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Weed management in blackgram

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ABSTRACT

A replicated field experiment was conducted during 2016 and 2017 for selecting suitable herbicide for weed management in rainfed blackgram at Krishi Vigyan Kendra Farm, Ashokenagar, West Bengal, India. Among the herbicides tested, pre-emergence application (PE) of pendimethalin 1.0 kg/ha *fb* post-emergence application (PoE) quizalofop-ethyl 50 g/ha 25 days after seeding (DAS) resulted in lower weed density and higher weed control efficiency (92.10%) with an average seed yield of 0.82 t/ha, which was 48.35% grain yield over the control. Pendimethalin (PE) 1.0 kg/ha *fb* quizalofop-ethyl 50 g/ha (PoE) could be used for effective and economic weed control in blackgram in rainfed conditions.

INTRODUCTION

Blackgram (*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 with 1.5 to 1.9 million tons of blackgram produced annually from about 3.5 million hectares of area, with an average productivity of 555 kg/ha (Anonymous 2014). In West Bengal, black gram is grown on about 76,000 hectares (Anonymous 2015) area, mostly under rainfed conditions. The major problem in blackgram production, particularly in *Kharif* season, is infestation of weeds. Associated weeds compete for nutrients, moisture, light and space. Due to non-availability and high prices of labour and continuous rains, it becomes difficult to manually remove weeds during critical period of crop growth, which is critical for higher crop productivity (Adhikary 2016). Unchecked weeds were reported to cause a considerable reduction in blackgram seed yield (upto 46-53%) in summer (Bhandari *et al*. 2004) and *Kharif* season (43.2-64.1 %) (Rathi *et al.* 2004). The losses caused by weeds exceed the losses from any other category of agricultural pests in West Bengal. Therefore, under these circumstances, use of herbicides may be desirable for the control of weeds particularly at early stages, which will control the emerging weeds for a substantial period of time. Farmers do not follow chemical weed control in blackgram, except for a few farmers who use pre-emergence herbicides followed by one or two hand weeding. Singh *et al*. (2014) pointed out the need of post-emergence herbicide to control the second flush of weeds in pulses and to reduce human labour. The post-emergence herbicides such as quizalofop-ethyl 50 to 75 g/ha were shown to provide season-long control of many weeds without crop injury (Ram *et al*. 2013). Imazethapyr 25 g/ha was found effective in controlling weeds on rainfed blackgram (Nandan *et al*. 2011).

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 (Balyan *et al*. 2016). Hence, the present study was undertaken to evaluate the various post-emergence herbicides along with one pre-emergence and hand weeding for managing weeds during critical period of crop weed competition in blackgram under rainfed conditions.

MATERIALS AND METHODS

The experiment was conducted during two consecutive *Kharif* seasons of 2016 and 2017 at the Krishi Vigyan Kendra Farm, Ashokenagar (latitude: 22° 50' 9.6324'' N, longitude: 88° 38' 13.8192'' E and altitude: 10.47 m) West Bengal, India. This soil was medium in organic carbon content (0.67%) and the available nutrient status was low in nitrogen, medium

range of phosphorus and the potassium status was high with neutral to alkaline in soil reaction. The variety used was '*Sulata*'. The experiment was laid out in randomized block design with seven treatments, *viz*. pre-emergence application (PE) of pendimethalin 1.0 kg/ha (PE) *fb* interculture 25 days after seeding (DAS); interculture 15 DAS *fb* post-emergence application (PoE) of imazethapyr 100 g/ha at 25 DAS; interculture 15 DAS *fb* quizalofop-ethyl 50 g/ha at 25 DAS; pendimethalin 1.0 kg/ha (PE) *fb* imazethapyr 100 g/ha at 25 DAS; pendimethalin1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha 25 DAS; weed-free and weedy check. The test herbicides were sprayed with the spray volume of 500 liters/ha using knapsack sprayer with flood jet deflector WFN 040 nozzle. All the other recommended agronomic and plant protection measures were adopted to raise the crop and the intercultural practices were taken as need based. The data on weed density and biomass were recorded at 45 DAS and weed control efficiency (WCE) of different treatments was computed using data on weed biomass. The data were analyzed following analysis of variance (ANOVA) technique and mean differences were adjusted by the multiple comparison test (Gomez and Gomez 1984)

RESULTS AND DISCUSSION

Effect on weeds

The major weeds at the experimental site were: *Cynodondactylon, Dactyloctenium aegyptium, Digitaria sanguinalis, Panicum maximum, Eleusine indica, Cyperus rotundus, Commelina bengalensis, Ageratum conyzoides, Euphorbia hirta, Tribulus terrestris, Trianthema monogynya, Fimbristylis penera, Digera arvensis, Cleome viscosa, Celosia argentia etc*. Similar observations were made by Balyan *et al.* (2016).

