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Integrated Weed Management in Soybean (*Glycine max*)

R. S. Malik, Ashok Yadav and R. K. Malik
Department of Agronomy
CCS Haryana Agricultural University, Hisar - 125 004 (Haryana), India

ABSTRACT

Pre-plant incorporation of trifluralin at 1500 g ha^{-1} alone, trifluralin 1000 g ha^{-1} fb hand hoeing at 20 DAS, pendimethalin at 1000 g ha^{-1} fb hand hoeing at 20 DAS and two hoeings (20 and 40 DAS) provided better control of weeds upto 90 DAS compared to other weed control treatments. Consequently, these being at par with each other produced pods/ plant and grain yield of soybean statistically equivalent to that of weed-free throughout the crop season.

INTRODUCTION

Being rich source of protein and vegetable oil, soybean is a dual purpose rainy season crop in India. It helps enrich soil fertility by fixing atmospheric N. It can also serve as an alternate in crop diversification under rice-wheat cropping system. But being rainy season crop, it encounters with severe infestation of weeds particularly Santhi (*Trianthema portulacastrum*) and Sawank (*Echinochloa colona*). Weeds have been reported to cause 29 to 87% yield losses in soybean (Mishra *et al.*, 1990). Since soybean is usually infested with complex weed flora, a single application of one of the soil applied herbicides (trifluralin or pendimethalin) may provide only a narrow spectrum of weed control. Thus, the application of more than one herbicide (tank mixture or sequential) or herbicide application integrated with mechanical or hand hoeing is often required. Keeping these points in view, the present investigation was planned to evaluate the efficacy of two soil applied herbicides alone and in integration with post-emergence herbicides or hand hoeing against grassy and broadleaf weeds in soybean.

MATERIALS AND METHODS

A field experiment was conducted in soybean to evaluate the efficacy of trifluralin and pendimethalin at varying doses alone and in integration with one hoeing or fenoxaprop against weeds during rainy seasons of 2004 and 2005 at Research Farm of CCS Haryana Agricultural University, Hisar, India. The soil of the experimental field was sandy loam in texture, low in available nitrogen (202 kg ha^{-1}), medium in phosphorus (18 kg ha^{-1}) and high in potash (353 kg ha^{-1}) with slightly alkaline in reaction (pH 8.1). Soybean variety PK-1042 using a seed rate of 75 kg ha^{-1} was sown on June 16 in 2004 and June 27 in 2005 under furrow irrigated raised bed system keeping two rows/bed. The crop was raised with all recommended package of practices. Treatments consisted of three herbicides (trifluralin, pendimethalin and fenoxaprop) at various doses, hoeing and their combinations alongwith weedy and weed-free (Table 1). Experiment with 16 treatments and three replications was laid out in randomized block design. Trifluralin was incorporated in upper 3-5 cm soil layer at sowing of soybean, whereas pendimethalin was applied one day after sowing. Fenoxaprop was applied 35 DAS. All the herbicides were applied manually using knapsack sprayer fitted with T-jet flat fan nozzle at a spray volume of 650 l ha^{-1}. The density and dry weight of weeds were recorded at 45 DAS. Visual control was also recorded at 90 DAS using 0 to 100 scale (where 0=no control and 100= complete control).

Table 1. Population and dry matter accumulation of weeds as influenced by different treatments at 45 DAS

