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Effect of pre-and post-emergence herbicides on weed infestation and productivity of soybean

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ABSTRACT

A field experiment was conducted during *kharif* 2008 and 2009, to study the effect of different pre-and post-emergence applications of herbicide on weed infestation and grain yield of soybean [*Glycine max* (L.)Merr.]. Among the different herbicides, the highest seed yield was recorded with lone application of diclosulam 18 g/ha as pre-emergence supplemented with one hand weeding at 20 DAS and application of diclosulam 18 g/ha as pre-emergence followed by haloxyfop 100 g/ha as post-emergence. However, these were significantly at par with weed-free treatment. The highest weed control efficiency and the lowest weed biomass were recorded in weed-free treatment followed by application of diclosulam 18 g/ha as pre-emergence with one hand weeding at 20 DAS. Application of diclosulam as pre-emergence also performed better over the standard check either applied pendimethalin as pre- or post-plant incorporation of fluchloralin before the sowing of the seed.

Key words: Weed control, Herbicides, Soybean, Diclosulam, Haloxyfop

Soybean has occupied first rank among the oil seed crops in India since 2005 onwards, however, its productivity in India is very low (about 1.07 t/ha) as compared to 2 t/ha globally (AICRP Soybean 2009) due to poor crop establishment, higher infestation of weeds, insects, diseases, *etc*. Intense weed competition is one of the constraints in realizing higher soybean productivity. Reduction in the yield due to weeds varied from 30 to 50%, depending on weed species, their intensity and critical duration of crop-weed competition (Chandel and Saxena 1988). Weeds not only compete with soybean for moisture, light, nutrients and space but also hamper operation of equipment, harbor crop pests such as insects and diseases and contaminate the harvested seed yield with foreign matter and weed seeds of different species (Lembi and Ross 1999). Unavailability of adequate laborers during peak period of weeding and difficulty in use of mechanical weeding in heavy soil due to rain creates problem for effective control of weeds in soybean crop. Weed management through the herbicidal application remains the only viable option under these situations.

Application of herbicides as pre-emergence for effective weed control in soybean are required to be used within very short period (2-3 DAS) of time after sowing. In monsoon season, if rain captures this critical period of application then pre-emergence herbicide can not be used effectively to control the weeds in soybean. This situation has necessitated the search of some post-emergence herbicides for effective and economic control of weeds in soybean crop. In view of above facts, an experiment was conducted to evaluate the bio-efficacy of pre- and post-emergence herbicides on weed growth and seed yield of soybean.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* 2008 and 2009 at Crop Research Centre of GBPUA & T, Pantnagar. The soil of the experimental field was silty clay loam in texture, containing 0.54% organic carbon, 0.066% total nitrogen, 24.18 kg/ha and 190.8 kg/ha of available phosphorus and available potassium, respectively with 7.2 pH. The experiment was laid out in randomized block design with four replications. The planting was done on July 10, 2008 and August 1, 2009 at the rate of 75 kg seed/ha at 45 cm of row spacing and was harvested on November 16, in both the years.

The experiment was consisted of 10 treatments *viz.* control (weedy), weed free, fluchloralin and pendimethalin each (1000 g/ha), diclosulam (26 g/ha), diclosulam (18 g/ha) *fb* one hand weeding at 20 DAS, fluchloralin (1000 g/ha) *fb* diclosulam (18 g/ha), haloxyfop (100 g/ha), fluchloralin (1000 g/ha) *fb* haloxyfop (100 g/ha) and diclosulam (18 g/ha) *fb* haloxyfop (100 g/ha). All the pre-emergence herbicides were applied the day after sowing of crop seed, whereas, fluchloralin incorporated within the soil one day before sowing of seed. Post-emergence application of haloxyfop was sprayed in standing crop at 21 DAS by using a Knapsack sprayer fitted with flat fan nozzle with volume of 750 lit/ha water. Recommended dose of fertilizer 20 kg N + 80 kg P + 5 kg Zn/ha was applied as basal at the time of sowing. Soybean seed *(PS*

1347) were treated with thiram 75% WP 2 g + bavistine 1.0 g/kg of seed before inoculation followed by inoculating with *Bradyrhizobium japonicum* culture (7 g/kg of seed). To protect the crop from stem fly, 2 to 3 spray of trizophos 40 EC 500 ml/ha was done during both the year of experimentation. Thinning to maintain optimum plant population (i.e. 0.4 million plants/ha) was completed within 15-20 DAS in both the years.

