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Pre and post emergence herbicides for weed control in blackgram (*Vigna mungo* L.)

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Abstract

A field experiment was conducted to study the pre and post emergence herbicides for weed control in blackgram at Agricultural Research Station, Anand Agricultural University, Derol, Gujarat, India during *Kharif*, 2016-17, 2017-18 and 2018-19. Eight treatments were studied in randomized block design with three replications. Among the different weed management practices, post-emergence (20 - 25 DAS) application of propaquizalafop 10% EC 75 g a.i./ha *fb* IC + HW at 30 DAS or quizalofop-ethyl 5% EC 50 g a.i./ha *fb* IC + HW at 30 DAS or fenoxaprop-p-ethyl 9% EC 67.5 g a.i./ha *fb* IC + HW at 30 DAS most efficient in reducing weed density, weed dry weight, weed index as well as higher weed control efficiency, seed yield, haulm yield, net return and BC ratio of blackgram.

Keywords: Herbicides, seed, haulm, weed dry weight (WDW)

Introduction

Blackgram [*Vigna mungo* (L.) Hepper] is one of the most important pulse crop grown throughout the country during *kharif* season. It contributes about 13 per cent of total pulse area and 10 per cent of their total production in our country. In India, blackgram is cultivated in area of 52.79 lakh hectare with the production and productivity of 34.92 lakh tonne and 662 kg/ha, respectively [1]. It is extensively grown in the states of Madhya Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka and Uttar Pradesh. The crop can be grown on all types of soils ranging from sandy loam to heavy clay except the alkaline and saline soil. In Gujarat, blackgram is cultivated in an area of about 1.36 lakh hectare, with the production of 0.87 lakh tonne and productivity of 636 kg/ha [1]. The lower productivity of blackgram was mainly due to higher weed infestation during early stages of crop growth which leads to reduction in yield up to 43.2-64.1 per cent in blackgram (Rathi *et al.*, 2004) [9]. Therefore, removal of weeds at appropriate time using a suitable weed control practices is essential to obtain higher yield of blackgram. In blackgram, weeds could be controlled by hand weeding (Chand *et al.*, 2004) [3] however, it is laborious, time consuming, costly and tedious. Moreover, many times labour is not available at the critical period of crop weed competition. Furthermore, during rainy season weather conditions do not permit timely hand weeding due to wet field conditions. Hence, use of herbicides offers an alternative for possible effective control of weeds. Therefore, the present study was conducted to study the pre and post emergence herbicides for weed control in *kharif* blackgram.

Materials and Methods

The field experiment was conducted at Agricultural Research Station, Anand Agricultural University, Derol, Panchmahal (Gujarat) during three consecutive *kharif* seasons of the year 2016-17, 2017-18 and 2018-19. The soil of the experimental field was loamy sand in texture having low in available nitrogen and medium in available phosphorus and high in potassium with pH 8.2. The experiment was laid out in randomized block design with three replications. Eight treatment comprised *viz.*, pendimethalin 30% EC 1000 g a.i./ha PE *fb* IC + HW at 30 DAS (T₁), pendimethalin 30% EC 1000 g a.i./ha PE *fb* quizalofop-ethyl 5% EC 50 g a.i./ha PoE (T₂), quizalofop-ethyl 5% EC 50 g a.i./ha PoE *fb* IC + HW at 30 DAS (T₃), imazamox 35% + imazethapyr 35% (Pre-mix) WG 70 g a.i./ha PoE (T₄), propaquizafop 10% EC 75 g a.i./ha PoE *fb* IC + HW at 30 DAS (T₅), fenoxaprop-p-ethyl 9% EC 67.5 g a.i./ha PoE *fb* IC + HW at 30 DAS (T₆), FP (IC *fb* HW at 20 & 40 DAS) (T₇) and weedy check (T₈).

