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RESEARCH NOTE

Efficacy of pre- and post-emergence herbicides on weed flora and nutrient uptake by weeds and blackgram

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ABSTRACT

The field experiment was carried out at Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India, during the *Kharif* season of 2018 to study the efficacy of pre- and post-emergence herbicides on suppressing weed flora and nutrients uptake by weed and blackgram (*Phaseolus mungo*) crop. The experiment was laid out with eleven treatments in a randomised complete block design with three replications. Nine weed species (one sedges, two grassy and six broad-leaved) belonging to eight families were found dominant in blackgram. Among the major sedges observed in the experimental plot, *Cyperus rotundus* (Cyperaceae) was the most dominant and aggressive weed. Some grass weeds were *Echinochola colona* (Poaceae) and *Cynodon dactylon* (Cyperaceae) whereas broad-leaved included *Phyllanthus niruri ((Phyllanthaceae), Solanum nigrum ((Solanaceae), Trianthema portulacastrum (Aizoaceae), Cucumis melo (*Cucurbitaceae), *Cleome gynandra (Capparaceae) and Mimosa pudica (Fabaceae).* A significant reduction in weed flora was observed in weed free plot, further among the herbicidal treatments' pre-emergence application of pendimethalin 30 EC 75 kg/ha followed by imazethapyr 0.060 kg/ha as post-emergence reduced the weed flora at 15, 30, 45 and 60 Days after sowing respectively. The lowest nutrient depletion by weed, highest seed yield (925 kg/ha), net return (₹ 48549/ha), B: C ratio (2.65) and nutrient uptake by blackgram were recorded with pre-emergence pendimethalin 30 EC 0.75 kg/ha followed by imazethapyr 0.060 kg/ha as post-emergence.

Key words: Blackgram, B: C ratio, Nutrient uptake, Pod yield, Weed flora

Blackgram (*Phaseolus mungo* L.) is the major *Kharif* pulse crops and the third most widely produced pulse crop in India after chickpea and pigeon pea. It is rich source of protein (24%), fat (1-5%), carbohydrates (60%), amino acids, minerals and vitamin. Blackgram fix nitrogen up to 20-80 kg/ha Hayat *et al.* (2008). This crop faces Critical period of crop-weed competition at 20-40 DAS (Singh *et al.* 2016). Crop weed competition leads to 50-70% reduction in seed yield of blackgram. The magnitude of loss as a result of crop weed competition depends upon type of weed species, associated with crop and duration of labour in time and field accessibility during *Kharif* season becomes the constrain in timely control of weeds. Hence selective pre- and post-emergence herbicide can one of the best alternatives for economical and timely weed control in blackgram. Therefore, keeping the facts in mind, the present study was undertaken to evaluate the performance of herbicide weed management in providing effective control on blackgram.

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The experiments were conducted in the Bihar Agricultural University (B.A.U.) Sabour, Bhagalpur, Bihar (25°23'N latitude and 87°07'E longitude with an altitude of 37.19 m above mean sea level), during the 2018 *Kharif* season. The experimental site was located in the Southern region of Bihar. The soil of the experimental site was well-drained sandy-loam in texture, comprising 47.4% sand, 32.6% silt and 19.6% %.Before the start of the experiment the initial reading of the soil pH was neutral (pH 7.4), low available nitrogen (206.20 kg/ha), medium available phosphorous (19.23 kg/ha) and potassium (168.42 kg/ha),low in organic carbon (0.46%), with electrical conductivity of 0.032 dS/m. Cumulative rainfall recorded was 248.7mm during experiment period from 13-19August to 19-25 November,2018 which was 916.3mm less than the normal rainfall (1165 mm) for this location. The experiment comprises of 11 treatment combinations (**Table 1**) were assigned in a randomized block design with three replications.

