Original Research Article

Effect of weed management practices and phosphorus levels on weed studies under Clusterbean (*Cyamopsis tetragonoloba* L.)

Abstract

Among the *Kharif* legumes clusterbean (*Cyamopsis tetragonoloba* L. Taub) is important crop and popularly known as "Guar" in India. A field experiment was conducted during *Kharif* 2013 at Agronomy farm, S.K.N. College of Agriculture, Jobner, Jaipur (Rajasthan).to evaluate the effect of weed management practices and phosphorus levels on weed studies under clusterbean crop. The treatments comprising 6 weed control treatments (Weedy check, one HW at 20 DAS, two HW at 20 and 40 DAS, pendimethalin at 0.75 kg/ha, imazethapyr at 100 g/ha and fenoxoprop-p-ethyl at 70 g/ha and four levels of phosphorus (0, 20, 40 and 60 kg/ha) assigned to main and sub plots of spilt plot design, respectively and replicated thrice. Results showed that HW twice at 20 and 40 DAS and pre emergence application of imazethapyr at 100 g/ha resulted significant reduction in weed density and weed dry matter in comparison to most of the treatments. Results further indicated that application of 60 kg P/ha in clusterbean recorded the highest density and dry weight of weeds at all the stages. Maximum Weed control efficiency was recorded under two hand at 20 & 40 DAS weeding.

Keywords: Hand weeding, pre emergence, phosphorus, weed density and dry weight.

Introduction

Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] commonly known as guar, Guar, sometimes referred to as clusterbean or *Cyamopsis tetragonoloba* (L.) Taub., is a significant drought-tolerant leguminous crop used in arid and semiarid regions. It is produced for a variety of uses, including as a vegetable, green manure, green fodder, and seed. Due to the high galactomanan content (gum) in the endosperm of its seeds (28–33%), which has numerous industrial uses including textiles, paper, petroleum, pharmaceuticals, food processing, cosmetics, mining explosives, oil drilling, etc., it has now gained the status of an industrial crop and is a major source of foreign exchange earnings. More than 80% of the world's total production of cluster beans is produced in India. This crop has taken up a considerable portion of land in Rajasthan, Gujarat, Haryana, and Punjab state, which are all

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dry and semi-arid regions. With regard to both area and production of clusterbeans, Rajasthan has emerged as a significant state in India for clusterbean cultivation [1].

With weeds, cluster beans struggle to compete. Guar is a rainy season crop, and because of the frequent rains, weed populations grow rapidly and compete with the primary crop for nutrients, moisture, and space, significantly reducing productivity. Weed competition for crops is critical between 20 and 30 DAS [2]. Both grass and weeds with wide leaves infest the guar crop. Cluster bean yields are severely reduced by weed competition throughout the growing season, with severity ranging from 29 to 48 percent and maybe much higher (70 to 98 percent) depending on the weed infestation [3]. According to Saxena et al. [4], weed invasion caused a 53.7% decrease in guar output. Hand weeding is a traditional and efficient method of controlling weeds, but its economic viability is severely constrained by the lack of labour during peak weeding seasons and rising labour costs.

Appropriate weed and nutrient control are regarded as the two most crucial agronomic aspects that can increase crop productivity. Clusterbean suffers greatly as a rainy season crop as a result of fierce competition with mixed weed flora. These weeds use natural resources more effectively than crop plants to develop quickly and vigorously, giving the crop plants a formidable competitor. The first 30 days after sowing are crucial, and weed presence after this can reduce output by up to 93.22 percent [5]. The plant height [6,7], extensive root development [8,] total dry weight [9], and leaf area of clusterbean all increased as a result of its treatment. Phosphorus also influences the symbiotic nitrogen fixation, yield and quality of clusterbean pods. Phosphorus has positive effect on nodulation [10,11] and activity of rhizobia present in root nodules of leguminous plant [12]. Keeping these factors in view, the present investigation was planned with an objective the study the effect of weed management practices and phosphorus on weed flora under clusterbean crop.

