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Effect of Weedicides on Physiological parameters, Growth, Yield and Yield components of Soybean (*Glycine max*. L) and Weed Growth.

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Research Article

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ABSTRACT

A field experiment was conducted during kharif 2006 to study the effect of weedicides on physiological parameters, growth, yield and yield components of Soybean (Glycine max. L) and weed growth at College of Agriculture, University of Agricultural Sciences, Dharwad. Data revealed that among herbicides pendimethalin 1350.5(g a.i/ha) and imazethepyr 87.50 (g a.i/ha) gave season long weed control and effectively checked the weed density. All herbicides increased leaf dry matter, stem dry matter and total dry matter. The herbicides also increased important physiological characters like leaf area ,LAD,RGR, CGR and NAR. Where, weed competition reduced all these parameters. Nitrate reductase activity and total chlorophyll content were higher in pendimethalin 1350.50 (g a.i/ha) and imazethepyr 87.50 (g a.i/ha) .tepraloxydim 100.0 (g a.i/ha).All herbicide treatments significantly improved yield and yield components like number of pods per plant, number of seeds per plant, 100 seed weight, pod weight and harvest index compared to control and increase was more in pendimethalin 1350.5 (g a.i/ha) and imazethepyr 87.50 (g a.i/ha) treatments.

INTRODUCTION

Soybean is one of the important pulse and oilseed crops of India. It grows well during the kharif or monsoon, season (July-October) in the dry-land areas of peninsular India. In kharif season due to continuous rains there will be high weed infestation and high weed competition is one of the most of important causes of yield loss in soybean and is estimated to be 22-77 % [5,12]. The costly and unavailability of labours coupled with unfavourable weather conditions offer an opportunity for the chemical weed control. The pre-emergent herbicides like alachlor, fluchloralin and metachlor have been recommended for weed control in soybean and are being used by the farmers from quite long time. An attempt has been made to study the effect of post emergent herbicides along with pre-emergent herbicides on physiological parameters, growth and yield components of soybean and weed growth.

MATERIALS AND METHODS

A field experiment was conducted during Kharif 2006 at College of Agriculture, University of Agricultural Sciences, and Dharwad. Soil was medium black clay loam soil (20.55 % sand, 27.52 % silt, 51.99 % clay), medium in organic carbon (0.52 %) and pH was 7.6. Twenty kg N ha-1, 80 kg P205 ha-1, 40 kg Potash ha-1 were applied uniformly to all plots. Soil had 221 kg ha-1 available N, 32.4 kg ha-1 available P, 318 kg ha-1 available K. Experiment was laid out in randomised block design with fourteen treatments and three replications. Treatments consisted of pendimethalin (pre-emergence) at 483.75, 580.50, 677.25, 750 and 1350.50 g.a.i.ha-1 followed by imazethepyr (post- emergent) at 52.50, 70.0, 87.50 and 175.0 g.a.i.ha-1 and tepraloxydim (post- emergent) at 25.0, 37.5, 50.0, and 100.0 g.a.i.ha-1 with weedy check. Soybean variety JS-335 was sown on July 19, 2006 with spacing of 30 x 10 cm. Plot size was 3m x 2.4 m. Pendimethalin was sprayed one day before sowing and imazethepyr, tepraloxydim were sprayed fifteen days after sowing.

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The dry weight of different plant parts and total dry weight was recorded at 45,60 and 75 days after planting. Leaf area was determined by using leaf disc method. Growth parameters were calculated from the data obtained on dry weight of different plant parts and the leaf area. Net assimilation rate (NAR),crop growth rate(CGR) ,leaf area duration(LAD), biomass duration (BMD) and specific leaf area (SLA) were calculated as per the formula given by Gregory [2], Watson [13] ,Power el al. [8] and Sestak et al [10], respectively. Chlorophyll content and Nitrate reductase (NRA) were analysed as per the methods mentioned by Arnon [1] and Saradhambal et al. [9] respectively. ANOVA was analysed and interpreted as per the methods of Panse and Sukhatme [7].