A knapsack sprayer equipped with a flat fan nozzle was used to apply pendimethalin (pre-emergence) 30 EC 0.75 kg/ha and Oxyfluorfen (pre-emergence) 23.5 EC 0.125 kg/ha were sprayed at within 24 hours of sowing, Fenoxaprop p-ethyl (post-emergence) 10 EC at 0.010 kg/ha, imazethapyr

(post-emergence) 10 SL 0.060 kg/ha, and quizalofop-p-ethyl (post-emergence) 5 EC 0.05 kg/ha at 23–25 days after sowing, using 500 litres of water per hectare. In case of Interculture operation, weeds were removed manually with a Trowel at 20 and 40 Days after sowing. In the case of weed control plots, weeds were allowed and in weed-free plots, weeds were removed with a Trowel tool during the growing season of the crop.

Seed of blackgram, variety "*IPU 2-43*" were sown in lines at the rate of 22-25 kg/ha and a depth of 2-3 cm maintaining spacing between plant to plant and row to row 30 x10 cm. The area of gross plot was 4.2 x 3.6 m^2, while net plot was 4 x 3 m^2. The crop was fertilized with 20-60-40 kg N-P-K/ha through Urea, Single super phosphate and Muriate of potash respectively. The crop was sown on 18th August and harvested at 20th November 2018.

Data on weeds were counted separately with in a random quadrat (50 x 50 cm) in each plot at 15, 30,45 and 60 DAS and expressed as number of no./ m^2. Weeds were cut near ground level in a quadrat in each plot and dried at 65°C for 48 hours to constant weight. At 15, 30, 45, and 60 days after sowing, the number of weeds was identified species wise from two spots selected randomly in each plot through a quadrat of 50 x 50 cm and expressed as number per meter square area. The average of the two counts was calculated and expressed in terms of weed count per m^2.Species wise (grass, sedge and subjected to square root transformation before statistical analysis to normalize their distribution. Seed yield was recorded from the net plot area and converted to kg/ ha.Net returns as well as benefit: cost (B:C) ratio were also worked out. Data obtained on the number of weeds, nutrient uptake by crop, and nutrient removal by weeds were tabulated and statistical analysis was performed using a randomized block design (RBD) with three replicates. Two–way ANOVA was performed to assess the variability of treatments and its spatial variability with depth Gomez and (Gomez 1984). The standard error of mean (SEm±) and the value of LSD (p=0.05) were indicated in the tables to compare the difference between the mean value.

Weed flora

Cypres rotundus (sedges) was the most prevalent weed at the experimental site, while *Cynodon dactylon* and *Echinochloa colona* were the most common grasses. Many types of broad-leaf weeds were also recorded during the crop growth period and prominent broad-leaf weeds were *Phyllanthus niruri, Trianthema portulacastrum, Mimosa pudica* (sweet melon), *Cucumis melo, Cleome gynandra* and *Solanum nigrum*. Similar weed flora has also been reported by Pankaj and Dewangan (2017) in their experiment. All the herbicide combination were found effective in supressing the different weed flora as compare to the weedy check at different stages of the crop. The most weeds were found in the weedy check, followed by the intercultural operation at 20 and 40 days after sowing at 15 days after sowing. (**Table 1**.). Out of these, weeds sedges have been found in the greatest number followed by weeds. In different herbicide treatments, higher weed flora was observed with the application of (pre-emergence) oxyfluorfen 23.5 EC 0.125 kg/ha followed by (pre-emergence) pendimethalin 30 EC 0.75 kg/ha. At 30, 45 and 60 DAS among chemical treatments (**Table 2, 3** and **4** respectively) total lowest numbers of different weed flora were recorded with Pendimethalin (pre-emergence) 30 EC 0.75 kg/ha followed by imazethapyr (post-emergence) 0.060 kg/ ha which was statistically at par with treatment oxyfluorfen 0.125 followed by imazethapyr 0.060 kg/ ha.

Nutrient uptake by crop and weed

Significant decrease in total N, P and K uptake by weed were recorded due to all weed management practices over weedy check (**Table 5**).

All weed control treatments significantly increased N, P, and K uptake by seed and straw compared to the weedy check. Weed free treatment resulted in significantly highest total uptake of N (71.76 kg/ha), P (13.22 kg/ha), and K (53.37 kg/ha) by the crop compared to weedy check (30.83, 5.94 and 25.53 kg/ha), respectively. The possible reason for better nutrient uptake by crop could be attributed to more favourable environment for growth and development of crop plants apparently due to lesser weed competition which led to increased growth of crop and thereby increase in nutrient uptake by accumulation of higher amount of nutrients in blackgram seeds.