The herbicides were applied by using knapsack sprayer fitted with flat fan nozzle by mixing in 500 litre of water ha⁻¹ as per treatments. Blackgram cv. T 9 was sown manually keeping the distance of 30 cm between two rows in all the three years of experimentation. The plot size was 3.60 x 5.00 m. All the recommended package of practices was adopted to raise the crop. The recommended dose of NPK and plant protection schedule was followed as per general recommendations. The weed count and dry weight of weeds were recorded from randomly selected four spots by using 0.25 m² iron quadrat from net plot through destructive sampling at 40 DAS and at harvest. Weed control efficiency (WCE) was calculated on the basis of standard formula as suggested by Maity and Mukherjee (2011) [7]. The seed and haulm yield was recorded from the net plot prevailing market price on the basis of pooled yield data and benefit cost ratio were calculated.

Results and Discussion

Weed flora

The experimental field was infested with *Echinochloa crusgalli*, *Eragrostis major*, *Digitaria sanguinalis* and *Cynodon dactylon* as a monocot weeds, while *Digera arvensis*, *Phyllanthus niruri* and *Launaea nudicauli* as a dicot weeds and *Cyperus rotundus* as sedge weed.

Effect on weed density

All the weed control treatments significantly reduced weed density (No./m²) at 40 DAS (Table 1). Significantly the lowest weeds count of monocot (6.8 weeds/m²), dicot (15.5 weeds/m²) and sedge (7.6 weeds/m²) were recorded under application of propaquizafop 75 g/ha PoE fb IC + HW at 40 DAS, but it was at par with quizalofop-ethyl 5% EC 50 g a.i./ha PoE fb IC + HW at 30 DAS for monocot weed density and with imazamox 35% + imazethapyr 35% (Pre-mix) WG 70 g a.i./ha PoE and quizalofop-ethyl 5% EC 50 g a.i./ha PoE fb IC + HW at 30 DAS for dicot and sedges. Maximum weed count of monocot, dicot and sedge was recorded under untreated check. Total weed count was recorded the lowest (29.9 weeds/m²) under application of propaquizafop 75 g/ha PoE fb IC + HW at 40 DAS which was at par with quizalofop-ethyl 5% EC 50 g a.i./ha PoE fb IC + HW at 30 DAS (32.0 weeds/m²). Channabasavanna *et al.*, (2016) [4] reported the among different doses of propaquizafop 0.062 kg/ha to 0.125 kg/ha reduced the weed count. Similar results also confirm with finding Khan Bahadar Marwat, *et al.* (2004) [6].

Effect on weed dry weight at 40 DAS

All the herbicidal treatments convincingly suppressed the weed dry weight of monocot, dicot, sedges and total weeds at 40 DAS and were found superior over weedy check. Among all the treatments, application of propaquizafop 10% EC 75 g a.i./ha PoE fb IC + HW at 30 DAS was found superior and recorded the lowest weed dry weight of monocot (1.65 g/m²), dicot (1.21 g/m²), sedges (1.24 g/m²) and total weed dry weight (4.10 g/m²) and it was at par with the quizalofop-ethyl 5% EC 50 g a.i./ha PoE fb IC + HW at 30 DAS (Table 1). The results confirm the finding of Balyan *et al.*, (2016) [2].

Effect on weed dry weight at harvest

The weed dry weight of monocot, dicot, sedges and total weed dry weight at harvest was recorded significantly lower under application of propaquizafop 10% EC 75 g a.i./ha PoE fb IC + HW at 30 DAS which recorded 7.64, 20.82, 3.14 and 31.59 g/m² dry weight of weeds, respectively, but it was at par with quizalofop-ethyl 5% EC 50 g a.i./ha PoE fb IC + HW at 30 DAS (Table 1). Mundra and Maliwal (2012) [8] reported similar finding in which the lowest weed dry weight at 30 DAS was recorded under application of quizalofop-ethyl @ 50 g/ha. Similarly, Balyan *et al.*, (2016) [2] reported that the lowest weed dry weight was recorded with quizalofop-ethyl 50 g/ha 30 DAS.

