Indian Journal of Agronomy **61** (4): 519–522 (December 2016)

Research Communication

Efficacy of sequential application of imazethapyr + imazamox and propaquizafop in cluster bean (*Cyamopsis tetragonoloba*) in two texturally different soils

MEENAKSHI SANGWAN[1], SAMUNDER SINGH[2] AND SATYAVAN[3]

Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana 125 004

Received : June 2016; Revised accepted : December 2016

ABSTRACT

A field experiment was conducted during winter (*kharif*) season of 2013 to evaluate at the farmer's field in Kheri Batter, Bhiwani on loamy sand soil and at Chaudhary Charan Singh Haryana Agricultural University, Hisar on sandy loam soil efficacy of sequential application of different herbicides on cluster bean [*Cyamopsis tetragonoloba* (L.) Taub] Pre-emergence (PRE) application of pendimethalin @ 1.0 kg/ha provided 85–90% weed dry weight reduction up to 30 days after sowing (DAS); however at 60 DAS percent reduction of weed dry weight was lowered by 25–30% under both the soil texture. At 60 DAS, maximum dry weight reduction (95% at Kheri Batter and 91% at Hisar) was recorded, under post-emergence (POE) sequential application of imazethapyr 100 g/ha *fb* propaquizafop 62.5 g/ha; which was at par with imazethapyr + imazamox (Odyssey) 70 g/ha *fb* propaquizafop 62.5 g/ha. The efficacy of imazethapyr + imazamox was lower in sandy loam soil than loamy sand. A sequential application of imazethapyr 100 g/ha *fb* propaquizafop 62.5 g/ha and imazethapyr + imazamox 70 g/ha *fb* propaquizafop 62.5 g/ha POE resulted in the highest seed yield and maximum net returns at the Kheri Batter location; but at Hisar location, highest seed yield and maximum net returns were observed under imazethapyr 100 g/ha *fb* propaquizafop 62.5 g/ha. Lower yield and net returns were observed under imazethapyr + imazamox 70 g/ha at 3 weak after sowing (WAS) *fb* propaquizafop 62.5 g/ha at 6 WAS at location Hisar, due to lower efficacy of Odyssey in sandy loam soil against *Trianthema portulacastrum*.

Key words **:** Cluster bean, Herbicide efficacy, Imazethapyr, Imazethapyr + Imazamox, Pendimethalin, Phytotoxicity, Propaquizafop, Sequential application

Cluster bean is a *kharif* legume grown for feed, fodder, green manure (as soil fertility enhancer), guar gum and vegetable purpose. India is the largest producer of cluster bean. It is primarily cultivated under rainfed or restricted irrigation conditions and Haryana is the 2nd largest producer of cluster bean, after Rajasthan. Cluster bean is a poor competitor with weeds and suffers heavily in the early growth stage due to favourable environment for weeds to thrive.

Weed infests tremendously due to frequent rains and cause severe yield reductions by 47 to 92% owing to season long competition between weeds and crop (Bhadoria *et al.* 2000 and Yadav 1998). Maximum net returns in cluster bean could be realized with the integrated application of imazethapyr 100 g/ha + HW 35 DAS (Dhaker *et al*., 2009). However, the existing herbicides alone were not effective for efficient weed management. Dhaker *et al*. (2009) also observed that application of pendimethalin 0.75-1.0 kg/ha as pre-emergence herbicide was effective against weeds in cluster bean, but at later stages due to emergence of new weeds its efficacy will be reduced. Hence, there is a need to screen new herbicides or their mixtures or sequential application for improved weed management. Hence the present experiment was planned to evaluate the efficacy of sequential application of imazethapyr + imazamox (Odyssey) followed by propaquizafop in cluster bean in two texturally different soils Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana during the *Kharif* 2013. The soil of experimental field was sandy loam at Hisar and loamy sand at Kheri Batter. These soils were deficient in N content (103.7 and 112 kg/ha), medium in P (12 and 14.4 kg/ha), sufficient in K (240 and 427 kg/ha) with low or-

