

Integrated weed management in soybean (*Glycine max* (L.) Merrill) under different moisture regimes

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Abstract : A field experiment was conducted at Agricultural College and Research Institute, Coimbatore during summer and Kharif seasons of 1994 to investigate the effect of weed control methods under different moisture regimes in soybean. The treatments included two moisture regimes and five weed control methods. Maximum grain yield was obtained when irrigation was resorted at 0.60 IW/CPE ratio with the pre-emergence application of alachlor@1.25 kg ha followed by handweeding at 40 DAS. (*Key Words :* Moisture regime; IW/CPW ratio; Weed DMP; Weed population).

Soybean is a two-in-one crop, both a pulse and an oil seed crop. Soybean seeds contain 42 per cent protein and 20 per cent oil. In India, soybean is cultivated in an area of 3.99 mha with an annual production of 3.66 million tonnes accounting to a productivity of 900kg ha⁻¹. However, as per the report of the National Commission of Agriculture, the requirement of soybean in India by 2000 AD will be 10 lakh tonnes. Mostly, the crop is grown under rainfed conditions, in poor and marginal lands and also intercropped with coconut and sugarcane. On the other hand, soybean being a high-energy crop receives low level of fertilizers and irrigation. Among the management practices, more important but often not recognized factor responsible for poor yield in soybean is inadequate weed control, especially during the early period of the crop under irrigated condition. In this period, slower crop canopy coverage favours heavy infestation of weeds causing considerable reduction in growth and yield of the crop. Hence, a study was undertaken to evaluate the effect of two levels of moisture regimes integrated with different weed management methods on weed population, weed dry matter production (DMP) and yield of soybean crop.

Materials and Methods

Filed experiments were conducted at the Agricultural College and Research Institute, Coimbatore during 1994 in Summer and Kharif seasons. The soil of the experimental site was deep, moderately well drained, sandy clay loam with low, medium and high available nitrogen, phosphorus and potassium 297.0, 25.5 and 505.0 kg ha⁻¹ respectively during summer and 288.0, 20.3 and 479.0 kg NPK respectively during Kharif. Soybean Co-1 with duration of 85 days was used in this study. The trial consisted of 10 treatments in a split plot design with three replications. Irrigation scheduling of 0.40(I₁) and 0.60 IW/CPE ratio (I₂) as main plots and weed management viz., unweeded control (W₁), hand weeding (HW) at 20 and 40

days after sowing (W₂), pre-emergence application of pendimethalin@0.75 kg ha⁻¹ +hand weeding at 40 days after sowing (W₃), and pre-emergence alachlor@1.25 kg ha⁻¹ +handweeding at 40 days after sowing (W₄) and pre-emergence Oxyflourfen@0.20 kg ha⁻¹ +hand weeding at 40 days after sowing (W₅), were allotted to sub plots. Weed count was taken on 20, 40 and 60 DAS and at harvest by using 0.5m x 0.5m quadrat and was converted into log (x+2) transformation. These values were statistically analyzed.

Results and Discussion

Results of the investigations revealed that (Table 1) the low moisture regime of 0.40 IW/CPE ratio reduced the weed population considerably as compared to the higher moisture regime of 0.60 IW/CPE ratio, since, the frequency of irrigation was more (Six no. of irrigations), which favoured more weed growth. The similar trend was also observed in weed dry matter production at harvest (T_{3,4}), wherein, it was significantly low in moisture regime of 0.40 IW/CPE ratio (four No. of irrigations) during both the seasons. The increase in the weed dry matter at high moisture regime (0.60 IW/CPE ratio) might be attributed to better availability of nutrients and moisture as compared to lower moisture regime (0.40 IW/CPE ratio). This difference was significant at all stages of crop growth during both the seasons. Similar observation has been reported by Nalayini (1990). The data on yield and yield attributes showed that higher frequency of irrigation at 0.60 IW/CPE ratio recorded increased yield by 18.04 per cent which is superior to the yield obtained under 0.40 IW/CPE ratio in which the yield attributes such as No of pods/plant, No. of seeds/pod and seed test weight (Table 2) were reduced drastically, though it registered low weed population and weed DMP in soybean. Moisture stress plays a vital role in pod filling in soybean. The difference in test weight may be due to the source and sink relationship, which was governed

