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# Effect of molybdenum and weed management practices on growth and yield of blackgram

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**Abstract**
A field experiment was conducted during *kharif* season of 2023 at Crop Research Farm Department of Agronomy, Naini Agricultural Institue, Sam Higginbottom University of Agriculture, Technology and Sciences, to determine "Effect of molybdenum and weed management practices on growth and yield of Blackgram". The treatments consisted of three levels of molybdenum (1, 1.5, 2 kg/ha) and weed management practices are done (hand weeding 20 and 35 DAS, pendimethalin 3.30 liters/ha). The experiment was laid out in a Randomized Block Design with 10 treatments and replication thrice. The result revealed that Treatment 9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding at 35 DAS] recorded significantly higher plant height (46 cm), maximum number of branches/plant (11.27), maximum number of nodules/plant (33.20), higher plant dry weight (13.13 g), maximum number of pods/plant (29.60), maximum number of seeds/pod (11.30), higher seed yield (1.87 t/ha), higher stover yield (4.02 t/ha), highest weed control efficiency (74%) and highest weed control index (93.3%). The aforesaid treatment also recorded maximum gross return (INR 117024.00), net return (INR 77525.5) and B:C ratio (1.96).

**Keywords:** Molybdenum, pendimethalin, growth, yield, economics

## 1. Introduction

Blackgram output makes up around 10% of India's total pulse production. Globally, pulses covers an area of 959.68 lakh hectares with the production of 973.92 lakh tons with the productivity of 1015 kg/ha (FAO, 2022). In India, blackgram is grown over an area about 48.38 lakh hectares with a production of 27.28 lakh tons and productivity of 564 kg/ha. During 2022 total area coverage under blackgram in Uttar Pradesh 5.72 lakh hectares with a production of 2.99 lakh tons and the productivity 522 kg/ha (GOI, 2022) [7].

In some crops, especially pulses and cauliflowers, there are very characteristic molybdenum deficiency symptoms. In others it is not always possible to diagnose with certainty whether a plant or a crop is suffering from a low supply of molybdenum. The best way to find out is to apply a solution of sodium molybdate or ammonium molybdate to the leaves of the plants or to the soil at their base, and see whether there is any response. This would be in the form of improved growth or development of a healthy leaf colour, compared with similar, untreated plants.

The cure is, in most soils, molybdenum present in an unavailable form will be released by applying lime or dolomite. The effect of liming on molybdenum availability is slow and it may take several months to correct the deficiency. The amounts of lime or dolomite needed may range from 2 to 8 tonnes per hectare, depending on initial pH of the soil and whether it is sandy or heavy textured. Unless lime is likely to be beneficial for other reasons, it is quicker and cheaper to apply a molybdenum compound to the soil or to the crop. Where one of the molybdenum compounds is used, the quantities recommended vary from 75 g to 1 kg/ ha depending on the crop and the molybdenum material. Molybdenum can be applied in many ways like mixed with fertilizer, or in solution, to seedlings in the seedbed before transplanting, the leaves of plants in the field, or to the soil at the base of plants in the field.

According to Karraja *et al*., (2023) [10] molybdenum is a crucial component for plant growth, contributing to cell wall and membrane structure, protein synthesis, and nitrogen fixation.

Legume also plays a function in symbiotic nitrogen fixation. Nitrogenase is a molybdenum-based enzyme responsible for nitrogen fixation. Nitrogen fixation requires this element in sufficient proportions. It is required for nitrate reductase, an enzyme that converts $NO_3^-$ to $NO_2$. It is a structural component of the nitrogenase enzyme, which aids bacteria in the root nodules of leguminous plants in fixing atmospheric nitrogen. Molybdenum is important for atmospheric nitrogen fixing. Molybdenum is a cofactor for enzymes that aid in redox reactions, such as converting nitrates to ammonia before producing amino acids and proteins in plant cells. It helps produce ascorbic acid and stimulates dehydrogenases and phosphatases. Sastry *et al.*, (2023) [18].

