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RESEARCH NOTE

Herbicidal combinations for managing weeds and improving crop productivity in summer blackgram

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ABSTRACT

An experiment was conducted at the Students Instructional Farm, Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, India during summer season of 2018 to find out the most effective pre- and post-emergent herbicide combination for effective management of weeds in blackgram. Experiments consisted of ten treatments. The lowest weed density and biomass, weed index and highest weed control efficiency and blackgram yield as well as B:C ratio was observed with pre-emergence application (PE) of pendimethalin 1000 g/ha followed by post-emergence application (PoE) of imazethapyr 50 g/ha which was effective and economical in managing weeds in blackgram.

Keywords: Blackgram, Imazethapyr, Pendimethalin, Weed management, Weed control efficiency

Blackgram is the fourth most important crop after chickpea, pigeon pea and green gram in India. Weeds pose a serious problem and compete for nutrients, water and light, which could have otherwise boosted up crop productivity. Blackgram is not good competitor against weeds in the earlier stages of its growth and weed management plan is required to ensure proper crop growth and productivity (Singh and Singh 2020). Farmers use of herbicides in pulses is less as hand weeding or inter-cultivation are normally practiced Bhandari *et al.* (2004) reported that application of imazethapyr at 25 g/ha had no adverse effects on rain-fed blackgram and resulted in statistically comparable seed yield to that of hand weeding twice at 20 and 40 days after sowing (DAS). Hence, weed management with herbicides is an option to manage weeds and thereby increasing the productivity of blackgram. As the broad-spectrum weeds management with single herbicides may not be effective, herbicide combinations may be more beneficial (Nandan *et al.* 2011). Thus, the present experiment was conducted to test the performance of a few post-emergence herbicides in combination with pre-emergence herbicides for weed management during critical period of crop weed competition in blackgram during summer season.

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Field experiment was conducted during summer season of 2018 at Students' Instructional Farm, Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India. The soil of experimental field was alkaline in reaction (8.2 pH), low in available nitrogen (176.74 kg/ha) and medium in organic carbon (0.56%), available phosphorus (19.30 kg /ha) and potassium (217.80 kg/ha). The experiments consisted of 10 treatments: pre-emergence application (PE) of pendimethalin 1000 g/ha, post-emergence application (PoE) of imazethapyr 50 g/ha at 20 DAS, quizalofop 50 g/ha PoE at 25 DAS, pendimethalin 1000 g/ha PE followed by (*fb*) imazethapyr 50 g/ha PoE at 20 DAS, pendimethalin 1000 g/ha PE *fb* quizalofop 50 g/ha PoE at 25 DAS, pendimethalin 1000 g /ha PE *fb* one hand weeding at 20 DAS, imazethapyr 50 g/ha at 20 DAS *fb* quizalofop 50 g/ha at 25 DAS, hand weeding twice at 20 and 40 DAS, weed free and weedy check. A randomized block design with three replications was used. Blackgram variety *Shekher-2* was sown on 10th March, 2018 keeping 30 cm distance apart with a depth of 5-7 cm by using the local plough. The recommended dose of fertilizers (20 kg N + 60 kg P + 40 kg K/ha) was applied to crop at the time of sowing through di-ammonium phosphate (DAP), urea and muriate of potash (MOP). Pre-emergence application of herbicides was done on next day of sowing while post-emergence application of herbicides was done at 20 DAS and 25 DAS or 3-4 leaf stage of weeds as per treatment with the help of manually operated Knapsack sprayer fitted using flat fan nozzle using

500 litres of water/ha. Observations on individual weed density were recorded from three spot selected randomly from each plot at 45 DAS with the help of 0.5 x 0.5 m size quadrat. Weeds occurring in the quadrat were counted species wise and total number of weeds/m^2 was calculated by multiplying by 4.

Dry weight of weeds (biomass) was recorded at 45 DAS. After counting, weeds were cut close to the ground surface and sun dried for two days. After that the samples were dried in hot air oven at 70 ± 1 ^{0}C for 48 hours till attain constant weight and then dry weight of weed was recorded in g/m^2.

