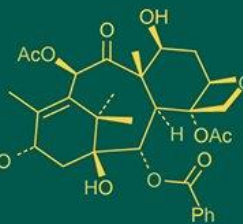
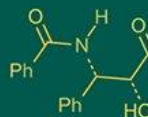


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Effect of pre and post-emergence herbicides on growth, yield attributes and yield of blackgram [*Vigna mungo* (L.) Hepper] in Chhattisgarh plains

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Abstract

The Present investigation entitled “Effect of pre and post-emergence herbicides on growth, yield attributes and yield of blackgram [*Vigna mungo* (L.) Hepper] in Chhattisgarh plains” was conducted at the Research-cum-Instructional Farm of Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (C.G.), during the *kharif* season of 2025. The experiment was laid out in a Randomized Block Design (RBD) with 7 treatments viz., T₁-Weedy Check, T₂-Weed free, T₃-Pendimethalin (38.7% EC) @ 1 Kg a.i. ha⁻¹ as pre-emergence, T₄-Pendimethalin (38.7% EC) @ 1 Kg a.i. ha⁻¹ as pre-emergence + Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha⁻¹ as post-emergence at 20 DAS, T₅-Pendimethalin (38.7% EC) @ 1 Kg a.i. ha⁻¹ as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha⁻¹ as post-emergence at 20 DAS, T₆-Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha⁻¹ as post-emergence at 20 DAS, T₇-Imazethapyr (10% SL) @ 0.2 Kg a.i. ha⁻¹ as post-emergence at 20 DAS. Observations on plant population, plant height, number of branches, number of leaves, dry matter accumulation, were recorded at different growth stages of the crop. Yield attributes such as number of pods, pod length, number of seeds, seed index, grain yield, stover yield and harvest index were subjected to statistical analysis. Total weed density was recorded at 30, 60, and at harvest, and the data were subjected to statistical analysis. At 30, 60 DAS, and at harvest, the weed free treatment (T₂) performed best with respect to growth parameters, yield attributes and yield, reduced weed dynamics, followed by herbicidal treatment T₅-Pendimethalin (38.7% EC) @ 1 Kg a.i. ha⁻¹ as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha⁻¹ as post-emergence at 20 DAS and T₇-Imazethapyr (10% SL) @ 0.2 Kg a.i. ha⁻¹ as post-emergence at 20 DAS. Higher weed control efficiency was also recorded under these treatments.

Keywords: Blackgram, weed management, pre-and post-emergence herbicides, pendimethalin, imazethapyr, weed control efficiency

1. Introduction

Blackgram is one of the major pulse crops grown in India. Blackgram [*Vigna mungo* (L.) Hepper] is a dicotyledonous plant belonging to the family Fabaceae. Blackgram, commonly referred to as urdbean in most parts of India, is cultivated in tropical and subtropical regions for grains, green manure, fodder, and forage. It is grown as a sole crop, intercrop, mixed crop, and in sequential cropping systems. Blackgram is commonly consumed in the form of dal (whole or split, with or without husk) or as roasted grains. It is the main ingredient in the preparation of papad and bari (spiced dumplings), which are used to prepare a tasty curry. It differs from other pulses in its peculiarity of attaining, when up with water, a somewhat mucilaginous pasty character, giving additional body to the mass. In southern India, the dehusked dal is ground into a smooth batter, fermented, and blended with an equal proportion of rice flour to prepare traditional foods such as Dosa and Idli. The grains are also deep-fried to make savoury dishes. Urd dal is further utilised in the preparation of sweets like Halwa and Imarti. In addition, blackgram serves as a nutritious fodder crop, particularly for feeding livestock. It is also cultivated as a green manure crop to improve soil productivity. Nutritionally, blackgram is rich in phosphoric acid, vitamins, and minerals, with 24% protein, 60% carbohydrates, and 1.3% fat. (Islam *et al.*, 2011) [6]. The total area under blackgram cultivation in India is about 5.89 lakh ha, and the production is 22.42 lakh tonnes

with an average productivity 3.81 tonnes/ha (Anonymous, 2024) ^[1]. In Chhattisgarh, the total black gram area is 65.26 thousand ha area with production of 25.17 thousand tons and an average productivity of 0.38 tonne/ha (Anonymous 2024) ^[2].

