



Weed management in blackgram under rainfed conditions

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ABSTRACT

Field study was conducted at Dryland Farming Research Station in Bhilwara, Rajasthan during *Kharif* seasons of 2010 and 2011 to study the weed control efficiency of different weed management practices including pre- and post-emergence herbicides in blackgram [*Vigna mungo* (L.) Hepper]. Among herbicidal weed control treatments, the lowest weed density and dry matter, and highest yield attributes, seed yield and economic return with B:C ratio was recorded with quizalofop-ethyl 50 g/ha 30 DAS and it was statistically at par with interculture at 15 DAS *fb* imazethapyr 100 g/ha 30 DAS, interculture at 15 DAS *fb* quizalofop-ethyl 50 g/ha 30 DAS, imazethapyr 100 g/ha 20 DAS and weed free. Whereas, highest weed control efficiency was recorded with alachlor 1.0 kg/ha PRE *fb* imazethapyr 100 g/ha 30 DAS. All herbicidal treatments reduced weed biomass and improved seed yield and yield attributing parameters as compared to weedy check. Weedy check registered the highest values of weed count and biomass and lowest seed yield and yield attributing characters. Rainfall was directly related to weed count and weed dry matter accumulation with the coefficient of 0.65 and 0.61, respectively.

Key words: Blackgram, Quizalofop-ethyl, Rainfed, Weed control efficiency, Weed, Yield

Black gram (*Vigna mungo* L.) is an important legume crop cultivated worldwide in tropical and subtropical regions of the world and is valued for high protein in its seeds. India is the world's largest producer as well as consumer of blackgram. It produces about 1.5 to 1.9 million tons of blackgram annually from about 3.5 million hectares of area, with an average productivity of 500 kg/ha (Anonymous 2014). Blackgram output accounts for about 10% of India's total pulse production. In Rajasthan, blackgram is grown on about 16,000 hectares area mostly under rainfed conditions.

Blackgram is usually accompanied by luxuriant weed growth during the rainy (*Kharif*) season owing to abundant rainfall received during monsoons leading to serious crop losses. The crop is not a very good competitor against weeds (Choudhary *et al.* 2012). Therefore, weed-control initiatives are essential to ensure proper crop growth particularly in the early growth period. The losses caused by weeds exceed the losses from any other category of agricultural pests in semi arid areas of south east Rajasthan. Farmers do not follow chemical weed control in pulses, except few farmers who use pre-emergence herbicides followed by one or two hand weedings. Singh *et al.* (2014) raised a need of post-emergence herbicide to control the second flush of weeds in pulses and to reduce human labour.

Recently some of the post-emergence herbicides such as quizalofop and imazethapyr have been found effective in controlling weeds in pulses. Imazethapyr applied as post-emergence at 50 to 75 g/ha showed season-long control of many weeds without injuring soybean (Ram *et al.* 2013). In blackgram, Nandan *et al.* (2011) reported that post-emergence application of imazethapyr at 25 g/ha had no adverse effects on rain-fed blackgram growth characters and resulted in statistically similar grain yield to that of two hand weeding (20 and 40 days after sowing).

Control of the weeds by using herbicides could be an alternative to manage the weeds and thereby increasing the yield of blackgram. Since application of single herbicide may not be effective in providing broad spectrum weed control, application of pre- and post-emergence herbicides in sequence or integrated with manual weeding may be more beneficial. Keeping these facts in view, the present investigation was undertaken to test the performance of various post-emergence herbicides along with one pre-emergence and hand weeding for providing weed control during critical period of crop weed competition in blackgram under dry land conditions.

MATERIALS AND METHODS

A field study was conducted during *Kharif* seasons of 2010 and 2011 at Dryland Farming

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Research Station, Arjia, Bhilwara, Rajasthan. The soil of the experimental site was sandy clay loam, having 0.48% organic carbon, 245, 41 and 465 kg/ha available N, P and K, respectively. The mean maximum and minimum temperature recorded were in the range of 31.8 to 37.4 °C and 16.1° to 25.3 °C, respectively (mean of two years). The mean sunshine hours among different weeks were 5.7 to 8.6 h in a day. The total evaporation observed was 393.1 mm, while total rainfall recorded 789.1 mm during both the years of study. The relative humidity in morning (RH1) and evening (RH2) were recorded in the range of 95 to 90 and 42 to 75%, respectively.

