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## Weed management in blackgram (*Vigna mungo* L.)

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### Abstract

A field experiment was carried out at research farm of I.G.K.V., Krishi Vigyan Kendra, Ajirma, Ambikapur (C.G.) during *kharif* season of 2022. The field experiment was laid out in a randomised block design with nine treatments in three replications. With the exception of pendimethalin at a dose of 1 kg a.i./ha, all herbicide treatments were effective in suppressing weeds, but pendimethalin had a phytotoxic effect on crop emergence relative to other treatments. Among herbicide weed control treatments, the lowest weed density and dry matter, higher growth characters and yield attributes and seed yield was recorded with two hand weeding at 15 and 30 DAS. It was at par with, sodium acifluorfen 16.5% (165g/ha) + clodinafop propargyl 8% (80 g/ha) (POE) at 20 DAS + one hand weeding, propaquizafop 2.5% + imazathapyr 3.75% 50+75 g/ha (POE) at 15 DAS + one HW at 30 DAS followed by quizalofop-p-ethyl @ 50 g/ha (POE) at 20 DAS + one HW at 40 DAS, imazathapyr 75 g/ha (POE) at 20 DAS + one HW at 40 DAS. In comparison to the other treatments, two HW recorded the greatest net income and B:C (34281 and 0.84, respectively).

**Keywords:** Blackgram, hand weeding, pre and post-emergence herbicide

### Introduction

Pulses are the second most important group of foodgrain crops after cereals in Indian. These are essential for healthy soil, sustainable agriculture, and food security. With respective shares of 25, 10, 5, 5, and 4%, India, China, Brazil, Canada, Myanmar, and Australia are the main producing countries for pulses. Since 2010, the nation's pulse output has been constant at around 18 million tons for the past three years. The act of producing 19.57 million tons for the 2013–14 fiscal year. The output of 22.30 million tons that was estimated for the 2020–2021 fiscal year would set a new record. Blackgram (*Vigna mungo* L.) is one of the popular pulse crops commonly known as “Urd bean” or “Urd” and it is grown throughout the country. According to Vavilov (1951) <sup>[17]</sup>, it originated in India and afterwards spread to other parts of the world at various times.

The majority of the blackgrams in the world are produced in India. In 2020–2021, it will produce around 22.30 lakh tonnes of urad annually from about 4.14 million hectares of land with an average yield of 538 kg/ha. The blackgram region accounts for around 19% of the overall pulse acreage in India and 23% of the entire pulse production in the country. It is commonly grown in the states of Andhra Pradesh (3.93 lakh ha), Uttar Pradesh (5.54 lakh ha), and Madhya Pradesh (13.14 lakh ha). (2020–2021 Anonymous) <sup>[1]</sup>.

According to Singh *et al.* (1989) <sup>[12]</sup>, the crucial period of crop-weed competition in blackgram normally lasts between 15 and 30 DAS. In Blackgram, traditional weed control methods are either manual or mechanical. 2-3 hand weedings are frequently required to maintain the crop's weed-free status. Pendimethalin is the herbicide that is most frequently used to all pulse crops. It has been suggested to use the post-emergence wide-range herbicide imazethapyr on pulses cultivated during the rainy season, such as pigeonpea, blackgram, and mungbean. Clodinafop and quizalofop-ethyl can also be applied to most pulse crops as post-emergence treatments if only grassy weeds are present in the field.

### Materials and Methods

The field experiment was carried out at research farm of I.G.K.V., Krishi Vigyan Kendra, Ajirma, Ambikapur (C.G.) during *kharif* season of 2022, which is situated at a latitude of 20°8'N, longitude of 83°15'E and altitude of 592.62 m MSL (mean sea level). Utilizing the variety Indira Urd Pratham and a plot size of 4 x 3 meters, the treatment was assessed using a randomized block design with three replications in blackgram. 500 liters of water per acre were used to apply the herbicide using a backpack sprayer with a flat nozzle.

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The crop was raised using all other suggested agronomic and plant protection techniques, and intercultural methods were used as needed. Growth metrics, yield characteristics, and crop economics data were recorded and computed. To standardize the distribution of the data on total weed count and weed dry matter, square root transformation ( $\sqrt{x+0.5}$ ) was applied (Gomez and Gomez 1984) [4].

