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Influence of weed-control method on productivity of rainfed soybean (*Glycine max*) in Vertisol of central India

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ABSTRACT

A field experiment was carried out during the rainy season of 1998 and 1999 to study the effect of different herbicides on growth and yield of 'JS 335' soybean [*Glycine max* (L.) Merr.] grown on clay-loam soil of Indore, Madhya Pradesh. The conventional practice of weed control involving *dora* (a small *bakhar* shape implement, drawn by a pair of bullocks between the rows of the crop) and 1 hand-weeding 30 days after sowing the crop, was effective in controlling the weeds and giving higher grain yield. The pre-emergence application of herbicides–metolachlor @ 1.0 kg/ha, chlorimuron ethyl @ 0.009 kg/ha and combined use of chlorimuron ethyl and metolachlor @ 0.009 kg and 1.0 kg/ha, respectively, were equally effective in controlling the weeds and influencing soybean yield favourably.

Key words: Soybean, Herbicides, Weed-control efficiency, Phyto-toxicity

Intensive weed competition is one of the important constraints for low productivity in soybean. Reduction in yield due to weeds varies from 35 to 50%, depending on type of weeds, their intensity and time of crop–weed competition (Chandel and Saxena, 1988). The nature of yield response to weed management and economic analysis determines the feasibility of adoption of the technology by the growers. The initial slow growth of the crop provides congenial environment for weed growth. Early control of weeds (first 30 days) in soybean is very critical (Bhan *et al.*, 1974). The incessant rains on Vertisols of Madhya Pradesh (Malwa Plateau) do not permit timely intercultivation and/or manual weeding in this crop during certain years. The use of selective herbicide in soybean can be effective and economical (Yadav and Shrivastava, 1999). In the present study, an attempt was made to evaluate cultural practices and selective herbicides for the control of weeds and to find out the effect of weed-control methods on yield of soybean.

MATERIALS AND METHODS

A field experiment was conducted during the rainy seasons of 1998 and 1999 at Indore. The experiment consisted of 17 different weed-control treatments (Table 1) laid out in randomized block design with 4 replications. Soybean variety 'JS 335' was sown in rows of 40 cm apart during the second fortnight of June, using a fertilizer dose of 20, 60 and 20 kg/ha of N, P_2O_5 and K_2O, respectively, at the time of sowing. The soil belonged to fine montmorillonitic, hyperthermic family of Typic chromasterts with swelling and shrinking properties. The soil was clay loam and having pH 7.8, EC 0.14 m mhos/cm, organic carbon 0.5%, available phosphorus 12.7 kg/ha and available K_2O was 255 kg/ha. The observations on weed number and dry weight/m^2 were recorded at 60 days after sowing of the crop. Visual observations on phyto-toxic effect of different herbicides on plant growth were recorded at pod-filling stage of the crop.

RESULTS AND DISCUSSION

Weed flora

The dominant weed species in soybean in the descending order of relative denstiy were barnyard grass (*Echinochloa crus galli* (L.) P. Beauv.], purple nut sedge (*Cyperus rotundus* L.), *doob grass* [*Cynodon dactylon* (L.) Pers.], *Alysicarpus rugosus* L., *Corchorus* spp., *Acalypha indica* L., *Euphorbia* spp., *Commelina benghalensis* L., *Parthenium hysterophorus* L., *Phyllanthus niruri* L. and *Setaria glauca* L. and *Eclipta alba* L. Hassk.

The population of grassy weeds was more than that of non-grassy weeds. The maximum number of narrow-leaf weeds were recorded in weed check plots, whereas it was the lowest in case of *dora* operation followed by 1 hand-weeding (Table 1). The maximum weed population (both narrow and broad leaf) were recorded in weedy check, which was significantly higher than all other treat-