Table 1: Effect of moisture regimes and weed management methods on weed population (No/m²)

Treatments	Summer 1994				Kharif 1994			
	20 DAS	40 DAS	60 DAS	At Harvest	20 DAS	40 DAS	60 DAS	At Harvest
MOISTURE REGIMES								
0.40 IW/CPE ratio	38.00 (1.477)	33.55 (1.432)	30.02 (1.170)	39.94 (1.621)	39.94 (1.621)	34.79 (1.474)	31.99 (1.191)	27.92 (1.133)
0.60 IW/CPE ratio	59.18 (1.658)	53.75 (1.654)	46.83 (1.383)	39.04 (1.342)	61.62 (1.855)	56.31 (1.698)	47.69 (1.397)	40.77 (1.356)
SE _d	0.044	0.042	0.021	0.044	0.109	0.095	0.042	0.064
CD (P=0.05)	0.10	0.10	0.05	0.04	0.11	0.10	0.04	0.06
WEED MANAGEMENT METHODS								
Unweeded Control	91.71 (1.954)	106.08 (2.033)	142.08 (2.115)	117.47 (2.054)	94.30 (2.013)	110.08 (2.101)	145.54 (2.136)	128.52 (2.071)
HW (20 & 40 DAS)	88.81 (1.932)	15.53 (1.195)	3.92 (0.731)	4.43 (0.778)	91.09 (1.959)	19.47 (1.217)	4.47 (0.768)	5.08 (0.793)
Pendimethalin 0.75 Kg ha ⁻¹ + HW (40 DAS)	35.42 (1.553)	41.75 (1.617)	20.88 (1.338)	17.09 (1.232)	37.68 (1.581)	43.97 (1.635)	23.19 (1.350)	18.79 (1.306)
Alachlor 1.25 kg ha ⁻¹ + HW (40 DAS)	11.24 (1.058)	23.31 (1.370)	9.71 (1.031)	7.70 (0.952)	12.30 (1.124)	25.24 (1.392)	10.52 (1.034)	8.40 (1.000)
Oxyflourfen 0.20 kg ha ⁻¹ + HW (40 DAS)	16.75 (1.245)	32.44 (1.501)	15.54 (1.217)	13.30 (1.154)	18.16 (1.263)	35.39 (1.511)	17.83 (1.255)	14.57 (1.189)
SE _d	0.103	0.059	0.036	0.04	0.099	0.124	0.035	0.061
CD (P=0.05)	0.20	0.12	0.07	0.08	0.20	0.25	0.07	0.12

Figures in the parentheses are log (x+2) transformed values.

DAS - Days after sowing ; HW - Hand Weeding

Table 2: Effect of moisture regimes and weed management methods on yield attributes of soybean

Treatments	Summer 1994			Kharif 1994		
	No. of Pods/Plant	No. of Seeds/Pod	Test Wt. of Seeds (g) (100 seed wt)	No. of Pods/Plant	No. of Seeds/Pod	Test Wt. of Seeds (g) (100 seed wt)
MOISTURE REGIMES						
0.40 IW/CPE ratio	29.72	2.25	8.99	32.56	2.27	9.00
0.60 IW/CPE ratio	37.73	2.40	9.12	40.07	2.43	9.12
SE _d	0.75	0.04	0.02	0.79	0.04	0.02
CD (P=0.05)	1.67	0.08	0.04	1.76	0.08	0.04
WEED MANAGEMENT METHODS						
Unweeded Control	24.51	2.15	8.78	27.39	2.17	8.79
+ HW (20+40 DAS)	37.36	2.40	9.13	40.57	2.40	9.13
Pendimethalin 0.75 Kg ha ⁻¹ + HW (40 DAS)	34.12	2.32	9.11	35.74	2.37	9.12
Alachlor 1.25 kg ha ⁻¹ + HW (40 DAS)	38.29	2.40	9.13	41.58	2.47	9.14
Oxyflourfen 0.20 kg ha ⁻¹ + HW (40 DAS)	34.41	2.32	9.12	36.28	2.37	9.12
SE _d	1.17	0.05	0.02	1.71	0.06	0.025
CD (P=0.05)	2.35	0.10	0.04	3.43	0.12	0.05