RESULTS AND DISCUSSION

The results pertaining to total dry matter (TDM) indicated significant difference among the treatments at all the stages (Table 1). The total dry matter increased from 20 DAS to harvest in all the treatments. Among the herbicide treatments, application with pendimethalin @ 1350.50 (g a.i/ha) has recorded significant increase in total dry matter content followed by imazethepyr @ 87.50 (g a.i/ha), tepraloxydim @ 100.0 (g a.i/ha) as compared to control. Significantly lower TDM was observed in control at all the stages. imazethepyr @ 175.0 (ga.i/ha) and imazethepyr @ 52.50 (g a.i/ha) is on par with control at all stages. Maximum totaldry weight was recorded in pendimethalin @ 1350.50 g a.i/ha (16.15 g plant-1) at harvest. The distribution of dry matter into assimilatory source leaves and reproductive parts mainly pods indicated greater efficiency of the plant. High dry matter accumulation in leaves which are photosynthetically active was responsible for better crop growth and yield. In general, the nitrate reductase activity decreased with of age the crop, differed significantly due to herbicides concentrations at all the stages of the crop growth (Table 3). Among herbicide treatment the pendimethalin @ 1350.50 (g a.i/ha) recorded higher values followed by imazethepyr @ 87.5 (g a.i/ha), tepraloxydim @ 100.0 (g a.i/ha) at all the stages compared to control. Lower value is observed in control which is on par with imazethepyr @ 175.0 (g a.i/ha), imazethepyr @ 52.5 (g a.i/ha). Maximum nitrate reductase activity (260.0) was observed in pendimethalin @ 1350.50 (g .a.i/ha) at 40 DAS. The total chlorophyll content decreases at later stages of crop. Among herbicides treatment pendimethalin @ 1350.50 (g a.i/ha) showed significantly higher values followed by imazethepyr @ 87.50 (g a.i/ha), tepraloxydim @ 100.0 (g a.i/ha) at all the stages as compared to control. While, lower value was observed in control which was on par with imazethepyr @ 175 (g a.i/ha), imazethepyr @ 52.5 (g a.i/ha). Maximum total chlorophyll content (2.87 mg g-1 fr.wt) was noticed in pendimethalin @ 1350.5 (g a.i/ha) at 40 DAS. Herbicides significantly reduced the weed intensity at all the stages of the crop growth (Table 2). Pre-emergence application of pendimethalin at 1350.50 g.a.i.ha-1 recorded lower number of weeds per m2 (8.0) which is on par with imazethepyr (post- emergent) at 87.50 g.a.i.ha-1 (10.4), tepraloxydim (post- emergent) at 100.0 g.a.i.ha-1 (10.4) and control recorded highest weed number (120.0) at 60 DAS.

Higher numbers of weeds per m2 was recorded in control at all the stages. All treatments effectively decreased the weed infestation compared to control. Where as in dry matter of weeds also showed similar results as number of weeds per m2, low weed dry matter accumulation was recorded in the treatments of pendimethalin at 1350.50 g.a.i.ha-1 followed by imazethepyr at 87.50 g.a.i.ha-1, tepraloxydim at 100.0 g.a.i.ha-1 . Higher weed control efficiency at 40DAS was recorded by pendimethalin at 1350.50 g.a.i.ha- (87.6%) which was on par with imazethepyr at 87.50 g.a.i.ha-1 (86.8 %), tepraloxydim at 100.0 g.a.i.ha-1 (86.5 %) and tepraloxydim at 50.0 g.a.i.ha-1 (83.8 %) over all other treatments. All herbicidal treatments effectively increased the weed control efficiency over control. Since the herbicidal application reduced the weed dry mass as compared to the control this resulted in increased weed control efficiency. Maximum weed control efficiency was recorded in pendimethalin at 1350.50 g g.a.i.ha-.1. Pendimethalin killed the weed seeds and weed effectively in early stages of crop growth hence it maintained the higher weed control efficiency. Similar result was also obtained by Manish Bhan and Kewat [6], Kalpana and Velyautham [4].