Farmers typically utilise hand weeding, which is labour intensive, time consuming and less cost effective during rainy seasons. Pre emergence herbicides only control weeds for a limited time, and late emerging weeds then compete with crops. To prevent weed competition, it may be necessary to employ pre-emergence herbicides to control early emerging weeds and post emergence herbicides sequentially to control late emerging weeds. This study aimed to assess the efficacy of herbicides, specifically a ready-mix combination of pre and post-emergence herbicides, for managing broad spectrum weeds in *Kharif* black gram. Dhayal *et al*., (2022) [2].

In developed agricultural systems, herbicides have replaced mechanical weed control methods. Unavailability of labour during weeding causes severe field infestation, making mechanical weeding ineffective, time-consuming, and expensive. Chemical weed control may be the most cost-effective option for this crop. Using a proper herbicide rate can effectively manage weeds and potentially replace traditional approaches. Minimizing weed development during crop competition can result in crop yields comparable to weed-free crops. Effective weed management is crucial during crop competitiveness. Deshmukh *et al*., (2018) [5].

Weeds can be controlled using numerous approaches, including cultural, manual, mechanical, biological, and chemical. Weeding can be laborious and time-consuming, both manually and mechanically. Labours are often unavailable during peak weeding periods. Even if they are accessible, the rising cost of labour further limits their options. Cultural weed management methods, such as crop rotation, stale seed beds, limited tillage, and soil solarization, require long-term preparation. Chemical weed management is cost-effective and effective in reducing weed infestations over the time. However, it requires careful application of the appropriate herbicide, dosage, and time frame. Seasonal weed management in blackgram can effectively control succeeding mustard in winter seasons. Herbicides with long-term persistence in soil can minimize weed infestation in subsequent crops. Unwanted herbicides can cause lingering dangers in soil and induce harm to humans and animals, depending on the crop, application technique, and dose. Pankaj *et al.* (2017) [17].

Weeding by hand can be time-consuming and expensive. Integrated weed management, including human weeding, herbicides, and various planting methods, might be more cost-effective and beneficial. High rainfall can lead to water stagnation, yellowing, and increased weed competition, resulting in lower blackgram production. Typically, crops are sown in flat fields. The current experiment aims to test the possibility of growing blackgram on ridges and raised beds with practically the necessary spacing. The purpose of this study was to evaluate the effectiveness of pendimethalin on blackgram plantation methods, including standard, raised bed, and ridge systems. Kumar and Angiras (2018) [8]. Keeping in view of the above fact, the experiment was conducted to find out "Effect of molybdenum and weed management practices on growth and yield of Blackgram".

## 2. Materials and Methods

The experiment was conducted during *kharif* season 2023 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of the experimental field was sandy loam in texture, with neutral soil (pH 7.8), low level of organic carbon (0.62%), available N (225 Kg/ha), P (38.2 kg/ha), K (240.7 kg/ha) and zinc (2.32 mg/kg). The treatment consists of three levels of molybdenum (1,1.5,2 kg/ha) and weed management practices are done (hand weeding 20 and 35 DAS, pendimethalin 3.30 liters/ha). The experiment was laid out in RBD with 10 treatments each replicated thrice. The treatment combinations are $T_1$ - Molybdenum (1.0 kg/ha) + Hand weeding (20 DAS) and (35 DAS), $T_2$ - Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha), $T_3$ - Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS), $T_4$ - Molybdenum (1.5 kg/ha) + Hand weeding (20 DAS) and (35 DAS), $T_5$ - Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha), $T_6$ - Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS), $T_7$ - Molybdenum (2.0 kg/ha) + Hand weeding (20 DAS) and (35 DAS), $T_8$ - Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha), $T_9$ - Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS), T10 - Control (RDF) – 20:40:20 (N:P:K) kg/ha. Data recorded on different aspects of crop, *viz.*, growth, weed management practices, yield attributes and yield were subjected to statistically analysed by analysis of variance method as described by Gomez and Gomez (1976) [6].

