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Effect of weed management practices on weed dynamics in clusterbean [*Cyamopsis tetragonoloba* (L.) Taub]

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Abstract

A field experiment was conducted to find out the effect of weed management practices on weed dynamics in clusterbean [*Cyamopsis tetragonoloba* (L.) Taub]. The experiment was carried out during *kharif* season of 2018 and ten treatment combination of different herbicides were replicated thrice in RBD. Results revealed that the early post-emergence application of imazethapyr + imazamox 50 g/ha + HW at 35 DAS was found the most effective treatment which recorded lowest density of narrow and broad leaved weeds and minimum weed dry matter at all growth stages. This treatment also recorded significantly higher seed yield (1180 kg/ha) with higher weed control efficiency (92.8%) and lowest weed competition index (4.6%). This practice of weed management was statistically at par with weed free season long plots and another treatment of application of imazethapyr 40 g/ha at 20 DAS + HW at 35 DAS.

Keywords: Clusterbean, weed density, weed dry matter, early post-emergence, HW, seed yield

Introduction

Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub] is commonly known as “Guar”. The primary centre of origin of clusterbean is India (Vavilov, 1951) [17]. It is an important cash crop of rain fed areas, particularly in semi-arid and arid regions of India. This crop belongs to the family fabaceae and sub family papilionaceae. It is well adapted to the agro-climatic conditions existing in Rajasthan and is being grown in areas receiving annual rainfall from 350 to 750 mm. Rajasthan is a major clusterbean growing state of India and it ranks first with respect to both area of 2.8 million hectares and production 1.2 million tonnes and productivity of 452 kg/ha of clusterbean (Govt. of Rajasthan, 2020) [2]. Clusterbean is grown for different purposes *viz.*, vegetable, green fodder, green manuring and seed. The gum/glutamin content in the endosperm of its seed (28-33 per cent) has several industrial uses *viz.*, textiles, paper, petroleum, pharmaceuticals, food processing, cosmetics, mining explosives, oil drilling etc. thus making it a good foreign exchange earner (Kumawat *et al.*, 2017) [5]. Tender pods of clusterbean are nutritionally wealthy in energy (116 k cal.), protein (3.2 g), fat (1.4 g), carbohydrate (10.8 g), vitamin-A (65.31 I.U.), vitamin-C (49 mg), calcium (57 mg) and iron (4.5 mg) per 100 g of edible portion (Kumar and Singh, 2002) [4].

Weeds infects vigorously due to frequent rains and presence of weeds beyond critical period of crop-weed competition results in yield reduction to the tune of 40-45 per cent (Sangwan *et al.*, 2016) [11]. The competition between crop and weeds caused 53.7 per cent reduction in grain yield (Singh *et al.*, 2008) [14]. Among different weed management practices, hand weeding is traditional and efficient option but unavailability of labour at peak weeding periods and increasing labour cost oblige major limitations on economic feasibility of manual weeding (Singh and Godara, 2015) [13]. Pre-emergence application of pendimethalin is recommended in this region but if pre-emergence herbicide is skipped due to one or another reason, hence post-emergence application of herbicide is effective and gives control mixed flora of narrow and broad-leaved weeds *viz.*, *Digera arvensis*, *Tribulus terrestris*, *Corchorus trilocularis*, *Phyllanthus niruri*, *Amaranthus viridis*, *Celosia argentea* and *Portulaca oleracea* among broad-leaved weeds and *Eragrostis minor*, *Cyperus rotundus*, *Cynodon dactylon* and

Dactyloctenium aegyptium among narrow leaved weeds. Keeping in view these facts, the present study was taken with an objective to find out suitable weed management practice for control of weeds in clusterbean.