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ments. The lowest number of weeds (12) were recorded with the treatment involving *dora* operation + 1 hand-weeding; followed by combined application of chlorimuron ethyl and metolachlor @ 0.009 kg and 1.0 kg/ha respectively; and pendimethalin granule @ 2.0 kg/ha. Herbicides application resulted varying degree of weed control for different treatments. Among the herbicides, the lowest weed population (14) and weed dry weight (16 g) were recorded with combined application of chlorimuron ethyl and metolachlor @ 0.009 kg and 1.0 kg/ha respectively. In general, all the weed-control treatments reduced the weed population and weed dry weight significantly compared with the weed check (Table 1). Among the herbicides, sole application of metolachlor @ 1.0 kg/ha, chlorimuron ethyl 0.006 and 0.009 kg/ha, pendimethalin (granule) @ 2.0 kg/ha and combined use of chlorimuron ethyl and metolachlor @ 0.009 kg and 1.0 kg/ha, respectively, resulted in significant decrease in weed dry weight compared with the control. These findings are in close agreement with those of Sharma *et al.* (1992), Dubey *et al.* (1996) and Joshi and Billore (1998).

Weed-control efficiency and weed index

Among the different weed-control treatments, the maximum weed-control efficiency (WCE) (95%) was obtained with combined application of chlorimuron ethyl and metolachlor @ 0.009 kg and 1.0 kg/ha, respectively and was closely followed by *dora* operation followed by 1 hand-weeding and pendimethalin (granule) @ 2.0 kg/ha, chlorimuron ethyl @ 0.006 kg/ha and metolachlor @ 1.0 kg/ha. Combined application of chlorimuron ethyl @ 0.006 kg/ha with metolachlor @ 1.0 kg/ha as post- and pre-emergence revealed that the former treatment was less effective in controlling the weeds than the latter one. Post- and pre-emergence application of imazethapyr @ 0.25 kg/ha and pre-emergence application of trifluralin @ 0.75 kg/ha were less effective on controlling weed and recorded WCE of 72.2, 66.2 and 51.2% respectively. Post-emergence application of imazethapyr was more effective than its pre-emergence application. The weedy check treatment showed the highest weed index (30.7%), as weeds caused greater reduction in plant dry weight, filled pods and seed yield/plant. However, weed index was the lowest (0.5%) in treatment receiving pre-emergence combined application of chlorimuron ethyl @ 0.006 kg/ha and 1.0 kg/ha of metolachlor and this was followed by the treatment only application of chlorimuron ethyl @ 0.006 kg/ha. Thus, herbicides were very effective in minimizing the losses due to weeds in soybean crop. The weed-control treatment consisting of *dora* operation + 1 hand-weeding was also very effective in controlling weeds with weed index of 2.0%.

Visual observations on phyto-toxic effect of different herbicides on plant growth revealed that the treatment involving chlorimuron ethyl @ 0.009 kg/ha with metolachlor @ 1.0 kg/ha resulted in effective control of both types of weeds, but this treatment had harmful effect on crop growth and resulted in less foliage development. Application of chlorimuron ethyl @ 0.006 kg/ha with metolachlor @ 1.0 kg/ha resulted in very good control of narrow and broad-leaf weeds with no harmful effect on crop growth. This treatment proved superior to application of chlorimuron ethyl @ 0.009 kg/ha with metolachlor @ 0.75 kg/ha. Post-emergence application of chlorimuron ethyl @ 0.009 kg/ha with metolachlor @ 1.0 kg/ha also exhibited toxic effect on crop growth. There was severe yellowing and necrosis of leaves and stunted growth of the crop. All other herbicides did not show any visual phyto-toxic symptom on soybean crop.

Yield attributes and yield

Except branches/plant, all other yield attributes, viz. dry matter/plant, grain yield/plant, pods/plant, 1,000-grain weight, were significantly influenced by the weed-control treatments (Table 1). Lowest number of pods and dry matter/plant were recorded in the weedy check. The maximum dry matter/plant was recorded with weed-free plots, followed by interculture with *dora* + 1 hand-weeding (26.7 g) and post-emergence application of imazethapyr. Pods/plant were highest in weed-free plot followed by application of chlorimuron ethyl @ 0.006 kg/ha + metolachlor @ 1.0 kg/ha and *dora* operation + 1 hand-weeding (35.7). The 1,000-grain weight, grain yield/plant and branches/plant also depicted similar trend.