DAS - Days after sowing; HW - Hand Weeding

Table 3: Interaction effect of moisture regime and weed management methods on weed population, weed dry matter production and yield of Soybean (Summer 1994)

Treatments	Weed population (No/m ²) at 40 DAS			Weed dry matter production (Kg ha ⁻¹) at harvest			Grain yield (kg ha ⁻¹)		
	I ₁	I ₂	Mean	I ₁	I ₂	Mean	I ₁	I ₂	Mean
Unweeded control	84.10 (1.923)	126.88 (2.150)	105.45 (2.033)	1024	1262	1155	1419	1485	1465
Hand weeding (20 & 40 DAS)	11.44 (1.103)	18.10 (1.291)	14.77 (1.195)	164	211	167	2092	2500	2296
Pendimathalin 0.75 kg ha ⁻¹ + HW (40 DAS)	32.32 (1.507)	51.22 (1.713)	41.77 (1.617)	214	277	246	1879	2234	2056
Alachlor 1.25 kg ha ⁻¹ + HW (40 DAS)	17.55 (1.256)	29.88 (1.453)	23.71 (1.370)	171	216	190	2120	2528	2324
Oxyflourfen 0.25 kg ha ⁻¹ + HW (40 DAS)	22.33 (1.382)	42.66 (1.617)	32.49 (1.501)	203	269	239	1970	2347	2158
Mean	33.55 (1.432)	53.75 (1.654)		355	447		1898	2218	
	Weed population (No/m ²)			Weed DMP (kg ha ⁻¹)			Grain yield (kg ha ⁻¹)		
	SED	CD (P=0.05)		SED	CD (P=0.05)		SED	CD (P=0.05)	
I	0.042	0.095		21.2	47.2		49.9	111.17	
W	0.059	0.118		17.0	34.0		43.4	87.29	
W at I	0.083	0.166		17.0	34.1		51.7	103.96	
I at W	0.110	0.220		6.0	12.0		49.6	99.74	

I₁: 0.40 IW/CPE ratio; I₂: 0.60 IW/CPE ratio

Table 4: Interaction effect of moisture regime and weed management methods on weed population, weed dry matter production and yield of Soybean (Kharif 1994)

Treatments	Weed population (No/m ²) at 40 DAS			Weed dry matter production (Kg ha ⁻¹) at harvest			Grain yield (kg ha ⁻¹)		
	I ₁	I ₂	Mean	I ₁	I ₂	Mean	I ₁	I ₂	Mean
Unweeded control	88.23 (1.911)	128.93 (2.092)	108.58 (2.001)	1044	1249	1183	1421	1696	1558
Hand weeding (20 & 40 DAS)	12.62 (1.078)	25.82 (1.354)	19.22 (1.216)	183	254	193	2271	2705	2486
Pendimathalin 0.75 kg ha ⁻¹ + HW (40 DAS)	28.84 (1.536)	58.10 (1.732)	43.47 (1.634)	245	303	269	1991	2343	2192
Alachlor 1.25 kg ha ⁻¹ + HW (40 DAS)	19.69 (1.348)	30.75 (1.417)	25.22 (1.382)	185	248	214	2309	2743	2506
Oxyflourfen 0.25 kg ha ⁻¹ + HW (40 DAS)	24.57 (1.319)	54.21 (1.523)	34.89 (1.421)	229	283	254	2031	2424	2227
Mean	34.79 (1.438)	57.76 (1.623)		377	467		2004	2388	
	Weed population (No/m ²)			Weed DMP (kg ha ⁻¹)			Grain yield (kg ha ⁻¹)		
	SE _d	CD (P=0.05)		SE _d	CD (P=0.05)		SE _d	CD (P=0.05)	
I	0.039	0.089		18.3	40.7		46.5	103.60	
W	0.055	0.115		19.4	39.0		41.9	84.26	
W at I	0.088	0.165		12.5	25.1		47.6	95.72	
I at W	0.113	0.189		16.9	33.9		46.7	93.71	

I₁: 0.40 IW/CPE ratio; I₂: 0.60 IW/CPE ratio

by moisture regime as opined by Ravi Bharathi (1994).

