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Efficacy of herbicides for control of weeds in mothbean

Ram Pratap, S.P. Singh*, R.S. Yadav and Amit Kumawat

College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner 334 006

**Email: spbhakar2010@gmail.com*

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ABSTRACT

A field experiment was conducted at College of Agriculture, S K Rajasthan Agricultural University, Bikaner during rainy season 2015 to find out the efficacy of herbicides for control of weeds in mothbean (*Vigna aconitifolia)*. The experiment comprised of 16 treatment combinations. Application of imazethapyr + imazamox 50 g/ha (20 DAS) + hand weeding at 35 DAS were significantly superior in reducing weed density and dry weight of both broad-leaved and grassy weeds. Weed free, pendimethalin 0.75 kg/ha + hand weeding at 25 DAS and pendimethalin 0.75 kg/ha PE alone, imazethapyr + imazamox 50 g/ha + hand weeding at 35 DAS and imazethapyr + imazamox 30 g/ha + hand weeding at 35 DAS registered 844, 827, 805, 801 and 781 kg/ha seed yield, respectively as against the seed yield of 427 kg/ha in weedy check. Among the weed control treatments, maximum net returns of ` 50529/ha was recorded under weed free treatment while highest B:C ratio was recorded with pendimethalin 0.75 kg/ha (2.48) closely followed by imazethapyr + imazamox 50 g/ha + hand weeding at 35 DAS (2.47).

Mothbean [*Vigna aconitifolia* (Jacq.) Marechal] is a short-day and most drought tolerant rainy season legume crop, grown extensively in arid and semi-arid regions of India for grain, green fodder and green manuring purposes. Investigations revealed a loss of 30-50% in the seed yield of mothbean due to weed infestation depending upon the intensity and type of weed flora (Shekhawat *et al.* 2003). Hand weeding is a traditional and effective method of weed control. But untimely rains, unavailability of labour at peak time and increasing labour cost are the main limitations of manual weeding. Under such situations, the only alternative that needs to be explored is the use of suitable herbicides which may be effective and economically viable.

In view of paucity of information on weed management especially the application of post-emergence herbicides in mothbean, an attempt has been made to test imazethapyr and imazethapyr + imazamox as a post-emergence herbicides, as these have shown encouraging results in other leguminous crops.

A field study was conducted during rainy season 2015 at Agronomy Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan. The experiment comprises of 16 treatment combinations (**Table 1**). The soil of experimental site was loamy sand having 0.08% organic carbon, 8.22 pH, 78, 22 and 210 kg/ha available N, P and K, respectively. Mothbean '*RMO-423*' was sown on 17 July 2015 at 30 cm row to row spacing using seed rate of 16 kg/ha and was harvested on 28 September 2015. Recommended dose of fertilizers (20 kg N + 40 kg P + 40 kg K/ha) was applied as basal dose. Pendimethalin was applied after the sowing of crop while imazethapyr and imazethapyr + imazamox were applied 20 days after sowing at 3-4 leaf stage. These herbicides were sprayed with knapsack sprayer using 500 litres of water per hectare. In the weed free plots, two hoeing were done at 15 and 30 DAS. In pendimethalin + one hand weeding treated plots, the hoeing was done at 25 DAS as well as in imazethapyr + one hand weeding and imazethapyr + imazamox + one hand weeding treated plots, the hoeing was done at 35 DAS. Weed density was recorded by using quadrate of 0.25 m^2 at 20 DAS and at harvest in all the treatments and then converted into number of weeds/m^2. The weeds were dried in oven till a constant weight was observed and then transformed into g/m^2 by using the appropriate formula. The data on total weed count and weed dry matter were subjected to square root transformation to normalize their distribution (Gomez and Gomez 1984).

