) where seed was treated with 4 g Mo kg$^{-1}$of seed and minimum carbohydrate content (49.30%) was recorded in (control). Rudresh et al. (2005) reported that application of micronutrient in green house experiments increased total carbohydrate content and nutrient uptake in mash bean. Protein content was significantly affected by molybdenum seed treatment. Significantly maximum protein content (24.53%) was recorded in treatment ($T_9$) where seed was treated with 4 g Mo kg$^{-1}$of seed and minimum protein content (18.63%) was recorded in control.

**Table 1: Effect of molybdenum seed treatment on yield and quality of Black gram**

| | Treatments | Plant height (cm) | Number of nodules per plant | Number of pod bearing branches | Number of pods per plant | Carbohydrate Content (%) | Protein content (%) |
|---|---|---|---|---|---|---|---|
| $T_1$ | Control(No seed treatment ) | 40.83f | 6.80f | 7.57cd | 16.30g | 49.30g | 18.63g |
| $T_2$ | 0.5 g Mo $kg^{-1}$seed | 45.53de | 7.43ef | 7.47cd | 16.60fg | 52.80f | 19.83fg |
| $T_3$ | 1.0 g Mo $kg^{-1}$seed | 44.67e | 6.93f | 7.30d | 17.43fg | 54.13ef | 19.80fg |
| $T_4$ | 1.5 g Mo $kg^{-1}$seed | 45.73cde | 7.50ef | 8.00bcd | 16.63fg | 55.50de | 19.83fg |
| $T_5$ | 2.0 g Mo $kg^{-1}$seed | 47.50cde | 8.36def | 8.03bcd | 18.56de | 57.10bcd | 20.20ef |
| $T_6$ | 2.5 g Mo $kg^{-1}$seed | 46.70cde | 9.4 1cd | 8.30bcd | 19.9d | 56.23bcd | 23.40abc |
| $T_7$ | 3.0 g Mo $kg^{-1}$seed | 49.03bcd | 9.27cd | 10.53abc | 21.26d | 55.73de | 21.70de |
| $T_8$ | 3.5 g Mo $kg^{-1}$seed | 51.96b | 10.13c | 6.93d | 23.80c | 58.00ab | 21.56de |
| $T_9$ | 4.0 g Mo $kg^{-1}$seed | 55.30a | 11.17a | 11.67a | 27.70a | 59.53a | 24.53a |
| $T_{10}$ | 4.5 g Mo $kg^{-1}$seed | 49.36bc | 8.70cde | 12.00a | 25.40bc | 57.00bcd | 22.10cd |
| $T_{11}$ | 5.0 g Mo $kg^{-1}$seed | 52.20b | 10.33bc | 10.73ab | 24.47c | 57.80abc | 22.00cd |
| $T_{12}$ | 5.5 g Mo $kg^{-1}$seed | 47.96cde | 9.73cd | 11.63a | 25.53bc | 57.23bcd | 22.33bcd |
| $T_{13}$ | 6.0 g Mo $kg^{-1}$seed | 47.33cde | 10.83ab | 13.43a | 26.20ab | 55.97cde | 23.67ab |
| | LSD (5%) | 3.79 | 1.67 | 2.19 | 2.00 | 1.97 | 0.78 |

