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# Influence of Nitrogen and Weed Management Practices on Yield and Economics of Blackgram (*Vigna mungo* L.)

**Samprikta Priyadarshini [a++*] and Rajesh Singh [a#]**

*[a] Department of Agronomy, Naini Agricultural institute, Sam Higginbottom University of Agriculture(SHUATS), Technology and Sciences, Prayagraj 211007, Uttar Pradesh, India.*

***Authors' contributions***

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## ABSTRACT

In *Kharif* 2022, a research study was conducted at Crop Research Farm, SHUATS, Prayagraj to investigate the "Influence of nitrogen and weed management practices on yield and economics of Blackgram (*Vigna mungo* L.)". The study included three levels of nitrogen (15, 30, and 45 kg/ha) and three weed management practices (hand weeding twice at 20 and 40 DAS, Pendimethalin pre-emergence at 5 DAS, and Imazethapyr post-emergence at 25 DAS). The experiment was designed using a randomized block design with 10 treatments, each replicated thrice. The results indicated that the higher pods/plant (32.13), seeds/pod (8.20), grain yield (1223.33 kg/ha), stover yield

[++] *M.Sc. Scholar;*
[#] *Associate Professor;*
**Corresponding author: E-mail: sampriktapriyadarshini20@gmail.com;*

(2472.67 kg/ha), lower weed population/$m^2$ (4.06), gross returns (83109.00), net returns (55489.05), and benefit-cost ratio (2.01) were observed in treatment 9, which involved the application of 45 kg/ha nitrogen and 75 g/ha Imazethapyr post-emergence.

*Keywords: Blackgram; nitrogen; pendimethalin, imazethapyr; yield attributes, economics.*

## 1. INTRODUCTION

Black gram, also known as *Vigna mungo* L., is a significant pulse crop in both Bangladesh and India, with approximately 12.55% of all pulse production and 70,000 ha of cultivated area coverage. It is a nutrient-dense legume, containing carbohydrates, protein, calcium, iron, fat, riboflavin, and thiamine [1]. However, the productivity of black gram is often constrained by weeds, particularly during the *kharif* season. To address this issue, increasing crop density is an alternative strategy to shift the competition towards the crop's favor, especially since black gram occupies 3.25 million hectares of land, with a total annual production of 1.54 million tonnes in India. In India during Vanakalam Kharif 2022-23, as on 30th September 2022 black gram area is up by 3.47 % at 39.6 lakh ha (97.85 lakh acres) as against 38.27 lakh ha (94.57 lakh acres) last year. The total production are in Uttar Pradesh state (6.991 lakh/ha.) [2]. The continuous rainfall during the season makes manual weeding infeasible. However, excessive use of herbicides can lead to environmental pollution and may also result in weeds developing resistance to the chemicals. Increasing the crop density appears to be a viable alternative, as it can shift the competition in favour of the crop, thereby reducing the weed population.

Nitrogen fertilization plays a crucial role in enhancing soil fertility and augmenting crop productivity by increasing grain yield and biomass [3]. The estimation of the weed seed bank is an additional approach to gain insight into the potential future weed infestation and to enhance control measures [4]. Nevertheless, this method appears to be laborious and costly. Hence, the utilization of chemical herbicides as a means of managing weed populations is a viable and appropriate alternative [5]. To achieve high yields in blackgram cultivation, it is essential to remove weeds at the appropriate time using suitable methods. Hand weeding has been suggested as an effective method by Chand et al. [6]. However, Pendimethalin, a pre-emergence herbicide, is commonly used to manage weeds, although it may not be effective against some perennial sedges and broad-leaved weeds, and can cause weeds to switch to having broad leaves with regular usage. Imazethapyr, a post-emergence herbicide, is applied to control late-blooming weeds, but its longer half-life duration can also affect subsequent grain harvests.