Experiments consisted of 15 treatments with three replication was undertaken in randomized block design (Table 1). Blackgram was sown at 30 cm row-to-row spacing using 20 kg seed/ha. Recommended dose of fertilizers (20 kg N + 30 kg P₂O₅/ha) was applied to blackgram crop at the time of sowing through di-ammonium phosphate (DAP) and urea. Pre-emergence application of pendimethalin and alachlor was done on next day of sowing and post-emergence application of other herbicides was done 30 DAS. Weed population was recorded by using 0.25 m quadrat at 60 DAS in all the treatments and then converted into number of weeds/m². The weeds were dried in oven till a constant weight was achieved and then transformed into g/m². Growth and yield parameters and yield of blackgram were recorded for both the years.

The data on total weed count and weed dry matter were subjected to square root transformation ($\sqrt{x+0.5}$) to normalize their distribution (Gomez and Gomez 1984). Weed control efficiency and different indices were calculated as per method given by Mani *et al.* (1973) and Devasenapathy *et al.* (2008).

Biological yield and grain yield were recorded on a plot basis and harvest index was calculated. Gross returns were calculated by taking the sale price of blackgram as 36 per kg. Net returns (per ha) was calculated as: Net returns = Gross returns - cost of cultivation including the cost of individual treatments. Benefit: cost ratio was calculated after dividing net returns with the cost of cultivation. All the data were subjected to analysis of variance (ANOVA) as per the standard procedures. The comparison of treatment means was made by critical difference (LSD) at P=0.05.

RESULTS AND DISCUSSION

Effect on weeds

The common weeds at the experimental site were *Cynodon dactylon* (bermuda grass), *Commelina*

bengalensis (Bengal dayflower), *Cyperus rotundus* (purple nut sedge), *Ageratum conyzoides* (billygoat-weed) *Setaria glauca* (foxtail grass), *Euphorbia hirta* (garden spurge), *Echinochloa colonum* (jungle rice), *Echinochloa crusgalli* (sawan grass), *Tribulus terrestris* (puncture vine), *Trianthema monogynia* (horse purselane), *Ipomoea pestigridis*, *Fimbristylis penera* *etc.*

The highest weed density (17.20/m² and 11.05/m²) and weed dry matter production (15.60 g/m² and 9.82 g/m²) at 30 and 60 DAS were recorded in weedy check plots (Table 1). Among post-emergence herbicides, quizalofop-ethyl 50 g/ha at 30 DAS was significantly superior in reducing weed density both at 30 and 60 DAS while remained at par with the treatments of interculture 15 DAS *fb* imazethapyr 100 g/ha 30 DAS, interculture 15 DAS *fb* quizalofop-ethyl 50 g/ha at 30 DAS, and imazethapyr 100 g/ha 20 DAS treatments and remained statistically superior over all other weed management practices except weed free treatment. Application of pendimethalin 1.0 kg/ha as pre-emergence also reduced the weed density to a level of 11.26/m² and 6.99/m² as compared to weedy check level of 17.20/m² and 11.05/m² at 30 and 60 DAS (Table 1). Results were in conformity with the Tan *et al.* 2005 that quizalofop-ethyl, chlorimuron and imazethapyr are new generation post-emergence herbicides used in many leguminous crops. These herbicides provide broad spectrum of weeds control, flexibility in application time, low usage rates and low mammalian toxicity.

Weed dry matter production was reduced significantly (4.40 g/m² and 2.13 g/m²) both at 30 and 60 DAS with interculture at 15 DAS *fb* quizalofop-ethyl 50 g/ha at 30 DAS over weedy check, pendimethalin 1.0 kg/ha as pre-emergence (PE), alachlor 1.0 kg/ha PE, pendimethalin 1.0 kg/ha PE *fb* interculture 30 DAS, and alachlor 1.0 kg/ha PE *fb* interculture at 30 DAS, except weed free treatment and remained at par among all other weed management practices (Table 1). The results were in conformity with the findings of Kantar *et al.* (1999), where about 84.6% weed biomass was controlled with application of imazethapyr. Papiernik *et al.* (2003) also recommended use of imezathapyr in legumes which inhibit acetohydroxy acid synthase and the synthesis of branched chain amino acids. Application of pendimethalin 1.0 kg/ha as PE also reduced the weed dry matter to a notable level of 9.98 g/m² and 5.18 g/m² at 30 and 60 DAS, respectively.

