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Efficacy of Pre and Post Emergence Herbicides on Sequential Basis for Weed Control in Soybean (*Glycine max* L.)

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ABSTRACT

A field experiment was carried out during *kharif* 2010 to study the effect of pre emergence (Diclosulam 22 g ha^{-1}, Oxyfluorfen 0.1 kg ha^{-1} and Chlorimuron-p-ethyl 9 g ha^{-1}) and post emergence (Imazethapyr 75 g ha^{-1}, Quizalofop-p-ethyl 75 gha^{-1}, Fenoxyprop-p-ethyl 75g ha^{-1} and Chlorimuron-p-ethyl 9 g ha^{-1}) herbicides either alone or in sequence along with standard check (Alachlor 2 $kgha^{-1}$ + 2 IC (30 & 45 DAS) + 2 HW (30 & 45 DAS) on weed control in soybean. Result revealed that sequential application of Oxyfluorfen 0.1kg ha^{-1} fb Imazethapyr 75g ha^{-1} and Diclosulam 22g ha^{-1} fb Imazethapyr 75 g ha^{-1} were quite effective in controlling weeds at 30 & 60 days as reflected in significantly lower weed count, dry matter, nutrients uptake and higher weed control index. Significantly higher soybean seed yield (27.21 and 25.96 q ha^{-1}, respectively) was also obtained in the same treatments. The growth (total dry matter) and yield parameters (pods per plant, seed weight per plant and 100 seed weight) followed the similar trend as that of seed yield. Higher net returns and B: C ratio were recorded with the application of Oxyfluorfen 0.1 kg ha^{-1} fb Imazethapyr 75g ha^{-1} (Rs 41,030 ha^{-1} and 3.18) and Diclosulam 22g ha^{-1} fb Imazethapyr 75 g ha^{-1} (Rs 38,384 ha^{-1} and 3.05) than other treatments.

Key words : Economics, Pre and post emergence herbicides, Sequential application of herbicides, Soybean, yield.

Soybean (*Glycine max*), is an important oil-yielding rainy-season (*kharif*) crop having multiple uses. Simultaneous emergence and rapid growth of large number of weed species causes severe crop-weed competitions and reduction in crop yields (30-80%) depending upon the type of weed flora and weed density (Kuruchania *et al.*, 2000 and Yaduraju, 2002). The incessant rains do not permit timely inter-cultivations and manual control of weeds is also difficult on large scale on account of high cost and labour shortage during weeding peaks. Therefore, there is a need for alternative methods of reducing the weed load during early crop-growth period of soybean i.e. 30-45 DAS (Chhokar *et.al*. 1995).The herbicides presently available are either pre-emergence (PRE) or pre-plant incorporated (PPI) and have a narrow spectrum weed control. The biology of some weeds that occur in soybean makes it difficult to achieve effective weed control with single application of herbicides. Recent studies clearly indicated that sequential application of herbicides will provide more consistent weed control than single application and helps to minimize the weed menace (Singh *et al.,* 2004 and Malik *et al.,* 2006). Hence, present investigation was undertaken to study the effect of sequential application of pre and post emergence herbicides on weed control in soybean.

MATERIAL AND METHODS

A field experiment to study the effect of sequential application of pre and post emergence herbicides application in soybean was carried out at Agricultural Research Station, Bailhongal during kharif 2010. The experiment was laid out in randomized block design replicated thrice with fifteen treatments (Table 1).The soil of the experimental plot was deep black soil with a pH of 7.2, 0.48% organic carbon, 280.5 $kgha^{-1}$ available N, 10.9 $kgha^{-1}$ available P_2O_5 and 591 kg ha^{-1} available K_2O. The soybean Crop variety 'JS-335' was sown on 20th June at a spacing of 30 x 10 cm.

