Indian Journal of Agronomy **46** (3) : 511–515 (September 2001)

Influence of weed-control methods on growth, yield and economics of rainfed soybean (*Glycine max*) at farmer's field

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Received : April 2000

ABSTRACT

A field experiment conducted at farmer's field during 1998 and 1999, on weed-control methods in soybean [*Glycine max* (L.) Merr.] showed that pendimethalin @ 1.0 kg a.i./ha (pre-emergence application) + hand-weeding resulted in significantly higher growth, yield-attributing characters, and seed yield over rest of the methods including control (farmer's practice). Significantly lower number of weeds/m^2 and weed dry matter were obtained with the use of pendimethalin supplemented with 1 hand-weeding. This treatment also gave the highest weed-control efficiency during both the years. The highest benefit : cost ratio was obtained with the use of pendimethalin alone.

Key words : Soybean, Weed control, Pendimethalin, Pre-emergence

The excessive presence of weeds limits the full expression of yield potential of soybean crop. Early control of weeds (first 30 days) in soybean is very critical and if not done, the yield losses may reach up to 43% (Bhan *et al.*, 1974). Unavailability of adequate labourers and difficulty in the use of mechanical weeders in heavy soils due to rains create problem in effective control of weeds. Herbicidal weed control remains the only choice unde00r such a situation. However, quality herbicides are costly and at times not available.

Therefore integrated approach of cultural, mechanical and chemical methods of weed control may be more feasible. Keeping this in view, the present investigation was undertaken to determine the effective integrated weed-management practice.

MATERIALS AND METHODS

A field experiment was conducted during the rainy season of 1998 and 1999, at farmers' fields of the K.V.K. adopted village-Barkheda of Rajgarh district. The soils of the farmers' fields were medium black to gravelled medium black and were free from waterlogging conditions. Soil had pH 7.9–8.6, organic carbon 0.51–0.59, available N 180–280 kg/ha, available P_2O_5 20–49.8 kg/

ha and potassium 320–450 kg/ha. The rainfall received during June to October was 831 and 932 mm, respectively, 1998 and 1999.

The experiment was conducted in randomized block design with 6 replications (farmer's field), having 5 plots of 200 m^2 area, taking 5 treatmens, viz.'1 *dora* (narrow blade interculture implement) operation (farmer's practice–control), 2 hand-weedings (at 20 and 30 days), 2 *dora (kulpa)* operations (at 20 and 30 days), use of pre-emergence herbicide pendimethalin @ 1.0 kg a.i./ha and use of pre-emergence herbicide pendimethalin @ 1.0 kg a.i./ha and use of pre-emergence herbicide pendimethalin @ 1.0 kg a.i./ha + 1 hand-weeding (at 30 days). Soybean ('JS 335') was sown during second and third week of July in 1998 and 1999, respectively, with seed rate of 100 kg/ha in rows 30 cm apart by bullock-drawn seed drill. The seed was first treated with thiram @ 3 g/kg seed followed by its inoculation with *Rhizobium* and PSB culture both @ 10 g/kg seed just before sowing on each farmer's field.

A uniform basal dose of N and P_2O_5 @ 20 and 60 kg/ha was applied at the time of sowing by drilling separately below the seed. Pendimethalin was sprayed @ 1.0 kg a.i./ha by knap-sack sprayer using flood jet nozzel, just after sowing using 750 litres water/ha, as per treatments. The plant-protection measures were adopted as per requirement of the crop in farmers' field. The crop was harvested at the end of second and third week of October in 1998 and 1999, respectively, and the yield data were recorded treatment-wise and statistically analysed.

RESULTS AND DISCUSSION

Weed flora

The dominant weeds in the experiments were *Cyperus rotundus Echinochloa crus-galli Cynodon dactylon* (L.) Pers., *Euphorbia* spp., *Commelina benghalensis* L., *Corchorus* spp, and *Parthenium hysterophorus* L.

Effect on weed

Different weed-control measures significantly influenced the weed intensity and weed dry matter. Most of the weeds were reduced by pre-emergence application of Pendimethalin @ 1.0 kg a.i./ha at early growth stages and removal of late emerged weeds by supplemental hand-weeding 30 days after sowing reduced the weed biomass significantly and recorded the lower dry weight of weeds and the higher weed-control efficiency (Table 1). Dubey *et al.* (1996) also obtained similar results.

Growth and yield attributes

Different weed-control measures significantly influenced the plant height in 1998. Maximum plant height of crop was recorded with pre-emergence application of Pendimethalin @ 1.0 kg a.i./ha + 1 hand-weeding during both the years, but differences in plant heights were not significant during 1999 (Table 2).

Branches/plant were significantly affected by Pendimethalin + 1 hand-weeding over farmers' practice (control), 2 *dora* (narrow blade implement) operations and 2 hand-weeding treatments during both the years.

