Indian Journal of Weed Science **48**(3): 336–338, 2016
DOI: 10.5958/0974-8164.2016.00085.X

Short communication

Integration of pre- and post-emergence herbicides for weed management in pigeonpea

Guriqbal Singh*, Harpreet Kaur and Veena Khanna
Punjab Agricultural University, Ludhiana, Punjab 141 004

Received: 23 July 2016; Revised: 28 August 2016

Key words: Net returns, Nodulation, Paraquat, Pendimethalin, Pigeonpea, Post-emergence

Pigeonpea is an important pulse crop of India. During 2012-13, it was cultivated in an area of 3.69 million hectares with a production of 2.75 million tonnes and productivity of 753 kg/ha (Indiastat 2014). Pigeonpea is a long duration and widely spaced row crop having slow initial growth rate. The crop canopy does not cover the inter row space during initial phase of growth due to which weeds compete with pigeonpea for available moisture, nutrients and light. The crop suffers from early weed infestation. Therefore, it is necessary to keep the crop weed-free during the early growth period (4-6 weeks). In pigeonpea, weeds cause yield reduction up to 80% (Talnikar *et al.* 2008). Only pre-emergence herbicides are available for weed control in pigeonpea. Among the pre-emergence herbicides, pendimethalin has been found promising in controlling weeds and improving grain yield (Reddy *et al.* 2007, Singh *et al.* 2010a, Singh *et al.* 2010b). However, it is effective only up to about a month and thereafter weeds may pose a problem. Furthermore, weeds emerge in different flushes due to rainy season. Also, one of the important benefits of growing any legume crop is its ability to fix atmospheric nitrogen to plant usable forms, thus, it becomes imperative to assess any possible effects of herbicide application on its symbiotic efficiency. So, there was a need to study the effect of integrated use of pre-emergence and post-emergence herbicides in pigeonpea.

A field experiment was conducted during *Kharif* 2011 at the research farm of Punjab Agricultural University, Ludhiana (30° 56'N, 72° 52'E, altitude 247 m), Punjab. The soil of the experimental site was loamy sand, having pH 8.7, organic carbon 0.29%, available P 11.5 kg/ha and available K 410 kg/ha. Eight treatments (Table 1) were arranged in a randomized block design with three replications. Pendimethalin was sprayed as pre-emergence and paraquat at 6, 8 and 10 weeks after sowing (WAS). These herbicides were sprayed using 375 litre of water per hectare with a knapsack sprayer fitted with a flat fan nozzle. Paraquat was applied between pigeonpea rows as directed spray on weeds only using a plastic hood to avoid any herbicide drift on the crop plants. In the case of two hand weedings, weeds were removed manually with a 'khurpi' (a small tool to remove weeds manually) at 25 and 50 days after sowing (DAS). In unweeded check plots, weeds were allowed during the whole crop growing season.

After pre-sowing irrigation the field was ploughed twice followed by planking at optimum soil moisture. The crop was sown on 14 June 2011. The sowing of variety *'PAU 881'* was done in rows 50 cm apart using a seed rate of 15 kg/ha. The crop was harvested on 28 October, 2011. The crop was raised with recommended package of practices (PAU 2011).

Nodule number was recorded by uprooting five randomly selected plants from each plot at flowering stage. The roots were gently washed and nodule number recorded, the nodules were then carefully detached and dried to constant weight at 60° C in an oven and dry weight recorded. 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. From the produce of each plot, 100 seeds were taken for 100-seed weight data. At harvest, weeds from the whole plot were harvested, dried and data converted into t/ha. Weed control efficiency (WCE) at harvest was calculated as per standard formula.

Gross returns, net returns as well as benefit : cost (B:C) ratio were also worked out using prevailing prices of inputs and output. Data were subjected to analysis of variance (ANOVA) in a randomized block design as per the standard procedure.

The predominant weed flora in the field were *Commelina benghalensis* (day flower), *Trianthema portulacastrum* (horse purslane), *Euphorbia hirta*

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

(snake weed), *Digitaria* spp. (crab grass), *Dactyloctenium aegyptiacum* (crow foot grass) and *Cyperus rotundus* (nut grass).

