Short communication

Indian Journal of Weed Science **46**(4): 392–395, 2014

Pre- and post-emergence herbicides for weed management in mungbean

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Received: 8 September 2014; Revised: 15 November 2014

Key words: Herbicides, Microbial population, Phytotoxicity, Post-emergence, Pre-emergence

Mungbean is recommended for cultivation mainly in *Kharif* season under Vidarbha condition in Maharastra, India. Weed management is an important factor for enhancing the productivity of mungbean as weeds compete for nutrients, water, light and space with crop during early growth period. Yield losses in mungbean due to weeds have been estimated to range between 30-50% (Kumar *et al*. 2004). Mechanical practices such as hand weeding and inter -culturing are effective but unavailability of labour and incessant rains during the early crop season normally limit the weeding operations. Therefore, chemical weeding under such circumstances become indispensible and can be the excellent alternate. Pendimethalin is only recommended pre-emergence herbicides in mungbean, however, peasants could not find time to apply it during the same day or next day due to busy shedule in sowing operation. This warrants the use of pre- and post-emergence herbicides for weed control. The present study was, therefore, conducted to evaluate the effect of different herbicides for mungbean, which can be cost effective and acceptable to the growers of this crop.

A field experiment was carried out at Pulses Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during the *Kharif* season to see the effect of post-emergence herbicides *viz*. imazethapyr 10 EC, quizalofop-ethyl 10 EC, fenoxoprop-ethyl 10 EC, imazethapy 35 EC + imazamox 35 EC and pre-emergence pendimethalin 30 EC and pendimethalin 2 EC + imazethapyr 30 EC on growth and yield of mungbean cultivar '*PKV Green Gold* (*AKM-9911*)'. The soil of experimental site was clayey with pH 7.8, having available N 235 kg/ha, available P 20.9 kg/ha, available K 323 kg/ha and OC 0.41 %. The experiment was laid out in randomized block design having three replications. All the herbicides alone or in combination were applied 20 days after sowing (DAS) with knapsack sprayer fitted with flat-fan nozzle using 500 litre water/ha. Mungbean seed was treated with carrier based *Rhizobium* and PSB, each at the rate of 2.5 g per kg seed and mixed well to ensure the inoculums to stick on to the surface of the seeds. The N and P through urea and diammonium phosphate were applied as basal at sowing. Serial dilution plate technique was used for isolation and enumeration of soil fungi, actinomycetes and bacteria as described by Pahwa *et al.* (1996).The crop was sown on 20 June 2010 and was harvested on 3 September 2010. The total rainfall received during the crop growth was 552.3 mm in 28 rainy days during 2010. The required plant population (30 cm row to row and 10 cm plant to plant) was maintained by thinning plants after three weeks of sowing.

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Weed flora

The weed flora emerge during the period of experimentation were grasses like, *Dactylectinum aegyptium, Echinochloa colona* and *Bracharia* sp., sedges like *Cyperus rotundus* and broad-leaved weeds like *Commelina diffusa, Amaranthus viridis, Digeria arvensis, Parthenium hysterophorus* and *Phyllanthus niruri*.

Among herbicides and cultural methods of weed control, application of imazethapyr at 1.0 kg/ha and 0.075 kg/ha at 20-25 DAS followed by HW twice recorded lowest dry weight of weeds at all the growth stages. However, imazethapyr was effective against annual broad-leaf weeds like *Commelina diffusa, Amaranthus viridis, Digeria arvensis, Parthenium hysterophorus* and grassy weeds like *Bracharia* sp. *Echinochloa colona,* perennial sedge like *Cyperus rotundus*. The highest total weed dry matter production (25.18 g/m^2) at 30 DAS was recorded in weedy check plots; whereas, the lowest total weed biomass was recorded with the HW twice (1.34 g/m^2) which was closely followed by application of imazethapyr at 1.0 kg/ha at 20-25 DAS (5.64 g/m^2), imazethapyr at 0.075 kg/ha (7.16 g/m^2) (Table 2). Higher weed control efficacy and long lasting effects of imazethapyr in reducing weed dry matter might be due to broad-spectrum activity of herbicides particularly on established plants of both narrow and broad-leaf weeds and its greater efficiency to retard cell division of meristems as a result of which weeds died rapidly.