## 3. Result and Discussion

### 3.1 Growth Attributes

#### 3.1.1 Plant height (cm)

The data revealed that significantly higher plant height (46 cm) was observed in the treatment 9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. However, treatment 3 [Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)], treatment 6 [Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)] and treatment 8 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha)] were found to be statistically at par with treatment 9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. Significant and higher plant height was observed with the application of molybdenum might be due to its important function as a promoter of cell division and as an agent in the induction and development of its meristematic tissues. Similar results were also reported by Karraja *et al*. (2023) [10]. Further, the higher plant height observed with the application of pendimethalin along with hand weeding may be due to more effective weed control measures that reduce the competition between weeds and the primary crop for resources, such as light, nutrients, and moisture by reducing crop weed competition hence improved overall crop growth particularly plant height. Similar findings were also observed by Dhayal *et al.* (2022) [2].

#### 3.1.2 Number of branches/plant

Significant and maximum number of branches/plant (11.1) was resulted in treatment-9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. However, treatment 3 [Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)] and treatment 6 [Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)] were found to be statistically at par with treatment 9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. Significantly and maximum number of branches/plant was observed with the application of molybdenum might be due the fact that it is a structural element of nitrogenase, an enzyme that is actively involved in nitrogen fixation by root nodule bacteria of leguminous crops, may account for the improvement in number of branches/plant. These findings were similar with Mahilane and Singh. (2018) [15, 16]. Further, significantly maximum number of branches/plant observed with the application of pendimethalin along with hand weeding may be due to weed-free conditions, giving crops a competitive advantage in utilizing humidity, vitamins, sunlight, and space. The present findings are within the close proximity of Taku *et al.* (2023) [22].

### 3.1.3 Number of nodules/plant

Significant and maximum number of nodules/plant (33.2) was observed significant and maximum treatment-9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. However, treatment 3 [Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)], treatment 6 [Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)] and treatment 7 [Molybdenum (2.0 kg/ha) + Hand weeding (20 DAS) and (35 DAS)] were found to be statistically at par with treatment 9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)].

Significant and maximum number of nodules/plant was observed with the application of molybdenum might be due to fact that nitrogenase enzyme which is essential for the symbiotic nitrogen fixation process also nitrate reductase is like a molecular enzyme in plants which converts nitrate into ammonia, it is essential step in assimilation of nitrogen in plants. These results were in conformity with those of Sastry and Dawson (2023) [18]. Further, significant and maximum number of nodules/plant observed with the application of pendimethalin along with hand weeding may be due to decreased weed ability to compete with the crop, which finally favoured a better environment for the crop growth and development. The present findings are within the close proximity of Deshmukh *et al.* (2018) [5] in greengram.

### 3.1.4 Plant dry weight (g)

Results revealed that significantly higher plant dry weight (13.13g) was observed in treatment-9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. However, treatment 3 [Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)], treatment 7 [Molybdenum (2.0 kg/ha) + Hand weeding (20 DAS) and (35 DAS)], treatment 6 [Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)] was found to be statistically at par with treatment 9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS The significant and higher plant dry weight was observed with the application of molybdenum may be due to better cell division, elongation, amino acid and protein synthesis, as well as greater expression of numerous crop development qualities and a rise in plant dry weight. These results are in agreement with finding of Kumbam *et al*. (2021) [11]. Further, significant and higher plant dry weight was recorded with the application of pendimethalin along with hand weeding may be due to effective weed management which involves techniques that reduce competition between weeds and the main crop for essential resources like light nutrients and water which resulted in overall improvement of crop growth particularly in plant dry weight. These findings were similar to Katoch *et al*. (2023) [12] in greengram.

### 3.1.5 Crop Growth Rate (g/m$^2$/day)

The data recorded during 60-80 DAS; Highest crop growth rate (9.03 g/m$^2$/day), was observed in treatment 9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)].

### 3.1.6 Relative Growth Rate (g/g/day)

The data revealed that during 60-80 DAS, treatment 2 [Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha)] recorded significantly higher Relative Growth Rate (0.0378g/g/day), though there was no significant difference among the treatments.

