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Influence of quizalofop-ethyl on narrow-leaved weeds in blackgram and its residual effect on succeeding crops

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ABSTRACT

A field experiment was conducted at Research Farm of MPUAT, Udaipur for two consecutive years during 2008-09 and 2009-10 to evaluate the efficacy of different doses of quizalofop-ethyl as post-emergences (at 4-6 leaf stage of weeds) in blackgram and residual effect thereof on succeeding *Rabi* crops (wheat, gram and mustard). The experiment comprising five weed control treatments, *viz*. quizalofop-ethyl at 37.5 and 50 g/ha as post-emergence, pendimethalin 750 g/ha as pre-emergence, farmers practice of two hand weedings at 20 and 35 days after sowing (DAS) and weedy check, was conducted in randomized block design with four replications. To study phytotoxicity, quizalofop-ethyl 100 g/ha was also included in addition to above treatments. In the experimental field, more than 50% weeds were dominated by *Echinochloa* spp. Results revealed that among the herbicidal treatments, quizalofop-ethyl 50 g/ha recorded the lowest narrow-leaved weed density and dry weight at 30 DAS and at harvest during both the years. Quizalofop-ethyl irrespective of its doses was not effective against broad-leaved weeds. The weed control efficiency of quizalofop-ethyl 50 g/ha was 81.3% than the highest (85.6%) under two hand weedings against grassy weeds at harvest. Number of branches and pods/plant, seeds/pod and grain and stover yields of blackgram were also superior in plots treated with quizalofop-ethyl 50 g/ha or two HW. Quizalofop-ethyl was found safe to blackgram, and did not cause any residual toxicity to succeeding crops.

Key words: Blackgram, Chemical control, *Echinochloa* spp., Quizalofop-ethyl, Residual effect

Blackgram (*Vigna mungo* L.) is one of the important pulse crops grown during *Kharif* season in south Rajasthan where the average productivity is only 0.30 t/ha (Anonymous 2010) which is quite low against its potential yield. High temperature coupled with frequent rains during growing period infest the crop heavily with weeds specially *by Echinochloa* spp. besides some broad-leaved weeds which adversely affect the productivity of this crop. The weeds reduce the seed yield of blackgram as high as 80-90% (Kumar *et al*. 2000). *Echinochloa colona* alone, one of the major weeds in blackgram, may reduce the seed yield to the extent of 49% (Rao and Rao 2003). Therefore, control of weeds during critical period of crop weed competition is very important to avoid severe yield losses. Due to labour scarcity, use of manual control of weed is very difficult. In monsoon season sometimes, pre-emergence herbicides become difficult, therefore, suitable post-emergence herbicide are required. Wheat, gram and mustard are the important succeeding crops grown after blackgram therefore, study was also done on residual effect of herbicides, on these crops.

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MATERIALS AND METHODS

A field experiment was conducted during the year 2008-09 and 2009-10 at the Instructional Farm of College of Technology and Engineering, MPUAT, Udaipur. The soil of the experimental field was sandy clay loam in texture with low in available nitrogen and phosphorus and high in available potassium. Experiment consisted of five weed control treatments, *viz*. quizalofop-ethyl (Targa super 5 EC) 37.5 and 50 g/ha as post-emergence (4-6 leaf stage of weeds), pendimethalin (Stomp 30 EC) 750 g/ha as pre-emergence, farmers' practice of doing two hand weedings at 20 and 35 DAS and weedy check. For residual study, the original experimental lay out was kept undisturbed, and wheat, gram and mustard were sown across the plots. The crops were raised as per recommended package. Treatments were evaluated in randomized block design with four replications in blackgram using variety '*T-9*' with the plot size of 9 x 3 m. The herbicides were applied by knapsack sprayer fitted with flat fan nozzle using 500 litres of water per hectare. Data on major weed flora, their per cent contribution, weed density and dry biom-

ass, growth and yield attributes as well as yield of blackgram were recorded following standard practices. Phytotoxicity of different treatments of quizalofop-ethyl on blackgram as well as on follow up *Rabi* crops were also studied. Residual effects of herbicides were studied in succeeding *Rabi* season crops in terms of germination count, plant height as well as yield of these crops.

RESULTS AND DISCUSSION

Weed flora

The major weed flora of the experimental field consisted of narrow-leaved weeds (*Echinochloa* spp. and *Cynodon dactylon*), sedges (*Cyperus rotundus)* and broad-leaved weeds (*Parthenium hysterophorus*, *Amaranthus viridis*, *Triantherma portulacastrum* and others). The mean per cent contribution of these weeds were 58.6, 0.9, 6.9, 15.8, 10.1, 4.2 and 3.5, respectively. *Echinochloa* spp. was the major narrow-leaved weed contributed 58.6% in the total weed density. In general, the density and dry biomass of weeds were comparatively higher in 2009 over 2008 which might be probably due to favourable environmental conditions leading to vigorous growth of weeds.