Treatment	Dose (g ha^{-1})	Application stage	Population of weeds (No. m^{-2})				Dry matter of weeds (g m^{-2})			
			Broadleaf weeds		Grasses and sedges		Broadleaf weeds		Grasses and sedges	
			2004	2005	2004	2005	2004	2005	2004	2005
Trifluralin	1000	PPI	8.06 (64)	8.94 (79)	4.47 (19)	4.36 (18)	42.9	51.4	21.5	17.2
Trifluralin	1500	PPI	5.38 (28)	6.08 (36)	3.60 (12)	3.32 (10)	20.3	26.1	14.0	11.0
Pendimethalin	1000	1 DAS	9.95 (98)	10.72 (114)	3.60 (12)	3.16 (9)	67.6	81.0	14.4	11.7
Pendimethalin	1250	1 DAS	8.30 (68)	9.00 (80)	3.32 (10)	3.00 (8)	47.3	56.8	11.7	9.2
Pendimethalin	1500	1 DAS	7.28 (52)	8.18 (66)	3.00 (8)	2.64 (6)	36.5	44.0	9.3	7.4
Hoeing fb trifluralin	1000	20 DAS	4.24 (17)	4.90 (23)	2.83 (7)	2.64 (6)	13.5	16.5	7.9	6.2
Hoeing fb pendimethalin	1000	20 DAS	4.80 (22)	5.38 (28)	2.24 (4)	2.24 (4)	17.6	21.2	4.6	3.6
Hoeing fb fenoxaprop	0050	20 DAS	5.19 (26)	5.57 (30)	4.12 (16)	3.60 (12)	18.9	22.5	18.2	15.0
Trifluralin fb hand hoeing	1000	PPI fb 20 DAS	5.00 (24)	5.39 (28)	3.32 (10)	3.16 (9)	17.7	21.3	11.7	9.3
Pendimethalin fb hand hoeing	1000	PE fb 20 DAS	5.29 (27)	6.08 (36)	3.00 (8)	3.00 (8)	19.1	23.7	9.4	7.8
Trifluralin fb fenoxaprop	1000 fb 50	PPI fb 30 DAS	7.55 (56)	8.48 (71)	4.12 (16)	3.60 (12)	39.2	47.4	18.6	14.8
Pendimethalin fb fenoxaprop	1000 fb 50	PE fb 30 DAS	9.64 (92)	10.39 (107)	3.60 (12)	3.16 (9)	63.6	77.0	14.0	10.9
One hand hoeing	-	20 DAS	5.10 (25)	5.74 (32)	4.36 (18)	3.74 (13)	17.6	20.4	20.4	15.9
Two hand hoeings	-	20 & 40 DAS	2.23 (4)	2.24 (4)	2.24 (4)	2.24 (4)	1.4	2.3	4.7	3.6
Unweeded	-	-	14.03 (196)	15.43 (237)	6.48 (41)	5.83 (33)	135.2	160.4	46.7	35.8
Weed-free	-	-	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	0.0	0.0	0.0	0.0
LSD (P=0.05)			0.57	0.69	0.73	0.61	5.6	7.1	2.7	3.1

Original values in parentheses were transformed to $\sqrt{X+1}$. fb+followed by, DAS–Days after sowing.

Table 2. Visual control of weeds, pods per plant and seed yield of crop as influenced by different treatments