Table 1. Grain yield, yield attributing characters and economics of mungbean as influenced by different weed management practices

Treatment	Grain yield (t/ha)	Plant height (cm)	Leaf area at 30 DAS (cm^2)	Root nodule /plant at 30 DAS	Pods/ plant	Test weight (g)	Cost of cultivation (x10^3 `/ha)	Net returns (x10^3 `/ha)	B:C ratio
Pendimethalin 1.0 kg/ha as PE	1.06	74.7	6.67	26.4	20.3	34.7	13.27	23.95	1.80
Pendimethalin + imazethapyr 0.75 kg/ha as PE	1.00	76.7	6.58	21.7	18.6	33.4	11.78	23.53	2.00
Pendimethalin + imazethapyr 1.0 kg/ha as PE	0.91	77.9	6.65	30.4	17.2	33.3	12.52	19.45	1.55
Quizalofop-ethyl 0.075 kg/ha at 20-25 DAS	1.01	75.4	7.48	27.0	18.7	33.2	14.02	21.29	1.52
Fenoxoprop-ethyl 0.075 kg/ha at 20-25 DAS	0.97	76.2	7.52	26.2	17.9	34.1	13.50	20.51	1.52
Imazethapyr + imazamox 0.075 kg/ha at 20-25 DAS	0.90	59.3	5.04	17.2	16.4	35.7	14.11	18.26	1.35
Imazethapyr + imazamox 1.0 kg/ha at 20-25 DAS	0.85	53.6	5.10	16.8	18.5	34.2	12.86	15.71	1.11
Imazethapyr 0.075 kg/ha at 20-25 DAS	1.19	74.7	7.82	17.9	24.0	37.5	13.27	28.78	2.24
Imazethapyr 1.0 kg/ha at 20-25 DAS	1.24	73.3	7.84	16.3	25.5	37.2	14.74	30.37	2.29
HW twice at 20 and 40 DAS	1.15	66.0	8.41	40.5	22.2	38.5	14.74	26.25	1.78
Weed free	1.27	75.9	7.71	35.4	21.2	38.8	11.14	29.73	2.02
Weedy check	0.53	78.9	6.21	35.4	12.8	31.2	11.14	18.08	1.62
LSD (P=0.05)	0.14	3.5	0.6	4.9	4.0	2.6	-	5.16	--

Effect on crop

The highest yield attributes, *viz*. branches/plant, pods/plant, grain weight/plant and test weight were recorded with the application of imazethapyr at 1.0 and 0.075 kg/ha at 20-25 DAS, respectively due to safer behaviour of herbicides against crop plants and phytotoxic effect on weeds. The data pertaining to test weight revealed that the HW twice and herbicides (pre- and post-emergence) had significant effect on test weight. The as highest test weight was recorded in plots maintained weed free and HW twice which was statistically at par with imazethapyr at 0.075 and 1.0 kg/ha. However, application of imazethapyr + imazamox at both the levels reduced the plant height, leaf area, branches/plant, pods/plant, pod length and grain weight/plant over remaining herbicides.

Application of pre- and post-emergence herbicides significantly reduce the nodulation, the degree of reduction was more with imazethapyr + imazamox at both the levels followed by pre-emergence application of pendimethlain and pemdimethalin + imazethapyr. The weed free treatment produced significantly maximum mungbean yield (1.27 t/ha) over remaining treatments except imazethapyr at 1.0 kg/ha at 20-25 DAS (1.24 t/ha) and hand weeding twice (1.15 t/ha). Higher seed yield of soybean was recorded due to effective control of weeds by imazethapyr at 1.0 kg/ha (Meena *et al*. 2011). However, pre-emergence application of pendimethalin at 1.0 kg/ha and pendimethalin + imazethapyr 0.75 kg/ha and 1.0 kg/ha, respectively, did not influenced grain yield. Higher weed control efficiency was observed with post-emergence application of imazethapyr at 1.0 kg (70.77%) followed by 0.075 kg/ha (67.74%) at 20-25 DAS, respectively. Weed index was computed as the yield reduction comparative to highest yielding treatment *i.e*. weed free. In case of weed management practices, hand weeding showed minimum weed index (9.21) followed by post-emergence application of imazethapyr at 1.0 kg/ha (1.89) and imazethapyr at 0.075 kg/ha (6.37). Post-emergence application of imazethapyr + imazamox at 1.0 kg/ha and 0.075 kg/ha recorded maximum weed index *i.e*. 32.97 and 28.64% respectively, indicating the reduction in mungbean grain yield due to presence of weeds throughout crop growth period.

Microbial population

Initially, after the herbicides treatment (15, 30 and at harvest) microbial counts was slightly less in pre-emergence application of pendimethalin and pemdimethalin + imazethapyr, reaching a maximum between 30 DAS and at harvest (Table 3). The toxic effect of herbicides normally appears immediately after the application when their concentration in the soil is highest. Later on, microorganism take part in degradation process and herbicide concentration and its toxic effect decreases (Radivojevic *et al*. 2004). The

Table 2. Effect of different weed management treatment on dry weight of weeds, weed control efficiency and weed index in mungbean

