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Effect of Herbicides on Growth, Yield and Economics of Urdbean (*Vigna mungo* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

A field experiment with the objectives to understand the effect of herbicides on weed infestation and blackgram yield involving herbicidal treatments (weedy check, hand weeding at 20 and 40 days after sowing, Pendimethalin 1000 g/ha (Pre-em), Imazethapyr 100 g/ha at 20 DAS, Fomesafen 250 g/ha at 20 DAS, Propaquizafop 100 g/ha at 20 DAS, Pendimethalin 1000 g/ha (Pre-em) *fb* Imazethapyr 100 g/ha at 20 DAS, Fomesafen 210 g/ha + propaquizafop 65 g/ha at 20 DAS was undertaken in RBD with three replications at Regional Research Sub-Center NARP, Saini, CSAUAT, Kanpur during kharif season 2021. Results revealed that sequential application of Pendimethalin 1000 g/ha (Pre-em) *fb* Imazethapyr 100 g/ha at 20 DAS recorded lower weed density, weed dry weight, weed index and the maximum WCE, crop yield as

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well as net returns and B-C ratio and was at par with Fomesafen 210 g/ha + propaquizafop 65 g/ha at 20 DAS over rest of the herbicidal treatments. Therefore, it is suggested that the sequential application of herbicides may be used for effective weed management and optimal yield of blackgram.

Keywords: Blackgram; economics; herbicides; weeds; WCE; yield; Vigna mungo.

1. INTRODUCTION

"Blackgram (*Vigna mungo* L) is one of the important nutritive pulse crops. In India, it is mostly grown in summer and rainy seasons, covering an area of 5.44 million hectares with total production of 3.56 million tones and average productivity of 655 kg/ha during 2017-18" [1]. "Major production of blackgram comes from the states of Madhya Pradesh, Rajasthan, Andhra Pradesh, Uttar Pradesh, Tamil Nadu, Maharashtra, Jharkhand, Gujarat, Karnataka and West Bengal. Although India is the largest producer and consumer of blackgram in the world, its realizable productivity is comparatively lower than the potential level" [2,3]. "Even blackgram productivity in the state of Uttar Pradesh is quite less than the national average [4]. Weeds are the principal biotic constraints in adversely influencing the productivity" [5]. "They compete for different growth-limiting resources like nutrient, moisture and light during critical period of crop-weed competition (first 20-40 days after sowing). Season long weed competition causes yield reduction to the extent of 27-84% depending on the kind and intensity of weed species" [6]. "Though hand weeding is usually preferred, it adds more to the cost of cultivation due to higher labour wages and does not ensure weed removal at the critical stages of crop-weed competition" [7]. Herbicidal weed management is cost effective but the identification of suitable herbicide and its efficacy is the most important to be known. Hence, evolving a suitable weed management strategy is essential to avoid yield loss. Thus a study was plan to conduct to evaluate the efficacy of different herbicides in blackgram at Regional Research Sub-Center NARP, Saini, Kaushambi, (UP) with an objective of identification of the best herbicide to effectively control weeds in blackgram.

2. MATERIALS AND METHODS

A fixed plot field experiment was carried out at Regional Research Sub Center NARP, Saini, Kaushambi, UP during *Kharif* season of 2021. This region comes under subtropical, climate with moderate rainfall. The soil of the experimental site falls under alluvial clay loam in texture, well drained and moderately fertile with good facility of irrigation. The experimental soil are with soil pH (7.58), low in organic carbon and available nitrogen and medium in available phosphorus and potassium. It was laid out in a Randomized Block Design with three replications and eight weed control treatments (weedy check, hand weeding at 20 and 40 days after sowing, Pendimethalin 1000 g/ha (Pre-em), Imazethapyr 100 g/ha at 20 DAS, Fomesafen 250 g/ha at 20 DAS, Propaquizafop 100 g/ha at 20 DAS, Pendimethalin 1000 g/ha (Pre-em) *fb* Imazethapyr 100 g/ha at 20 DAS, Fomesafen 210 g/ha + propaquizafop 65 g/ha at 20 DAS) with a gross plot size of 5m x 4 m^2 and net plot size of 4 m x 3 m^2. The 20+60+20 kg ha^{-1} N, P_2O5 and K_2O, respectively were applied as basal in the form of urea, DAP and MOP. Need based agronomic practices were performed for better growth and development of crop. Weed density and their dry weight were taken at 30 and 60 DAS of crop stage and also calculate the weed control efficiency. All the dada of crop growth and yield was recorded at the harvest. Cost incurred for completing experiment and returns was calculated based on the local market price (Grain Rs.70/kg and straw Rs. 2.50/kg). Recorded data was statistically analyzed by standard statistical procedure to draw a valid conclusion.