## 3.2 Yield and Yield Parameters

### 3.2.1 Number of pods/plant

Treatment-9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)] recorded significant and maximum number of pods/plant (29.60). However, treatment 3 [Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)], treatment 6 [Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)] and treatment 7 [Molybdenum (2.0 kg/ha) + Hand weeding (20 DAS) and (35 DAS)] were found to be statistically at par with treatment 9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. Significant and maximum number of pods/plant was with the application of molybdenum might be due to its vital role in the regulation of numerous plant physiological processes, as well as being an essential component of several enzymes involved in the metabolism of nitrogen and carbohydrates. These findings are in accordance with the findings of Karraja *et al.* (2023) [10]. Further, significant and maximum number of pods/plant was with the application of pendimethalin along with hand weeding might be due to preventing weeds to develop throughout the growing period of the crops can lead to a more lavish growth of the crop itself which can result in additional branches, blossoms, and green pods, ultimately increasing the overall yield of pods/plant. These results are in agreement with finding of Supriya *et al*. (2023) [14].

### 3.2.2 Number of seeds/pod

Significantly higher number of seeds/pod (11.27) was observed in treatment-9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. However, treatment 3 [Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)], treatment 6 [Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)] and treatment 8 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha)] were found to be statistically at par with treatment 9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. The significant and higher number of seeds/pod was with the application of molybdenum is due to it's active involvement in controlling the production and function of the nitrogenase enzyme, which is responsible for nitrogen fixation in urdbean. The result was in corroboration with Mahilane *et al.* (2028) [15, 16]. Further, increase in seeds/pod was obtained with the application of pendimethalin along with hand weeding might be due to improved translocation and distribution of photosynthesis from source to sink, which, in turn, results in effective control of weeds allowing the crop plants to receive adequate space, maximum light interception, moisture, and nutrient absorption. The results of present investigation are in line with those of Tiwari *et al.* (2020) [19].

### 3.2.3 Test weight (g)

Statistically highest test weight (33.20g) was found in Treatment-7 [Molybdenum (2.0 kg/ha) + Hand weeding (20 DAS) and (35

DAS)], though there is no significant difference found among all the treatments.

### 3.2.4 Seed yield (t/ha)
Significant and higher Seed Yield (1.87 t/ha) was recorded in treatment-9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. However, treatment 8 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha)] was found to be statistically at par with treatment 9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. Significant and higher seed yield was obtained with the application of Molybdenum may be due to improved plant growth and metabolism, which boosts crop yield by improving nutrient uptake, ultimately leading to higher seed production. The present findings are closely followed by the results of Kaniki *et al*. (2023) [9]. Further, significant increase in seed yield was with the application of pendimethalin along with hand weeding might be due to higher absorption of N, P and K, as the crop plants produced greater surface area for a higher photosynthetic rate and maximal translocation of photosynthates from where they're produced to where they're needed, resulting in improved seed yield. The present findings are within the close proximity of Chavan *et al*. (2018) [3] in pigeonpea.

### 3.2.5 Stover yield (t/ha)
Significant and higher strover yield (1.87 t/ha), was found in treatment-9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. However, treatment 5 [Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha)], treatment 6 [Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)], treatment 7 [Molybdenum (2.0 kg/ha) + Hand weeding (20 DAS) and (35 DAS)] and treatment 8 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha)] were found to be statistically at par with treatment 9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. Significant and higher stover yield was obtained with the application of molybdenum may be due increased sugar transport, enhanced microbial survival and multiplication, and improved plant uptake and assimilation of available nutrients throughout their entire growth period. Similar results were reported by Anand *et al*. (2018) [1]. Further, significant increase in stover yield was with the application of pendimethalin along with hand weeding might be due to successful weed control methods that reduces inter crop-weed competition, preventing plants from moisture or nutrient stress conditions, which favours in optimal soil environment, with a superior supply of water and nutrients, leading to better yield quality and ultimately higher stover yield. In close conformity with the current result of (Singh and Lal 2022) [21].