All herbicidal treatments significantly increased yield and yield components like seed yield, test weight, pod dry weight, number of pods per plant, number of seeds per plant, harvest index (Table 4). The maximum grain yield of 1950 kg ha-1 was recorded in pendimethalin at 1350.50 g.a.i.ha-1 which was on par with imazethepyr at 87.50 g.a.i.ha-1 (1836 kg ha-1) , tepraloxydim at 100.0 g.a.i.ha- 1 (1792 kg ha-1) and minimum in control (695 kg ha-1) . Higher yield in these treatments may be attributed to effective control of weeds during the early stages of crop growth and helped in better development of infrastructure of the plant. Due to less competition for nutrients, radiation and water from weeds facilitated for the better growth and development of the crop. Similar result was also reported by Singh and Singh [11] and Joshi and Billore [3].

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Table 1: Effect of herbicides on total dry matter, leaf area, total chlorophyll content and nitrate reductase activity at different stages of crop growth in soybean

Sl. No	Treatments	Total drymatter (gram/plant)				Leaf area (cm ^{2}/plant)			Chlorophyll content (mg/gram FW)			Nitrate reductase activity (µ mol $NaNO_3$/ g fr. wt./ hr)	
		Days after sowing				Days after sowing			Days after sowing			Days after sowing	
		20	40	60	harvest	20	40	60	20	40	60	20	40
T_1	Pendimethalin (483.75 g a.i.ha^{-1})	2.04	6.92	12.94	13.71	57.4	341	764	1.34	2.25	0.99	219.8	201.5
T_2	Pendimethalin (580.50 g.a.i ha^{-1})	2.19	7.41	13.60	14.34	62.8	365	805	1.42	2.42	1.07	231.6	211.5
T_3	Pendimethalin (677.25 g.a.i ha^{-1})	2.27	7.92	13.94	14.64	65.7	394	935	1.50	2.55	1.14	237.8	224.6
T_4	Pendimethalin (750.0 g a.i ha^{-1})	2.33	8.04	14.14	14.87	67.6	401	859	1.54	2.55	1.16	242.6	231.6
T_5	Pendimethalin (1350.50 g a.i ha^{-1})	2.84	8.83	15.17	16.15	69.3	438	984	1.95	2.87	1.34	260.0	244.5
T_6	Imazethepyr (52.50 g.a.i ha^{-1})	2.00	6.63	12.78	13.04	55.6	337	752	1.30	2.22	0.92	216.5	193.6
T_7	Imazethepyr (70.0 g.a.i ha^{-1})	2.08	7.08	13.23	14.01	59.0	351	784	1.37	2.33	1.02	223.0	203.5
T_8	Imazethepyr (87.50 g.a.i ha^{-1})	2.69	8.60	14.91	15.70	69.1	425	906	1.70	2.70	1.26	257.3	242.5
T_9	Imazethepyr (175.0 g.a.i ha^{-1})	1.94	6.39	12.55	12.68	52.5	326	741	1.28	1.98	0.89	210.2	189.7
T_{10}	Tepraloxydim (25.0 g.a.i ha^{-1})	2.14	7.26	13.40	14.23	60.3	358	793	1.42	2.49	1.04	227.2	209.5
T_{11}	Tepraloxydim (37.50 g.a.i ha^{-1})	2.22	7.73	13.77	14.61	64.1	379	816	1.43	2.47	1.11	233.7	216.7
T_{12}	Tepraloxydim (50.0 g.a.i./ha)	2.46	8.18	14.53	15.31	67.7	412	864	1.62	2.64	1.18	246.2	236.5
T_{13}	Tepraloxydim (100.0 g.a.i ha^{-1})	2.54	8.32	14.69	15.50	68.0	419	890	1.66	2.68	1.24	250.1	239.6
T_{14}	Control (no weeding)	1.91	6.29	11.26	11.69	51.1	325	632	1.25	1.70	0.76	175.6	161.6
	SEm ±	0.11	0.27	0.31	0.46	0.88	6.29	3.09	0.11	0.10	0.05	2.27	1.96
	CD at 5%	0.32	0.83	0.89	1.32	2.53	18.5	8.98	0.32	0.29	0.15	6.56	5.69

