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Nutrient uptake by clusterbean as influenced by weed management and sulphur nutrition

R.K. Yadav*, S.L. Mundra, L.N. Dashora and Bhagwat Singh Chouhan
MaharanaPratap University of Agriculture and Technology, Udaipur, Rajasthan 313 001

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ABSTRACT

A field experiment was carried out during two consecutive seasons of *Kharif* 2013 and 2014 to evaluate effect of weed management and sulphur nutrition on the nutrient uptake by weeds and crop in clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.]. Minimum weed dry matter of narrow-leaved (239 kg/ha), broad-leaved (285 kg/ha) and total dry weight (524 kg/ha) was observed under hand weeding at 20 and 40 days after sowing (DAS),which was closely followed by the sequential application of pre-emergence application of pendimethalin 0.75 kg/ha followed by (*fb*) imazethapyr 0.075 kg/ha as post-emergence. The highest seed (1.22 t/ha), haulm (2.44 t/ha) and biological yields (3.66 t/ha) was registered in hand weeded twice, which was statistically at par to pendimethalin *fb* imazethapyr. Hand weeding twice and pendimethalin *fb* imazethapyr, with non-significant difference between these two, saved N and P uptake by 56, 47 and 55, 46%, respectively, compared to weedy check in combined uptake of nutrient both by weeds and crop.

Key words: Clusterbean, Nutrient uptake, Sulphur, Weed management, Yield

Clusterbean, popularly known as 'Guar', is being cultivated in India since ancient time for various purposes. Among leguminous crops, it is comparatively more drought hardy, which is grown during rainy season in semi-arid and arid regions of India. Being a rainy season crop, it suffers badly due to severe competition by mixed weed flora. Presence of weeds beyond the critical period of crop weed competition results in yield reductions up to 46% (Sangwan *et al*. 2016). Therefore, weed control needs to be restored to exploit the yield potential of this crop. In addition to weed management, nutrition in this crop is of paramount importance. Besides application of N and P in legumes, sulphur (S) is now required as the fourth major plant nutrient (Tandon and Messick 2007). Results of research over the years have convincingly shown that S application can bring about significant increases in crop yield. Keeping this in view, an experiment was formulated to assess the losses caused by weeds and uptake of nutrients both by crop and weeds.

MATERIAL AND METHODS

A field experiment was conducted during the *Kharif* seasons of 2013 and 2014 at the Instructional Farm of Department of Agronomy, Rajasthan college of Agriculture, MPUAT, Udaipur. The soil was medium in available nitrogen (274.56 and 279.61 kg/ha), phosphorus (19.27 and 18.69 kg/ha), high in available potassium (318.83 and 324.17 kg/ha) and low in sulphur (9.7 and 9.6 ppm) during 2013 and 2014, respectively. The experiment consisted of eight weed management treatments, *viz.* weedy check, one hand weeding at 20 DAS, two hand weeding at 20 and 40 DAS, pre-emergence (PE) application of pendimethalin 1.0 kg/ha, post-emergence (PoE) application of imazethapyr 0.1 kg/ha, PoE application of quizalofop-ethyl 0.05 kg/ha, PE application of pendimethalin 0.75 kg/ha *fb* PoE imazethapyr 0.075 kg/ha and PE pendimethalin 0.75 kg/ha *fb* PoE quizalofop-ethyl 0.04 kg/ha and four levels of sulphur (control, 15, 30 and 45 kg/ha) supplied through mineral gypsum, thereby making 32 treatments combinations.

The experiment constituted in a split plot design with weed management treatments assigned in main plots and sulphur levels in sub plots. All treatment combinations were replicated thrice. Clusterbean variety '*RGC-1017*' was used as the test crop and crop was raised as per package of practices recommended for sub humid Southern Plain and Aravalli hills of Rajasthan. The weeds under 0.25 m^2 area were removed at 75 DAS after categorizing these weeds into narrow and broad-leaved weeds and oven dried at 65^{0}C temperature till a constant weight was obtained and expressed in kg/ha. The estimation of N and P both in crop and weeds was done following the procedures given by Snell and Snell (1949) and Jackson (1973), respectively. The data were

***Corresponding author:** yaduvanshi02ranveer@gmail.com

subjected to statistical analysis by adopting appropriate methods as described by Cocharan and Cox (1967).