Nutrient uptake by weed

The removal of N, P and K by weeds was reduced significantly by various herbicidal interventions and it was found negligible under weed-free treatment, whereas significantly highest N, P and K uptake by weeds was recorded in the weedy check treatment (**Table 5**). This could possibly be attributed to luxuriant growth of unchecked weeds in weedy check treatment. These results corroborate the findings of Kaur *et al.* (2010). Among the herbicidal

Table 1. Effect of major weed flora (no./m^2) at 15 DAS as influenced by weed control treatment in blackgram

Treatment	Sedge	Grasses		Broad-leaved						Total
	Cyperus rotundus	*Cynodon dactylon*	*Echinochloa colona*	*Trianthema portulacastrum*	*Phyllanthus niruri*	*Solanum nigrum*	*Mimosa pudica*	*Cucumis melo*	*Cleome gynandra*	
Pendimethalin 0.75 kg/ha	4.30 (18.0)	2.17 (4.2)	1.36 (1.3)	1.22 (1.0)	2.86 (7.7)	1.34 (1.3)	1.58 (2)	1.87 (3)	1.22 (1)	6.33 (39.4)
Oxyfluorfen 0.125 kg/ha	4.26 (17.7)	2.59 (6.2)	1.67 (2.3)	1.87 (3.0)	2.61 (6.3)	1.79 (2.7)	1.58 (2)	2.02 (3.6)	1.22 (1)	6.73 (44.77)
Pendimethalin 0.75 *fb* imazethapyr 0.060 kg/ha	4.18 (17.0)	2.34 (5.0)	1.41 (1.5)	1.41 (1.5)	2.17 (4.2)	1.41 (1.5)	1.34 (1.3)	1.22 (1)	0.89 (0.3)	5.81 (33.3)
Pendimethalin 0.75 *fb* fenoxaprop 0.10 kg/ha	4.26 (17.7)	2.13 (4.0)	1.92 (3.2)	1.48 (1.7)	2.05 (3.7)	0.89 (0.3)	1.48 (1.7)	2.26 (4.6)	0.71 (0)	6.11 (36.9)
Pendimethalin 0.75 *fb* quizalofop 0.05 kg/ha	4.30 (18.0)	2.35 (5.0)	1.67 (2.3)	1.34 (1.3)	2.68 (6.7)	1.10 (0.7)	1.22 (1)	1.95 (3.3)	1.10 (0.7)	6.29 (39.04)
Oxyfluorfen 0.125 *fb* imazethapyr 0.060 kg/ha	4.26 (17.7)	2.40 (5.2)	1.30 (1.2)	1.34 (1.3)	2.28 (4.7)	1.55 (1.9)	0.89 (0.3)	1.70 (2.4)	0.89 (0.3)	5.96 (35.02)
Oxyfluorfen 0.125 *fb* fenoxaprop 0.10 kg/ha	4.14 (16.7)	2.39 (5.2)	1.67 (2.3)	1.48 (1.7)	2.68 (6.7)	1.22 (1)	1.34 (1.3)	2.19 (4.3)	0.71 (0)	6.30 (39.17)
Oxyfluorfen 0.125 *fb* quizalofop 0.05 kg/ha	4.10 (16.3)	2.72 (6.9)	1.70 (2.4)	0.71 (0)	1.58 (2)	1.58 (2)	1.87 (3)	1.87 (3)	0.71 (0)	6.01 (35.61)
Hand weeding 20 and 40 DAS	4.64 (21.0)	3.32 (10.5)	3.24 (10)	1.22 (1)	1.48 (1.7)	1.45 (1.6)	1.10 (0.7)	2.19 (4.3)	1.05 (0.6)	7.20 (51.4)
Weedy check	4.74 (22.0)	3.55 (12.1)	3.06 (8.9)	1.34 (1.3)	1.10 (0.7)	1.84 (2.9)	1.52 (1.8)	2.34 (5)	1.22 (1)	7.49 (55.7)
Weed free	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)
SE m ±	0.08	0.04	0.03	0.02	0.04	0.02	0.02	0.03	0.01	0.12
LSD (p=0.05)	0.23	0.13	0.10	0.06	0.11	0.06	0.06	0.09	0.03	0.35