Materials and Methods

The experiment was carried out at Agricultural Research Station, Mandor-Jodhpur during *kharif* season of 2018. The soil was loamy sand in texture, slightly alkaline in reaction (pH 7.2), low in organic carbon (0.13%) and available nitrogen (184 kg/ha). The Field experiment was laid out in randomized block design (RBD) with ten treatments of replicated thrice. The treatments comprises of weedy check, weed free, pendimethalin 750 g/ha (PE), imazethapyr 40 g/ha at 20 DAS, pendimethalin + imazethapyr 750 g/ha (PE), imazethapyr + imazamox 50 g/ha at 20 DAS, pendimethalin 750 g/ha (PE) + HW at 25 DAS, imazethapyr 40 g/ha at 20 DAS + HW at 35 DAS, pendimethalin + imazethapyr 750 g/ha (PE) + HW at 25 DAS and imazethapyr + imazamox 50 g/ha at 20 DAS + HW at 35 DAS. In rainy season, clusterbean variety RGC-1017 was used as a test crop in rows 30 cm apart using a seed rate of 15 kg/ha. Recommended dose of fertilizers, nitrogen at 10 kg and phosphorus at 40 kg/ha was applied at the time of field preparation through urea and DAP fertilizers. According to treatments, pendimethalin and imazethapyr was applied as pre-emergence next day after sowing, while imazethapyr and its ready mix with imazamox was applied as early post-emergence (20 DAS). Hand weeding operation was done at 25 and 35 days after sowing as per the treatments. Weed density and weed dry matter was recorded at 40, 60, 80 DAS and at harvest stages.

Weed control efficiency (WCE) was calculated on the basis of weed dry matter in weedy check and treated plots using formulae suggested by Mani *et al.* (1973) ^[6] while weed competition index was worked out through seed yield recorded in weed free and treated plots by using formulae given by Yadav and Mishra (1982) ^[18].

Results and Discussion

Effect on weed dynamics

All the weed management treatments recorded significant reduction in density and weed dry matter compared to weedy check. The early post-emergence application of imazethapyr + imazamox 50 g/ha at 20 DAS + HW at 35 DAS and imazethapyr 40 g/ha at 20 DAS + HW at 35 DAS significantly reduced the density and dry matter of narrow and broad leaved weeds as compared to weedy check plots and other treatments at 40, 60, 80 DAS and at harvest during experimentation (Table 1 and 2). It was due to effective control of weeds by early post-emergence application of imazethapyr + imazamox (ready mix) which was found effective against all kind of weeds especially broad-leaved weeds and resulted in significant reduction in the population of weeds. Similar results are reported by Gupta *et al.* (2016) and Sharma *et al.* (2017) ^[12] in clusterbean crop. Punia *et al.* (2011) also reported better control of weeds in clusterbean by imazethapyr. Further, pre emergence application of pendimethalin + imazethapyr 750 g/ha + HW at 25 DAS and pendimethalin 750 g/ha (PE) + HW at 25 DAS recorded significantly lower density and weed dry matter compared to

weedy check and alone application of these herbicides but these treatments were statistically at par with alone application of imazethapyr + imazamox 50 g/ha at 20 DAS. A judicious combination of chemical and cultural methods of weed management would not only reduce the expenditure on herbicides but would benefit the crop by providing proper aeration and conservation of moisture (Prakash *et al.*, 1991) ^[8]. The weed control efficiency showed the efficacy of herbicides with respect to controlling weeds over weedy check. Data (Table 3) revealed that higher weed control efficiency brought up by the early post-emergence application of imazethapyr + imazamox 50 g/ha at 20 DAS + HW at 35 DAS followed by imazethapyr 40 g/ha at 20 DAS + 1 HW at 35 DAS and attained highest weed control efficiency *viz.*, 92.8 and 91.1 per cent, respectively. However, the minimum weed control efficiency (61.6%) was recorded under pre emergence application of pendimethalin 750 g/ha. Herbicide imazethapyr has a broad spectrum control of weeds (Saltoni *et al.*, 2004) ^[10]. Herbicide imazethapyr inhibits the plastid aceto-lactate synthesis (ALS) in plants. The ALS inhibitors stop cell division and reduces carbohydrate translocation in susceptible plants (Gupta, 2008) ^[3]. Imazethapyr by virtue of wide spectrum weed control (both grassy and broad-leaved weeds) throughout the growing season without causing any phytotoxicity to crop plants emerged as a technically sound and economically viable option of post-emergence application in this study. Similar results are reported by Patil *et al.* (2013) ^[7] and Sharma *et al.* (2017) ^[12] in clusterbean crop. Application of imazethapyr + imazamox 50 g/ha (ready mix) at 20 DAS without hand weeding recorded weed control efficiency of 74 per cent which was further improved up to 92.8 per cent when this treatment was super imposed with hand weeding at 35 DAS. The seed yield and weed control efficiency was positively correlated with correlation coefficient of 0.956. This was further supported by the regression analysis, which revealed that as the density and dry weight of weeds decreased, the seed yield of clusterbean was increased by 10.52 kg/ha (Figure 1) in terms of weed control efficiency.