The superior performance of Pendimethalin and Pendimethalin + 1 hand-weeding

Table 1. Influence of weed-control treatment on weeds in soybean

Treatment	Weed population (m^2)		Weed dry matter (g/m^2) (at 50 days*)		Weed -control efficiency (%)	
	1998	1999	1998	1999	1998	1999
Farmers' practice (1 *dora*) [control]	41.83	43.66	84.83	87.33		
2 hand-weedings (at 20, 30 days*)	21.66	24.66	34.16	41.16	59.73	52.86
2 *dora* operations (at 20, 30 days)	34.00	37.50	73.00	75.33	13.94	13.74
Pendimethalin @ 1.0 kg a.i./ha PE	27.00	30.66	21.16	25.66	75.05	70.61
Pendemethalin @ 1.0 kg a.i./ha PE + 1 hand-weeding (at 30 days*)	17.83	22.83	12.00	13.50	85.85	84.54
CD (P=0.05)	2.87	3.54	2.30	2.33		

*Days, Days after sowing; *Dora*, interculture by bullock-drawn narrow-blade implement; PE, pre-emergence

Table 2. Growth and yield parameters of soybean as affected by weed-control treatments

Treatment	Plant height (cm)		Branches/ plant		Pods/ plant		1,000-seed weight (g)	
	1998	1999	1998	1999	1998	1999	1998	1999
Farmers' practice (1 *dora*) [control]	44.50	47.33	2.33	2.33	27.33	23.00	96.00	86.66
2 hand-weedings (at 20, 30 days*)	49.33	46.16	2.50	2.50	34.16	33.33	96.66	96.66
2 *dora* operations (at 20, 30 days)	46.16	47.00	2.33	2.33	40.33	31.83	95.50	95.16
Pendimethalin @ 1.0 kg a.i./ha PE	51.00	48.00	3.00	3.00	41.33	31.83	97.83	96.00
Pendemethalin @ 1.0 kg a.i./ha PE + 1 hand-weeding (at 30 days*)	51.16	50.00	3.33	3.50	42.33	37.66	98.66	98.00
CD (P=0.05)	2.48	NS	0.70	0.84	3.60	1.46	1.12	1.48

*Days, Days after sowing; *Dora*, interculture by bullock-drawn narrow-blade implement; PE, pre-emergence

could be attributed to the reduced weed–crop competition in the initial stages and removal of late-emerged weeds by supplemental hand-weeding at 30 days. This resulted in more pods/plant and 1,000-seed weight in this treatment. Even Pendimethalin + 1 hand-weeding at 30 days and Pendimethalin alone were at par with each other in both the years, except for pods/plant and 1,000-seed weight during 1999, where Pendimethalin supplemented 1 hand-weeding at 30 days was statistically superior to Pendimethalin alone (Table 2).

Jain and Tiwari (1992) and Dubey (1998), also reported such effects on growth and yield-attributing characters.

Yields and economics

Among weed-control measures, pre-emergence application of Pendimethalin supplemented with 1 hand-weeding at 30 days recorded the maximum seed yield

Table 3. Seed yield and economics of different methods of weed control in soybean

Treatment	Treatment cost (Rs/ha)	Cost of cultivation (Rs/ha)		Seed yield (q/ha)			Net income (Rs/ha)			Benefit : cost ratio	
		1998	1999	1998	1999	Mean	1998	1999	Mean	1998	1999
Farmers' practice (1 *dora*) [control]	1,000	8,115	8,870	21.00	12.41	16.70	570	1,616	1,093	2.07	1.18
2 hand-weedings (at 20, 30 days*)	3,200	10,315	11,070	23.33	15.50	19.41	-1,966	2,028	31	1.80	1.18
2 *dora* operations (at 20, 30 days)	2,000	9,115	9,870	26.50	15.16	20.83	2,970	2,940	2,955	2.32	1.29
Pendimethalin @ 1.0 kg a.i./ha PE	1,250	8,365	9,120	26.33	17.91	22.12	4,334	6,014	5,174	2.51	1.65
Pendemethalin @ 1.0 kg a.i./ha PE + 1 hand-weeding (at 30 days*)	2,770	9,885	10,640	28.50	20.25	24.37	3,030	6,471	4,750	2.30	1.60
CD (P=0.05)				0.58	1.49						

*Days, Days after sowing; *Dora*, interculture by bullock-drawn narrow implement; PE, pre-emergence

(Table 3), owing to more branches/plant, pods/plant and 1,000-seed weight.

The lower yield levels under treatments in 1999 than that in 1998, may be due to more rainfall at the time of sowing and flowering, effecting the germination and flower setting. Lower temperature in 1999 during crop-growth period may also be responsible for reduction in seed yield. The seed yield was significantly higher under Pendimethalin +1 hand-weeding at 30 days.

Use of Pendimethalin only @ 1 kg a.i./ha, 2 *dora* (narrow blade implement) operations and 2 hand-weedings also significantly increased seed yield over farmer's practice (1 *dora*). Mishra and Kushwaha (1992) also reported significant differences in yield of soybean due to weed control on farmers' fields. Pendimethalin also showed significant increase over 2 hand-weedings. Significant increase in yield of soybean by the use of pendimethalin was also obtained by Jain and Tiwari (1992). Two *dora* (narrow blade implement) operations were at par with Pendimethalin alone in 1998 and with 2 hand-weedings in 1999.

Highest benefit : cost ratio was obtained under Pendimethalin only, though maximum net profit was not obtained under it in 1999. The lowest benefit : cost ratio was obtained with 2 hand-weedings during both the years, which may be because of high cost of manual weed control. The results are in confirmity with the findings of Singh and Bajpai (1994) and Dubey (1998).

Thus pre-emergence application of Pendimethalin followed by 1 hand-weeding 30 days after sowing can profitably be practiced for the control of weeds in soybean.

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