The data on weed density and biomass were put to square root transformation ($\sqrt{x+0.5}$) to normalize their distribution as per the procedure suggested by Gomez and Gomez (1984). The weed index was computed using formula of Gill and Kumar (1969). The Benefit: Cost Ratio (B:C) is the ratio of gross realisation to total cultivation cost calculated using the formula below.

$$\text{B:C} = \frac{\text{Gross realisation (Re/ha)}}{\text{Total cost of cultivation (Re/ha)}}$$

Effect on weeds

The major weeds in the experimental site were, broad-leaved weeds: *Trianthema monogyna* (horse purslane) and *Commelina benghalensis* (tropical spiderwort*)*, *Eclipta alba* (false daisy*)* and *Parthenium hysterophorus* (congress grass); grassy weeds: *Digitaria sanguinalis* and *Cynodon dactylon* (bermuda grass) and the sedge *Cyperus rotundus* (purple nut sedge). Weedy check recorded the highest weed density and biomass (**Table 1)** whereas, the lowest being observed under weed free. Hand weeding twice at 20 and 40 DAS proved most effective to reduce the weeds weed density and biomass. However, application of pendimethalin 1000 g/ha PE + one hand weeding at 20 DAS recorded the lowest density of all weeds at 45 DAS except *Digitaria sanguinalis* followed by pendimethalin 1000 g/ha PE + imazethapyr 50 g/ha PoE. Lower weed biomass was recorded with pendimethalin 1000 g/ha PE+ one hand weeding at 20 DAS as reported by Kumar and Tewari (2004) and pendimethalin 1000 g/ha PE + imazethapyr 50 g/ha PoE . Kumar and Tewari (2004) reported the very good control of *Trianthema monogyna* by pendimethalin.

Among herbicide-based treatments, pendimethalin 1000 g/ha PE + one hand weeding at 20 DAS gave maximum (52.89%) weed control efficiency followed by pendimethalin 1000 g/ha PE + imazethapyr 50 g/ha PoE which is 51.24%. Raju *et al. (*2017) observed higher WCE with application of pendimethalin 750 g /ha *fb* imazethapyr 75 g/ha. The maximum WCE was recorded with two hand weeding at 20 and 40 DAS and weed free.

The treatments having high WCE recorded lower value of weed index. The lowest weed index was observed under pendimethalin 1000 g/ha PE+ imazethapyr 50 g/ha PoE (3.92%) followed by pendimethalin 1000 g/ha PE + one hand weeding at 20 DAS (4.84%). Similar observation was also noted by Patel *et al*. (2015) in blackgram. The efficient control of weeds in combined application of pre- and post-emergent herbicides resulted in higher yield and lower weed index.

Table 1. Effect of weed control treatments on density and biomass of different weed species at 45 DAS in blackgram

Treatment	Weed density (no./m^2)							Total weed biomass (g/m^2)
	Trianthema monogyna	*Digitaria sanguinalis*	*Eclipta alba*	*Cyperus rotundus*	*Cynodon dactylon*	*Parthenium hysterophorus*	Total weed density	
Pendimethalin 1000 g/ha PE	2.35 (8.05)	2.75 (7.10)	3.05 (8.85)	10.66 (113.19)	3.53 (11.99)	3.64 (12.81)	13.09 (171)	9.84 (96.40)
Imazethapyr 50 g/ha at 20 DAS	2.73 (6.99)	2.57 (6.13)	2.70 (6.80)	10.79 (116.12)	3.54 (12.09)	3.60 (12.46)	12.97 (167.92)	9.30 (86.05)
Quizalofop 50 g/ha at 25 DAS	3.48 (11.63)	3.77 (10.89)	3.56 (12.20)	10.51 (110.01)	3.27 (10.21)	3.92 (14.92)	13.53 (182.64)	10.05 (100.61)
Pendimethalin 1000 g/ha PE + Imazethapyr 50 g/ha at 20 DAS	2.21 (4.40)	1.73 (2.51)	2.14 (4.11)	10.24 (104.41)	3.06 (8.91)	3.02 (8.63)	11.76 (138.01)	8.24 (67.47)
Pendimethalin 1000 g/ha PE + qquizalofop 50 g/ha at 25 DAS	2.64 (6.52)	2.55 (6.04)	2.60 (6.31)	10.11 (101.83)	2.98 (8.41)	3.10 (9.12)	12.04 (144.66)	8.90 (78.85)
Pendimethalin 1000 g/ha PE + one hand weeding at 20 DAS	2.18 (4.26)	2.10 (3.39)	2.07 (3.79)	8.64 (74.25)	2.90 (7.92)	2.77 (7.22)	10.29 (105.46)	7.96 (62.93)
Imazethapyr 50 g/ha at 20 DAS + quizalofop 50 g/ha at 25 DAS	2.44 (5.50)	2.49 (5.71)	2.57 (6.13)	10.05 (100.54)	2.86 (7.72)	3 (8.52)	11.76 (138.6)	8.38 (69.81)
Hand weeding twice (20 and 40 DAS)	2.00 (3.53)	1.76 (2.60)	1.95 (3.32)	7.63 (57.78)	2.57 (6.11)	2.18 (4.28)	9.03 (81.15)	7.48 (55.83)
Weed free	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.00
Weedy check	3.66 (12.93)	3.96 (15.21)	3.90 (15.21)	12.44 (154.46)	4.34 (18.39)	4.45 (19.37)	16.01 (255.83)	16.90 (285.24)
LSD (p=0.05)	0.210	0.257	0.350	0.396	0.833	0.261	1.014	0.773