The highest weed density (108.33 /m^2) and weed biomass (80.22 g /m^2) at 45 DAS were recorded in weedy check (**Table 1**). Among herbicide treatments, pendimethalin 1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha at 25 DAS was significantly superior in reducing weed density (11.67/m^2) at 45 DAS followed by pendimethalin 1.0 kg/ha (PE) *fb* interculture 25 DAS, pendimethalin 1.0 kg/ha (PE) *fb* imazethapyr 100 g/ha at 25 DAS and remained statistically superior over all other weed management practices except weed free treatment.

Weed biomass was reduced significantly (6.34 g/m^2) at 45 DAS with pendimethalin 1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha at 25 DAS. About 86% weed biomass reduction was observed with application of pendimethalin1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ ha 30 DAS as also reported by Balyan *et al.* (2016).

The highest weed control efficiency (96.66 %) at 45 DAS (**Table 1**) was recorded in weed free. and in pendimethalin 1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha at 25 DAS (92.10 %). Other herbicides, pendimethalin, imazethapyr, quizalofop-ethyl alone or in combination also registered notable weed control efficiency (78.06 to 88.01%).

Weed persistence index (WPI) and herbicide efficacy indices (HEI) express the tolerance of weeds to different herbicide treatments as well as their efficacy to eradicate the weeds (**Table 2**). Pendimethalin 1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha 25 DAS recorded lowest WPI (0.73%) followed by pendimethalin 1.0 kg/ha (PE) *fb* interculture 25 DAS. Pendimethalin 1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha 25 DAS produced higher HEI (11.85%) than all other herbicidal treatments. Maximum crop resistance index (CRI), 58.31 was noticed in weed free plots. Balyan *et al.* (2016) also observed similarly in blackgram. HEI, WPI, CRI and WI were earlier reported by Adhikary *et al.* (2016) in groundnut.

Effect on crop

Germination was not affected by herbicide application (**Table 3**) and around 93.50% to 97.23% seed germination was occurred. Herbicidal effect on nodulation in blackgram crop was very prominent.

Table1. Effect of different weed control treatments on weed density and biomass at 45 DAS of blackgram (pooled value)

Treatment	Weed density (no./m^2) 45 DAS	Weed biomass (g/m^2) 45 DAS	Weed control efficiency (%) 45 DAS	Weed infestation (%)
Pendimethalin 1.0 kg/ha (PE) *fb* interculture 25 DAS	16.67	9.62	88.01	23.26
Interculture 15 DAS *fb* imazethapyr 100 g/ha 25 DAS	22.33	17.6	78.06	28.88
Interculture 15 DAS *fb* quizalofop-ethyl 50 g/ha 25 DAS	20.67	15.58	80.58	27.31
Pendimethalin 1.0 kg/ha (PE) *fb* imazethapyr 100 g/ha 25 DAS	14.33	10.78	86.56	20.67
Pendimethalin 1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha 25 DAS	11.67	6.34	92.10	17.50
Weed-free	6.67	2.68	96.66	10.81
Weedy check	108.33	80.22	0	66.33
LSD (p=0.05)	5.98	3.24	-	-

The number of root nodules differed from treatment to treatment (21.00 to 25.33).The maximum number of nodules per plant (25.33) was recorded in weed free plots. Pre-emergence application of pendimethalin 1.0 kg/ha with quizalofop-ethyl 50 g/ha at 25 DAS recorded 24.00 nodules per plant. While the lowest nodules were found in weedy check plots. Similar results were reported by Adhikary *et al*. (2016).

Significant difference in plant height were observed with pre-emergence and post-emergence herbicides applied alone or in combination ($p<0.05$). The pre-emergence application of pendimethalin1.0 kg/ha (PE) recorded 62.25 cm plant height Among the post-emergence treatments, the maximum height (61.67 cm) was recorded under quizalofop-ethyl 50 g/ha at 25 DAS treatment (**Table 3**). The combined application of pendimethalin 1.0 kg/ha PE and quizalofop-ethyl 50 g/ha PoE at 25 DAS recorded 63.39 cm plant height, which was highest among the herbicidal treatments. The lowest plant height was observed in the weedy check plots (56.30 cm). The tested herbicides had no significant difference on days to 50% bloom. 50% blooming has occurred between 48 to 52 days. Similar trend was found by Balyan *et al.* (2016).

The longest pod size 5.63 cm was recorded in weed free plots and the shortest (5.27 cm) was found in weedy check plots (**Table 4**). 5.50 cm long pod was found in pendimethalin 1.0 kg/ha and quizalofop-ethyl 50 g/ha treated plots.

Number of pods per plant was significantly influenced by weed control practices (**Table 4**). Significantly higher number of pods (17.55) were produced by application of pendimethalin1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha at 25 DAS. However pendimethalin 1.0 kg/ha (PE) *fb* imazethapyr 100 g/ha 25 DAS was on par with treatment T5. The highest number of pods per plant (19.24) was found in weed free plots and significantly lowest number of pods per plant was recorded by weedy check (14.5). The higher number of seeds per pod was observed in (T6) weed free plots (8.86) and was followed by (T5) pendimethalin 1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha at 25 DAS (8.69). While, the least numbers of seeds per pod were observed in weedy check (6.56). Significantly higher test weight was recorded in weed free (4.98 g) which was on par with pendimethalin 1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha at 25 DAS (4.66 g). Significantly lowest test weight was recorded in weedy check (3.67 g). Similar result was recorded by Balyan *et al.* (2016).