RESULTS AND DISCUSSION

Clusterbean was mainly infested with mixed flora of narrow and broad-leaved weeds, *viz*. *Cynodon dactylon, Echinochloa colona, Cyperus rotundus, Brachiaria reptans, Dinebra retroflexa* and *Dactyloctenium aegyptium* among narrow-leaved weeds and *Amaranthus viridis, Commelina benghalensis, Digera arvensis, Trianthema portulacastrum* and *Physalis minima* among broad-leaved weeds.

Weed dry matter

It was found that dry biomass of narrow-leaved, broad-leaved weeds and total weed dry weight at 75 DAS was affected significantly by all weed management treatments (**Table 1**). During both the years, two hand weeding recorded the lowest dry matter, however its effect differed non significantly with pendimethalin0.75 kg/ha *fb* imazethapyr 0.075 kg/ha. Averaged over the years, two hand weeding reduced the biomass of narrow and broad-leaved weeds by 83 and 86% compared to weedy check while the corresponding reduction in biomass of these categories of weeds under pendimethalin 0.75 kg/ha *fb* imazethapyr 0.075 kg/ha was 81 and 85%.

Yield

Two hand weeding treatment recorded the maximum seed yield (1.22 t/ha), haulm (2.44 t/ha) and biological yields (365 kg/ha) closely followed by the sequential application of pendimethalin with imazethapyr and both of these treatments were found significantly superior over rest of treatments (**Table 2**). The improvement in yield with hand weeding have also been reported by Tiwana *et al.* (2002). Soil enrichment with 45 kg sulphur/ha showed a significant results in terms of seed, haulm and biological yields of clusterbean with the percent increase of 28, 30 and 29, respectively, compared to control.

Nutrient uptake by weeds

The minimum N depletion by narrow-leaved (4.13 kg/ha), broad-leaved (6.02 kg/ha) and total (10.14 kg/ha) and P uptake by narrow-leaved (0.58 kg/ha), broad-leaved (0.92 kg/ha) and total (1.50 kg/ha) was found under two hand weeding which was closely followed by the sequential application of pendimethalin *fb* imazethapyr (**Table 1**). Application of different doses of sulphur had no significant impact on N uptake by narrow-leaved; however, uptake of nitrogen by broad-leaved and total uptake enhanced upto 30 kg S/ha compared to control but at par to 15 and 45 kg S/ha, however, application of 15 kg S/ha did not differ significantly compared to control. Sulphur application in various doses could not bring about a significant variation in P uptake by both categories of the weeds and thereby total uptake. The uptake of N and P by the weeds was estimated at 67 and 53%, respectively of the total removal (weeds + crop) in weedy check and only 10.8 and 6.3% N and P, respectively in the two hand weeding treatment and the corresponding N and P in pendimethalin *fb* imazethapyr treatment was 12.0 and 7.1%. Thus,

Table 1. Weed management and sulphur nutrition on dry matter of weeds and nutrient removal at 75 DAS (pooled)

Treatment	Weed dry matter (t/ha)			Nutrient removal by weeds (kg/ha)					
				Nitrogen			Phosphorus		
	Narrow-leaved	Broad-leaved	Total	Narrow-leaved	Broad-leaved	Total	Narrow-leaved	Broad-leaved	Total
Weed management									
Pendimethalin 1.0 kg/ha PE	0.63	1.09	1.72	10.68	22.75	33.43	1.49	3.52	5.01
Imazethapyr 0.1 kg/ha PoE	0.47	0.53	1.00	8.11	11.09	19.20	1.13	1.69	2.83
Quizalofop 0.05 kg/ha PoE	0.58	1.65	2.23	9.68	34.37	44.05	1.37	5.25	6.62
Pendimethalin 0.75 kg/ha PE *fb* imazethapyr 0.075 kg/ ha PoE	0.27	0.31	0.58	4.56	6.53	11.10	0.64	1.02	1.66
Pendimethalin 0.75 kg/ha PE *fb* quizalofop 0.04 kg/ha	0.37	0.91	1.28	6.38	18.92	25.30	0.90	2.90	3.79
One hand weeding at 20 DAS	0.68	1.11	1.79	11.54	23.12	34.66	1.63	3.54	5.17
Two hand weeding at 20 and 40 DAS	0.24	0.28	0.52	4.13	6.02	10.14	0.58	0.92	1.50
Weedy check	1.40	2.04	3.44	23.38	41.20	64.58	3.27	6.42	9.69
LSD (p=0.05)	0.05	0.07	0.07	0.84	1.46	1.59	0.10	0.24	0.27
Sulphur									
15 kg/ha	0.58	0.99	1.57	9.72	20.36	30.07	1.37	3.13	4.50
30 kg/ha	0.58	1.00	1.58	9.94	20.86	30.80	1.38	3.19	4.57
45 kg/ha	0.59	1.00	1.59	10.00	20.99	31.00	1.40	3.20	4.60
Control	0.58	0.98	1.55	9.57	19.79	29.36	1.36	3.11	4.47
LSD (p=0.05)	NS	NS	NS	NS	0.57	0.89	NS	NS	NS