The highest value of weed control efficiency at 60 DAS (Table 1) was recorded under weed free treatment. Among herbicides, it was recorded highest

Table 1. Effect of different weed control treatments on weed density and dry weight at different growth stages of blackgram (pooled value)

Treatment	Weed density (no./m ²) (*TAV)		Weed dry matter (g/m ²) (*TAV)		Weed control efficiency (%) 60 DAS	Weed persistence Index (%) 60 DAS
	30 DAS	60 DAS	30 DAS	60 DAS		
Pendimethalin 1.0 kg/ha (PE)	11.36 (126.9)	6.99 (48.3)	9.98 (100.0)	5.18 (26.7)	54.9	19.43
Alachlor 1.0 kg/ha (PE)	11.14 (125.0)	7.67 (58.3)	10.02 (100.3)	5.30 (27.8)	55.9	17.69
Pendimethalin 1.0 kg/ha (PE) <i>fb</i> interculture 30 DAS	9.24 (85.2)	4.48 (19.7)	8.20 (70.4)	4.02 (16.3)	64.5	10.53
Alachlor 1.0 kg/ha (PE) <i>fb</i> interculture 30 DAS	8.95 (79.9)	4.50 (19.8)	7.50 (57.6)	3.95 (15.5)	72.0	7.63
Pendimethalin 1.0 kg/ha (PE) <i>fb</i> imazethapyr 100 g/ha 30 DAS	6.69 (44.5)	3.44 (11.3)	4.90 (24.4)	2.83 (8.0)	88.3	1.74
Pendimethalin 1.0 kg/ha (PE) <i>fb</i> quizalofop-ethyl 50 g/ha 30 DAS	6.90 (47.4)	3.45 (11.5)	5.42 (29.7)	3.18 (10.3)	86.0	2.38
Alachlor 1.0 kg/ha (PE) <i>fb</i> imazethapyr 100 g/ha 30 DAS	6.56 (43.5)	3.71 (13.3)	4.81 (23.0)	2.83 (7.7)	89.8	1.51
Alachlor 1.0 kg/ha (PE) <i>fb</i> quizalofop-ethyl 50 g/ha 30 DAS	6.51 (42.8)	3.60 (12.5)	5.06 (26.0)	2.27 (5.3)	87.6	1.70
Interculture 15 DAS <i>fb</i> imazethapyr 100 g/ha 30 DAS	5.88 (34.2)	2.73 (7.0)	4.55 (22.8)	2.29 (5.0)	87.7	1.47
Interculture 15 DAS <i>fb</i> quizalofop-ethyl 50 g/ha 30 DAS	5.59 (31.2)	2.79 (7.3)	4.40 (21.0)	2.13 (4.7)	89.1	1.18
Imazethapyr 100 g/ha 20 DAS	5.68 (32.0)	2.85 (7.7)	4.51 (21.5)	2.87 (8.5)	89.3	1.22
Quizalofop-ethyl 50 g/ha 30 DAS	5.57 (30.8)	2.58 (6.2)	4.89 (25.4)	2.79 (7.8)	86.6	1.58
Farmer's practice	12.94 (171.4)	10.56 (111.0)	13.42 (186.0)	8.04 (66.7)	26.3	44.55
Weed-free	4.57 (20.5)	2.76 (7.2)	3.29 (11.0)	1.68 (2.7)	94.6	0.40
Weedy check (control)	17.20 (295.8)	11.05 (121.7)	15.60 (249.4)	9.82 (96.2)	0.0	100.00
LSD (P=0.05)	0.60	0.30	0.94	0.69	7.9	4.13

*TAV- Angular Transformation Values

with alachlor 1.0 kg/ha (PE) *fb* imazethapyr 100 g/ha at 30 DAS, which was at par with pendimethalin 1.0 kg/ha PE *fb* imazethapyr 100 g/ha at 30 DAS, pendimethalin 1.0 kg/ha PE *fb* quizalofop-ethyl 50 g/ha at 30 DAS, alachlor 1.0 kg/ha PE *fb* quizalofop-ethyl 50 g/ha at 30 DAS, interculture 15 DAS *fb* imazethapyr 100 g/ha at 30 DAS, interculture 15 DAS *fb* quizalofop-ethyl 50 g/ha at 30 DAS, imazethapyr 100 g/ha at 20 DAS, quizalofop-ethyl 50 g/ha at 30 DAS and statistically superior over all other management practices. Singh and Chandel (1995) also reported higher weed control efficiency with two hand weeding. Kantar *et al.* (1999) also reported 84.6% weed control with imazethapyr. However, the other herbicides quizalofop-p-ethyl, fenoxaprop-p-ethyl and chlorimuron-p-ethyl alone or in combination also registered notable values of weed control efficiency in the range of 78.8 to 89.3%. Vyas and Jain (2003) also reported higher weed control efficiency, seed yield with application of imezathapyr over quizalofop-p-ethyl in soybean crop.