Weed Index (%)

Weed index generally driven based on abundance of weed species present in the field. Among different herbicidal application significantly the lowest weed index was obtained in propaquizafop 10% EC 75 g a.i./ha PoE fb IC + HW at 30 DAS while the highest weed index (50.10%) was recorded in weedy check (Table 1).

Weed control efficiency (%)

The weed control efficiency was the highest recorded at 40 DAS (85%) and at harvest (89%) under application of propaquizafop 10% EC 75 g a.i./ha PoE fb IC + HW at 30 DAS. Whereas, the lowest weed control efficiency was noticed in pendimethalin 30% EC 1000 g a.i./ha PE fb quizalofop-ethyl 5% EC 50 g a.i./ha PoE (Table 1). Channabasavanna *et al.*, (2015) [4] also reported that post-emergence application of propaquizafop 10% EC @ 0.062 kg/ha controlled monocot weeds efficiently.

Seed and haulm yield

Seed and haulm yield of the crop was distinctly influenced by the weed management practices (Table 2). The maximum seed yield (910 kg/ha) and haulm yield (1309 kg/ha) was obtained in propaquizafop 10% EC 75 g a.i./ha PoE fb IC + HW at 30 DAS and it was at par with quizalofop-ethyl 5% EC 50 g a.i./ha PoE. The minimum seed yield (454 kg/ha) and haulm yield (656 kg/ha) was recorded in weedy check (Table 2). Jana *et al.*, (2012) [5] reported the application of propaquizafop 10% EC @ 62.5 g a. i/ha recorded higher productivity.

Economics

The economics analysis of the different weed management practices for the blackgram revealed that application of post emergence propaquizafop 75 g/ha PoE at 20 to 25 DAS fb IC + HW at 30 DAS recorded highest BCR of 1.90 along with maximum net return (Rs. 25753/ha) and was closely followed by quizalofop-ethyl 50 g/ha PoE at 20 to 25 DAS fb IC + HW at 30 DAS which recorded BCR value of 1.70 with net return of Rs.20527/ha and fenoxaprop-p-ethyl 67.5 g/ha PoE at 20 to 25 DAS fb IC + HW at 30 DAS which recorded of BCR of 1.73 with net return of Rs. 21022/ha (Table 2). The weedy check treatment had the lowest BCR of 1.36 with net return (Rs. 7170/ha) due to poor yield in this treatment. The results confirm the findings of Mundra and Maliwal (2012) [8].

Table 1: Weed count and weed dry weight (WDW) of monocot, dicot, sedges and total weeds as influenced by different weed management practices in blackgram (Three years pooled data)