Table 2. Effect of herbicides on weed control efficiency (WCE), weed control and yield of summer blackgram

Treatment	WCE (%) at 45 DAS	Weed Index (%)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)
Pendimethalin 1000 g/ha PE	41.77	25.11	820	2910	21.19
Imazethapyr 50 g/ha at 20 DAS	44.97	23.10	842	2932	22.31
Quizalofop 50 g/ha at 25 DAS	40.53	28.12	787	2853	21.62
Pendimethalin 1000 g/ha PE + imazethapyr 50 g/ha at 20 DAS	51.24	3.92	1052	3468	23.27
Pendimethalin 1000 g/ha PE + quizalofop 50 g/ha at 25 DAS	47.33	10.68	978	3312	22.79
Pendimethalin1000 g/ha PE + one hand weeding at 20 DAS	52.89	4.84	1042	3436	23.26
Imazethapyr 50g/ha at 20 DAS + quizalofop 50 g/ha at 25 DAS	50.41	5.47	1035	3405	23.30
Hand weeding twice (20 and 40 DAS)	55.73	3.01	1062	3552	23.01
Weed free	100	0.0	1095	3645	23.10
Weedy check	0	37.44	685	2640	20.60
LSD (p=0.05)			101	160	_

Table 3. Effect of weed management treatments on economics of summer blackgram

Treatment	Cost of cultivation ($x10^3$ `/ha)	Gross return ($x10^3$ `/ha)	Net return ($x10^3$ `/ha)	B:C ratio
Pendimethalin 1000 g/ha PE	30.50	61.74	31.24	2.02
Imazethapyr 50 g/ha at 20 DAS	30.62	63.06	32.44	2.05
Quizalofop 50 g/ha at 25 DAS	30.91	59.62	28.71	1.92
Pendimethalin 1000 g/ha PE + imazethapyr 50 g/ha at 20 DAS	31.76	77.62	45.86	2.44
Pendimethalin 1000 g/ha PE + quizalofop 50 g/ha at 25 DAS	32.10	72.68	40.59	2.26
Pendimethalin1000 g/ha PE + one hand weeding at 20 DAS	34.25	76.88	42.64	2.24
Imazethapyr 50g/ha at 20 DAS + quizalofop 50 g/ha at 25 DAS	32.22	76.32	44.10	2.30
Hand weeding twice (20 and 40 DAS)	36.56	78.66	42.10	2.15
Weed free	40.56	81.00	37.13	1.99
Weedy check	29.31	50.59	18.31	1.72

Effect on blackgram

The highest blackgram seed yield (1052 kg/ha) was recorded with the pendimethalin 1000 g/ha PE *fb* imazethapyr 50 g/ha PoE with an increase in the seed yield of 34.8% over the weed check followed by pendimethalin 1000 g /ha PE *fb* one hand weeding at 20 DAS. The weed free treatment noted the highest increase in yield of seed by 37.4% over the weedy check. Crop yield was inversely associated with the density of weeds. The weedy check caused 37.40% reduction in seed yield, when compared to weed free. Harisha *et al*. (2021) also recorded higher seed yield with lower weed index under twice hand weeding treatment. Biological yield was found to be significantly higher with the application of pendimethalin 1000 g/ha PE+ imazethapyr 50 g/ha PoE with highest harvest index. The cost of weed management practices has influenced the total cost of cultivation in blackgram. The highest benefit-cost ratio (2.44), gross return as well as net return was realised with pendimethalin 1000 g/ha PE+ imazethapyr 50 g/ha PoE.

It was concluded that pendimethalin 1000 g/ha PE *fb* imazethapyr 50 g/ha PoE and pendimethalin 1000 g/ha PE *fb* one hand weeding at 20 DAS could be the best possible alternative options for effective and economic weed management in blackgram.

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