Paraquat controlled all weed species whereas pendimethalin controlled all other weed species except *Commelina benghalensis* and *Cyperus rotundus*. Unweeded control plot recorded the highest dry matter of weeds, which was reduced drastically by all other treatments (Table 1). Pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha 6 WAS recorded the lowest dry matter of weeds, followed by pendimethalin 0.45 kg/ha (PE) + hand weeding 50 DAS and pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha 8 WAS. The sole application of pendimethalin as pre-emergence at 0.45 or 0.75 kg/ha was less effective in controlling weeds and improving grain yield, as also reported in earlier studies (Singh and Sekhon 2013). Two hand weedings at 25 and 50 DAS recorded the highest weed control efficiency (86.6%) followed by pendimethalin + paraquat 0.48 kg/ha 6 WAS (85.9%). In pigeonpea, effective weed control has been reported with integrated use of pendimethalin and hand weeding (Rao *et al.* 2003, Shinde *et al*. 2003, Tomar *et al.* 2004, Singh and Sekhon 2013).

Higher nodule number and dry weight was recorded with treatments of integrated use of pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha (8 and 10 WAS), pendimethalin 0.45 kg/ha (PE) + hand weeding 50 DAS, and pendimethalin 0.75 kg/ha (PE). All the treatments significantly enhanced nodule biomass, which is indicative of nodule efficiency. These observations were in accordance with earlier studies (Khanna *et al.* 2012) where no apparent adverse effect of pendimethalin on *Rhizobium* growth was observed under laboratory conditions. Paraquat was found to effect *Rhizobium* growth under in vitro conditions, however, since nodule initiation starts early, so application of paraquat at 8 and 10 WAS, did not hinder nodulation. All the weed control treatments did not affect plant biomass which was more than weedy check, this may be due to effective weed control effected by these treatments.

Integrated use of pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha at 6 WAS, pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha at 8 WAS and pendimethalin 0.45 kg/ha (PE) + hand weeding at 50 DAS recorded plant height and branches/plant statistically at par with those in two hand weedings at 25 and 50 DAS (Table 1). Pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha at 6 WAS and pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha at 8 WAS recorded significantly higher pods/plant than other treatments except two hand weedings at 25 and 50 DAS. The seeds/pod and 100-seed weight were not influenced significantly by different weed control treatments.

Hand weeding at 25 and 50 DAS recorded the highest biological yield and pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha 6 WAS recorded the highest grain yield (Table 2). The integrated use of pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha at 6 WAS, pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha at 8 WAS and pendimethalin 0.45 kg/ha as pre-emergence (PE) + hand weeding at 50 DAS recorded biological yield and grain yield statistically similar to that in two hand weedings at 25 and 50 DAS and pendimethalin 0.75 kg/ha (PE). Higher yield

Table 1. Dry matter of weeds, weed control efficiency, plant characters and yield attributes of pigeonpea as influenced by different weed control treatments

Treatment	Dry matter of weeds (kg/ha)	Weed control efficiency (%)	Number of nodules /plant	Nodule dry weight (mg/plant)	Plant dry weight (g/plant)	Plant height (cm)	Branches/ plant	Pods/ plant	Seeds/ pod	100-seed weight (g)
Pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha (6WAS)	361	85.9	6.8	48.6	9.6	189.9	16.7	201.8	4.1	6.67
Pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha (8WAS)	448	82.6	8.0	54.6	9.8	187.2	15.7	194.7	4.1	6.40
Pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha (10WAS)	1010	60.7	8.0	51.3	9.5	180.9	13.9	163.6	3.9	6.27
Pendimethalin 0.45 kg/ha as pre-emergence (PE)	1429	44.4	7.7	51.3	9.2	187.7	14.0	168.4	4.1	6.50
Pendimethalin 0.45 kg/ha (PE) + HW at 50 DAS	400	84.4	7.8	53.3	9.5	189.0	17.2	184.1	4.1	6.47
Pendimethalin 0.75 kg/ha (PE)	743	71.1	7.5	52.0	10.3	187.5	15.7	185.1	4.1	6.27
Hand weeding at 25 and 50 DAS	343	86.6	8.0	50.6	8.7	191.9	17.7	193.5	4.3	6.80
Weedy check	2571	-	4.2	42.6	8.2	147.7	12.1	145.0	3.9	6.47
LSD (P=0.05)	170		2.2	6.0	NS	5.8	2.6	14.1	NS	NS

Table 2. Yield, harvest index and economics of pigeonpea as influenced by different weed control treatments

