Indian Journal of Weed Science **50**(2): 182–185, 2018

Print ISSN 0253-8040 Online ISSN 0974-8164

Efficacy of post-emergence herbicides for weed control in soybean

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Article information

DOI: 10.5958/0974-8164.2018.00043.6

Type of article: Research note

Received : 4 May 2018
Revised : 15 June 2018
Accepted : 17 June 2018

Key words
Leghaemoglobin content
Nodulation
Post-emergence herbicides
Soybean
Weeds

ABSTRACT

A field experiment was conducted at Punjab Agricultural University, Ludhiana to study the efficacy of post-emergence herbicides for weed control in soybean. The herbicides (pendimethalin, imazethapyr, imazethapyr + imazamox and quizalofop-p-ethyl) did not show any significant adverse effects on the number, dry weight and leghaemoglobin content of nodules. Application of pendimethalin 0.45 kg/ha as pre-emergence (PE) + hand weeding (HW) at 40 days after sowing (DAS) recorded significantly higher seed yield than other treatments, however, it was at par with two hand weeding. Among the herbicides, imazethapyr at 75 g/ha applied at 3 weeks after sowing (WAS) recorded significantly higher seed yield than pendimethalin 0.45 kg/ha (PE) and weedy check and was at par with imazethapyr + imazamox 70 g/ha and quizalofop-p-ethyl 50 g/ha applied at 3 WAS. Application of pendimethalin 0.45 kg/ha (PE) + HW at 40 DAS provided the highest net returns (` 49496/ha) followed by two hand weedings. However, application of post-emergence herbicides imazethapyr at 75 g/ha and imazethapyr + imazamox 70 g/ha at 3 WAS were found promising in controlling weeds, providing optimum seed yield and higher B:C ratio. In case of scarcity of labour, post-emergence herbicides can play an important role in controlling weeds effectively.

Soybean [*Glycine max* (L.) Merrill] is an important oilseed crop grown globally. Weeds are one of the most limiting factors in successful soybean production. Due to monsoon rainfall in rainy season, weeds grow luxuriantly and their management is very critical factor for the successful production of soybean. Weeds compete for nutrients, water, light and space with crop during early growth period. Raising of soybean requires a lot of labour due to more weeds and farmers generally are not able to harvest profitable yields. Weeds can cause significant seed yield losses in soybean (Jha *et al.* 2014, Singh *et al.* 2014).

Due to involvement of high cost and scarcity of labour for manual weeding, there is a need of application of pre- and post-emergence herbicides in soybean for effective weed control. Mostly farmers are using pendimethalin as pre-emergence herbicide for controlling weeds in soybean. But the application window of pre-emergence herbicides is narrow. Therefore, there was a dire need to explore the possibility of post-emergence herbicides for effective control of weeds.

A field experiment was conducted during rainy season of 2016 at Punjab Agricultural University, Ludhiana (30° 54' N, 75° 48' E, altitude 247 m). The soil of the experimental site was loamy sand, having pH 7.5, organic carbon 0.36%, available P 24.0 kg/ha and available K 150 kg/ha. A total 496.1 mm (22 rainy days) rainfall was received during the crop growing season. The objective was to study the efficacy of post-emergence herbicides namely pre-mix of imazethapyr + imazamox, imazethapyr and quizalofop-p-ethyl against different weeds and their effect on the growth, nodulation and seed yield of soybean. Seven treatments, *viz.* pendimethalin 0.45 kg/ha as pre-emergence (PE), pendimethalin 0.45 kg/ha (PE) + hand weeding (HW) at 40 days after sowing (DAS), imazethapyr 75 g/ha 3 WAS, imazethapyr + imazamox 70 g/ha at 3 WAS, quizalofop-p-ethyl 50 g/ha at 3 weeks after sowing (WAS), two hand weeding at 20 and 40 DAS and weedy check were evaluated in a randomized complete block design with three replications. Post-emergence herbicides and pendimethalin as pre-emergence (within 24 hours of sowing) were applied

with a knapsack sprayer fitted with a flat fan nozzle using 375 litres of water per hectare. In case of two hand weeding, weeds were removed manually at 20 and 40 DAS. In weedy check, weeds were allowed to grow during the whole crop growing season. The preceding crop was wheat. After pre-sowing irrigation, at optimum soil moisture, the field was ploughed twice followed by planking. The crop was sown on 11 June, 2016. The sowing of soybean variety '*SL 958*' was done in rows 45 cm apart using a seed rate of 75 kg/ha. The gross plot size was 6.0 m × 2.25 m. The crop was harvested on 3 November, 2016.