"Many herbicides are available in the market for effective weed control in blackgram crop, including imazethapyr. Imazethapyr is currently considered a very effective post-emergence herbicide for controlling broad leaf and some grassy weeds in blackgram. However, its efficacy has not been tested in combination with other herbicides for wide-spectrum weed control in blackgram", as reported by Verma and Choudhary [7]. "In rainfed conditions, if weeds have not yet germinated, Pendimethalin may be effective when applied after the first shower. However, the appropriate weed management practice may vary depending on the specific weed species present and the local climatic conditions" [8]. Keeping in view the above facts, the present experiment was undertaken to find out "Influence of nitrogen and weed management practices on yield and economics of Blackgram (*Vigna mungo* L.)".

## 2. MATERIALS AND METHODS

A field experiment was conducted during the *kharif* season of 2022 at the CRF, Department of Agronomy in SHUATS, Prayagraj. The location of the experiment was 25° 24' 42" N latitude, 81° 50' 56" E longitude, and 98 m altitude over the mean sea level. The experiment aimed to investigate the effect of nitrogen and weed management practices on the growth and yield of blackgram (*Vigna mungo* L.). The experimental design was a Randomized Block design with ten treatments, which was replicated three times. each plot was 9 $m^2$ or 3m×3m size. The recommended dose of Potash (20 kg/ha) *via* Muriate of Potash and Phosphorus (40 kg/ha) *via* DAP were applied in combination. The treatments combination are T1: Nitrogen (15 kg/ha) + Hand weeding twice (20 & 40 DAS), T2: Nitrogen (15 kg/ha) + Pendimethalin (0.75 ml/ha) Pre-emergence, T3: Nitrogen (15 kg/ha) + Imazethapyr (75 g/ha) Post-emergence, T4:

Nitrogen (30 kg/ha) + Hand weeding twice (20 & 40 DAS), T5: Nitrogen (30 kg/ha) + Pendimethalin (0.75 ml/ha) Pre-emergence, T6: Nitrogen (30 kg/ha) + Imazethapyr (75 g/ha) Post-emergence, T7: Nitrogen (45 kg/ha) + Hand weeding twice (20 & 40 DAS), T8: Nitrogen (45 kg/ha) + Pendimethalin (0.75 ml/ha) Pre-emergence, T9: Nitrogen (45 kg/ha) + Imazethapyr (75 g/ha) Post-emergence, T10: Control plot (RDF). At harvesting maturity, the blackgram crop was harvested at 60 DAS, and plant height (cm) and dry weight accumulation g/plant were recorded for five randomly selected representative plants from each plot of each replication. Seeds were harvested from each plot, dried under the sun for three days, winnowed and the seed yield per hectare was calculated and expressed in kg/hectare. The Stover production from each plot was measured and expressed in kg/hectare after ten days of drying in the sun. The data was analysed using statistical analysis. The benefit: cost ratio was recalculated after replacing the seed value with stover and including the overall cost of crop cultivation. All agronomic practices are followed in order in the crop period. “Experimental data collected was subjected to statistical analysis by adopting Fisher’s method of analysis of variance (ANOVA) as outlined by Gomez and Gomez [9]. Critical Difference (CD) values were calculated wherever the ‘F’ test was found significant at 5 percent level” [9].

## 3. RESULTS AND DISCUSSION

## 3.1 Yield and Yield Attributes

### 3.1.1 Seed yield (kg/ha)

The significant and higher seed yield (1223.33 kg/ha) [Table 2] was observed in treatment 9 [Nitrogen (45 kg/ha) + Imazethapyr (Post-emergence)], which was significant superior over rest of the treatments. However, treatment 8 [Nitrogen (45 kg/ha) + Pendimethalin (Pre-emergence)], treatment 7 [Nitrogen (45 kg/ha) + Hand weeding twice (20 & 40 DAS)], treatment 6 [Nitrogen (30 kg/ha) + Imazethapyr (Post-emergence)], was found to be statistically at par with treatment 9 [Nitrogen (45 kg/ha) + Imazethapyr (Post-emergence)]. “The increase in seed yield due to nitrogen application is attributed to source and sink relationship. It appears that greater translocation of photosynthates from source to sink might have increased seed yield” [10]. weed control treatments had pronounced effect on grain yield but could not be comparable to manual weeding twice. Manual weeding once followed by one hoeing and pendimethalin (0.5 kg/ha) one hoeing through five tined hoe reported similar grain yield. Similar result was reported by Jain et al. [11].