3. RESULTS AND DISCUSSION

3.1 Effects on Weed

Significantly the lowest weed density and their dry weight was recorded with the application of Pendimethalin 1000 g/ha (Pre-em) followed by Imazethapyr 100 g/ha (at 20 DAS) and it was statistically at par with Fomesafen 210 g/ha + propaquizafop 65 g/ha (20 DAS) and significantly superior over Pendimethalin 1000 g/ha (Pre-em), Imazethapyr 100 g/ha (at 20 DAS), Propaquizafop 100 g/ha (20 DAS), Fomesafen 250 g/ha (20 DAS), respectively. Same treatments was also recorded the highest weed

control efficiency with the lowest weed index. Similar results was reported by Verma *et al*. [8,9]. "However, two hand weeding at 20 and 40 DAS (weed free) was found more effective than the herbicides, due to slow pace of growth of first flush of weeds, 20 days after sowing thereafter the emergence of new flushes of weeds could not attain full growth under the shade of crop plants" [5,8,9].

3.2 Crop Growth

"Highest plant height and crop dry matter was recorded with Pendimethalin 1000 g/ha (Pre-em) followed by Imazethapyr 100 g/ha (at 20 DAS) in comparison to alone application of Pendimethalin 1000 g/ha (Pre-em), Imazethapyr 100 g/ha (at 20 DAS), Propaquizafop 100 g/ha (20 DAS), Fomesafen 250 g/ha (20 DAS), respectively and it was statistically at par with Fomesafen 210 g/ha + propaquizafop 65 g/ha (20 DAS) (Table 2) while, the statistically lowest plant height and crop dry matter was recorded under weedy check (T1). The reason for higher values on growth parameter can be discussed in the light of fact that crop under this treatment had comparatively less weed competition" [5,8,9]. "The reduction in weed competition in blackgram by the use of herbicides or hand weeding not only favoured the crop growth with abundant availability of moisture, nutrients, light and space, but also reduced over all weed interference, facilitating vigorous growth and development of crop plants" [8,9].

3.3 Yield Attributes

"The branches/plants, pod length, grains/pod and 1000 grain weight as affected by different treatments have been summarized (Table 3). The outcome of different weed control treatments was found significant. The number of branches/plants, pod length, grains/pod and 1000 grain weight was recorded significantly maximum under the treatment T_7 (Pendimethalin 1000 g/ha (Pre-em) followed by Imazethapyr 100 g/ha at 20 DAS) in comparison to alone application of Pendimethalin 1000 g/ha (Pre-em), Imazethapyr 100 g/ha (at 20 DAS), Propaquizafop 100 g/ha (20 DAS), Fomesafen 250 g/ha (20 DAS) respectively", [5,8,9] and "it was statistically at par with Fomesafen 210 g/ha + propaquizafop 65 g/ha (20 DAS). Higher yield attributes under these treatments may be due to lesser crop-weed competition, which gave better environment for crop growth and development of crop. Because in these treatments weed population and their growth were abstracted due to sequential control of weed flush by mentioned herbicide" [5,8,9].

3.4 Yield and Harvest Index

"The grain yield, straw yield, biological yield and harvest index was significantly influenced by the different weed control treatments over weedy check (Table 4). The minimum grain and straw yield was recorded in weedy check because of more weed growth and poor performance of yield attributing characters. The maximum yield and harvest index was recorded with the application of Pendimethalin 1000 g/ha (Pre-em) followed by Imazethapyr 100 g/ha (at 20 DAS) in comparison to alone application of Pendimethalin 1000 g/ha (Pre-em), Imazethapyr 100 g/ha (at 20 DAS), Propaquizafop 100 g/ha (20 DAS), Fomesafen 250 g/ha (20 DAS), respectively and it was statistically at par with Fomesafen 210 g/ha + propaquizafop 65 g/ha (20 DAS)" [5,8,9].

"Relative weed free situation under herbicidal treatments reduced the crop weed competition and thus lead to higher vegetative growth and yield attributes significantly affected the grain and straw yield. These results are corroborated with the research findings of" [5,8,9].

3.5 Economics

The treatment T_7 observed significantly maximum value of gross and net returns and the B-C ratio which was closely followed by treatment T_8 (Table 5) However, lowest net returns and B- C ratio was obtained in weedy check. This may be due to the proper growth and development of the crop as well as highest grain and straw yield obtained (T_7) and proportionally higher gross return than that of the cost of cultivation. Another possible reason that can be ascertained to these findings is that this could have happened due to the fact that all treatments associated with chemical weed control which was more remunerative than hand weeding. Similar results were reported by Verma *et al*. [8,9] and Verma *et al*. [5].

