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Effect of weed management practices on weed dynamics of soybean [*Glycine max (*L.*) Merill*

Rohit B Umbarkar[1*], Rahul R Vikhe[2], Ravindra A Daspute[1]
[1] Department of Agronomy, College of Agriculture, Loni, Maharashtra, India
[2] Department of Agronomy, College of Agriculture Business Management, Loni, Maharashtra, India

Abstract
A field experiment was conducted at College of Agriculture, Loni farm during kharif 2015 entitled "Integrated Weed Management in Soybean" on silty clay loam soil with 7.4 P^H. The climatic conditions were suitable during experimental period. The experiment was laid out in randomized block design with three replications and eight treatments. The treatments were consisting of combination of pre and post emergence herbicides, cultural treatments as well as unweeded check. The results indicated that the minimum number of weed count, weed dry matter and weed index were observed in treatment one hoeing at 15 DAS and two HW at 20 and 45 DAS, followed by treatments pendimethalin 30 percent CS (PE) @ 700 g a.i. ha^{-1} fb 1 HW 30 DAS, meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb 1 HW 30 DAS, meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb quizalofop ethyl 5 percent EC (POE) @ 50 ga.i. ha^{-1} at all the stages of plant. However the highest percent of the weed control efficiency was recorded with treatment one hoeing at 15 DAS and 2 HW at 20 and 45 DAS which found significantly superior over rest of the treatments which was followed by the treatments pendimethalin 30 percent CS (PE) @ 700 g a.i. ha^{-1} fb 1 HW 30 DAS, meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb 1 HW 30 DAS and meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb quizalofop ethyl 5 percent EC (POE) @ 50 ga.i. ha^{-1}. Significantly maximum number of weed count, weed dry matter, weed index and lowest weed control efficiency were noticed in treatment unweeded control.

Keywords: integrated weed management, soybean, weed index, weed control efficiency

Introduction
Soybean (*Glycine max (L.) Merrill*) is the premier pulse and oil seed crop of the family Leguminaceae, subfamily Papilionaceae and genus Glycine. It provides the cheapest as well as the largest source of edible vegetable protein than any other pulse crop. The protein content in soybean accounts to 40 to 43 per cent with an edible oil content of 20 per cent. Among the various factors of low productivity of soybean, competition by weeds is the major one. Being a rainy season crop, it is invaded by a wide variety of weed flora in different flushes which compete with the crop plants for nutrients, light and moisture apart from their allelopathic effects. First 15 to 45 days is considered as the most critical period of weed infestation for soybean. Soybean suffers from heavy infestation of various complex weed flora *viz*, grasses, broad leaf weeds, perennial weeds and sedges. Weeds have been reported to reduce soybean seed yield by 20 to 77 percent (Kurchania, *et al*., 2001) depending upon nature, intensity and duration of weed species present in the field. Weeds increase cost of cultivation and deplete resource base). Various workers have estimated different levels of reduction in grain yield of soybean due to differential intensity of weeds infesting soybean fields. It is estimated that the extent of reduction in yield ranges from 18.8 to 42.4 per cent (Mishra J.S., 1997) [2]. The continuous use of pre-emergent herbicides has led to the changes in the emergence patterns of weeds in different crop ecosystems. This has led to the discovery of post emergent herbicides. Apart from this, the composition of weed flora occurring in different crop ecosystems is also changing from dicots to more of grasses and sedges. Therefore, there is need to evaluate the efficacy of grass killers in different crop ecosystems. Weeds also increase the cost of cultivation and lower the resource base. Soybean is a rainy season crop hence it is very difficult to control the weeds manually. The traditional methods of weed control are costly and labor problem occurs during weeding peak so use of herbicides is more effective. The herbicides should be applied in sequential basis for controlling the weeds for longer time of crop growth because the biology of some weeds which found in soybean makes it difficult for effective weed control with the single use of either PPI or PRE or Post emergence herbicide. Less weed biomass and greater yield in soybean is due to new selective herbicides *viz*. imazethapyr, propaquizafop ethyl. At present about 90 percent of soybean cultivated area is treated with various herbicides. It is also reported that selective herbicides do not control all the weeds. Therefore integrated weed control methods *viz*, chemical and cultural may be more feasible and practicable.

