Indian Journal of Weed Science **47**(1): 38–42, 2015

Effect of herbicides on weeds growth and yield of greengram

Guriqbal Singh*, Harpreet Kaur, Navneet Aggarwal and Poonam Sharma
Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana, Punjab 141 004

Received: 14 January 2015; Revised: 11 March 2015

ABSTRACT

A field experiment was conducted during *Kharif* season of 2009 and 2010 to study t-he effect of pre- and post-emergence herbicides on weeds, growth, symbiotic traits and grain yield of greengram. Post-emergence application of imazethapyr at 75 g/ha 17 days after sowing was found to be effective for controlling sedges, grassy and broad-leaf weeds as well as in improving grain yield of greengram and net returns whereas imazethapyr at lower doses (25 and 40 g/ha), did not control weeds effectively. Weed free and two hand weeding treatments gave higher grain yield than the other treatments during both the year. Imazethapyr at 25, 40 and 75 g/ha and pendimethalin at 0.75 and 1 kg/ha had negative effect on different symbiotic parameters such as nodule number, dry weight and leghaemoglobin content as compared to two hand weeding.

Key words: Chemical control, Greengram, Imazethapyr, Nodulation, Weeds

Greengram [*Vigna radiata* (L.) Wilczek] is an important grain legume grown during *Kharif* season. It is threatened by luxuriant growth of weeds due to high monsoon rainfall and short stature of the crop.. Greengram is not very competitive against weeds and, therefore, weed control is essential 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 losses due to weeds ranged from 30 to 85% (Pandey and Mishra 2003, Raman and Krishnamoorthy 2005, Mirjha *et al*. 2013). Herbicides have also been reported for their negative effect on legume-*Rhizobium* interactions that either directly affect the rhizobial structure (Anderson *et al*. 2004) or indirectly reduce the photosynthate transport to symbiotic organ ''nodules'' for N_2 fixation (Ahemad and Khan 2011). Hence, the present study was done to see the effect of pre- and post-emergence herbicides on weeds, growth, symbiotic traits and grain yield of greengram.

MATERIALS AND METHODS

A field experiment was conducted during *Kharif* 2009 and 2010 at the research farm of Punjab Agricultural University, Ludhiana (30° 56'N, 72° 52'E, altitude 247 m), Punjab. Soil of the experimental site was loamy sand (80.3% sand, 14.3% silt and 5.4% clay), having pH 8.7, organic carbon 0.29%, available P 11.5 kg/ha and available K 410 kg/ha. A total of 68.8 cm (22 rainy days) and 45.4 cm (29 rainy days) rainfall was received during the crop growing season in 2009 and 2010, respectively (Fig. 1). Nine treatments (Table 1) were arranged in a randomized block design with three and four replications during 2009 and 2010, respectively. Imazethapyr was sprayed at 17 days after sowing (DAS) and pendimethalin as pre-emergence during both the year. These herbicides were sprayed using water 375 L/hectare with a knapsack sprayer fitted with a flat fan nozzle. In the case of two hand weeding, weeds were removed manually with a *khurpa* (hand tool) at 20 and 40 DAS. In case of unweeded check plots weeds were allowed during the whole crop growing season.

The crop was sown on 10 July, 2009 and 9 July, 2010. The sowing of cultivar '*PAU 911*' was done in rows 30 cm apart using a seed rate of 20 kg/ha. Each plot measured 6.0 m × 2.70 m in 2009 and 4.00 m × 2.10 m in 2010. The crop was harvested on 29 September, 2009 and 23 September, 2010.

Data on weed species count were recorded at 60 DAS from a randomly selected area measuring 50 × 50 cm from each plot and then converted to weed species count per m^2 area. Weed species after taking the weed count data were dried together plot-wise and the data converted to dry matter of weeds in kg/ha. Weed control efficiency (WCE), at harvest, was calculated as per standard formula.

Data on symbiotic parameter *viz*. number and dry weight of nodules and leghaemoglobin were recorded at 40 DAS. Five plants per plot were

***Corresponding author:** singhguriqbal@pau.edu

randomly selected for number and dry weight of nodules, and average was worked out. Leghaemoglobin content in nodules was determined (Wilson and Reisenauer, 1963) extracted with Drabkin's solution and absorbance of extract was read at 560 nm.

Observations on phytotoxic effects of herbicides were observed visually. At maturity, data on plant height, branches/plant and pods/plant were recorded from randomly selected five plants from each plot, and seeds/pod from randomly selected 20 pods. Biological yield and grain yield was recorded on the basis of whole plot area and converted into kg/ha. From the produce of each plot 100 seeds were taken for 100-seed weight data. Harvest index (HI) was also calculated.

