Short communication

Indian Journal of Weed Science 45(3): 219–222, 2013

Effect of post-emergence herbicides on growth and yield of soybean

Mahendra Singh*, M.L. Kewat, Anil Dixit[1], Kaushal Kumar[2] and Vijaypal[2]

Department of Agronomy Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482 004

Received: 21 August 2013; Revised: 11 September 2013

Key words: Chemical control, Herbicide mixture, Soybean, Weed management, Yield attributes

Soybean [*Glycine max* (L.) Merrill] is an important oilseed crop of the twentieth century. In India, it is cultivated in 9.60 million ha area with the annual production of 12.74 million tones. Madhya Pradesh contributes nearly 5.56 million ha and 6.67 million tones to the total area and production of soybean in the country, respectively (Anonymous 2011). Being a rainy season crop, it has high yielding capacity but weed infestation is one of the major constraints in the cultivation of soybean. It weeds, are not controlled during critical period of weed-crop competition, there is reduction in the yield of soybean from 35 to 50% depending upon the weed flora and density. Hand-weeding is a traditional and effective method of weed control, but untimely and continuous rains as well as unavailability of labour during peak period of demand, are the main limitations of manual weeding. Mostly, farmers are using pre-plant incorporated or pre-emergence herbicides for weed control in soybean, but their efficacy is reduced due to variation in climatic and edaphic factors. Therefore, need was felt to explore the possibility of post-emergence herbicides for effective control of weed.

An experiment was conducted at JNKVV, Jabalpur during *Kharif* 2008. The total rainfall received during crop period was 1380 mm. The maximum and minimum temperature was 38.6^{0}C and 33.6^{0}C, respectively. The soil of the experimental field was clay in texture, having pH 7.3, organic carbon 0.63% and low in available N (246 kg/ha), medium in P (16 kg/ha) and high in K (298 kg/ha). The experiment was laid out in randomized block design with three replications. The experiment consisted of ten treatments. All the herbicides were applied as post-emergence (PoE) *i.e.* 20 DAS by using a knapsack sprayer fitted with flat fan nozzle with volume of 600 l/ha water. The sowing was done on 16 July, 2008 at the rate of 70 kg/ha at 45 cm of row spacing and was harvested on 1 November, 2008. The recommended dose of N, P_2O_5 and K_2O (20, 80 and 20 kg/ha), respectively were applied as basal at the time of sowing. Before sowing, soybean seed (*'JS 93-05'*) were treated with Thiram 2.5 g/kg of seed followed by inoculation with rhizobium culture 5 g/kg of seed. Weed data on species wise weed density and dry weight were recorded at 40 DAS and at harvest using 0.25 m^2 quadrate randomly at two places in a plot. While observations on grain yield and yield attributing parameters, *viz*. pods/plant and seed/pods were recorded at harvest. The economics of treatment was computed with minimum support price or prevailing market rate of products. All the data were subjected to analyses with standard statistical procedure. The data of weed density and dry weight were subjected to square root transformation$\sqrt{x+0.5}$ before statistical analysis. Net assimilation rate (NAR) was calculated as per formula given.

Echinochloa colona (22.6 and 17.6%) was the most dominant weed followed by *Dinebra retroflexa* (18.7 and 18.8%) and *Cyprus iria* (17.0 and 16.5%) among the monocot weed at 40 DAS and harvest, respectively. Dicot weeds like *Eclipta alba* (22.3 and 24.7%) and *Alternanthera philoxeroides* (19.2 and 20.2%) (Fig.1) were less dominant in soybean ecosystem at 40 DAS and harest, resprctivly. The highest weed infestations were recorded in weedy check plot.

