Indian Journal of Agronomy **51** (4) : 314–317 (December 2006)

Effect of weed control and nutrient management on soybean *(Glycine max)* productivity

PRATAP SINGH[1], V. NEPALIA[2] AND S.S. TOMAR[3]

Department of Agronomy, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313 001

Received : October 2006

ABSTRACT

A field experiment was conducted at Kota during rainy season of 2002 and 2003 to evaluate the effect of herbicides and their mixtures and of fertility levels on the extent of weed control and productivity of soybean [*Glycine max* (L.) Merr]. Two hand-weedings at 30 and 45 days after sowing (DAS), alachlor applied pre-emergence @ 2 kg/ha + hand-weeding (HW) at 30 DAS and tank mixture of chlorimuron ethyl + fenoxaprop-p-ethyl (9+70 and 6+50 g/ha) as post-emergence reduced the weed density and dry matter at 50 and 70 DAS. These treatments also recorded significantly higher pods/plant, 1000-seed weight, seed yield and net return of soybean crop. Lowest NPK uptake by weeds was recorded by two hand-weedings and the maximum NPK uptake by the crop under alachlor 2 kg/ha + HW at 30 DAS, two hand weedings and chlorimuron ethyl + fenoxaprop-p-ethyl (9+70 g/ha) treatments. Fertility levels did not influence the weed density, but a decrease in fertilizer application to 75% of recommended dose of fertilizer (RDF) reduced the dry matter of weeds. The yield and net returns decreased on reducing the rate of fertilizer application. No significant influence on NPK uptake by weeds was registered by applying 125% RDF, but nutrient uptake by crop increased significantly.

Key words : Soybean, Herbicides, Nutrient management

Soybean [*Glycine max* (L.) Merr.] has emerged as a potential crop and has brought about perceptible change in the economy of the farmers in south-east Rajastahan. Being a rainy season crop, its growth and yield are, however, reduced by 25-77 per cent (Kurchania *et al.*, 2001). Mostly the farmers use pre-plant incorporated and pre-emergence herbicides for weed control in soybean, but their efficacy is reduced by various climatic and edaphic factors. Hand-weeding is a traditional and effective method of weed control, but untimely and continuous rains as well as unavailability of labour at peak time are main limitations of manual weeding. The only alternative that needs to be explored is the use of post-emergence herbicides. The screening of such herbicides in soybean reveals their efficiency against either monocotyledonous or dicotyledonous weeds. Hence their mixtures may broaden the window of weed management by broad-spectrum weed control (Bineet *et al.*, 2001). Soybean seeds contain 20-22 per cent oil and 40-42 per cent protein. Therefore it is essential to look into nutritional requirement of the crop. Weeds also exploit the habitat more efficiently and reduce the availability of nutrients to the crop. Therefore an experiment was conducted to assess the bio-efficacy of herbicides and nutrient management on soybean productivity.

MATERIALS AND METHODS

The experiment was conducted during rainy season *(kharif)* 2002 and 2003 at Agricultural Research Station, Kota. The soil was clay loam, having pH 7.7, organic carbon 0.56%, and 367, 23.5 and 310 kg/ha available N, P and K respectively. A split-plot design was followed, comprising 12 weed-control treatments. These were : T_1, weedy check; T_2, one hand-weeding HW at 30 DAS; T_3, two HW at 30 and 45 DAS; T_4, alachlor 2.0 kg/ha as pre-emergence (PE); T_5, alachlor 2.0 kg/ha + one HW at 30 DAS; T_6, chlorimuron ethyl (CE) @ 9 g/ha; T_7, fenoxaprop-*p*-ethyl (FPE) @ 70 g/ha; T_8, quizalofop ethyl (QE) @ 50 g/ha; T_9, CE + FPE @ 9+70 g/ha; T_{10}, CE + FPE @ 6+50 g/ha; T_{11}, CE + QE @ 9+50 g/ha; and T_{12}, CE + QE @ 6 + 37.5 g/ha as post emergence (POE). There were three fertility levels, viz., F_1, 75% of recommended dose of fertilizers (RDF), F_2, 100%; and F_3, 125% RDF, in sub-plots. Soybean cv. 'Pratap Soya' was

Present address : [1]Agricultural Research Station, Kota 324 001 (Rajasthan); [2]Rajasthan College of Agriculture (MPUAT), Udaipur; [3]Krishi Vigyan Kendra, Kota

Table 1. Effect of weed control and fertility level on weed density* and dry matter of weeds in soybean (pooled data of 2002 and 2003)