Table 2. Effect of major weed flora (no./m^2) at 30 DAS as influenced by weed control treatment in blackgram

Treatment	Sedge	Grasses		Broad-leaved						Total
	Cyperus rotundus	*Cynodon dactylon*	*Echinochloa colona*	*Trianthema portulacastrum*	*Phyllanthus niruri*	*Solanum nigrum*	*Mimosa pudica*	*Cucumis melo*	*Cleome gynandra*	
Pendimethalin 0.75 kg/ha	5.92 (34.6)	3.27 (10.2)	2.02 (3.6)	0.84 (0.2)	2.59 (6.2)	1.41 (1.5)	0.89 (0.2)	0.71 (0)	1.70 (2.4)	7.70 (58.90)
Oxyfluorfen 0.125 kg/ha	6.14 (37.23)	3.87 (14.5)	2.17 (4.2)	0.71 (0)	2.85 (7.6)	1.30 (1.2)	0.71 (0)	1.76 (2.6)	1.48 (1.7)	8.34 (69.03)
Pendimethalin 0.75 *fb* imazethapyr 0.060 kg/ha	3.96 (15.23)	2.95 (8.23)	1.38 (1.4)	1.22 (1)	1.58 (2)	0.71 (0)	0.89 (0.3)	0.71 (0)	1.05 (0.6)	5.41 (28.76)
Pendimethalin 0.75 *fb* fenoxaprop 0.10 kg/ha	4.85 (23)	2.85 (7.6)	1.76 (2.6)	0.95 (0.4)	1.92 (3.2)	0.71 (0)	1.22 (1)	1.22 (1)	0.84 (0.2)	6.28 (39.00)
Pendimethalin 0.75 *fb* quizalofop 0.05 kg/ha	5.84 (33.58)	2.97 (8.3)	2.26 (4.6)	0.89 (0.3)	2.12 (4)	0.89 (0.3)	0.71 (0)	1.05 (0.6)	1.22 (1)	7.29 (52.68)
Oxyfluorfen 0.125 *fb* imazethapyr 0.060 kg/ha	4.01 (15.63)	2.99 (8.43)	1.64 (2.2)	0.84 (0.2)	1.87 (3)	0.71 (0)	1.30 (1.2)	0.71 (0)	0.71 (0)	5.58 (30.66)
Oxyfluorfen 0.125 *fb* fenoxaprop 0.10 kg/ha	4.25 (17.6)	2.95 (8.2)	1.58 (2)	0.95 (0.4)	2.12 (4)	0.84 (0.2)	1.22 (1)	1.05 (0.6)	0.71 (0)	5.87 (34.00)
Oxyfluorfen 0.125 *fb* quizalofop 0.05 kg/ha	4.70 (21.6)	3.02 (8.6)	2.55 (6)	0.71 (0)	2.34 (5)	0.71 (0)	1.14 (0.8)	0.71 (0)	1.22 (1)	6.59 (43.00)
Hand weeding 20 and 40 DAS	3.70 (13.23)	3.03 (8.7)	2.85 (7.6)	0.71 (0)	2.34 (5)	0.71 (0)	0.71 (0)	1.05 (0.6)	1.22 (1)	6.05 (36.13)
Weedy check	7.36 (53.65)	4.37 (18.57)	3.18 (9.6)	1.30 (1.2)	3.33 (10.6)	1.55 (1.9)	1.10 (0.7)	1.26 (1.1)	2.17 (4.2)	10.10 (101.52)
Weed free	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)
SE m ±	0.09	0.06	0.04	0.01	0.04	0.01	0.01	0.01	0.02	0.13
LSD (p=0.05)	0.27	0.17	0.11	0.03	0.12	0.03	0.03	0.04	0.05	0.38

treatments at different intervals, significantly lowest values of N, P and K uptake by weeds were recorded with the application of pendimethalin (pre-emergence) 30 EC 0.75 kg/ha followed by imazethapyr (post-emergence) 0.060 kg/ha followed by oxyfluorfen (pre-emergence) 0.125 kg/ha followed by imazethapyr (post-emergence) 10 SL 0.060 kg/ha 23-25 days after sowing showed relatively better efficacy against weeds whose infestation was predominantly lower in these relatively superior herbicidal treatments. Similar findings were made by Komal *et al.* (2015) and Kavad *et al.* (2016). Reduced-nutrient uptake by weeds under the influence of different weed control measure had also reported by Kavad *et al.* (2016) and Mahajan *et al.* (2022).