Effect on weeds

The experimental field was infested with *Amaranthus spinosus*, *Digera arvensis*, *Aristida depressa*, *Portulaca oleracea*, *Cenchrus biflorus*, *Tribulus terrestris*, *Digiteria* spp. and *Dactyloctenium*

aegyptium.The density and dry weight of broad-leaf and grassy weeds as well as total weeds were significantly reduced by pendimethalin 1.0 kg/ha in controlling weeds at 20 DAS (**Table 1**). On the other hand, pre-emergence application of pendimethalin 0.75 kg/ha alone and pendimethalin 0.75 kg/ha + hand weeding at 25 DAS were superior over imazethapyr 50, 40 or 30 g/ha alone and integrated with hand weeding and imazethapyr + imazamox 50 or 30 g/ha alone and along with hand weeding and these treatments statistically at par each other. This might be due to effective control of weeds either by manual weeding or herbicides or integrated approach. Moreover, dense crop canopy might have smothering effect on weeds. At 20 DAS, more reduction in both density and dry weight of grassy and broad-leaved weeds with application of pendimethalin. Application of imazethapyr + imazamox 50 or 30 g/ha at at 20 DAS + one hand weeding at 35 DAS, pendimethalin 1.0 kg/ha and imazethapyr 30 g/ha + one hand weeding at 35 DAS was found at par with each other and significantly superior over pendimethalin 0.75 kg/ha alone and integrated with hand weeding and imazethapyr 50 or 40 g/ha + one hand weeding at 35 DAS. Hand weeding 20 DAS and imazethapyr + imazamox 50 g/ha significantly decreased weed density compared to imazethapyr 50, 40 or 30 g/ha alone and imazethapyr + imazamox 30 g/ha alone. On other hand the lowest dry weight found in imazethapyr + imazamox 50 g/ha + one hand weeding at 35 DAS, which remained at par with imazethapyr + imazamox 30 g/ha + one hand weeding at 35 DAS and pendimethalin 1.0 kg/ha. Performance of herbicidal (all levels of imazethapyr and pendimethalin) treatments along with one hand weeding were found superior over application of herbicide alone with respect to both density and dry weight of broad-leaved, grassy and total weeds. In case of application

Tables 1. Effect of weed control measure on density and dry weight of weed at harvest