The crop was supplied with 40:80:25 N; P_2O_5 and K_2O kg ha^{-1}. Pre-emergence herbicides (Diclosulam 22 g ha^{-1}, Oxyfluorfen 0.1 kg $ha^{-1}$and Chlorimuron-p-ethyl 9 gha^{-1}, Alachlor 2 kg ha^{-1}) were sprayed immediately next day after sowing. Post emergence herbicides (Imazethapyr 75 g ha^{-1}, Quizalofop-p-ethyl 75 g $ha^{-1}$and Fenoxyprop-p-ethyl 75 g ha^{-1}) were sprayed at 21 DAS. Herbicides were sprayed with knapsack sprayer using 750 liters of spray solution per hectare.Observations on weeds were recorded from 0.5 m^2 quadrat at 60 DAS and at harvest for weed population and weed dry matter and these data were subjected to square root transformation of "x+0.5 before analysis. The weed control index was computed at 60 DAS using the formula given by Mishra and Tosh (1979). Observations on crop such as dry matter, seed weight and test weight were recorded as per standard procedure. Cost of cultivation in each treatment was worked out to obtain total cost of cultivation. Based on the prevailing market price of the produce and cost of cultivation, the net returns and B:C ratio was computed.

RESULTS AND DISCUSSION

The weed flora of the experimental site comprised of grasses, sedges and broad leaved weeds. The important grassy weeds observed were *Brachiaria eruciformis, Cynodon dactylon, Digitaria sanguinalis* and *Dinebra retroflexa. Cyperus rotundus* was the lonely weed under sedge category. Among broad leaved weeds, *Digera muricata* L, *Amaranthus viridis, Amaranthus spinosus, Commelina bengalensis, Cyanotis cucullata, Phyllanthus fraternus* and *Argemone mexicana* were the dominant weeds.

Effect on weeds

At 60 DAS, significantly higher weed dry weight was recorded in weedy check compared to rest of the treatments (Table 1). This could be attributed to higher density of grasses, sedges, broad leaved weeds and total weed population. This non interference of weed growth resulted in maximum utilization of resources resulting in higher weed dry weight. Among various herbicide treatments, Oxyfluorfen fb Imazethapyr and Diclosulam fb Imazethapyr recorded lower weed population and weed dry weight (Table 1) and were comparable to that of standard check. This could be attributed to effective control of weeds by use of pre and post emergence herbicides in sequence. Meena *et.al*. (2009) also reported significantly lower weed dry weight with sequential application of herbicides. The variations in weed dry weight could be attributed to variations in weed population and weed control index. The weed control index was significantly lower in the above treatments when compared to weedy check.

Effects on yield attributes and yield of soybean

Sequential application of had a preformed effect on total dry matter production, yield attributes and yield of soybean (Table 2). Total dry matter production at harvest was significantly higher in Oxyfluorfen 0.1 kg ha^{-1} fb Imazethapyr 75 g ha^{-1} which in turn was on par with Alachlor 2 kg ha^{-1} +2 IC ha^{-1} +2 HW, Diclosulam 22 g ha^{-1} fb Imazethapyr 75 g ha^{-1}, Oxyfluorfen 0.1 kg ha^{-1} a fb Quizalofop-p-ethyl 75 g ha^{-1} and Fenoxyprop-p-ethyl 75 g ha^{-1}. The similar trend was observed. The seed weight / plant and 100 seed weight were significantly higher in Oxyfluorfen 0.1 kg ha^{-1} fb Imazethapyr 75 g ha^{-1}. The treatments namely Alachlor 2 kg ha^{-1} +2 IC ha^{-1} +2 HW, Diclosulam 22 g ha^{-1}fb Imazethapyr 75 g ha^{-1}, Oxyfluorfen 0.1 kg ha^{-1} fb Quizalofop-p-ethyl 75 g ha^{-1} and Fenoxyprop-p-ethyl 75 g ha^{-1} were on par with Oxyfluorfen 0.1 kg ha^{-1} fb Imazethapyr 75 g ha^{-1}. Significantly higher seed yield (27.21q ha^{-1}) was obtained with Oxyfluorfen 0.1 kg ha^{-1} fb Imazethapyr 75 g ha^{-1} when compared with weedy check. However, Diclosulam 22 g ha^{-1} fb Imazethapyr 75 g ha^{-1}(25.96 q ha^{-1}), Oxyfluorfen 0.1 kg ha^{-1} fb Quizalofop-p-ethyl 75 g ha^{-1}(25.62 q ha^{-1}), Diclosulam 22 g ha^{-1} fb Fenoxyprop-p-ethyl 75 g ha^{-1} (24.38 q ha^{-1}),Chlorimuron-p-ethyl 9 g ha^{-1} fb Chlorimuron-p-ethyl 9 g ha^{-1} (23.93 q ha^{-1}), Quizalofop-p-ethyl 75 g ha^{-1} (23.39 q ha^{-1}) and standard check were on par with Oxyfluorfen 0.1 kg ha^{-1} fb Imazethapyr 75 g ha^{-1}-.The higher yield in above treatments was attributed to higher total dry matter production and yield attributing characters. These treatments were quite effective in controlling grasses and broad leaved weeds which ultimately reduced their population and dry weight (Table 1).