Weed density

All the weed control treatments significantly reduced the density of narrow-leaved weeds during both the years compared to weedy check. Quizalofop-ethyl 50 g/ha resulted into significantly less narrow-leaved weed density over all other treatments. The mean weed density in quizalofop-ethyl 50 g/ha, farmers' practice, quizalofop-ethyl 37.5 g/ha and pendimethalin 750 g/ha was 2.04, 3.45, 4.20 and 6.5/m^2, respectively as against 9.8/m^2 in weedy check. The herbicide quizalofop-ethyl at either levels of its application did not have any effect on broad-leaved weeds during both the years. However, farmers' practice of two hand weeding during both the years and pendimethalin 750 g/ha were found significant in reducing the density of broad-leaved weeds only in 2009 compared to weedy check. Better response of quizalofop-ethyl in controlling narrow-leaved weeds might be due to the fact that aryloxyphen-oxypropionates (AOPP) class to which this herbicide belongs is readily absorbed and translocated to meristematic region and exert herbicide activity. It acts by inhibiting the enzyme Acetyl Coenzyme–A carboxylase (ACCase) in susceptible species (Burton 1997). Acetyl coenzyme catalyzes, the first committed step of fatty acid biosynthesis, is adenosine triphosphate dependent carboxylation of acetyl Co A to malonyl Co A. Grass species have a eukaryotic type ACCase in the chloroplasts which is sensitive to ACCase inhibitors. Whereas most broad-leaved species have a prokaryotic type of ACCase, which is not sensitive to ACCase inhibitors (Incledon and Hall 1997).

Dry weight of weeds

It was found that the dry biomass of narrow-leaved weeds at 30 days after treatment (DAT) and at harvest was affected significantly. The mean data on dry weed biomass of narrow-leaved weeds at harvest revealed that lowest weed biomass in farmers' practice (0.53 t/ha) followed by quizalofop-ethyl 50 g/ha (0.68 t/ha), and pendimethalin (1.03 t/ha) as against 3.78 t/ha in weedy check on mean basis (Table 1). The weed control efficiency against narrow-leaved weeds at 30 DAT and at

Table 1. Weed density, their dry biomass and weed control efficiency as affected by weed control treatments

Treatment	Weed density no./m^2 at 30 DAT				Dry biomass of weeds (t/ha)						Weed control efficiency (%)					
					30 DAT				At harvest narrow-leaved weeds		30 DAT				At harvest narrow-leaved weeds	
	Narrow-leaved weeds		Broad-leaved weeds		Narrow-leaved weeds		Broad-leaved weeds				Narrow-leaved weeds		Broad-leaved weeds			
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Quizalofop-ethyl 37.5 g/ha	4.61 (21)*	3.79 (15)	7.90 (63)	8.83 (78)	0.52	0.65	1.57	1.70	0.71	0.84	76.6	87.1	1.1	3.0	75.4	81.9
Quizalofop-ethyl 50 g/ha	1.74 (3)	2.33 (5)	7.45 (56)	9.27 (86)	0.21	0.37	1.53	1.68	0.61	0.76	90.4	92.7	3.3	4.5	78.9	83.7
Pendimethalin 750 g/ha	6.30 (40)	6.86 (47)	6.55 (43)	5.96 (36)	0.25	0.75	1.01	1.10	1.01	1.45	85.6	85.2	36.0	37.2	65.1	69.0
Farmers practice	3.22 (10)	3.67 (13)	0.71 (0)	5.49 (29)	0.09	0.19	0.46	0.29	0.46	0.60	96.0	96.2	70.7	83.3	84.2	87.2
Weedy check	8.41 (70)	11.18 (126)	7.57 (63)	9.37 (88)	2.9	5.06	1.58	1.75	2.9	4.7	-	-	-	-	-	-
LSD (P=0.05)	1.18	1.41	2.16	1.48	0.63	0.51	0.56	0.47	0.34	0.39	-	-	-	-	-	-

*Original figures in parentheses were subjected to square root transformation ($\sqrt{x+0.5}$) before statistical analysis. DAT – days after treatment

harvest also depicted the same trend and the maximum of 96.08 and 85.68% was found in farmers practice, respectively on mean basis followed by quizalofop-ethyl 50 g/ha with the mean values of 91.55 and 81.30% at 30 DAT and at harvest, respectively. The results were in conformity with the findings of Singh *et al.* (2006).

Different weed control treatments had significant effect on all the growth and yield attributing characters except plant height and 1000-seed weight during both the years (Table 2). The highest number of branches/plant, pods/plant and seeds/pod were recorded in farmers' practice during both the years with mean values of 4.99, 37.48 and 6.93, respectively. However, among the herbicidal treatments, application of quizalofop-ethyl 50 g/ha recorded the maximum number of branches (4.23/plant), pods/plant (31.67) and seeds/pod (6.47) in individual years as well as on mean basis. The increase in growth and yield attributes under these treatments might be attributed due to the reduction in weed competitiveness with the crop which ultimately favoured better environment for growth and development of crop.