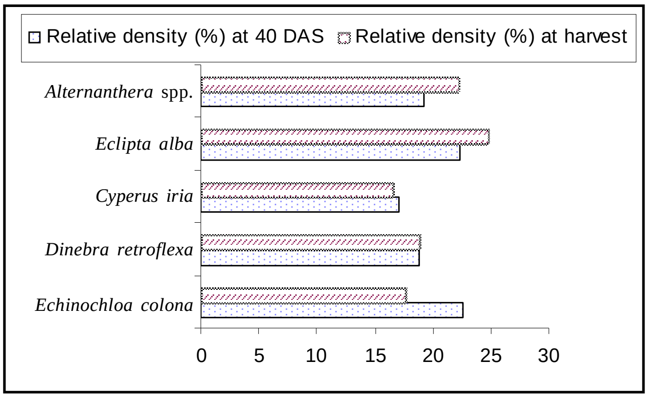

Fig. 1. Relative density of weeds at 40 DAS and harvest

*__Corresponding author:__ mahendraagro@gmail.com
[1]Directorate of Weed Science Research, Jabalpur, Madhya Pradesh 482 004
[2]Department of Agronomy, Banaras Hindu University, Varanasi, Uttar Pradesh 221 005

Application of quizalofop-p-ethyl at 37.5 g/ha marginally reduced density and dry weight of monocot weeds but result was more pronounced at higher rate (50 and 62.5 g/ha). Combined application of quizalofop-p-ethyl + chlorimuron (37.5 + 24 g/ha) effectively controlled both monocot and dicot weeds. The presence of quizalofop-p-ethyl molecule in non lethal concentration at the site of action could be the reason for poor activity of quizalofop-p-ethyl when applied at the lower rate (37.5 g/ha) but the reverse was true when it was applied at higher rate (50 and 62.5 g/ha) or when quizalofop-p-ethyl 37.5 g/ha was applied along with chlorimuron (24 g/ha). On the other hand, imazethapyr 75 g/ha and fenoxaprop-ethyl 100 g/ha caused more reduction in density and dry weight of monocot weeds. These results were in conformity with Jadhav (2013) (Table 1 and 2).

Two hand weeding (20 and 40 DAS) reduced the density and dry weight of weeds to the maximum extent over herbicidal treatments due to elimination of all sort of weeds. Similar views were endorsed by Pal *et al* (2013).

Crop biomass and NAR

Two hand weeding (20 and 40 DAS) gave significantly higher crop biomass (Table 3) as compared to other treatments and it was at par with quizalofop-p-ethyl + chlorimuron (37.5 + 24 g/ha). Application of imazethapyr 75 g/ha was comparable with quizalofop-p-ethyl + chlorimuron (37.5 + 24 g/ha) and significantly superior over weedy check in respect of crop biomass. These findings were in close agreement with Kelly *et al*. (1998). The higher crop biomass might be due to better weed control by herbicidal mixture. Whereas, lower rates of quizalofop-p-ethyl at (37.5 and 50 g/ha) were ineffective in curbing the weed menace and thereby produced inferior crop biomass. Application of different herbicides did not influence significant effect on net assimilation rate (NAR).

Yield attributes and yield

The yield and yield attributes, *viz.* pods/plant, seed yield and stover yield were recorded significantly higher under two hand weeding (20 and 40 DAS) as compared to other treatments (Table 3) due to elimination of weeds

Table 1. Effect of post-emergence herbicides on weed density (no./m^2) in soybean

