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Integrated weed management in soybean (*Glycine max*) under different moisture regimes and population densities

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ABSTRACT

A field experiment was conducted during summer and rainy seasons of 1994 at Coimbatore, to study the effects of weed-management methods with varying levels of plant densities under 2 irrigation moisture regimes on soybean [*Glycine max* (L.) Merr.]. Though the lowest moisture regime (0.40 IW : CPE) recorded better weed-control efficiency and decreased N uptake by weeds at harvest, the higher moisture regume (0.60 IW : CPE) enhanced the N uptake and crop dry-matter production. Weed-control efficiency was found higher at 666,000 plants/ha. Among the weed-management methods, alachlor 1.25 kg/ha + hand-weeding 40 days after sowing recorded the highest weed-control efficiency and was as good as hand-weeding twice. An increase in yield of the crop as well as the net return was registered under higher moisture regime of 0.60 IW : CPE ratio. The density of 444,000 plants/ha markedly increased the yield in summer, whereas it was comparable with 666,000 plants/ha during the rainy season.

Key words : Moisture regime, Plant density, Weed dry-matter production, Weed-control efficiency

Soybean productivity is low due to its growing in nutrients-deprived poor soils and non-adoption of improved technologies, where the attention given to weed management is very poor. Weeds infesting soybean caure losses ranging from 20 to 77% (Kolhe, 1996). Crop yield is reduced by 17% due to weed, besides affecting the seed quality due to mixing of weed seeds with soybean, resulting poor market price of soybean. Among the various factors causing heavy infestation of weeds, the available inter- and intra-row spaces during early stages of the crop facilitate easy extraction of sufficient soil moisture and nutrients and interception of more light by the weeds. Keeping in view these facts, a study was carried out to find out the suitable weed-management practice at varying moisture regimes and population densites in soybean.

MATERIALS AND METHODS

The experiment was conducted at

Agricultural College and Research Institute, Coimbatore, during summer and the rainy seasons of 1994. The soil was deep, moderately well-drained, sandy clay loam with low, medium and high available N, P and K respectively. Soybean 'Co 1' of '85 days duration was used. The trial was laid out in split-plot design with 3 replications. The treatments comprising 2 levels of moisture regimes, viz. 0.40 and 0.60 IW : CPE ratio, in combination with 3 plant densities, viz. 333,000, 444,000 and 666,000 plants/ha, were the main plots. Weed-management methods like unweeded control, hand-weeding twice on 20 and 40 days after sowing (DAS), pre-emergence pendimethalin 0.75 kg/ha + hand-weeding (HW) at 40 days, pre-emergence alachlor 1.25 kg/ha + HW at 40 days and oxyflourfen 0.20 kg/ha + HW at 40 days were allotted to subplot treatments. Weed count was taken by using the quadrate and the obtained number of weeds was converated into log (x + 2) transformed values.

Weed-control efficiency was computed by arriving a ratio for the differences in weed population between control and treated plots and to the weed population of control plot, expressed in per cent. The weed samples were air-dried and then oven-dried at 80 ± 20°C till a constant weight was obtained and expressed in kg/ha. All the bio-metric observations on plants and weeds were recorded at harvest and data were analysed statistically.

RESULTS AND DISCUSSION

Weed-control efficiency

Weed-control efficiency for soybean was not altered by the water regimes or by the plant densities. However, weed-management practices had a distinct impact on this character. Application of alachlor 1.25 kg/ha + hand-weeding improved the efficiency close to hand-weeding twice.

N uptake by weeds

Scheduling irrigation at 0.60 IW : CPE ratio indirectly favoured the nitrogen uptake by weeds during both the seasons as compared to 0.40 IW : CPE ratio. Increased nutrient removal of weeds under high moisture regime might be due to higher dry matter of weeds associated with favourable soil moisture and nutrient status of the soil. The crop densities showed significant difference in N removal by weeds. Crop densities of 666,000 and 444,000 plants/ha decreased the N removal by weeds due to less growth of weeds (Table 1). All the weed-management methods greatly reduced the nutrient removal by weeds, due to effective control of regenerated weeds. Lower nutrient removal by weeds was recorded in alachlor integrated with hand-weeding (Singh and Sharma, 1991) and oxyflourfen in combination with 1 hand-weeding (Maurya *et al.*, 1999).

Crop dry-matter production

Irrigation treatment differed significantly during summer and rainy season with respect to crop dry-matter production. Higher crop dry-matter production was recorded when irrigation was given at 0.60 IW : CPE ratio (Table 2). Though moisture regimes could not alter the weed-control efficiency, the crop growth, physiological parameters and water relation were

Table 1. Effect of moisture, plant density and weed control on weed dry-matter production, weed-control efficiency and N removal by weeds at harvest

Treatment	Weed dry-matter production (kg/ha)		Weed-control efficiency		N removal by weeds (kg/ha)	
	Summer 1994	*Kharif* 1994	Summer 1994	*Kharif* 1994	Summer 1994	*Kharif* 1994
Moisture regime						
0.40 IW : CPE	355	377	91.8	90.8	15.98	16.73
0.60 IW : CPE	447	467	90.4	88.3	18.91	19.02
CD (P=0.05)	47	41			0.06	0.06
Plant density (plants/ha)						
333,000	455	481	90.5	88.8	18.17	18.52
444,000	396	414	90.9	89.6	17.28	17.35
666,000	343	371	91.6	90.7	16.89	17.03
CD (P=0.05)	60	49			0.40	0.35
Weed management						
Unweeded control	1,155	1,183	0.00	0.00	67.77	69.11
Hand-weeding (HW) (at 20, 40 DAS)	167	193	96.2	93.4	4.49	4.73
Pendimethalin 0.75 kg ha + HW (at 40 DAS)	246	269	85.4	84.3	5.32	545
Alachlor 1.25 kg/ha + HW (at 40 DAS)	190	214	93.4	91.5	4.56	4.82
Oxyflourfen 0.20 kg/ha + HW (at 40 DAS)	239	254	88.6	86.9	5.10	5.38
CD (P = 0.05)	34	39			0.86	0.82

