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Weed control in clusterbean through post-emergence herbicides

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ABSTRACT

Field experiment was conducted at Bikaner for two consecutive years during *Kharif* seasons of 2012 and 2013 to test the efficacy of different weed control measures against weeds in clusterbean *Cyamopsis tetragonoloba* (L.) Taub. The experiment consisting of seven treatments, *viz*. imazethapyr 40 g/ha, quizalofop-ethyl 37.5 g/ha, fenoxaprop-p-ethyl 50 g/ha, imazethapyr + imazamox 40 g/ha, pendimethalin 0.75 kg/ha as pre-emergence (PE), hand weeding twice at 20 and 40 DAS and weedy check. Among herbicids, post-emergence application of imazethapyr + imazamox (ready mix) 40 g/ha applied at 3-4 leaf stage (around 20 DAS) recorded lowest weed density and dry weight of both grassy and broad-leaved weeds with maximum weed control efficiency (88.1%). Application of imazethapyr alone at 40 g/ha applied at 3-4 leaf stage (around 20 DAS) significantly reduced the density and dry weight of broad-leaved weeds but not effective significantly against grassy weeds. Yield attributes *i.e* pods/plant, seed and straw yields, net return and B: C ratio were also superior with imazethapyr + imazamox 40 g/ha applied at 3-4 leaf stage (around 20DAS).

Key words: Clusterbean, imazethapyr, imazethapyr + imazamox, post-emergence herbicidal control, Weed control efficiency

Clusterbean *Cyamopsis tetragonoloba* (L.) Taub. locally known as guar, is an important drought hardy leguminous crop. Guar is basically a crop that is cultivated mostly in the arid and semiarid areas. Its seeds contain 28-33% gum. Clusterbean is mainly cultivated in marginal and rain fed areas where inadequate weed management is a major constraint in harnessing its production potential. Being a rainy season crop, it suffers badly due to severe competition by mixed weed flora. Yield reduction due to weed infestation is of the tune of 53.7% (Saxena *et al.* 2004).

Hand weeding is a traditional and effective method of weed control, but untimely rains, unavailability of labour at peak time and increasing labour cost are the main limitations of manual weeding. Under such situations, the only alternative that needs to be explored is the use of suitable herbicide, which may be effective and economically viable. Application of fluchloralin and pendimethalin at 0.75-1.0 kg/ha as pre-emergence were effective against weeds in clusterbean (Dhaker *et al.* 2009) but inadequate moisture and westerly winds blowing at time of sowing in this region left little moister for soil applied herbicide to act effectively, which resulted poor efficiency of these herbicides in most of the time in arid zone soils (Punia *et al.* 2011). To overcome the problem, post-emergence herbicides for pulses and leguminous crops were tried at the critical period of crop weed competition at 20-30 DAS (Yadav 1998) of clusterbean. With these points in view, the present investigation aims to test the efficacy of early post-emergence herbicides in cluster bean.

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MATERIALS AND METHODS

Field experiment was carried out for two consecutive years during *Kharif* seasons of 2012 and 2013 at SK Rajasthan Agricultural University Farm, Bikaner to test the efficacy of different weed control measures against weeds. There were seven treatments consisting of imazethapyr 40 g/ha, quizalofop ethyl 37.5 g/ha, fenoxaprop-p-ethyl 50 g/ha, imazethapyr + imazamox 40 g/ha, pendimethalin 0.75 kg/ha as pre-emergence (PE), hand weeding twice at 20 and 40 DAS and weedy check. The treatments were arranged in randomized block design (RBD) with three replications.

The soil of the experimental field was loamy sand with low in organic carbon (0.08%) and available N (78 kg/ha), medium in available P (22 kg/ha) and available K (210 kg/ha) with pH 8.2. Cluster bean variety '*RGC-1066*' was sown on 18 July 2012 and 20 July 2013 with crop geometry of 30 x 10 cm with recommended package of practices. The pre-sowing irrigation was given for sowing the crop during both the years. The total rainfall during the season was 174.8 mm in 2012 and 202.6 mm in 2013. There was a stress period of about 28 days during 2012 and 25 days in 2013 season. Fertilizers

were applied uniformly through urea and DAP at 20 kg N and 40 kg P_2O_5/ha. Above ground weed biomass was sampled at 60 DAS using a quadrant of 0.5 x 0.5 m. Plant material was dried at 65°C for 48 h before determining dry weight. Standard methods were followed for weed, crop and economics analysis.