Table 3. Effect of major weed flora (no./m²) at 45 DAS as influenced by weed control treatment in blackgram

Treatment	Sedge	Grasses		Broad-leaved						Total
	Cyperus rotundus	*Cynodon dactylon*	*Echinochloa colona*	*Trianthema portulacastrum*	*Phyllanthus niruri*	*Solanum nigrum*	*Mimosa pudica*	*Cucumis melo*	*Cleome gynandra*	
Pendimethalin 0.75 kg/ha	5.85	3.09	1.80	1.36	0.91	1.46	0.90	1.59	2.25	7.50
	(33.75)	(9.05)	(2.75)	(1.35)	(0.32)	(1.63)	(0.31)	(2.02)	(4.55)	(55.73)
Oxyfluorfen 0.125 kg/ha	6.05	3.77	1.88	1.82	0.71	1.96	0.71	1.80	2.08	8.13
	(36.08)	(13.75)	(3.05)	(2.81)	(0)	(3.34)	(0)	(2.73)	(3.84)	(65.59)
Pendimethalin 0.75 *fb*	3.82	2.75	0.74	1.24	0.76	0.71	1.35	0.71	1.10	4.98
imazethapyr 0.060 kg/ha	(14.08)	(7.08)	(0.05)	(1.04)	(0.08)	(0)	(1.33)	(0)	(0.71)	(24.36)
Pendimethalin 0.75 *fb*	4.82	2.69	1.50	1.36	1.46	0.71	1.23	1.23	0.89	6.09
fenoxaprop 0.10 kg/ha	(22.75)	(6.75)	(1.75)	(1.35)	(1.62)	(0)	(1.02)	(1.02)	(0.3)	(36.57)
Pendimethalin 0.75 *fb*	5.74	2.71	2.06	1.24	1.76	1.39	0.71	1.49	0.71	7.09
quizalofop 0.05 kg/ha	(32.42)	(6.85)	(3.75)	(1.04)	(2.59)	(1.42)	(0)	(1.72)	(0)	(49.79)
Oxyfluorfen 0.125 *fb*	3.86	2.79	1.24	1.26	1.38	0.71	1.35	0.71	0.71	5.20
imazethapyr 0.060 kg/ha	(14.42)	(7.28)	(1.05)	(1.08)	(1.4)	(0)	(1.33)	(0)	(0)	(26.56)
Oxyfluorfen 0.125 *fb*	4.09	2.75	1.50	1.61	1.26	1.35	1.01	1.10	0.71	5.59
fenoxaprop 0.10 kg/ha	(16.25)	(7.05)	(1.75)	(2.08)	(1.08)	(1.31)	(0.53)	(0.71)	(0)	(30.76)
Oxyfluorfen 0.125 *fb*	4.61	2.87	2.50	1.36	1.63	0.71	1.53	1.49	0.71	6.47
quizalofop 0.05 kg/ha	(20.75)	(7.75)	(5.75)	(1.35)	(2.16)	(0)	(1.84)	(1.73)	(0)	(41.33)
Hand weeding 20 and 40	3.05	2.29	1.80	1.10	1.38	0.71	0.71	1.10	0.71	4.43
DAS	(8.8)	(4.75)	(2.75)	(0.7)	(1.4)	(0)	(0)	(0.7)	(1)	(19.1)
Weedy check	7.27	4.23	3.04	1.82	2.01	1.85	2.09	1.93	1.96	9.94
	(52.42)	(17.42)	(8.75)	(2.81)	(3.56)	(2.93)	(3.88)	(3.24)	(3.33)	(98.34)
Weed free	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
SE m ±	0.09	0.05	0.03	0.02	0.02	0.06	0.02	0.02	0.02	0.12
LSD (p=0.05)	0.27	0.16	0.09	0.06	0.06	0.16	0.05	0.05	0.06	0.36

