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Research Paper

Effective weed management in clusterbean (*Cyamopsis tetragonoloba*) through post-emergence herbicide

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ABSTRACT

A field experiment was conducted at the Research Farm of Agricultural Research Station, Swami Keshwanand Rajasthan Agricultural University, Bikaner during the rainy (*kharif*) seasons of 2012, 2013 and 2014 to test the efficacy of different weed control measures against weeds in clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.]. The experiment comprising seven weed control 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 days after sowing (DAS) and weedy check was laid out in a randomized block design with four replications. Amongst the herbicidal treatments, post-emergence application of imazethapyr + imazamox 40 g/ha applied at 3–4-leaf stage resulted in the lowest weed density and dry weight of both grassy and broad-leaf weeds. Application of imazethapyr alone at 40 g/ha applied at 3–4-leaf stage significantly reduced the density and dry weight of broad-leaf weeds, but it was not effective against grassy weeds. Pods/plant and seed and straw yields, net returns and benefit: cost ratio were also superior with imazethapyr + imazamox 40 g/ha compared to the other treatments.

Key words: Clusterbean, Economics, Herbicide, Imazethapyr, Weed control

Clusterbean commonly known as *guar*, is an important drought-hardy leguminous crop. It is basically a crop that is cultivated mostly in the arid and semi-arid areas. Seeds of guar contain 28–33% gum. Clusterbean is mainly cultivated in marginal and rainfed 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.

Saxena *et al.* (2004) reported yield reduction of 53.7% due to weed infestation. Hand-weeding is a traditional and effective method of weed control, but untimely rains, unavailability of labour on time and higher labour cost are the major limitations of manual weeding. Under such a situation, the only alternative that needs to be explored is the use of suitable herbicide which may be effective and economically viable. Application of pendimethalin at 0.75–1.0 kg/ha as pre-emergence was effective against weeds in clusterbean (Dhaker *et al.,* 2009). But inadequate moisture and prevailing western winds at time of sowing in this region resulted in surface soil-moisture deficit which reduces the efficiency of pre-emergence herbicides (Punia *et al*., 2011). To overcome these problems, post-emergence herbicides may be used in clusterbean as recommended in many other pulse crops (Singh *et al*., 2017). Hence, present investigation was carried out to test the efficacy of new generation, early post-emergence herbicides in clusterbean.

MATERIALS AND METHODS

A field experiment was carried out during the rainy (*kharif*) seasons of 2012, 2013 and 2014 at the Swami Keshwanand Rajasthan Agricultural University Farm, Bikaner, to test the efficacy of different weed-control measures in clusterbean. Seven treatments consisting of imazethapyr 40 g/ha, quizalofopethyl 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 days after sowing (DAS) and weedy check. The treatments were arranged in randomized block design with four replications. The soil of the experimental field was loamy sand with low in organic carbon (0.08%), available nitrogen (78 kg/ha), available phosphorus (22 kg/ha) and medium in available potassium (210 kg/ha) with *p*H 8.2. Clusterbean variety 'RGC 1066'

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was sown on 18 July 2012, 20 July 2013 and 16 July 2014, with crop geometry of 30 cm × 10 cm under recommended package of practices. The pre-sowing irrigation was given for sowing the crop during the experimental years. The total rainfall received during the season was 174.8 mm in 2012, 202.6 mm in 2013 and 427.9 mm in 2014. There was a mid-season stress period of about 28 days during 2012. Fertilizers were applied uniformly through urea and diammonium phosphate at the rate of 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 m × 0.5 m. Weeds plants were 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 of experimental field consisted of *Amaranthus spinosus, Gisekia pharnaceoides, Digera arvensis, Portulaca oleracea, Trianthema portulacastrum, Mollugo* sp., *Tribulus terrestris, Phyllanthus niruri, Physalis minima* and *Corchorus* sp. among broad-leaf weeds; and *Cenchrus biflorus, Eragrostis pilosa* and *Eragrostis tennela* were important grassy weeds. Density of grassy weeds was lower than broad-leaf weeds in the experiment.

Among the weed-management practices, imazethapyr + imazamox 40 g/ha, imazethapyr 40 g/ha applied at 3–4 leaf stage (20 DAS) and pendimethalin at 0.75 kg/ha as pre-emergence showed significant reduction in the density and dry weight of broad-leaf weeds in clusterbean than the weedy check and the other herbicide treatments (Table 1). Punia *et al.* (2011) also reported better control of weeds in clusterbean with the use of imazethapyr. Further, imazethapyr + imazamox 40 g/ha and imazethapyr 40 g/ha significantly reduced the density and dry weight of broad leaf weeds as compared to pendimethalin at 0.75 kg/ha. Similar results were also reported by Samant and Mohanty (2017) in mungbean. The pooled data of three years revealed that, imazethapyr + imazamox 40 g/ha recorded significantly lower density and dry weight of total weeds than all the other herbicide treatments except pendimethalin 0.75 kg/ha. Quizalofop-ethyl at 37.5 g/ha and fenoxaprop-p-ethyl 50g/ha failed to control broad-leaf 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 and imazethapyr 40 g/ha, but statistically at par with pendimethalin at 0.75 kg/ha. Similar results were also reported by Jinger *et al*. (2016). Mundra and Maliwal (2012) also revealed that, quizalofop-ethyl 37.5 g/ha and fenoxaprop-ethyl 50 g/ha effectively controlled grassy weeds but poorly managed the broad-leaf weeds in urdbean. Herbicide imazethapyr and imazethapyr + imazamox belong to group of imidazolinones. These are selective and applied as post emergence with a view to control late-emerging weeds. It inhibits the plastid enzyme acetolactate syntheses (ALS) in plants which catalyses the first step in the biosynthesis of essential branched chain amino acids (valine, leucine, isoleucine). The ALS inhibitors thus, stop cell-division and reduce carbohydrate translocation in the susceptible plants (Gupta, 2008). Saltoni *et al.* (2004) suggested that imazethapyr and imazethapyr + imazamox are imidazolinones herbicide, which are absorbed both by the roots and the shoots. These can effectively control a broad spectrum of weeds.