RESULTS AND DISCUSSION

Effect on weed

The major weed flora in experimental field consisted of *Amaranthus viridis, Gisekia poiedious, Digera arvensis, Portulaca olerecea, Trianthema portulacastrum* among broad-leaved weeds and *Cenchrus biflorus, Eragrostis pilosa* and *Eragrostis tanella* among grassy weeds.

Imazethapyr + imazamox (ready mix) 40 g/ha, imazethapyr alone at 40 g/ha applied at 3-4 leaf stage (around 20 DAS) and pendimethalin at 0.75 kg/ha as pre-emergence significantly reduced the density and dry weight of broad-leaved weeds in clusterbean as compared to weedy check and other herbicidal treatments during both the years (Table 1 and 2). Punia *et al.* (2011) also reported better control of weeds in clusterbean by imazethapyr. Further, imazethapyr + imazamox (ready mix) at 40 g/ha and imazethapyr alone at 40 g/ha applied at 3-4 leaf stage (around 20 DAS) significantly lower down the density and dry weight of broad- leaved weeds as compared to pendimethalin at 0.75 kg/ha during 2012. However, during 2013 pendimethalin at 0.75 kg/ha reduced broad-leaved weeds significantly as compared to imazethapyr at 40 g/ha but statistically at par with imazethapyr + imazamox at 40 g/ha. The pooled data of two years revealed that imazethapyr + imazamox at 40 g/ha recorded significantly lower density and dry weight of total weeds as compare to all other herbicidal treatments except pendimethalin at 0.75 kg/ha as pre-emergence. Quizalofop-ethyl 37.5 g/ha and fenoxaprop-p-ethyl 50 g/ha at 3-4 leaf stage failed to control density and dry weight of broad-leaved weeds. As far as grassy weeds were concerned, imazethapyr + imazamox 40 g/ha, quizalofop-ethyl 37.5 g/ha and fenoxaprop-ethyl 50 g/ha significantly controlled the grassy weeds as compared to weedy check, imazethapyr alone at 40 g/ha but statistically at par with pendimethalin at 0.75 kg/ha as pre-emergence during both the years and pooled basis. Mundra and Maliwal (2012) and Nandan *et al.* (2011) also revealed that quazalfop-ethyl 37.5 g/ha and fenoxaprop-ethyl 50 g/ha effectively controlled grassy weeds but poorly managed the broad leaved weeds in blackgram and greengram, respectively. Density of grassy weeds was lower than broad-leaved weeds in the experiment.

Poor performance of pendimethalin at 0.75 kg/ha during 2012 in controlling weeds was due to hot Westerly winds blowing just after sowing of crop which reduced the upper layer moisture of the soil thus reduced the efficacy of the pendimethalin, however, in 2013 continuous rains for 3 days after sowing of clusterbean was recorded with commencement of monsoon in the region and therefore, moisture remained in the upper layer of the soil during germination phase which increased the

Table 1. Effect of weed control measures on weed density in clusterbean

Treatment	Weed density (no./m^2)								
	2012			2013			Pooled		
	Broad-leaved	Grassy	Total	Broad-leaved	Grassy	Total	Broad-leaved	Grassy	Total
Imazethapyr 40 g/ha (at 3-4 leaf stage)	1.90 (*2.7)	2.73 (6.50)	3.20 (9.25)	3.42 (10.4)	5.38 (27.9)	6.27 (38.30)	3.75 (13.11)	5.95 (34.4)	6.97 (47.5)
Quizalofop-ethyl 37.5 g/ha (at 3-4 leaf stage)	4.36 (18.2)	1.49 (1.25)	4.53 (19.5)	5.50 (29.2)	1.71 (1.9)	5.66 (31.10)	6.95 (47.4)	2.02 (3.1)	7.17 (50.5)
Fenoxaprop-p-ethyl 50 g/ha (at 3-4 leaf stage)	4.15 (16.2)	1.47 (1.25)	4.30 (17.5)	5.89 (33.7)	1.75 (2.1)	6.06 (35.80)	7.13 (49.9)	2.07 (3.3)	7.36 (53.2)
Imazethapyr + imazamox 40 g/ha (at 3-4 leaf stage)	2.16 (4.2)	2.28 (4.25)	3.10 (8.5)	2.34 (4.5)	2.95 (7.7)	3.63 (12.20)	3.11 (8.7)	3.59 (11.9)	4.65 (20.6)
Pendimethalin 0.75 kg/ha as pre-emergence	3.54 (12.0)	1.96 (3.00)	4.0 (15)	2.63 (5.9)	2.27 (4.1)	3.31 (10.00)	4.35 (17.9)	2.84 (7.1)	5.10 (25.0)
Hand weeding at 25 and 40 DAS	2.08 (3.7)	1.31 (0.75)	2.34 (4.5)	1.65 (1.72)	2.03 (3.1)	2.41 (4.82)	2.55 (5.55)	2.19 (3.8)	3.21 (9.3)
Weedy check	4.55 (19.7)	3.15 (9.00)	5.43 (28.7)	8.59 (72.8)	5.76 (32.2)	10.5 (105.00)	9.67 (92.5)	6.50 (41.2)	11.61 (133.7)
LSD (P=0.05)	0.96	0.39	0.66	0.75	0.65	0.61	0.71	0.44	0.97