RESULTS AND DISCUSSION

Effect on weeds

The major weed flora was *Cyperus rotundus* (nut grass), *Eleucine aegyptiacum* (crow foot grass), *Trianthema portulacastrum* (horse purslane) and *Commelina benghalensis* (day flower) during 2010 (Table 1). At 60 DAS, weedy check recorded the highest weed density of *Cyperus rotundus, Trianthema portulacastrum* and *Commelina benghalensis,* whereas hand weeding recorded the lowest number of weeds followed by imazethapyr 5 g/ha. In general, the post-emergence herbicide, imazethapyr 75 g/ha controlled the weeds more effectively than pendimethalin at different rates of application. Similarly, lowest dry matter of weeds was found in two hand weeding and imazethapyr 75 g/ha.

During both the year, dry matter of weeds was the highest in weedy check at harvest. Lowest weed dry matter was observed in two hand weeding, which was at par with application of imazethapyr 75 g/ha in 2009 (Table 2). Dry matter of weeds was higher during 2010, which might be due to change in site which had higher weed seed bank and more rainy days during the crop growth period (Fig. 1).

Amongst herbicide treatments in 2009, imazethapyr 75 g/ha recorded lowest dry matter of weeds followed by pendimethalin 1.00 kg/ha, whereas in 2010, pendimethalin 0.45 kg/ha as pre-emergence + one hand weeding had the lowest dry matter of weeds followed by post-emergence herbicide imazethapyr 75 g/ha. Imazethapyr has been reported to provide effective control of weeds in greengram (Singh *et al*. 2014a), blackgram (Aggarwal *et al*. 2014) and lentil (Singh *et al*. 2014b). Weed free recorded the highest weed control efficiency. Two hand weeding recorded the highest weed control efficiency in both the year, followed by imazethapyr 75 g/ha in 2009 and pendimethalin 0.45 kg/ha + hand weeding 30 DAS and imazethapyr 75 g/ha. in 2010 due to lower dry matter of weeds.

Symbiotic parameters

In 2009, number of nodules/plant was significantly higher in weed free than other treatments

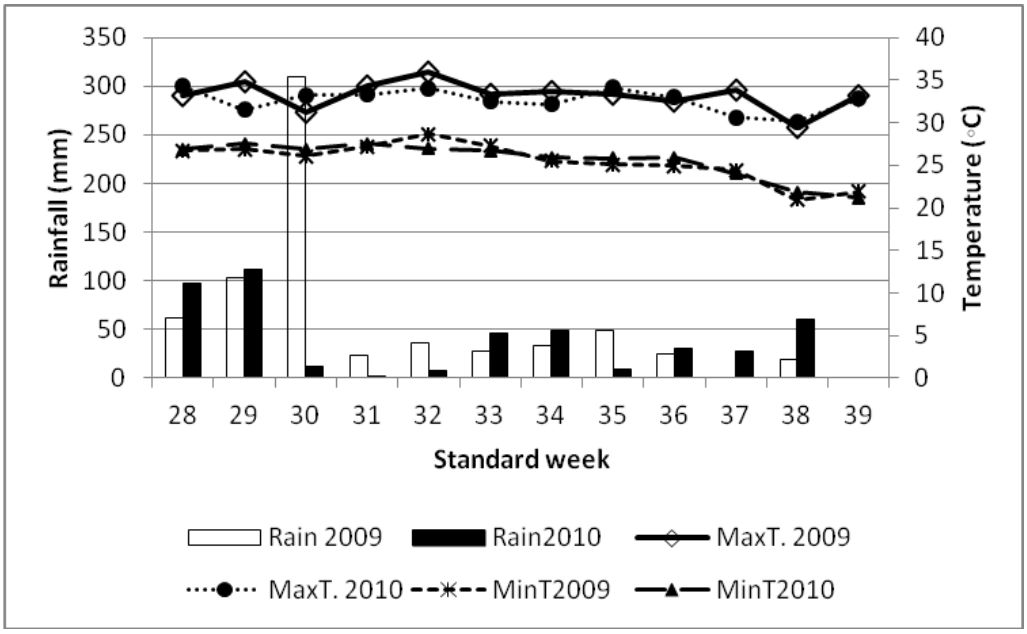

Fig. 1. Weekly mean weather conditions of maximum temperature, minimum temperature and rainfall in 2009 and 2010 during the greengram crop season