Table 4. Effect of major weed flora (no./m²) at 60 DAS as influenced by weed control treatment in blackgram

Treatment	Sedge	Grasses		Broad-leaved						Total
	Cyperus rotundus	*Cynodon dactylon*	*Echinochloa colona*	*Trianthema portulacastrum*	*Phyllanthus niruri*	*Solanum nigrum*	*Mimosa pudica*	*Cucumis melo*	*Cleome gynandra*	
Pendimethalin 0.75 kg/ha	5.65	2.70	0.95	0.92	1.68	2.26	1.95	1.23	1.40	7.21
	(31.45)	(6.78)	(0.40)	(0.34)	(2.31)	(4.62)	(3.21)	(1.01)	(1.45)	(51.57)
Oxyfluorfen 0.125 kg/ha	5.85	3.45	1.10	1.14	1.75	2.20	1.22	1.49	1.11	7.58
	(33.73)	(11.40)	(0.70)	(0.80)	(2.55)	(4.33)	(1.00)	(1.72)	(0.74)	(56.97)
Pendimethalin 0.75 *fb*	3.50	2.29	0.71	1.23	1.60	0.71	1.32	0.71	0.71	4.61
imazethapyr 0.060 kg/ha	(11.73)	(4.73)	(0.00)	(1.02)	(2.07)	(0)	(1.23)	(0)	(0)	(20.78)
Pendimethalin 0.75 *fb*	4.58	2.22	1.47	0.91	1.76	1.22	0.71	1.23	0.84	5.67
fenoxaprop 0.10 kg/ha	(20.45)	(4.45)	(1.65)	(0.32)	(2.61)	(1.00)	(0)	(1.01)	(0.20)	(31.69)
Pendimethalin 0.75 *fb*	5.53	2.25	1.38	1.23	1.75	1.68	0.71	1.06	0.71	6.57
quizalofop 0.05 kg/ha	(30.15)	(4.56)	(1.40)	(1.02)	(2.58)	(2.32)	(0)	(0.62)	(0)	(42.65)
Oxyfluorfen 0.125 *fb*	3.56	2.35	1.22	1.25	1.70	0.71	1.32	0.71	0.71	4.83
imazethapyr 0.060 kg/ha	(12.15)	(5.01)	(1.00)	(1.07)	(2.39)	(0)	(1.23)	(0)	(0)	(22.85)
Oxyfluorfen 0.125 *fb*	3.74	2.28	1.47	1.60	1.25	1.34	0.96	1.05	0.71	5.08
fenoxaprop 0.10 kg/ha	(13.52)	(4.70)	(1.65)	(2.06)	(1.07)	(1.29)	(0.43)	(0.71)	(0)	(25.33)
Oxyfluorfen 0.125 *fb*	4.35	2.43	1.97	0.92	1.91	1.58	1.11	1.06	0.71	5.88
quizalofop 0.05 kg/ha	(18.45)	(5.40)	(3.40)	(0.34)	(3.15)	(2.00)	(0.74)	(0.63)	(0)	(34.11)
Hand weeding 20 and 40	2.85	2.04	1.47	1.10	1.82	1.70	0.71	1.05	1.07	4.54
DAS	(7.65)	(3.65)	(1.65)	(0.70)	(2.80)	(2.40)	(0)	(0.60)	(0.65)	(20.10)
Weedy check	6.75	4.06	2.83	1.14	3.15	2.33	1.87	1.62	1.32	9.52
	(45.10)	(16.00)	(7.50)	(0.80)	(9.43)	(4.92)	(3.00)	(2.14)	(1.23)	(90.12)
Weed free	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
	(0)	(0)	(0)	(0.00)	(0)	(0)	(0)	(0)	(0)	(0)
SE m ±	0.08	0.05	0.02	0.01	0.03	0.02	0.02	0.01	0.01	0.11
LSD (p=0.05)	0.25	0.13	0.07	0.04	0.09	0.07	0.05	0.04	0.03	0.34

Effect on crop yield

Weed free (1024 kg/ha) recorded the highest seed yield followed by interculture operation 20 and 40 DAS (950 kg/ha) and among the chemical treatment pendimethalin (pre-emergence) 30 EC 0.75 kg/ha followed by imazethapyr (post-emergence) 0.060 kg/ha (925 kg/ha). Weed free plot was significantly superior to all other treatments in respect of yield whereas minimum yield was obtained under weed control treatment (399 kg/ha).