Treatment	Dry weight of weeds (g/m^2)		Weed control efficiency (%)	Weed index (%)
	30 DAS	At harvest		
Pendimethalin 1.0 kg/ha as PE	8.15	14.6	57.7	16.2
Pendimethalin + imazethapyr 0.75 kg/ha as PE	9.11	15.4	55.2	20.6
Pendimethalin + imazethapyr 1.0 kg/ha as PE	8.64	15.2	56.0	28.0
Quizalofop-ethyl 0.075 kg/ha at 20-25 DAS	16.1	14.0	59.2	19.9
Fenoxoprop-ethyl 0.075 kg/ha at 20-25 DAS	16.2	14.1	58.9	23.5
Imazethapyr + imazamox 0.075 kg/ha at 20-25 DAS	6.11	12.5	63.8	28.6
Imazethapyr + imazamox 1.0 kg/ha at 20-25 DAS	5.64	13.9	67.6	33.0
Imazethapyr 0.075 kg/ha at 20-25 DAS	7.16	11.1	67.7	6.37
Imazethapyr 1.0 kg/ha at 20-25 DAS	4.38	10.1	70.7	1.89
HW twice at 20 and 40 DAS	1.34	4.12	88.0	9.21
Weed free	1.13	3.13	90.9	0.0
Weedy check	25.1	34.5	0.0	57.9
LSD (P=0.05)				

Table 3. Microbial population at periodical growth stages as influenced by different weed management practices

Treatment	Bacteria (cfu $\times 10^7$/g soil)			Fungi (cfu $\times 10^4$/g soil)			Actinomycetes (cfu $\times 10^6$/g soil)		
	Before sowing	30 DAS	At harvest	Before sowing	30 DAS	At harvest	Before sowing	30 DAS	At harvest
Pendimethalin 1.0 kg/ha as PE	15.1	22.3	38.8	14.8	20.8	31.1	10.2	17.7	26.7
Pendimethalin + imazethapyr 0.75 kg/ha as PE	15.2	22.2	38.7	14.6	20.8	31.9	10.3	17.3	26.7
Pendimethalin + imazethapyr 1.0 kg/ha as PE	15.5	22.1	38.7	14.6	20.8	31.2	10.3	17.1	26.5
Quizalofop-ethyl 0.075 kg/ha at 20-25 DAS	15.4	20.8	38.7	14.4	20.1	32.8	10.2	15.5	24.5
Fenoxoprop-ethyl 0.075 kg/ha at 20-25 DAS	15.5	20.9	38.6	14.6	20.2	32.9	10.2	15.7	24.7
Imazethapyr + imazamox 0.075 kg/ha at 20-25 DAS	15.5	20.7	38.5	14.5	20.1	32.9	10.1	15.8	24.8
Imazethapyr + imazamox 1.0 kg/ha at 20-25 DAS	15.4	20.6	38.4	14.6	20.1	31.7	10.1	15.3	24.3
Imazethapyr 0.075 kg/ha at 20-25 DAS	15.4	20.8	38.5	14.6	20.1	33.6	10.2	15.6	24.6
Imazethapyr 1.0 kg/ha at 20-25 DAS	15.5	20.7	38.4	14.7	20.1	33.0	10.3	15.3	24.3
HW twice at 20 and 40 DAS	15.4	24.7	39.9	14.5	24.1	35.2	10.3	20.1	28.2
Weed free	14.5	24.8	40.0	14.4	24.2	36.5	10.3	20.1	28.3
Weedy check	15.6	24.2	39.0	0.06	23.3	34.1	10.2	19.2	26.1
LSD (P=0.05)	15.4	0.08	0.13	14.4	0.06	2.22	0.10	0.09	0.07

total microbial population was highest with cultural operations and lower with herbicides. The application of herbicides in recommended dose did not affect the microbial population significantly. Among herbicides results showed that application of herbicide in combinations resulted in reduced microbial populations compare to soils treated with single herbicide. Balasubramanian and Sankaran (2004) also reported initial suppression of soil micro flora but the herbicides application in different soils which recovered later on.

Economics

Among the herbicides, application in alone or with combinations has recorded higher monetary returns over weedy check. Among the weed-control treatments, imazethapyr at 1.0 kg/ha (` 30,370/ha) and imazethapyr at 0.075 kg/ha (` 28,776/ha) gave the maximum monetary returns, due to excellent control of grassy and broad-leaf weeds without any adverse effect on crop growth. Lower monetary returns which is at par with each other was recorded with imazethapyr + imazamox at 1.0 kg/ha (` 15,710/ha), imazethapyr

+ imazamox at 0.075 kg/ha (` 18,260/ha) due to inability of this herbicides to control weeds. Weed free treatment recorded lower monetary returns and benefit cost ratio than imazethapyr at 1.0 kg/ha, mainly due to the high cost involved in repeated manual weeding to keep these crop weed free in spite of higher grain yield. Among the weed-control treatments, highest benefit ratio (2.29) was recorded with imazethapyr at 1.0kg/ha followed by imazethapyr at 0.075 kg/ha (2.24) and least with imazethapyr + imazamox at 1.0 kg/ha (1.11).

It was concluded that imazethapyr at 0.075 kg/ha applied 20-25 days after sowing was the most remunerative and effective herbicide for controlling the complex weed flora in mungbean under Eastern Maharashtra conditions.

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