Pulse crops generally exhibit slow growth during the early seedling stage. Moreover, during the initial period, they develop a limited canopy due to fewer branches and smaller leaf area, which lowers their ability to compete effectively with weeds. In black gram (*Vigna mungo*), weed infestation can cause yield losses of about 45 to 60 percent. Furthermore, with the development of short-statured, compact and early-maturing cultivars, the weed problem has become more serious. (Sasikala *et al.* 2014) ^[11].

There are various factors that contribute to the low yield of black gram. i.e losses caused by agricultural pests, such as insects, nematodes, disease, rodents, etc. Among the various constraints to realize its potential yield, weeds are the major hindrance in exploiting the full utilization of production factors for higher yield. The common weeds associated with blackgram are *Echinochloa colonum*, *Sorghum halepense*, *Echinochloa crusgalli*, *Cyperus rotundus*, *Commelina benghalensis*, *Cyperus iria*, *Cynodon dactylon*, *Cleome viscosa*, *Trianthema monogyna*, *Amaranthus* spp, *Eleusine indica* and *Physalis minima*. Weeds compete for water and light and deplete nutrients from the soil, resulting in a drastic decline of yield in blackgram if grown uncontrolled (Mansoori *et al.*, 2015) ^[8]. Timely weed control is essential for higher black gram yield. Although hand weeding is effective, it is labour-intensive, costly, and often delayed due to labour shortage and rainy conditions, reducing its effectiveness compared with timely weed management. The chemical method of weed control is economical and effective in reducing weed infestation for a longer duration when applied properly. In recent years, several new herbicide molecules have been developed that provide higher weed control efficiency even at lower doses, with shorter persistence and reduced toxicity to mammals. These herbicides are broad-spectrum in action and offer a wider period of application. Their environmental advantage lies in the very low application rate in grams rather than kilograms per hectare, which significantly decreases the chemical burden on the environment. But certain important factors must be considered while applying herbicides for weed control. The herbicides should be selective to the crop and should not leave harmful residues in the soil that may affect the succeeding crops in the rotation. In pulse crops, special attention is required because these chemicals should not

damage the soil microflora responsible for maintaining soil fertility or the root-nodule forming organisms that fix atmospheric nitrogen.

2. Materials and Methods

2.1 Experimental Site and Location: The field experiment was conducted during the Kharif 2025 at the Agricultural Research Farm of Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (Chhattisgarh). The Research Farm is located at 22. 09° N latitude, 82.15° E longitude and at an altitude of 298 m above mean sea level. The region comes under the Eastern Plateau and Hill Region (Agro-climatic Zone VII) of India. Chhattisgarh state is classified into 3 agro-climatic zones, and Bilaspur falls into the Chhattisgarh plains zone.

2.2 Climate Condition: During the experimental period, the area experienced high to moderate temperatures, with average daily temperatures ranging between 26.5 °C and 30.1 °C, and relative humidity fluctuating between 61% and 95%. The minimum rainfall received during the crop growing period was 1.6 mm, and the maximum rainfall of 32.2 mm.

2.3 Treatment details

The experiment was laid out in a Randomized Block Design (RBD) with seven treatments replicated thrice. The treatments were T₁-Weedy Check, T₂-Weed free, T₃-Pendimethalin (38.7% EC) @ 1 Kg a.i. ha⁻¹ as pre-emergence , T₄-Pendimethalin (38.7% EC) @ 1 Kg a.i. ha⁻¹ as pre-emergence + Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha⁻¹ as post-emergence at 20 DAS, T₅-Pendimethalin (38.7% EC) @ 1 Kg a.i. ha⁻¹ as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha⁻¹ as post-emergence at 20 DAS , T₆-Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha⁻¹ as post-emergence at 20 DAS , T₇-Imazethapyr (10% SL) @ 0.2 Kg a.i. ha⁻¹ as post-emergence at 20 DAS.

2.4 Statistical analysis

The data collected for all the characters were subjected to statistical analysis as per the procedure of Randomized Block Design with factorial concept in OPSTAT. The 'F' test was used for the test of significance. The Standard Error of Mean (S.E.m.±) was computed in each case. For the treatment effects which were found significant, the critical difference (C.D.) at 5 percent level of probability was worked out to compare the treatment means.