Table 1. Effect of herbicides on weeds in blackgram

Treatment	Weed density (m^2)		Weed dry weight (g/m^2)		Weed control efficiency (%) at 60 DAS	Weed index
T1-Weed check	120	180	19.20	41.4	-	55.5
T2-Weed free (hand weeding at 20 and 40 DAS)	0	0	0.00	0.0	100.0	-
T3-Pendimethalin 1000 g/ha (Pre-em)	35	54	5.60	12.42	70.0	10.1
T4-Imazethapyr 100 g/ha at 20 DAS	39	61	6.24	13.5	67.4	11.2
T5-Fomesafen 250 g/ha at 20 DAS	42	66	6.72	13.9	66.4	12.2
T6-Propaquizafop 100 g/ha at 20 DAS	49	74	7.84	14.1	65.9	13.9
T7-Pendimethalin 1000 g/ha (Pre-em) followed by Imazethapyr 100 g/ha at 20 DAS	10	32	1.60	7.36	82.2	3.6
T8-Fomesafen 210 g/ha + propaquizafop 65 g/ha at 20 DAS	20	37	3.20	8.51	79.4	6.3
CD (p=0.05)	11.2	16.3	2.6	3.4	6.9	-

Table 2. Effect of herbicides on plant height and crop dry weight of blackgram at harvest

Treatment	Plant height (cm)	Crop dry weight (g/plant)
T1-Weed check	32.4	7.43
T2-Weed free (hand weeding at 20 and 40 DAS)	39.1	11.06
T3-Pendimethalin 1000 g/ha (Pre-em)	37.4	9.68
T4-Imazethapyr 100 g/ha at 20 DAS	35.6	8.85
T5-Fomesafen 250 g/ha at 20 DAS	35.3	8.65
T6-Propaquizafop 100 g/ha at 20 DAS	33.7	8.53
T7-Pendimethalin 1000 g/ha (Pre-em) followed by Imazethapyr 100 g/ha at 20 DAS	38.7	10.15
T8-Fomesafen 210 g/ha + propaquizafop 65 g/ha at 20 DAS	38.5	10.07
CD (p=0.05)	1.5	0.9

Table 3. Effect of herbicides on yield attributes of blackgram

Treatment	Branches /plant	Pod length (cm)	Grains/pod	1000 grain weight (g)
T1-Weed check	3.76	5.47	6.25	36.4
T2-Weed free (hand weeding at 20 and 40 DAS)	5.71	6.32	7.29	51.0
T3-Pendimethalin 1000 g/ha (Pre-em)	4.95	5.93	6.89	44.5
T4-Imazethapyr 100 g/ha at 20 DAS	4.88	5.71	6.59	44.2
T5-Fomesafen 250 g/ha at 20 DAS	4.78	5.63	6.42	43.6
T6-Propaquizafop 100 g/ha at 20 DAS	4.60	5.56	6.35	42.9
T7-Pendimethalin 1000 g/ha (Pre-em) followed by Imazethapyr 100 g/ha at 20 DAS	5.67	6.32	7.19	50.5
T8-Fomesafen 210 g/ha + propaquizafop 65 g/ha at 20 DAS	5.52	6.13	7.02	50.1
CD (p=0.05)	0.21	0.36	0.22	3.5

Table 4. Effect of herbicides on yield and harvest index of blackgram

Treatment	Grain yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
T1-Weed check	397	799	1196	33.2
T2-Weed free (hand weeding at 20 and 40 DAS)	892	1696	2588	34.5
T3-Pendimethalin 1000 g/ha (Pre-em)	802	1620	2422	33.1
T4-Imazethapyr 100 g/ha at 20 DAS	792	1614	2406	32.9
T5-Fomesafen 250 g/ha at 20 DAS	783	1602	2385	32.8
T6-Propaquizafop 100 g/ha at 20 DAS	768	1595	2363	32.5
T7-Pendimethalin 1000 g/ha (Pre-em) followed by Imazethapyr 100 g/ha at 20 DAS	860	1649	2509	34.3
T8-Fomesafen 210 g/ha + propaquizafop 65 g/ha at 20 DAS	836	1640	2476	33.8
CD (p=0.05)	45	84	123	NS

Table 5. Effect of herbicides on yield and harvest index of blackgram

Treatment	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B-C ratio
T1-Weed check	22344	29787	7443	1.33
T2-Weed free (hand weeding at 20 and 40 DAS)	36224	66680	30456	1.84
T3-Pendimethalin 1000 g/ha (Pre-em)	23242	60190	36948	2.59
T4-Imazethapyr 100 g/ha at 20 DAS	23215	59475	36260	2.56
T5-Fomesafen 250 g/ha at 20 DAS	22800	58815	36015	2.58
T6-Propaquizafop 100 g/ha at 20 DAS	22650	57748	35098	2.55
T7-Pendimethalin 1000 g/ha (Pre-em) followed by Imazethapyr 100 g/ha at 20 DAS	24026	64323	40297	2.68
T8-Fomesafen 210 g/ha + propaquizafop 65 g/ha at 20 DAS	23521	62620	39099	2.66
CD (p=0.05)	-	2456	3268	0.06

4. CONCLUSION

It may be concluded that the treatment (T_7) Pendimethalin 1000 g/ha (Pre-em) followed by Imazethapyr 100 g/ha (at 20 DAS) was found to be the best treatment in terms of reducing weed infestation; and increasing crop growth, yield and economic returns of blackgram.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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