Based on a part of M.Sc. thesis of the first author submitted to CCS HAU, Hisar, Haryana (Unpublished)

[1]Corresponding author's Email: meenakshisangwan1991@gmail.com

[1]Ph.D. Scholar, [2]Principal Scientist, [3]Principal Scientist, Department of Agronomy, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Hisar, Haryana 125 004

ganic carbon content (0.24 and 0.3%) at Kheri Batter and Hisar, respectively. Both locations are characterized by the semi-arid climate with hot and dry summers and extremely cold winters. The crop received 444.0 mm and 477.1 mm of rainfall in the growing season at Kheri Batter and Hisar locations, respectively. The average relative humidity (RH) during the experimental season fluctuated between 78 to 99% in the morning time and 37 to 84% in the evening time. Mean weekly maximum temperature fluctuated between 36.5 and 30.3° C and minimum between 14.2 and 27.1°C during the crop period.

The experiments were laid out in a randomized block design, having 14 treatments with three replications at both the locations. Treatments consisted of pendimethalin (1.0 kg/ha, PRE), imazethapyr + imazamox (Odyssey) POE at 43.75, 52.5, 61.5 and 70 g/ha 3 weeks after sowing (WAS) alone and followed by (*fb*) propaquizafop, 62.5 g/ha (6 WAS), imazethapyr (50, 75 and 100 g/ha *fb* propaquizafop 62.5 g/ha applied at 3 fb 6 WAS), weedy check and weed free. Cluster bean variety 'HG 563' was sown on 22 June and 11 July, respectively in a plot size of 5.0 m × 4.5 m at a spacing of 30 cm × 15 cm row- to -row and plant- to -plant at Hisar and Kheri Batter respectively using 20 kg seeds/ha. Seed was treated with streptocyclin 1.2 g/kg seed. Irrigation and fertilizer application was done as per improved package of practices. Application of PRE and POE herbicides in different treatments were done by using flat fan nozzle mounted on a backpack sprayer with a spray discharge of 250 l/ha at 42 p.s.i. pressure. Total weed density observations was recorded by randomly placing a quadrate (0.25 m^2) in each plot at 30 and 60 days after sowing (DAS). Visual crop injury to cluster bean due to different herbicides and their rates was quantified visually at 14, 21 and 28 days after treatment (DAT) on 0–100 scale where 0 = no effect and 100 = complete mortality. The crop was harvested on 1 and 20 October at Hisar and Kheri Batter, respectively.

The weed density data were subjected to square root transformation and percent data of weed control and visual crop injury were subjected to arcsine transformation in order to normalize their distribution. All experimental data were analyzed using SPSS and significance difference among treatments was tested by calculating critical difference at 5% level of significance.

RESULTS AND DISCUSSION

Total weed density and weed control efficiency (%)

Weed flora at location 1 (Kheri Batter) was *Dactyloctinium aegypticum* (35%), *Trianthema portulacastrum* (20%), *Digera arvensis* (15%), *Cyperus rotundus* (10%), *Bulbostylis barbata* (5%)., and *Mollugo cerviana* (5%), and other weeds (10%). The major weeds at location 2 (Hisar) were *T. portulacastrum* (35%), *Echinochloa colona* (30%), *C. rotundus* (25%), and *C. arvensis* (10%). All the weed control treatments significantly reduced weed density as compared to weedy check at 30 and 60 days after sowing (Table 1). Pendimethalin 1.0 kg/ha pre- emergence although provided 88 and 86% control of weeds up to 30 days after sowing, but at 60 days after sowing, weed control efficiency was reduced to 68 and 63%, at location 1 and 2, respectively due to emergence of new weeds and it had no effect on *D. arvensis*, *B. barbata* and *M. cerviana.* At 60 days after sowing, among all the herbicidal treatments, sequential application of imazethapyr 100 g/ha 3 weeks after sowing *fb* propaquizafop 62.5 g/ha at 6 weeks after sowing was found most effective in controlling weeds and recorded maximum weed control efficiency (%) as compared to stand alone application, but the effect was statistically similar to imazethapyr + imazamox 70 g/ha at 3 weeks after sowing *fb* propaquizafop 62.5 g/ha at 6 weeks after sowing and imazethapyr 75 g/ha 3 weeks after sowing *fb* propaquizafop 62.5 g/ha 6 weeks after sowing at location 1, but at location 2 imazethapyr 100 g/ha 3 weeks after sowing *fb* propaquizafop 62.5 g/ha at 6 weeks after sowing was statistically different from all other treatments and lowest weed control efficiency (60.0%) at 60 days after sowing was recorded with imazethapyr+ imazamox 43.75 g/ha at 3 weeks after sowing treated plot due to less efficacy against *Trianthema portulacastrum* (Table 1). Weed control efficiency was statistically higher in loamy sand soil as compared to sandy loam soil under imazethapyr + imazamox at all herbicidal doses due to heavy infestation of *Trianthema portulacastrum* in sandy loam soil and that herbicide was less effective against that weed. Under sequential application of imazethapyr + imazamox and imazethapyr with propaquizafop, complete mortality of *Echinochloa colona* was observed at location 2. These treatments provided effective control of *Digera arvensis and Bulbostylis barbata* at location 1, but the efficacy of imazethapyr + imazamox 70 g/ha at 3 WAS was lower due to heavy infestation of *Trianthema portulacastrum* at location 2.