Treatment	Weed density* (no./m²)						Dry matter of weeds (kg/ha)						Weed-control efficiency (%)	
	50 DAS			70 DAS			50 DAS			70 DAS			50 DAS	70 DAS
	Monocot	Dicot	Total	Monocot	Dicot	Total	Monocot	Dicot	Total	Monocot	Dicot	Total		
Weed control														
T_1 : Weedy check	11.36	10.66	15.56	13.27	11.34	17.44								
	(128.52)	(113.33)	(241.86)	(175.60)	(128.15)	(303.75)	612.59	799.23	1,411.83	917.71	1,472.75	2,390.46		
T_2 : One HW at 30 DAS	9.32	8.32	12.48	10.23	9.40	13.88								
	(86.46)	(68.87)	(155.43)	(104.34)	(88.16)	(192.60)	155.92	32.24	488.16	319.68	838.80	1,158.49	65.60	51.29
T_3 : Two HW at 30, 45 DAS	0.71	0.71	0.71	4.18	4.04	5.77								
	(0.00)	(0.00)	(0.00)	(17.00)	(15.87)	(32.88)	0.00	0.00	0.00	17.72	30.60	48.32	99.99	98.02
T_4 : Alachlor 2 kg/ha	7.10	9.83	12.11	8.04	10.66	13.34								
	(50.21)	(96.31)	(146.53)	(64.49)	(113.21)	(177.83)	243.28	785.55	1,028.84	329.67	1,429.39	1,759.06	27.16	26.37
T_5 : Alachlor + 1 HW	3.18	5.49	6.31	4.76	5.38	7.14								
	(9.62)	(29.99)	(39.68)	(22.24)	(28.57)	(50.72)	52.39	56.17	108.58	41.22	95.05	136.27	92.33	94.34
T_6 : CE (9 g/ha)	10.50	5.78	11.96	11.79	6.52	13.46								
	(109.68)	(33.12)	(142.70)	(138.51)	(42.26)	(180.76)	371.67	51.36	423.03	474.77	179.87	654.64	70.02	72.76
T_7 : FPE (70 g/ha)	6.27	10.59	12.28	6.74	11.16	13.01								
	(38.82)	(111.79)	(150.51)	(44.93)	(124.09)	(168.98)	154.08	770.48	924.57	135.12	1,442.77	1,577.88	34.64	34.03
T_8 : QE (50 g/ha)	6.02	10.41	12.01	6.52	10.97	12.72								
	(35.97)	(107.97)	(144.05)	(42.10)	(120.01)	(161.50)	150.86	767.00	917.86	130.72	1,420.70	1,551.44	35.12	35.09
T_9 : CE+FPE (9+70 g/ha)	4.21	2.61	4.90	5.03	3.78	6.26								
	(17.31)	(6.41)	(23.69)	(24.83)	(13.87)	(38.79)	63.85	22.03	85.89	41.19	77.12	118.32	93.97	95.15
T_{10} : CE+FPE (6+50 g/ha)	4.45	3.17	5.43	5.25	4.20	6.69								
	(19.37)	(9.82)	(29.20)	(27.16)	(17.24)	(44.45)	69.26	27.09	96.34	44.04	86.09	130.13	93.25	94.70
T_{11} : CE+QE (9+50 g/ha)	4.85	5.50	7.31	5.42	6.00	8.05								
	(22.99)	(29.85)	(52.96)	(28.85)	(35.50)	(64.31)	80.89	64.31	145.19	57.05	148.61	205.65	89.76	91.56
T_{11} : CE+QE (6+37.5 g/ha)	5.01	6.07	7.84	5.66	6.47	8.56								
	(24.58)	(36.42)	(61.04)	(31.56)	(41.30)	(72.86)	88.46	74.54	162.99	63.33	172.06	235.39	88.50	90.29
CD (P=0.05)	0.35	0.30	0.42	0.31	0.32	0.52	11.21	20.34	27.56	14.18	42.80	57.87		
Fertility level														
F_1 : 75% RDF	6.04	6.16	8.75	7.18	7.48	10.42								
	(35.98)	(37.51)	(76.23)	(51.10)	(55.55)	(108.15)	159.34	296.62	455.96	200.59	584.10	784.67	66.26	64.92
T_2 : 100% RDF	6.08	6.19	8.80	7.24	7.48	10.43								
	(36.48)	(37.89)	(77.13)	(52.03)	(55.55)	(108.45)	173.56	316.35	489.91	218.70	626.89	845.19	66.05	65.04
T_3 : 125% RDF	6.13	6.25	8.89	7.30	7.51	10.48								
	(37.09)	(38.63)	(78.62)	(52.90)	(56.00)	(109.34)	177.92	324.54	502.45	223.77	637.47	861.24	65.81	64.89
CD (P=0.05)	NS	NS	NS	NS	NS	NS	5.31	8.17	13.23	6.11	15.32	23.44		

Values are $*\sqrt{x + 0.5}$ transformed and actual values are in parentheses

Details of Treatments are given in the text

sown with the onset of monsoon on 21 July 2002 and 7 July 2003. The post-emergence herbicides were applied at 10-20 DAS. Apart from treatments, the crop was raised with standard package of practices as per zonal recommendation.