Materials and Methods

The experiment was conducted during *Kharif* season 2013 at Agronomy farm, S.K.N. College of Agriculture, Jobner, Jaipur (Rajasthan), research area was in semi- to arid (26°06' 56" N latitude and 75°28' 29" E longitude). Summer temperatures range from 26 to 48.5 ^{0}C, and winter temperature varied from -4.5 to 32 ^{0}C. The majority of the yearly rainfall is anticipated during the monsoon season (July to September), and ranges from 400 to 660 mm on average. In the soil, the water is around 90–100 m below the surface. The soil of the experimental field was loamy-sand in texture, alkaline in reaction (pH 8.10), poor in organic carbon (0.19 %), low in available nitrogen (126.30 kg/ha), medium in phosphorus (19.23 kg/ha) and potassium (150.26 kg/ha). The treatments comprising six weed control treatments

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(Weedy check, one HW at 20 DAS, two HW at 20 and 40 DAS, pendimethalin at 0.75 kg/ha, imazethapyr at 100 g/ha and fenoxoprop-p-ethyl at 70 g/ha and four levels of P (0, 20, 40 and 60 kg/ha), phosphorus was applied through DAP and assigned to main and sub plots of spilt plot design, respectively and replicated thrice. Clusterbean variety RGC-1003 was used as a test crop.

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Weed density was taken at 30 and 60 DAS from two random spots in each plot by counting the number of weeds per quadrate of 1.0 m^2 and the average was computed. Weed samples from two randomly selected spots in each plot were taken at 30 and 60 DAS with the help of 1.0 m^2 quadrate and the average was worked out. The samples so collected were subjected to sun dry for sufficient time, weighed and average was computed as dry matter kg/ha. In order to evaluate the weed control treatments for their efficacy weed control efficiency of each treatment was calculated by using the following formula [13].

$$\text{WCE (\%)} = \frac{\text{Weed dry matter in weedy check plot} - \text{Weed dry matter in treated plot}}{\text{Weed dry matter in weedy check plot}} \times 100$$

Weed infestation (WI was calculated using the following formula [14].

$$\text{WI (\%)} = \frac{\text{Total no. of weeds in a unit area}}{\text{Total no. of weeds and crop plants in the same area}} \times 100$$

Weed competition index (WCI) was calculated by using the formula [14].

$$\text{WCI (\%)} = \frac{\text{Grain yield of weed free plot - Grain yield of treated plot}}{\text{Grain yield of weed free plot}} \times 100$$

Result and Discussion

Weed density

Data presented in Table 1 revealed that all the treatments adopted for weed control in clusterbean resulted significant reduction in density of weeds at all the stages of observation in comparison to weedy check. At 30 DAS, the lowest weed density (7.24 per 0.25 cm^2) was noted under two hand weeding treatment. However, it was found at par with rest of the treatments except fenoxoprop-p-ethyl @ 70 g/ha applied 15-20 DAS. However, every increase in level of phosphorus significantly enhanced the weed density upto 20 kg/ha at 60 DAS stage and 40 kg/ha at harvest stage over preceding levels, though, the maximum density was observed at 60 kg P_2O_5/ha. At harvest stage, application of P at 60 kg/ha recorded the highest weed density of 10.10 per 0.25 m^2 that was 12.8 and 25.9 per cent more than 20 kg/ha and control.

Weed infestation

A perusal of data presented in Table 1 showed that all the weed management practices treatments represented significantly lower weed infestation than weedy check plots at all the stages of observation. The minimum weed infestation of 22.13, 20.12 and 20.68 per cent at 30 and 60 DAS and at harvest stages, respectively was noted when the crop was hand weeded twice at 20 and 40 DAS. It was found at par with imazethapyr @ 100 g/ha (PE) and one HW at 20 DAS at all the stages and with pre emergence application of pendimethalin @ 0.75 kg/ha at 30 and 60 DAS which were noted to be the next superior treatments in order of their effectiveness. Whereas at harvest stage, application of phosphorus at 40 kg/ha registered weed infestation of 28.42 per cent in crop which was significantly higher than control. However, it was found at par with 20 and 60 kg/ha.

Weed dry matter

It is obvious from the data that all the weed control treatments recorded significantly lower weed dry matter production at all the stages than weedy check (Table 2). At 30 DAS, two HW at 20 and 40 DAS, one HW at 20 DAS and imazethapyr @ 100 g/ha were found the most superior and equally effective treatments in reducing the weed dry matter production. Whereas at 60 DAS and at harvest stage, HW twice at 20 and 40 DAS registered the significantly lowest weed dry matter of 319.07 and 568.42 kg/ha, respectively. Increasing the level of phosphorus from 0 to 40 kg/ha significantly increased the weed dry matter at 30 DAS than control. Whereas, at 60 DAS and harvest stages, significant increase over preceding levels was noted upto 60 kg P_2O_5/ha.