### 3.2.6 Harvest Index (%)
Statistically highest harvest index (32.1 %) was recorded in treatment-8 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha)]. Though, there is no significant difference found among all the treatments.

### 3.2.7 Weed Population
Significantly lowest weed population (7.8) was recorded in treatment-9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)], and is found statistically significant as compared to rest of the treatments. Significant and lowest weed population was with the application of pendimethalin along with hand weeding as it works by slowing down the growth of weed seedlings because it interferes with their ability to divide cells and elongate, essentially stunting their growth. It is in close conformity with the current results of Mansoori *et al*. (2013) [15].

### 3.2.8 Weed dry weight (g)
At 80 DAS, significantly lowest weed dry weight (0.6g) was recorded in treatment-9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. However, treatment 3 [Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)] and treatment 6 [Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)] were found to be statistically at par with treatment 9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)]. Significant and lowest weed dry weight was with the application of pendimethalin along with hand weeding at 20 and 35 DAS effectively kept the field free from weeds for a longer time which happened due to loosening of soil and better aeration around the crop root zone accelerated its growth, leading to fewer weeds and hence less weed dry weight. Similar results were reported by Shashidhar *et al*. (2020) [20].

### 3.2.9 Weed control efficiency (%)
At 80 DAS, statistically highest weed control efficiency (74%) was observed in treatment 9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)] as compared to other treatments. Highest weed control efficiency was observed with the application of pendimethalin along with hand weeding might be due to regular weed removal by hand weeding, hand hoeing, or herbicidal treatment, which led to a significant decline in the number of weeds and eventually a decrease in the overall dry weight of weeds. It is in close conformity with the current results of Chaudhari *et al*. (2016) in greengram.

### 3.3 Weed Control index (%)
At 80 DAS, statistically highest weed control index (93.3%) was observed in treatment-9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)] as compared to other treatments. Highest weed control index was with the application of pendimethalin along with hand weeding as it initially stopped the first wave of weed growth, and, later on, manual weeding took care of any weeds that managed to sprout afterwards. It is in close conformity with the current results of Mansoori *et al*. (2013) [15].

### 3.4 Economics
The result showed that Maximum gross return (117024.00INR/ha), higher net return (77525.5 INR/ha) and highest benefit cost ratio (1.96) was recorded in treatment 9 [Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS)] as compared to other treatments. Maximum benefit cost ratio was recorded with the application of Molybdenum might be due to the fact that after harvesting black gram, it is analyzed that how much money is made by selling it, considering the market prices, which, in turn, showed that as the yield increased, so did the profit, which is a good sign. Similar results were also reported by Sastry *et al*. (2023) [18]. Further, higher B:C ratio was with the application of pendimethalin along with hand weeding may be due to cost of input used in comparison to crop profitability, to figure out, whether growing black gram was worth it financially. These findings are similar to those of Taku *et al*. (2023) [22].

**Table 1:** Effect of molybdenum and weed management practices on growth attributes of blackgram.

| S No | Treatments | Plant height (cm) | Number of Branches/ plant | Number of Nodules/ plant | Plant dry weight (g) | CGR ($g/m^2/day$) | RGR (g/g/day) |
|---|---|---|---|---|---|---|---|
| 1. | Molybdenum (1.0 kg/ha) + Hand weeding (20 DAS) and (35 DAS). | 32.60 | 6.93 | 20.53 | 9.30 | 7.27 | 0.0316 |
| 2. | Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha). | 33.67 | 7.60 | 22.33 | 9.00 | 7.92 | 0.0378 |
| 3. | Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS). | 43.87 | 10.30 | 30.93 | 11.37 | 7.12 | 0.0234 |
| 4. | Molybdenum (1.5 kg/ha) + Hand weeding (20 DAS) and (35 DAS). | 37.67 | 8.40 | 25.00 | 9.90 | 7.44 | 0.0297 |
| 5. | Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha). | 38.50 | 8.47 | 25.60 | 9.67 | 7.23 | 0.0300 |
| 6. | Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS). | 45.00 | 10.37 | 31.80 | 12.17 | 8.28 | 0.0260 |
| 7. | Molybdenum (2.0 kg/ha) + Hand weeding (20 DAS) and (35 DAS). | 41.23 | 9.67 | 29.93 | 11.43 | 8.04 | 0.0276 |
| 8. | Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha). | 42.53 | 9.67 | 27.87 | 10.37 | 8.82 | 0.0361 |
| 9. | Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS). | 46.03 | 11.07 | 33.20 | 13.13 | 9.03 | 0.0264 |
| 10. | Control (RDF) – (Unweeded) | 36.67 | 7.73 | 24.07 | 10.37 | 7.63 | 0.0263 |
| | F-test | S | S | S | S | NS | NS |
| | SEm(±) | 1.15 | 0.29 | 1.10 | 0.68 | 1.26 | 0.0041 |
| | CD (P=0.05) | 3.42 | 0.87 | 3.28 | 2.01 | -- | -- |