Treatment	Biological yield (t/ha)	Grain yield (t/ha)	Harvest index (%)	Gross returns (x10^3 Rs/ha)	Net returns (x10^3 Rs/ha)	B:C ratio
Pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha (6 WAS)	8.12	1.57	19.38	67.64	51.73	3.25
Pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha (8 WAS)	7.68	1.55	20.14	66.52	50.62	3.18
Pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha (10 WAS)	6.52	1.20	18.40	51.60	35.69	2.24
Pendimethalin 0.45 kg/ha as pre-emergence (PE)	6.67	1.25	18.79	53.88	38.60	2.53
Pendimethalin 0.45 kg/ha (PE) + HW at 50 DAS	8.06	1.49	18.53	64.20	44.29	2.23
Pendimethalin 0.75 kg/ha (PE)	7.25	1.39	19.14	59.64	43.69	2.74
Hand weeding (HW) at 25 and 50 DAS	8.26	1.52	18.40	65.36	41.51	1.74
Weedy check	5.65	0.91	16.05	39.00	24.40	1.67
LSD (P=0.05)	1.06	0.25	-	-	-	-

in these treatments was due to better control of weeds. Similar results were reported by Padmaja *et al.* (2013). In case of pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha at 10 WAS, the grain yield was quite low. This might be due to result of delayed application of paraquat (10 WAS) as by that time weeds might had adversely affected the growth of the crop.

The maximum harvest index was obtained with the application of pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha at 8 WAS followed by pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha at 6 WAS (Table 2). The maximum gross returns (` 67639/ha), net returns (` 51734/ha) and B:C ratio (3.25) were obtained with the integrated use of pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha at 6 WAS followed by pendimethalin 0.45 kg/ha (PE) + paraquat 0.48 kg/ha at 8 WAS.

SUMMARY

A field experiment was conducted at Punjab Agricultural University, Ludhiana to study the effect of integrated use of pre-emergence herbicide pendimethalin and post-emergence herbicide paraquat on weeds, growth and yield of pigeonpea. Paraquat should be applied between pigeonpea rows as directed spray on weeds only using a plastic hood to avoid any herbicide drift on the crop plants. Pre-emergence application of pendimethalin 0.45 kg/ha followed by paraquat 0.48 kg/ha at 6-8 weeks after sowing effectively controlled the weeds, improved the grain yield of pigeonpea and also provided the high returns. Herbicides did not advesely affect nodule number and nodule dry weight, indicating their safe use under field conditions.

REFERENCES

Indiastat. 2014. http//=www.indiastat.com

Khanna V, Singh G, Sharma P and Kaur H. 2012. Influence of herbicides on *Rhizobium* growth and its symbiosis with pigeonpea. *Trends in Bioscience* **5**(2): 133-135.

Padmaja B, Reddy MM and Reddy DVV. 2013. Weed control efficiency of pre- and post-emergence herbicides in pigeonpea (*Cajanus cajan* L.). *Journal of Food Legumes* **26**: 44-45.

PAU. 2011. *Package of Practices for Crops of Punjab, Kharif 2011*. Punjab Agricultural University, Ludhiana, India.

Rao MM, Ramalakshmi D, Khan MM, Sree SP and Reddy MV. 2003. Effect of integrated weed management in post-rainy season pigeonpea + mungbean intercropping system in vertisols. *Indian Journal of Pulses Research* **16**: 112-115.

Reddy MM, Vilatha AM and Rao LJ. 2007. Integrated weed management in pigeonpea (*Cajanus cajan*)-soybean (*Glycine max*) intercropping system on Vertisol under rainfed conditions. *Indian Journal of Agricultural Sciences* **77**: 177-178.

Shinde SH, Pawar VS, Suryawanshi GB, Ahire NR and Surve US. 2003. Integrated weed management studies in pigeonpea+pearl millet intercropping (2:2) system. *Indian Journal of Weed Science* **35**: 90-92.

Singh G, Aggarwal N and Ram H. 2010a. Effect of row spacing and weed management practices on weeds, growth and yield of pigeonpea [*Cajanus cajan* (L.) Millsp.]. *Indian Journal of Weed Science* **42**: 241-243.

Singh G, Ram H, Sekhon HS, Aggarwal N, Buttar GS, Singh K, Kaur H and Khanna V. 2010b. Bioefficacy of pendimethalin for the control of weeds in pigeonpea [*Cajanus cajan* (L.) Millsp.]. *Journal of Research Punjab Agricultural University* **47**(3&4): 121-126.

Singh G and Sekhon HS. 2013. Integrated weed management in pigeonpea [*Cajanus cajan* (L.) Millsp.]. *World Journal of Agricultural Sciences* **9**: 86-91.

Talnikar AS, Kadam GL, Karande DR and Jogdand PB. 2008. Integrated weed management in pigeonpea [*Cajanus cajan* (L.) Millsp.]. *International Journal of Agricultural Science* **4**: 363-370.

Tomar J, Singh HB, Vivek and Tripathi SS. 2004. Integrated weed management in intercropping of mungbean (*Vigna radiata*) and cowpea fodder (*Vigna unguiculata*) with pigeonpea (*Cajanus cajan*) under western U.P. condition. *Indian Journal of Weed Science* **36**: 133-134.