Treatment	Rate (g/ha)	*Echinochloa colona*		*Eclipta alba*		*Dinebra retroflexa*		*Cyperus iria*		*Alternanthera philoxeroides*	
		40 DAS	Harvest	40 DAS	Harvest	40 DAS	Harvest	40 DAS	Harvest	40 DAS	Harvest
Quizalofop-p-ethyl	37.5	5.04	3.16	5.18	5.18	4.97	3.84	4.39 (15.3)	3.41	5.11	5.11
		(20.7)	(7.3)	(22.0)	(22.0)	(20.0)	(11.3)		(8.7)	(21.3)	(21.3)
Quizalofop-p-ethyl	50	4.41	2.65	4.88	4.88	3.75	2.93	3.44	2.65	5.04	5.04
		(15.3)	(4.7)	(19.3)	(19.3)	(10.7)	(6.0)	(8.7)	(4.7)	(20.7)	(20.7)
Quizalofop-p-ethyl	62.5	3.94	2.58	4.74	4.74	3.08	2.65	2.93	1.74	4.81	4.81
		(11.4)	(4.3)	(18.0)	(18.0)	(6.7)	(4.7)	(6.0)	(2.7)	(18.7)	(18.7)
Quizalofop-p-ethyl	37.5	4.89	3.08	5.10	5.10	3.81	2.93	3.96	3.05	5.04	5.04
+ vit-o-vit	+750	(19.3)	(6.7)	(21.3)	(21.3)	(11.3)	(6.0)	(12.0)	(6.7)	(20.7)	(20.7)
Fenoxaprop-ethyl	100	3.41	2.65	4.96	4.96	3.44	2.50	3.05	1.85	4.49	4.49
		(8.7)	(4.7)	(20.0)	(20.0)	(8.7)	(4.0)	(6.7)	(2.7)	(16.0)	(16.0)
Imazethapyr	75	4.32	2.93	3.65	2.65	3.31	2.93	2.78	1.83	2.50	1.17
		(14.7)	(6.0)	(10.0)	(4.7)	(8.0)	(6.0)	(5.3)	(2.7)	(4.0)	(1.3)
Imazaquin	93.75	5.66	5.66	3.96	2.80	5.79	5.91	5.72	5.72	3.44	2.50
		(26.7)	(26.7)	(12.0)	(5.3)	(28.0)	(29.3)	(27.3)	(27.3)	(8.7)	(4.0)
Quizalofop-p-ethyl	37.5 +	3.75	2.55	3.41	2.78	3.31	2.41	3.05	1.17	2.96	1.83
+ chlorimuron	24	(10.7)	(4.3)	(8.6)	(5.3)	(8.0)	(3.6)	(6.7)	(1.3)	(6.2)	(2.7)
Hand weeding	20 and	0.70	2.50	0.70	2.60	0.70	2.93	0.70	2.93	0.70	2.93
	40 DAS	(0.0)	(4.0)	(0.0)	(5.2)	(0.0)	(6.0)	(0.0)	(6.0)	(0.0)	(6.0)
Weedy check	-	7.28	7.43	6.92	7.03	7.13	7.43	7.13	7.38	6.15	6.50
		(46.0)	(48.0)	(41.3)	(42.7)	(44.0)	(48.0)	(44.0)	(47.3)	(32.0)	(36.0)
LSD (P=0.05)		0.59	0.53	0.63	0.57	0.51	0.57	0.58	1.28	0.47	0.99

Data subjected to $\sqrt{x+0.5}$ transformation and figures in parentheses are the original values; DAS- Days after sowing

Table 2. Effect of post-emergence herbicides on weed dry weight (g/m^2) in soybean