## Results and Discussion

### Effect on weeds

In comparison to other treatments, pendimethalin @ 1 kg/ha (PE) + one HW at 30 DAS, pendimethalin @ 1 kg/ha (PE) fb imazathapyr 75 g/ha (POE) at 20 DAS (19.33, 27.47, and 17.07 plant m<sup>-2</sup>) and two hand weeding (36, 28.00, and 18.90 plant m<sup>-2</sup>) significantly reduced the total weed density (15, 26 and 16 plant m<sup>-2</sup>) followed by sodium acifluorfen 16.5% (165g/ha) + clodinafop propargyl 8% (80 g/ha) (POE) at 20 DAS + one HW at 40 DAS (60.70, 29 and 19.97 plant m<sup>-2</sup>) (Table 1). However, application of pendimethalin at 1.0 kg a.i/ha had a phytotoxic impact on the germination of blackgram. In addition, all additional herbicidal treatments (162.66, 203.93, and 142.73 plant m<sup>-2</sup>) were much better than the weedy check. Weed density trends almost exactly paralleled those at 25 DAS at 50 DAS and at harvest. Even still, compared to weedy check, all weed management methods resulted in reduced weed densities throughout the whole process. Similar result was reported by Singh *et al* (2023) [11].

In comparison to other weed management techniques, pendimethalin @ 1 kg/ha (PE) + one HW at 30 DAS, pendimethalin @ 1 kg/ha (PE) fb imazathapyr 75 g/ha (POE) at 20 DAS (9.69 g m<sup>-2</sup>), and two hand weeding at 15 and 30 DAS produced the lowest dry weight of total weed (8.67 g m<sup>-2</sup>) at 25 DAS. Significantly, the maximum dry weight (111.33 g m<sup>-2</sup>) was obtained under the Weedy Check. Sodium acifluorfen 16.5% (165g/ha) + clodinafop propargyl 8% (80 g/ha) (POE) at 20 DAS + one HW at 40 DAS were found to significantly reduce the dry weight of total weed (11.33, 8.33 g m<sup>-2</sup>) at 50 DAS and at harvest, respectively, compared to the other treatments. Propaquizafop 2.5% + imazathapyr 3.75% 50+75 g/ha (POE) at 15 DAS + one HW at 30 DAS was the next effective weed control method. Similar result was reported by Jagadesh *et al.* (2021) [5].

Weed control efficiency (WCE) was higher with two hand weeding 87.72, 93.97, and 92.18% at 25, 50 DAS and harvest, respectively, because of complete removal of weed at 15 and 30 DAS. Pendimethalin @ 1 kg/ha (PE) + one-handed weeding at 25 DAS had the highest weed control efficacy when compared to herbicides (91.32%). Weed control efficiency (WCE) under sodium acifluorfen 16.5% (165g/ha) + clodinafop propargyl 8% (80 g/ha) (POE) at 20 DAS + one hand weeding was higher at 50 DAS and at harvest (96.34, and 94.79%), but it was comparable to quizalofop-p-ethyl @ 50 g/ha (POE) + one hand weeding (96.18, 94.60%), and imazathapyr 75 g/ha (POE) at 20 DAS + one hand weeding (96.07, 94.47%). Similar result was reported by Mudalagiriappa *et al.* (2021) [8].

The findings make it very evident that weedy check produced the highest weed index (56.86%) followed by pendimethalin @ 1 kg/ha (PE) + one HW (49.27%) and pendimethalin @ 1 kg/ha (PE) fb imazathapyr 75 g/ha (POE) at 20 DAS (46.74%) since the lowest seed yield, whereas the lowest weed index was seen in sodium acifluorfen 16.5% (165g/ha) + clodinafop propargyl 8% (80 g/ha) (POE) at 20 DAS + one HW at 40 DAS (14.31%). This may be because weeds were effectively controlled during a crucial period of the crop plant,

which led to the best grain production possible. Similar result was reported by Elankavi *et al.* (2019) [3].

