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Post-Emergence Chemical Weed Control in *Kharif* Greengram (*Vigna radiata*)

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ABSTRACT

An experiment was carried out during *kharif* 2018 to evaluate the effect of imazethapyr and pendimethalin on the growth and productivity of greengram at the instructional farm of Krishi Vigyan Kendra Langroya, district Shaheed Bhagat Singh Nagar. The experiment was laid out in Randomized Complete Block Design (RCBD) consisting of 6 treatments *viz,* T_1- pendimethalin @ 750 g a.i.//ha as pre-emergence; T_2-pendimethalin @ 750 g a.i.//ha as pre-emergence followed by imazethapyr @ 37.5 g a.i.//ha at 25-30 DAS; T_3- pendimethalin @ 750 g a.i.//ha as pre-emergence followed by imazethapyr @ 50 g a.i.//ha at 25-30 DAS; T_4-pendimethalin @ 750 g a.i.//ha as pre-emergence followed by imazethapyr @ 62.5 g a.i.//ha at 25-30 DAS; T_5-pendimethalin @ 750 g a.i.//ha as pre-emergence followed by imazethapyr @ 75 g a.i.//ha at 25-30 DAS; T_6-weed free (manual weeding) with four replications. Post-emergence application of imazethapyr @ 75 g a.i./ha after pre-emergence application of pendimethalin @ 750 g a.i./ha resulted in significant decrease in weed density, weed dry matter, highest weed control efficiency and weed control index relative to other herbicide treatments. Post-emergence application of imazethapyr @ 62.5g a.i./ha resulted in significantly higher number of pods/plant followed by of imazethapyr @ 75 g a.i./ha. A non-significant difference between pod length, 100 seed weight and seeds/pod were observed. Form the study it can be concluded that farmers can go for pre-emergence application of pendimethalin @ 750g a.i./ha followed by post-emergence application of imazethapyr @ 62.5g a.i./ha at 25-30 DAS for better weed management and higher seed yield.

Key Words: Greengram, Imazethapyr, Pendimethalin, Seed yield, Weed control efficiency.

INTRODUCTION

Greengram (*Vigna radiata* L.) is an important grain legume grown during *Kharif* season. Realization of better seed yield faces major challenge of high infestation of weed due to high rainfall and short stature. Greengram being less competitive against weeds requires intensive management of weeds to ensure proper crop growth, especially in early stages. The magnitude of yield losses in greengram caused by weeds depends upon weed species, their densities and crop-weed competition period. Yield loss of greengram due to weeds ranged from 30 to 85 per cent (Pandey and Mishra, 2003; Raman and Krishnamoorthy, 2005; Mirjha *et al,* 2013). Weeding and hoeing are common weed management practices being followed by farmers for weed management in greengram. Manual weeding is a difficult, time consuming and expensive task due to intermittent rainfall during rainy season and scanty labour. In this situation, use of herbicides at optimum dose remains the pertinent choice for controlling the weeds. Furthermore, combination of chemical methods of weed control would not only reduce the cost of cultivation but would benefit the crop by providing proper aeration and conservation of moisture. Thus, an experiment was conducted with an objective to identify the optimum level of pendimethalin and imazethapyr in their sequential application for effective weed management and seed yield of greengram.

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MATERIALS AND METHODS

An investigation was carried out during *kharif* 2018 to evaluate the effect of imazethapyr and pendimethalin on the growth and productivity of greengram at the instructional farm of Krishi Vigyan Kendra (KVK) Langroya, district Shaheed Bhagat Singh Nagar. KVK Langroya is located in sub-tropical climatic regime with height of 247 m from mean sea level. The experiment was laid out in Randomized Complete Block Design (RCBD) consisting of 6 treatments *viz.,* T_1- pendimethalin @ 750 g a.i.//ha as pre-emergence; T_2-pendimethalin @ 750 g a.i.//ha as pre-emergence followed by imazethapyr @ 37.5 g a.i./ha at 25-30 DAS; T_3-pendimethalin @ 750 g a.i.//ha as pre-emergence followed by imazethapyr @ 50 g a.i.//ha at 25-30 DAS; T_4-pendimethalin @ 750 g a.i.//ha as pre-emergence followed by imazethapyr @ 62.5 g a.i.// ha at 25-30 DAS; T_5-pendimethalin @ 750 g a.i.// ha as pre-emergence followed by imazethapyr @ 75 g a.i.//ha at 25-30 DAS; T_6-weed free (manual weeding) with four replications. Pre-sowing irrigation was followed by preparation of fine seed bed with 3-4 ploughings. The sowing of crop was done on 26.07.2018 on the beds prepared in east-west direction in 45×5 cm crop geometry with a seed rate of 25 kg/ha. Fertilizers were as applied as per recommendations of the Punjab Agricultural University, Ludhiana *i.e.,* urea @ 27.5 kg/ha, SSP @ 250 kg/ha as basal dose. Yield attributes like number of pods/plant, seeds/pod, pod length and 100 seed weight were measured by randomly selecting 5 plants from each experimental plot. All data were represented as average value of these 5 plants. Parameters like weed density and weed dry matter was recorded by collecting the weed samples from one m^2 area in each experimental unit, both before and 10d after post-emergence application of herbicide. Different indices like weed index, weed control efficiency were calculated as follows:

Weed control efficiency (WCE), which reflects per cent reduction in weed density by a treatment was determined using eq.1 (Nath *et al*, 2016) as

$$WCE(\%) = [\{(WPc - WPt)\ x100\}/WPc] \quad (1)$$

where, WP_c and WP_t are weed density in control and treated plots, respectively.

Weed control index (WCI), which reflects per cent reduction in weed dry weight by a treatment was determined using eq. 2 (Nath *et al*, 2016).

$$WCI(\%) = [\{(WDc - WDt)\ x100\}/WDc] \quad (2)$$

where, WD_c and WD_t are weed dry weights in control and treated plots, respectively. Treatment T_1 *i.e.* pendimethalin @ 750 g a.i./ha as pre-emergence was taken as control while calculation of weed control index and weed control efficiency.

Weed index (WI) is a measure of the efficacy of particular treatment in terms of yield output when compared with weed-free treatment. It reflects per cent yield loss due to a treatment was calculated using eq. 3 (Asres and Das, 2011).

$$WI\ (\%) = [(Ywf - Yt)/Ywf] \quad (3)$$

where, Y_{wf} and Y_t are wheat yields in weed-free and treatment, respectively.

Relative yield loss: Crop yield loss was calculated based on the maximum yield obtained from a treatment /treatment combination *i.e.* interaction as follows:

Relative yield loss (%)= [{(Ywf-Yt) /Ywf }*100]

Where, Ywf= yield of weed free, Yt = yield from a particular treatment.

RESULTS AND DISCUSSION

Weed density and dry matter

Scrutiny of data collected before herbicide application showed a non-significant difference in the herbicide treatments with respect to population of broad leaf, grassy weeds and sedges (Table 1). At the same time maintenance of weed free condition by manual weeding resulted in significant reduction in weed density of all weeds types. After spray, significantly lower density of broad leaf weeds (BLW) was recorded in weed free treatment as compared to rest of the treatments. Among herbicide treatments, post-emergence application of imazethapyr @ 75g a.i./ha recorded lowest

weed density which was statistically at par with post-emergence application of imazethapyr @ 62.5g a.i./ha but significantly different from other herbicide treatments. Furthermore, highest density of BLW was recorded where only pendimethalin was applied @ 750 g a.i./ha as pre-emergence application. Similar results were recorded in case of grassy weeds where lowest and significantly different weed population was observed in weed free treatment. Among chemical weed control treatments, lowest density of grassy weeds was observed when imazethapyr was applied @ 75g a.i./ha as post-emergence application which was statistically at par with post-emergence application of imazethapyr @ 62.5 g a.i./ha but differed significantly from rest of the herbicide treatments. Out of all the treatments, highest weed density was recorded in treatment where only pendimethalin was applied @ 750 g a.i./ha as pre-emergence application. Data pertaining to population of sedges revealed that weed free treatment had lowest density which significantly different from rest of the treatments. On the contrary, significantly higher weed population was recorded where pendimethalin was applied @ 750 g a.i./ha as pre-emergence as compared to other herbicide treatments. Among herbicide treatments, post-emergence application of imazethapyr @ 75 g a.i./ha after pre-emergence application of pendimethalin @ 750 g a.i./ha resulted in lowest density of sedges which was statistically at par with post-emergence application of imazethapyr @ 62.5g a.i./ha but significantly different from other chemical treatments. From the data it can be concluded that post-emergence application of imazethapyr @ 62.5 and 75 g a.i./ha after pre-emergence application of pendimethalin @ 750 g a.i./ha resulted in better control of all weed flora. Furthermore, application of imazethapyr @ 62.5g a.i./ha can be preferred over 75g a.i./ha which can decrease the quantity of herbicide use, chemical load on the environment and cost of production.

The perusal of the data (Table 2) recorded before spray showed that manual weeding resulted in significantly lower dry matter of all weed flora relative to rest of the treatments. Similar results were recorded after spray of herbicides where manual

Table 1.Weed density in different weed management practices in *kharif* greengram.