Materials and methods
The research entitled "Integrated Weed Management in Soybean" was conducted at College of Agriculture, Loni farm during kharif 2015. The soil of experimental plot was silty clay with 7.4 P^H, EC was 0.53 dsm^{-1} and the organic carbon was 0.45 percent. The available N was 163.28 kg ha^{-1}, available P was 20 kg ha^{-1} and available K was 455.16 kg ha^{-1}. The layout of experiment was a randomized block design. The replications were three and the treatments were: **(S_1)** Pendimethalin 30 percent CS (PE) @ 700 g a.i. ha^{-1} fb 1 HW 30 DAS, **(S_2)** meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb 1 HW 30 DAS. **(S_3)** Pendimethalin 30 percent CS (PE) @ 700 g a.i. ha^{-1} fb imazethapyr 10 percent SL (POE) @ 80 g a.i. ha^{-1}, **(S_4)** Meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb imazethapyr 10 percent SL (POE) @ 80 g a.i. ha^{-1}, **(S_5)** Pendimethalin 30 percent CS (PE) @ 700 g a.i. ha^{-1} fb quizalofop ethyl 5 percent EC (POE) @ 50 g a.i. ha^{-1},

(S_6) Meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb quizalofop ethyl 5 percent EC (POE) @ 50 g a.i. ha^{-1}, **(S_7)** 1 hoeing at 15 DAS and 2 hand weeding at 20 DAS and 45 DAS and **(S_8)** Unweeded control. The recommended dose of fertilizer was 50:75:00 kg NPK ha^{-1} which was calculated for each plot and applied in the form of urea and single and super phosphate at the time of sowing. The variety DS-228 (Phule kalyani) was sown on 25/06/2015. The seed rate was 75 kg ha^{-1} and row spacing was 30 cm and plant to plant spacing was 10 cm. The observations on total weed count and weed control efficiency were recorded at 20, 40, 60 DAS and at harvest and the observation on weed dry matter and weed index were taken at harvest. The data were analyzed statistically for test of significance. The interpretation of data was done by using CD value calculated at P≥ 0.05 and level of significance for F test was tested at 5 percent.

Results and discussions

Total weed count m-2

The minimum number of weed count was observed in treatment one hoeing at 15 DAS and two HW at 20 and 45 DAS (S7), followed by treatments pendimethalin 30 percent CS (PE) @ 700 g a.i. ha^{-1} fb 1 HW 30 DAS (S1), meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb 1 HW 30 DAS (S2), meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb quizalofop ethyl 5 percent EC (POE) @ 50 ga.i. ha^{-1} (S6) at all the stages of plant. Maximum number of weeds was observed in treatment unweeded control (S8) at all stage of crop growth.

Dry matter of weed

The dry matter of weed was significantly lowest in treatment one hoeing at 15 DAS and two HW at 20 and 45 DAS (S7), followed by the treatments pendimethalin 30 percent CS (PE) @ 700 g a.i. ha^{-1} fb 1 HW 30 DAS (S1), meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb 1 HW 30 DAS (S2) and meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb quizalofop ethyl 5 percent EC (POE) @ 50 g a.i. ha^{-1} (S6). The weed dry matter was significantly higher in treatment unweeded control (S8) over rest of the treatments. Similar results were observed by Dubey (2002) [15], Mohod (2002) [6] and Karande *et al*. (2008) [16].

Weed Index

Significantly minimum weed index was observed in treatment one hoeing at 15 DAS and two HW at 20 and 45 DAS (S7) over rest of the treatments. The lowest weed index among herbicide and mechanical method combination treatments was recorded with the treatment meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb 1 HW 30 DAS (S2) followed by pendimethalin 30 percent CS (PE) @ 700 g a.i. ha^{-1} fb 1 HW 30 DAS (S1) and meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb quizalofop ethyl 5 percent EC (POE) @ 50 g a.i. ha^{-1}(S6). Weed index was significantly higher in treatment unweeded control treatment (S8). These results are in close conformity with Deore *et al*. (2008) [4].