All the weed control treatments significantly increased both seed and stover yields of blackgram in both the years of experimentation (Table 2). It was found that the highest seed yield and stover yield of blackgram was recorded in farmers practice followed by post-emergence application of quizalofop-ethyl 50 g/ha. Mean data for two years revealed per cent increase in seed yield due to farmers' practice, quizalofop-ethyl 50 g/ha, pendimethalin 750 g/ha and quizalofop-ethyl 37.5 g/ha and was 226.1, 188.6, 141.7 and 126.5, respectively compared to weedy check. The corresponding increase in stover yield under these treatments was 249.8, 219.7, 147.9 and 129.5 % as against the lowest recorded in weedy check. The yield levels during first year under different treatments were lower compared to second year because during first year, there were continuous rains at flowering stage resulting in falling of flowers as well as shattering of pods ultimately led to poor yield of crop. The highest yield under farmers practice of two hand weedings at 20 and 35 DAS was due to the fact that this treatment controlled early as well as late flushes of weeds and provided weed free environment to the crop during critical period of crop weed competition. The results are in conformity with the findings of Rajput and Kushwah (2004). On the other hand quizalofop-ethyl 50 g/ha had significantly controlled the most dominated narrow-leaved weed *Echinochloa* spp. and saved the crop efficiently from its infestation and it reflected in terms of significant increase in growth and yield attributes which

Table 2. Growth, yield attributes and yield of blackgram as affected by weed control treatments

Treatment	Plant height at harvest (cm)		No. of pods/ plant		No. of seeds/pod		1000-seed weight (g)		Yield (t/ha)			
									Grain		Stover	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Quizalofop-ethy 37.5 g/ha	55.4	53.3	21.20	31.50	5.91	6.20	56.1	53.6	0.31	0.63	0.62	1.57
Quizalofop-ethyl 50 g/ha	53.3	50.8	24.33	39.00	6.45	6.48	57.8	54.0	0.38	0.83	0.72	2.34
Pendimethalin 750 g/ha	53.8	55.0	25.15	31.75	6.21	6.53	57.6	55.0	0.36	0.65	0.70	1.67
Farmers practice	48.1	54.6	29.70	45.25	6.87	6.98	58.7	55.7	0.41	0.96	0.80	2.54
Weedy check	55.6	60.0	18.95	21.25	5.56	5.63	54.6	53.0	0.21	0.21	0.42	0.52
LSD (P=0.05)	NS	NS	4.13	9.09	0.38	0.58	NS	NS	0.06	0.16	0.11	0.32

Table 3. Residual effect of weed control treatments on germination count, plant height and yield of succeeding crops

Treatment	Plant height (cm)						Grain/seed yield (t/ha)					
	Wheat		Mustard		Gram		Wheat		Mustard		Gram	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Quizalopof-ethyl 37.5 g/ha	80.3	82.4	181.6	179.2	42.1	42.0	3.39	4.14	1.74	1.50	1.07	0.66
Quizalopof-ethyl 50 g/ha	79.7	81.5	179.9	180.8	42.1	40.6	3.48	3.99	1.75	1.37	1.17	0.58
Pendimethalin 750 g/ha	79.1	81.8	182.9	182.2	43.9	42.6	3.37	4.12	1.78	1.45	1.19	0.63
Farmers practice	80.7	84.1	182.5	179.5	42.2	41.4	3.51	4.13	1.69	1.47	1.18	0.66
Weedy check	80.0	81.8	181.7	179.4	42.4	44.4	3.39	4.10	1.74	1.54	1.07	0.64
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

ultimately resulted into higher yield of crop. Similar findings were also reported by Khedkar *et al.* (2009) and Meena *et al.* (2009) in soybean.

Visual phytotoxicity on blackgram in terms of epinasty, hyponasty, necrosis, vein clearing and wilting at 3,5,7,10 and 15 days after quizalofop-ethyl application did not show any type of phytotoxic effects and thus, found completely safe for the crop.

Residual phytotoxicity on suceeding crops

Herbicides applied in blackgram did not show any kind of phytotoxicity on any of the succeeding crops, *viz.* wheat, mustard and gram. Post-emergence application of quizalofop-ethyl 37.5, 50.0 and 100.0 g/ha and pre-emergence application of pendimethalin 750 g/ha used in blackgram also did not show any residual effect on germination, plant height as well as seed/grain yield of these crops as evident from the data presented in (Table 3). The mean grain/seed yield of wheat, mustard and gram ranged between 3.72 and 3.77, 1.57 and1.64, and 0.86 and 0.92 t/ha, respectively.

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