Data on weed species count were recorded randomly from each plot at 40 and 70 DAS by using a quadrate of size 50 × 50 cm and then converted to weed species count per m^2. At harvest, weeds from the whole plot were harvested, dried and data were converted to kg/ha. Data on symbiotic parameter, *viz*. number and dry weight of nodules were assessed at 80 DAS. Five plants per plot were randomly selected for number and dry weight of nodules, and then average was worked out. Leghaemoglobin content in nodules was determined at 80 DAS with the method described by Wilson and Reisenauer (1963). At maturity, data on plant height and pods/plant were recorded from randomly selected five plants from each plot. Biological yield and grain yield were recorded on the basis of whole plot area and converted into kg/ha. From the produce of each plot 100 seeds were taken for recording seed index. Harvest index (HI) was also calculated. Gross returns, net returns as well as benefit:cost (B:C) ratio were worked out using prevailing prices of inputs and output. Data were subjected to analysis of variance (ANOVA) in a randomized complete block design as per the standard procedure.

Effect of herbicides

The major weed flora comprised of *Cyperus rotundus*, *Arechne racemosa*, *Commelina benghalensis*, *Digitaria ciliaris* and *Eleucine aegyptiacum*. Weedy check recorded the highest weed density at 40 and 70 DAS **(Table 1)**. Application of imazethapyr 75 g/ha and pre-mix of imazethapyr + imazamox 70 g/ha at 3 WAS recorded the lower weed density of *Cyperus rotundus* at 40 DAS than other treatments.

Dry weight of weeds was significantly affected by different weed control treatments **(Table 2)**. Weedy check recorded the highest dry weight of weeds at 40, 70 DAS and harvest. Application of imazethapyr + imazamox 70 g/ha at 3 WAS recorded the lowest dry weight of weeds at 40 DAS followed by two hand weeding. However, two hand weeding recorded the lowest dry weight of weeds followed by pendimethalin 0.45 kg/ha PE + hand weeding at 70 DAS and at harvest. Application of imazethapyr (Gare *et al.* 2016) and pre-mix of imazamox + imazethapyr (Pandey *et al.* 2007) as post-emergence herbicides effectively controlled weeds in soybean. Hand weeding recorded the lowest dry weight of weeds due to effective elimination of weeds. Similarly, Pal *et al.* (2013) also reported that two hand weeding (20 and 40 DAS) reduced the density and dry weight of weeds more than the herbicidal treatments. Among post-emergence application of herbicides, quizalofop-p-ethyl 50 g/ha at 3WAS recorded the highest dry weight of weeds as it did not control *Cyperus rotundus* and *Commelina benghalensis* **(Table 1)**.

The number and dry weight of nodules and leghaemoglobin content were not significantly affected by different weed control treatments **(Table 3)**. The applied herbicides, did not show any adverse effects on the number and dry weight of nodules and leghaemoglobin content significantly. However, two

Table 1. Effect of different weed control treatments on weed density

Treatment	Weed density/ m^2							
	40 DAS			70 DAS				
	Cyperus rotundus	*Arechne racemosa*	*Commelina benghalensis*	*Cyperus rotundus*	*Arechne racemosa*	*Commelina benghalensis*	*Digitaria ciliaris*	*Eleucine aegyptiacum*
Pendimethalin 0.45 kg/ha PE	12.4 (155)	1.0 (0)	3.3 (11)	8.5(77)	2.7 (8)	4.7 (24)	6.4 (43)	1.0 (0)
Pendimethalin 0.45 kg/ha PE + HW at 40 DAS	10.5 (115)	1.0 (0)	1.8 (3)	9.1 (83)	2.1 (7)	2.2 (5)	3.3 (11)	1.0 (0)
Imazethapyr 75 g/ha at 3 WAS	5.8 (35)	1.8 (3)	1.8 (3)	8.2 (68)	5.1 (27)	4.2 (17)	6.6 (44)	2.9 (9)
Imazethapyr + imazamox 70 g/ha at 3 WAS	5.8 (35)	1.4 (2)	1.8 (3)	7.9 (65)	3.2 (12)	3.1 (9)	6.0 (36)	3.7 (15)
Quizalofop-p-ethyl 50 g/ha at 3WAS	10.3 (108)	1.4 (2)	2.3 (5)	10.4 (109)	4.9 (28)	4.7 (24)	2.0 (4)	1.0 (0)
Two hand weedings at 20 and 40 DAS	10.3 (107)	1.0 (0)	1.4 (2)	10.1 (104)	3.2 (19)	1.8 (3)	1.8 (3)	1.0 (0)
Weedy check	13.9 (196)	2.7 (7)	3.5 (12)	11.1 (123)	9.5 (91)	5.1 (27)	10.0 (101)	10.1 (104)
LSD (p=0.05)	4.3	0.9	NS	NS	3.8	1.7	3.9	3.2

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

hand weeding recorded the highest number and dry weight of nodules and leghaemoglobin content. Aggarwal *et al.* (2014) also reported that post-emergence application of imazethapyr 75 g/ha had no adverse effect on number, dry weight and leghaemoglobin content of nodules in blackgram.