Weed index indicates the loss of yield caused by weed-crop competition under particular treatment in comparison to yield obtained from weed free plot. Application of imazethapyr + imazamox 50 g/ha (ready mix) at 20 DAS + HW at 35 DAS recorded lowest weed index (4.6) followed by imazethapyr 40 g/ha at 20 DAS + HW at 35 DAS (9.4) (Table 3). It was due to lowest weed density and weed dry matter recorded in these treatments which ultimately provided weed free environment and produced higher yield attributes and yield. The huge losses in yield was observed in weedy check plots due to heavy flushes of weeds during entire crop growth period and thereby caused severe weed-crop competition by the uncontrolled weed growth and thus, resulted in higher yield losses. These results corroborate the findings of Sharma *et al.* (2017) ^[12] and Singh and Godara (2015) ^[13] in cluster bean crop. The seed yield and weed index was negatively correlated with correlation co-efficient of 1.00. This was further supported by the regression analysis, which revealed that as the density and dry weight of weeds increased, the seed yield of clusterbean was decreased by 12.37 kg/ha (Figure 2) in terms of weed index.

Table 1: Density of weeds as influenced by various weed management treatments

Treatments	Weed density (No./m ²)							
	40 DAS		60 DAS		80 DAS		At harvest	
	NLW	BLW	NLW	BLW	NLW	BLW	NLW	BLW
Weedy check	2.91 (8.00*)	10.22 (104.0)	3.62 (12.67)	11.98 (143.00)	3.08 (9.00)	10.98 (120.00)	2.61 (6.33)	9.62 (92.00)
Weed free	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
Pendimethalin 750 g/ha (PE)	2.55 (6.00)	5.59 (31.00)	2.86 (7.67)	6.36 (40.33)	2.68 (6.67)	5.86 (34.33)	2.20 (4.33)	5.52 (30.33)
Imazethapyr 40 g/ha at 20 DAS	2.48 (5.67)	5.39 (28.67)	2.80 (7.33)	5.94 (35.00)	2.61 (6.33)	5.58 (31.00)	2.12 (4.00)	5.23 (27.00)
Pendimethalin + imazethapyr 750 g/ha (PE)	2.48 (5.67)	5.31 (28.00)	2.74 (7.00)	5.68 (32.00)	2.55 (6.00)	5.52 (30.00)	2.04 (3.67)	5.21 (26.67)
Imazethapyr + imazamox 50 g/ha at 20 DAS	2.20 (4.33)	3.52 (12.33)	2.26 (4.67)	4.33 (18.67)	1.95 (3.33)	4.10 (16.33)	1.87 (3.00)	3.52 (12.00)
Pendimethalin 750 g/ha (PE) + HW at 25 DAS	2.12 (4.00)	3.94 (15.33)	2.12 (4.00)	3.85 (14.67)	1.96 (3.33)	3.81 (14.00)	1.68 (2.33)	3.76 (13.67)
Imazethapyr 40 g/ha at 20 DAS + HW at 35 DAS	1.68 (2.33)	2.39 (5.33)	1.56 (2.00)	2.32 (5.00)	1.47 (1.67)	2.27 (4.67)	1.22 (1.00)	2.27(4.67)
Pendimethalin + imazethapyr 750 g/ha (PE) + HW at 25 DAS	2.12 (4.00)	4.06 (16.33)	2.03 (3.67)	3.54 (12.33)	1.77 (2.67)	3.39 (11.00)	1.58 (2.00)	3.24 (10.00)
Imazethapyr + imazamox 50 g/ha at 20 DAS + HW at 35 DAS	1.58 (2.00)	2.33 (5.00)	1.34 (1.33)	2.14 (4.33)	1.22 (1.00)	2.12 (4.00)	1.08 (0.67)	2.04 (3.67)
S Em ±	0.07	0.32	0.10	0.32	0.06	0.20	0.06	0.18
CD (P=0.05)	0.22	0.96	0.32	0.95	0.20	0.60	0.18	0.55