The highest weed index (98.8%) was recorded with interculture at 15 DAS *fb* quizalofop-ethyl 50 g/ha at 30 DAS, which was at par with pendimethalin 1.0 kg/ha PE *fb* imazethapyr 100 g/ha at 30 DAS, pendimethalin 1.0 kg/ha PE *fb* quizalofop-ethyl 50 g/ha at 30 DAS, alachlor 1.0 kg/ha PE *fb* imazethapyr

100 g/ha at 30 DAS, alachlor 1.0 kg/ha PE *fb* quizalofop-ethyl 50 g/ha at 30 DAS, interculture 15 DAS *fb* imazethapyr 100 g/ha at 30 DAS, imazethapyr 100 g/ha at 20 DAS, and quizalofop-ethyl 50 g/ha at 30 DAS and lowest weed index was found in manual weeding at 15 and 30 DAS (55.45%) (Table 1). These results were in conformity of Arya *et al.* (2007) who have recorded good yield of chickpea and mustard due to quizalofop-ethyl 60 g/ha.

Yield

Different weed management practices had significant positive impacts on yield attributes and yield (Table 2). Lowest values of plant height (59.38 cm), branches/plant (3.57), pods/plant (40.33), grains/pod (6.33), pod length (4.90 cm), and 1000-seed weight (43.82 g) were recorded under weedy check. The highest values for plant height (64.68 cm), branches/plant (4.67), pods/plant (48.67), grains/pod (8.07), pod length (5.48 cm), and 1000-seed weight (45.90 g) were recorded under interculture at 15 DAS *fb* quizalofop-ethyl 50 g/ha at 30 DAS due to reduced crop-weed competition. Mundra and Maliwal (2012) also reported that among the herbicidal treatments, application of quizalofop-ethyl 50 g/ha recorded maximum number of branches, pods/plant and seeds/pod. The increase in growth and yield attributes might be due to the

Table 2. Effect of different weed control treatments on growth parameters and yield attributes of blackgram (pooled value)

Treatment	Plant height (cm)	Branches/plant (no.)	Days to 50% bloom	Pods/plant (no.)	Grains/pod (no.)	Pod length (cm)	1000-seed wt. (g)
Pendimethalin 1.0 kg/ha (PE)	63.1	4.03	54.8	43.3	7.50	5.15	45.8
Alachlor 1.0 kg/ha (PE)	63.2	4.10	54.8	42.5	7.57	5.48	45.6
Pendimethalin 1.0 kg/ha (PE) <i>fb</i> interculture 30 DAS	64.8	4.60	55.0	45.5	7.37	5.07	46.0
Alachlor 1.0 kg/ha (PE) <i>fb</i> interculture 30 DAS	64.5	4.47	54.7	46.8	7.77	5.25	46.5
Pendimethalin 1.0 kg/ha (PE) <i>fb</i> imazethapyr 100 g/ha 30 DAS	64.1	4.17	54.3	46.0	7.03	5.30	46.0
Pendimethalin 1.0 kg/ha (PE) <i>fb</i> quizalofop-ethyl 50 g/ha 30 DAS	64.5	4.13	54.3	44.7	8.03	5.32	46.2
Alachlor 1.0 kg/ha (PE) <i>fb</i> imazethapyr 100 g/ha 30 DAS	63.9	3.97	54.7	44.0	7.70	5.40	46.4
Alachlor 1.0 kg/ha (PE) <i>fb</i> quizalofop-ethyl 50 g/ha 30 DAS	64.1	3.97	53.5	45.0	7.17	5.20	45.8
Interculture 15 DAS <i>fb</i> imazethapyr 100 g/ha 30 DAS	64.0	4.33	55.0	44.7	7.42	5.27	46.5
Interculture 15 DAS <i>fb</i> quizalofop-ethyl 50 g/ha 30 DAS	64.7	4.67	54.8	48.7	7.37	5.38	45.9
Imazethapyr 100 g/ha 20 DAS	61.8	4.40	55.2	47.7	8.03	5.47	46.5
Quizalofop-ethyl 50 g/ha 30 DAS	62.2	4.23	54.5	48.7	7.87	5.38	46.4
Farmer's practice	60.9	3.73	54.5	40.3	7.17	5.00	45.0
Weed free	65.8	4.53	53.8	50.2	7.53	5.52	47.3
Weedy check (control)	59.4	3.57	54.7	40.3	6.33	4.90	43.8
LSD (P=0.05)	2.02	0.56	0.88	3.19	0.73	0.24	1.39

