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Effect of integrated weed management on growth, productivity and economics of soybean [*Glycine max* (L.) Merrill]

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Abstract
A field experiment entitled "Integrated Weed Management in Soybean Wheat sequence cropping" was conducted at College of Agriculture, Loni farm during kharif 2015 and kharif 2016 on silty clay loam soil with 7.4 P^H. The climatic conditions during experimental period was favorable. The experiment was laid out in split plot design with three replications. The treatments were consisting of combination of pre and post emergence herbicides, cultural treatments as well as unweed check. The results revealed that the growth parameters, yield attributes, seed yield and straw yield were increased significantly by treatment 1 hoeing at 15 DAS and 2 hand weeding at 20 DAS and 45 DAS over rest of the treatments however it was at par with treatment pendimethalin 30 percent CS (PE) fb 1 HW 30 DAS, meteribuzin 70 percent WP (PE) fb 1 HW 30 DAS and meteribuzin 70 percent WP (PE) fb quizalofop ethyl 5 percent EC (POE) which was followed by treatment metribuzin 70 percent WP (PE) fb imazethapyr 10 percent SL (POE) and pendimethalin 30 percent CS (PE) fb quizalofop ethyl 5 percent EC (POE). The B: C ratio and net returns were found significantly higher in meteribuzin 70 percent WP (PE) fb 1 HW 30 DAS. Significantly minimum growth, yield attributes, yield and economics were noticed in treatment unweeded control for both the years.

Keywords: economics, integrated weed management, soybean, yield

Introduction
Soybean [*Glycine max* (L.) Merrill] is the important oil seed and pulse crop from the family Leguminaceae, sub family Papilionoideae and genus Glycine. Soybean crop is also called as miracle crop of 20th century as it is having various uses and also contains 40 percent protein and 20 percent oil. Among the various factors, weed is the major factor responsible for low yield in soybean. Soybean seed yield is reduced by 86 percent due to weed [1]. Weeds also increase the cost of cultivation and lowers the resource base.First 15 to 45 days is considered as the most critical period of weed infestation for soybean [2]. Soybean suffers from heavy infestation of various complex weed flora viz, grasses, broad leaf weeds, perennial weeds and sedges.

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 [3]for controlling the weeds for longer time of crop growthbecause 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 [4]. At present about 90 percent of soybean cultivated area is treated with various herbicides [5]. It is also reported that selective herbicides do not control all the weeds [6]. Therefore integrated weed control methods viz, chemical and cultural may be more feasible and practicable.

Materials and Methods
The field experiment entitled "Integrated Weed Management in Soybean Wheat sequence cropping" was conducted at College of Agriculture, Loni farm during kharif 2015 and kharif 2016. 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 split plot design. The main plot treatments comprising of: **(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} fbquizalofop 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 and three treatments in wheat as sub plot factors. The replications were three. The recommended dose of 50:75:00 kg NPK ha^{-1} was calculated for each plot and applied in the form of urea and single and super phosphate at the time of sowing. The soybean variety DS-228 (Phule kalyani) was sown on 25/06/2015 and 28/06/2016. 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 growth, yield, yield attributes and economics were recorded at harvest. The data were analyzed statistically for

test of significance [7]. 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

The data revealed that growth characters, yield attributing characters, yield and economics were significantly increased by different weed control practices in both the years (Table 1 and Table 2). Maximum plant height, number of leaves and number of branches were noticed with treatment 1 hoeing at 15 DAS and 2 hand weeding at 20 DAS and 45 DAS which was at par with 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} fbquizalofop ethyl 5 percent EC (POE) @ 50 g a.i.ha^{-1} for both the years [8]. The yield attributing characters viz. number of pods $plant^{-1}$, number of seeds $plant^{-1}$, weight of seeds $plant^{-1}$ and test weight were found significantly increased by treatment 1 hoeing at 15 DAS and 2 hand weeding at 20 DAS and 45 DAS which was at par with 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} fbquizalofop ethyl 5 percent EC (POE) @ 50 g a.i.ha^{-1} for both the years [9]. The results revealed that significantly the highest seed yield and straw yield was registered with treatment 1 hoeing at 15 DAS and 2 hand weeding at 20 DAS and 45 DAS except 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} fbquizalofop ethyl 5 percent EC (POE) @ 50 g a.i.ha^{-1} for both the years [10]. The economic factors viz. net returns and B: C ratio were found significantly superior with treatment meteribuzin 70 percent WP (PE) @ 525 g a.i.ha^{-1}fb 1 HW 30 DAS except treatment 1 hoeing at 15 DAS and 2 hand weeding at 20 DAS and 45 DAS, pendimethalin 30 percent CS (PE) @ 700 g a. i. ha^{-1} fb 1 HW 30 DAS and Meteribuzin 70 percent WP (PE) @ 525 g a.i.ha^{-1} fbquizalofop ethyl 5 percent EC (POE) @ 50 g a.i.ha^{-1} for both the years [11, 12]. Significantly the lowest growth characters viz. plant height, number of leaves, number of branches, yield attributing factors viz. number of pods $plant^{-1}$, number of seeds $plant^{-1}$, weight of seeds $plant^{-1}$, test weight, seed yield, straw yield, B:C ratio and net returns were associated with treatment unweeded control for both the years [13].