appreciably influenced by irrigation schedule with low pan value, ultimately leading to higher dry-matter production as also reported by Singaram (1990). The crop dry-matter production increased significantly with the increase in crop density at harvest. However, the higher plant densities 666,000 and 444,000 lakh plants/ha were comparable to each other (Table 2). However, increase in the dry-matter production for the increased plant density was not proportional to the density. At the same time, lowest crop density 333,000 plants/ha recorded distinctly lower crop dry-matter production due to higher weed dry matter and N uptake of weeds. Balyon and Mohto (1985) reported a increase in plant dry-matter production in soybean up to 0.06 million plants/ha, but in our study the optimum plant density was found to be 444,000 plants/ha. The reduction in crop dry-matter production was 45.5 and 45.1% by weed infestation during summer and rainy season when compared to hand-weeding twice. Chemical weed management in combination with hand-weeding once could improve this situation satisfactorily.

Table 2. Effect of moisture, plant density and weed control on N uptake by plants, dry matter of plants, grain yield and net return in soybean

Treatment	N uptake by plant at harvest (kg/ha)		Dry matter of plants at harvest (kg/ha)		Grain yield (kg/ha)		Net return (Rs/ha)	
	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*	Summer	*Kharif*
Moisture regime								
0.40 IW : CPE	72.85	73.51	4,485	4,543	1,898	2,004	8,655	9,567
0.60 IW : CPE	83.27	84.36	6,560	6,595	2,218	2,388	11,206	12,406
CD (P = 0.05)	1.15	0.91	140	121	111	104		
Plant density (plants/ha)								
333,000	77.57	78.62	5,008	5,083	1,955	2,078	9,998	11,094
444,000	77.62	78.75	5,717	5,799	2,188	2,258	10,962	11,626
666,000	78.99	79.63	5,842	5,901	2,037	2,241	9,469	10,237
CD (P = 0.05)	NS	NS	172	139	146	141		
Weed management								
Unweeded control	42.46	43.78	3,481	3,525	1,465	1,558	6171	6,635
Hand-weeding (HW) (at 20, 40 DAS)	88.93	90.43	6,382	6,422	2,296	2,486	1137	12,667
Pendimethalin 0.75 kg ha + HW (at 40 DAS)	84.11	85.12	5,506	5,555	2,056	2,192	9997	10,765
Alachlor 1.25 kg/ha + HW (at 40 DAS)	90.33	90.56	6,554	6,613	2,324	2,506	12466	13,842
Oxyflourfen 0.20 kg/ha + HW (at 40 DAS)	84.48	85.97	5,689	5,741	2,158	2,227	10,706	11,010
CD (P = 0.05)	4.14	4.24	248	243	87	84		

Grain yield

Higher frequency of irrigation at 0.60 IW : CPE ratio increased the yield by 18.04% compared to the yield obtained under 0.40 IW : CPE ratio. Density of 444,000 plants/ha was found optimum, as evident from the highest soybean yield, in both the seasons. The yield levels accounted for 11.9 and 8.6% more than those of lower density of 333,000 plants/ha in summer and rainy season respectively (Table 2). This might be due to increased dry-matter production (14.1 and 14.0% more than that in lower density of 333,000 plants/ha in summer and rainy season respectively). Among weed-management treatments, alachlor 1.25 kg/ha + hand-weeding, hand-weeding twice and oxyflourfen 0.20 kg/ha + hand-weeding resulted in higher grain yields accounting 58.6, 56.7 and 47.3% increase over the unweeded check the rainy reason respectively (Table 2). This might be due to effective control of weeds resulting in less competition for moisture nutrients and sunlight; facilitating the crop to grow better as evident from increased crop dry-matter production at harvest (Table 2). The uptake of N by the crop was also more under these treatments than in unweeded control. Herbicides were effective only in early stages. But when 1 hand-weeding was done along with alachlor 1.25 kg/ha, hand-weeding twice and oxyflourfen 0.20 kg/ha + HW, the weeds were effectively controlled and the competition was reduced up to 60 DAS and after that, the crop was able to smother the weeds which reflected in increasing the crop yield substantially, as also reported by Sing and Sharma (1991).

Economics

Net returns realized from high moisture regime were higher than that from lower moisture regime. The plants @ 444,000/ha had better net returns over other plant populations studied. Lower net return worked out at highest plant density was due to lower grain yield and more seed cost (Table 2). Chemical weed control (alachlor 1.25 kg/ha) in combination with hand-weeding once was better than hand-weeding twice in terms of economy. Alachlor + hand-weeding could enhance the net returns from Rs 6,171 to Rs 12,466 in summer and from Rs 6,635 to 13,892 in the rainy season. The higher net returns were obtained because of good control of weeds with higher yield in these treatments. Singh and Sharma (1991) also reported similar increased net return by alachlor + hand-weeding.

Thus pre-emergence application of alachlor 1.25 kg/ha and hand-weeding once (40 days after sowing) under the crop density of 444,000 plants/ha (30 cm × 7.5 cm spacing) was found the most effective integrated weed-management method under the irrigation regime of 0.60 IW : CPE ratio for getting higher yield and economic return in soybean.

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