Higher seed yield (0.82 t/ha) was recorded with the application of pendimethalin 1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha 25 DAS, which showed 48.35% increment over the weedy check (**Table 4**).

Table 2. Effect of treatments on weed indices in blackgram (pooled value)

Treatment	HEI	WPI	CRI	WI	AMI
Pendimethalin 1.0 kg/ha (PE) *fb* interculture 25 DAS	6.62	0.78	14.96	7.89	-0.50
Interculture 15 DAS *fb* imazethapyr 100 g/ha 25 DAS	3.37	1.06	7.93	10.68	-0.46
Interculture 15 DAS *fb* quizalofop-ethyl 50 g/ha 25 DAS	3.91	1.02	9.06	9.71	-0.46
Pendimethalin 1.0 kg/ha (PE) *fb* imazethapyr 100 g/ha 25 DAS	6.42	1.02	13.86	4.37	-0.46
Pendimethalin 1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha 25 DAS	11.85	0.73	24.50	0.61	-0.48
Weed-free	28.38	0.54	58.31	0.00	-0.50
Weedy check	0.00	1.00	1.00	48.67	

HEI = Herbicide efficacy index; WPI= Weed persistence index; CRI = Crop resistance index; WI = Weed Index; AMI = Agronomic management index

Table 3. Effect of different weed control treatments on growth parameters of blackgram (pooled value)

Treatment	Germination (%)	Plant height (cm)	Nodules/ plant	Days to 50% bloom
Pendimethalin 1.0 kg/ha (PE) *fb* interculture 25 DAS	94.67	62.25	23.67	48.33
Interculture 15 DAS *fb* imazethapyr 100 g/ha25 DAS	95.33	59.59	22.67	51.67
Interculture 15 DAS *fb* quizalofop-ethyl 50g/ha 25 DAS	94.23	61.67	21.67	50.67
Pendimethalin 1.0 kg/ha (PE) *fb* imazethapyr100 g/ha 25 DAS	93.50	60.59	22.00	49.67
Pendimethalin 1.0 kg/ha (PE) *fb* quizalofopethyl50 g/ha 25 DAS	97.23	63.39	24.00	51.33
Weed-free	97.00	65.42	25.33	50.33
Weedy check	96.5	56.30	21.00	49.67
LSD (P=0.05)	-	2.65	3.14	-

Table 4. Effect of different weed control treatments on yield attributing characters, yield and economics of blackgram (pooled value)

Treatment	Pod size (cm)	Pods/ plant	Seeds / pod	100-seed weight (g)	Yield (t/ha)	Yield increase (%)	Gross cost (x10^3 `/ha)	Gross return (x10^3 `/ha)	B:C ratio
Pendimethalin 1.0 kg/ha (PE) *fb* interculture 25 DAS	5.47	16.40	7.87	4.59	0.76	44.27	24.75	41.74	1.69
Interculture 15 DAS *fb* imazethapyr 100 g/ha 25 DAS	5.43	15.98	7.38	4.28	0.74	42.53	24.60	40.48	1.65
Interculture 15 DAS *fb* quizalofop-ethyl 50 g/ha 25 DAS	5.33	16.33	7.55	4.39	0.74	43.15	24.65	40.92	1.66
Pendimethalin 1.0 kg/ha (PE) *fb* imazethapyr 100 g/ha 25 DAS	5.20	17.45	8.05	4.43	0.79	46.32	24.85	43.34	1.74
Pendimethalin 1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha 25 DAS	5.50	17.55	8.69	4.66	0.82	48.35	24.54	45.04	1.84
Weed-free	5.63	19.24	8.86	4.98	0.82	48.67	25.50	45.32	1.78
Weedy check	5.27	14.50	6.56	3.67	0.42	0.00	21.50	23.26	1.08
LSD (p=0.05)	1.37	2.01	1.28	NS	0.13	-	-	-	-

The highest per cent (48.67%) increase in seed yield of blackgram with the weed free over the weedy check. The seed yield was negatively associated with total weed density, weeds biomass and positively associated with plants (no./m^2), pods/plant, seed/pod and 100-seed weight (g). This might be due to effective control of weeds, less crop weed competition throughout the crop growth period which resulted in improved growth parameters of the crop. These findings were agreement with Singh *et al*. (2014); Rajput and Kushwah (2004). The highest value of gross return (45320) and B:C ratio (1.78) was recorded in weed free while highest B:C ratio (1.84) was recorded with pendimethalin 1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha at 25 DAS.

Application of pendimethalin 1.0 kg/ha (PE) *fb* quizalofop-ethyl 50 g/ha at 25 DAS could be the possible alternative options for effective and economic weed management in blackgram under rainfed system in West Bengal conditions.

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