### Effect on crop

#### Growth parameter

Plant population of blackgram recorded at 25 DAS and at harvest was presented in (Table 2). Blackgram's plant population generally varied from 19.33 to 33.33 plant m<sup>-2</sup> at 25 DAS and from 19.03 to 32.67 plant m<sup>-2</sup> at harvest. The crop observation revealed that, for all treatments, seedling emergence (germination) and crop growth were almost normal, with the exception of the two plots treated with pendimethalin at a rate of 1 kg/ha (PE), where the plant populations at 25 DAS and harvest ranged from 19.33 to 20.6 and 19.03 to 20.23, respectively. These herbicidal treatments showed hazardous and significantly decreased crop emergence (from 32.9 at 25DAS to 30.60 at harvest) compared to other treatments. Mortality was 6.9% in weedy check, though. Compared to clay soil, sandier soil requires a smaller amount of herbicide. This is conformity with the finding of Singh and Singh (1990) [13] for pendimethalin @ 0.75 kg/ha in light texture soil, Sai (2017) [15], Zain (2020) [14]. In comparison to other weed management techniques, pendimethalin @ 1 kg/ha (PE) + one HW at 30 DAS was found to produce the highest plant height (24.67, 51.67, and 52.23 cm), branches plant<sup>-1</sup> (3.53, 6.33, and 6.33), dry matter accumulation (3.13, 8.23, and 10.17 g plant<sup>-1</sup>), and crop growth rate (0.13, 0.20, and 0.13 g plant<sup>-1</sup> day<sup>-1</sup>) at 25, 50 DAS, and at harvest closely followed by pendimethalin @ 1 kg/ha (PE) fb imazathapyr 75 g/ha (POE) at 20 DAS and two hand weeding at 15 and 30 DAS. Next superior treatments were sodium acifluorfen 16.5% (165g/ha) + clodinafop propargyl 8% (80 g/ha) (POE) at 20 DAS + one HW at 40 DAS, propaquizafop 2.5% + imazathapyr 3.75% 50+75 g/ha (POE) at 15 DAS + one HW at 30 DAS and quizalofop-p-ethyl @ 50 g/ha (POE) at 20 DAS + one HW at 40 DAS, imazathapyr 75 g/ha (POE) at 20 DAS + one HW at 40 DAS. Similar result was reported by Kumar *et al.* (2019) [6], Meena *et al.* (2018) [7].

#### Yield attributes

Among the various weed control methods, pendimethalin @ 1 kg/ha (PE) + one HW at 30 DAS produced considerably more pods plant<sup>-1</sup> (31.67) and grain pod<sup>-1</sup> (8.47). Following closely after were pendimethalin @ 1 kg/ha (PE) fb imazathapyr 75 g/ha (POE) at 20 DAS (30.03 and 8.33), and two hand weeding at 15 and 30 DAS (28.50 and 7.67). Under both treatments of pendimethalin @ 1 kg/ha, poor crop stand and effective weed management from 25 DAS to harvest (fewer weeds), its dry weight and greater WCE (%) induced superior plant development and yield-attributing character (table 2). Next, the best weed control methods were sodium acifluorfen 16.5% (165g/ha) + clodinafop propargyl 8% (80 g/ha) (POE) at 20 DAS + one HW at 40 DAS, propaquizafop 2.5% + imazathapyr 3.75% 50+75 g/ha (POE) at 15 DAS + one HW at 30 DAS and quizalofop-p-ethyl @ 50 g/ha (POE) at 20 DAS + one HW at 40 DAS, imazathapyr 75 g/ha (POE) at 20 DAS + one HW at 40 DAS. The number of pod plants generated by one hand weeding at 15 DAS was substantially greater than that of the weedy control (19.23), although the amount of seeds produced per pod was not statistically different. Weights for 1000 seeds, which were unaffected, varied from 41.03 to 41.83g. All yield attributes in the weedy check were considerably lower (19.23 and 5.80) than in the other treatments. Similar observation have been reported by Meena *et al.* (2018) [7], Kumar *et al.* (2019) [6].