Effect on crop

Application of imazethapyr + imazamox 40 g/ha and imazethapyr 40 g/ha and pendimathalin at 0.75 kg/ha significantly increased the plant height and pods/plant and consequently seed and straw yields of clusterbean compared to weedy check and quizalofop-ethyl at 37.5 g/ha and fenoxaprop-p-ethyl 50 g/ha; however, statistically at par with two hand-weeding (Table 2). Our results confirm

Table 1. Effect of weed-control measures on weed density and dry weight in clusterbean (pooled data over 3 years)

Treatment	Weed density (Nos./m^2)			Weed dry weight (g/m^2)		
	Broad leaf	Grassy	Total	Broad leaf	Grassy	Total
Imazethapyr 40 g/ha	2.87 (7.79)	3.69 (14.31)	5.48 (31.70)	9.71	6.08	15.79
Quizalofop ethyl 37.5 g/ha	5.19 (26.47)	1.57 (1.66)	5.79 (33.70)	59.19	0.90	60.09
Fenoxaprop-p-ethyl 50 g/ha	5.28 (27.58)	1.63 (1.88)	5.91 (35.50)	53.20	1.23	54.43
Imazethapyr + Imazamox 40 g/ha	2.27 (4.54)	2.23 (4.62)	3.79 (13.77)	4.62	1.95	6.57
Pendimethalin 0.75 kg/ha PE	2.92 (8.07)	2.22 (4.23)	4.14 (16.67)	7.21	2.40	9.62
2 hand-weedings	1.71 (2.27)	1.77 (2.41)	2.65 (6.21)	1.96	1.16	3.12
Weedy check	7.35 (56.91)	4.93 (25.15)	9.18 (89.15)	64.00	9.40	73.40
SEm±	0.26	0.18	0.27	2.61	0.38	3.00
CD (P=0.05)	0.77	0.53	0.75	7.82	1.15	8.95

Original values are in parentheses; PE, Pre-emergence

Table 2. Effect of weed-control measures on growth, yield attributes, yield and economics of clusterbean (pooled data over 3 years)

Treatment	Plant height (cm)	Pods/ plant	Seed index (g)	Yields (t/ha)			Net returns ($\times 10^3$ ₹/ha)	Benefit: cost ratio
				Seed	Straw	Biological		
Imazethapyr 40 g/ha	102.1	61.7	3.5	1.06	2.53	3.59	34.97	3.04
Quizalofop ethyl 37.5 g/ha	96.4	45.2	3.4	0.71	1.69	2.40	17.47	1.99
Fenoxaprop-p-ethyl 50 g/ha	95.5	47.2	3.4	0.79	1.84	2.62	20.92	2.18
Imazethapyr + Imazamox 40 g/ha	101.2	66.1	3.6	1.26	2.58	3.83	43.68	3.53
Pendimethalin 0.75 kg/ha PE	96.1	59.3	3.4	1.12	2.50	3.62	36.57	3.03
2 hand-weedings	107.7	66.7	3.5	1.20	2.65	3.85	39.10	3.00
Weedy check	89.1	40.9	3.4	0.65	1.33	1.98	15.03	1.91
SEm±	3.9	4.7	0.09	0.12	0.26	0.38	5.23	0.52
CD (P=0.05)	11.8	14.1	NS	0.37	0.78	1.15	15.12	1.53

PE, Pre-emergence

the findings of Kumar *et al.* (2016). On the basis of pooled data, it was noticed that maximum pods/plant and yields were recorded with two hand weedings at 20 and 40 DAS. This might be owing to better growth environment. Among the herbicide treatments, application of imazethapyr + imazamox 40 g/ha resulted in significantly higher pods/plant and seed and straw yields of clusterbean as compared to weedy check and quizalofop-ethyl at 37.5 g/ha and fenoxaprop-p-ethyl 50 g/ha. Results further revealed that, imazethapyr + imazamox 40 g/ha significantly increased the seed yield of clusterbean compared to the other herbicide treatments but statistically at par with two hand-weedings. This might be owing to the fact that, imazethapyr + imazamox 40 g/ha and imazethapyr 40 g/ha significantly controlled both broad-leaf and grassy weeds and consequently resulted in significantly higher yield attributes and yield. The performance of pendimathalin 0.75 kg/ha was not consistent, as it was not able to the control weeds (Table 1). Shaikh *et al*. (2002) also reported poor control of weeds in blackgram 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 50g/ha at 3–4–leaf stage (around 20 DAS), as these herbicides were able to reduce density and dry weight of grassy weeds only but as earlier state broad-leaf weeds dominated the experimental fields during both the years. Jinger *et al.* (2016) also reported similar results in mungbean.

Economics

The net returns of ₹43,677/ha and benefit: cost of 3.53 ratio were maximum for imazethapyr + imazamox at 40 g/ha (Table 2) followed by hand-weeding twice at 20 and 40 DAS with B : C ratio of 3.00 and pendimethalin with B:C ratio of 3.03.

It was concluded that application of imazethapyr + imazamox 40 g/ha at 20 days after sowing (3–4-leaf stage) was more effective in controlling both broad-leaf and grassy weeds, increasing seed yield and economically feasible in clusterbean in arid regions. The other herbicides are pendimethalin at 0.75 kg/ha pre-emergence and imazethapyr at 40 g/ha applied at 20 days after sowing also effective where broad leaved weeds were more dominated.

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