Sr. No.	Treatments	Weed count (No./m ²) at 40 DAS				Weed dry weight (g/m ²) at 40 DAS				Weed dry weight at harvest				Weed Index (%)	WCE (%)	
		Monocot	Dicot	Sedges	Total weed count	Monocot	Dicot	Sedges	Total weed dry weight	Monocot	Dicot	Sedges	Total weed dry weight		40 DAS	At Harvest
1	Pendimethalin 30% EC 1000 g a.i./ha PE fb IC + HW at 30 DAS	3.07 ^d (8.5)	4.38 ^{bc} (18.5)	3.51 ^b (11.5)	6.26 ^{de} (38.4)	1.72 ^{de} (1.97)	1.93 ^c (2.78)	1.63 ^{cd} (1.66)	2.72 ^c (6.42)	4.77 ^c (22.15)	4.51 ^{cd} (17.47)	2.04 ^{bc} (3.18)	6.84 ^d (46.14)	14.7	77	84
2	Pendimethalin 30% EC 1000 g a.i./ha PE fb quizalofop-ethyl 5% EC 50 g a.i./ha PoE	3.67 ^c (12.6)	5.13 ^b (19.4)	3.99 ^a (15.3)	7.39 ^b (53.9)	2.08 ^c (3.36)	2.29 ^b (4.33)	1.85 ^b (2.46)	3.33 ^b (10.15)	4.79 ^c (23.80)	5.49 ^{bc} (29.62)	3.75 ^a (13.59)	8.19 ^c (67.01)	11.2	64	77
3	Quizalofop-ethyl 5% EC 50 g a.i./ha PoE fb IC + HW at 30 DAS	2.97 ^{de} (7.9)	3.99 ^c (15.2)	3.14 ^{bc} (8.9)	5.74 ^{de} (32.0)	1.65 ^e (1.74)	1.63 ^{cd} (1.68)	1.60 ^{cd} (1.63)	2.45 ^{cd} (5.05)	3.26 ^d (9.92)	4.91 ^{cd} (23.94)	1.96 ^c (4.03)	6.11 ^{de} (36.88)	9.0	82	87
4	Imazamox 35% + imazethapyr 35% (Pre-mix) WG 70 g a.i./ha PoE	4.07 ^b (15.7)	5.03 ^{bc} (24.9)	3.29 ^{bc} (10.4)	7.20 ^{bc} (51.0)	2.31 ^b (4.37)	1.93 ^c (2.81)	1.69 ^{bc} (1.91)	3.17 ^b (9.09)	7.64 ^b (59.58)	5.47 ^{bc} (30.46)	2.32 ^b (4.43)	9.65 ^b (94.47)	23.7	68	67
5	Propaquizafop 10% EC 75 g a.i./ha PoE fb IC + HW at 30 DAS	2.77 ^e (6.8)	4.01 ^{bc} (15.5)	2.91 ^c (7.6)	5.53 ^e (29.9)	1.62 ^e (1.65)	1.48 ^d (1.21)	1.49 ^d (1.24)	2.25 ^d (4.10)	2.91 ^d (7.64)	4.57 ^{cd} (20.82)	2.01 ^{bc} (3.14)	5.64 ^e (31.59)	0.0	85	89
6	Fenoxaprop-p-ethyl 9% EC 67.5 g a.i./ha PoE fb IC + HW at 30 DAS	3.24 ^d (9.7)	4.63 ^{bc} (22.1)	3.29 ^{bc} (10.3)	6.48 ^{cd} (42.0)	1.85 ^d (2.47)	1.81 ^c (2.33)	1.64 ^{cd} (1.73)	2.73 ^c (6.38)	5.33 ^c (28.23)	6.15 ^b (38.37)	3.63 ^a (12.29)	8.89 ^{bc} (78.89)	8.3	77	73
7	FP (IC fb HW at 20 & 40 DAS)	1.00 ^f (0.00)	1.00 ^d (0.00)	1.00 ^d (0.00)	1.00 ^f (0.00)	1.00 ^f (0.00)	1.00 ^e (0.00)	1.00 ^e (0.00)	1.00 ^e (0.00)	3.16 ^d (9.17)	4.35 ^d (18.27)	1.87 ^c (2.57)	5.54 ^e (30.00)	4.7	100	90
8	Weedy check	6.27 ^a (38.6)	8.14 ^a (65.4)	4.35 ^a (18.0)	11.08 ^a (121.9)	3.70 ^a (12.76)	3.52 ^a (11.47)	2.22 ^a (4.00)	5.40 ^a (28.23)	10.39 ^a (107.53)	12.79 ^a (165.42)	3.91 ^a (14.52)	16.94 ^a (287.31)	50.1	-	-
	S.Em. ± LSD (P=0.05)	0.12 Sig.	0.35 Sig.	0.14 Sig.	0.27 Sig.	0.04 Sig.	0.15 Sig.	0.05 Sig.	0.09 Sig.	0.27 Sig.	0.32 Sig.	0.09 Sig.	0.36 Sig.			
	Y x T S.Em. ± LSD (P=0.05)	0.16 NS	0.25 Sig.	0.27 NS	0.22 Sig.	0.09 NS	0.11 Sig.	0.10 NS	0.11 Sig.	0.46 NS	0.89 NS	0.16 NS	0.39 Sig.			
	CV%	7.09	11.17	16.67	6.8	8.77	11.76	12.47	7.41	20.62	18.39	12.21	9.18			