**Yield and economics**

The current results clearly shown that two hand weeding at 15 and 30 DAS generated considerably greater biological yield (3131 kg ha<sup>-1</sup>), grain yield (1027 kg ha<sup>-1</sup>), straw yield (2103 kg ha<sup>-1</sup>), and harvest index (32.81%) than all other treatments (Table 2). Next, the best weed control methods were sodium acifluorfen 16.5% (165g) + clodinafop propargyl 8% 80 g/ha (POE) at 20 DAS + one HW at 40 DAS (880, 2043, 2924kg/ha and 30.10%), propaquizafop 2.5% (50 g/ha) + imazethapyr 3.75% (75 g/ha) (POE) at 15 DAS + one HW at 30 DAS (843, 2007, 2850kg/ha and 29.59%) and quizalofop-p-ethyl @ 50 g/ha (POE) at 20 DAS + one HW at 40 DAS, imazathapyr 75 g/ha (POE) at 20 DAS + one HW at 40 DAS. Similar observation has also been reported by Singh (1989) [12], Sai (2017) [15], Deshmukh (2018) [2], Painkra (2021) [10], Poornima (2018) [9]. Under weed control, significantly decreased biological yields (1777 kg ha<sup>-1</sup>), grain yields (443 kg ha<sup>-1</sup>), straw yields (1333 kg ha<sup>-1</sup>), and harvest indices (24.96%) were noted, followed by pendimethalin @ 1 kg/ha (PE) + one HW 30 DAS (521, 1343, 1865kg/ha and 27.95%) and pendimethalin @ 1 kg/ha (PE) fb imazethapyr 75 g/ha

(POE) at 20 DAS (547, 1353, 1900kg/ha and 28.79%) because there are less plants per unit area.

The data also showed that two hand weedings at 15 and 30 DAS produced the highest gross return (Rs.74971 ha<sup>-1</sup>), net return (Rs.34281 ha<sup>-1</sup>), and B: C ratio (0.84), which were followed by two hand weedings at 20 DAS and one HW at 40 DAS (Rs.64240, 27765, and 0.76). There are a number of factors that affect the gross and net returns under two-hand weeding at 15 and 30 DAS, but it's possible that the decrease in the number of weeds and the suppression of the growth of any that remain gave the crop the best possible space, nutrients, moisture, and use of solar radiation, which led to a higher yield being recorded. Similar observations were noted by Sai (2017) [15], Deshmukh (2018) [2], Painkra (2021) [10], Poornima (2018) [9], Singh (2017) [16]. Pendimethalin @ 1 kg/ha (PE) + one HW 30 DAS and Pendimethalin @ 1 kg/ha (PE) fb imazethapyr 75 g/ha (POE) at 20 DAS were followed by Weedy Check, which had the lowest gross returns (Rs. 38033 and 39931 ha<sup>-1</sup>), net returns (4948 and 8374 ha<sup>-1</sup>), and B: C ratios (0.14 and 0.26). Singh and Singh (1990) [13], Sai (2017) [15], Zain (2020) [14].

**Table 1:** Total weed density (no. m<sup>-2</sup>), dry matter production (g. m<sup>-2</sup>), weed control efficiency (WCE %) and weed index (%) of blackgram as influenced by different weed management practices