Table 1. Population of different weed species and dry matter of weeds as affected by different weed control treatments in greengram at 60 DAS during *Kharif* 2010

Treatment	No. of weeds/m^{2*}				Dry matter of weeds* (kg/ha)
	Cyperus rotundus	*Eleucine aegyptiacum*	*Trianthema portulacastrum*	*Commelina benghalensis*	
Hand weeding (HW) at 20 and 40 DAS	4.9 (24)	1.0 (0)	1.0 (0)	1.0 (0)	16.7 (280)
Pendimethalin 0.45 kg/ha + HW at 30 DAS	5.8 (34)	2.9 (8)	1.0 (0)	1.0 (0)	21.4 (460)
Pendimethalin 0.75 kg/ha	5.7 (32)	3.6 (16)	1.3 (1)	2.1 (4)	23.2 (540)
Pendimethalin 1.00 kg/ha	6.5 (45)	2.3 (7)	1.8 (3)	1.8 (3)	560 (23.6)
Imazethapyr 25 g/ha	4.9 (25)	6.5 (44)	2.3 (5)	1.8 (3)	19.2 (370)
Imazethapyr 40 g/ha	5.9 (35)	4.9 (26)	1.6 (2)	1.6 (2)	18.1 (330)
Imazethapyr 75 g/ha	3.4 (17)	3.0 (10)	1.3 (1)	1.0 (0)	16.7 (280)
Weedy check	7.9 (63)	5.6 (31)	4.0 (16)	3.0 (9)	50.4 (2550)
Weed free	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)
LSD(P=0.05)	(1.7)	(1.9)	(1.1)	(NS)	(3.0)

*Values are square root transformed ($\sqrt{x+0.5}$), original value mentioned in parentheses

Table 2. Dry matter of weeds and weed control efficiency at harvest as influenced by different weed control treatments in greengram

Treatment	Dry matter of weeds* (kg/ha)		Weed control efficiency (%)	
	2009	2010	2009	2010
Hand weeding (HW) at 20 and 40 DAS	24.3(593)	18.9(357)	75.2	92.7
Pendimethalin 0.45 kg/ha+ HW at 30 DAS	30.1(907)	35.7(1279)	61.8	74.0
Pendimethalin 0.75 kg/ha	31.3(981)	52.5(2767)	59.3	43.6
Pendimethalin 1.00 kg/ha	28.8(833)	55.2(3065)	65.5	37.6
Imazethapyr 25 g/ha	45.7(2092)	64.0(4107)	12.4	16.4
Imazethapyr 40 g/ha	35.6(1277)	59.7(3571)	46.4	27.3
Imazethapyr 75 g/ha	25.8(667)	51.7(2678)	72.2	45.5
Weedy check	48.8(2388)	70.0(4910)	-	-
Weed free	1.0(0)	1.0(0)	100	100
LSD (P=0.05)	(1.7)	(4.1)		

*Values are square root transformed $\sqrt{x+0.5}$, original value mentioned in parentheses

which was, however, at par with two hand weedings (20 and 40 DAS). The parameters significantly reduced with imazethapyr application at different doses during both the years (Table 3). Hand weeding recorded maximum nodule dry weight during both the year. In 2009, leghaemoglobin content was significantly higher under weed free which was at par to hand weeding and pendimethalin 0.45 kg/ha. + HW at 30 DAS whereas, in 2010, leghaemoglobin content was significantly higher under hand weeding which was statistically at par with weed free treatment. In 2010, number of nodules was low but bold in size and effective as reflected in their dry weight and leghaemoglobin content. It was found that imazethapyr 40 and 75 g/ha had negative effect on different symbiotic parameters like nodule number, dry weight and leghaemoglobin content. *Rhizobium* infects plant roots through root hairs and thus it was hypothesized that herbicides affecting root hair development might interfere with nodulation. Ahmad and Khan (2010) also reported negative effects of quizalafop-p-ethyl and clodinafop on growth, symbiosis, grain yield, and nutrient uptake by greengram plants and their effects enhanced gradually with the increase in dose of herbicides.

Effect on crop

Weed control treatments significantly influenced plant height, branches/plant, pods/plant, seeds/pod and 100-seed weight (Table 4). In general, these plant growth and yield attributes were superior in the case of weed free, hand weeding, pendimethalin 0.45 kg/ha. + HW at 30 DAS and imazethapyr 75 g/ha treatment.