Table 1. Effect of sequential application of pre and post emergence herbicides on weed count, weed dry weight and weed control index in soybean Ecosystem at 60 DAS.

Treatments	Weed count (per 0.5 m^2)	Weed dry weight (per 0.5 m^2) (g)	WCI (%)
T_1 - Diclosulam 22 g ha^{-1} fb Imazethapyr 75 g ha^{-1}.	1.27 (1.17)	1.67 (2.32)	94.15
T_2 - Oxyfluorfen 0.1 kg ha^{-1} fb Imazethapyr 75 g ha^{-1}	1.70 (2.50)	1.02 (0.6)	98.47
T_3 - Chlorimuron-p-ethyl 9 g ha^{-1} fb Imazethapyr 75 g ha^{-1}	1.85 (3.17)	2.46 (6.43)	83.66
T_4 - Diclosulam 22 g ha^{-1} fb Quizalofop-p-ethyl 75 g ha^{-1}	1.73 (2.50)	1.64 (2.32)	94.13
T_5 - Oxyfluorfen 0.1 kg ha^{-1} fb Quizalofop-p-ethyl 75 g ha^{-1}	1.92 (3.33)	1.99 (3.5)	91.16
T_6 - Chlorimuron-p-ethyl 9 g ha^{-1} fb Quizalofop-p-ethyl 75 g ha^{-1}	1.73 (2.50)	2.68 (6.97)	82.42
T_7 - Diclosulam 22g ha^{-1} fb Fenoxyprop-p-ethyl 75 g ha^{-1}	1.68 (2.33)	1.88 (3.28)	91.67
T_8 - Oxyfluorfen 0.1 kg ha^{-1} fb Fenoxyprop-p-ethyl 75 g ha^{-1}	1.76 (2.67)	1.91 (3.42)	91.37
T_9 - Chlorimuron-p-ethyl 9 g ha^{-1} fb Fenoxyprop-p-ethyl 75 g ha^{-1}	1.95 (3.33)	1.58 (2.08)	94.76
T_{10} - Imazethapyr 75 g ha^{-1}	2.46 (5.67)	2.60 (6.1)	84.54
T_{11} - Quizalofop-p-ethyl 75 g ha^{-1}	1.67 (2.33)	2.23 (4.93)	87.58
T_{12} - Fenoxyprop-p-ethyl 75 g ha^{-1}	1.77 (2.67)	2.16 (4.23)	89.33
T_{13} - Alachlor 2 kg ha^{-1} +2 IC (30 & 45 DAS) + 2 HW (30 & 45 DAS)	1.07 (0.67)	1.10 (0.77)	98.08
T_{14} - Chlorimuron -p-ethyl 9 g ha^{-1} fb Chlorimuron-p-ethyl 9 g ha^{-1}	1.73 (2.50)	1.91 (3.38)	91.47
T_{15} - Weedy check	3.97 (15.33)	6.34 (39.65)	-
SE.m (±)	0.19	0.32	3.86
CD at 5%	0.54	0.92	11.17

Note: IC: Intercultivation, HW: Hand weeding, DAS: Days after sowing, WCI: Weed control Index, fb: Followed by. Figures in the parentheses indicate original values, $(x+0.5)^{1/2}$ transformed data.

Economic analysis of various weed control measures revealed that application of Oxyfluorfen fb Imazethapyr recorded significantly higher net returns. The treatments namely Diclosulam fb Imazethapyr, Oxyfluorfen fb Quizalofop-p-ethyl, Fenoxyprop-p-ethyl, Alachlor 2 kg ha^{-1} +2 IC ha^{-1} +2 HW and Diclosulam fb Quizalofop-p-ethyl also realized higher net returns and thus could be attributed to higher seed yield and lower cost of cultivation. Benefit: cost ratio was significantly higher with Oxyfluorfen 0.1 kg ha^{-1} fb Imazethapyr 75 g ha^{-1} (3.18) when compared with rest of the treatments.