Table 2: Effect of herbicides on total number of weeds m^{-2}, total dry matter of weeds (g m^{-2}) and weed control efficiency (%) at different stages of crop growth in soybean

Sl. No.	Treatments	Total number of weeds m-2 Days after sowing			Total dry matter of weeds (g m-2) Days after sowing			Weed control efficiency (%)
		20	40	60	20	40	60	40 DAYS
T_1	Pendimethalin (483.75 g a.i.ha^{-1})	40.0	69.2	41.2	13.2	40.0	38.5	44.4
T_2	Pendimethalin (580.50 g.a.i ha^{-1})	26.4	42.4	32.0	10.4	24.0	22.8	66.6
T_3	Pendimethalin (677.25 g.a.i ha^{-1})	25.2	38.4	25.2	8.6	16.2	5.8	77.5
T_4	Pendimethalin (750.0 g a.i ha^{-1})	25.2	37.2	20.0	6.7	12.0	2.8	83.3
T_5	Pendimethalin (1350.50 g a.i ha^{-1})	3.0	25.4	8.0	2.9	8.9	2.7	87.6
T_6	Imazethepyr (52.50 g.a.i ha^{-1})	45.2	69.2	42.4	14.4	50.8	47.6	29.4
T_7	Imazethepyr (70.0 g.a.i ha^{-1})	37.2	50.4	40.0	12.6	28.0	27.8	61.1
T_8	Imazethepyr (87.50 g.a.i ha^{-1})	12.0	28.0	10.4	2.9	9.5	2.76	86.8
T_9	Imazethepyr (175.0 g.a.i ha^{-1})	50.4	72.0	52.4	16.6	55.2	56.6	23.3
T_{10}	Tepraloxydim (25.0 g.a.i ha^{-1})	30.4	45.2	40.0	12.5	26.0	29.9	63.8
T_{11}	Tepraloxydim (37.50 g.a.i ha^{-1})	26.4	41.2	28.0	8.8	17.5	9.36	75.6
T_{12}	Tepraloxydim (50.0 g.a.i./ha)	22.4	34.4	14.4	6.6	11.6	2.96	83.8
T_{13}	Tepraloxydim (100.0 g.a.i ha^{-1})	44.4	28.0	10.4	6.1	9.7	2.90	86.5
T_{14}	Control (no weeding)	81.2	86.4	120.0	27.4	72.0	57.4	0
	SEm ±	3.64	4.18	2.25	1.62	1.83	1.70	0.89
	CD at 5%	10.52	12.12	6.56	4.69	5.30	4.96	2.56

Table 3: Effect of herbicides on Crop growth rate, Net assimilation rate, Relative growth rate and leaf area duration during different stages of crop growth in soybean