Treatment	Dose (g ha^{-1})	Application stage	Visual control (%) 90 DAS				Pods/plant		Grain yield (kg ha^{-1})	
			Broadleaf weeds		Grasses and sedges		2004	2005	2004	2005
			2004	2005	2004	2005				
Trifluralin	1000	PPI	56.2 (69)	49.6 (50)	45.0 (50)	47.3 (54)	84	78	1560	1286
Trifluralin	1500	PPI	67.2 (85)	55.5 (68)	49.6 (58)	56.8 (70)	111	106	1806	1598
Pendimethalin	1000	1 DAS	45.0 (50)	40.4 (42)	49.0 (57)	56.8 (70)	83	76	1533	1384
Pendimethalin	1250	1 DAS	53.7 (65)	49.6 (58)	51.9 (62)	60.0 (75)	99	92	1702	1480
Pendimethalin	1500	1 DAS	58.7 (73)	52.5 (63)	54.9 (67)	63.4 (80)	110	102	1784	1564
Hoeing fb trifluralin	1000	2ODAS	71.6 (90)	62.0 (78)	58.7 (73)	67.2 (85)	82	76	1457	1266
Hoeing fb pendimethalin	1000	20 DAS	69.7 (88)	60.0 (75)	63.4 (80)	71.6 (90)	81	81	1382	1198
Hoeing fb fenoxaprop	0050	20 DAS	68.0 (86)	60.0 (75)	49.0 (57)	51.4 (61)	77	72	1074	878
Trifluralin fb hand hoeing	1000	PPI fb 20 DAS	68.9 (87)	61.3 (77)	58.0 (72)	60.0 (75)	112	109	1866	1673
Pendimethalin fb hand hoeing	1000	PE fb 20 DAS	68.0 (86)	60.0 (75)	60.0 (75)	63.4 (80)	110	106	1879	1694
Trifluralin fb fenoxaprop	1000 fb 50	PPI fb 30 DAS	57.4 (71)	53.7 (65)	47.9 (55)	50.8 (60)	87	82	1594	1367
Pendimethalin fb fenoxaprop	1000 fb 50	PE fb 30 DAS	46.7 (53)	45.0 (50)	52.5 (63)	56.8 (70)	90	84	1667	1289
One hand hoeing	-	20 DAS	68.9 (87)	61.3 (77)	46.7 (53)	48.4 (56)	78	72	1060	904
Two hand hoeings	-	20 & 40 DAS	81.9 (98)	74.7 (93)	73.6 (92)	71.6 (90)	114	108	1885	1667
Unweeded	-	-	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	48	43	861	774
Weed-free	-	-	90.0 (100)	90.0 (100)	90.0 (100)	90.0 (100)	119	112	1953	1722
LSD (P=0.05)			7.2	5.1	5.3	6.3	9	7	167	145

Original per cent control data in parentheses were arcsin transformed. fb–followed by, DAS–Days after sowing.

RESULTS AND DISCUSSION

Effect on Weeds

Experimental field was infested with broadleaf weeds (80%) (*Celosia argentea* L. and *Digera arvensis* Forsk) and grassy weeds (*Echinochloa colona* L., *Dactyloctenium aegyptium* and *Cyperus rotundus* L.). Grasses and sedges constituted 20% of the total weed population. *Trianthema portucastrum* constituted 75% of total broadleaf weeds and *Echinochloa colona* 90% of the total grasses. The density and dry weight of weeds were reduced with the corresponding increase in the dose of trifluralin as well as pendimethalin (Table 1) and similar effects were observed on per cent control of weeds at 90 DAS (Table 2). Trifluralin alone at 1500 g ha^{-1} and trifluralin or pendimethalin each at 1000 g ha^{-1} fb one hand hoeing 20 DAS provided better control of weeds compared to all other herbicidal treatments. On an average, these three treatments provided 80% control of broadleaf and 71.5% control of grassy weeds. Two hand hoeings (20 and 40 DAS) resulted in 95 and 91% control of broadleaf and grassy weeds, respectively. These results are in strong conformity with the earlier findings (Chhokar and Balyan, 1999). Lower doses of trifluralin and pendimethalin applied alone or integrated with fenoxaprop, one hoeing (20 DAS) and one hoeing 20 DAS fb fenoxaprop at 50 g ha^{-1} (20 DAS) were less effective on weeds. In general, trifluralin proved superior to pendimethalin against broadleaf weeds at respective doses (Tables 1 and 2).

Effect on Crop

There was no herbicidal toxicity on soybean. The highest number of pods/plant and grain yield of soybean were obtained in the plots kept weed-free throughout the crop season (Table 2). All weed control treatments registered significantly higher number of pods/plant and grain yield of soybean than weedy check. Trifluralin at 1500 g ha^{-1}, trifluralin and pendimethalin each at 1000 g ha^{-1} fb one hoeing 20 DAS, and two hoeings (20 and 40 DAS) being at par with each other produced pods/plant and grain yield statistically similar to weed-free. This could be obviously due to better control of weeds as discussed earlier. Trifluralin at 1000 g ha^{-1} and all doses of pendimethalin applied alone failed to provide satisfactory control of weeds. Integration of fenoxaprop at 20 DAS with hoeing, trifluralin or pendimethalin did not provide any additional benefit in terms of weed control as well as grain yield. Weeds growing throughout crop season reduced the grain yield of soybean by 55%.

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