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Pre- and post-emergence herbicides for weed control in greengram and their residual effect on succeeding crops

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ABSTRACT

Comparative efficacy of pre- and post-emergence herbicides in greengram and their residual effect on succeeding crops was studied during *Kharif* season of the year 2011-2013. Inter-culturing and hand weeding carried out at 20 and 40 DAS produced the lowest weed dry weight with higher weed control efficiency. Among herbicidal treatments, pre-emergence application of pendimethalin at 500 g/ha or imazethapyr 75 g/ha followed by interculturing and hand weeding at 30 DAS proved to be efficient in reducing weed dry weight with more than 70% of weed control efficiency and recorded higher seed and haulm yield of greengram. Further, it was observed that none of the herbicides applied at tested rates had adverse effect on succeeding wheat, chickpea and mustard crops.

Key words: Greengram, Herbicides, Haulm, Residual effect, Seed, Weed control, Weed dry weight

Greengram (*Vigna radiata* L.) belongs to the family Fabaceae. It is an important conventional pulse crop being cultivated in rainfed area. The lower productivity is mainly due to unawareness and improper use of improved practices by the farming community. The gap between actual and potential production can be minimized with the use of adequate level of inputs in proportionate manner along with other improved cultural practices. Among several factors, proper weed management plays an important role in improving the production. Weeds being the major problem which provide opportunities for harboring insects, pests and diseases and result in yield reduction. They reduce the crop yield and deteriorate the quality of produce and hence, reduce the market value of the turnout. Decrease in mungbean productivity due to weed competition to the extent of 45.6% (Pandey and Mishra 2003).

Therefore, management of weeds in all agro-ecosystems is imperative to sustain our crop productivity and to ensure the food security to the ever increasing population. Herbicides are commonly used for weed control in high-input crop production systems. Due to extensive and injudicious application, most of the unused fractions of herbicides however, may persist within soils (Madhaiyan *et al*. 2006). Hence, information regarding persistence and residual effect of herbicides in soil is essential to use them safely, effectively and for non-hazardous chemical weed control strategy. For that bioassay remains a major tool for qualitative and quantitative determination of herbicides residue in soil. Considering above facts, an attempt has been made to study the comparative efficacy of pre and post emergence herbicide in greengram and their residual effect on succeeding crops.

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MATERIALS AND METHODS

With a view to determine the comparative efficacy of different pre- and post-emergence herbicide in greengram and their residual effect on succeeding crops, the present field experiment was conducted at DWR-Anand Centre, B.A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) during *Kharif* season of the year 2011 to 2013. The soil of the experimental field was sandy loam in texture having low in available nitrogen and medium in available phosphorus and high in potassium with pH 8.2. The experiment was laid out in randomized complete block design with four replications. Ten treatment comprised, *viz*. pendimethalin 500 g/ha PE, pendimethalin 500 g/ha PE *fb* IC+HW at 30 DAS, quizalofop-ethyl 50 g/ha POE *fb* IC at 30 DAS, quizalofop-ethyl 50 g/ha POE *fb* IC+HW at 30 DAS, imazethapyr 75 g/ha *fb* IC at 30 DAS, imazethapyr 75 g/ha *fb* IC+HW at 30 DAS, fenoxaprop-p-ethyl 100 g/ha POE *fb* IC at 30 DAS, fenoxaprop-p-ethyl 100 g/ha POE *fb* IC + HW at 30 DAS, IC + HW at 20 and 40 DAS and weedy check. The herbicides were applied using knapsack sprayer

fitted with flat fan nozzle by mixing in 500 litre of water/ha as per treatments. Greengram cv. '*Meha*' was sown manually keeping the distance of 30 cm between two rows in all the three years of experimentation. After harvesting of the greengram, without disturbing the layout, each plot were manually prepared for sowing of succeeding crops crop to know the residual effect of herbicides. Four rows of each succeeding crop, *viz*. chickpea, wheat and mustard were sown in each plot during *Rabi* season at a recommended spacing of respective crop during all the three years of experimentation. The observation of succeeding crops, *viz*. germination (no. of plant/m row length) at 10 DAS while plant height (cm) and dry matter accumulation (g/plant) of chickpea, wheat and mustard crops were recorded at 30 DAS and data were used for analysis.