Economics

The economic feasibility and utility of a treatment could be properly determined in terms of benefit: cost ratio and net returns (**Table 5**). The maximum net returns were obtained from the weed free plots, followed by treatment. among the herbicide treatment maximum net return (₹ 48549/ha) with benefit cost ratio (BCR) of 2.65 was obtained under treatment pendimethalin (pre-emergence) 30 EC 0.75 kg/ha followed by imazethapyr (post-

Table 5. Effect of different weed management practices on nutrient uptake by crop, weed, grain yield, net returns and B: C ratio in blackgram

Treatment	Nutrient uptake by crop (kg/ha)			Nutrient uptake by weeds (kg/ha)			Seed yield (kg/ha)	Net returns (x10^3 ₹/ha)	B:C ratio
	N	P	K	N	P	K			
Pendimethalin 0.75 kg/ha	44.55	6.54	35.22	15.98	6.85	15.78	560	25.69	1.51
Oxyfluorfen 0.125 kg/ha	42.72	8.34	34.04	17.62	6.97	17.30	558	24.16	1.34
Pendimethalin 0.75 *fb* imazethapyr 0.060 kg/ha	65.58	13.11	50.01	6.60	2.40	6.26	925	48.55	2.65
Pendimethalin 0.75 *fb* fenoxaprop 0.10 kg/ha	62.95	12.71	47.32	6.66	3.43	6.31	885	44.80	2.32
Pendimethalin 0.75 *fb* quizalofop 0.05 kg/ha	62.14	11.91	46.66	8.86	2.83	8.48	860	43.55	2.27
Oxyfluorfen 0.125 *fb* imazethapyr 0.060 kg/ha	64.80	12.64	48.33	7.08	3.63	8.95	892	45.69	2.37
Oxyfluorfen 0.125 *fb* fenoxaprop 0.10 kg/ha	62.45	12.94	47.03	9.52	3.75	6.72	865	42.71	2.10
Oxyfluorfen 0.125 *fb* quizalofop 0.05 kg/ha	60.53	12.82	47.70	10.36	4.08	9.89	814	40.06	1.99
Hand weeding 20 and 40 DAS	67.39	13.62	51.29	5.74	2.40	5.44	950	44.52	1.86
Weedy check	30.83	5.94	25.53	21.61	8.96	21.17	399	14.51	0.89
Weed free	71.76	13.22	53.37	0.00	0.00	0.00	1024	46.79	1.77
LSD (p=0.05)	6.71	1.32	5.12	2.58	1.37	2.88	92.81	6.77	0.34

emergence) 0.060 kg/ha which was at par with oxyfluorfen (pre-emergence) 0.125 kg/ha followed by imazethapyr (post-emergence) 0.060 kg/ha with net retruns of (₹ 45686/ha) and BCR 2.37 as compared to interculture operation 20 and 40 DAS (BCR of 1.86) (**Table 5**). weedy check recorded the lowest net returns (₹ 14509/ha)with minimum BCR (0.89), This could be because of the low yield obtained in this treatment due to severe weed competition. These results were in harmony with the finding of Sakthi *et al.* (2018).

It can be concluded that among the different herbicides, pre-emergence followed by post-emergence application of pendimethalin (pre-emergence) 30 EC 0.75 kg/ha *fb* imazethapyr (post-emergence) 0.060 kg/ha improve the grain yield of blackgram by effectively controlling the weeds, lowest values of N, P and K uptake by weeds and provides highest net return (₹ 48549/ha) and B: C ratio (2.65).

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