In most of the treatments, herbicides application showed significant positive influence in controlling the weed over the weedy check. The seed yield due to various weed-control treatments varied significantly (Table 1). The highest seed yield (2,364 kg/ha) was obtained with weed-free check, closely followed by metolachlor + chlorimuron ethyl at different rates and operation of *dora* + 1 hand-weeding. The herbicides chlorimuron ethyl @ 0.006 and 0.009 kg/ha with metolachlor @ 1.0 kg/ha resulted effective control of weed which was reflected in producing 42–44% higher seed yield over the weedy check. Post-emergence application of chlorimuron ethyl 0.006 kg + metolachlor 1.0 kg/ha was less effective than its pre-emergence in controlling weeds. However, post-emergence application of imazethapyr was more effective than its pre-emergence application and this treatment resulted in higher grain yield. Pendimethalin in its granular form was more effective than its liquid form. *Dora* operation followed by hand-weeding was one of the traditional practice of the farmers of the area and this was found to

Table 1. Effect of weed-control treatments on weed population and dry weight, weed-control efficiency and weed index, grain yield and its attributes of soybean (mean data of 2 years)

Treatment	Time of application	Rate (kg ai/ha)	Weed population (No./m²)			Weed dry weight (g/m²)	Weed-control effiicency (%)	Weed index (%)	Grain yield (kg/ha)	Dry matter/ plant (g)	Pods/ plant	1,000-seed weight (g)
			Narrow	Broad leaf	Total							
Metolachlor	PE	0.75	150	3	153	120	62.5	12.0	2,081	21.7	37.8	135.2
Metolachlor	PE	1.0	16	2	18	30	90.6	14.7	2,016	18.8	46.2	138.4
Chlorimuron ethyl	PE	0.006	15	4	19	25	92.1	1.6	2,327	17.7	35.3	140.0
Chlorimuron ethyl	PE	0.009	20	2	22	28	89.0	4.7	2,252	18.4	29.4	137.2
Chlorimuron ethyl + metolachlor	PE	0.006+1.0	17	2	19	20	93.7	0.5	2,352	19.9	36.1	140.6
Chlorimuron ethyl + metolachlor	PE	0.009+1.0	13	1	14	16	95.0	1.3	2,332	18.4	30.4	140.2
Chlorimuron ethyl + metolachlor	PE	0.009+0.75	23	2	25	40	87.5	7.7	2,182	17.1	30.6	136.4
Chlorimuron ethyl + metolachlor	14 DAS	0.006+1.0	60	2	62	200	37.5	6.3	2,215	18.8	31.2	137.8
Trifluralin	PE	0.75	100	12	112	156	51.2	19.5	1,903	17.2	27.0	132.0
Pendimethalin (granule)	PE	2.0	12	2	14	18	94.4	3.3	2,285	20.7	31.6	137.4
Pendimethalin (liquid)	PE	1.0	48	8	56	80	75.0	22.8	1,825	23.1	27.6	128.6
Imazethapyr	PE	0.25	38	13	51	108	66.2	15.8	1,990	21.8	34.9	129.6
Imazethapyr	18 DAS	0.25	25	16	41	89	72.2	14.8	2,012	25.3	28.6	131.8
Alachlor (granule)	PE	2.0	26	8	34	48	85.0	10.4	2,118	24.6	33.2	134.0
Dora operation once + 1 hand-weeding	20 DAS + 30 DAS	-	9	3	12	18	94.4	2.0	2,317	26.7	35.7	142.5
Weed-free	-	-	-	-	-	0	100	0	2,364	27.0	36.5	142.0
Weedy check	-	-	160	20	180	320	0	30.7	1,637	16.2	25.2	116.4
CD (P=0.05)					23.0	15.0			445	7.8	10.34	11.6

PE, Pre-emergence; DAS, days after sowing; HW, hand-weeding

be a suitable, sustainable, eco-friendly and effective method of weed control in rainfed soybean.

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