RESULTS AND DISCUSSION

Effect on weeds

All the weed management practices showed effective control of individual group of monocot and dicot weeds resulting in reduction of weed dry weight as well as increasing weed control efficiency as compared to weedy check (Table 1). Among the herbicidal treatments, significantly the lowest monocot weed count at 25 DAS was observed under imazethapyr 75 g/ha PE *fb* IC at 30 DAS, while significantly lower dicot weed count was noticed under imazethapyr 75 g/ha PE *fb* IC + HW at 30 DAS as compared to rest of the herbicidal treatment except imazethapyr 75 g/ha PE *fb* IC at 30 DAS. At harvest, IC + HW at 20 and 40 DAS recorded significantly lower dry weight of weeds than that of recorded in other treatments except pendimethalin 500 g/ha PE *fb* IC + HW at 30 DAS and pendimethalin 500 g/ha PE. Similarly, minimum weed dry weight under manual weeding and with application of pendimethalin was also noticed by Kaur *et al*. (2009) in greengram. Further, it was observed that imazethapyr 75 g/ha PE integrated with either with IC or IC + HW at 30 DAS showed their superiority over quizalofop-ethyl 50 g/ ha POE and fenoxaprop-p-ethyl 100 g/ha POE integrated with either with IC or IC + HW at 30 DAS in respect of recording weed dry weight at harvest. Weed control efficiency at harvest was recorded maximum under IC + HW at 20 and 40 DAS followed by pendimethalin 500 g/ha PE *fb* IC + HW at 30 DAS and pendimethalin 500 g/ha PE. The higher weed control efficiency under said treatment might be due to effective reduction of dry weed weight at harvest.

Table 1. Number and dry weight of monocot and dicot weeds and weed control efficiency as influenced by different weed management practices in greengram (pooled data)

Treatment	Weed count at 25 DAS (no./m^2)		Dry weed weight at 25 DAS (g/m^2)		Weed dry weight at harvest (g/m^2)	WCE at harvest (%)
	Monocot	Dicot	Monocot	Dicot		
Pendimethalin 500 g/ha PE	11.6^{c} (134.7)	5.7^{ef} (31.7)	9.6^{bc} (91.4)	6.1^{c} (40.8)	8.0^{def} (63.2)	71
Pendimethalin 500 g/ha PE *fb* IC+HW at 30 DAS	11.4^{c} (130.2)	6.1^{de} (36.8)	10.3^{b} (108.4)	5.8^{c} (32.7)	7.8^{ef} (59.3)	73
Quizalofop-ethyl 50 g/ha POE*fb* IC at 30 DAS	9.6^{d} (90.9)	9.9^{b} (99.2)	9.5^{bc} (90.3)	7.5^{b} (56.2)	14.0^{bc} (195.1)	11
Quizalofop-ethyl 50 g/ha POE *fb* IC+HW at 30 DAS	9.5^{d} (89.0)	9.3^{c} (85.8)	9.3^{bc} (85.4)	6.0^{c} (35.1)	13.9^{c} (192.5)	12
Imazethapyr 75 g/ha *fb* IC at 30 DAS	8.4^{e} (69.0)	5.2^{fg} (26.1)	7.5^{d} (55.7)	3.2^{e} (9.4)	8.6^{d} (74.5)	66
Imazethapyr 75 g/ha *fb* IC+HW at 30 DAS	9.2^{d} (84.7)	5.0^{g} (24.0)	8.9^{c} (78.1)	3.9^{e} (14.1)	8.5^{de} (71.1)	68
Fenoxaprop-p-ethyl 100 g/ha POE *fb* IC at 30 DAS	12.7^{b} (160.6)	6.1^{de} (36.0)	9.9^{bc} (96.6)	4.8^{d} (24.0)	14.7^{ab} (215.1)	2
Fenoxaprop-p-ethyl 100 g/ha POE *fb* IC+HW at 30 DAS	12.9^{b} (165.4)	6.5^{d} (41.2)	8.8^{c} (77.1)	6.6^{bc} (46.3)	14.3^{abc} (203.5)	7
IC+HW at 20 and 40 DAS	1.0^{f} (0.0)	1.0^{h} (0.0)	1.0^{e} (0.0)	1.0^{f} (0.0)	7.3^{f} (53.1)	76
Weedy check	17.8^{a} (351.4)	11.0^{a} (120.5)	16.4^{a} (269.5)	8.5^{a} (72.1)	14.8^{a} (219.7)	-
SEm±	0.20	0.189	0.37	0.29	0.23	-
LSD (P=0.05)	Sig.	Sig.	Sig.	Sig.	Sig.	-
CV (%)	6.94	10.95	10.24	12.06	7.58	-
Y x T SEm±	0.36	0.36	0.46	0.55	0.42	-
LSD (P=0.05)	NS	NS	NS	NS	NS	-