### 3.1.2 Stover yield (kg/ha)

The significant and higher Stover yield (2472.67 kg/ha) was observed in treatment 9 [Nitrogen (45 kg/ha) + Imazethapyr (Post-emergence)], which was significant superior over rest of the treatments. However, treatment 8 [Nitrogen (45 kg/ha) + Pendimethalin (Pre-emergence)], treatment 7 [Nitrogen (45 kg/ha) + Hand weeding twice (20 & 40 DAS)], treatment 6 [Nitrogen (30 kg/ha) + Imazethapyr (Post-emergence)], was found to be statistically at par with treatment 9 [Nitrogen (45 kg/ha) + Imazethapyr (Post-emergence)]. “Might be due to the Stover yield of Black gram was significantly higher under integrated weed control treatments (herbicide + hand weeding) may be attributed mainly to the better control of weeds during different stages, manual removal of emerging weeds by hand by herbicides and thereby providing better yield attributes” [12].

## 3.2 Economics

### 3.2.1 Gross return

Maximum (INR 83,109.00/ha) [Table- 2] gross return was obtained with the application of $T_9$ (Nitrogen (45 kg/ha) + Imazethapyr (75 g/ha) (post-emergence), while the lowest (INR 52772.10/ha) gross return was obtained with application of $T_{10}$ (RDF). “maximum gross return was obtained with PE application of pendimethalin + imazethapyr 1000 g/ha supplemented with HW at 30 DAS. However, higher benefit-cost ratio was realized with PE application of pendimethalin + imazethapyr 1000 g/ha. Hand weeding twice at 15 and 30 DAS lag behind compared to PE application of pendimethalin + imazethapyr 1000 g/ha, with respect to net returns and benefit-cost ratio of blackgram cultivation” [13].

### 3.2.2 Net return

Maximum (INR 55489.05/ha) [Table- 2] net return was obtained with the application of $T_9$ (Nitrogen (45 kg/ha) + Imazethapyr (75 g/ha) (post-emergence), while the lowest (INR 26852.15/ha) net return was obtained with application of $T_{10}$ (RDF). Might be due to it can

be concluded that pre-emergence application of pendimethalin + imazethapyr “This is due to reduced seed yield because of severe crop injury in addition to high cost of chemical. From this study, it can be concluded that pre-emerfence application of pendimethalin 1.0 kg a.i. ha· is cost effective method of controlling weeds of black gram grown in rice-fallow 2020” [14].

**Table 1. Influence of Nitrogen and weed management practices on yield of blackgram**

| Treatment No | Treatments | Seed yield (kg/ha) | Stover yield (kg/ha) |
|---|---|---|---|
| 1. | Nitrogen (15 kg/ha) + Hand weeding twice (20 & 40 DAS) | 729.33 | 1616.67 |
| 2. | Nitrogen (15 kg/ha) + Pendimethalin (0.75 ml/ha) Pre-emergence | 856.67 | 1718.67 |
| 3. | Nitrogen (15 kg/ha) + Imazethapyr (75 g/ha) Post-emergence | 851.67 | 1846.33 |
| 4. | Nitrogen (30 kg/ha) + Hand weeding twice (20 & 40 DAS) | 962.67 | 2003.33 |
| 5. | Nitrogen (30 kg/ha) + Pendimethalin (0.75 ml/ha) Pre-emergence | 1034.33 | 2124.33 |
| 6. | Nitrogen (30 kg/ha) + Imazethapyr (75 g/ha) Post-emergence | 1069.67 | 2217.00 |
| 7. | Nitrogen (45 kg/ha) + Hand weeding twice (20 & 40 DAS) | 1113.67 | 2274.33 |
| 8. | Nitrogen (45 kg/ha) + Pendimethalin (0.75 ml/ha) Pre-emergence | 1163.00 | 2392.67 |
| 9. | Nitrogen (45 kg/ha) + Imazethapyr (75 g/ha) Post-emergence | 1223.33 | 2472.67 |
| 10. | Control plot (RDF) | 630.67 | 1548.33 |
| | F-test | S | S |
| | SEm (±) | 30.54 | 58.63 |
| | CD (p=0.05) | 90.74 | 174.21 |