*Original values are in parentheses, PE- Pre-emergence, DAS- Day after sowing

Table 2. Effect of weed control measures on weed dry weight in clusterbean

Treatment	Weed dry weight (g/m^2)									Weed control efficiency (%)		
	2012			2013			Pooled					
	Broad-leaved	Grassy	Total	Broad-leaved	Grassy	Total	Broad-leaved	Grassy	Total	Broad-leaved	Grassy	Total
Imazethapyr 40 g/ha at 3-4 leaf stage	1.68	4.42	6.12	13.4	9.98	23.4	15.1	14.4	29.5	85.2	14.4	75.2
Quizalofop-ethyl 37.5 g/ha at 3-4 leaf stage	20.55	0.22	20.75	77.5	1.10	78.7	98.1	1.3	99.4	4.22	92.3	16.6
Fenoxaprop-p-ethyl 50 g/ha at 3-4 leaf stage	18.82	0.25	19.14	69.5	1.60	71.1	88.3	1.83	90.1	13.7	89.0	24.4
Imazethapyr + imazamox 40 g/ha at 3-4 leaf stage	0.62	1.80	2.45	9.32	2.55	11.8	9.9	4.35	14.2	90.3	74.1	88.1
Pendimethalin 0.75 kg/ha as PE	5.380	2.08	7.45	7.4	1.75	9.1	12.8	3.83	16.6	87.4	77.2	86.4
Hand weeding at 25 and 40 DAS	0.92	0.38	1.36	2.3	1.20	3.50	3.25	1.53	4.82	96.8	90.9	95.9
Weedy check	18.08	6.20	24.3	84.3	10.6	94.9	102.4	16.83	119.2	0.00	0.00	0.00
LSD at (0.05)	0.49	0.16	O.61	15.9	1.31	78.6	20.2	2.46	23.8	-	-	-

Table 3. Effect of weed control measures on yield attributes and yield of clusterbean

Treatment	Plant height (cm)			Pods/plant			Seed index (g)			Seed yield (t/ha)			Straw yield (t/ha)		
	2012	2013	Mean	2012	2013	Mean	2012	2013	Mean	2012	2013	Mean	2012	2013	Mean
Imazethapyr 40 g/ha at 3-4 leaf stage	99.5	108.2	103.8	64.2	57.0	60.6	3.4	3.6	3.5	0.93	1.19	1.06	3.43	1.85	2.64
Quizalofop-ethyl 37.5 g/ha at 3-4 leaf stage	85.5	103.5	94.5	48.7	37.2	42.9	3.4	3.4	3.3	0.41	0.74	0.57	1.96	1.15	1.56
Fenoxaprop-p-ethyl 50 g/ha(at 3-4 leaf stage	76.5	103.5	90.0	45.2	43.2	44.2	3.4	3.4	3.3	0.48	0.86	0.67	2.11	1.33	1.72
Imazethapyr + imazamox 40 g/ha at 3-4 leaf stage	98.5	108.2	103.3	67.7	59.0	63.3	3.5	3.8	3.6	1.12	1.37	1.24	3.40	2.12	2.76
Pendimethalin 0.75 kg/ha PE	85.7	95.8	90.7	53.0	54.0	53.5	3.4	3.4	3.3	0.72	1.47	1.10	2.92	2.28	2.60
Hand weeding at 25 and 40 DAS	107.0	107.0	107	66.7	61.0	63.8	3.5	3.5	3.5	0.83	1.44	1.13	3.39	2.24	2.81
Weedy check	73.7	88.7	81.2	47.7	33.5	40.6	3.4	3.6	3.5	0.41	0.80	0.60	1.65	1.23	1.44
LSD a(P=0.05)	8.8	11.5	7.4	5.4	13.0	2.8	NS	NS	NS	0.16	0.34	0.14	0.76	0.53	0.46

efficacy of pendimethalin. Sireesha *et al.* (2011) reported that performance of pendimethalin depends upon the moister in the soil.