Table 3. Effect of different weed control treatments on yield and economics of blackgram (pooled value)

Treatment	Seed yield (t/ha)	Haulm yield (t/ha)	Harvest index	Gross returns (x10 ³ /ha)	Net returns (x10 ³ /ha)	B:C ratio
Pendimethalin 1.0 kg/ha (PE)	0.97	4.18	19.3	44.08	36.69	5.19
Alachlor 1.0 kg/ha (PE)	0.98	4.13	19.7	44.45	36.65	4.87
Pendimethalin 1.0 kg/ha (PE) <i>fb</i> interculture 30 DAS	1.03	4.54	19.0	47.05	38.05	4.52
Alachlor 1.0 kg/ha (PE) <i>fb</i> interculture 30 DAS	0.95	4.06	19.3	43.26	33.86	3.77
Pendimethalin 1.0 kg/ha (PE) <i>fb</i> imazethapyr 100 g/ha 30 DAS	0.99	4.33	19.1	45.08	36.10	4.29
Pendimethalin 1.0 kg/ha (PE) <i>fb</i> quizalofop-ethyl 50 g/ha 30 DAS	1.03	4.21	20.1	46.22	37.16	4.36
Alachlor 1.0 kg/ha (PE) <i>fb</i> imazethapyr 100 g/ha 30 DAS	0.99	4.51	18.8	45.63	36.24	4.11
Alachlor 1.0 kg/ha (PE) <i>fb</i> quizalofop-ethyl 50 g/ha 30 DAS	1.00	4.26	19.7	45.43	35.97	4.07
Interculture 15 DAS <i>fb</i> imazethapyr 100 g/ha 30 DAS	1.08	4.49	20.2	48.75	39.51	4.63
Interculture 15 DAS <i>fb</i> quizalofop-ethyl 50 g/ha 30 DAS	1.07	4.56	19.7	48.39	39.06	4.47
Imazethapyr 100 g/ha 20 DAS	1.10	4.56	20.1	49.62	41.98	5.83
Quizalofop-ethyl 50 g/ha 30 DAS	1.13	4.60	20.4	50.53	42.80	5.92
Farmer's practice	0.94	4.17	18.9	42.93	35.62	5.30
Weed free	1.05	4.48	19.7	47.94	37.64	4.01
Weedy check (control)	0.88	3.77	19.2	39.79	33.98	6.22
LSD (P=0.05)	0.09	0.43	1.22	3.772	3.77	0.48

reduction in weed competitiveness with the crop which ultimately favored better environment for growth and development of crop.

Economics

Seed and biological yield recorded with quizalofop-ethyl 50 g/ha at 30 DAS were 28.53 and 21.84%, respectively, which were higher than weedy check. The corresponding figure in case of imazethapyr 100 g/ha at 20 DAS were 25.8 and 21.0% higher. However, herbicides along with other weed management practices registered significant increase in seed yield with quizalofop-ethyl 50 g/ha at

30 DAS (1.13 t/ha) over weedy check (0.88 t/ha), while remained statistically at par with interculture at 15 DAS *fb* imazethapyr 100 g/ha at 30 DAS, interculture at 15 DAS *fb* quizalofop-ethyl 50 g/ha at 30 DAS, imazethapyr 100 g/ha at 20 DAS including weed free treatment (Table 3). Mundra and Maliwal (2012) reported that the highest seed yield and stover yield of blackgram was recorded with quizalofop-ethyl 50 g/ha. The results were also in conformity with the findings of Rajput and Kushwah (2004). The highest value of net return (₹ 42803) and B:C ratio (5.92) was recorded with application of quizalofop-ethyl 50 g/ha at 30 DAS, followed by net return (₹

41976) and B:C ratio (5.83) with imazethapyr 100 g/ha 20 DAS (Table 3). The minimum net return and B:C ratio among other herbicidal treatment was obtained with alachlor 1.0 kg/ha PRE fb interculture 30 DAS.

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