Weed control efficiency (WCE) was computed by using formula, WCE = (P-Q/P) x 100, where P and Q respectively, refer to oven dry weight of weeds at specific sampling in weedy check and particular treatment for which value is computed. Weed index (WI) was computed by WI = (A-B/A) x 100, where A and B refer to grain yield in weed-free and treated plots respectively. Necessary statistical analysis was carried out by method of Sokal and Rohlf (1981).

RESULTS AND DISCUSSION

Weed density

The experimental plot was mainly infested with *Echinochloa colona* (27%), *Eleusine indica* (9%), *Brachiaria ramose* (7%), *Digitaria sanguinalis* (6%), *Eragrostis japonica* (4%) among the mocot weeds while *Celosia argentea* (34%), *Lindernia ciliate* (4%), *Eclipta alba* (4%) and *Trianthema monogyna* (6%) were among the dicot weeds. Their occurrence and intensity varied in different treatments. Intensity of weeds varied due to application of different herbicide and manual weeding plots at different growth stages. The highest weed infestation was recorded in control (weedy check) plot.

The weed intensity of all species significantly reduced by the application of herbicide either applied as pre- or post-emergence at both stages of crop (30 and 60 DAS) growth. It might be due to application of diclosulam which was most effective to control the broad spectrum of weed flora and haloxyfop only effective to control the grassy weeds. Application of diclosulam 18 g/ha supplemented with one hand weeding at 20 DAS recorded significantly the lowest weed population of grassy as well as non grassy weeds at both 30th and 60th days stage (Table 1). It was also observed that the application of diclosulam among the pre-emergence herbicides effectively controlled both monocot and dicot weeds whereas, application of haloxyfop as post-emergence was found mainly effective to control the grassy weeds. Tiwari *et al.* (2007) also reported that haloxyfop application in soybean as post-emergence gave effective control over the grassy weeds.

Table 1. Effect of different weed control treatments on density and dry matter of weed at 30 and 60 DAS in soybean (pooled data of two years)

Treatments	Dose (g/ha)	Application stage DAS	Weed density (no./m^2)				Weed dry matter (60 DAS) (g/m)
			30 DAS		60 DAS		
			Monocot	Dicot	Monocot	Dicot	
Fluchloralin 45 EC	1000	PPI	73 (3.9)	43 (2.8)	185 (5.0)	65 (4.2)	680.9 (6.5)
Pendimethalin 30 EC	1000	1-2	33 (3.1)	23 (3.1)	128 (4.5)	53 (4.0	496.7 (6.2)
Diclosulam 84 WP	26	1-2	18 (2.3)	7 (1.5)	59 (3.9)	29 (3.2)	362.6 (5.7)
Diclosulam 84 WP *fb* HW (20 DAS)	18	1-2	13 (2.5)	6 (1.4)	26 (3.1)	18 (2.7)	250.0 (5.5)
Fluchloralin 45 EC *fb* diclosulam 84 WP	1000 + 18	PPI + 1-2	26 (3.0)	14 (2.4)	84 (4.0)	34 (3.3)	394.0 (5.9)
Haloxyfop 10 EC	100	21	29 (3.2)	20 (2.6)	36 (3.5)	49 (3.8)	581.3 (6. 3)
Fluchloralin 45 EC *fb* haloxyfop 10 EC	1000 + 100	PPI + 21	29 (3.2)	19 (2.5)	34 (3.5)	47 (3.9)	575.5 (6.3)
Diclosulam 84 WP *fb* Haloxyfop 10 EC	18 + 100	1-2 + 21	17 (2.8)	10 (1.7)	34 (3.5)	44 (3.8)	306.2 (5.7)
Control	-	-	178 (5.0)	124 (4.3)	222 (5.3)	85 (4.4)	813.2 (6.7)
Weed free	-	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.0 (0.0)
LSD (P=0.05)			0.8	0.9	0.3	0.3	0.3