*Figures in parentheses are the original value

NLW = Narrow-leaved weeds

BLW = Broad-leaved weeds

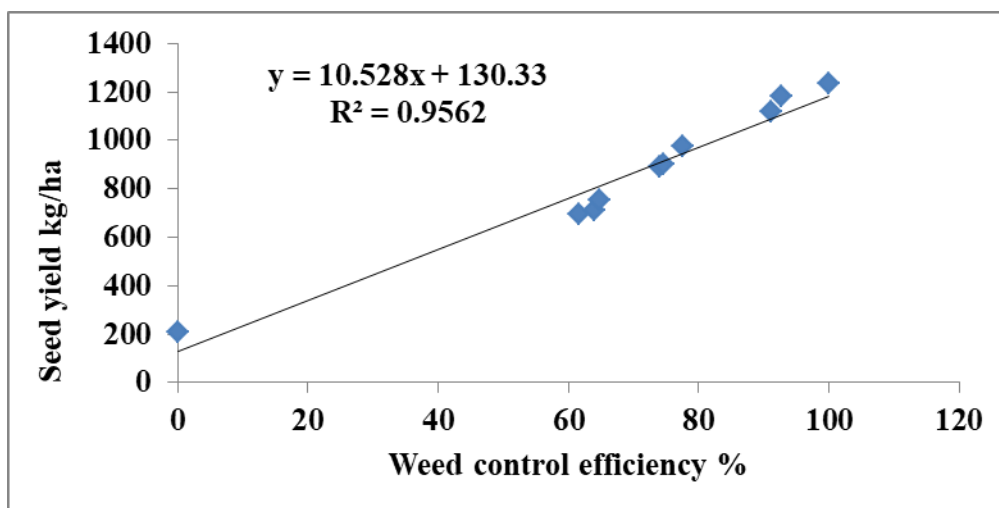


Fig 1: Regression analysis between seed yield and weed control efficiency of clusterbean