Sl. No	Treatments	Crop growth rate (g m^{-2} day^{-1})		Net assimilation rate (g m^{-2} day^{-1})		Relative growth rate (g g^{-1} day^{-1})		Leaf area duration (Days)	
		20-40	40-60	20-40	40-60	20-40	40-60	20-40	40-60
T_1	Pendimethalin (483.75 g a.i.ha^{-1})	8.13	10.03	0.0153	0.0054	8.13	10.03	13.3	36.8
T_2	Pendimethalin (580.50 g.a.i ha^{-1})	8.70	10.31	0.0152	0.0056	8.70	10.31	14.3	39.0
T_3	Pendimethalin (677.25 g.a.i ha^{-1})	9.41	10.05	0.0154	0.0051	9.41	10.05	15.3	41.0
T_4	Pendimethalin (750.0 g a.i ha^{-1})	9.52	10.16	0.0153	0.0051	9.52	10.16	15.6	42.0
T_5	Pendimethalin (1350.50 g a.i ha^{-1})	9.99	10.56	0.0155	0.0061	9.99	10.56	16.9	47.4
T_6	Imazethepyr (52.50 g.a.i ha^{-1})	7.72	10.25	0.0148	0.0059	7.72	10.25	13.1	36.3
T_7	Imazethepyr (70.0 g.a.i ha^{-1})	8.34	10.25	0.0153	0.0057	8.34	10.25	13.7	37.9
T_8	Imazethepyr (87.50 g.a.i ha^{-1})	9.85	10.51	0.0151	0.0050	9.85	10.51	16.5	44.4
T_9	Imazethepyr (175.0 g.a.i ha^{-1})	7.43	10.26	0.0149	0.0057	7.43	10.26	12.6	35.6
T_{10}	Tepraloxydim (25.0 g.a.i ha^{-1})	8.54	10.23	0.0153	0.0056	8.54	10.23	13.9	38.4
T_{11}	Tepraloxydim (37.50 g.a.i ha^{-1})	9.17	10.08	0.0150	0.0053	9.17	10.08	14.8	39.8
T_{12}	Tepraloxydim (50.0 g.a.i./ha)	9.53	10.60	0.0150	0.0053	9.53	10.60	16.0	42.6
T_{13}	Tepraloxydim (100.0 g.a.i ha^{-1})	9.63	10.63	0.0150	0.0051	9.63	10.63	16.2	42.6
T_{14}	Control (no weeding)	7.31	8.28	0.0148	0.0047	7.31	8.28	16.2	43.6
	SEm ±	0.33	0.39	0.001	0.0001	0.33	0.39	0.33	1.65
	CD at 5%	0.96	1.13	0.003	0.0004	0.96	1.13	0.94	4.86

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Table 4: Effect of herbicides on seed yield and yield components of soybean at harvest

	Treatments	Pod weight (g plant^{-1})	Seed yield (g plant^{-1})	Seed yield (kg ha^{-1})	100 Seed weight (g)	Harvest index (%)	No of pods per plant	No of seeds per plant
T_1	Pendimethalin (483.75 g a.i ha^{-1})	8.10	4.53	1510	9.51	33.0	41.5	71.1
T_2	Pendimethalin (580.50 g.a.i ha^{-1})	8.37	4.81	1602	9.88	33.5	43.0	76.6
T_3	Pendimethalin (677.25 g.a.i ha^{-1})	8.51	5.10	1699	10.16	34.8	51.5	81.3
T_4	Pendimethalin (750.0 g a.i ha^{-1})	8.66	5.19	1730	10.35	34.9	51.6	83.8
T_5	Pendimethalin (1350.50 g a.i ha^{-1})	9.41	5.85	1950	12.55	36.2	60.5	98.8
T_6	Imazethepyr (52.50 g.a.i ha^{-1})	7.48	3.92	1307	9.32	30.1	40.6	69.2
T_7	Imazethepyr (70.0 g.a.i ha^{-1})	8.22	4.66	1552	9.60	33.2	41.8	73.4
T_8	Imazethepyr (87.50 g.a.i ha^{-1})	9.07	5.51	1836	11.62	35.1	58.6	95.6
T_9	Imazethepyr (175.0 g.a.i ha^{-1})	7.25	3.69	1230	9.21	29.1	38.0	66.9
T_{10}	Tepraloxydim (25.0 g.a.i ha^{-1})	8.36	4.80	1601	9.79	33.7	42.1	73.6
T_{11}	Tepraloxydim (37.50 g.a.i./ha)	8.55	4.99	1663	9.97	34.2	47.6	77.6
T_{12}	Tepraloxydim (50.0 g.a.i ha^{-1})	8.83	5.27	1757	10.44	34.4	52.5	86.8
T_{13}	Tepraloxydim (100.0 g.a.i ha^{-1})	8.94	5.38	1792	10.93	34.7	57.5	92.6
T_{14}	Control (no weeding)	6.39	2.09	695	8.90	17.8	37.7	49.6
	S. Em. ±	0.44	0.44	41.34	0.04	0.80	1.78	2.11
	CD at 5%	1.26	1.29	120.3	0.13	2.31	5.13	6.12

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