Table 2: Yield and economics of blackgram as influenced by different weed management practices (Three years pooled data)

S. No.	Treatment	Seed yield (kg/ha)	Haulm yield (kg/ha)	Gross return (₹/ha)	Addi. cost over control (₹/ha)	Cost of cultivation (₹/ha)	Net return (₹/ha)	BCR
T ₁	Pendimethalin 30% EC 1000 g a.i./ha PE fb IC + HW at 30 DAS	774 ^{bc}	1121 ^b	46360	9324	29344	17016	1.58
T ₂	Pendimethalin 30% EC 1000 g a.i./ha PE fb quizalofop-ethyl 5% EC 50 g a.i./ha PoE	807 ^{ab}	1160 ^{ab}	48319	4544	24564	23755	1.97
T ₃	Quizalofop-ethyl 5% EC 50 g a.i./ha PoE fb IC + HW at 30 DAS	829 ^{ab}	1197 ^{ab}	49647	9100	29120	20527	1.70
T ₄	Imazamox 35% + imazethapyr 35% (Pre-mix) WG 70 g a.i./ha PoE	688 ^c	1082 ^b	41380	2550	22570	18810	1.83
T ₅	Propaquizafop 10% EC 75 g a.i./ha PoE fb IC + HW at 30 DAS	910 ^a	1309 ^a	54488	8715	28735	25753	1.90
T ₆	Fenoxaprop-p-ethyl 9% EC 67.5 g a.i./ha PoE fb IC + HW at 30 DAS	831 ^{ab}	1180 ^{ab}	49727	8685	28705	21022	1.73
T ₇	FP (IC fb HW at 20 & 40 DAS)	867 ^{ab}	1220 ^{ab}	51859	12100	32120	19739	1.61
T ₈	Weedy check	454 ^d	656 ^c	27190	-	20020	7170	1.36

Price of produce	Blackgram seed = ₹.57/kg (MSP – 2019-20) and haulm: ₹.20/kg	BC ratio = $\frac{\text{Gross return}}{\text{Cost of cultivation}}$
Cost of inputs	Pendimethalin (Stomp 30 EC) 3.300 lit/ha x ₹. 480/lit. = ₹.1584/ha	
	Quizalofop-ethyl (Targasuper 5 EC) 1.000 lit/ha x ₹.1360 /lit. = ₹.1360/ha	IC = ₹. 1600/ha
	Imazamox + Imazethapyr (Pre-mix) (Odyssey 70 WG) 100 g /ha x ₹.700/40 g = ₹.1750/ha	HW labour rate = ₹. 178/day (50 labour unit) * 20 DAS HW= 30 labour unit, 40 DAS HW = 20 labour unit and 30 DAS HW= 30 labour unit
	Propaquizafop (Society 10 EC) 0.750 lit/ha x ₹. 1300 /lit. = ₹.975 /ha	Herbicide application cost = ₹. 800/ha
	Fenoxaprop-p-ethyl (Whipsuper 9 EC) 0.750 lit/ha x ₹.1260 /lit. = ₹. 945 /ha	

Conclusion

From the above result it can be concluded that post-emergence (20 - 25 DAS) application of propaquizafop 10% EC 75 g a.i./ha fb IC + HW at 30 DAS or quizalofop-ethyl 5% EC 50 g a.i./ha fb IC + HW at 30 DAS or fenoxaprop-p-ethyl 9% EC 67.5 g a.i./ha fb IC + HW at 30 DAS found effective for the control of complex weed flora, higher seed yield, net return and BCR.

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