**Table 2:** Effect of molybdenum and weed management practices on yield attributes and yield of blackgram.

| S No | Treatments | Number of pods/ plant | Number of Seeds/ Pod | Test Weight (g) | Seed yield (t/ha) | Stover yield (t/ha) | Harvest index (%) |
|---|---|---|---|---|---|---|---|
| 1. | Molybdenum (1.0 kg/ha) + Hand weeding (20 DAS) and (35 DAS). | 21.60 | 9.00 | 30.0 | 1.23 | 3.31 | 26.92 |
| 2. | Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha). | 22.00 | 9.20 | 29.40 | 1.33 | 3.25 | 28.75 |
| 3. | Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS). | 29.00 | 11.00 | 28.60 | 1.37 | 3.44 | 28.29 |
| 4. | Molybdenum (1.5 kg/ha) + Hand weeding (20 DAS) and (35 DAS). | 23.34 | 10.00 | 31.80 | 1.49 | 3.56 | 29.55 |
| 5. | Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha). | 24.20 | 10.20 | 31.20 | 1.53 | 3.60 | 29.82 |
| 6. | Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS). | 29.28 | 11.20 | 30.80 | 1.56 | 3.63 | 29.92 |
| 7. | Molybdenum (2.0 kg/ha) + Hand weeding (20 DAS) and (35 DAS). | 27.60 | 9.40 | 33.20 | 1.62 | 3.72 | 30.37 |
| 8. | Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha). | 26.20 | 10.63 | 32.60 | 1.79 | 3.78 | 32.05 |
| 9. | Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS). | 29.60 | 11.30 | 31.00 | 1.87 | 4.02 | 31.77 |
| 10. | Control (RDF) – (Unweeded) | 23.00 | 9.80 | 30.87 | 1.27 | 3.50 | 26.72 |
| | F-test | S | S | NS | S | S | NS |
| | SEm (±) | 0.74 | 0.31 | 1.28 | 0.13 | 0.14 | 1.81 |
| | CD (P=0.05) | 2.21 | 0.93 | -- | 0.18 | 0.42 | -- |

**Table 3:** Effect of molybdenum and weed management practices on weed observations of blackgram.

| S No | Treatments | Weed population (Numbers/$m^2$) | Weed dry weight (g) | Weed control efficiency * (%) | Weed control index * (%) |
|---|---|---|---|---|---|
| 1. | Molybdenum (1.0 kg/ha) + Hand weeding (20 DAS) and (35 DAS). | 27.33 | 8.46 | 8.10 | 13.53 |
| 2. | Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha). | 19.67 | 5.35 | 33.90 | 45.83 |
| 3. | Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS). | 9.73 | 1.43 | 67.37 | 86.67 |
| 4. | Molybdenum (1.5 kg/ha) + Hand weeding (20 DAS) and (35 DAS). | 25.00 | 7.64 | 15.93 | 20.57 |
| 5. | Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha). | 17.67 | 5.10 | 40.63 | 48.63 |
| 6. | Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS). | 9.33 | 1.90 | 68.70 | 81.80 |
| 7. | Molybdenum (2.0 kg/ha) + Hand weeding (20 DAS) and (35 DAS). | 22.93 | 7.39 | 22.93 | 23.37 |
| 8. | Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha). | 17.60 | 5.09 | 40.87 | 48.67 |
| 9. | Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS). | 7.80 | 0.64 | 73.97 | 93.33 |
| 10. | Control (RDF) – (Unweeded) | 29.73 | 9.90 | 0.00 | 0.00 |
| | F-test | S | S | -- | -- |
| | SEm(±) | 0.19 | 0.54 | -- | -- |
| | CD (P=0.05) | 0.58 | 1.63 | -- | -- |