Table 1: Effect of Integrated Weed Management on growth, yield attributing characters, grain yield, straw yield and economics of soybean (Kharif 2015)

Treatment	Plant height (cm)	No of leaves	No of branches	No of Pods/ plant	No of Seeds/ plant	Weight of seed/ plant(g)	Test weight (g)	Seed yield (q/ha)	Straw yield (q/ha)	Net returns (Rs) (x 10^3/ha)	B:C ratio
S_1	63.7	6.9	13.7	59.3	170.1	23.6	14.9	24.3	26.5	43.05	2.04
S_2	64.9	7.1	14.2	60.7	176.0	24.7	15.9	24.9	26.8	49.02	2.19
S_3	57.4	4.2	9.7	53.8	151.7	19.7	13.0	20.1	22.3	29.45	1.72
S_4	62.5	5.6	12.4	58.7	166.7	23.1	14.6	23.4	25.3	40.67	2.00
S_5	61.3	5.1	11.3	55.3	158.1	21.6	14.5	22.5	24.6	37.95	1.94
S_6	65.3	6.7	13.8	60.6	172.7	23.9	15.0	24.8	26.7	46.92	2.17
S_7	68.7	7.3	15.1	65.2	183.8	26.6	16.2	26.7	28.3	48.90	2.10
S_8	51.3	3.3	7.4	47.2	132.1	15.9	11.6	15.4	16.9	14.80	1.40
CD (P=0.05)	5.1	1.5	2.1	4.8	13.9	2.7	1.3	3.2	3.3	6.45	0.19

Table 2: Effect of Integrated Weed Management on growth, yield attributing characters, grain yield, straw yield and economics of soybean (Kharif 2016)

Treatment	Plant height (cm)	No of leaves	No of branches	No of Pods/ plant	No of Seeds/ plant	Weight of seed/ plant(g)	Test weight (g)	Seed yield (q/ha)	Straw yield (q/ha)	Net returns (Rs) (x 10^3/ha)	B:C ratio
S_1	64.8	7.2	14.3	61.4	171.9	23.8	15.2	24.9	27.3	45.05	2.07
S_2	65.7	7.6	15.3	62.9	177.2	25.2	16.3	25.7	27.9	51.14	2.24
S_3	58.2	5.1	10.2	56.3	153.0	20.3	13.4	20.2	23.6	31.85	1.77
S_4	63.8	6.2	13.5	60.9	168.3	23.4	15.0	24.1	26.6	42.43	2.04
S_5	62.4	5.8	12.4	58.4	159.9	22.2	14.8	23.3	25.3	40.36	1.99
S_6	66.5	7.8	14.7	62.8	173.9	24.8	16.2	25.4	27.6	49.19	2.22
S_7	69.3	8.6	16.3	67.4	184.7	27.4	16.6	27.3	29.5	51.11	2.14
S_8	53.2	4.5	8.2	50.7	134.8	16.3	12.2	16.2	17.3	15.85	1.43
CD (P=0.05)	4.6	1.4	2.1	4.2	13.2	2.8	1.4	3.1	3.4	6.5	0.19

(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} fbquizalofop 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

One hoeing at 15 DAS and two hand weeding at 20 DAS and 45 DAS resulted in higher growth parameters, yield attributing

factors, seed yield and grain yield. This method found to be the best method of weed control where labors are cheap 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}.

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