Table 1: Details of treatment combination

S. No.	Treatments
T ₁	Weedy Check
T ₂	Weed free
T ₃	Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence
T ₄	Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS
T ₅	Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS
T ₆	Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS
T ₇	Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS

3. Results and Discussion

3.1 Growth parameters

3.1.1 Plant population

The plant population did not differ significantly among

treatments, indicating a uniform plant stand under various weed management treatments. These results are also in accordance with the findings of Dhayal *et al.* (2022) ^[4].

3.1.2 Plant height

Plant height at 30, 60 DAS and at harvest revealed significant differences among the treatments. At all observation stages, significantly taller plants were recorded under weed free (T_2), followed by T_5 -Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS and T_7 -Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS, while the control plot (T_1) recorded the shortest plants. The increase in plant height is due to eliminating weed competition throughout the crop growth period, enabling better resource utilization, eliminating weed competition throughout the crop growth period, reduce competition and promoting photosynthesis. These results are also in accordance with the findings of Dhayal *et al.* (2022) [4].

3.1.3 Number of branches plant⁻¹

At 30,60 DAS and at harvest, a significantly maximum number of branches were found under weed free (T_2), followed by T_5 -Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS and T_7 -Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS, while the Weedy Check plot (T_1) recorded the lower number of branches. The increase in number of branches is due to reduced weed competition and better utilisation of growth resources. Similar findings were also reported by Reddy *et al.* (2022) [10].

3.1.4 Number of leaves plant⁻¹

A clear difference in leaf number was recorded among treatments during the crop growth period. At 30,60 DAS and at harvest, significantly higher leaf counts were found under weed free (T_2), followed by T_5 -Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS and T_7 -Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS, while the Weedy Check plot (T_1) consistently recorded the lower leaf count. The better leaf initiation is due to reduced crop-weed competition for nutrients, light, moisture, space and higher photosynthetic activity. These findings are in close conformity with those of Gendlal *et al.* (2024) [5].

3.1.5 Dry matter accumulation (g plant⁻¹)

Dry matter accumulation per plant at 30, 60 DAS and at harvest was highest under weed free (T_2). Among the chemical weed management treatments, the highest dry matter accumulation per plant was recorded under T_5 -Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS followed by T_7 -Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS. The Weedy Check plot (T_1) recorded the lowest dry matter accumulation. The increase in dry matter accumulation may be attributed to effective weed control and efficient utilization of soil moisture, nutrients and solar energy. These results are in accordance with the findings of Kumar *et al.* (2017) [7].

3.2 Yield attributes

Yield attributes such as number of pods per plant, seeds per pod, pod length and seed index were maximum under weed

free (T_2), followed by T_5 -Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS and T_7 -Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS. The minimum values were recorded in the Weedy Check (T_1). This result may be due to reduced crop-weed competition during the critical growth stages and more effective weed suppression under combined herbicide application, which enabled the crop to utilize adequate growth resources. This, in turn, promoted greater translocation of photosynthates towards the reproductive organs and resulted in a higher number of pods plant⁻¹. Similar findings were also reported by Reddy *et al.* (2022) [10].

3.3 Yield parameter

3.3.1 Grain yield (Kg/ha)

Grain yields were highest under weed free (T_2), followed by T_5 -Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS and T_7 -Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS. The Weedy Check plot (T_1) recorded the lowest yields. The increase in Seed yield depends on efficient photosynthesis, assimilate translocation, and yield-contributing traits. Weed-free conditions and effective herbicide treatments increased seed yield by reducing weed competition and improving resource utilization. Similar findings were also reported by Nirala *et al.* (2012) [9] and Adhikary (2018) [3].

3.3.2 Stover yield (Kg/ha)

stover yields were highest under weed free (T_2), followed by T_5 -Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS and T_7 -Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS. The Weedy Check plot (T_1) recorded the lowest yields. The higher stover yield under weed-free conditions and effective herbicide treatments was due to reduced weed competition, better resource utilization, and increased dry matter accumulation. Similar findings were also reported by Nirala *et al.* (2012) [9] and Adhikary (2018) [3].

3.3.3 Harvest index

The harvest index did not differ significantly among treatments. This is due to both grain yield and total biological yield increasing proportionally under different weed management practices, resulting in a similar partitioning of assimilates between grain and vegetative parts. The results are supported by the findings of Nirala *et al.* (2012) [9] and Adhikary (2018) [3].