Combined effect (Table 3) of weed control and P fertilization was also found to significantly influence the weed dry matter production at 60 DAS and harvest stages. Significant increase in weed dry matter under fenoxoprop-p-ethyl at 70 g/ha treatment was noted upto 20 kg P/ha. Rest of the weed control treatments showed poor response to increasing levels of P, though, the highest dry matter under all the weed control treatments was recorded when they were combined with 60 kg P/ha.

Weed control efficiency

Different weed control treatments differed widely in the extent to which they controlled the weeds (Table 4). Two HW at 20 and 40 DAS was found the most superior treatment which controlled the weeds to the extent of 80.51, 81.83 and 74.70 per cent at 30 and 60 DAS and at harvest stages of crop, respectively in comparison to weedy check. It was

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very closely accompanied by pre-emergence application of imazethapyr @ 100 g/ha treatment which also registered higher weed control efficiencies of 78.79, 77.26 and 69.66 per cent at these three stages.

Weed competition index

Critical examination of the data presented in Table 5 indicated that different weed control treatments differed widely in their effect on weed competition index. Weedy check plots offered the maximum crop weed competition, wherein, a reduction of 47.45 per cent in grain yield of clusterbean was noted in comparison to two HW at 20 and 40 DAS that registered the maximum grain yield of 5441 kg/ha and was treated as weed free treatment. The least reduction in grain yield due to presence of weeds was observed in imazethapyr @ 100 g/ha treatment (10.39 %) and was closely accompanied by one HW at 20 DAS.

The increase in population and dry matter production of weeds to such a high level under weedy check may be attributed to uninterrupted weed growth throughout the crop season. Pendimethalin exerts its herbicidal effect by inhibiting both root and shoot growth and development through disruption of ATP formation and inhibition of cell division in the meristematic tissues. The growth is inhibited directly following absorbing through hypocotyls and shoot region. The plants die shortly after germination or emergence from the soil. Similar results were observed by [15,16,17]. The huge increase in density and weed biomass production under weedy check treatment might be attributed to uninterrupted growth of weeds throughout the crop season coupled with greater competition ability than crop that was almost smothered due to fast growing of weeds. Heavy dry weight of weeds under unweeded control in clusterbean has also been reported by [18] in clusterbean and [19] in urdbean.

Conclusion

On the basis of one year experimentation, it may be concluded that hand weeding twice at 20 and 40 DAS and pre emergence application of imazethapyr at 100 g/ha resulted significant reduction in weed density and weed dry matter in comparison to most of the treatments. Results further indicated that application of 60 kg P/ha in clusterbean recorded the highest density and dry weight of weeds at all the stages. Maximum Weed control efficiency was recorded under two hand at 20 & 40 DAS weeding.

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Table 1. Effect of weed management practices and phosphorus levels on density and infestation of weeds at different stages of crop

Treatments	Weed density (per 0.25 m^2)			Weed infestation (%)		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At Harvest
A. Weed control						
Weedy check	8.40 (70.50)	6.64 (44.15)	5.89 (34.70)	48.78	45.45	45.84
One HW at 20 DAS	3.07 (9.45)	2.69 (7.21)	2.40 (5.74)	24.90	23.33	23.84
Two HW at 20 & 40 DAS*	2.69 (7.24)	2.32 (5.40)	2.08 (4.33)	22.13	20.12	20.68
Pendimethalin @ 0.75 kg/ha (PE)	3.10 (9.60)	2.88 (8.30)	2.59 (6.70)	25.25	25.83	25.62
Imazethapyr @ 100 g/ha (PE)	3.05 (9.30)	2.60 (6.77)	2.32 (5.40)	24.57	23.17	23.02
Fenoxoprop-p-ethyl @ 70 g/ha (POE)	3.72 (13.82)	3.24 (10.47)	2.89 (8.33)	29.25	28.23	28.50
SEm$\pm$	0.14	0.08	0.07	0.74	0.88	0.70
CD (P = 0.05)	0.43	0.26	0.22	2.34	2.78	2.20
CV (%)	11.68	8.56	8.15	8.81	11.03	8.67
B. Phosphorus levels (kg/ha)						
0	3.92 (15.34)	3.21 (10.30)	2.83 (8.02)	28.92	26.99	26.93
20	4.00 (16.03)	3.41 (11.60)	2.99 (8.95)	29.14	27.85	27.66
40	4.04 (16.33)	3.46 (12.00)	3.12 (9.75)	29.26	27.86	28.42
60	4.06 (16.50)	3.51 (12.33)	3.18 (10.10)	29.32	28.05	28.67
SEm$\pm$	0.09	0.07	0.05	NS	NS	0.41

CD (P = 0.05)	NS	0.18	0.12	1.14	1.25	1.08
CV (%)	9.15	8.37	6.41	6.26	7.24	6.19

*Treatment was partially applied at 30 DAS stage.