Treatment	Total weed density (no. m <sup>-2</sup> )			Dry matter production (g. m <sup>-2</sup> )			Weed control Efficiency (%)			Weed index (%)
	25 DAS	50 DAS	at Harvest	25 DAS	50 DAS	at Harvest	25 DAS	50 DAS	at Harvest	
T <sub>1</sub>	12.77 (162.66)	14.28 (203.93)	11.92 (142.73)	10.58 (111.33)	17.61 (310.00)	12.66 (160.0)				56.86
T <sub>2</sub>	6.32 (39.60)	11.22 (125.70)	8.53 (72.50)	3.84 (14.33)	13.11(171.66)	9.51 (90.00)	87.12	44.62	43.75	34.47
T <sub>3</sub>	6.09 (36.7)	5.41 (28.00)	4.40 (18.90)	3.76 (13.67)	4.37 (18.66)	3.60 (12.50)	87.72	93.97	92.18	
T <sub>4</sub>	3.93 (15.00)	5.23 (26.90)	4.10 (16.37)	3.02 (8.67)	4.32 (18.16)	3.54(12.03)	91.32	94.13	92.47	49.27
T <sub>5</sub>	4.45 (19.33)	5.28 (27.47)	4.18 (17.07)	3.18 (9.69)	6.63 (43.66)	5.27(27.67)	91.31	85.91	82.70	46.74
T <sub>6</sub>	10.01 (99.83)	5.81 (33.30)	4.93 (23.83)	6.56 (42.67)	3.55 (12.16)	3.05 (8.83)	61.67	96.07	94.47	27.65
T <sub>7</sub>	9.38 (87.63)	5.72 (32.23)	4.80 (22.60)	6.23 (38.33)	3.50 (11.83)	3.02 (8.63)	65.56	96.18	94.60	23.08
T <sub>8</sub>	7.82 (60.70)	5.50 (29.77)	4.55 (19.97)	5.08 (25.33)	3.43 (11.33)	2.97 (8.33)	77.24	96.34	94.79	14.31
T <sub>9</sub>	8.48 (71.50)	5.62 (31.13)	4.52 (21.03)	5.21 (30.00)	4.45 (19.33)	3.65 (12.90)	73.05	93.76	91.93	17.92
S.Em±	0.08	0.16	0.12	0.06	0.13	0.18				
CD (5%)	0.24	0.50	0.36	0.20	0.40	0.55				

\*Figures in without parenthesis indicates the transformation value ( $\sqrt{x+0.5}$ )

T<sub>1</sub>: Weedy Check, T<sub>2</sub>: One hand weeding at 15 DAS, T<sub>3</sub>: Two hand weeding at 15 and 30 DAS, T<sub>4</sub>: Pendimethalin @ 1 kg/ha (PE) + one hand weeding at 30 DAS, T<sub>5</sub>: Pendimethalin @ 1 kg/ha (PE) fb imazathapyr 75 g/ha (POE) at 20 DAS, T<sub>6</sub>: Imazathapyr 75 g/ha (POE) at 20 DAS + one hand weeding at 40 DAS, T<sub>7</sub>: Quizalofop-p-ethyl @ 50 g/ha (POE) at 20 DAS + one hand weeding at 40 DAS, T<sub>8</sub>: Sodium acifluorfen 16.5% (165g/ha) + clodinafop Propargyl 8% (80 g/ha) (POE) at 20 DAS + one hand weeding at 40 DAS, T<sub>9</sub>: Propaquizafop 2.5% (50 g/ha) + imazathapyr 3.75% (75 g/ha) (POE) at 15 DAS + one hand weeding at 30 DAS.

**Table 2:** Growth parameter, yield attributes, yield and economics of blackgram as influenced by weed management practices

Treatment	Plant population	Plant height (cm)	Number of branches	Dry matter accumulation	Crop growth rate	Number of pods plant <sup>-1</sup>	Number of seeds pod <sup>-1</sup>	Test weight (1000 seeds g)	Seed yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)	Gross return (Rs. ha <sup>-1</sup> )	Net return (Rs. ha <sup>-1</sup> )	B:C Ratio
	at Harvest	at Harvest	at Harvest	at Harvest	at Harvest										
T <sub>1</sub>	30.60	39.33	3.73	6.50	0.07	19.23	5.80	41.03	443	1333	1777	24.96	32339	4249	0.15
T <sub>2</sub>	31.67	47.33	4.67	7.27	0.08	24.33	6.13	41.13	673	1683	2357	28.57	49129	14039	0.40
T <sub>3</sub>	32.67	50.13	5.83	9.60	0.13	29.50	7.67	41.53	1027	2103	3131	32.81	74971	34281	0.84
T <sub>4</sub>	19.03	52.33	6.33	10.47	0.14	31.67	8.47	41.83	521	1343	1865	27.95	38033	4948	0.14
T <sub>5</sub>	20.23	51.67	6.03	10.00	0.14	30.03	8.33	41.63	547	1353	1900	28.79	39931	8374	0.26
T <sub>6</sub>	31.87	48.33	4.73	7.83	0.09	26.33	7.03	41.26	743	1873	2617	28.40	54239	19277	0.55
T <sub>7</sub>	32.03	48.34	5.10	8.35	0.10	26.67	7.17	41.33	790	1943	2734	28.91	57670	21590	0.59
T <sub>8</sub>	32.33	49.34	5.67	8.97	0.11	27.67	7.47	41.43	880	2043	2924	30.10	64240	27765	0.76
T <sub>9</sub>	32.10	48.8	5.33	8.53	0.10	27.30	7.27	41.40	843	2007	2850	29.59	61539	25789	0.72
S.Em±	0.39	0.32	0.22	0.24	0.017	0.23	0.30	0.17	8.10	13.03	15.50	0.24			
CD (5%)	1.17	0.96	0.68	0.73	0.052	0.70	0.90	NS	24.31	39.08	56.47	0.72			