Effect on crop

Application of imazethapyr + imazamox at 40 g/ha and imazethapyr alone at 40 g/ha at 20 DAS (3-4 leaf stage) and pendimathalin 0.75 kg/ha as PE significantly increased the plant height and pods/plant and consequently seed and straw yield of cluster bean compared to weedy check and quizalofop-ethyl 37.5 g/ha and fenoxaprop-p-ethyl 50 g/ha at 3-4 leaf stage (around 20 DAS) but statistically at par with two hand weeding during both the years and pooled basis (Table 3). The results were in closed conformity with the finding of Yadav *et al.* (2011). Imazethapyr + imazamox 40 g/ha produced maximum and significantly higher yield attributes (pods/plant) and seed and straw yield of clusterbean as compared to imazethapyr 40 g/ha and pendimathalin 0.75 kg/ha during 2012, while it was statistically at par with pendimathalin 0.75 kg/ha in 2013, however, on pooled basis, imazethapyr + imazamox 40 g/ha at 20 DAS significantly increased the seed yield of cluster bean compared to other herbicides but it was statistically at par with two hand weeding. This might be due to the fact that imazethapyr + imazamox 40 g/ha significantly controlled both broad-leaved and grassy weeds while imazethapyr alone at 40 g/ha controlled only broad-leaved and not of grassy weeds and consequently produced significantly lower yield attributes particularly of pods/plant (Table 1,2 and 3). The performance of pendimathalin 0.75 kg/ha was not consistent as it was not able to control weeds during 2012 (Table 1 and 2). Mundra and Maliwal (2012) also reported poor control of weeds in black gram by pendimethalin in rainfed areas. Significantly lower seed and straw yields were also obtained in the plots applied with quizalofop-ethyl at 37.5 g/ha and fenoxaprop-p-ethyl 50 g/ha at 3-4 leaf stage as these herbicides were able to reduce density and dry weight of grassy weeds only but as earlier state broad-leaved weeds dominated the experimental fields during both the years. Nandan *et al.* (2011) also reported similar results in blackgram.

Table 4. Effect of weed control measures on economics of cluster bean

Treatment	Net returns (x10^3 `/ha)			B:C ratio		
	2012	2013	Mean	2012	2013	Mean
Imazethapyr 40 g/ha at 3-4 leaf stage	30.99	39.87	35.43	2.81	3.33	3.07
Quizalofop-ethyl 37.5 g/ha at 3-4 leaf stage	4.15	17.85	11.00	1.24	2.01	1.62
Fenoxaprop-p-ethyl 50 g/ha at 3-4 leaf stage	7.64	23.38	15.51	1.43	2.32	1.87
Imazethapyr + imazamox 40 g/ha at 3-4 leaf stage	39.05	48.07	43.56	3.26	3.78	3.52
Pendimethalin 0.75 kg/ha as pre-mergence	19.58	52.21	35.89	2.09	3.90	2.99
Hand weeding at 25 and 40 DAS	23.60	49.35	36.47	2.21	3.53	2.87
Weedy check	4.70	21.48	13.09	1.28	2.30	1.79

Economics

The net returns and benefit: cost ratio were maximum for imazethapyr + imazamox at 40 g/ha during both the years and on pooled basis (Table 4). It was followed by imazethapyr 40 g/ha applied at 20 DAS with B:C ratio of 3.07 and pendimethalin with B:C ratio of 2.99 on pooled basis.

It was concluded that application of imazethapyr + imazamox (ready mix) 40 g/ha at 20 DAS (3-4 leaf stage) was more effective in controlling both broad-leaved and grassy weeds, increasing seed yield and economically feasible in cluster bean in arid regions. Other herbicide imazethapyr 40 g/ha applied at 20 DAS was also effective where broad-leaved were more dominated.

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