**Table 2. Influence of nitrogen and weed management on economics of blackgram**

| Treatment no | Treatments | Cost of cultivation (INR/ha) | Gross return (INR/ha) | Net return (INR/ha) | B:C ratio |
|---|---|---|---|---|---|
| 1. | Nitrogen (15 kg/ha) + Hand weeding twice (20 & 40 DAS) | 27169.95 | 66300.20 | 39130.25 | 1.44 |
| 2. | Nitrogen (15 kg/ha) + Pendimethalin (0.75 ml/ha) Pre-emergence | 27069.95 | 68436.20 | 41366.25 | 1.53 |
| 3. | Nitrogen (15 kg/ha) + Imazethapyr (75 g/ha) Post-emergence | 27319.95 | 68949.50 | 41629.55 | 1.52 |
| 4. | Nitrogen (30 kg/ha) + Hand weeding twice (20 & 40 DAS) | 27319.95 | 70765.00 | 43445.05 | 1.59 |
| 5. | Nitrogen (30 kg/ha) + Pendimethalin (0.75 ml/ha) Pre-emergence | 27219.95 | 71246.50 | 44026.55 | 1.62 |
| 6. | Nitrogen (30 kg/ha) + Imazethapyr (75 g/ha) Post-emergence | 27469.95 | 73505.50 | 46035.55 | 1.68 |
| 7. | Nitrogen (45 kg/ha) + Hand weeding twice (20 & 40 DAS) | 27469.95 | 76231.50 | 48761.55 | 1.78 |
| 8. | Nitrogen (45 kg/ha) + Pendimethalin (0.75 ml/ha) Pre-emergence | 27369.95 | 79369.00 | 51999.05 | 1.90 |
| 9. | Nitrogen (45 kg/ha) + Imazethapyr (75 g/ha) Post-emergence | 27619.95 | 83109.00 | 55489.05 | 2.01 |
| 10. | Control plot (RDF) | 25919.95 | 52772.10 | 26852.15 | 1.04 |

### 3.2.3 Benefit-cost ratio

Highest (2.01) [Table- 2] benefit cost ratio was obtained with the application of $T_9$ (Nitrogen (45 kg/ha) + Imazethapyr (75 g/ha) (post-emergence), while lowest (1.04) benefit cost ratio was obtained with application of $T_{10}$ (RDF). maximum B:C ratio was obtained with the application of Pre-emergence application of trifluralin at 0.50 kg/ha + one HW resulted in highest net returns and B:C ratio followed by its application as pre-plant + one HW and both these treatments increased the net return and B:C ratio. respectively, over two HW despite statistically similar yields. Lower profit in case of two HW can be ascribed to additional expenditure for manual weeding as compared to application of herbicide along with only one HW (Rs.2600 ha) [15].

## 4. CONCLUSION

It is concluded that the treatment T9 with the combination of Nitrogen (45 kg/ha) + Imazethapyr (75 g/ha) post-emergence was found significantly more productive. It is also recorded that maximum Benefit cost ratio (2.0) as compared to other treatment combinations. Since the findings are based on one season, further trails may be required for further confirmation.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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