Treatment	Weed density (no./m^2)						Weed dry weight (g/m^2)					
	Broad-leaved		Grassy		Total		Broad-leaved		Grassy		Total	
	20 DAS	At harvest	20 DAS	At harvest	20 DAS	At harvest	20 DAS	At harvest	20 DAS	At harvest	20 DAS	At harvest
Pendimethalin 0.75 kg/ha as PE	1.53 (1.8)	1.42 (1.5)	0.71 (0)	1.58 (2.1)	1.53* (1.8)#	2.02 (3.58)	4.11 (16)	3.63 (13)	0.71 (0)	1.44 (1.6)	16.4	14.2
Pendimethalin 1 kg/ha as PE	0.71 (0)	0.99 (0.5)	0.71 (0)	1.26 (1.1)	0.71 (0.0)	1.44 (1.57)	0.71 (0)	3.15 (9.4)	0.71 (0)	1.26 (1.1)	0	10.5
Pendimethalin 0.75 kg/ha as PE + 1 HW at 25 DAS	1.53 (1.8)	1.40 (1.5)	0.71 (0)	1.25 (1.1)	1.53 (1.8)	1.74 (2.53)	4.11 (16)	3.61 (12)	0.71 (0)	1.25 (1.1)	16.4	13.6
Imazethapyr 30 g/ha at 20 DAS	7.72 (59)	2.71 (6.8)	5.13 (26)	3.13 (9.3)	9.24 (85)	4.08 (16.2)	8.66 (74)	4.78 (22)	2.92 (8.0)	2.10 (3.9)	82.6	26.2
Imazethapyr 40 g/ha at 20 DAS	7.60 (57)	2.64 (7.1)	5.15 (29)	3.03 (8.7)	9.25 (85)	4.01 (15.6)	8.52 (73)	4.68 (22)	2.91 (8.1)	2.05 (3.7)	81.5	25.5
Imazethapyr 50 g/ha at 20 DAS	7.66 (58)	2.48 (5.8)	5.11 (26)	2.74 (7.0)	9.18 (84)	3.63 (12.6)	8.63 (74)	4.59 (21)	2.92 (8.0)	1.95 (3.3)	82.0	23.9
Imazethapyr 30 g/ha at 20 DAS + 1 HW at 35 DAS	7.77 (60)	1.37 (1.4)	5.07 (25)	1.05 (0.6)	9.25 (85)	1.58 (2.0)	8.69 (75)	3.57 (12)	2.91 (8.0)	1.15 (0.8)	83.0	13.1
Imazethapyr 40 g/ha at 20 DAS + 1 HW at 35 DAS	7.70 (59)	1.37 (1.4)	5.18 (26)	1.32 (1.2)	9.25 (85)	1.76 (2.6)	8.65 (74)	3.57 (12)	2.94 (8.1)	1.30 (1.2)	82.5	13.4
Imazethapyr 40 g/ha at 20 DAS + 1 HW at 35 DAS	7.83 (61)	1.35 (1.3)	5.20 (26)	1.40 (1.4)	9.37 (87)	1.81 (2.8)	8.72 (76)	3.55 (12)	2.94 (8.1)	1.34 (1.3)	83.7	13.4
Imazethapyr + imazamox 30 g/ha at 20 DAS	7.70 (61)	2.78 (7.2)	5.16 (26)	2.94 (8.5)	9.28 (85)	4.00 (15)	8.65 (74)	4.83 (23)	2.93 (8.0)	2.03 (3.6)	82.4	26.5
Imazethapyr + imazamox 50 g/ha at 20 DAS	7.65 (58)	2.35 (5.0)	5.18 (26)	2.11 (4.0)	9.21 (84)	3.08 (9.0)	8.63 (74)	4.49 (20)	2.94 (8.1)	1.69 (2.4)	82.0	22.0
Imazethapyr + imazamox 30 g/ha at 20 DAS + 1 HW at 35 DAS	7.74 (60)	1.00 (0.5)	5.18 (26)	1.26 (1.1)	9.30 (85)	1.44 (1.6)	8.67 (75)	3.16 (9.5)	2.94 (8.1)	1.26 (1.1)	82.9	10.6
Imazethapyr + imazamox 50 g/ha at 20 DAS + 1 HW at 35 DAS	7.63 (58)	0.84 (0.2)	5.19 (26)	1.00 (0.5)	9.20 (84)	1.10 (0.7)	8.62 (74)	2.96 (8.3)	2.94 (8.1)	1.10 (0.7)	81.9	9.0
Hand weeding 20 DAS	7.66 (58)	1.64 (2.2)	5.10 (25)	2.14 (4.2)	9.18 (84)	2.61 (6.3)	8.59 (73)	3.85 (14)	2.92 (8.0)	1.71 (2.4)	81.3	16.7
Weedy check	7.80 (60)	9.35 (86)	5.10 (25)	6.64 (44)	9.30 (85)	11.4 (130)	8.71 (75)	8.52 (72)	2.92 (8.0)	3.11 (9.2)	83.4	81.2
Weed free	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0.71 (0)	0	0
LSD (p=0.05)	0.96	0.83	0.83	0.47	1.0	0.49	0.61	0.51	0.35	0.47	9.1	3.8

HW= Hand weeding DAS=Day after sowing *: Figures in parenthesis are original, #: Weed density transformed to "n+0.