Table 2: Dry matter of weeds as influenced by various weed management treatments

Treatments	Dry matter of weeds (g/m ²)											
	40 DAS			60 DAS			80 DAS			At harvest		
	NLW	BLW	Total	NLW	BLW	Total	NLW	BLW	Total	NLW	BLW	Total
Weedy check	1.47 (1.67*)	4.91 (19.67)	4.67 (21.33)	1.94 (3.27)	8.62 (74.13)	8.81 (77.40)	2.53 (5.90)	12.91 (166.67)	13.14 (172.57)	2.86 (7.71)	14.28 (203.33)	14.54 (211.04)
Weed free	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.7 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
Pendimethalin 750 g/ha (PE)	1.33 (1.28)	2.96 (8.25)	3.17 (9.53)	1.66 (2.27)	5.28 (27.33)	5.49 (29.60)	2.12 (4.05)	8.00 (63.53)	8.25 (67.58)	2.46 (5.64)	8.67 (75.36)	8.99 (81.00)
Imazethapyr at 40 g/ha at 20 DAS	1.26 (1.08)	2.91 (7.96)	3.09 (9.04)	1.66 (2.24)	5.17 (26.27)	5.39 (28.51)	2.15 (4.12)	7.78 (60.00)	8.04 (64.12)	2.45 (5.52)	8.43 (70.52)	8.75 (76.04)
Pendimethalin + imazethapyr 750 g/ha (PE)	1.23 (1.03)	2.84 (7.59)	3.02 (8.62)	1.64 (2.20)	5.02 (24.73)	5.24 (26.93)	2.17 (4.21)	7.75 (59.51)	8.01 (63.73)	2.44 (5.43)	8.33 (68.97)	8.65 (74.40)
Imazethapyr + imazamox 50 g/ha at 20 DAS	1.12 (0.76)	2.27 (4.64)	2.43 (5.40)	1.38 (1.42)	4.39 (18.79)	4.55 (20.21)	1.99 (3.26)	6.38 (40.18)	6.63 (43.44)	1.97 (3.37)	7.21 (51.55)	7.44 (54.92)
Pendimethalin 750 g/ha (PE) + HW at 25 DAS	1.10 (0.72)	2.23 (4.45)	2.38 (5.18)	1.37 (1.37)	4.24 (17.46)	4.40 (18.83)	1.89 (3.08)	6.30 (39.17)	6.54 (42.25)	1.93 (3.21)	7.11 (50.06)	7.33 (53.27)

Imazethapyr 40 g/ha at 20 DAS + HW at 35 DAS	0.87 (0.26)	1.48 (1.70)	1.57 (1.96)	1.02 (0.54)	2.44 (5.46)	2.55 (6.00)	1.14 (0.80)	3.32 (10.53)	3.44 (11.33)	1.29 (1.17)	4.26 (17.67)	4.40 (18.84)
Pendimethalin + imazethapyr 750 g/ha (PE) + HW at 25 DAS	1.02 (0.55)	2.16 (4.16)	2.28 (4.70)	1.27 (1.12)	3.99 (15.44)	4.13 (16.56)	1.82 (2.81)	6.02 (35.74)	6.64 (38.55)	1.81 (2.77)	6.71 (44.49)	6.91 (47.26)
Imazethapyr + imazamox 50 g/ha at 20 DAS + HW at 35 DAS	0.84 (0.20)	1.34 (1.29)	1.41 (1.59)	0.97 (0.44)	2.25 (4.56)	2.34 (5.00)	1.07 (0.65)	3.14 (9.35)	3.24 (10.00)	1.26 (1.10)	3.82 (14.08)	3.96 (15.18)
S Em ±	0.03	0.06	0.06	0.05	0.14	0.13	0.06	0.15	0.15	0.07	0.24	0.18
CD (P=0.05)	0.10	0.20	0.20	0.15	0.42	0.40	0.19	0.47	0.46	0.21	0.53	0.54