**Table 2: Effect of molybdenum seed treatment on yield and quality of Black gram**

| | Treatments | Number of seed per pod | Pod length (cm) | 1000-seed weight (g) | Seed yield (kg $ha^{-1}$) | Biological yield (kg $ha^{-1}$) | Harvest index (%) |
|---|---|---|---|---|---|---|---|
| $T_1$ | Control(No seed treatment ) | 6.33d | 5.42e | 34.53cde | 915.1d | 5978.8f | 15.33bc |
| $T_2$ | 0.5 g Mo $kg^{-1}$seed | 8.00bc | 5.80de | 35.87cd | 959.6cd | 5988.8ef | 15.55bc |
| $T_3$ | 1.0 g Mo $kg^{-1}$seed | 7.33cd | 5.95bcde | 31.53f | 963.4bcd | 6052.2ef | 15.12bc |
| $T_4$ | 1.5 g Mo $kg^{-1}$seed | 7.67bc | 6.67abc | 33.43def | 968.9bcd | 6259.2bcbe | 15.67bc |
| $T_5$ | 2.0 g Mo $kg^{-1}$seed | 8.00bc | 5.90cde | 32.39ef | 993.2bc | 6192.7cdef | 16.33ab |
| $T_6$ | 2.5 g Mo $kg^{-1}$seed | 8.33bc | 6.87a | 33.37def | 989.1bc | 6165.1cdef | 16.00abc |
| $T_7$ | 3.0 g Mo $kg^{-1}$seed | 8.00bc | 6.60abcd | 34.89cde | 1016.4ab | 6596.4a | 15.33bc |
| $T_8$ | 3.5 g Mo $kg^{-1}$seed | 8.66bc | 6.75ab | 36.34bc | 1007.9abc | 6259.0bcdef | 16.00abc |
| $T_9$ | 4.0 g Mo $kg^{-1}$seed | 10.00a | 6.29abc | 40.18a | 1049.2a | 6344.1abcd | 16.67a |
| $T_{10}$ | 4.5 g Mo $kg^{-1}$seed | 8.67bc | 6.70ab | 38.64ab | 995.4abc | 6414.1abc | 15.00c |
| $T_{11}$ | 5.0 g Mo $kg^{-1}$seed | 8.67 b | 6.98a | 39.04ab | 993.3bc | 6366.0abcd | 15.33bc |
| $T_{12}$ | 5.5 g Mo $kg^{-1}$seed | 8.00 bc | 6.57abcd | 36.54bc | 1009.1abc | 6125.4def | 16.33ab |
| $T_{13}$ | 6.0 g Mo $kg^{-1}$seed | 8.66b | 6.67abc | 36.33bc | 997.7abc | 6480.0ab | 15.67bc |
| | LSD (5%) | 1.07 | 0.8231 | 2.7303 | 83.46 | 280.23 | 1.2439 |

These results are given in Table 1.Maximum number of seeds per pod (10.00) was recorded in treatment ($T_9$) where seed was treated with 4 g Mo $kg^{-1}$ of seed and minimum number of seeds per pod (6.33) was recorded in control. Landge et al. (2002) found that application of P and Mo led to increase the number of seeds per pod of Mungbean. Maximum pod length (6.98 cm) was recorded in treatment ($T_{11}$) where seed was treated with 5 g Mo $kg^{-1}$of seed and minimum pod length (5.42 cm) was recorded in control.

Kulsum et al. (2007) reported that application of Mo as seed treatment increased pod length in mash bean. Maximum 1000 seed-weight (40.18 g) was recorded in treatment ($T_9$) where seed was treated with 4 g Mo $kg^{-1}$of seed and minimum 1000 seed weight (31.53 g) was recorded in control. Seed treated with Mo resulted an increase in seed weight which might be due to the increase in phosphorus contents of the seed (phospholipids and phosphorus-protein) and resulted in increased seed weight because it is known that molybdenum is involved in many physiological processes in plants (Bauchot et al., 1999). Liu and Yang (2002) and Hongen et al. (2012) reported that the component 1000-seed weight was considerably promoted by the application of molybdenum. Maximum seed yield (1049.2 kg $ha^{-1}$) was recorded in the treatment ($T_9$) where seed was treated with 4 g Mo $kg^{-1}$ seed and minimum seed yield (915.1 kg $ha^{-1}$) was recorded in control. Seed treated with Mo resulted an increase in seed yield might be due to enhanced chlorophyll formation which enhances photosynthesis resulting an increase in plant attributes which ultimately increased the seed yield. Deo and Kothari (2002) cited that the seed yield was enhanced by seed treatment with 3.5 g sodium molybedate $kg^{-1}$seed. Biological yield was significantly affected by molybdenum seed treatment. Maximum biological yield (6480 kg $ha^{-1}$) was recorded in treatment ($T_{13}$) where seed was treated with 6 g Mo $kg^{-1}$of seed and minimum biological yield (5978.8 kg $ha^{-1}$) was recorded in control. Seed treated with molybdenum resulted an increase in biological yield which might be due to the increase due to improved germination and balanced growth pattern of plants. Bhuyian et al. (2008) found that application of

molybdenum and P considerably increased growth of plants, dry matter production as well as grain yield of mash bean as compared to control. Harvest index was significantly affected molybdenum seed treatment. Significantly maximum harvest index (16.67%) was recorded in treatment ($T_9$) where seed was treated with 4 g Mo $kg^{-1}$of seed and minimum harvest index (15.33%) was recorded in control. These results are given in Table 2.

**Conclusion**

The results of this study highlighted the role of molybdenum as seed treatment for improving the yield and quality in mashbean. It is recommended that the mash bean crop treated with 4 g Mo $kg^{-1}$ of seed gave better result as compared to all other treatments under agro-ecological conditions of Faisalabad and adjoining areas.

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