Treatment	Rate (g/ha)	*Echinochloa colona*		*Eclipta alba*		*Dinebra retroflexa*		*Cyperus iria*		*Alternanthera philoxeroides*	
		40 DAS	Harvest	40 DAS	Harvest	40 DAS	Harvest	40 DAS	Harvest	40 DAS	Harvest
Quizalofop-p-ethyl	37.5	7.24 (45.6)	4.59 (17.5)	8.70 (67.5)	9.08 (73.7)	8.31 (61.2)	6.37 (35.9)	6.27 (33.7)	4.65 (17.7)	8.91 (70.8)	9.70 (85.0)
Quizalofop-p-ethyl	50	6.27 (33.4)	3.67 (10.1)	8.35 (61.8)	8.46 (63.6)	6.17 (32.3)	4.51 (16.2)	4.70 (17.8)	3.52 (9.1)	8.83 (69.5)	9.48 (80.9)
Quizalofop-p-ethyl	62.5	5.81 (28.4)	3.44 (8.6)	8.04 (57.1)	8.25 (60.1)	4.98 (20.2)	3.26 (11.4)	4.14 (13.4)	2.50 (6.0)	8.53 (64.5)	9.08 (73.9)
Quizalofop-p-ethyl + vit-o-vit	37.5 +750	6.83 (40.3)	4.23 (14.0)	8.63 (66.4)	8.73 (68.0)	6.36 (34.9)	5.56 (26.1)	5.63 (26.4)	4.12 (13.5)	8.81 (69.2)	9.44 (80.2)
Fenoxaprop-ethyl	100	4.79 (18.8)	3.31 (7.9)	8.38 (62.3)	8.51 (64.5)	4.26 (14.2)	2.29 (9.6)	4.31 (18.8)	2.37 (5.2)	7.88 (54.5)	8.50 (64.2)
Imazethapyr	75	6.16 (32.1)	3.98 (12.3)	6.10 (31.6)	4.11 (13.2)	5.48 (25.2)	4.94 (19.9)	3.83 (11.5)	1.46 (2.8)	5.01 (20.9)	3.03 (9.6)
Imazaquin	93.75	8.04 (57.0)	8.12 (58.2)	6.65 (38.0)	4.29 (14.4)	8.85 (70.0)	10.4 (99.7)	8.03 (56.8)	8.40 (62.6)	5.71 (27.3)	4.49 (16.0)
Quizalofop-p-ethyl + chlorimuron	37.5 + 24	5.43 (24.6)	3.87 (11.4)	5.71 (27.7)	4.31 (14.8)	5.42 (25.1)	5.28 (23.2)	4.09 (13.3)	2.33 (5.0)	4.22 (13.8)	2.86 (5.5)
Hand weeding	20 and 40 DAS	0.70 (0.0)	2.88 (5.7)	0.70 (0.0)	3.47 (8.9)	0.70 (0.0)	5.43 (24.7)	0.70 (0.0)	4.18 (13.8)	0.70 (0.0)	3.78 (10.9)
Weedy check	-	10.36 (97.4)	10.52 (100.6)	11.84 (128.7)	11.91 (130.3)	11.72 (125.9)	15.13 (214.1)	10.24 (94.9)	10.74 (104.9)	10.73 (105.)	11.77 (127.3)
LSD (P=0.05)		0.90	0.85	0.86	0.78	0.98	0.98	0.90	1.89	0.79	1.90

Data subjected to $\sqrt{x+0.5}$ transformation and figure in parentheses are the original value; DAS- Days after sowing

Table 3. Effect of post-emergence herbicides on yield attributes, yield and economic of soybean

Treatment	Rate (g/ha)	NAR (g/m^2/day) at 30-60DAS	Crop biomass (g/m^2)	Pods/ plant	Seeds/ pod	Seed yield (t/ha)	Stover yield (t/ha)	GMR (x10^3 `/ha)	NMR (x10^3 `/ha)
Quizalofop-p-ethyl	37.5	0.20	472.4	14.2	2.39	1.05	2.66	20.99	5.17
Quizalofop-p-ethyl	50	0.21	512.8	15.5	2.43	1.17	2.97	23.41	7.25
Quizalofop-p-ethyl	62.5	0.22	520.2	17.6	2.43	1.35	3.27	27.00	10.48
Quizalofop-p-ethyl + vit-o-vit	37.5 + 750	0.20	492.2	16.4	2.41	1.22	3.18	24.57	8.46
Fenoxaprop-ethyl	100	0.21	542.3	17.7	2.45	1.36	3.39	27.27	11.16
Imazethapyr	75	0.22	556.6	19.2	2.51	1.52	3.64	30.41	14.71
Imazaquin	93.75	0.19	454.3	14.0	2.41	1.01	2.58	20.23	4.53
Quizalofop-p-ethyl +chlorimuron	37.5 + 24	0.22	591.9	19.4	2.56	1.59	3.74	31.85	15.92
Hand weeding	20 & 40 DAS	0.23	609.9	21.0	2.65	1.87	4.31	37.36	15.59
Weedy check	-	0.17	315.8	12.0	2.28	0.81	2.11	16.09	1.33
LSD (P=0.05)		NS	42.1	0.9	NS	0.15	0.40	-	-

NAR: Net assimilation rate; GMR: Gross monetary returns; NMR: Net monetary returns from inter and intra row spaces besides better aeration due to manipulation of surface soil and thus, more space, water, light and nutrients were available for the better growth and development. Pal *et al.* (2013) also reported hand weeding as an effective method of weed control for achieving the maximum yield of soybean.