Tables 2. Effect of weed control measure on weed control efficiency, weed index, yield and economics in mothbean

Treatment	Weed control efficiency (%)	Weed index (%)	Seed yield (t/ha)	Straw yield (t/ha)	Net returns (x10^3 `/ha)	B:C ratio
Pendimethalin 0.75 kg/ha as PE	96.04	4.69	0.80	1.61	48.75	2.48
Pendimethalin 1 kg/ha as PE	98.26	13.11	0.73	1.48	42.36	2.11
Pendimethalin 0.75 kg/ha as PE + 1 HW at 25 DAS	97.23	2.04	0.83	1.62	47.22	2.05
Imazethapyr 30 g/ha at 20 DAS	82.39	12.95	0.73	1.48	43.49	2.29
Imazethapyr 40 g/ha at 20 DAS	83.49	12.45	0.74	1.48	43.69	2.28
Imazethapyr 50 g/ha at 20 DAS	86.10	12.15	0.74	1.49	43.76	2.26
Imazethapyr 30 g/ha at 20 DAS + 1 HW at 35 DAS	97.77	9.76	0.76	1.54	45.67	2.39
Imazethapyr 40 g/ha at 20 DAS + 1 HW at 35 DAS	97.13	9.02	0.77	155	46.01	2.38
Imazethapyr 40 g/ha at 20 DAS + 1 HW at 35 DAS	96.98	8.49	0.77	1.57	46.23	2.37
Imazethapyr + imazamox 30 g/ha at 20 DAS	82.99	10.81	0.75	1.49	44.90	2.35
Imazethapyr + imazamox 50 g/ha at 20 DAS	90.23	10.59	0.75	1.47	44.59	2.29
Imazethapyr + imazamox 30 g/ha at 20 DAS + 1 HW at 35 DAS	98.27	7.50	0.78	1.59	47.25	2.46
Imazethapyr + imazamox 50 g/ha at 20 DAS + 1 HW at 35 DAS	99.23	5.14	0.80	1.61	48.49	2.47
Hand weeding 20 DAS	93.05	9.99	0.76	1.53	44.84	2.27
Weedy check	0.00	49.41	0.43	0.95	18.07	0.98
Weed free	100.0	0.00	0.84	1.64	50.53	2.39
LSD (p=0.05)	-	-	0.10	0.23	-	-

of imazethapyr + imazamox integrated with hand weeding showed superior effect on reducing weed density and weed dry weight with or without hand weeding. At harvest more reduction in both density and dry weight of grassy weeds with application of imazethapyr + imazamox was might be due to the more effectiveness of imazamox against grassy weeds. The results also corroborated with the finding of Singh *et al.* (2015), and Reddy *et al.* (2016). Saltoni *et al.* (2004) have 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. Imazethapyr + imazamox 50 or 30 g/ha at 20 DAS + hand weeding 35 DAS, pendimethalin 1.0 kg/ha as PE and imazethapyr 50 g/ha + one hand weeding at 35 DAS recorded higher weed control efficiency (**Table 2**). The lowest weed index was recorded under pendimethalin 0.75 kg/ha as PE + one hand weeding at 25 DAS (0.87%) followed by pendimethalin 0.75 kg/ha as PE (3.54%) and imazethapyr + imazamox 50 g/ha at 20 DAS + one hand weeding at 35 DAS (4.0%). This might be due to elimination of weeds by manual weeding and interculturing or by herbicides.

Effect on mothbean

Among different treatments, significant superiority of weed free treatment over all weed control methods significantly enhanced yield components with concomitant increased in seed and straw yield (**Table 2**). The extents of increase in seed and straw yield of mothbean were by 97.65 and 73.07 per cent under weed free treatment, respectively compared to weedy check. Similar results were also reported by Upadhayay *et al.* (2013). Maximum net returns of ` 50529/ha was realized under the weed free treatment and it was closely followed by pendimethalin 0.75 kg/ha alone and imazethapyr + imazamox 50 g/ha at 20 DAS as PoE which recorded net return of ` 48753 and ` 48492/ha, respectively. The higher seed yield recorded with this treatment might be responsible for higher net returns. The maximum B:C ratio (2.48) was accrued under treatment pendimethalin at 0.75 kg/ha as PE followed by imazethapyr + imazamox 50 g/ha + one hand weeding 35 DAS and imazethapyr + imazamox 30 g/ha + one hand weeding 35 DAS values 2.47 and 2.46.

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