Sr. No.	Treatment	Weed density (m2)					
		Broad Leaf Weeds		Grassy Weeds		Sedges	
		Before spray	After spray	Before Spray	After Spray	Before Spray	After Spray
1	T1	11.08	10.89	7.26	8.23	8.17	9.59
2	T2	11.31	8.22	7.28	4.86	9.08	6.22
3	T3	10.26	6.93	6.37	3.35	8.56	6.09
4	T4	10.74	2.02	6.62	1.85	8.34	2.22
5	T5	11.50	1.83	7.24	1.79	8.56	2.10
6	T6	1.18	0.61	2.01	0.39	2.13	0.51
CD		1.48	0.75	1.08	0.44	1.47	0.61
CV		10.54	10.34	11.74	8.59	13.09	9.07

BLW: *Digra arvensis*, *Lepidium sativa, Trianthema portulacastrum, Euphorbia microphylla*

Grassy weeds: *Digitaria sanguinalis*, *Eleucine indica*, *Dactyloctenium aegyptiacum*

Sedges: *Cyperus rotundus*

Table 2. Dry matter of different weed flora in different practices in *kharif* greengram.

Sr. No.	Treatment	Weed dry matter (g/m2)					
		Broad Leaf Weeds		Grassy Weeds		Sedges	
		Before spray	After spray	Before Spray	After Spray	Before Spray	After Spray
1	T1	8.15	9.90	6.05	7.44	6.58	7.95
2	T2	9.02	7.22	5.09	4.62	6.22	5.58
3	T3	8.16	5.81	5.76	4.39	5.45	3.45
4	T4	8.51	1.79	5.72	1.22	5.24	2.46
5	T5	9.52	1.11	5.66	1.15	5.92	2.20
6	T6	0.20	0.10	0.39	0.18	0.21	0.10
CD		1.32	0.64	0.83	0.53	0.85	0.63
CV		12.04	9.32	11.59	11.15	11.49	11.47

weeding resulted in lowest dry matter of weed flora. At the same time, highest weed dry matter was reported in treatment where alone pendimethalin was applied as pre-emergence application @ 750 g a.i./ha. Out of herbicide treatments, post-emergence application of imazethapyr @ 75 g a.i./ha had lowest weed dry matter, irrespective of weed type, which was statistically at par with 62.5 g a.i./ha dose but significantly different from all other herbicide treatments. As both treatments including 62.5 and 75 g a.i./ha application of imazethapyr are statistically at par with each other so it can be worth to prefer 62.5 g a.i./ha which can have direct effect on cost of production. The results were in line with Komal *et al* (2015) who also reported significant decrease in weed density and dry matter with sequential application of pendimethalin and imazethapyr as compared to pendimethalin alone.

Weed indices

Data pertaining to weed indices (Table 3) showed highest value of weed index in treatment where only pendimethalin was applied as pre-emergence @ 725 g a.i./ha while lowest was recorded by weed free treatment. Among herbicide treatments, lowest value was recorded where imazethapyr was applied @ 62.5 g a.i./ha. Efficacy of any weed control practice is inversely proportional to weed index value which clearly indicates that post-emergence application of imazethapyr @ 62.5 g a.i./ha had better weed control as compared to other herbicide treatments. Furthermore, in all the weed types, highest weed control efficiency was recorded in weed free treatment followed by treatment where imazethapyr was applied @ 75g a.i./ha. At the same time, lowest weed control efficiency was observed when only pendimethalin was applied as pre-emergence @ 750g a.i./ha which shows better weed management when imazethapyr was applied as post-emergence @ 75g a.i./ha after the pre-emergence application of pendimethalin @ 750g a.i./ha. Computation of weed control index revealed highest weed control index in weed free treatment followed by treatment where imazethapyr was applied as post-emergence @ 75 g a.i./ha.

Yield and yield attributes

Number of pods/plant

The perusal of data on number of pods/plant (Table 4) revealed that weed free treatment had highest number of pods/plant (30.14) which was found statistically at par with post-emergence application of imazethapyr @ 62.5 and 75 g a.i./ha. Among herbicide treatments, highest number of pods/plant was recorded in treatment where imazethapyr was applied @ 62.5 g a.i./ha (29.43) followed by 75 g a.i./ha (28.26). Out of all the treatments, minimum number of pods/plant (20.81) was observed when alone pendimethalin was applied

Table 3. Weed indices as affected by weed management practices in *kharif* greengram.