Reduction in weed dry weight (%)

Pre-emergence application of pendimethalin although provided 85–90% weed dry weight reduction over control up to 30 days after sowing, but at 60 days after sowing percent reduction of weed dry weight was lowered by 25–30% in pendimethalin due to emergence of new weeds at both the locations (Table 1). At location 1, dry weight reduction was significantly higher under imazethapyr + imazamox at all the doses as compared to sandy loam soil due to lower efficacy of herbicide against existing weed viz. *Trianthema portulacastrum*. At 60 days after sowing, highest weed dry weight reduction over control (90–95%) was recorded under post- emergence sequential application of imazethapyr 100 g/ha *fb* propaquizafop 62.5 g/ha, which was at par with

Table 1. Effect of different weed control treatments on weed flora of cluster bean at both the locations

Treatment	Rate (g/ha)	Time of application	Total weed density (No./m^2)				Weed dry weight reduction (%)				Weed-control efficiency (%)			
			30 DAS		60 DAS		30 DAS		60 DAS		30 DAS		60 DAS	
			L1	L2	L1	L2	L1	L2	L1	L2	L1	L2	L1	L2
Pendimethalin	1000	PRE	7.1 (50.0)	10.2 (104.0)	12.8 (161.7)	7.9 (64.0)	87.5	85.6	62.1	60.2	88	86	68	63
Imazethapyr + imazamox (RM)	43.75	3 WAS	12.6 (156.7)	13.2 (173.3)	11.4 (129.0)	8.1 (65.3)	46.6	65.7	77.2	75.8	47	68	67	60
Imazethapyr + imazamox (RM)	52.5	3 WAS	12.0 (143.0)	13.0 (169.3)	10.1 (101.0)	7.4 (56.0)	55.2	67.3	77.6	78.6	55	70	78	71
Imazethapyr + imazamox (RM)	61.5	3 WAS	11.5 (132.7)	12.9 (165.3)	8.3 (68.0)	8.1 (65.3)	57.4	70.1	86.4	79.9	57	74	86	74
Imazethapyr + imazamox (RM)	70	3 WAS	11.2 (124.0)	13.1 (171.3)	6.9 (46.3)	6.8 (48.0)	66	73.5	90.6	84.8	66	83	91	82
Imazethapyr + imazamox (RM) *fb* propaquizafop	43.75 *fb* 62.5	3 WAS *fb* 6 WAS	12.7 (161.3)	12.9 (166.7)	8.4 (70.0)	7.0 (49.3)	45	62.4	85.7	83.3	45	68	86	74
Imazethapyr + imazamox (RM) *fb* propaquizafop	52.5 *fb* 62.5	3 WAS *fb* 6 WAS	12.2 (148.0)	13.2 (173.3)	7.0 (48.0)	6.6 (45.3)	52.9	69.2	90.8	85.5	53	69	91	77
Imazethapyr + imazamox (RM) *fb* propaquizafop	61.5 *fb* 62.5	3 WAS *fb* 6 WAS	12.1 (144.7)	13.0 (169.3)	6.5 (40.7)	7.7 (58.7)	61.3	71.6	91.5	88.8	61	72	91	80
Imazethapyr + imazamox (RM) *fb* propaquizafop	70 *fb* 62.5	3 WAS *fb* 6 WAS	11.5 (131.7)	12.6 (158.7)	4.6 (19.7)	6.1 (39.3)	66.9	74.7	93.8	90.9	67	80	94	83