Plant height, branches/plant, seed index, straw yield and harvest index were not significantly influenced by different treatments of weed control **(Table 4)**. Application of pendimethalin 0.45 kg/ha (PE) + HW at 40 DAS recorded the highest pods/ plant followed by two hand weeding. The weedy check decreased the grain yield by 55.1% as compared to two hand weeding. Reduction in soybean seed yield due to uncontrolled weeds has been reported to be 58.8% (Singh and Jolly 2004). Application of pendimethalin 0.45 kg/ha PE + HW at 40 DAS recorded significantly higher seed yield than other treatments which was, however, at par with two hand weeding treatment**(Table 4)** and it might be due to effective control of weeds **(Table 2)**. Integrated use of pendimethalin 0.45 kg/ha and HW has been found effective in soybean (Singh 2005, Singh 2007). Pre-emergence application of pendimethalin controlled the weeds at early stages followed by one hand weeding gave a less competition to the crop. Pal *et al.* (2013) also reported hand weeding as an effective method of weed control for attaining the maximum yield of soybean. Among the herbicides, imazethapyr 75 g/ha applied at 3 WAS recorded significantly higher seed yield than pre-emergence application of pendimethalin 0.45 kg/ha and weedy check and was at par with imazethapyr + imazamox 70 g/ha and quizalofop-p-ethyl 50 g/ha applied at 3 WAS. Imazethapyr 75 g/ha was found effective in soybean (Ram *et al.* 2013). The application of imazethapyr 75 g/ha, imazethapyr + imazamox 70 g/ha, quizalofop-p-ethyl 50 g/ha at 3 WAS and pendimethalin 0.45 kg/ha as pre-emergence recorded 35.6, 32.7, 29.7 and 11.4% higher seed yield of soybean over weedy check. Ram *et al.* (2013) also reported high net returns and B:C ratio with the application of imazethapyr at 75 g/ha.

Table 2. Effect of different weed control treatments on dry weight of weeds

Treatment	Dry weight of weeds (t/ha)		
	40 DAS	70 DAS	At harvest
Pendimethalin 0.45 kg/ha PE	0.63	1.39	1.46
Pendimethalin 0.45 kg/ha PE + HW at 40 DAS	0.91	0.27	0.29
Imazethapyr 75 g/ha at 3 WAS	0.34	1.33	1.08
Imazethapyr + imazamox 70 g/ha at 3 WAS	0.09	1.56	1.32
Quizalofop-p-ethyl 50 g/ha at 3WAS	1.04	1.90	1.57
Two hand weedings at 20 and 40 DAS	0.31	0.24	0.29
Weedy check	1.09	3.37	3.18
LSD(p=0.05)	0.22	0.78	0.55

Table 3. Effect of different weed control treatments on symbiotic traits in soybean

Treatment	No. of nodules/ plant	Dry weight of nodules/plant (mg)	Leghaemoglobin content (mg/g fresh weight of nodules)
Pendimethalin 0.45 kg/ha PE	27.3	74.5	3.80
Pendimethalin 0.45 kg/ha PE + HW at 40 DAS	27.0	75.7	3.82
Imazethapyr 75 g/ha at 3 WAS	26.3	70.8	3.65
Imazethapyr + imazamox 70 g/ha at 3 WAS	25.7	71.5	3.68
Quizalofop-p-ethyl 50 g/ha at 3WAS	26.0	72.0	3.70
Two hand weedings at 20 and 40 DAS	28.7	78.7	3.85
Weedy check	28.0	73.0	3.70
LSD (p=0.05)	NS	NS	NS

Application of imazethapyr and imazethapyr + imazamox was found better than quizalofop-p-ethyl in terms of seed yield of soybean due to better control of weeds **(Table 2)**. Application of quizalofop-p-ethyl at 50g/ha produced lower seed yield of soybean than imazethapyr 75 g/ha (Singh *et al.* 2013).