Table 2. Weed management and sulphur nutrition on yield and nutrient depletion by clusterbean (pooled)

Treatment	Yield (t/ha)			Nutrient removal (kg/ha)					
				Nitrogen			Phosphorus		
	Seed	Haulm	Biological	Seed	Haulm	Total	Seed	Haulm	Total
Weed management									
Pendimethalin 1.0 kg/ha PE	0.81	1.90	2.70	32.23	26.38	58.61	8.99	6.40	15.39
Imazethapyr 0.1 kg/ha POE	0.84	1.92	2.76	33.73	26.92	60.65	9.45	6.53	15.98
Quizalofop 0.05 kg/ha POE	0.67	1.63	2.30	26.85	22.63	49.48	7.46	5.49	12.94
Pendimethalin 0.75 kg/ha PE *fb* imazethapyr 0.075 kg/ha PoE	1.19	2.40	3.59	47.80	33.99	81.79	13.47	8.19	21.66
Pendimethalin 0.75 kg/ha PE *fb* quizalofop 0.04 kg/ha	1.05	2.25	3.30	42.01	31.73	73.74	11.76	7.63	19.40
One hand weeding at 20 DAS	0.77	1.83	2.60	30.68	25.38	56.06	8.63	6.19	14.82
Two hand weeding at 20 and 40 DAS	0.12	2.44	3.66	49.03	34.38	83.41	13.72	8.33	22.04
Weedy check	0.41	1.17	1.58	16.18	16.11	32.29	4.56	3.96	8.52
LSD (p=0.05)	0.05	0.11	0.11	1.89	1.77	2.46	0.53	0.45	0.62
Sulphur									
15 kg/ha	0.85	1.89	2.74	33.43	26.13	59.56	9.49	6.42	15.91
30 kg/ha	0.92	2.05	2.97	37.17	29.09	66.26	10.28	6.99	17.28
45 kg/ha	0.96	2.16	3.12	39.49	30.96	70.45	10.84	7.36	18.20
Control	0.75	1.66	2.42	29.17	22.57	51.74	8.40	5.59	13.99
LSD (p=0.05)	0.03	0.06	0.07	1.20	0.85	1.57	0.33	0.22	0.42

savings of 56 and 47% nitrogen and phosphorus could be obtained by adoption of the two hand weeding treatment while the respective saving of nitrogen and phosphorus under the pendimethalin *fb* imazethapyr treatment was 55and 46%. Nutrient uptake by weeds is the function of per cent nutrient content and biomass, thus a similar trend in uptake and total weed biomass production was an expected outcome (Shruthi and Salakinkop 2015).

Nutrient uptake by crop

Hand weeding twice recorded the highest N uptake by seed, haulm and total uptake (49.03, 34.08 and 83.41 kg/ha) and P uptake by seed, haulm and total uptake (13.72, 8.33 and 22.04 kg/ha) but differed non significantly with sequential application of pendimethalin with imazethapyr. Application of imazethapyr, pendimethalin and one hand weeding were found superior over quizalofop-ethyl and weedy check. It was found that increasing S levels successively increased N and P uptake by seed, haulm and total uptake. Pooled analysis reflects a significant increase in this parameter with increasing S levels up to 45 kg/ha. The highest N and P uptake by the crop was recorded with two hand weeding which might be ascribed to higher yield with this treatment as uptake of nutrient is mainly the function of crop yield. Nutrient uptake by any crop is primarily a function of yield and nutrient concentration. Thus, higher nutrient uptake by crop might be due to cop weed competition, which had concurrently increased in nutrient availability, better crop growth and higher crop biomass production coupled with more nutrient content. Such results corroborate with the findings of Yadav *et al.* (2013) and Singh *et al.* (2014). Thus, it is apparent that whenever the removal of nutrient by weeds was more, corresponding uptake by the crop was less and vice-versa. Therefore, for efficient utilization of applied nutrients, the weeds should be kept under control.

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