Data in parentheses indicate the original weed density per 0.25 m^2.

Square root transformation $\sqrt{x}$ was applied

Table 2. Effect of weed management practices and phosphorus levels on periodical weed dry matter production

Treatments	Weed dry matter (kg/ha)		
	30 DAS	60 DAS	At harvest
A. Weed control			
Weedy check	824.6	1755.6	2246.9
One HW at 20 DAS	187.0	456.1	763.2
Two HW at 20 & 40 DAS*	160.7	319.1	568.4
Pendimethalin @ 0.75 kg/ha (PE)	205.6	519.4	788.2
Imazethapyr @ 100 g/ha (PE)	174.9	399.2	681.7
Fenoxoprop-p-ethyl @ 70 g/ha (POE)	297.7	722.8	1027.2
SEm±	8.35	22.42	34.69
CD (P = 0.05)	26.30	70.64	109.31
CV (%)	9.38	11.17	11.87
B. Phosphorus levels (kg/ha)			
0	278.3	561.6	846.4
20	305.4	694.0	986.2
40	321.9	746.0	1079.9
60	328.0	779.9	1137.9
SEm±	5.96	13.19	20.48
CD (P = 0.05)	15.83	35.01	54.37
Interaction (WXP)	NS	Sig.	Sig.
CV (%)	8.20	8.05	8.58

*Treatment was partially applied at 30 DAS stage

Sig. = Significant NS= Non significant

Table 3. Combined effect of weed management practices and phosphorus levels on weed dry matter production at 60 DAS and at harvest stages of the crop

Treatments	60 DAS				At harvest			
	P_0	**P_{20}**	**P_{40}**	**P_{60}**	**P_0**	**P_{20}**	**P_{40}**	**P_{60}**
W_1 - Weedy check	1417.8	1752.2	1883.5	1968.9	1878.1	2188.4	2396.1	2524.8
W_2 - One HW at 20 DAS	368.3	455.2	489.3	511.5	637.9	743.3	813.9	857.6
W_3 - Two HW at 20 & 40 DAS	257.7	318.5	342.3	357.9	475.1	553.6	606.2	638.7
W_4 - Pendimethalin @ 0.75 kg/ha (PE)	419.5	518.4	557.2	582.5	658.8	767.7	840.6	885.7
W_5 - Imazethapyr @ 100 g/ha (PE)	322.4	398.4	428.3	447.7	569.8	663.9	727.0	766.0
W_6 - Fenoxoprop-p-ethyl @ 70 g/ha (POE)	583.8	721.4	775.5	810.7	858.6	1000.5	1095.5	1154.3
For P at same level of W								
SEm±				25.4				39.3
CD (P=0.05)				72.2				111.9
For W at same or different levels of P								
SEm±				32.3				50.2
CD (P=0.05)				92.6				143.9

Table 4. Effect of weed management practices treatments on weed control efficiency at different stages of crop

Treatments	Weed control efficiency (%)		
	30 DAS	60 DAS	At harvest
Weedy check	-	-	-
One HW at 22 DAS	77.32	74.02	66.03
Two HW at 20 & 40 DAS	80.57	81.83	74.70
Pendimethalin @ 0.75 kg/ha (PE)	75.07	70.41	64.92
Imazethapyr @ 100 g/ha (PE)	78.79	77.26	69.66
Fenoxoprop-p-ethyl @ 70 g/ha (POE)	63.90	58.83	55.28

Table 5. Effect of different weed management practices treatments on weed competition index

Treatments	Weed competition index (%)
Weedy check	47.45
One HW at 20 DAS	14.03
Two HW at 20 & 40 DAS	-
Pendimethalin @ 0.75 kg/ha (PE)	19.93
Imazethapyr @ 100 g/ha (PE)	10.39
Fenoxoprop-p-ethyl @ 70 g/ha (POE)	29.83