(*) Data was not subjected to statistical analysis.

**Table 4:** Effect of molybdenum and weed management practices on economics of blackgram.

| S. No | Treatments | Total cost of cultivation (INR/ha) | Gross Returns (INR/ha) | Net Returns (INR/ha) | B:C ratio |
|---|---|---|---|---|---|
| 1. | Molybdenum (1.0 kg/ha) + Hand weeding (20 DAS) and (35 DAS). | 36518.48 | 77772.00 | 41253.50 | 1.13 |
| 2. | Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha). | 38498.48 | 83700.00 | 45201.50 | 1.17 |
| 3. | Molybdenum (1.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS). | 38498.48 | 86328.00 | 47829.50 | 1.24 |
| 4. | Molybdenum (1.5 kg/ha) + Hand weeding (20 DAS) and (35 DAS). | 37018.48 | 93672.00 | 56653.50 | 1.53 |
| 5. | Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha). | 38998.48 | 96120.00 | 57121.50 | 1.46 |
| 6. | Molybdenum (1.5 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS). | 38998.48 | 97956.00 | 58957.50 | 1.51 |
| 7. | Molybdenum (2.0 kg/ha) + Hand weeding (20 DAS) and (35 DAS). | 37518.48 | 101664.00 | 64145.50 | 1.71 |
| 8. | Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha). | 39498.48 | 111936.00 | 72437.50 | 1.83 |
| 9. | Molybdenum (2.0 kg/ha) + Pendimethalin (3.30 l/ha) + Hand weeding (35 DAS). | 39498.48 | 117024.00 | 77525.50 | 1.96 |
| 10. | Control (RDF) – (Unweeded) | 38127.18 | 80400.00 | 42272.80 | 1.11 |

## Conclusion
From the results, it is concluded that in Blackgram (treatment 9), combination of Molybdenum (2.0 kg/ha) and Pendimethalin (3.30 l/ha) along with hand weeding (35 DAS) recorded highest seed yield and benefit cost ratio.