The biological yield was recorded as highest in weed free followed by two hand weeding, which was significantly higher than other treatments. Similarly, weed free followed by two hand weeding registered the highest grain yield, which was significantly higher than other treatments in 2010 but at par with imazethapyr 75 g/ha in 2009 (Table 5). Imazethapyr when applied at lower dose (25 and 40 g/ha.) was

Table 3. Symbiotic parameters as influenced by different weed control treatments in greengram at 40 DAS

Treatment	Number of nodules/ plant		Dry weight of nodules (mg/plant)		Leghaemoglobin content (mg/g fresh weight of nodules)	
	2009	2010	2009	2010	2009	2010
Hand weeding (HW) at 20 and 40 DAS	29.7	25.3	55.3	49.5	1.95	1.70
Pendimethalin 0.45 kg/ha+ HW at 30 DAS	27.0	25.0	50.5	47.3	1.89	1.60
Pendimethalin 0.75 kg/ha	26.3	24.0	49.0	45.8	1.72	1.54
Pendimethalin 1.00 kg/ha	25.7	23.7	48.5	45.0	1.68	1.51
Imazethapyr 25 g/ha	25.7	22.3	48.5	45.3	1.65	1.50
Imazethapyr 40 g/ha	23.3	21.7	45.5	42.1	1.58	1.47
Imazethapyr 75 g/ha	22.0	21.0	44.0	40.0	1.56	1.46
Weedy check	26.3	29.7	47.8	45.3	1.70	1.52
Weed free	30.3	23.8	52.7	48.8	1.99	1.68
LSD (P=0.05)	1.7	0.5	0.7	0.5	0.11	0.06

Table 4. Plant growth and yield attributes of greengram as influenced by weed control treatments

Treatment	Plant height (cm)		Branches/ plant		Pods/plant		Seeds/pod		100-seed weight (g)	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Hand weeding (HW) at 20 and 40 DAS	71.4	58.6	5.53	5.20	27.9	21.8	11.9	12.0	3.07	3.45
Pendimethalin 0.45 kg/ha+ HW at 30 DAS	67.2	57.7	5.53	4.55	22.9	19.1	11.0	11.2	2.97	3.37
Pendimethalin 0.75 kg/ha	57.9	53.9	4.87	4.75	21.1	17.2	10.8	11.5	3.00	3.22
Pendimethalin 1.00 kg/ha	60.2	59.3	5.73	4.65	25.3	16.5	11.4	11.1	3.00	3.25
Imazethapyr 25 g/ha	63.4	55.7	6.27	4.45	12.7	8.6	10.0	11.1	2.73	3.50
Imazethapyr 40 g/ha	67.0	48.3	6.13	4.70	18.1	13.4	10.2	10.7	2.90	3.42
Imazethapyr 75 g/ha	57.1	55.7	5.80	4.60	25.5	18.1	10.9	11.1	2.73	3.25
Weedy check	68.0	51.1	4.40	3.85	17.6	8.7	10.3	10.8	2.53	3.17
Weed free	67.7	61.3	6.00	5.55	29.1	25.5	11.2	12.4	3.13	3.70
LSD (P=0.05)	4.9	4.22	0.51	0.66	3.2	2.56	1.0	1.04	0.19	0.31

Table 5. Grain yield, biological yield and harvest index of greengram as influenced by weed control treatments

Treatment	Grain yield (t/ha)		Biological yield (t/ha)		Harvest index (%)	
	2009	2010	2009	2010	2009	2010
Hand weeding (HW) at 20 and 40 DAS	1.58	1.40	5.88	6.43	26.88	21.75
Pendimethalin 0.45 kg/ha+ HW at 30 DAS	1.31	1.28	5.53	5.89	23.67	21.71
Pendimethalin 0.75 kg/ha	1.28	0.96	5.23	5.50	24.53	17.51
Pendimethalin 1.00 kg/ha	1.46	0.85	5.93	4.97	24.59	17.06
Imazethapyr 25 g/ha	0.72	0.41	3.06	2.83	23.39	14.47
Imazethapyr 40 g/ha	1.06	0.67	4.05	3.54	26.20	18.89
Imazethapyr 75 g/ha	1.48	1.13	5.18	5.53	28.56	20.42
Weedy check	0.76	0.33	2.96	2.41	25.82	13.86
Weed free	1.68	1.61	6.32	6.64	26.56	24.22
LSD (P=0.05)	0.18	0.15	0.82	0.68		

ineffective in controlling weeds and improving the productivity of greengram. However, imazethapyr 75 g/ha was found to be effective for controlling sedges, grassy and broad-leaf weeds as well as in improving grain yield of greengram than at lower doses due to its high weed control efficiency (Table 2). Harvest index was recorded maximum in imazethapyr 75 g/ha (28.5%) in 2009 and in weed free treatment (24.2%) in 2010.