RESULTS AND DISCUSSION

Weed flora

The predominant weeds of the experimental site were *Echinochloa colonum, E. crus-galli, Cyperus rotundus, Cyanodon dactylon* and *Dinebra arabica* among the grasses; and *Celosia argentea, Digera arvensis, Commelina benghalensis* and *Trianthema portulacastrum* were among broad-leaf weeds.

Effects on weeds

Weed control through various means reduced the weed density at 50 and 70 DAS (Table 1). The treatments differed significantly with each other in controlling monocot and dicot weeds. Two hand-weedings at 30 and 45 DAS resulted in complete absence of weeds at 50 DAS, whereas post-emergence application of herbicidal mixtures consisting of chlorimuron ethyl + fenoxaprop-*p*-ethyl (9+70 g/ha) resulted in significantly lowering the weed density than other weed-control treatments, Two hand-weedings, alachlor + 1 hand-weeding and chlorimuron ethyl + fenoxaprop-*p*-ethyl (9+70 and 6+50 g/ha) respectively reduced the weed density, by 89.2, 83.3, 87.2 and 85.4 per cent at 70 DAS over weedy check. The highest dry weight of weeds was recorded with weedy check at both the crop stages. All the herbicidal treatments significantly reduced the dry biomass of weeds during both the years. Two hand-weedings at 30 and 45 DAS respectively gave the lowest dry biomass and highest weed-control efficiency. Among the herbicides, tank mixture of chlorimuron ethyl + fenoxaprop-*p*-ethyl (9+70 g/ha) recorded the highest weed-control efficiency (93.9 and 95.1%), which was closely followed by chlorimuron ethyl + fenoxaprop-*p*-ethyl (6+50 g/ha). The different fertility levels could not influence the weed density but marginally increased the dry matter of weeds with increase in fertility levels at both the stages, i.e. 50 and 70 DAS of crop growth (Table 1).

Effect on crop : Yield attributes and yield

Herbicidal treatments significantly increased the yield attributes and yield over the weedy check. The maximum values of yield attributes, viz. pods/plant and 1,000-seed weight, were recorded with two hand-weedings (Table 2). Among herbicides, chlorimuron ethyl + fenoxaprop-*p*-ethyl (9+70 g/ha) gave the highest yield, which was on par with that of chlorimuron ethyl + fenoxaprop-*p*-ethyl at 6 + 50 g/ha, alachlor 2 kg/ha + one hand-weeding during both the years. No crop injury could be seen on crop due to herbicides and herbicidal mixtures, except during the second year, when slight yellowing of soybean leaves was seen due to chlorimuron ethyl and its mixture with other herbicides. But the plants soon recovered within 3-5 days. The better yield attributes and yield could be ascribed to better weed control by herbicidal mixtures. Application of post-emergence herbicides was also significantly superior to alachlor, one hand-weeding and weedy

Table 2. Effect of weed control and fertility level on yield attributes, yield and returns of soybean (pooled data 2002 and 2003)

Treament	Pods/plant	1,000-seed weight (g)	Seed yield (q/ha)	Net returns (Rs/ha)	Returns/rupee invested
Weed control					
Weedy check	21.50	89.84	8.54	5,368	0.78
One HW at 30 DAS	40.84	108.10	14.38	11,011	1.15
Two HW at 30, 45 DAS	63.31	131.39	23.13	21,653	1.89
Alachlor 2 kg/ha	38.03	104.27	12.78	10,038	1.24
Alachlor + 1 HW	61.81	130.69	22.07	21,398	2.18
CE (9 g/ha)	52.03	112.76	15.97	14,689	1.82
FPE (70 g/ha)	46.97	111.03	14.08	12,006	1.49
QE (50 g/ha)	49.64	111.16	14.90	12,873	1.52
CE + FPE (9+70 g/ha)	60.36	128.96	22.52	22,734	2.53
CE + FPE (6+50 g/ha)	58.89	128.16	22.21	22,885	2.71
CE + QE (9+50 g/ha)	52.45	127.10	18.82	17,311	1.84
CE +QE (6+37.5 g/ha)	50.28	125.84	18.54	17,545	2.00
CD (P=0.05)	3.84	4.29	1.31	1,665	0.19
Fertility level					
75% RDF	45.23	115.18	15.69	13,860	1.60
100% RDF	50.75	118.29	17.92	16,584	1.85
125% RDF	53.04	118.86	18.37	16,933	1.83
CD (P=0.05)	1.76	1.82	0.56	705	0.08

Table 3. Effect of weed control and fertility levels on total N, P and K uptake by weeds and soybean at harvest (pooled data 2002 and 2003)