Thus, the study clearly revealed that sequential application of Oxyfluorfen 0.1 kg ha^{-1} fb Imazethapyr 75 g ha^{-1} or Diclosulam 22 g ha^{-1} fb Imazethapyr 75 g ha^{-1} recorded significantly higher seed yield of soybean and economic returns besides effective control of weeds. These treatments were however comparable with that of standard check (Alachlor 2 kg ha^{-1} +2 IC ha^{-1} +2 HW).

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Table 2. Effect of sequential application of pre and post emergence herbicides on total dry matter production, yield parameters yield and economics in soybean ecosystem.

Treatments	TDMP at harvest (g plant^{-1})	Seed weight (g plant $^{-1}$)	100 seed weight (g)	seedyield (q ha^{-1})	Haulmyield (q ha^{-1})	Net income (Rs. ha^{-1})	B:C ratio
T_1 - Diclosulam 22 g ha^{-1} fb Imazethapyr 75 g ha^{-1}.	62.31	35.32	13.01	25.96	29.53	38384	3.05
T_2 - Oxyfluorfen 0.1 kg ha^{-1} fb Imazethapyr 75 g ha^{-1}	68.15	40.04	14.27	27.21	29.77	41030	3.18
T_3 - Chlorimuron-p-ethyl 9 g ha^{-1} fb Imazethapyr 75 g ha^{-1}	48.63	29.08	10.27	20.51	24.70	25927	2.35
T_4 - Diclosulam 22 g ha^{-1} fb Quizalofop-p-ethyl 75 g ha^{-1}	61.66	35.01	12.43	25.10	26.78	35775	2.87
T_5 - Oxyfluorfen 0.1 kg ha^{-1} fb Quizalofop-p-ethyl 75 g ha^{-1}	62.09	35.15	12.83	25.62	28.91	36829	2.89
T_6 - Chlorimuron-p-ethyl 9 g ha^{-1} fb Quizalofop-p-ethyl 75 g ha^{-1}	51.08	29.61	10.57	21.73	30.86	27894	2.40
T_7 - Diclosulam 22g ha^{-1} fb Fenoxyprop-p-ethyl 75 g ha^{-1}	60.00	33.79	12.33	24.38	24.48	34191	2.76
T_8 - Oxyfluorfen 0.1 kg ha^{-1} fb Fenoxyprop-p-ethyl 75 g ha^{-1}	54.20	31.56	10.73	22.00	27.28	28865	2.48
T_9 - Chlorimuron-p-ethyl 9 g ha^{-1} fb Fenoxyprop-p-ethyl 75 g ha^{-1}	56.04	31.58	11.43	22.12	25.97	28766	2.45
T_{10} - Imazethapyr 75 g ha^{-1}	49.41	28.57	10.40	20.96	21.88	27880	2.53
T_{11} - Quizalofop-p-ethyl 75 g ha^{-1}	57.75	32.50	11.93	23.39	25.00	32516	2.72
T_{12} - Fenoxyprop-p-ethyl 75 g ha^{-1}	61.04	34.67	12.40	24.95	26.69	35955	2.90
T_{13} - Alachlor 2 kg ha^{-1} +2 IC (30 & 45 DAS) + 2 HW (30 & 45 DAS)	64.18	36.78	13.75	26.27	29.04	35852	2.63
T_{14} - Chlorimuron -p-ethyl 9 g ha^{-1} fb Chlorimuron-p-ethyl 9 g ha^{-1}	59.14	33.28	11.98	23.93	28.24	34128	2.84
T_{15} - Weedy check	40.70	23.36	9.67	18.78	21.43	24724	2.49
SE.m (±)	2.14	2.73	0.74	1.15	1.96	2533	
CD at 5%	6.19	7.92	2.15	3.33	5.68	7337	

Note: IC: Intercultivation, HW: Hand weeding, TDMP: Total dry matter production, DAS: Days after sowing, fb: Followed by

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