In herbicidal treatments, application of quizalofop-p-ethyl + chlorimuron (37.5 + 24 g/ha) and imazethapyr 75 g/ha were at par with each other and significantly superior to rest of other treatments in respect of pods/plant, seed and stover yield due to effectively control of monocot and dicot weeds. These results were in close agreement with the findings of Jadhav (2013). Kelly *et al*. (1998) reported that imazethapyr as post-emergence effectively controlled gassy as well as broad leaf weeds in soybean. Application of fenoxaprop 100 g/ha produced better pods/plant, seed and stover yield as compared to quizalofop-p-ethyl 62.5 g/ha because of relatively low competition stress and better yield attributes. Whereas, lower rates of quizalofop-p-ethyl at 37.5 and 50 g/ha were ineffective in controlling broad leaved weeds thereby produced lower yield attributes leads to lower seed yield. The seed yield was lowest in the plots receiving no weed control (weedy check) due to severe competition stress right from crop establishment up to the end of critical period of crop growth, leading to poor growth parameters and yield attributing traits and finally the minimum seed yield. The seeds/pod of soybean showed marked difference due to application of post-emergence herbicides.

Economics

The gross and net returns were minimum in weedy check because of lowest economic yield *i.e.* grain yield. The plots receiving combined application of quizalofop-p-ethyl (37.5 g/ha) + chlorimuron (24 g/ha) fetched the higher gross and net returns followed by imazethapyr 75 g/ha and fenoxaprop-ethyl 100 g/ha. However, the gross return was maximum under 2 Hand-weeding (20 and 40 DAS) but lowest net returns due to higher cost of manual labour for weeding.

SUMMARY

The field was mainly infested with monocot weeds like *Echinochloa colona, Dinebra retroflexa* and *Cyperus iria, w*hereas dicot weeds *Eclipta alba* and *Alternanthera philoxeroides* were less dominant in soybean. The application of quizalofop-p-ethyl 37.5 g/ha + chlorimuron 24 g/ha gave satisfactory control of weeds and it gave highest crop biomass (592 g/m^2), seed yield (1.59 t/ha) and net monetary returns (₹15,918/ha) followed by imazethapyr 75 g/ha which registered the crop biomass (557 g/m^2), seed yield (1.52 t/ha) and net monetary returns (₹14,712/ha). However, 2 hand weedings checked the weed growth and recorded significantly higher seed yield (1.87 t/ha) over rest of the treatments, but net monetary return (₹15,594/ha) were lower than application of quizalofop-p-ethyl 37.5 g/ha + chlorimuron 24 g/ha.

REFERENCES

Anonymous. 2011. *Agricultrual Economics and Statistics*. Directorate of Economics and sStatistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi.

Jadhav VT. 2013. Yield and economics of soybean under integrated weed management practices. *Indian Journal of Weed Science* **45**(1): 39–41.

Kelly A Nelson, Karen A Renner and Donald Penner. 1998. Weed control in soybean (*Glycine max*) with imazamox and imazethapyr. *Weed Science* **46**(5): 584–594.

Kewat ML, Pandey J, Yaduraju NT and Kulshreshtra G. 2000. Economic and eco-friendly weed management in soybean. *Indian Journal of Weed Science* **32**(3&4): 135–139.

Pal Debesh, 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.

Singh Guriqbal. 2007. Integrated weed management in soybean. *Indian Journal of Agriculture Science* **77**(10): 675–676.