Treatment	Nutrient uptake (kg/ha) by weeds			Nutrient uptake (kg/ha) by soybean		
	N	P	K	N	P	K
Weed control						
Weedy check	69.21	12.444	76.68	71.12	7.22	50.59
One HW at 30 DAS	48.09	9.075	54.94	119.17	11.96	77.07
Two HW at 30, 45 DAS	1.69	0.324	1.69	203.63	20.02	130.41
Alachlor 2 kg/ha	55.21	10.061	64.88	107.51	10.85	69.87
Alachlor + 1 HW	4.30	0.805	4.87	193.68	19.06	125.99
CE (9 g/ha)	16.31	3.136	16.45	136.33	13.80	92.14
FPE (70 g/ha)	47.81	8.560	58.25	119.05	12.06	80.37
QE (50 g/ha)	46.98	8.547	56.80	127.35	12.99	87.41
CE + FPE (9+70 g/ha)	3.64	0.678	3.83	193.20	19.17	122.31
CE + FPE (6+50 g/ha)	4.02	0.767	4.23	189.63	18.68	119.93
CE + QE (9+50 g/ha)	6.77	1.262	7.52	164.53	16.16	106.99
CE +QE (6+37.5 g/ha)	7.41	1.387	8.27	161.42	15.75	104.07
CD (P=0.05)	2.52	0.440	2.47	10.13	0.89	7.22
Fertility level						
75% RDF	23.71	4.375	27.31	131.49	13.38	90.28
100% RDF	26.74	4.878	30.78	155.05	15.28	99.34
125% RDF	27.44	5.009	31.52	160.11	15.77	102.17
CD (P=0.05)	1.13	0.193	1.10	4.00	0.39	2.59

check in terms of yield. These results are in close conformity with those of Tiwari and Mathew (2002). The yield of soybean was significantly influenced by different fertility levels. Application of 125 per cent RDF gave the highest yield which was on par with that of 100 per cent RDF, but both these were significantly superior to 75% RDF. Joshi *et al.* (1998) and Vyas *et al.* (2004) also reported similar findings. The increase in yield under weed-control treatments may be attributed to significant reduction in dry matter of weeds, thereby reducing the crop-weed competition, which provided congenial environment to the crop for better expression of vegetative and reproductive potential. These results corroborate the findings of Chhokar *et al.* (1997).

Nutrient uptake

The NPK uptake by weeds decreased significantly by applying various weed-control measures (Table 3). The lowest nutrient uptake was recorded by two hand-weedings. However, it was on par with that of chlorimuron + fenoxaprop (9+70 and 6+50 g/ha) for N uptake and with chlorimuron + fenoxaprop (9+70 g/ha) for P and K uptake. The nutrient uptake by crop showed a reverse trend. While minimum uptake was recorded under weedy condition, maximum was observed when weeds were controled by alachlor 2 kg/ha + HW at 30 DAS. However, it was on a par with that obtained by weed control through chlorimuron + fenoxaprop (9+70 and 6+50 g/ha). The data also indicate that enhanced nutrient application (125% RDF) had no significant influence on NPK uptake by weeds but the crop showed significantly higher uptake.

Economics

Among the herbicidal treatments, the highest monitory returns and returns per rupee invested were obtained with the application of chlorimuron ethyl + fenoxaprop-*p*-ethyl (6+50 g/ha), whereas 100% recommended dose of fertilizers was most economical among the fertility levels (Table 2).

REFERENCES

Bineet, M., Andani, G. and Mohammed, T.A. 2001. Herbicide mixture in agriculture : a review. (In) : *Proceedings of Biennial Conference, Indian Society of Weed Science,* pp. 236, held at Bangalore.

Chhokar, R.S., Balyan, R.S. and Pahuja, S.S. 1997. Nurient removal of weeds in soybean under integrated weed management. *Indian Journal of Agronomy* **42** (1) : 138–141.

Joshi, O.P., Billore, S.D. and Bundela, V.P.S. 1998. Fertilizer management in soybean-chickpea crop sequence. *Journal of Oilseed Research* **15** (1) : 118–122.

Kurchania, S.P., Bhalla, C.S. and Rathi, G.S. 2001. Effect of different rates of alachlor and metolalchlor on weed control and herbicide residue in soybean [*Glycine max* (L.) Merrill]. *Pestology* **25** (7) : 19–21.

Tiwari, B. and Mathew, R. 2002. Influence of post-emergence herbicide on growth and yield of soybean. *JNKVV Research Journal* **36** (1, 2) : 17–21.

Vyas, A.K., Billore, S.D. and Joshi, O.P. 2004. Land configuration and nutrient management for sustainable soybean *(Glycine max)* production (In) : *Proceeding of National Symposium on Resource Conservation* and *Agricultural Productivity,* pp. 113–114.