3.4 Weed parameter

3.4.1 Weed density (m⁻²)

At 30, 60 DAS, and at harvest, total weed density was recorded at a minimum under weed-free (T_2). Among herbicidal treatments, at 30 DAS the significantly lowest total weed density was recorded under T_5 -Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS followed by T_4 -Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre emergence + Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha^{-1} as post-emergence at 20 DAS. At 60 DAS and at harvest, the lower weed density was recorded

under T₅-Pendimethalin (38.7% EC) @ 1 Kg a.i. ha⁻¹ as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha⁻¹ as post-emergence at 20 DAS, followed by T₇-Imazethapyr (10% SL) @ 0.2 Kg a.i. ha⁻¹ as post-emergence at 20 DAS. The Weedy Check plot (T₁) recorded the highest weed density.

3.4.2 Weed dry matter (g m⁻²)

At 30, 60 DAS, and at harvest, dry matter accumulation of weed was recorded lowest under weed free (T₂), followed by T₅-Pendimethalin (38.7% EC) @ 1 Kg a.i. ha⁻¹ as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha⁻¹ as

post-emergence at 20 DAS and T₇-Imazethapyr (10% SL) @ 0.2 Kg a.i. ha⁻¹ as post-emergence at 20 DAS. The highest values were recorded in T₁-Weedy Check (T₁).

3.4.3 Weed control efficiency (%)

At 30, 60 DAS, and at harvest, Weed control efficiency (WCE) was recorded highest under T₂-Weed free (100%), followed by T₅-Pendimethalin (38.7% EC) @ 1 Kg a.i. ha⁻¹ as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha⁻¹ as post-emergence at 20 DAS and T₇-Imazethapyr (10% SL) @ 0.2 Kg a.i. ha⁻¹ as post-emergence at 20 DAS. The lowest values of WCE were recorded in T₁-Weedy Check.

Table 1: Effect of pre and post-emergence herbicides on the plant population of blackgram

Treatments	Plant population (m ⁻²)
Weedy Check	30.07
Weed free	31.34
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence	30.47
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	30.5
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	30.75
Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	30.39
Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	30.54
SEm (±)	0.64
CD (5%)	NS

Table 2: Effect of pre and post-emergence herbicides on plant height (cm) of blackgram

Treatments	30 DAS	60 DAS	At harvest
Weedy Check	18.56	29.4	31.91
Weed free	30.79	47.65	51.43
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence	22.65	35.61	38.49
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	22.84	35.82	38.60
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	26.73	42.73	45.50
Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	22.49	35.43	38.21
Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	24.52	41.75	43.91
SEm (±)	1.25	1.86	1.76
CD (5%)	3.88	5.74	5.44

Table 3: Effect of pre and post-emergence herbicides on the number of branches plant⁻¹ of blackgram

Treatments	30 DAS	60 DAS	At harvest
Weedy Check	2.13	4.05	4.95
Weed free	4.52	7.40	7.82
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence	2.72	5.32	5.59
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	3.00	5.56	5.83
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	3.80	6.45	6.8
Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	2.64	5.01	5.24
Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	3.49	6.38	6.75
SEm (±)	0.16	0.27	0.28
CD (5%)	0.50	0.86	0.89

Table 4: Effect of pre and post-emergence herbicides on the number of leaves plant⁻¹

Treatments	30 DAS	60 DAS	At harvest
Weedy Check	7.30	14.20	14.88
Weed free	13.92	25.27	25.75
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence	9.60	18.23	18.56
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	9.94	18.69	19.00
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	11.9	22.2	22.52
Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	9.20	17.98	18.21
Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	10.8	20.4	20.57
SEm (±)	0.58	0.99	0.93
CD (5%)	1.79	3.06	2.89

Table 5: Effect of pre and post-emergence herbicides on dry matter accumulation (g plant⁻¹) of blackgram

Treatments	30 DAS	60 DAS	At harvest
Weedy Check	2.09	5.11	6.09
Weed free	4.62	10.97	12.83
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence	3.04	7.56	8.89
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	3.18	7.73	9.10
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	3.88	9.69	11.23
Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	2.93	7.4	8.56
Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	3.23	8.98	10.45
SEm (±)	0.21	0.37	0.44
CD (5%)	0.65	1.15	1.36

Table 6: Effect of pre and post-emergence herbicides on number of pods, pod length, number of seeds and Seed index of blackgram.