Application of pendimethalin 0.45 kg/ha (PE) + HW at 40 DAS provided the highest gross and net

Table 4. Plant characters, yield attributes, seed yield, straw yield and harvest index ofsoybean as influenced by different weed control treatments

Treatment	Plant height (cm)	Branches/plant	Pods/ plant	Seed index (g)	Biological yield (t/ha)	Straw yield (t/ha)	Seed yield (t/ha)	Harvest index (%)
Pendimethalin 0.45 kg/ha PE	93.3	3.1	43.9	10.2	5.93	3.98	1.95	33.1
Pendimethalin 0.45 kg/ha PE + HW at 40 DAS	91.9	3.3	57.6	10.5	8.00	5.24	2.75	34.6
Imazethapyr 75 g/ha at 3WAS	91.0	3.1	48.9	10.3	7.85	5.48	2.37	30.2
Imazethapyr + imazamox 70 g/ha at 3 WAS	91.7	3.4	48.3	10.0	7.56	5.24	2.32	30.7
Quizalofop-p-ethyl 50 g/ha at 3WAS	91.8	3.3	46.6	9.9	7.26	4.99	2.27	31.3
Two hand weedings at 20 and 40 DAS	94.1	31	56.7	10.0	7.85	5.14	2.71	34.5
Weedy check	88.9	3.0	38.2	9.7	5.48	3.73	175	32.5
LSD (p=0.05)	NS	NS	10.0	NS	1.63	NS	0.37	NS

Table 5. Economics of soybean as influenced by different weed control treatments

Treatment	Cost of cultivation (x103 `/ha)	Gross returns (x103 `/ha)	Net returns (x103 `/ha)	B:C ratio
Pendimethalin 0.45 kg/ha PE	20.56	54.07	33.50	1.63
Pendimethalin 0.45 kg/ha PE + HW at 40 DAS	26.96	76.46	49.50	1.84
Imazethapyr 75 g/ha at 3WAS	20.56	65.78	45.21	2.20
Imazethapyr + imazamox 70 g/ha at 3 WAS	21.41	64.38	42.96	2.00
Quizalofop-p-ethyl 50 g/ha at 3 WAS	21.53	62.89	41.36	1.92
Two hand weedings at 20 and 40 DAS	26.21	75.23	49.01	1.87
Weedy check	19.81	48.52	28.70	1.45
LSD (p=0.05)		10.37	10.37	NS

returns followed by two hand weeding **(Table 5)**. It might be due to higher seed yield of soybean. Sharma *et al.* (2016) also reported highest net returns and B:C ratio in pendimethalin 0.75 kg/ha + HW 30 DAS. All the post-emergence herbicides, pendimethalin 0.45 kg/ha (PE) + HW and two hand weedings gave significantly higher gross and net returns than pendimethalin 0.45 kg/ha PE and weedy check. Application of post-emergence herbicide imazethapyr at 75 g/ha gave the highest B:C ratio followed by imazethapyr + imazamox at 70 g/ha, however, the differences were non-significant.

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**(3): 421–426.

Gare BN, Raundal PU and Burli AV. 2016. Weed management in soybean with post emergence herbicides. *Journal of Farm Science* **29**(2): 271–72.

Jha BK, Chandra R and Singh R. 2014. Influence of post emergence herbicides on weeds, nodulation and yields of soybean and soil properties. *Legume Research* **37**(1): 47–54.

Meena DS, Ram B and Jadon CK. 2009. Effect of integrated weed management on growth and productivity of soybean. *Indian Journal of Weed Science* **41**(1&2): 93–95.

Pal D, Bera S and Ghosh RK. 2013. Influence of herbicides on soybean yield, soil microflora and urease enzyme activity. *Indian Journal of Weed Science* **45**(1): 34–38.

Pandey AK, Joshi OP, Billore SD and Kumar D. 2007. Effect of weed management practices on productivity of soybean, [*Glycine max* (L.) Merrill]. *Haryana Journal of Agronomy* **23**: 82–86.

Ram H, Singh G, Aggarwal N, Buttar GS and Singh O. 2013. Standardization of rate and time of application of imazethapyr weedicide in soybean. *Indian Journal of Plant Protection* **41**(1): 33–37.

SharmaNK, MundraSL andKalita S. 2016. Effect of weed control on growth and productivity of soybean. *Indian Journal of Weed Science* **48**(1): 90–92.

Singh D, Mir NH, Singh N and Kumar J. 2014. Promising early post-emergence herbicides for effective weed management in soybean. *Indian Journal of Weed Science* **46**(2): 135–37.

Singh G and Jolly RS. 2004. Effects of herbicides on the weed infestation and grain yield of soybean (*Glycine max*). *Acta Agronomica Hungarica* **50**: 199–203.

Singh G. 2005. Effect of chemical and mechanical methods on weed management, growth and grain yield of soybean [*Glycine max* (L.) Merrill]. *Indian Journal of Weed Science* **37**: 131–132.

Singh G. 2007. Integrated weed management in soybean (*Glycine max*). *Indian Journal of Agricultural Sciences* **77**(10): 675–676.

Singh M, Kewat ML, Dixit A, Kumar K and Vijaypal. 2013. Effect of post-emergence herbicides on growth and yield of soybean. *Indian Journal of Weed Science* **45**(3): 219–222.

Wilson D O and Reisenauer H M.1963. Determination of leghaemoglobin in legume nodules. *Analytical Biochemistry* **6**: 27-30.