Imazethapyr *fb* propaquazafop	50 *fb* 62.5	3 WAS *fb* 6 WAS	12.8 (164.0)	11.8 (137.3)	6.1 (36.0)	6.5 (44.0)	58.1	69.4	90.0	86.4	58	69	90	87
Imazethapyr *fb* propaquazafop	75 *fb* 62.5	3 WAS *fb* 6 WAS	11.8 (139.3)	11.5 (132.0)	5.7 (31.0)	5.1 (25.3)	61.8	72.5	91.6	88.7	62	80	92	90
Imazethapyr *fb* propaquazafop	100 *fb* 62.5	3 WAS *fb* 6 WAS	11.6 (134.3)	10.9 (118.7)	4.1 (15.7)	4.9 (22.7)	75.7	79.2	95.2	91.6	76	82	95	92
Weed free	-	-	1 (0)	1 (0)	1 (0)	1 (0)	100	100	100	100	100	100	100	100
Weedy check	-	-	16.2 (261.3)	15.6 (245.3)	15.7 (245.7)	10.1 (102.7)	0	0	0	0	0	0	0	0
SEm±	-	-	0.4	0.5	0.3	0.8	-	-	-	-	-	-	-	-
CD (P=0.05)	-	-	1.0	1.5	0.8	1.3	-	-	-	-	-	-	-	-

Original data were subjected to square root $\sqrt{x+0.5}$ transformation and presented in parentheses

WAS, Week after sowing; PRE, pre-emergence; FB, followed by; DAS, days after sowing, L, location, RM, Ready mix

Table 2. Effect of different weed control treatments on seed yield and economics of cluster bean at both the locations

Treatment	Rate (g/ha)	Time of application	Seed yield (t/ha)		Net returns (× 10³₹/ha)		Benefit: cost ratio	
			L1	L2	L1	L2	L1	L2
Pendimethalin	1000	PRE	1.12	1.24	44.2	49.2	2.4	2.5
Imazethapyr + imazamox (RM)	43.75	3 WAS	1.10	1.02	44.0	29.7	2.4	1.9
Imazethapyr + imazamox (RM)	52.5	3 WAS	1.19	1.13	47.7	35.6	2.5	2.1
Imazethapyr + imazamox (RM)	61.5	3 WAS	1.21	1.11	52.2	41.8	2.6	2.3
Imazethapyr + imazamox (RM)	70	3 WAS	1.32	1.27	58.0	49.3	2.8	2.5
Imazethapyr + imazamox (RM) *fb* propaquizafop	43.75 *fb* 62.5	3 WAS *fb* 6 WAS	1.19	1.11	48.0	36.7	2.5	2.1
Imazethapyr + imazamox (RM) *fb* propaquizafop	52.5 *fb* 62.5	3 WAS *fb* 6 WAS	1.24	1.20	50.8	35.6	2.5	2.1
Imazethapyr + imazamox (RM) *fb* propaquizafop	61.5 *fb* 62.5	3 WAS *fb* 6 WAS	1.31	1.29	56.3	48.5	2.7	2.4
Imazethapyr + imazamox (RM) *fb* propaquizafop	70 *fb* 62.5	3 WAS *fb* 6 WAS	1.42	1.38	60.2	53.7	2.8	2.6
Imazethapyr *fb* propaquazafop	50 *fb* 62.5	3 WAS *fb* 6 WAS	1.22	1.29	53.5	50.2	2.6	2.5
Imazethapyr *fb* propaquazafop	75 *fb* 62.5	3 WAS *fb* 6 WAS	1.35	1.42	58.0	55.9	2.7	2.7
Imazethapyr *fb* propaquazafop	100 *fb* 62.5	3 WAS *fb* 6 WAS	1.58	1.47	69.8	57.7	3.1	2.7
Weed free	-	-	1.58	1.51	58.4	50.2	2.3	2.1
Weedy check	-	-	0.72	0.94	17.6	26.8	1.6	1.9
SEm±	-	-	0.07	0.06	-	-	-	-
CD (P=0.05)	-	-	0.19	0.17	-	-	-	-