T<sub>1</sub>: Weedy Check, T<sub>2</sub>: One hand weeding at 15 DAS, T<sub>3</sub>: Two hand weeding at 15 and 30 DAS, T<sub>4</sub>: Pendimethalin @ 1 kg/ha (PE) + one hand weeding at 30 DAS, T<sub>5</sub>: Pendimethalin @ 1 kg/ha (PE) fb imazathapyr 75 g/ha (POE) at 20 DAS, T<sub>6</sub>: Imazathapyr 75 g/ha (POE) at 20 DAS + one hand weeding at 40 DAS, T<sub>7</sub>: Quizalofop-p-ethyl @ 50 g/ha (POE) at 20 DAS + one hand weeding at 40 DAS, T<sub>8</sub>: Sodium acifluorfen 16.5% (165g/ha) + clodinafop Propargyl 8% (80 g/ha) (POE) at 20 DAS + one hand weeding at 40 DAS, T<sub>9</sub>: Propaquizafop 2.5% (50 g/ha) + imazathapyr 3.75% (75 g/ha) (POE) at 15 DAS + one hand weeding at 30 DAS.

## Conclusion

From the present investigation, it is concluded that:

- Two hand weeding at 15 and 30 DAS were most effective treatment for controlling weeds followed by sodium acifluorfen 16.5% (165g/ha) + clodinafop propargyl 8% (80 g/ha) (POE) at 20 DAS + one hand weeding, propaquizafop 2.5% + imazathapyr 3.75% 50+75 g/ha (POE) at 15 DAS + one HW at 30 DAS, quizalofop-p-ethyl @ 50 g/ha (POE) at 20 DAS + one HW at 40 DAS, imazathapyr 75 g/ha (POE) at 20 DAS + one HW at 40 DAS.
- Almost all the growth and yield parameter measured in this study were higher under pendimethalin @ 1 kg/ha (PE) + one HW at 30 DAS and pendimethalin @ 1 kg/ha (PE) fb imazathapyr 75 g/ha (POE) at 20 DAS and seed yield per plant was also higher but it was not enough to compensate the yield on unit area basis because of plant population was (> 40 percent) lower as compared to other treatments which resulted in lower seed yield.
- The higher biological yield, grain yield and straw yield (3131, 1027, and 2103 kg/ha respectively) were found under two hand weeding at 15 and 30 DAS. Which was significantly superior over remaining treatments. Amongst the herbicidal treatments sodium acifluorfen 16.5% (165g/ha) + clodinafop propargyl 8% (80 g/ha) (POE) at 20 DAS + one hand weeding was found to better followed by propaquizafop 2.5% + imazathapyr 3.75% 50+75 g/ha (POE) at 15 DAS + one HW at 30 DAS. The yield between both treatments were comparable. It was lower under weedy check closely followed by pendimethalin @ 1 kg/ha (PE) + one HW 30 DAS, pendimethalin @ 1 kg/ha (PE) fb Emazathapyr 75 g/ha (POE) at 20 DAS.
- Two hand weeding at 15 and 30 DAS registered the economical treatments, followed by sodium acifluorfen 16.5% (165g/ha) + clodinafop propargyl 8% (80 g/ha) (POE) at 20 DAS + one hand weeding, propaquizafop 2.5% + imazathapyr 3.75% 50+75 g/ha (POE) at 15 DAS + one HW at 30 DAS, quizalofop-p-ethyl @ 50 g/ha (POE) at 20 DAS + one HW at 40 DAS and imazathapyr 75 g/ha (POE) at 20 DAS + one HW at 40 DAS.

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