*Figures in parentheses are the original value

NLW = Narrow-leaved weeds

BLW = Broad-leaved weeds

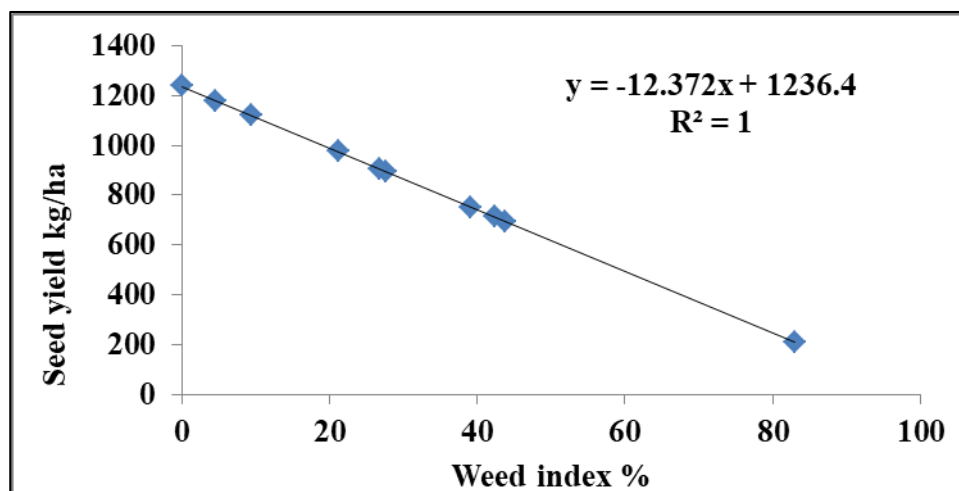


Fig 2: Regression analysis between seed yield and weed index of clusterbean

Table 3: Weed control efficiency, weed index and seed yield as influenced by various weed management treatments

Treatments	WCE (%)	Weed index (%)	Seed yield (kg/ha)	Net return (₹/ha)
Weedy check	0.00	83.0	210.0	-9,333
Weed free	100.00	0.00	1237.0	47,663
Pendimethalin 750 g/ha (PE)	61.6	43.8	694.0	20,720
Imazethapyr 40 g/ha at 20 DAS	63.9	42.4	713.0	22,819
Pendimethalin + imazethapyr 750 g/ha (PE)	64.7	39.1	752.0	24,076
Imazethapyr + imazamox 50 g/ha at 20 DAS	74.0	27.7	893.0	34,370
Pendimethalin 750 g/ha (PE) + HW at 25 DAS	74.7	26.8	903.0	32,275
Imazethapyr 40 g/ha at 20 DAS + HW at 35 DAS	91.1	9.4	1120.0	46,002
Pendimethalin + imazethapyr 750 g/ha (PE)+ HW at 25 DAS	77.6	21.2	975.0	36,619
Imazethapyr + imazamox 50 g/ha at 20 DAS + HW at 35 DAS	92.8	4.6	1180	49,693
S Em ±	-	-	44.23	-
CD (P=0.05)	-	-	131.44	-

Effect on seed yield

Among various herbicidal treatments, significantly higher seed yield (1180 kg/ha) was recorded with the application of imazethapyr + imazamox 50 g/ha at 20 DAS but it was found equally effective with imazethapyr 40 g/ha at 20 DAS + HW at 35 DAS (1120 kg/ha). Both these treatments were significantly superior over rest of the treatments and remained statistically at par with weed free season long plot. Application of pendimethalin + imazethapyr 750 g/ha + HW at 25 DAS and imazethapyr 40 g/ha at 20 DAS + HW at 35 DAS recorded increase of 765 and 910 kg/ha higher seed yield, respectively over weedy check. The seed yield was reduced by 24.3 per cent when application of imazethapyr + imazamox 50 g/ha at 20 DAS was applied without one hand weeding at 35 DAS. Application of imazethapyr + imazamox 50 g/ha at 20 DAS without hand weeding produce seed yield of 893 kg/ha which was further improved by 287 kg/ha when this treatment was super imposed with hand weeding at 35 DAS. This might be due to better control of weeds as herbicides were applied 20 DAS and most of the weeds were suppressed at 2-3 leaf stage. But even then some of remaining

weeds started flourishing and started competition with the crop plants during the critical phase of crop-weed competition. All those weeds were suppressed when these treatments were super imposed with hand weeding 35 DAS and due to this a complete/full weed free period existed during the entire crop pendency. These results corroborate the findings of Gupta *et al.* (2016), Sharma *et al.* (2017) [12] and Yadav and Mundra (2017) [19] in clusterbean.

Conclusion

It can be concluded that early post-emergence application of imazethapyr + imazamox 50 g/ha at 20 DAS + HW at 35 DAS was more effective in management of both narrow and broad leaved weeds resulting higher grain yield and economics of clusterbean (1180 kg/ha and ₹ 49,693/ha, respectively).

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