Figures in parenthesis are logarithmic transformed (log (x+1))data, DAS: Days after sowing; PPI: Pre Plant Incorporation

Dry matter, weed control efficiency (WCE) and weed index (WI)

In general, the dry matter accumulation of weeds increased with the increasing weed density as well as variation of weed species and their growth. The highest weed dry matter was achieved under weedy check at 60 DAS (Table 1) and the lowest weed dry matter was recorded in weed-free plot. Among the herbicidal treatments, diclosulam 18 g/ha supplemented with one hand weeding (20 DAS) resulted in maximum reduction (69.3% over control) in weed dry matter. However, the highest weed dry matter was recorded with sole application of fluchloralin 1000 g/ha, which was followed by sole application of haloxyfop 100 g/ha and combined application of both fluchloralin 1000 g/ha as pre planting incorporation (PPI) and haloxyfop 100 g/ha as post-emergence. It might be less effective to control the broad leaf weeds (especially *Celosia argentea*) and it's vigorous growth.

The highest weed control efficiency was achieved by weed-free plots followed by application of diclosulam 18 g/ha supplemented with one hand weeding at 20 days stage (69%) than the combined application of diclosulam 18 g/ha as pre-emergence followed by haloxyfop 100 g/ha (62%) as post-emergence. Among the herbicidal treatments, sole application of fluchloralin 1000 g/ha recorded the lowest weed control efficiency (16%) while the highest weed index (75%) was recorded in sole application of haloxyfop 100 g/ha, however the lowest weed index (11%) was observed with application of diclosulam 18 g/ha supplemented with one hand weeding (at 20 DAS) due to broad spectrum effect on different weed species (Fig. 1).

Yield and yield attributes

The yield and yield attributing characters, *viz.,* branches and pods per plant were significantly influenced by different weed control treatments (Table 2). The highest values of these parameters over control (weedy check) were higher in weed-free. Among herbicidal applications, diclosulam 18 g/ha supplemented with one hand weeding (20 DAS) recorded the higher values of these parameters followed by all the herbicides except than the sole application of haloxyfop 100 g/ha and combined application of fluchloralin 1000 g/ha as PPI followed by haloxyfop 100 g/ha post-emergence. Higher level of these parameters could be attributed to low competition stress of crop with weed plants.

Weed-free treatment significantly enhanced the seed yield (81%) over the control followed by the application of diclosulam 18 g/ha supplemented with one hand weeding (20 DAS) and enhanced the seed yield up to 78.8% over the control. This treatment was found at par with combined application of diclosulam 18 g/ha and haloxyfop 100 g/ha used as pre- and post-emergence, respectively and alone application of diclosulam at higher dose 26 g/ha.

The lowest seed yield (454 kg/ha) was obtained in weedy plot indicating the higher weed infestation and it's impact on soybean crop. Tiwari and Kurchania (1990) also reported that weed infestation in soybean field may reduce yield up to 77% depending upon the intensity, nature and