Values followed by the same letter in a column were not significantly different from each other at P=0.05, PE - pre-emergence, POE - post-emergence

Effect on crop

The impact of different weed management practices were clearly reflected their positive impact on yield attributes and yield of green gram (Table 2). Plant stands were unaffected due to different weed management practices. However, periodical plant height measured at 30 DAS and at harvest showed positive effect and maximum plant height was recorded under weedy check treatment at 30 DAS while at harvest it was higher under IC + HW at 20 and 40 DAS. The higher plant height under weedy check treatment at 30 DAS might be due to severe crop weed competition occur during initial stage of the crop, which leads to restrict the development of the plant, hence the height of the plant is increase, while hand weeding treatment provide weed free environment to the crop leads to better growth and development of plant which help in increase the height of the crop. The non-significant variations in dry weight of *Rhizobium* nodules were observed due to different weed management practices.

Further, it was observed that IC + HW carried out at 20 and 40 DAS recorded significantly higher seed and haulm yield of greengram than that of recorded in other treatment except pre-emergence application of pendimethalin 500 g/ha *fb* IC + HW at 30 DAS, pendimethalin 500 g/ha pre-emergence, imazethapyr 75 g/ha post-emergence *fb* IC + HW at 30 DAS and imazethapyr 75 g/ha post-emergence *fb* IC at 30 DAS. Whereas, significantly the lowest seed and haulm yield (584 kg/ha and 932 kg/ha, respectively) was observed in weedy check. Higher seed and haulm yield under IC+HW at 20 and 40 DAS was also recorded by Raj *et al*. (2012) and Kaur *et al*. (2009) in greengram.

Economics

The results of the economics analysis of the weed management practices revealed that maximum net return (₹ 34626/ha) was recorded in IC + HW carried out at 20 and 40 DAS followed by pre emergence application of pendimethalin 500 g/ha, pre emergence application of pendimethalin 500 g/ha *fb* IC + HW at 30 DAS, pre-emergence application of imazethapyr 75 g/ha *fb* IC at 30 DAS and pre emergence application of imazethapyr 75 g/ha *fb* IC + HW at 30 DAS with more than 1.25 BCR. Similarly, Chhodavadia *et al*. (2013) also observed higher BC ratio with IC + HW at 20 and 40 DAS and use of pendimethalin with integration of IC + HW at 30 DAS.

Bioassay study

To know the residual effect of pre and post emergence application of herbicides in greengram, succeeding crops, *viz*. chickpea, wheat and mustard

Table 2. Yield attributes, yield and economics of greengram as influenced by weed management (pooled data)