Sr. No.	Treatment	Weed Index	Weed Control Efficiency (%)			Weed Control Index		
			BLW	Grassy Weeds	Sedges	BLW	Grassy Weeds	Sedges
1	T1	0.26	0.00	0.00	0.00	0.00	0.00	0.00
2	T2	0.19	24.03	40.94	35.11	0.27	0.38	0.30
3	T3	0.09	36.49	59.21	36.49	0.41	0.41	0.57
4	T4	0.04	81.29	77.50	76.84	0.82	0.84	0.69
5	T5	0.09	83.02	78.17	78.14	0.89	0.85	0.72
6	T6	0.00	94.36	95.32	94.77	0.99	0.98	0.99

@ 750 g a.i./ha as pre-emergence application. Higher number of pods in weed free treatment can be attributed to significantly lower weed density (Table 2), weed dry matter (Table 3), weed index (Table 4), highest weed control efficiency (Table 4) and weed control index (Table 4) as compared to other treatments. Also, maintenance of lowest weed density and weed dry matter, weed index and highest weed control efficiency and weed control index by post-emergence application of imazethapyr @ 62.5 and 75 g a.i./ha led to significantly higher number of pods/plant among herbicide treatments. Furthermore, data on pod length of greengram showed a gradual increase in pod length with increase in dose of imazethapyr but all treatments could not reach level of significance. Highest value of pod length (8.63 cm) was recorded in weed free treatment followed by post-emergence application of imazethapyr @ 75 g a.i./ha (8.52 cm).

Number of seeds/pod and seed yield

Data pertaining to number of seeds/pod and 100-seed weight showed a non-significant difference between all the treatments. Highest seed yield (11.10 q/ha) of greengram was observed in weed free treatment which was found statistically at par with post-emergence application of imazethapyr @ 62.5 g a.i./ha (10.63 q/ha). Furthermore, significantly lower seed yield (8.13 q/ha) was recorded when only pendimethalin was applied @ 750g a.i./ha. Among chemical treatments, highest seed yield was resulted by post-emergence application of imazethapyr @ 62.5g a.i./ha which was found statistically at par with imazethapyr @ 50 (10.05 q/ha) and 75 g a.i./ha (10.13 q/ha). Significantly higher seed yield in weed free can be attributed to significant increase in number of pods/plant. At the same time, higher number of pods in imazethapyr @ 62.5 and 75g a.i./ha resulted in better seed yield relative to single pre-emergence application of pendimethalin @ 750 g a.i./ha. It can be concluded that as post-emergence application of imazethapyr @ 62.5 g a.i./ha was statistically at par with weed free as well imazethapyr @ 75 g a.i./ha, so farmers can go for post-emergence application of imazethapyr @ 62.5 g a.i./ha after pre-emergence application of pendimethalin @ 750 g a.i./ha.

Furthermore, maintenance of weed free condition with manual weeding can also be omitted by farmers as it can lead to saving of time, capital and labour which can be utilized in other agricultural operations. Kaur *et al* (2016) also reported that imazethapyr alone and its premixes with pendimethalin and imazamox recorded effective control of mixed weed flora and produced significantly higher greengram seed yield. Data regarding relative yield loss (Table 5) showed that pre-emergence application of pendimethalin @ 750g a.i./ha recorded highest yield loss (26.44%) with respect to weed free treatment. At the same time, minimum loss of yield was observed in treatment where pre-emergence application of pendimethalin was followed by post-emergence application of imazethapyr @ 62.5g a.i./ha (4.04%). Data clearly depict an effective control of weeds

Table 4. Seed yield and yield attributes of *kharif* greengram under different weed management practices.

Sr. No.	Treatment	Pods/Plant	Pod Length (cm)	Seeds/Pod	100-Seed Weight (g)	Seed Yield (q/ha)	Relative Yield Loss (%)
1	T1	20.81	8.19	12.69	3.18	8.13	26.44
2	T2	23.84	8.35	13.25	3.27	9.18	19.34
3	T3	26.13	8.38	12.63	3.24	10.05	9.49
4	T4	29.43	8.52	12.75	2.94	10.63	4.04
5	T5	28.26	8.40	12.63	3.31	10.13	8.90
6	T6	30.14	8.63	13.00	3.33	11.10	0.00
CD		3.82	NS	NS	NS	0.98	--
CV		9.59	2.63	6.64	6.75	6.58	--

when imazethapyr is applied as post-emergence application after pre-emergence application of pendimethalin @ 750 g a.i./ha then when only pendimethalin is applied as pre-emergence.

CONCLUSION

Maintenance of weed free conditions by manual weeding resulted in lowest density an dry matter of all types of weed flora, weed index but highest weed control efficiency, weed control index, number of pods/plant and seed yield of greengram as compared to herbicide treatments. at the same data showed an effective control of weeds by post-emergence application of imazethapyr @ 62.5 and 75g a.i./ha which was clearly depicted by decreased weed density, weed dry matter, weed index and increased weed control efficiency and weed control index relative to other chemical treatments. As post-emergence application of imazethapyr @ 62.5g a.i./ha was statistically at par with weed free as well imazethapyr application @ 75 g a.i./ha, so farmers can go for post-emergence application of imazethapyr @ 62.5 g a.i./ha after pre-emergence application of pendimethalin @ 750 g a.i./ha. Furthermore, by this maintenance of weed free condition with manual weeding can also be omitted by farmers as it can lead to saving of time, capital and labour which can be utilized in other agricultural operations.

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