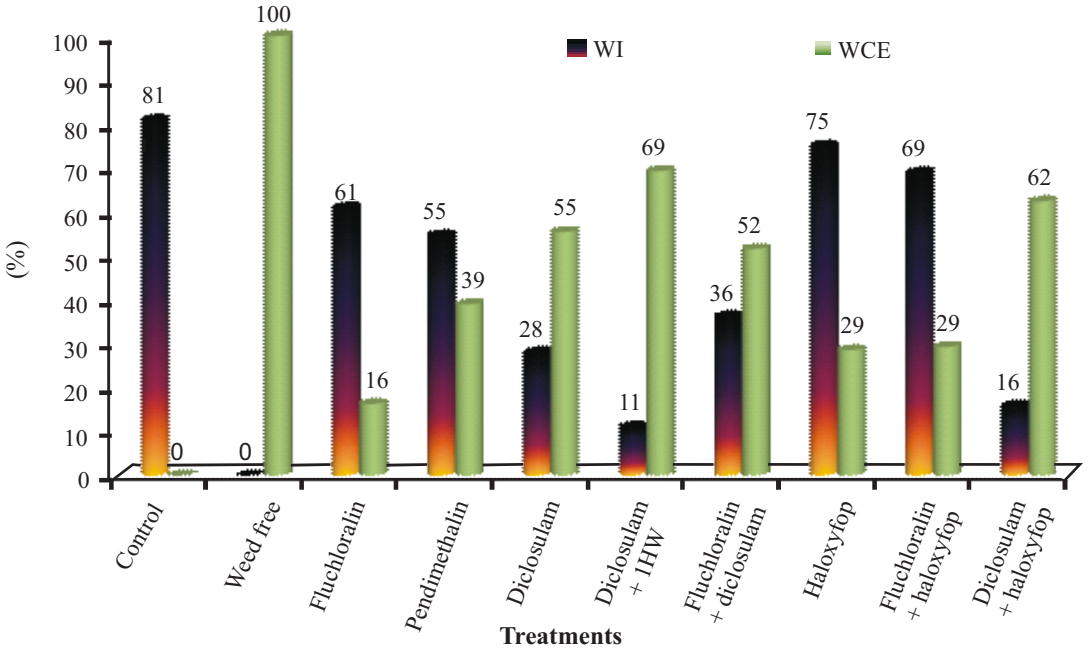

Fig. 1. Effect of weed control treatments on weed index (WI) and weed control efficiency (WCE)

Table 2. Effect of different weed control treatments on yield and yield attributing parameters of soybean (pooled data of two years)

Treatments	Dose (g/ha)	Application stage (DAS)	Plant height (cm)	Branches/ plant	Dry wt./ plant (g/ha)	Pods/ plant	Seed yield (kg/ha)	Straw yield (kg/ha)
Fluchloralin 45 EC	1000	PPI	50.0	5.0	18.9	40.3	935	2052
Pendimethalin 30 EC	1000	1-2	53.9	4.4	21.7	41.4	1085	2414
Diclosulam 84 WP	26	1-2	56.3	5.4	22.6	48.6	1723	3661
Diclosulam 84 WP *fb* HW (20 DAS)	18	1-2	55.2	5.5	27.1	53.5	2129	4392
Fluchloralin 45 EC *fb* diclosulam 84 WP	1000+18	PPI + 1-2	53.6	5.2	27.1	46.8	1527	3256
Haloxyfop 10 EC	100	21	53.9	3.5	17.2	32.0	596	1286
Fluchloralin 45 EC *fb* haloxyfop 10 EC	1000+100	PPI + 21	53.7	4.0	19.8	36.6	743	1786
Diclosulam 84 WP *fb* haloxyfop 10 EC	18 + 100	1-2 + 21	54.1	5.1	26.0	53.4	2015	4416
Control	-	-	51.3	3.8	14.0	26.9	454	1497
Weed free	-	-	54.8	5.5	25.2	52.4	2394	4332
LSD (P=0.05)			3.1	1.3	3.8	10.2	411	850

DAS: Days after sowing; PPI: Pre-plant incorporation

the duration of weed competition. The lowest seed yield was recorded with weedy plot which was at par with sole application of haloxyfop 100 g/ha and combined application of fluchloralin 1000 g/ha followed by haloxyfop 100 g/ha applied as pre-plant incorporation and post-emergence, respectively. The lower yield obtained in these treatments might be due to the higher infestation of broad leaved weeds and their high dry matter accumulation in those plots and less effectiveness against broad leaved weeds. On the other hand, the higher seed yield obtained with application of diclosulam showed its higher efficacy to control the broad spectrum of weeds.

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