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## References
1. Anand A, Umesha C, Kumar SL. Effect of Phosphorous and Molybdenum on Yield and Economic of Black gram (*Vigna mungo* L.) The Pharma Innovation Journal. 2018;11(5):1417-1420.
2. Dhayal S, Yadav SL, Baldev R, Sharma A. Effect of herbicides on associated weeds and growth of blackgram. Indian Journal of Weed Science. 2022;54(2):203-207.
3. Chavan AS, Raj VC, Waghmare PK. Residues Studies of Pendimethalin and Other Herbicides in Pigeon pea Field Through Bioassay Technique. International Journal of Current Microbiology and Applied Sciences. 2018;6:1866-1873.
4. Chaudhari VD, Desai LJ, Chaudhari SN, Chaudhari PR. Effect of Weed Management on Weeds, Growth and Yield of Summer Greengram (Yield of Summer Greengram (*Vigna radiata* L.). An International Quarterly Journal of life sciences. 2016;11(1):531-534.
5. Deshmukh DD, Gokhale DN, Deshmukh VA, Kote GM. Effect of Weed Management on Growth and Yield of Green Gram (*Vigna radiata* L.). International Journal of Current Microbiology and Applied Sciences. 2018;6:2319-7692.
6. Gomez KA, Gomez AA. Three or more factor experiment. (In:) Statistical Procedure for Agricultural research 2nd ed.; c1976. p. 139-141.
7. GOI. Agricultural statistics at glance: Ministry of agriculture, Government of India; c2022. http://www.agricoop.nic.in
8. Kumar S, Angiras NN. Effect of Weed Management on Growth and Yield of Green Gram (*Vigna radiata* L.). International Journal of Current Microbiology and Applied Sciences. 2018;6:2319-7692.
9. Reddy K, Thulasi K, Victor D, Reddy S, Kumar P. Influence of Sulphur and Foliar Application of Molybdenum on Growth and Yield of Summer Cowpea (*Vigna unguiculata* L.). 2023;13(6):2.
10. Karraja, Kathyayani, Singh R, Chhetri P. Effect of Levels of Boron and Molybdenum on Growth and Yield of Blackgram (*Vigna mungo* L.). International Journal of Current Microbiology and Applied Sciences. 2023;10(2):339-345.
11. Kumbam M, Umesha C, Budige K, Rodda S, Swetha A, Priyadharshini. Performance of phosphorus and molybdenum levels on growth and economics of blackgram (*Vigna mungo* L.). The Pharma Innovation Journal. 2021;10(7):867-869.
12. Katoch A, Singh B, Choudhary R, Kartikeya S, Sood A. Effect of Different Weed Management Practices on Growth Characters of Mungbean under Mid-Hills of Himachal Pradesh, India. International Journal of Environment and Climate Change. 2023;13(11):574-582.
13. Nazma M, Bhadauria N, Rajput RL. Effect of weed control practices on weeds and yield of black gram (*Vigna mungo*). Legume Research. 2015;38(6):855-857.
14. Muduli S, Patel VJ, Chaudhari DD, Patel AP. Efficacy of Herbicides against Complex Weed Flora and Yield of Summer Blackgram (*Vigna mungo* L.). International Journal of Plant & Soil Science. 2023;35(18):2211-2218.
15. Chhatrapati M, Singh V. Effect of zinc and molybdenum on growth, yield attributes, yield and protein in grain on summer black gram (*Vigna mungo* L.). International journal of current microbiology and applied sciences. 2018;7(1):1156-1162.
16. Chhatrapati M, Singh V. Effect of zinc and molybdenum on growth, yield attributes, yield and protein in grain on summer black gram (*Vigna mungo* L.). International journal of current microbiology and applied sciences. 2018;7(1):1156-1162.
17. Chandra PS, Kumar DP. Weed Management in Black Gram (*Vigna mungo* L.) and Residual Effect of Herbicides on Succeeding Mustard (*Brasica juncea* L.) International Journal of Current Microbiology and Applied Sciences. 2017;6(11):865-881.
18. Sunayan SY, Joy D. Influence of Sulphur and Molybdenum on Growth and Yield of Black Gram (*Vigna mungo* L.). International Journal of Environment and Climate Change. 2023;13(9):2714-2720.
19. Sruthi DSVS, Singh S, Tiwari D, Kavya P. Effect of foliar spray of nutrient and plant growth regulators on growth and yield of greengram (*Vigna radiata* L.). The Bioscan. 2020;15(2):253-256.
20. Shashidhar KS, Samuel J, Premaradhya M, Singh A, Kumar N, Bhuvaneswari S. Weed management effect in blackgram under acidic soils of Manipur. Indian Journal of Weed Science. 2020;52(2):147-152.
21. Singh N, Lal M. Response of different weed management practices on growth and yield of black gram (*Vigna mungo* L.) under irrigated conditions of Punjab. The Pharma

Innovation Journal. 2022;11(12):2425-2429.
22. Taku A, Tzudir L, Kumari S, Nongmaithem D. Weed Management Strategies in Summer Blackgram (*Vigna mungo* L. Hepper) Grown in Sandy Loam Soils of Western Nagaland. Biological Forum – An International Journal. 2023;15(2):719-723.
23. Kumar TD, Chaturvedi DP, Singh T, Kumar YT, Prachi A. Effect of nitrogen and Sulphur levels on growth, yield and quality of maize (*Zea mays* L.) The Pharma Innovation Journal. 2022;11(1):418-422.