WAS, Week after sowing; PRE, pre-emergence; FB, followed by; DAS, days after sowing, L, location, RM, Ready mix

imazethapyr + imazamox 70 g/ha *fb* propaquizafop 62.5 g/ha. However, the efficacy of imazethapyr + imazamox 70 g/ha was lower under Hisar condition (Table 1).

Among herbicidal treatments, the highest seed yield was recorded with sequential application of imazethapyr 100 g/ha 3 weeks after sowing *fb* propaquizafop 62.5 g/ha at 6 weeks after sowing, which was statistically at par with imazethapyr + imazamox 70 g/ha at 3 weeks after sowing *fb* propaquizafop 62.5 g/ha at 6 weeks after sowing at location 1. But at location 2, imazethapyr + imazamox 70 g/ha at 3 WAS *fb* propaquizafop 62.5 g/ha at 6 weeks after sowing provided lower seed yield and net return due to lower efficacy of imazethapyr + imazamox (odyssey) against *T. portulacastrum* (Table 2). At location 1 and 2, the highest net returns (₹69.8 × 10^3 and 5.77 × 10^3₹/ha respectively) and benefit: cost ratio was observed under sequential application of imazethapyr 100 g/ha 3 weeks after sowing *fb* propaquizafop 62.5 g/ha at 6 weeks after sowing. These results corroborate with the finding of Meena *et al*. (2011), where application of imazethapyr 100 g/ha significantly reduced the density of weeds and provided higher net returns and increase over weedy check in soybean. Aggarwal *et al.* (2014) also revealed that imazethapyr 100 g/ha at 15 and 25 days after sowing recorded the highest gross and net returns in black gram.

It may be concluded from the present study, that sequential application of imazethapyr 100 g/ha 3 weeks after sowing *fb* propaquizafop 62.5 g/ha at 6 weeks after sowing and imazethapyr + imazamox 70 g/ha at 3 weeks after sowing *fb* propaquizafop 62.5 g/ha at 6 weeks after sowing, were found effective in controlling weeds, increasing productivity and net income in cluster bean.

REFERENCES

Aggarwal, N., Singh, G., Ram, H. and Khanna, V. 2014. Effect of post-emergence application of imazethapyr on symbiotic activities, growth and yield of blackgram (*Vigna mungo*) cultivars and its efficacy against weeds. *Indian Journal of Agronomy* **59**(3): 421–426.

Bhadoria, R. B. S., Jain, P. C. and Tomar, S. S. 2000. Crop-weed competition in cluster bean (*Cyamopsis tetragonoloba*) under rainfed condition. *Indian Journal of Agronomy* **45**(4): 737–739.

Dhaker, H., Mundra, S.L. and Jain, N.K. 2009. Weed management in cluster bean (*Cyamopsis tetragonoloba*). *Indian Journal of Weed Science* **41**(3 and 4): 224–227.

Meena, D.S., Ram, B., Jadon, C. and Tetarwal, J.P. 2011. Efficacy of imazethapyr on weed management in soybean. *Indian Journal of Weed Science* **43**(3 and 4): 169–171.

Yadav, A., Budhiraja, M.S., Rathee, S., Yadav, J.S. and Malik, R.K. 1998. Selectivity of cluster bean varieties to dinitroanilines in different soils. *Indian Journal of Weed Science* **30**(3 and 4): 108–112.