Imazethapyr at high dose (75 g/ha) not only controlled the weeds effectively but also improved grain yield of greengram as a post-emergence herbicide. Similarly, imazethapyr 90 g/ha. at 21 or 28 DAS has been reported to provide effective control of weeds in blackgram (Veeraputhiran *et al*. 2008). The grain yield was lower in 2010 than in 2009 due to heavy incidence of weeds causing more crop-weed competition and reduced crop yield.

Table 6. Economics of greengram as influenced by weed control treatments

Treatment	Gross returns (x10^3 `/ha)		Net returns (x10^3 `/ha)		B:C ratio	
	2009	2010	2009	2010	2009	2010
Hand weeding (HW) at 20 and 40 DAS	69.52	61.51	50.82	42.81	3.72	3.29
Pendimethalin 0.45 kg/ha+ HW at 30 DAS	57.60	56.28	40.76	39.44	3.42	3.34
Pendimethalin 0.75 kg/ha	56.50	42.42	41.85	27.77	3.86	2.90
Pendimethalin 1.00 kg/ha	64.11	37.31	49.14	22.35	4.28	2.49
Imazethapyr 25 g/ha	31.50	18.00	17.35	3.85	2.23	1.27
Imazethapyr 40 g/ha	46.68	29.44	32.23	14.99	3.23	2.04
Imazethapyr 75 g/ha	65.16	49.72	49.96	34.52	4.29	3.27
Weedy check	33.66	14.70	19.96	1.00	2.46	1.07
Weed free	73.88	70.71	53.93	50.76	3.70	3.54

Economics of different weed control treatments (Table 6) showed that weed free treatment gave the maximum gross returns and net returns. Among herbicides, high gross returns, net returns and B:C ratio were obtained in imazethapyr 75 g/ha followed by pendimethalin 1.00 kg/ha in 2009 whereas in 2010, pendimethalin 0.45 kg/ha. + hand weeding at 30 DAS gave the maximum gross returns and net returns followed by imazethapyr 75 g/ha.

It was concluded that imazethapyr 75 g/ha as post-emergence herbicide was found to be effective for controlling sedges, grassy and broadleaf weeds as well as in improving grain yield of greengram when there was scarcity of labour.

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**: 421-426.

Ahemad M and Khan MS. 2010. Phosphate-solubilizing and plant growth promoting *Pseudomonas aeruginosa* PS 1 improves greengram performance in quizalofop-p-ethyl and clodinafop amended soil. *Archives Environmental Contamination and Toxicology* **58**: 361-72.

Ahemad M and KhanM S. 2011. Effect of pesticides on plant growth promoting traits of greengram-symbiont, *Bradyrhizobium* sp. strain MRM 6.*Bulletin of Environmental Contamination and Toxicology* **86**: 384-88.

Anderson A, Baldock JA, Rogers SL, Bellotti W and Gill G. 2004. Influence of chlorsulfuron on rhizobial growth, nodule formation, and nitrogen fixation with chickpea. *Australian Journal of Agricultual Research* **55**: 1059-1070.

Mirjha PR, Prasad SK, Singh MK, Paikra RH, Patel S and Majumdar M. 2013. Effect of weed control measures on weeds, nodulation, growth and yield of greengram (*Vigna radiata*). *Indian Journal of Agronomy* **58**: 615-617.

PandeyJ and Mishra BN. 2003. Effect of weed management practices in a rice-mustard-greengram cropping system on weeds and yield of crops. *Annals of Agricultural Research* **24**: 737-742.

Raman R and Krishnamoorthy R. 2005. Nodulation and yield of greengram {(*Vigna radiata* (L.)} influenced by integrated weed management practices. *Legume Reseach* **28**: 128-130.

Singh H, Agarwal N and Ram H. 2014a. Efficacy of post-emergence herbicide imazethapyr for weed anagement in different greengram (*Vigna radiata*) cultivars. *Indian Journal of Agricultural Science* **84**: 540-543.

Singh G, Kaur H and Khanna V. 2014b. Weed management in lentil with post-emergence herbicides. *Indian Journal of Weed Science* **46**:187-189.

Veeraputhiran R, Srinivasan S and Chinnusamy C. 2008. Evaluation of post emergence herbicide and its time of application on blackgram under rice fallow condition. *Madras Agricultural Journal* **95**: 376-379.

Wilson DO and Reisenauer HM. 1963. Determination of leghaemoglobin in legume nodules. *Annals of Biochemistry* **6**: 27-30.