Treatments	Number of pods plant ⁻¹	Pod length (cm)	Number of seeds pod ⁻¹	Seed Index (gm)
Weedy Check	16.00	3.29	3.08	2.98
Weed free	26.78	5.61	6.64	3.90
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence	19.93	4.27	3.87	3.26
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	20.31	4.29	4.51	3.30
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	23.36	4.98	5.73	3.59
Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	19.87	4.03	3.81	3.23
Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	21.72	4.81	4.65	3.45
SEm (±)	0.98	0.20	0.23	0.08
CD (5%)	3.04	0.61	0.72	0.24

Table 7: Effect of pre and post-emergence herbicides on Grain yield, stover yield and harvest index of blackgram.

Treatments	Grain yield Kg ha ⁻¹	Stover yield Kg ha ⁻¹	Harvest index
Weedy Check	361.23	630	36.44
Weed free	1042.8	1680.23	38.30
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence	651.39	1113.5	36.91
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	726.46	1232.63	37.08
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha ⁻¹ as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	887.51	1471.23	37.63
Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	610.58	1056.65	36.62
Imazethapyr (10% SL) @ 0.2 Kg a.i. ha ⁻¹ as post-emergence at 20 DAS	837.39	1393.32	37.54
SEm (±)	38.81	65.90	0.76
CD (5%)	119.61	203.08	NS

Table 8. Effect of pre and post-emergence herbicides on weed density (m^{-2}) of blackgram.

Treatments	30 DAS	60 DAS	At harvest
Weedy Check	7.50 (55.83)	8.22 (67.23)	8.55 (72.67)
Weed free	0.00	0.00	0.00
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence	5.13 (25.87)	5.93 (34.76)	6.24 (38.55)
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha^{-1} as post-emergence at 20 DAS	5.11 (25.6)	4.73 (21.96)	4.94 (23.95)
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS	5.07 (25.23)	4.04 (15.87)	4.23 (17.23)
Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha^{-1} as post-emergence at 20 DAS	6.96 (48.28)	5.00 (24.61)	5.20 (26.57)
Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS	6.78 (45.78)	4.56 (20.34)	4.75 (22.13)
SEm ($\pm$)	0.27	0.20	0.21
CD (5%)	0.85	0.63	0.65

*Data analyzed using Square root transformation = $\sqrt{(x + 0.5)}$ *Data in parentheses are original values

Table 9. Effect of pre and post-emergence herbicides on weed dry matter (g m^{-2}) of blackgram.

Treatments	30 DAS	60 DAS	At harvest
Weedy Check	4.88 (23.38)	6.11 (36.87)	7.20 (51.47)
Weed free	0.00	0.00	0.00
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence	2.82 (7.48)	4.34 (18.34)	5.48 (29.57)
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha^{-1} as post-emergence at 20 DAS	2.78 (7.22)	3.54 (12.05)	4.34 (18.34)
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS	2.00 (3.52)	2.71 (6.88)	3.17 (9.91)
Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha^{-1} as post-emergence at 20 DAS	3.20 (9.78)	4.68 (21.47)	5.60 (30.94)
Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS	2.37 (5.14)	3.10 (9.11)	3.77 (13.74)
SEm ($\pm$)	0.29	0.21	0.35
CD (5%)	0.90	0.65	1.10

*Data analyzed using Square root transformation = $\sqrt{(x + 0.5)}$ *Data in parentheses are original values

Table 10. Effect of pre and post-emergence herbicides on weed control efficiency(%) of blackgram

Treatments	30 DAS	60 DAS	At harvest
Weedy Check	0.00	0.00	0.00
Weed free	100	100	100
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence	68.00	50.25	42.54
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha^{-1} as post-emergence at 20 DAS	69.11	67.31	64.36
Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS	84.94	81.33	80.74
Quizalofop ethyl (5% EC) @ 0.05 Kg a.i. ha^{-1} as post-emergence at 20 DAS	58.16	41.76	39.88
Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS	78.01	74.07	73.30

Conclusion

At 30, 60 and at harvest, weed free (T_2) have registered higher growth, yield attributes and yield, and reduced weed dynamics. Among chemical treatment, T_5 -Pendimethalin (38.7% EC) @ 1 Kg a.i. ha^{-1} as pre-emergence + Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS followed by T_7 -Imazethapyr (10% SL) @ 0.2 Kg a.i. ha^{-1} as post-emergence at 20 DAS recorded higher growth, yield attributes and yield, and reduced weed dynamics. Higher weed control efficiency was also recorded under these treatments.

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