Pre-emergence application of alachlor (1.25 kg ha⁻¹) + HW reduced weed population on DAS, closely followed by pre-emergence application of Oxyflourfen (0.20 kg ha⁻¹) + HW during both the seasons (Table 1). At 40 DAS, hand weeding tried during summer 1994 and it was superior to alachlor (1.2 kg ha⁻¹) + HW, which inturn comparable with Oxyflourfen (0.20 kg ha⁻¹) + HW and pendimethalin (0.75 kg ha⁻¹) + HW during Kharif 1994 (Table 1). Tiwari and Kurcharia (1990) reported that Oxyflourfen at 0.20 kg ai ha⁻¹ controlled the weeds and was economical compared with hand weeding. Hand weeding given at 20 and 40 DAS considerably reduced the weed population at 60 DAS and at harvest (Table 1). Similar trend was observed in weed dry matter production at harvest but it was at par with alachlor (1.25 kg ha⁻¹) + HW during both the seasons. Effective control of weed population during early stages of the crop growth in alachlor (1.25 kg ha⁻¹) + HW enhanced the yield attributes like No. of pods/plant, No. of seeds/pod and seed test weight of the crop, which contributed increased in yield during both the seasons (Table 2,3,4) but it was comparable with hand weeding treatment given on 20 and 40 DAS. Vedparkash et al (1991) recorded that hand weeding twice gave effective weed control and the highest seed yield in soybean. Borgohain and Dhua (1987) reported that application of alachlor at 1.5-kg ha⁻¹ gave the highest grain yield in soybean as compared to handweeding twice.

Interactions between moisture regimes and different weed management methods were observed in controlling weed population at 40 DAS. There was considerable depression of weed growth in 0.40 IW/CPE ratio in association with HW on 20 and 40 DAS (I₁ W₂) closely followed by alachlor (1.25 kg ha⁻¹) + HW imposed on 40 DAS (I₁ W₄), which in turn comparable with 0.60 IW/CPE ratio (I₂ W₄) during Kharif 1994. Similar trend was also noticed during summer 1994, while the moisture regime of 0.40 IW/CPE ratio, (I₁ W₂) and 0.60 IW/CPE (I₂ W₂) were inferior to each other under hand weeding treatment given on 20 and 40 DAS.

At harvest 0.40 IW/CPE ratio (I₁) recorded significantly lowest weed DMP under HW followed on 20 & 40 DAS (I₁ W₂), but it was on par with alachlor (1.25 kg ha⁻¹) + HW (I₁ W₄) while, the weed DMP was significantly higher over that of 0.60 ratio (I₂), at all the weed management methods tried during both seasons.

Interactions effect on yield of the crop was also observed between main plot and sub plot treatments. The maximum yield was obtained in

0.60 IW/CPE ratio at alachlor (1.25 kg ha⁻¹) + hand weeding imposed on 40 DAS (I₂ W₄), which was 19.2 and 18.7 per cent higher over 0.40 IW/CPE ratio under alachlor (1.25 kg ha⁻¹) + HW during summer and kharif respectively. It was as evidenced by, more No. of pod/plant, No. of seeds/pod and seed test weight of the crop at higher moisture regime of 0.60 IW/CPE ratio (I₂) and at alachlor (1.25 kg ha⁻¹) + HW. This might be due to effective control of weeds resulting in less competition to the crop for moisture, nutrients and sunlight at (W₄) alachlor treated plots. Further, the higher frequency of irrigation at 0.60 IW/CPE ratio enabled the yield of soybean crop by 18.04 per cent, which is significantly superior to the yield obtained under 0.40 IW/CPE ratio. The result confirms the findings of Garside *et al.*, (1992). Similarly, higher moisture regime with all weed management methods increased the yield over lower mixture regime during both the seasons.

From this study it may be concluded that pre-emergence application of alachlor (1.25 kg ha⁻¹) plus hand weeding on 40 DAS under higher moisture regime of 0.60 IW/CPE ratio is the effective weed control measure and for getting higher yield in soybean.

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