Treatment	Plant stand (no./m row length)	Plant height at 30 DAS (cm)	Plant height at harvest (cm)	Dry weight of *Rhizobium* nodules (mg/plant) at 35 DAS	Seed yield (kg/ha)	Haulm yield (kg/ha)	Gross realization ($x10^3$ `/ha)	BC ratio
Pendimethalin 500 g/ha PE	10.6	50.0^{abc}	73.0^{abc}	60.7	1135^{abc}	1705^{ab}	55.62	1.53
Pendimethalin 500 g/ha PE *fb* IC+HW at 30 DAS	10.6	47.9^{bcd}	45.1^{ab}	65.3	1151^{ab}	1762^{a}	56.47	1.38
Quizalofop-ethyl 50 g/ha POE *fb* IC at 30 DAS	10.7	50.6^{ab}	73.1^{abc}	65.9	1028^{def}	1493^{c}	50.27	1.17
Quizalofop-ethyl 50 g/ha POE *fb* IC+HW at 30 DAS	10.7	46.0^{d}	73.3^{abc}	63.3	1062^{cde}	1597^{bc}	52.05	1.13
Imazethapyr 75 g/ha *fb* IC at 30 DAS	10.7	46.0^{d}	70.8^{bcd}	65.6	1097^{abc}	1714^{ab}	53.89	1.33
Imazethapyr 75 g/ha *fb* IC+HW at 30 DAS	10.5	46.4^{cd}	72.3^{abcd}	66.1	1114^{abc}	1698^{ab}	54.75	1.25
Fenoxaprop-p-ethyl 100 g/ha POE *fb* IC at 30 DAS	10.6	47.3^{bcd}	72.3^{abcd}	63.8	987^{f}	1545^{c}	48.49	1.08
Fenoxaprop-p-ethyl 100 g/ha POE *fb* IC + HW at 30 DAS	10.7	47.0^{bcd}	69.9^{cd}	63.8	1003^{ef}	1459^{c}	49.06	1.00
IC+HW at 20 and 40 DAS	10.6	46.8^{cd}	75.5^{a}	68.5	1198^{a}	1809^{a}	58.73	1.45
Weedy check	10.7	52.9^{a}	68.3^{d}	60.5	584^{g}	932^{d}	28.73	0.40
SEm±	0.08	1.15	1.36	2.50	35	45	-	-
LSD (P=0.05)	NS	Sig.	Sig.	NS	Sig.	Sig.		
CV (%)	2.59	4.46	5.90	6.13	7.86	8.48		
Y x T SEm±	0.13	1.0	1.1	4.4	40.71	82.65	-	-
LSD (P=0.05)	NS	NS	NS	NS	NS	NS		

Values followed by the same letter in a column are not significantly different from each other at P=0.05, PE - pre-emergence, POE - post-emergence

Table 3. Residual effect of herbicides applied in greengram on succeeding *Rabi* crops (Pooled data)

Treatment	Germination at 10 DAS (no. of plant/m row length)			Plant height at 30 DAS (cm)			Dry matter at 30 DAS (g/plant)		
	Chickpea	Wheat	Mustard	Chickpea	Wheat	Mustard	Chickpea	Wheat	Mustard
Pendimethalin 500 g/ha PE	10.37	45.12	22.70	13.85	36.82	34.87	1.366	4.542	0.923
Pendimethalin 500 g/ha PE *fb* IC+HW at 30 DAS	10.32	45.62	22.72	14.02	36.97	34.75	1.390	4.634	0.923
Quizalofop-ethyl 50 g/ha POE *fb* IC at 30 DAS	10.62	46.35	22.90	13.97	37.0	34.87	1.395	4.575	0.919
Quizalofop-ethyl 50 g/ha POE *fb* IC+HW at 30 DAS	10.45	45.35	22.35	13.87	37.05	34.87	1.394	4.651	0.912
Imazethapyr 75 g/ha *fb* IC at 30 DAS	10.47	45.30	22.63	13.95	37.12	35.02	1.435	4.686	0.931
Imazethapyr 75 g/ha *fb* IC+HW at 30 DAS	10.45	45.27	22.47	13.75	36.75	34.82	1.433	4.638	0.915
Fenoxaprop-p-ethyl 100 g/ha POE *fb* IC at 30 DAS	10.35	45.22	22.92	13.92	36.92	34.80	1.423	4.636	0.928
Fenoxaprop-p-ethyl 100 g/ha POE *fb* IC+HW at 30 DAS	10.35	45.77	22.97	14.07	36.82	34.82	1.492	4.584	0.931
IC+HW at 20 and 40 DAS	10.42	45.65	22.70	14.0	37.02	34.81	1.409	4.644	0.919
Weedy check	10.37	45.22	22.65	13.97	36.97	34.80	1.415	4.659	0.932
SEm±	0.20	1.76	0.30	0.16	0.24	0.15	0.05	0.06	0.02
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	5.91	3.19	3.84	3.53	1.97	1.31	4.19	3.74	5.41
Y x T SEm±	0.31	2.53	0.44	0.25	0.36	0.23	0.07	0.09	0.02
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

PE - pre-emergence, POE - post-emergence

were sown and growth parameters, *viz.* germination count (at 10 DAS), plant height as well as dry matter accumulation (at 30 DAS) were recorded. The results in (Table 3) indicated that there was no residual impact of pendimethalin, quizalofop-ethyl, imazethapyr or fenoxaprop-p-ethyl applied as alone or in integration with either IC or IC + HW at 30 DAS on succeeding wheat, chickpea and mustard crops. This indicated that the said herbicides can safely be used in greengram.

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