Weed control efficiency

The highest percent of the weed control efficiency was recorded with treatment one hoeing at 15DAS and 2 HW at 20 and 45 DAS (S7) which found significantly superior over rest of the treatments which was followed by the treatments pendimethalin 30 percent CS (PE) @ 700 g a.i. ha^{-1} fb 1 HW 30 DAS (S1), meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb 1 HW 30 DAS (S2) and meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb quizalofop ethyl 5 percent EC (POE) @ 50 ga.i. ha^{-1} (S6). Among the weed control treatments treatment pendimethalin 30 percent CS (PE) @ 700 g a.i. ha^{-1} fb 1 HW 30 DAS (S1) recorded maximum weed control efficiency which was at par with treatment meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb 1 HW 30 DAS (S2) and meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb quizalofop ethyl 5 percent EC (POE) @ 50 ga.i. ha^{-1} (S6). Similar results were obtained by Gurjar *et al*. (2001) [17], Sadehi *et al*. (2004) and Kushwah and Vyas (2005) [19].

Table 1: Total weed count (m^{-2}), Dry weight of weeds (g m-2), Weed index (%) and Mean weed control efficiency (%) as influenced periodically by different weed control treatments

Treatments	Mean weed Count m^{-2}				Dry weight of weeds (g m-2)	Weed index (%)	Mean weed control efficiency (%)			
	20 DAS	40 DAS	60 DAS	At harvest			20 DAS	40 DAS	60 DAS	At harvest
S_1	15.25	6.45	14.05	21.17	97.18	8.80	82.83	93.00	84.28	76.63
S_2	15.84	6.63	13.68	18.06	94.23	6.70	82.17	92.81	84.70	80.06
S_3	37.19	32.67	43.2	52.78	192.28	24.57	58.14	64.57	51.69	41.73
S_4	21.96	13.68	24.36	34.92	110.78	12.36	75.28	85.16	72.76	61.45
S_5	21.76	16.56	23.93	32.54	115.12	15.54	75.51	82.04	73.24	64.07
S_6	17.17	9.03	16.31	20.44	80.23	7.15	80.67	90.20	81.76	77.43
S_7	8.67	6.40	3.91	4.39	5.18	00.00	90.24	93.06	95.62	95.15
S_8	88.86	92.23	89.43	90.59	516.48	42.18	00.00	00.00	00.00	00.00
S.E.±	0.28	0.21	0.23	0.24	0.48	1.13	2.54	2.93	2.90	2.88
CD @ 5%	0.82	0.63	0.69	0.74	1.46	3.43	7.71	8.87	8.81	8.75
General mean	28.33	22.95	28.60	34.36	151.43	14.66	68.10	75.10	68.00	62.06

(S_1) Pendimethalin 30 percent CS (PE) @ 700 g a.i. ha^{-1} fb 1 HW 30 DAS

(S_2) meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb 1 HW 30 DAS

(S_3) Pendimethalin 30 percent CS (PE) @ 700 g a.i. ha^{-1} fb imazethapyr 10 percent SL (POE) @ 80 g a.i. ha^{-1}

(S_4) Meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb imazethapyr 10 percent SL (POE) @ 80 g a.i. ha^{-1}

(S_5) Pendimethalin 30 percent CS (PE) @ 700 g a.i. ha^{-1} fb quizalofop ethyl 5 percent EC (POE) @ 50 g a.i. ha^{-1}

(S_6) Meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb quizalofop ethyl 5 percent EC (POE) @ 50 g a.i. ha^{-1}
(S_7) 1 hoeing at 15 DAS and 2 hand weeding at 20 DAS and 45 DAS
(S_8) Unweeded control

Conclusion

The minimum number of weed count, weed dry matter, weed index and highest percent of the weed control efficiency were observed in treatment one hoeing at 15 DAS and two HW at 20 and 45 DAS at all the stages of plant. Significantly maximum number of weed count, weed dry matter, weed index and lowest weed control efficiency were noticed in treatment unweeded control. So the mechanical methods of weed control found to be the best method of weed control in soybean where labors are cheap, readily available and not a constraint but the places where labors are expensive and time is a constraint then meteribuzin 70 percent WP (PE) @ 525 g a.i. ha^{-1} fb quizalofop ethyl 5 percent EC (POE) @ 50 g a.i. ha^{-1} and Pendimethalin 30 percent CS (PE) @ 700 g a.i. ha^{-1} fb 1 HW 30 DAS are best methods of weed control in soybean.

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